

Daniel Neuhoﬀ, Sang Mok Sohn, Charles Ssekyewa, Niels Halberg,
Ilse. A. Rasmussen and John Hermansen (Editors)

Organic is Life Knowledge for Tomorrow

Volume 2

Socio-Economy, Livestock, Food Quality, Agro-Ecology and Knowledge Dissemination

Proceedings of the Third Scientific Conference of the
International Society of Organic Agriculture Research
(ISO FAR), held at the 17th IFOAM Organic World Congress in
Cooperation with the International Federation of Organic
Agriculture Movements (IFOAM) and the Korean Organizing
Committee (KOC)

28. September - 1. October 2011 in Namyangju, Korea



The contents of the articles in this volume are the responsibility of the authors. The information contained herein, including any expression of opinion and any projection or forecast, has been obtained from sources believed by the authors to be reliable but is not guaranteed as to accuracy or completeness. The information is supplied without obligation and on the understanding that any person who acts upon it or otherwise changes his/her position in reliance thereon does so entirely at his/her own risk.

Should the publication of corrigenda become necessary, these will be posted at the conference homepage <http://www.isofar.org/kowc2011>

The 3rd Scientific Conference of the International Society of Organic Agriculture Research (ISOFAR) was held from 28. September to 1. October 2011 in Namyangju, Republic of Korea, in the frame of the 17th Organic World Congress of the International Federation of Organic Agriculture Movements (IFOAM), organised by the Korean Organizing Committee (KOC).

Daniel Neuhoff, Sang Mok Sohn, Charles Ssekyewa, Niels Halberg, Ilse. A. Rasmussen and John Hermansen (Editors) (2011):

Organic is Life - Knowledge for Tomorrow. Volume 1 - Organic Crop Production. Proceedings of the Third Scientific Conference of the International Society of Organic Agriculture Research (ISOFAR)

© 2011, International Society of Organic Agriculture Research (ISOFAR), c/o Institute of Organic Agriculture (IOL), University of Bonn, Katzenburgweg 3, D-53115 Bonn, Tel. +49 228 735616, Fax +49 228 735617, E-mail info@isofar.org; Internet www.isofar.org

Cover: Christian Dahn, IOL, Bonn, Germany

Layout: Beke Katharina Jeschkies, IOL, Bonn, Germany

Printed in Korea

Distribution: Paper copies may be ordered from ISOFAR via email to: info@isofar.org

A PDF version can be downloaded free of charge for ISOFAR members via the member area of www.isofar.org.

Table of contents

| | |
|-------------------------|------------|
| Preface | I |
| Dear Reader | II |
| Acknowledgements | III |
| Index of Authors | 361 |

Organic consumers

| | |
|---|----|
| Consumer views on the new mandatory EU logo for organic food | 2 |
| <i>Hamm, U. & Janssen, M.</i> | |
| Consumer preferences with respect to innovation in organic baby food in four European Countries | 6 |
| <i>Naspetti, S. & Zanoli, R.</i> | |
| Organic Food at the Point of Purchase: The final hurdle | 10 |
| <i>Henryks, J.</i> | |
| Consumer acceptance of alternatives to piglet castration without anaesthesia in organic farming | 14 |
| <i>Heid, A. & Hamm, U.</i> | |
| Consumer's beliefs about the contribution from organic food | |
| to an environmentally sustainable diet | 18 |
| <i>Pearson, D.</i> | |
| Consumer concerns regarding additional ethical attributes of organic food | 22 |
| <i>Zander, K., Hamm, U., Freyer, B., Gössinger, K.², Naspetti, S., Padel, S., Stolz, H., Stolze, M.⁵ & Zanoli, R.³</i> | |
| Consumer attitudes to ethical standards beyond organic guidelines - the example of eggs | 26 |
| <i>Gössinger, K., Hametter, M., Freyer, B., & Zanoli, R.</i> | |
| Lessons learned from implementing organic food into European school meals | 30 |
| <i>Kristensen, N. H., Hansen, M. W., & Nielsen, T.</i> | |
| Organic food for the youth – potentials and challenges. Knowledge extracted from the iPOPY project | 34 |
| <i>Løes, A.-K. & Nölting, B.</i> | |

| | |
|--|----|
| Are consumers willing to pay a price premium | |
| for specific organic logos? | 38 |
| <i>Janssen, M. & Hamm, U.</i> | |
| Defining organic consumers | 42 |
| <i>Oates, L., Cohen, M. & Mann, N.</i> | |
| Demand elasticities of organic vegetables in Taiwan | 46 |
| <i>Huang-Tzeng, Chang-Ju and Lin, Yu-Ting</i> | |
| Water quality protection and organic farming development in France..... | 51 |
| <i>Fleury, Ph. & Vincent A.</i> | |
| Benefits Associated With U.S. Organic Farm Sector Expansion, a Ten-Year Assessment..... | 55 |
| <i>Lohr, L.</i> | |
| Assessing the public goods provided by organic agriculture: lessons learned from practice | 59 |
| <i>Smith, L., Padel, S., Pearce, B., Lampkin, N., Gerrard, C., Woodward, L., Fowler, S. & Measures, M.</i> | |

Farm economics, marketing and certification

| | |
|---|----|
| On the economics of organic grassland and alternative bio-energy systems – A risk modelling approach | 64 |
| <i>Blumenstein, B. & Möller, D.¹</i> | |
| Producing a local, organic diet gives a healthy, sustainable and more climate-friendly diet | 68 |
| <i>Mogensen, L.¹, Kristensen, T.¹, Hermansen, J. & Kristensen, I.S.¹</i> | |
| Ecopreneurship in Aquaculture | |
| – The adoption of organic fishfarming methods | 72 |
| <i>Lasner, T. & Hamm, U.</i> | |
| The drivers of the conversion in organic farming (OF): | |
| a review of the economic literature..... | 76 |
| <i>Geniaux, G., Latruffe, L., Lepoutre, J., , Nauges, C., Napoléone C., Sainte Beuve, J., & Sautereau, N.</i> | |

| | |
|---|-----|
| Technical and allocative efficiency of organic marketing choices: Influence of gender and participatory research..... | 80 |
| <i>Lohr, L.</i> | |
| Important attributes to pre-purchasing evaluation relating to organic food in urban China..... | 84 |
| <i>Chen, J.</i> | |
| Characteristics of price and demand for organic vegetables..... | |
| in the Japanese food retailing market | 88 |
| <i>Takada,N., Taniguchi, Y.</i> | |
| Analysis of regulatory framework affecting sensory properties of organic products | 92 |
| <i>Schmid, O.</i> | |
| Nanomaterials in food and agriculture: The big issue of small matter for organic food and farming..... | 96 |
| <i>Paull, J.</i> | |
| Compliance with the New USDA-NOP pasture rule: | |
| Monitoring progress in small-holder vs. corporate dairies | 100 |
| <i>Baker, B., Delate, K., Turnbull, B, & Cwach, D.</i> ³ | |
| Farm animal welfare legislation and standards in Europe and world-wide – a comparison with the EU regulatory framework..... | 104 |
| <i>Schmid, O. & Kilchsperger, R.</i> | |
| An evaluation of the EU new organic import regulation..... | |
| from the perspective of the third country stakeholders..... | 108 |
| <i>Miran, B., Abay, C.</i> ¹ , <i>Karahan Uysal Ö.</i> ¹ , <i>Boyacı M., Stolze M., & Huber B.</i> ² | |
| Non compliance in organic certification: determinants for Italy..... | 112 |
| <i>Gambelli, D., Solfanelli, F, & Zanoli, R.</i> | |
| Modelling risk-based inspections in EU organic certification: data requirements and analysis tools..... | 116 |
| <i>Gambelli, D., Solfanelli, F., Zorn, A., Lippert, C. , Dabbert, S. & Zanoli, R.</i> | |

| | |
|--|-----|
| Environmental and socioeconomic impact of organic coffee certification in Central America as compared with other certification seals | 120 |
| <i>Soto, G., Haggard, J., Le Coq, J.F., Gonzalez, C., Soto, A. Casanoves, F., Corrales, E., De Melo, E., Jerez, R. & Quilo, A.</i> | |
| Costs of certification of organic operators | 124 |
| <i>Stolze, M., Moschitz, H., Hartmann, M. & Huber, B.</i> | |

Smallholders

| | |
|--|-----|
| Organic agriculture networks in Argentina. A case study | 129 |
| <i>Grasa, O. & Ghezán, G.</i> | |
| Organic tea production in China | 133 |
| <i>Qiao Y., Wang D. , Meng F., Fu Sh.</i> | |
| Organic pineapple farming in Ghana - A good choice for smallholders? ... | 137 |
| <i>Linda Kleemann.</i> | |
| Economic feasibility of organic agriculture for small scale farmers in Sri Lanka | 141 |
| <i>Karandana, P.</i> | |
| Organizational patterns of small-scale farmers access certified organic agriculture (COA) : Cases in China | 146 |
| <i>Liu Y.</i> | |
| Impact of large-scale conversion to organic farming on food production and food security for resource poor farmers in India | 151 |
| <i>Panneerselvam, P , Hermansen, J.E, Halberg, N, & Murali Arthanari, P ..</i> | |
| Organic Agriculture: A Tool for Improving Small Farmers' Livelihood in Bangladesh | 157 |
| <i>Sarker, M.A., Hoque, M., Nanseki, T. & Itohara, Y.</i> | |
| Farmers' attitudes and level of knowledge on organic farming in the ilocos region, Philippines | 161 |
| <i>Pastor, F., Legaspi, N.², Agbigay, L.³, Pastor, C.D.⁴, Salas, M.A.⁵, Cacatian, M.⁶ & De Padua M.V.⁷</i> | |

Food Quality

| | |
|--|-----|
| Product quality of rocket (<i>Eruca sativa</i> L.)..... | |
| as a function of light intensity and nitrogen supply | 166 |
| <i>Athmann, M. & Köpke, U.</i> | |
| Differences in fatty acid and antioxidant profiles of milk from German biodynamic and conventional low- and high-input systems in summer and winter..... | 170 |
| <i>Kusche, D. and Baars, T.</i> | |
| Nitrate and Chlorophyll Contents in Organically Cultivated Chinese Cabbages..... | 174 |
| <i>Sang Mok Sohn</i> | |
| Influence of nutrient management on the grain quality, cooking and eating quality of rice in Taiwan..... | 178 |
| <i>Kesarwani, A.¹, Chen, S.S.² and Lee, J.F.³</i> | |
| Development of simple processed products using paprika leaves | 182 |
| <i>Kim, Y., Kim, K. M., Kim, Y. S., Kim, G.C. & Kim, J. S.</i> | |
| Physiochemical and Functional Characterization of Conventional or Organic Pear..... | 186 |
| <i>J.H. Park, S.H. Nam*, J.H. Seong, Y.S. Cho, J.H. Choi, J.J. Choi, K.J. Choi and H.S. Hwang</i> | |
| Fruit quality, antioxidant capacity and nutrients between organic and conventional kiwifruit in Korea..... | 189 |
| <i>Cho, H., Cho, J., Cho, Y. & Park, J.</i> | |
| Triticum spelta – source of antioxidants | 193 |
| <i>Fatrcová-Šramková, K., Máriássyová, M. & Lacko-Bartošová, M.</i> | |
| Organic cultivation of the potato cultivars Mayan Gold and Mayan Twilight – yield analysis and secondary plant substances..... | 197 |
| <i>Trautz, D., Hillebrand, S., Schliephake, U.¹, Herrmann, M.E.¹, Burmeister, A., Fleischmann, P., Hüsing. B.¹</i> | |

Livestock

| | |
|--|-----|
| Combined pig and energy crop production – crop damage and animal behaviour | |
| <i>Kongsted, AG, Jørgensen, U, Sørensen, J³ & Horsted, K.</i> | 202 |
| Effect of protein supplementation of ewes and grazing management on performance of organic lambs | 206 |
| <i>Gekara, J., Basweti, E., Kotcon, J., Minch, M., Eddy, J., Mata, D. & Bryan, W.</i> | |
| Resource requirements for farm conversion to organic livestock farming: A study in India | 210 |
| <i>Subrahmanyaswari, B & Mahesh Chander</i> | |
| Organic beef cattle development in central Thailand | 215 |
| <i>Putsakum, M., Wongpichet, S. & Kantanamalakul, J.</i> | |
| Evaluation of organic Sudangrass silage for feed value, silage quality and palatability in Korea | 218 |
| <i>Kim J. D., Shim, K. S., Lee, H. J., Jeon, K. H., Lee, M. H., Youn, Y. Y., Oh, E. Y., and Lee, H. W.</i> | |
| Performance and bone mineral density of laying hens fed with organic diets | 222 |
| <i>Jeong, Y. D., Hassan, M. R., Jee, H. J., Ryu, K. S</i> | |
| Increasing ranging area improved laying hens' welfare and affected egg production and quality | 226 |
| <i>Oliveira, D. G, Leite, R. M. & Khatounian, C. A.</i> | |
| Satisfaction and attitude survey of organic goat milk acceptance in Thailand. | 230 |
| <i>Danviriyakul, S., Seilsuth, S.¹, Nongyao, C.¹, Kittipongpysan, S.¹ & Rakkumsuk, T.</i> | |

Agro-Ecology and Environment

| | |
|---|-----|
| The relationships between organic farming and agroecology | 235 |
| <i>Bellon, S., Lamine, C., Ollivier, G. , de Abreu, L. S.</i> | |
| Use of agro-ecological methods by Asian smallholder farms and relation to organisation of certified organic cash crop production | 239 |
| <i>Halberg, N.¹, Qiao, Y², Vaheesan³ & Zoysa, K.⁴</i> | |
| Organic farming for Resource conservation under soybean-wheat for rain-fed conditions of lower Himalayas, India | 243 |
| <i>Sharma, P., Singh, P., Prasad, R., & Arya, S. L.</i> | |
| Impact of organic cultivation and agro ecosystem diversity on natural populations of amphibians and fungi in Sri Lankan agricultural landscapes | 247 |
| <i>Palihawadana, A.....</i> | |
| A meta-analysis comparing environmental impacts of organic and conventional farming in Europe | 252 |
| <i>Tuomisto, H. L., Hodge I. D.², Riordan, P.¹ & Macdonald, D. W.¹</i> | |
| Life cycle assessment of organic and conventional soybean production in Northeast and Northwest China | 256 |
| <i>Qiao Y., Luo Y. , Zeng G. Wu W. & Halberg N.</i> | |
| Analysis on Heavy Metal Concentrations in Organic Production Base of Ili District, Xinjiang Province..... | 260 |
| <i>Li, H., Yang, J., Qiao, Y., Meng, F., Guo, Y. & Wu, W.....</i> | |
| Conversion to agroecological practices:..... | 264 |
| the case of family farmers of Ubatuba, Sao Paulo, Brazil | |
| <i>Souza, M.C.M., Otani, M.N., Oliveira, M.D.M., Moreira, S.R., Castro, C.E., Turco, P.H.N. & Marchiori, A. 264</i> | |
| Feeding the world with a climate friendly agriculture: the story so far | 268 |
| <i>Wright, J.</i> | |
| Resilience to a changing climate: carbon stocks in two organic farming systems in Africa | 273 |
| <i>Koopmans, C.J., Bos¹, M. M. & Luske¹, B.</i> | |

| | |
|---|-----|
| Nitrous oxide emission from livestock compost applied arable land..... | 277 |
| Seo, Y. [*] , Cho, B. ¹ , Kang, A. ¹ , Jeong, B. ¹ & Jung, Y. | |
| Influence of the cultivation technologies on CO ₂ Emission..... | 281 |
| Moudrý, J., jr., Jiroušková, Z., Moudrý, J. & Konvalina, P. | |
| Spiders as important predators | 285 |
| in Korean rice fields | |
| Kim, S.T., Lee, S.Y., Jung, J.K. and Lee, J-H..... | |
| Ecological traits of weed flora as affected by | 290 |
| different soil moisture condition | |
| Hwang, Jaebok & Yun, Eulsoo & Jung, Kiyoul & Park, Changyoung & Choi, Youngdae & Nam, Minhee | |
| Effects of long-term organic management on major pests and coccinellid predators in the peach fields | 295 |
| Ding-wu Zhang, Min Dong, Xiang-ge Du | |
| Bioassay study of fenugreek extract's allelopathic effects on the germination and growth of crops and weeds | 299 |
| Azizi, G., Jahani Kondori, M. , Alimoradi, L. & Siah-marguee, A. | |
| Influences of crop rotation in energy crops and biogas slurry application on earthworm populations..... | 303 |
| Wolfrum, S., Thoma-Rademacher, M. ¹ , Papaja, S. ¹ , Reents, H. J. ¹ , Kainz, M. ¹ , Hülsbergen, K. J. ¹ | |
| Effect of nutrient resource and crop diversity | 307 |
| Azizi, G., Jahani Kondori, M. koocheki, A & Nassiri-Mahallati, M | |
| A cross-disciplinary approach to multicriteria assessment and communication of the effects of organic food systems | 313 |
| Alrøe, H.F. & Noe, E. | |
| The fairtrade movement: Six lessons for the organics sector | 317 |
| Paull, J..... | |

Research Methodology and Knowledge Dissemination

| | |
|--|-----|
| Dynamic of thematic and citation patterns in Organic Food & Farming research | 321 |
| <i>Ollivier, G., Bellon, S.1 & Penvern, S.1</i> | |
| Organic Eprints – making research in Organic Food and Farming more visible | 326 |
| <i>Rasmussen, I.A., Meier, J. & Willer, H.....</i> | |
| Technology platform organics: knowledge generation and exchange in organic food and farming research..... | 330 |
| <i>Padel S., Pearce B¹, Cuoco E., Schlüter M², Niggli U., Schmid O³, Willer H³, Huber M., Halberg N. & Micheloni C.</i> | |
| Metabolite profiling for the evaluation of organic amendments. | 334 |
| <i>Okazaki, K., Shinano, T., Oka, N., Saito, S., Sugikawa, Y., Nakatsuji, T., Tanaka, F & Takabe, M.</i> | |
| Italian networking of public experimental sites working on Organic Farming: an experience of networking in research..... | 338 |
| <i>Ortolani, L., Micheloni, C. Barberi, P. , Bonazinga, M.</i> | |
| Identification of research priorities in transnational EU projects in Organic Food & Farming..... | 342 |
| <i>Bellon S., Alföldi, T., Anil, S., van der Meulen, S.</i> | |
| Lifelong learning in organic agriculture: a degree program for working professionals..... | 346 |
| <i>Specht, J., Haering, A. M.....</i> | |
| Comparing farmland biodiversity in organic and conventional farming systems: making sense and including context | 350 |
| <i>Langer, V., Rasmussen, J. & Henriksen, C.I.</i> | |
| ORCA-Research.org: The new website of the Organic Research Centres Alliance (ORCA)..... | 354 |
| <i>Willer, H., Frieden, C. and Nadia Scialabba</i> | |
| Toward organic shrimp aquaculture development: Experiences from Bangladesh..... | 357 |
| <i>Paul, B & Vogl, C.</i> | |

Preface

The Third International Scientific Conference of ISOFAR was held from 28 September to 1 October 2011 in the frame of the 17th IFOAM Organic World Congress (OWC) in Gyeonggi Paldang, Republic of Korea. The practical implementation of the OWC was managed by the Korean Organizing Committee, while ISOFAR was responsible for the scientific part of the conference, the so-called 'research track'.

Interest is deepening in agricultural practices that promote environmentally sound agriculture, well-grounded on scientific knowledge and facts. Scientists working on the organic research track are aware that the cradle of their daily work is based on the numerous practical approaches and the experiences gained under diverse site conditions and given obstacles to clear. Trial and error are part of the daily life of researchers as well as of practitioners. Thus, the value of this scientific conference can be measured in the stimulus it provides to the individual researcher and farmer, especially the young ones, knowing that future progress will depend on them. Furthermore, the value of this conference lies in the opportunity offered to us to discuss possible strategies how to overcome future restrictions Organic Agriculture will be confronted with under the individual site conditions in different regions.

It's a pleasure for me to express my gratitude to those who made this conference possible and to those preparing the proceedings. I want to thank our benefactors for their efforts and our institutional hosts in Korea for providing the conference venue and for supporting all the conference activities. On behalf of the participants of the Third Scientific Conference of ISOFAR, I gratefully recognize the diversity of contributions which reflect the broad spectrum of Organic Agriculture worldwide.

I'm especially indebted to the editors of the proceedings for their diligent and tireless efforts in preparing and polishing the submitted manuscripts. These proceedings can be regarded as an anticipatory window opened to a promising future to come. In general, editors share a common experience: after all their hard work and the given functional relationship between the quality of the submitted papers and editors' general well-being, they will not deal with a legacy of 'again another international conference proceedings booklet – grey literature, nothing else', but conference proceedings that are cherished as not less than a milestone for the further evolution of Organic Agriculture based on science. This aim could further be fulfilled by publishing of many of the four page contributions reviewed for the proceedings as extended versions in ISOFAR's new scientific journal 'Organic Agriculture' or at least by submitting them to other international highly ranked journals.

May these proceedings that comprehensively represent the current state of the art in Organic Agriculture Research find a good reception among its readers and encourage further research activities that contribute to a more complete understanding of what is required for a successful use of unique approaches and techniques in Organic Agriculture in order to expand organic production worldwide.

Ulrich Köpke

President ISOFAR Dear Reader,

The present two volumes of the Proceedings of the Third Scientific Conference of ISOFAR, carried out during the OWC in Korea in autumn 2011, are noticeably thinner compared to the previous conference. It would certainly be a mistake to draw premature conclusions on an alleged drawback of organic agricultural research. The decrease of paper submissions is a simple result of a lower participation of European researchers, who traditionally have a strong position within the international research community. From a total of 400 submitted papers finally some 250 were selected for oral (150) or poster presentation (100) and subsequent publication.

Volume 1 of the proceedings covers various aspects of soil fertility and nutrient management as well as a considerable range of topics on organic crop production. The majority of the papers deal with specific aspects of crop productivity with a strong emphasis on organic fertilization and crop protection rather than on systemic approaches. No need to say that these facts also reflect the world-wide diversity of self-conceptions on Organic agriculture. From a pure agronomic point of view problem oriented research approaches a more than reasonable, in particular in countries with a high population density. Strategically, however, it should not be forgotten that the largest capital of Organic Agriculture are still the consumers and their permanent readiness to purchase organic products with an expected superior overall quality.

Accordingly volume 2 begins with papers on consumer research including also other important topics such as marketing, certification and organic food quality. Since smallholders play a key role for food security and poverty eradication especially in Asia and Africa, joint sessions of ISOFAR and IFOAM will be dedicated to this important topic. The final part of the second volume is dedicated to agro-ecological research as well as to specific aspects of research methodology and knowledge dissemination. The editors are very grateful to the authors for their valuable contributions, as well as to the innumerable reviewers, who significantly improved the final quality of the papers

ISOFAR is greatly indebted to the Korean Organizing Committee (KOC), which spared no efforts to design an attractive overall programme for the Organic World Congress. In particular we would like to express our sincere gratitude to Mrs. Jennifer Chang (KOC). Thanks to her excellent competence and her tireless helpfulness, the cooperation between the partners turned out to be delightful. All that glitters is not gold. Therefore we offer our sincere apologies to all, who have suffered under inefficient communication or technical problems during the preparation of this conference.

It is our sincere hope that the proceedings of the Third Scientific Conference of ISOFAR in Korea in 2011 will be a useful source of information not only for the organic research community but also a valuable incentive for the whole organic movement.

On behalf of the Editors

Daniel Neuhoﬀ, Sang Mok Sohn and Niels Halberg

Acknowledgements

Thanks to the following reviewers:

Jules Bos, The Netherlands; Marc Benoit, France; Stephane Bellon, France; Bruce Bearce, United Kingdom; Wijnand Sukkel, The Netherlands; David Midmore, Australia; Ralf Loges, Germany; Martin Entz, Canada; Jürgen Friedel, Austria; Jochen Mayer, Switzerland; Kurt Möller, Germany; Sissel Hansen, Norway; Christine Stark, United Kingdom; Christopher Penfold, Australia; Albert Markart, United States; Ulrich Schmutz, United Kingdom; Todd Kabbaluk, Canada; Anet Spengler, Switzerland; Andrea Martini, Italy; Peter Klocke, Switzerland; Gerold Rahmann, Germany; Thomas Alföldi, Switzerland; Matthias Stolze, Switzerland; Frank Offermann, Germany; Anna-Maria Häring, Germany; Ulrich Hamm, Germany; Stefan Dabbert, Germany; David Pearson, United Kingdom; Bernd Freyer, Austria; Concetta Vazzana, Italy; Maria Müller Lindenlauf, Germany; Ellen Majory, United States; Manolis Kabourakis, Greece; William Lockeretz, United States; James Kotcon, United States; Ulrich Köpke, Germany; Grete Kongsted, Denmark; Yuhui Quiao, China; Vivian Burnett, United States; Christian Swensson, Sweden; Christine Watson, United Kingdom; Jan Paul Wagenaar, The Netherlands; Peter Cornish, Australia; Kiro Petrowsky, United States; Karen Klonsky, United States; John Paull, United Kingdom; Francois Casablanca, France; Paul Kristiansen, Australia; Andrea Martini, Italy; Roland Kubiak, Germany; Stefan Kühne, Germany; Brian Baker, United States; Giorgio Balestra, Italy; Jean-Charles Munch, Germany; Martin Hommes, Germany; David Granatstein, United States; Joe Montecalvo, United States; Heather Darby, United States; Kathleen Delate, United States; Bo Melander, Denmark; Gharieb El-Bana, Egypt; Derek Lynch, Canada; Wilhelm Claupein, Germany; Geert Vanderburgh, The Netherlands; Ulrike Steiner, Germany; Thorsten Haase, Germany; Jürgen Heß, Germany.

Organic consumers

Consumer views on the new mandatory EU logo for organic food

Hamm, U.¹ & Janssen, M.²

Key words: EU logo for organic food, consumer perceptions, organic certification

Abstract

In July 2010, the new mandatory EU logo for organic food was introduced to make the identification of organic products easier for consumers. In the present study we analysed how consumers in five EU countries view a mandatory EU logo for organic food to make recommendations for agrarian decision-makers and market actors in the organic sector. The study was based on a combination of qualitative and quantitative methods with consumers of organic food in the Czech Republic, Denmark, Germany, Italy and the United Kingdom. Firstly, 15 focus group discussions were conducted to reveal the spectrum of consumer perceptions. In a subsequent survey with 2042 participants consumer views on key issues were quantified. Finally, the results of the qualitative and quantitative studies were brought together. Our findings suggest that a mandatory EU logo for organic food was basically welcomed in all countries, however, trust in the underlying production standards and the inspection system was not very pronounced (except in Italy). We conclude that the introduction of the new EU logo should be supported by communication campaigns to make clear what the new logo stands for and remove unfounded consumer concerns regarding the downscaling of standards and the trustworthiness of the inspection system.

Introduction

In the European Union (EU), a food product can be labelled 'organic' if it complies with the principles for organic production, processing, labelling and control according to Regulation (EC) No 834/2007. Since July 2010, all prepacked organic products produced within the EU must carry the new mandatory EU logo for organic food. The mandatory logo is targeted at end-consumers: It was introduced to strengthen the organic sector by making the identification of organic products easier for consumers (Regulation (EU) No 271/2010). While the proposal of a mandatory EU logo was discussed controversially within the organic sector upon announcement of the draft regulation (see e.g. Blake 2009), to date little is known about consumer views on the issue. Consumer trust, however, is of crucial importance for an organic label to be effective (Jahn *et al.* 2005, Golan *et al.* 2001). The present study analyses consumer views towards a mandatory EU logo in five European countries by a combination of qualitative and quantitative methods. The aim is to get insights into the positive and negative aspects that consumers connect with such a label. The overall objective of the study is to give recommendations for agrarian decision-makers and market actors in the organic sector.

¹ Department of Agricultural and Food Marketing, University of Kassel, Steinstrasse 19, 37213 Witzenhausen, Germany, E-Mail hamm@uni-kassel.de, Internet www.agrar.uni-kassel.de/alm.

² As above.

Materials and methods

The present study was based on a combination of qualitative and quantitative methods to get a more comprehensive picture of consumer views in the five EU countries Czech Republic (CZ), Denmark (DK), Germany (DE), Italy (IT), and United Kingdom (UK). With qualitative methods it was identified *which* issues and concerns matter to consumers regarding a mandatory EU logo for organic food and *why* this is the case. In focus group discussions, the participants were asked for their views on the introduction of a new mandatory EU logo for organic food.¹ A total of 15 focus groups (3 groups per country) with 149 consumers of organic food was conducted in May and June 2009. The data was analysed with qualitative content analysis. In the subsequent quantitative study conducted in February and March 2010, 2042 consumers of organic food participated in structured written interviews in the five countries to quantify and statistically test consumer views on key issues that were raised in the focus group discussions. In the self-administered questionnaire, the participants were asked to indicate their level of agreement with statements on different aspects of the new labelling regulations.³ A seven-point Likert-scale was used with 1 'I strongly disagree', 4 'I neither agree nor disagree' and 7 'I strongly agree'. The data analysis was based on descriptive statistics and one-way analysis of variance (ANOVA) to determine whether the statement means were significantly different in the five study countries.² In the final step, the results of the qualitative and quantitative studies were brought together in a combined analysis.

Results

In the focus group discussions, the introduction of a new mandatory EU logo for organic food was both welcomed and contested. On the one side it was suggested that a mandatory logo would make the recognition of organic products easier, whereas other people found the existing organic logos were sufficient or even feared that a new logo could cause consumer confusion. In the quantitative survey (see Table 1), the great majority of participants in all countries welcomed to have an EU-wide logo for certified organic products (statement 1), whereas a more diverse picture was found for statement 2 "without a mandatory EU organic logo, some food products are hard to identify as organic at the point of sale". The participants only slightly disagreed with or tended to be undecided on statement 3 "there are more than enough organic logos already and a new mandatory organic logo will just add complexity to the market". The focus group discussions revealed interesting consumer perceptions of the production standards and the inspection system behind a mandatory EU logo. In all countries except Italy, it was assumed that the production standards behind the new EU logo would be lower than the respective domestic standards. In addition, concerns were raised in all countries except Denmark regarding the trustworthiness of the inspection system. Nevertheless, it was generally welcomed to have common EU-wide minimum standards for organic production and control, as long as each member state would be free to have stricter national regulations. The results of the quantitative survey (see

¹ Since the study took place prior to the final decision on the design of the new logo, the participants were informed that a common mandatory logo would be introduced, but a picture of the new EU logo itself was not shown. The new mandatory indication of origin of the raw materials was also subject of the focus group discussions and the structured interviews but the results are not included in this paper due to the limited space.

² ANOVA techniques are based on a comparison of the variance among the means with the variance within the samples, and not on a direct comparison of group means (Hair et al. 2010).

Table 1) confirmed that in all countries, it was largely welcomed to have the same minimum standards all over the EU (statement 4). However, the level of agreement with the statements on trust in the inspection system (statement 5) and the organic standards (statement 6) behind an EU logo was significantly lower in all countries.

The overall country comparison revealed that consumer acceptance of the new logo was different across the EU countries. Two significantly distinct countries could be identified: In Italy, the new EU logo was basically welcomed without reservation, whereas in the UK, both support and scepticism towards a mandatory EU logo were present. In Denmark, Germany and the Czech Republic, trust in the standards and the inspection system behind the EU logo was higher than in the UK but still not particularly pronounced.

Tab. 1: Country comparison of views on a new mandatory EU logo

| Statements | Statement means ¹ | | | | | ANOVA Welch-value ² |
|---|------------------------------|---------------------|---------------------|-------------------|-------------------|-----------------------------------|
| | CZ | DE | DK | IT | UK | |
| 1. It is a good idea to have an EU-wide logo for certified organic products. | 5.52 ^a | 5.72 ^b | 5.62 ^b | 6.51 ^c | 5.12 ^a | 65.03*** |
| 2. Without a mandatory EU organic logo, some food products are hard to identify as organic at the point of sale. | 4.31 ^{a,b} | 5.43 ^{a,b} | 5.23 ^{a,c} | 6.06 ^b | 4.18 ^c | 10.10*** |
| 3. There are more than enough organic logos already and a new, mandatory organic logo will just add complexity to the market. | 3.15 ^a | 3.32 ^a | 3.44 ^a | 2.95 ^b | 3.76 ^c | 38.02*** |
| 4. It is a good idea to have the same minimum standards for organic products all over the EU. | 5.52 ^a | 6.19 ^{b,c} | 6.05 ^c | 6.40 ^b | 5.72 ^a | 36.16*** |
| 5. I have great trust in the inspection system behind an EU-wide organic logo. | 4.76 ^a | 4.18 ^b | 4.36 ^b | 5.17 ^c | 3.78 ^d | 41.37*** |
| 6. I have great trust in the organic standards behind an EU-wide organic logo. | 4.87 ^a | 4.30 ^b | 4.47 ^b | 5.20 ^c | 3.91 ^d | 20.76*** |

¹ The level of agreement was measured on a seven-point Likert-scale with 1 'I strongly disagree', 4 'I neither agree nor disagree' and 7 'I strongly agree'.

² The ANOVA was based on the Welch-test since equality of variances in the different countries could not be assumed (based on Levene's test for equality of variances).

^{a, b, c, d} Statement means with different letters are significantly different between the countries ($p < 0.05$, ANOVA post-hoc tests Tamhane's T2).

*** Differences in variance significant at the level $p < 0.001$.

Discussion and Conclusions

In accordance with previous studies we found that many participants lacked knowledge on organic production and certification (Sawyer *et al.* 2009, Aertsens *et al.* 2009, Hughner *et al.* 2007), which gave rise to (unfounded) concerns regarding the production standards and the inspection system behind the new EU logo. This might be problematic since according to Verbeke (2008), product information – like a logo – can only have a favourable impact on food choice if consumers have a sufficient level of knowledge about the subject at hand. Thus, our findings suggest that for achieving the objective of strengthening the organic sector (Regulation (EU) No 271/2010), it might not be enough to simply launch a new mandatory organic logo without any supportive communication measures. In particular, this holds true since the new logo (a stylised leaf composed of stars) is not self-explanatory and does not clearly refer to organic production. We therefore conclude that consumer trust should be strengthened by communication campaigns explaining what the new logo stands for and why it is a benefit, especially in those countries where the former voluntary EU logo for organic food was not very common. Public financial support for the new EU logo is recommended and also justified since organic agriculture contributes to public

welfare by preserving natural resources and contributing to rural development, which is recognised by EU legislation (Regulation (EC) No 834/2007). Given the country differences in consumer perceptions, communication campaigns on the new EU logo should be tailored to specific country conditions. In Germany, for instance, it should be highlighted that the new EU logo is equivalent to the German governmental logo 'Bio-Siegel'. In Denmark and the Czech Republic, it should be communicated that the new EU logo and the governmental logo are based on the same production standards. An aspect that should be emphasised in all countries is that the logo guarantees EU-wide regular inspection of production processes, since our study showed that consumers know very little about organic certification.

Acknowledgments

This publication was generated as part of the CERTCOST Project, agreement no. 207727 (<http://www.certcost.org>), with financial support from the European Community under the 7th Framework Programme. The publication reflects the views of the authors and not those of the European Community, who is not to be held liable for any use that may be made of the information contained. The authors gratefully acknowledge funding from the European Community.

References

- Aertsens J., Verbeke W., Mondelaers K., van Huylenbroeck G. (2009): Personal determinants of organic food consumption: A review. *British Food Journal* 111(10):1140-1167.
- Blake, F. (2009): General analysis of the new regulation. In IFOAM EU Group (ed.): *The new EU Regulation for Organic Food and Farming: (EC) No 834/2007 – Background, assessment, interpretation*. IFOAM EU Group, Brussels, pp. 18-21.
- Commission Regulation (EU) No 271/2010 of 24 March 2010 amending Regulation (EC) No 889/2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007, as regards the organic production logo of the European Union. *Official Journal of the European Union*, L84 (31.03.2010), p. 19-22.
- Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91. *Official Journal of the European Union*, L189 (20.07.2007), p. 1-122.
- Hair, J., Black, W., Babin, B. and Anderson, R. (2010): *Multivariate data analysis*. 7th ed. Upper Saddle River: Pearson Prentice Hall.
- Jahn G., Schramm M., Spiller A. (2005): The reliability of certification: Quality labels as a consumer policy tool. *Journal of Consumer Policy* 28(1):53-73.
- Golan E., Kuchler F., Mitchell L. (2001): Economics of food labeling. *Journal of Consumer Policy* 24(2):117-184.
- Hughner R. S., McDonagh P., Prothero A., Shultz II C. J., Stanton J. (2007): Who are organic food consumers? A compilation and review of why people purchase organic food. *Journal of Consumer Behaviour* 6(2-3):94-110.
- Sawyer E. N., Kerr W. A., Hobbs J. E. (2009): International marketing of organic foods: Consumers, standards, and harmonization. *Journal of International Food & Agribusiness Marketing* 21:44-66.
- Verbeke W. (2008): Impact of communication on consumers' food choices. *Proceedings of the Nutrition Society* 67(3):281-288.

Consumer preferences with respect to innovation in organic baby food in four European Countries

Naspetti, S. & Zanolì, R.¹

Key words: choice experiment, preference, taste heterogeneity, organic baby food

Abstract

This paper reports partial results from a larger study on organic baby food products. An unlabelled choice experiment was conducted to investigate consumer preferences for organic and conventional of special baby food with respect to sensory and nutritional quality cues. Results show that there is room for introducing quality enhancing innovations in the processing, storage and retail stages.

Introduction

Organic baby food is increasingly being chosen by European mothers, although to date, no publicly available studies have addressed the consumer (i.e. mothers) preferences of this very specific category of food. More in general, only a few studies have specifically explored the demand and characteristics of organic baby food (Harris, 1997; Thomson and Glaser, 2001; Maguire et al., 2004) but none of them have studied consumer attitudes and preferences.

This paper reports the results of a stated preference survey on organic baby food products with respect to novel quality attributes in four European Countries

Materials and methods

In the first step five focus groups were conducted in Germany (DE) and Italy (IT) in October-November 2007. Participants were recruited from among mothers who were responsible for family food purchases. Only organic purchasers were selected. In addition, a qualitative experience survey was conducted on the companies that produce organic baby food in Europe. The information sought related to processor attitudes, awareness and expectations of the sensory and nutritional quality characteristics of organic baby food. In addition, information was sought on the critical processing steps, with respect to quality parameters.

Results indicated that purchasers have rather fuzzy and imprecise ideas about the processing of baby vegetable purées by the industry. Purchasers strongly rejected the idea of dried or freeze-dried baby food as substitutes for traditional UHT sterilised jars, though some mothers showed some interest for pasteurised, shorter-shelf life baby food to be purchased in the refrigerated section of shops and supermarkets. The processor survey showed that the use of raw materials (fresh or frozen) is expected to have a significant impact on quality.

Therefore, in the second step, a choice experiment was conducted to investigate consumer preferences with respect to these two novel processing and storage

¹ Università Politecnica delle Marche, Ancona, Faculty of Engineering, Via Brecce Bianche, I-60131 Ancona.

attributes that could enhance the quality of the final product, in relation to the usual intrinsic quality cues in both organic and conventional baby food.

The larger research project of which this study is part was investigating novel processing methods to enhance the quality of carrot baby food puree. Therefore, mothers, purchasing organic baby food, were presented with six hypothetical choice tasks consisting of two alternative baby carrot purees options and a 'No buy' option. This option was included in order to make the choice more realistic (Haaijer et al. 2001). These unlabelled alternatives included six attributes with two level per attribute: production method (organic/conventional), carrot taste (mild/intense), colour of the purée (brighter/darker orange), processing method & related shelf life (pasteurised – 15 days/UHT – one year), raw material (fresh/frozen) and price on three levels ranging from one half to the double of the current organic market price in each country.

The allocation of attribute levels to alternatives was designed using a sequential Bayesian approach, first tested in a pilot study on 40 subjects (10 per country) and then refined and optimized for Bayesian D-efficiency (Scarpa and Rose 2008). All designs involved 36 choice tasks, orthogonally blocked in 6 blocks of 6 each and were obtained using the Ngene software. Data on 1000 organic baby food purchasers were collected simultaneously in four different European Countries (250 in each country DE, DK, FR and IT) by means of an online questionnaire in October and November 2009, resulting in 990 valid interviews. Respondents were recruited among mothers with children, older than 6 months and up to 5 years old. Respondents were aged between 18 and 57 (mean 33.6, std.dev. 5.3), with an average family size of 3.75 (std.dev. 0.9) and an average of 1.82 (std.dev. 0.8) children in families. Average stated monthly baby-food expenditure was 97.23 Euros (std.dev. 83.62).

The data was analysed using Random Utility Models (RUMs). The basic model is the Multinomial Logit (MNL) model. This model is relatively unrealistic since is based on the following three assumptions: independence across utility functions of alternatives, the same taste parameters (betas) for all individuals and identical variances for all individuals. Most recent applications address the issue of unobserved taste heterogeneity by using continuous or finite mixing of individual taste distributions by means of Mixed Logit (MXL) models. We have allowed all taste coefficients (including price) to be randomly distributed following a normal distribution. Although this solution may result in estimates that imply counter-intuitive distributions of marginal willingness to pay (Scarpa et al., 2008), it does not impose a priori constraints on the signs of parameters, allowing for the heterogeneity of the tastes to be fully represented. Since reference prices were different in each country, willingness to pay can only be analysed at the country level. In this study we will focus on the overall, average pattern of preferences in all the studied countries: therefore we will not report country specific results and willingness to pay, and we will assume that taste parameters are normally distributed, permitting standard deviations that can result in a change of sign throughout the full range (Hensher et al, 2005).

In a mixed Logit model the utility of individual i from alternative j is specified as:

$$U_{ij} = \beta_i X_{ij} + e_{ij},$$

where x_{ij} are the observed variables that relate to the alternative and decision maker, β_i is a vector of coefficients of these variables for individual i representing that person's tastes, and e_{ij} is a random term.

Results and discussion

Table 1 reports the results of the parameter estimates. The second column reports the MNL model results, under the assumption of taste homogeneity. The third column reports the estimates of the random parameters MXL model, in the panel version, which allows for taste heterogeneity. The MXL estimates were obtained by simulating 200 times the likelihood of the sample by means of Halton draws (Train, 1999). The No choice option parameter was treated as fixed (i.e. non random).

Tab. 1: Parameter estimates of the MNL and MXL models

| | MNL | MXL |
|-----------------------------|------------------|------------------|
| Parameters | | |
| Organic | .56*** | .85*** |
| Mild taste | .16*** | .21*** |
| Refrigerated | .11*** | .24*** |
| Bright orange colour | .31*** | .52*** |
| Fresh raw material | .31*** | .48*** |
| Price | -.49*** | -.98*** |
| ASC No buy | -1.97*** | -3.21*** |
| σ Organic | | .78*** |
| σ Mild taste | | .40*** |
| σ Refrigerated | | .67*** |
| σ Bright colour | | .80*** |
| σ Fresh raw material | | .77*** |
| σ Price | | 1.26*** |
| Log-likelihood | -5392.692 | -4903.900 |
| Pseudo-R² | 0.08 | 0.25 |

The MXL model – allowing for taste heterogeneity – has a superior fit, as it can be seen from a quick inspection to the log likelihood and the pseudo R². Besides, all the estimated standard deviations of the taste parameters are significant, suggesting that the existence of significant taste heterogeneity. In the following, we will therefore discuss only the estimates of the latter model. The sign of Alternative Specific Constant (ASC) for the “No buy” option is negative, showing that – in general – respondents associated higher utility in any of the competing alternatives of purchase: they choose not to choose only in 13.5% of choice tasks. The price parameter has the expected (negative) sign in both models: as price increase the utility decreases. The highest marginal utility is associated, on average, to the organic attribute, as expected given the respondents were all recruited among organic consumers. Among the traditional sensory cues, the (bright orange) colour unexpectedly has the highest impact on utility, and its contribution is more than double that of the (mild) taste parameter. In any case, results show that *ceteris paribus* mothers prefer – on average – bright orange and mild tasting carrot purees. Among the processing/storage attributes, fresh raw material exhibits a marginal utility that is exactly double the marginal utility of the refrigerated option. These utility parameters are estimated at the sample population level, and are capturing the mean of the assumed distribution (in this case the normal distribution). The associated standard deviations are also

reported in Table 1, showing that tastes are distributed with very long tails: all parameters standard deviations – with the exception of the organic attribute – are of greater magnitude than their respective betas. This means that, albeit on average mothers prefer for their babies organic, bright orange, mild tasting, refrigerated purees made of fresh carrots, others have contrasting preferences. Therefore it is useful to analyse the individual-specific utility parameters, in order to grasp the effective share of respondents exhibiting the majority preferences. From inspecting the individual-specific parameters (available by request from the Authors), 17.15% of mothers appear to prefer frozen carrots as raw materials, while a higher proportion (26.7%) prefer UHT jars to refrigerated ones. This result was somehow expected, since during the focus groups many participants expressed the opinions that baby purees can easily be prepared at home from fresh raw materials, while UHT jars with long shelf life are chosen for convenience. Regarding taste, preferences are more univocal, since 91.6% of respondent associate higher utility to mild taste. But in terms of colour, 20% of respondents seem to prefer darker orange purees, probably because oxidation is perceived as a “natural” process. Given the sampled population, only 1.5% prefers conventional purees, while 13% of purchasers seem to exhibit a positive price coefficient, indicating either price non-attendance or that price is seen as indicator of quality. This was confirmed in the post-choice debriefing questionnaire, since 11.5% of respondents declared that they rarely or never looked at price in accomplishing the choice task, while 17.9% thinks that a high price is a positive quality signal.

Conclusions

The study aimed at exploring consumer reactions to specific quality enhancing innovations in baby food. Results show that fresh raw material is actually increasing the overall utility of baby food as perceived by mothers, while refrigerated, short shelf life baby food – albeit being seen as of higher quality – appear to have a lower impact on utility, given it reduces the convenience of purchased baby food. Country differences are likely to exist but were beyond the scope of the current paper.

Acknowledgments

This study was carried out with financial support from the Italian Government, under the ERANET - CORE ORGANIC project “Quality analysis of critical points within the whole food chain and their impact on food quality, safety and health” – QACCP).

References

- Haaijer, R., Kamakura, W., and Wedel, M. 2001. The ‘no-choice’ alternative in conjoint choice experiments. *International Journal of Market Research* 43: 93-106.
- Harris, J. M. (1997). Consumers pay a premium for organic baby foods. *Food Review*, 20, 13-16.
- Hensher, D.A., Rose, J. M., Greene, W. H. (2005). *Applied Choice Analysis. A primer*. Cambridge, UK: Cambridge university Press.
- Maguire, K. B., Owens, N., & Simon, N. B. (2004). The price premium for organic baby food: A hedonic analysis. *Journal of Agricultural and Resource Economics*, 29, 132-149.
- Scarpa, R. and Rose, J. M. 2008. Design efficiency for non-market valuation with choice modelling: how to measure it, what to report and why, *Australian Journal of Agricultural and Resource Economics*, 52:253-282.

Organic Food at the Point of Purchase: The final hurdle

Henryks, J.¹

Key words: Organic Food, Buyer Behaviour, Point of Purchase.

Abstract

Organic food has entered the mainstream and can no longer be viewed as a niche product and around 60% of consumers still purchase a mixture of organic and conventional food (Mitchell et al 2010). This paper focuses on understanding the barriers and facilitators to purchasing organic food at the final hurdle: the point of purchase (POP). Nine factors that influence buyer behaviour at the POP are identified and these are: consumer intention to purchase organic food when entering the retail outlet; visibility, location and access of organic food; whether consumers are familiar with the organic product; actual availability of the organic product; appearance; packaging; price; and labelling. These can often be the final hurdle to consumers choosing (or not) organic food at the POP.

Introduction

Organic food has entered the mainstream and can no longer be viewed as a niche product. Globally the sales of organic products continue to increase and are estimated to be almost \$60 billion (Willer 2010) whilst the most recent Australian market figures are almost \$950 million (Mitchell et al 2010). Consumers in Australia have embraced organic food with around 60% purchasing at least one product in the last year (Mitchell et al. 2010) an increase from previous studies which found that around 40% of people purchase it at least occasionally (Lockie et al. 2002, Pearson, Henryks & Moffitt 2007). This paper examines one area of the organic consumer buying process where retailers can make an impact upon sales: point of purchase.

Methods

A grounded theory approach was chosen with the overall intention of gaining a deeper understanding of the complexities and contexts involved in the organic food buying process. This paper examines one aspect of a larger study into the organic food buying process amongst consumers that 'switch' between organic and conventional food. Selected participants were the primary shopper for their household and, to ensure that they were 'switchers', they must buy at least 3 organic items per week but not the majority of their food as organic. Further, in order to cover a spread of lifestyles, participants were chosen on the following demographic basis: couple with no children living at home; couple with young children (at least one preschool child); household shopper with older children and single people with no children living at home. The demographic criteria serve to provide a context for the stories and perspectives that emerged from the data. A snowball sampling technique was used (Minichiello, Aroni & Hays, 2008). The final sample consisted of 21 participants from two cities in Australia: Armidale and Canberra. In line with the grounded theory method the data analysis consisted of two practices: coding and memos. Coding for

¹ Assistant Professor Advertising and Marketing Communication, Faculty of Arts and Design, University of Canberra, Canberra, Australia. E-Mail Joanna.Henryks@canberra.edu.au

this research followed the guidelines set down by Charmaz (2006) which consisted of a two stage process where initial open coding is followed by selective coding. Additionally, memos were composed and used for the duration of the project in order to aid reflexivity.

Results

Once consumers have chosen a retail outlet for a given shopping event, either consciously or through habit, they are met with a plethora of food choices. Whether the actual purchase eventuates as an organic or a conventional one depends upon many factors. These are referred to, in this paper, as barriers to purchase or facilitators to the purchase of organic food. They include: whether or not the consumer went into the outlet with the intention to purchase organic food; visibility, location and access of organic food; whether consumers are familiar with the organic product; actual availability of the organic product; appearance; packaging; price; and labelling. Given the qualitative nature of this research is not possible to prioritise their relative importance; however, availability is critical as a lack of organic choice prevents potential purchase. These results are very briefly explained and illustrated in Figure 1 below.



Figure 1 Barriers and Facilitators at the Point of Purchase

Intention refers to participants going to a shopping outlet with intention to buy a specific organic product. In most cases these consumers would do so unless one of the other factors, such as unavailability or price, became a barrier.

Habit and familiarity could be viewed as both a barrier and a facilitator to the purchase of organic products. It differs from intention in that it refers to routine shopping behaviour as opposed to specific or one-off shopping behaviour. For example, habit can act as a barrier if the retail outlet does not stock a large selection of organic food and conversely as a facilitator if there a large range of organic food.

Visibility and Accessibility Once in the shop, participants could be influenced to buy or not to buy organic food by the visibility and accessibility of the organic product in the retail outlet. If they could not easily see the product in the first instance, it was unlikely to become part of their choice unless they were specifically searching it out. Some supermarkets separate organic and conventional food. Where organic food was kept in a different section to conventional food, some consumers would not walk specifically to the organic section to seek it out.

Availability The limited range of organic food at certain outlets meant that it was not easily available at the POP. Consequently, shopping for organic food was perceived

to be more work for some participants. This became a barrier at the POP when consumers were time pressured: they may not have chosen to put in the extra work (perceived or actual) to buy organic food, perhaps needing to go to specialty outlets rather than just one main shop.

Visual and olfactory cues could be both a barrier and a facilitator to the purchase of organic food. This was particularly the case with organic fresh fruit and vegetables. However, for some consumers, a few bug holes also bode well in that they suggest pesticides have not been used and therefore underscore the product's organic credentials.

Packaging Organic food in supermarkets was often pre-packed in order to differentiate it from the conventional equivalent at the checkout and this could be a potential barrier to purchase if consumers were seeking an amount other than the prepacked quantity. Interestingly, no participants mentioned the potentially easier visibility of pre-packaged fresh organic produce.

Price One of the most cited barriers to the purchase of organic food was its premium price. The perception that organic food is more expensive than conventional existed. It is therefore not surprising that the higher price of organic food was noted by most participants. However, not everyone felt that the prices of organic food were higher than conventional, particularly when purchased at the farmers' market or food co-op.

Assumptions could also be both a barrier and a facilitator to purchase. Confusion existed around what participants were eating: some participants thought they were eating organic food when in fact it was not organic. This incorrect assumption resulted in a barrier to the purchase of organic food: participants would not be seeking out organic food if they already assumed they were eating organic food.

Labelling serves to identify certified organic food at the POP and to differentiate it from conventional food. Given that it is generally not possible to identify organic food by simply looking at the raw product, information provided on labels allows consumers to differentiate it from non organic food at the POP. This becomes a facilitator to purchase for those consumers positively predisposed to organic food as they can seek out labelling information.

Discussion

These nine factors are largely supported by findings in the current literature. Space precludes a detailed discussion of each of the factors and consequently two have been chosen as being particularly relevant and actionable by organic food retailers: availability and perceptions arising from consumer assumptions.

Availability is the physical presence of stock at the point of purchase. As Rozin (1996:86) states: 'we can only eat what there is to eat'. If organic products are unavailable at a particular retail outlet, it is impossible for consumers to purchase them at that outlet. Therefore, the lack of availability is a barrier to purchase and conversely the availability of organic food acts as a facilitator. Although organic food is becoming increasingly available in retail outlets (Shepherd, Magnusson & Sjöden 2005), it is still considered to be an issue in some areas with access to organic food being poor, not consistent or simply unavailable (Fearne 2008). The importance of consistent supply is critical for facilitating the purchase of organic food. Perceptions exist in all markets and it is consumer perceptions that marketers need to work with in order to bring consumer perceptions in line with the realities of the product/service on offer. The organic market is no different and consumer perceptions abound. For example, some switchers assume that organic food is being purchased when it is actually conventional food. Some participants claimed to be buying organic chicken from the

supermarket but were in fact buying free-range chicken. This mirrors the findings by Harper and Makatouni (2002) who found consumers confused free range with organic meat. Similarly, consumers shopping at a farmers' market often assumed they were buying organic food when it was not necessarily the case. This incorrect assumption that organic food is being purchased and consumed is a further barrier to the sales of organic food on two counts. Firstly, it can lead to an over reporting of organic food consumption from consumers and, secondly, if consumers assume they are already buying organic food, they will not be seeking it out. Radman (2005) found a similar situation whereby shoppers at a local market claimed to be buying organic food when in fact there was no organic food sold at that market. This can act as a barrier to the purchase of organic goods as people assume that they are purchasing organic when they are not. It's important for organic food retailers and marketers to consider these factors and address them wherever possible through distribution, product quality, clear labelling, and marketing communication.

Conclusions

Nine separate factors that can act as either barriers or facilitators to organic food at the point of purchase have been described and briefly discussed. These factors can influence purchase either in isolation or combination. For instance, a consumer may go in to a retail outlet planning to purchase organic chicken for dinner (*intention*) but be deterred by its premium price (*price*) or be unable to find it on the shelf (*visibility*). Factors such as ensuring consistent availability of organic food in retail outlets, ensuring organic products are in prime shelf positions, stocking fresh produce (and removing limp and spoilt produce) and having clear labelling of organic products will all serve to facilitate the purchase of organic food. Thus POP factors contribute to the purchase or non purchase of organic food and shed further light on factors that contribute or detract from organic food purchase behaviour. POP factors constitute the last component of the organic buying process, they are the final hurdle that needs to be jumped before purchase of organic food can occur.

References

- Charmaz K. (2006): Constructing Grounded Theory. Sage, London, 208 p.
- Harper G.C., Makatouni A. (2002): Consumer perception of organic food production and farm animal welfare. *British Food Journal*. 104(3/4/5): 287-299.
- Lockie S., Lyons K., Lawrence G., Mummery K. (2002): Eating green: Motivations behind organic food consumption in Australia. *Sociologia Ruralis*. 42(1): 20-37.
- Minichiello V., Aroni R. & Hays T. (2008): In-depth Interviewing: Principles, Techniques, Analysis. Pearson Education, Sydney, 342 p.
- Mitchell A., Kristiansen P., Bez N., Monk A. (2010): Australian Organic Market Report 2010. Biological Farmers of Australia Ltd, Chermshire, 102p .
- Radman M. (2005): Consumer consumption and perception of organic products in Croatia. *British Food Journal*. 107 (4):263-273.
- Rozin P. (1996): The socio-cultural context of eating and food choice. In Meiselman, H.L., MacFie H.J.M. (eds): *Food Choice, Acceptance and Consumption*. Blackie Academic & Professional, Melbourne, p. 83-104.
- Shepherd R., Magnusson M., Sjöden P-O. (2005): Determinants of consumer behaviour related to organic food. *Ambio*. 34 (4/5):352-360.
- Willer H. (2010): Organic Agriculture World-wide: Current Statistics. In Willer, H., Kilcher, L. (eds): *The World of Organic Agriculture: Statistics and emerging trends 2010*. International Federation of Organic Agriculture, Bonn, Germany, p.27-52.

Consumer acceptance of alternatives to piglet castration without anaesthesia in organic farming

Heid, A.¹ & Hamm, U.²

Key words: consumer acceptance, willingness-to-pay, organic farming, piglet castration

Abstract

Increasing animal welfare concerns over piglet castration without anaesthesia led to an EU-wide ban of this practice in organic farming from 2012 on. Since castration is performed in order to avoid the occurrence of boar taint, the organic sector needs to implement alternatives which meet animal welfare requirements as well as ensure sensory meat quality. This paper presents results of a consumer study about the attitudes towards and willingness-to-pay for alternatives to piglet castration without anaesthesia. Participants were consumers of organic food. The aspects animal welfare, health / food safety and taste were important for consumers' perception of the alternatives and should be included in communication measures. The results indicate that from a consumer perspective fattening of boars and castration with anaesthesia and analgesia are appropriate alternatives for organic pig production.

Introduction

In order to prevent the occurrence of boar taint male piglets are usually castrated. Until recently piglet castration was mainly conducted without anaesthesia and analgesia – also in organic pig production. However, this practice fails to meet animal welfare criteria of organic farming. Therefore, it will be banned in organic farming in Europe from 2012 on. Now, the task for the organic sector is to implement appropriate alternatives to piglet castration without anaesthesia which meet animal welfare requirements and ensure sensory quality of pork. There are three possible alternatives: castration with anaesthesia and analgesia, immunocastration (vaccination against boar taint), fattening of entire males (boars). An important issue for the implementation of alternatives is their acceptance by organic consumers. However, there is little scientifically based knowledge about organic consumers' attitudes towards the issue. The objective of this paper is therefore to explore consumer attitudes towards and willingness-to-pay for piglet castration without anaesthesia in organic farming and the above mentioned alternatives. On the basis of the presented results from Germany conclusions for the implementation of alternatives to piglet castration without anaesthesia in organic farming and consumer communication are drawn.

Materials and methods

A twofold methodological approach combining qualitative and quantitative elements was applied in order to analyse consumers' attitudes and willingness-to-pay. Firstly,

¹ University of Kassel, Department of Agricultural and Food Marketing, Steinstraße 19, 37213 Witzenhausen, Germany, E-Mail a.heid@uni-kassel.de, Internet www.uni-kassel.de/agrar/alm

² As Above

attitudes and opinions towards piglet castration without anaesthesia and the three alternatives were explored by focus group discussions. Focus groups are moderated group discussions with 6 to 12 participants. The aim of this qualitative research method is to identify participants' attitudes and opinions towards a certain topic in order to gain background information on certain consumer behaviour (Finch & Lewis 2006). The qualitative approach was chosen because the research topic is unfamiliar to consumers and therefore it is not clear which aspects are relevant to them. Consumers received neutral and standardised information on piglet castration and the alternative methods at the beginning of each focus group discussion. Secondly, willingness-to-pay for the alternatives was analysed by a Vickrey auction, i.e. a sealed bid second price auction (Völckner 2006). Participants of each focus group were asked to bid on four salamis which only differed in the alternative to piglet castration without anaesthesia used. Zero bids were possible if a participant did not want to purchase one of the salamis at all. Overall, 89 consumers participated in nine focus group discussion with a following Vickrey auction. All consumers were buyers of organic pork.

Results

A short questionnaire revealed that 54 % of the participating consumers did not know that male piglets are castrated for fattening. During the discussions it became clear that very few of them were aware that castration was usually conducted without anaesthesia in organic farming, too. Consumers reacted negatively when they were informed about this practice. Piglet castration without anaesthesia was considered a needless cruelty to animals and did not fit in the image people have of animal friendly husbandry in organic farming. Many participants were surprised and shocked.

During the discussion of the different alternative methods several topics became apparent. To some extent, these topics were subject of controversy. Castration with anaesthesia and analgesia was mainly considered as an animal friendly method because of the avoidance of pain. The alternative appeared to be well comprehensible for consumers. They drew comparisons to the use of anaesthesia in human medicine (e.g. at the dentist, during surgery). To some consumers the use of pharmaceuticals in organic farming seemed inappropriate. All the same, many consumers regarded the risk of pharmaceutical residues in pork as low because of the time lag between castration and slaughter. Costs of castration with anaesthesia and analgesia were assumed to be high and therefore rising meat prices were expected. Yet, only a few participants assumed that they could not afford organic pork for this reason.

Immunocastration was assessed positively with regard to animal welfare because there are only two injections and hardly any pain for the pigs. However, the method was often associated with hormones although it was explained that it is a vaccination. Obviously, the method was difficult to understand. In some cases consumers even had doubts that immunocastration could indeed be a vaccination. There was an elaborate discussion on possible risks of this alternative due to residues in meat. Negative effects on human health (e.g. fertility) were feared as well as yet unknown long term effects on both humans and pigs. Trust in the information that there are no residues in the meat was crucial for the perception of immunocastration. Consumers who did trust the information given considered the risk of residues as lower than consumers who did not trust the information. Immunocastration was perceived as a strong invasion into natural processes and as inappropriate for organic farming.

In contrast to the other alternatives, fattening of boars was explicitly described as an appropriate alternative for organic farming because of its perceived naturalness. The absence of surgical intervention and pharmaceuticals was noted positively. The risk of boar taint influenced consumers' opinions towards fattening of boars differently since only a few participants had personally experienced boar taint before. The question was raised how unpleasant boar taint really is. Yet, good taste of meat was important for many participants. Possible aggressions among boars and resulting stress and injuries of the pigs were negatively rated aspects of fattening of boars. Costs of this alternative and therefore the meat were expected to be high due to higher production costs and the necessary sorting of carcasses.

Figure 1 shows results from the Vickrey auctions. In comparison to the mean willingness-to-pay for castration without anaesthesia consumers were on average willing to pay the highest premium (83 %) for castration with anaesthesia and analgesia followed closely by fattening of boars (78 %). For immunocastration consumers were on average only willing to pay 12 % more than for castration without anaesthesia.

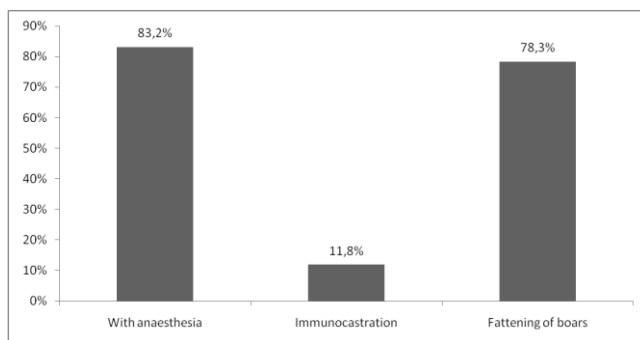


Figure 1: Relative willingness-to-pay for the alternatives in comparison to castration without anaesthesia (n=88)

Discussion

The main topics consumers considered for their assessment of the three alternatives were animal welfare, health, food safety and for fattening of boars taste. These aspects are also main purchasing motives for organic food (Hughner *et al.* 2007). Therefore, it is not surprising that consumers consider if the alternatives to piglet castration meet these criteria. A recent study by Fredriksen *et al.* (2010) found a high acceptance of castration with local anaesthesia among Norwegian consumers and very similar concerns and a high degree of scepticism regarding immunocastration (residuals, unknown long term effects, association with hormones). In a Swiss research project consumers strongly rejected immunocastration while the lowest disagreement was observed for castration with anaesthesia (Huber-Eicher & Spring 2008). Only 11 % of the participants of the Swiss study associated immunocastration with hormones (*ibid.*). Here, focus group discussions could to some degree reflect public debates. If one participant related immunocastration to hormones others would also address the issue. This intensified the discussion on hormones and risks of residues of immunocastration as it would be very likely in a public discussion. In

contrast, other studies found a relatively good acceptance of immunocastration (Lagerkvist *et al.* 2006, Vanhonacker *et al.* 2009). In comparison to other research results, which showed a low acceptability and even negative willingness-to-pay (Huber-Eicher & Spring 2008, Lagerkvist *et al.* 2006, Liljenstolpe 2008), the acceptance and willingness-to-pay for fattening of boars is quite good in the present study. This indicates that organic consumers may value the perceived naturalness of the alternative, i.e. the absence of surgical intervention and pharmaceuticals.

Conclusions

From a consumer's perspective only fattening of boars and castration with anaesthesia and analgesia are suitable alternatives to piglet castration without anaesthesia in organic pig production. However, the implementation of fattening of boars requires reliable methods for the identification of boar taint since taste is an important criterion for consumers. The use of immunocastration in organic farming would very likely cause unease and concerns among consumers which would be difficult to dispel. Eventually, the decision about the method(s) of choice is left to stakeholders of the organic sector. As fattening of boars and castration with anaesthesia and analgesia are acceptable to consumers the adoption of both methods in organic pig production would be an option. It then has to be explored whether product differentiation based on the topic of piglet castration is possible.

Acknowledgments

We gratefully acknowledge funding from the Bundesanstalt für Landwirtschaft und Ernährung (BLE) within the framework of the Federal programme for organic agriculture and other forms of sustainable agriculture (BÖLN). We also wish to thank C. Brenninkmeyer and U. Knierim (Department of Farm Animal Behaviour and Husbandry, University of Kassel) for providing us with information on piglet castration and the alternatives.

References

- Finch H., Lewis J. (2006): Focus Groups. In Ritchie J., Lewis J. (eds.): *Qualitative Research Practice*. Sage Publ., London, p. 170-198.
- Fredriksen B., Johnsen A. M. S., Skuterud E. (2010): Consumer attitudes towards castration of piglets and alternatives to surgical castration. *Research in Veterinary Science* In Press, Corrected Proof.
- Huber-Eicher B., Spring P. (2008): Attitudes of Swiss consumers towards meat from entire or immunocastrated boars: A representative survey. *Research in Veterinary Science* 85:625-627.
- Hughner R. S., McDonagh P., Prothero A., Shultz II C. J., Stanton J. (2007): Who are organic food consumers? A compilation and review of why people purchase organic food. *Journal of Consumer Behaviour* 6:94-110.
- Lagerkvist C. J., Carlsson F., Viske D. (2006): Swedish consumer preferences for animal welfare and biotech: A choice experiment. *AgBioForum* 9:51-58.
- Liljenstolpe C. (2008): Evaluating animal welfare with choice experiments: An application to Swedish pig production. *Agribusiness* 24:67-84.
- Vanhonacker F., Verbeke W., Tuytens F. A. M. (2009): Belgian consumers' attitude towards surgical castration and immunocastration of piglets. *Animal Welfare* 18:371-380.
- Völckner F. (2006): An empirical comparison of methods for measuring consumers' willingness to pay. *Marketing Letters* 17:137-149.

Consumer's beliefs about the contribution from organic food to an environmentally sustainable diet

Pearson, D.¹

Key words: organic products, sustainable consumption, consumer behaviour

Abstract

Within the context of existing behaviour and potential changes, empirical results from a survey of consumers in Australia are presented. These conclude that consumers believe their purchases of organic food do contribute to an environmentally sustainable diet. In addition there is scope to promote the co-benefits from other environmentally friendly food related behaviours, such as encouraging reductions in eating meat and junk food as well as minimising the amount of food waste. This will assist the Government in achieving its environmental and health policy agendas.

Introduction

Sustainable consumption has emerged as a relative new area of research to address the impact that consumerism, from an expanding and increasingly affluent population, is having on the natural environment. It focuses on the equitable use of resources across the planet (inter-generational equity) and for future generations (intra-generational equity) as well as encompassing consideration of the full product life cycles, minimisation of wastes and pollution as well as the use of renewable resources within their capacity for renewal (NME, 1994).

Not surprisingly food is a major focus for sustainable consumption, as it is a daily choice for citizens and the food system is a large contributor to global warming, at around 20% of green house gas emissions (Friel, et al., 2009). The United Nations has identified improving the environmental sustainability of diets through consumer education as a priority area within the more general area of the 'green' economy initiative (UNEP, 2010). The understanding of food related consumer behaviour, and ultimately being able to influence it, is what the UK Government has recently referred to as demand led change towards low impact diets (Defra, 2010).

Organic food is recognised as contributing to sustainable consumption by many influential organisations (OECD, 2008; UN, 2006). As such it offers an exemplar of a more sustainable food system which includes many features that maybe incorporated into other food systems. In addition, it is recognised that diets and their associated food systems are hugely complex and there are many areas in which environmental sustainability may be improved.

Eating healthily has been identified as the primary link for how consumers engage in sustainable food consumption in the UK (Defra, 2007). In a more recent report, the Sustainable Development Commission in the UK (SDC, 2009), placed the highest priority on four behavioural changes for consumers, these being: lowering consumption of meat, lowering consumption of dairy products, consuming less low

¹ Sustainability Development and Food Security Research Cluster, University of Canberra, ACT 2601, Australia, E-Mail david.pearson@canberra.edu.au

nutritional value products, and reducing food waste. The other, lower priority, behavioural change areas identified were: reducing consumption of out of season fresh produce, reducing consumption of non-sustainable fish, increasing consumption of organic food, reducing energy use in food purchases and cooking, and finally, reducing consumption of bottled water.

This paper contributes to the literature by exploring consumer purchases of organic food within the context of these opportunities for consumers to make changes that lead towards a more sustainable diet.

Materials and methods

After undertaking focus group discussions an online questionnaire containing both open and closed-ended questions was developed. This was pilot tested with undergraduate students, and, with minor modifications, was made available to self selected food shoppers in the city of Canberra in Australia. A total of 163 responses were received. The questionnaire responses were collected and collated using online survey tool prior to analysis with descriptive statistics. As anticipated the majority of the respondents (75%) were female. They represented all age groups (15 to 55+ year olds) and living arrangements (ranging from unrelated single adults through the various stages of having children to empty nesters). Most households (73%) had children living at home. In addition, they had slightly higher than average levels of income and education. This would be expected in a city like Canberra where the dominant employment opportunities focus around white collar government jobs.

Results and Discussion

The results indicate that household food buyers are concerned about the environment is important, with nearly all respondents (96%) wanting to lead a more environmentally friendly lifestyle. Further, just over half (56%) think about the environment when making food related choices. Food is often seen as a relatively frequent low value purchase where consumers tend to rely on habits that enable them to simplify the choice task. Hence it is important to understand the relative importance of organic within the context of other product features, some of which contribute to a sustainable diet. It is generally recognised that health, quality, price and convenience dominate food buyer's decision making and this was supported by the results from this research. These were twice as important as organic. In addition, the results showed that, in order of decreasing importance, minimal processing, ethical treatment of animals, seasonal fruits and vegetables, minimal packaging, produced in Australia, Fair Trade and being produced locally, were all more important than organic. However, in spite of the relatively low importance that buyers place on organic, the vast majority (87%) claim that they buy it, albeit most only do this rarely (33%) or sometimes (36%) with a small proportion purchasing frequently (15%) and only a few (3%) always purchasing it. This is generally consistent with the results from other research which has shown that most food buyers purchase organic products some of the time and only a few are dedicated to it (Pearson & Henryks, 2008).

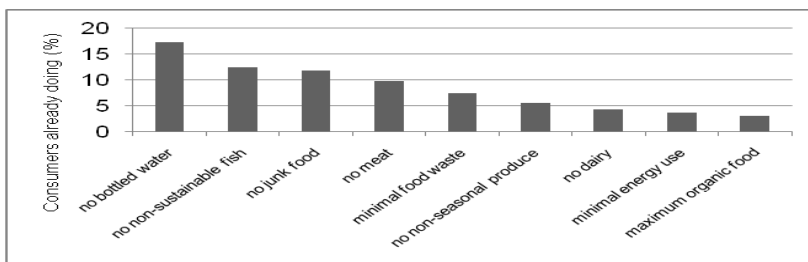


Figure 1: Percentage of consumers engaging in sustainable dietary behaviours.

In contrast to the small percentage of buyers (3% or around 1 in 30 Figure 1) already purchase as much organic food as they can, a larger number are already engaged in contributing to reducing the environmental impact of their diet through other behaviours. In relation to those behaviours that have the biggest impact on the environment, around 1 in every 10 food buyers have already stopped eating junk food and meat. However, it is important to note that the motivation for this may not be to contribute to the environment as it may related to their own health and/or animal welfare concerns. Within the vast majority of the population, that is around 19 out of every 20 food buyers who waste food, there are the combined issues of throwing food out as well as eating more than is required. This latter issue is important as a significant portion of the survey respondents, at around 1 in 3, were classified as being overweight or obese. The range of motivations for those who have already given up eating dairy products are similar to those for meat. However, they represent a much smaller portion of the population, at around only 1 in 20 food buyers.

In relation to the less important behaviours, almost 1 in 5 do not purchase bottled water. In addition, over 1 in 10 food buyers either do not purchase fish, or only purchase fish that has been sourced from sustainable sources. Just over 1 in 20 believe that they only eat seasonal fruits and vegetables. And finally, only a small portion, around 1 in 25, have reduced the energy used to purchase, store and cook their food.

In relation to improving the sustainability of their diet in the nine areas identified, many buyers (50%) indicated that they would increase their purchases of organic products, and this was similar to the number, who were prepared to reduce purchases of non-sustainably sourced fish and reduce energy use. However, in relation to the four most important areas, most food buyers (70%) would reduce food waste and their consumption of junk food, a much small number (30%) would reduce their purchases of meat and even less (15%) would consider reducing their consumption of dairy products. Whilst in relation to the less important areas, the majority (80%) would consider reducing their purchases of bottled water and of non-seasonal fruits and vegetables.

Conclusions

The results from this research show consumers believe that organic food does contribute to an environmentally sustainable diet, and, importantly, that there is scope to enhance this impact.

Historically the dominant choice criteria for organic food has been its personal health benefits. However, as environmental concerns, such as those associated with climate change, are moving up the political agenda in countries like Australia, there is scope to align the superior environmental credentials of organic food with Government policies, and emerging consumer concerns. Hence promoting the contribution that choosing organic food makes to improving the natural environment would appear to be a priority area for the industry. This is likely to change the behaviour of a large portion of the population by migrating them along the continuum from 'rarely to frequent' purchasers of organic food. This promotion of organic food could be combined with co-benefits for the environment, such as encouraging reductions in eating meat and junk food as well as eating responsibly and minimising the amount of food that is wasted. However, to achieve sustained sales growth the individual organic food products will still need to be comparable to consumer's expectations regarding convenience and the price-quality tradeoffs.

This research has added to the literature by identifying the relative importance consumers place on organic food in relation to a sustainable diet. Whilst its specific contribution is modest, the opportunity to align with other sustainable diet activities would appear to be significant. Hence to achieve the Government's environmental agenda, continued protection and enhanced support for organic food producers, processors, retailers and consumers is justified. In addition, this support will assist the Government in achieving its health aims.

References

- Defra (2007): Public understanding of sustainable consumption of food. London: Department of Environment Food and Rural Affairs.
- Defra (2010): Food: a recipe for a healthy, sustainable and successful future. London: Department for Environment Food and Rural Affairs.
- Friel, S., Dangour, A., Garnett, T., Lock, K., Chalabi, Z., Roberts, I., et al. (2009): Public health benefits of strategies to reduce greenhouse-gas emissions: food and agriculture. *Lancet*, November, 46-55.
- NME (1994): Oslo Roundtable on Sustainable Production and Consumption: Norwegian Ministry of the Environment.
- OECD (2008): Household Behaviour and the Environment. Paris: Organisation for Economic Cooperation and Development.
- Pearson, D., & Henryks, J. (2008): Marketing organic products: Exploring some of the pervasive issues. *Journal of Food Products Marketing*, 14(4), 95-108.
- SDC (2009): Setting the table: Advice to Government on priority elements of sustainable diets. London: Sustainable Development Commission.
- UN (2006): The guide: towards sustainable lifestyles. Rome: United Nations.
- UNEP (2010): Assessing the Environmental Impacts of Consumption and Production Rome: United Nations Environment Program.

Consumer concerns regarding additional ethical attributes of organic food

Zander, K.¹, Hamm, U.¹, Freyer, B.², Gössinger, K.², Naspetti, S.³, Padel, S.⁴, Stolz, H.⁵, Stolz, M.⁵ & Zanolli, R.³

Key words: local production, animal welfare, fair prices, ethical consumerism

Abstract

In a world where more and more organic products are mass produced, and where most consumers have little – if any – contact with the organic farmers who have produced their food, many people feel that the underlying principles of the organic movement are coming under threat. According to our research consumers are mostly interested in additional ethical attributes like “higher animal welfare standards”, “regional/local production” and “fair producer prices” and they are willing to pay more for organic products which are produced following these higher standards. This gives producers the opportunity to differentiate their products in the organic market. When communicating these additional ethical attributes of organic food producers must take care to use a wording in accordance with their customers’ comprehension in order to build up and sustain a trustful producer-consumer-relationship.

Introduction

There is growing evidence that consumers are becoming more critical of the increasing globalisation, international trade and ‘mass production’ associated with parts of today’s organic sector. Many organic consumers see these new developments as fundamentally opposed to the underlying principles of the organic movement, and are willing to pay a price premium for organic food which is produced according to their personal values which go beyond the basic ethical criteria established by EU regulation on organic farming (EC 834/2007) referred to as ‘OrganicPlus’ in this contribution (e.g. Zanolli et al. 2004).

Simultaneously, organic producers and processors integrate ethical concerns exceeding the requirements of the EU regulation on organic farming in their production processes. These production processes usually are more expensive resulting in the potential loss of market shares due to lower competitiveness. In this situation improved communication is essential in order to connect these ‘ethical’ farmers and consumers and to open up an organic market segment beyond organic farming standards with ‘OrganicPlus’ products.

¹ University of Kassel, Agricultural and Food Marketing, Steinstrasse 19, D-37213 Witzenhausen, E-Mail k.zander@uni-kassel.de, Internet <http://www.uni-kassel.de/agrar/alm/>.

² University of Natural Resources and Life Sciences, Division of Organic Farming, Gregor Mendel Straße 33, A-1180 Wien.

³ Università Politecnica delle Marche, Ancona, Faculty of Engineering, Via Brecce Bianchi, I-60131 Ancona.

⁴ The Organic Research Centre, Elm Farm, Hamstead Marshall, Newbury, Berkshire RG20, UK.

⁵ Research Institute of Organic Agriculture, Socio-Economics Department, Ackerstrasse, CH-5070 Frick.

The aim of this contribution is to identify additional ethical attributes which consumers are mostly interested in, since these attributes seem to be most promising regarding market differentiation within the organic market. Additionally, needs for a successful communication of food suppliers with consumers are discussed. This contribution summarises the results of a European project which aimed at the improvement of the communication between organic farmers and consumers on behalf of ethical considerations in organic production.¹

Materials and methods

In the first step we carried out an extensive literature review on ethical concerns in (organic) food production. In the following we analysed the additional 'ethical' activities of more than 100 farmers in Austria, Germany, Italy, United Kingdom and Switzerland (Padel & Gössinger 2008). Based on these results we selected seven different additional ethical attributes and tested them regarding their relevance for the purchase decision with about 1200 organic consumers by means of an Information-Display-Matrix (IDM) (Zander & Hamm 2010). The three most important attributes according to this step were used to develop egg package labels which were discussed in depth with organic consumers in 18 focus group discussions in the five study countries (Naspetti & Zanolli 2010). These results were the basis for consumer choice tests which aimed at eliciting consumers' willingness to pay for additional ethical attributes of organic food. These tests were conducted with 400 consumers of organic eggs. Each test person made 6 independent choice decisions in the tests (Stolz & Stolze 2010).

Results and discussion

The survey among organic small and medium sized enterprises with farmer participation in five European countries regarding additional ethical activities showed that a large array of different ethical arguments are realised but not always well communicated (Padel & Gössinger 2008). For the conduction of the computer-based survey IDM the seven ethical attributes 'animal welfare', 'regional/local production', 'fair prices for farmers', 'care farming', 'social aspects of production', 'protection of biodiversity' and 'preservation of cultural features' were selected. The results indicate that 'animal welfare', 'regional/local production' and 'fair prices for farmers' are the most relevant additional ethical attributes for the purchase decision. Issues like 'care farming', 'protection of biodiversity', 'consideration of cultural features in production' and 'social aspects of production' (such as working conditions) are also important, but for a lower share of organic consumers (Zander & Hamm 2010).

In the focus group discussions, different arguments regarding the most important ethical attributes were tested using egg packages. Egg packages with claims regarding 'higher animal welfare standards' were preferred over those with claims on 'regional/local production' or on 'fair prices for farmers'. All egg packaging labels presented to consumers in this research step were rather emotive and aimed at touching the heart of the consumers. In all countries – except Italy – the focus group participants generally disliked such labels. They felt under pressure to 'do something good' by purchasing 'ethical' eggs. Consequently, it is essential to say that most

¹ CORE Organic Project 'Farmer Consumer Partnerships'. Further information on the project at <http://fcp.coreportal.org/>.

consumers preferred labels with short and simple statements referring to the relevant (ethical) aspects of production (Naspetti & Zanoli 2010).

The results of the following consumer choice test confirmed that people generally preferred organic products with additional ethical characteristics. Comparing the willingness to pay for each of these additional ethical attributes gives information on the participants' relative preferences for the various OrganicPlus arguments (Table 1). In most countries the argument 'from the own region' was most important. This was followed by 'higher animal welfare standards' and, only in Germany and Switzerland, by 'fair prices for farmers'. In Austria, the additional willingness to pay was highest for the 'animal welfare' argument and lowest for being produced from the own region. However, the 'fair prices for farmers' provoked no additional willingness to pay at all for people in Austria, Italy and UK. Interestingly, in Italy and in the UK there was no additional willingness to pay for any of the tested arguments, except for 'from the own region' (Stolz & Stolze 2010).

Tab. 1: Ranking of additional ethical attributes in different countries according to the respondents' willingness to pay

| | Austria | Germany | Italy | Switzer-land | United Kingdo m |
|--|---------|---------|-------|--------------|--------------------|
| From the own region | 3 | 1 | 1 | 1 | 1 |
| From national production | 2 | -- | -- | -- | -- |
| Higher animal welfare standards | 1 | 2 | -- | 2 | -- |
| Fair prices to our farmers: plus 20 pence/ 20 cents/50 Rappen | -- | 3 | -- | 3 | -- |

Source: Own presentation.

Conclusions

The main outcome of our comprehensive research on additional ethical attributes of organic food is that the communication of such attributes offers many organic businesses ample opportunities to differentiate their products in the wider organic market. Many consumers and producers already agree that organic production in accordance with the EU regulation on organic farming (834/2007) is not the 'final stage' with respect to sustainable and ethical food production. The EU regulation on organic farming (EC 834/2007) fails to adequately address a number of key areas which are of concern to both consumers and producers, such as fairness.

Another important result from our research was the fact that many producers refuse to communicate additional ethical attributes of their products or production processes because they believe it is 'unethical' to make money from these concerns, since all (organic) production should follow ethical considerations. However, from our point of view there is no doubt that consumers must know about additional benefits of ethical production methods, if these aspects of production should be successful in an increasingly competitive marketing environment. Therefore, we highly recommend targeted communication of the specific ethical characteristics of the production

methods to ensure that consumers are given the opportunity to make purchasing decisions according to their personal ethical considerations.

With respect to an improved communication between farmers and consumers, farmers who wish to make claims about additional ethical activities should target their efforts in areas where there are clear differences in their practices compared to existing organic standards. In this way, businesses can ensure that their activities are clearly visible to the consumer, and that consumers can easily verify any communication – thereby creating credibility and building trust. Effective communication of additional ethical values requires a common understanding of each particular attribute. However, so far there are no general definitions or standards for these additional ethical attributes. The terms 'fair' and 'regional/local' have become very popular in the discussions about future perspectives of organic farming. 'Fairness' makes people feel good because it implies not only well-being for farmers but also for customers, while high expectations rest on 'local' or 'regional' organic food as new opportunities for reconnecting producers and consumers. However, as both terms are not clearly defined or protected in law, consumers and producers may have a very different understanding of what the terms mean. There is an alarming potential for misleading claims and confusion. This holds particularly true as the terms under discussion are well-known by today's consumers. Indeed, many consumers already have their own ideas on what is 'fair' and what is 'regionally/locally produced', which is why it is not up to the producers and marketers to define these terms on their own. As common definitions and standards are lacking in most areas, and given the different ways in which these 'ethical' claims can be interpreted by consumers and producers alike, organic businesses should be very cautious when making claims in these areas. They should accompany concise claims with sufficient information on what is standing behind. It is our belief that it is time for the organic movement to hold a comprehensive discussion on the additional ethical attributes associated with its farming and processing activities in order to prevent that the organic movement loses its basic principles which differentiate their products from mass production of food.

Acknowledgments

The authors gratefully acknowledge the financial support for this report provided by the members of the CORE Organic Funding Body Network.

References

- Naspetti, S., Zanoli, R. (2010): Elaboration and test of new communication arguments. CORE Organic Project Series Report 'Farmer Consumer Partnerships'. Deliverable no. 3. Ancona/Italy. <http://orgprints.org/16678/>.
- Padel, S., Gössinger, K. (Eds) (2008): Farmer Consumer Partnerships. Communicating ethical values: a conceptual framework. CORE Organic Project Series Report 'Farmer Consumer Partnerships', Deliverable no. 1. Aberystwyth/UK and Vienna/Austria. <http://orgprints.org/12821/>.
- Stolz, H., Stolze, M. (2010): Farmer Consumer Partnerships: WP 5 report on the results of Consumer Choice Experiments. CORE Organic Project Series Report 'Farmer Consumer Partnerships', Deliverable no. 4, Frick/Switzerland. <http://orgprints.org/17247/>.
- Zander, K., Hamm, U. (2010): Consumer preferences for additional ethical attributes of organic food. *Food Quality and Preference* 21(5):495-503.
- Zanoli, R., Bähr, M., Botschen, M., Laberenz, H., Naspetti, S. and Thelen, E. (2004). The European consumer and organic food. - Organic marketing initiatives and rural development Vol. 4, University of Wales, Aberystwyth.

Consumer attitudes to ethical standards beyond organic guidelines - the example of eggs

Gössinger, K.¹, Hametter, M.², Freyer, B.³, & Zanolì, R.⁴

Key words: consumer, eggs, ethics, organic, marketing

Abstract

The aim of the survey, conducted in the framework of the “CORE Organic project Farmer Consumer Partnerships”, was to explore how organic consumers perceived ethical arguments that go beyond organic guidelines, using the example of eggs. In three focus groups with approximately 12 consumers, different egg box labels referring to animal welfare, regional production and fair prices were discussed. The survey shows how controversial consumers perceive and interpret different advertisements of ethical arguments. In addition, the broad range of perceptions and reflections of the consumers underline that focus group discussions offer fruitful contributions for the development of organic marketing strategies.

Introduction

There is an ongoing debate within the organic agriculture movement on how to increase the awareness of the ethical concerns and values expressed in the IFOAM principles (health, ecology, fairness and care), the organic pioneers' ideas (Jurtschitsch 2010), as well as ethical and philosophical reflections (Freyer 2007, Kirschenmann 2010, Thompson 2010). To ensure the outstanding position of organic in the globalised food market, ethical concerns tend to have a key function in the relation between farmer and consumer.

Numerous Austrian organic enterprises already practise ethical activities that go beyond the EU Regulations on organic farming. These approaches are diverse and include for example social agriculture, offering better working conditions or paying a higher producer price. Farmers, processors and retailers practise these additional ethical activities partly out of internal beliefs and convictions, and partly to meet the demands of critical organic consumers (Padel & Goessinger 2008). In this context, our general research interest was to identify consumers' attitudes towards higher ethical standards in organic farming. This survey took place in the framework of the European CORE Organic research project “Farmer Consumer Partnerships⁵”. In a former

¹ University of Natural Resources and Life Sciences, Division of Organic Farming, Gregor Mendel Strasse 33, 1180 Wien, Austria, E-Mail Katharina.goessinger@boku.ac.at, Internet www.nas.boku.ac.at/oekoland.html

² As Above, E-Mail Monika.hametter@boku.ac.at

³ As Above, E-Mail Bernhard.freyer@boku.ac.at

⁴ Università Politecnica delle Marche, Ancona, Faculty of Engineering, Via Brecce Bianchi, 60131 Ancona, Italy, E-Mail zanolì@agrecon.univpm.it

⁵ The overall objective of the research project “Farmer Consumer Partnerships” was to analyse and test ethical communication arguments of organic companies in five European countries (Austria, Germany, Italy, United Kingdom, Switzerland) as a means to reconnect organic farmers and consumers.

research step, animal welfare, regional production and fair prices were identified by organic consumers as the most relevant ethical arguments (Zander & Hamm 2010). The specific research question was how organic consumers deal with different egg box labels that refer to 'animal welfare', 'fair prices' and 'regional production'. Our aim was to explore the perceptions and attitudes provoked by the different labels.

Methods

For our research a focus group-setting was chosen (Morgan 1998). Three focus group discussions (FG) with 12 or 13 persons at a time were conducted in Vienna (see Tab. 1). The quotas for each FG were as follows:

- only organic egg consumers and buyers (regular or occasional)
- age: 50% between 25 and 45 years, 50% between 46 and 65 years;
- gender: 1/3 male, 2/3 female;
- employment: at least one participant per FG should be unemployed/ student/ housewife (but no more than 1/3 of participants per FG);
- all as buyers responsible (or co-responsible) for household food purchases;
- not employed in the agricultural sector (farmers or growers).

Tab. 1: Sample description

| Female | Male | Age 25-45 | Age 46-65 | Full or part-time employed | Not employed | Total |
|--------|------|--------------|--------------|-------------------------------|-----------------|-------|
| 24 | 13 | 21 | 16 | 17 | 20 | 37 |

The basis for the FG discussions were six fictitious labels for egg boxes which had been designed by an Italian advertising company. Each label consisted of graphical elements, a headline, a slogan as well as a body copy (see Tab. 2) and communicated one of the three arguments (animal welfare, local/regional and fair price). The labels were distributed and additionally presented by PowerPoint. The FG discussion was structured into several phases: introduction, recognition, liking and effectiveness (Naspetti & Zanolli 2010). The discussions lasted two hours, were moderated by two persons and recorded. The qualitative analysis using *Atlas.ti* was transcript-based and performed on the basis of a reporting structure.

Tab. 2: Egg box labels

| Animal Welfare | Regional | Fair price |
|--|--|--|
| The heart's choice The hens are looked after with love and care, fed organic free from GMOs and are free to live and roam outdoors | From the heart of our region! These organic eggs are produced close to where I live and are brought to my table with minimum transport and less pollution! | I support those who have our world at heart! Buying these eggs rewards the work of organic farmers who safeguard and preserve our Mother Earth! |
| Produced with the heart! The welfare of our hens is close to our heart! They have access to the outdoors where they are free to roam, and they are fed on natural, GMO-free feed. For them we have chosen a 100% ORGANIC healthy life! | The heart of tradition! Our region is close to our heart. This regional product safeguards our rural values and traditions. | The wellbeing of our farmers is close to our heart! A fair deal: buying these eggs rewards the hard work of organic farmers and their families and secures their survival! |

Results and discussion

Almost all participants disliked the lively design, the cartoon type images as well as the harsh pink and yellow on the labels. Instead of that they preferred the brown egg and the green colour, which symbolized organic farming and naturalness for them. Some participants were irritated by the informal language used (you, I, me, we) while others found that innovative and interesting.

Animal Welfare theme

Free-range husbandry, the wellbeing of the hens and a GMO-free feed were often described as primarily influencing their purchase decision. For the majority the distinction between free-range eggs and organic eggs was not clear. The degree of *emotionalisation* in communicating animal welfare was controversial. Some claimed a factual and rational approach doubting the credibility of the emotional formulations, whereas others found the labels appealing. In general, the knowledge about GMOs diverged heavily.

Regional theme

Regional production attracted all participants for various reasons. The main factors were reduced food miles and little environmental pollution. Another argument was the support of the regional economy. Imprecise formulations like 'short transport' or 'region' without a concrete reference to the eggs' provenance led to confusion. In this context, it was proposed to introduce criteria for the transport of organic products in general e.g. in view of the CO₂-balance. Additionally, some participants remarked that organic production should always only be marketed through regional supply chains. Several participants did not know that the Austrian organic certification mark also communicated the Austrian origin of the eggs.

While some participants perceived Austria or parts of Austria as a region, others disliked the reference to a nation and stressed the importance to view a region in terms of spatial closeness (e.g. to consider parts of Hungary as region around Vienna). Whereas some participants liked the expression 'Austrian farmers' or 'Austrian eggs', others said that the national reference was not important to them or even considered it as nationalistic. Almost all participants aimed to support local and small-scale farmers with their purchase. In many cases they would even prefer local conventional products to foreign organic ones. The term 'tradition' was widely disliked. Mainly the younger participants associated traditional farming with times when hens had been kept in laying batteries.

Fair price theme

The 'fair price' theme was rather new to the participants – meaning that they didn't recognize it as something typical of organic farming. Its acceptance ranged from understanding for the concerns of organic farmers and the will to support them and their farming method, to participants attaching little attention to the subject and claiming to care about the hens and not the farmers. Some declared that they bought organic for health reasons and their own wellbeing and not for the sake of the farmers. In general, the participants were not mainly put off by the idea of supporting farmers with fair prices but by the way the message was formulated. Many participants complained that the formulation of the 'fair price' labels reminded them of a charity organisation asking for donations and emphasized the importance of not giving the impression that farmers were suffering and in need of charitable support. They stated that the linkage of their purchase decision with the survival of farming families was a

hard burden and inappropriate. In fact they claimed information about the operationalisation of the 'fair price'. Due to the 'foreign' looking farmer and the term 'fair price', the labels were often associated with 'fair trade' products from overseas.

Conclusions

The reported results of the focus group discussions demonstrate how controversial consumers perceive and interpret different advertisements of ethical arguments. Several focus group participants recommended combining all three arguments – 'animal welfare', 'fair price' and 'regional production' – by considering each of them in an equal way. It was stressed that a local organic product covered most of their demands anyway. Apart from this result, which is of high relevance for organic marketing strategies, the survey underlines the appropriateness of the chosen FG discussion approach. Furthermore, many participants did not link organic agriculture to general ecological issues such as climate change. A solution to this problem could be to introduce a logo representing the holistic aspect of organic agriculture. Becoming an organic consumer seems to be related to a learning process of the complex organic agri-food system. Further results, theoretical implications and the practical impacts will be explored in future publications.

Acknowledgments

The authors gratefully acknowledge funding from the CORE organic partnership of national funding bodies and the contributions that all project partners have made to the Farmer Consumer Partnership CORE project (<http://fcp.coreportal.org/>).

References

- Freyer, B.(2007): Organic agriculture in a changing agricultural world and societal environment - between criticism and ethical positioning. 7th Congress of the European Society for Agricultural and Food Ethics, Vienna, September, p.13-15.
- Jurtschitsch, A (2010): Bio-Pioniere in Österreich. Vierundvierzig Leben im Dienste des biologischen Landbaus. Böhlau, Grüne Reihe des Lebensministeriums, Band 21, Wien, 279 p.
- Kirschenmann, F. (2010): Cultivating an ecological conscience. Essays from a farmer philosopher, The University Press of Kentucky, Lexington, 392 p.
- Morgan, D. L. (1998): The Focus Group Guidebook, Thousand Oaks, Cal.: Sage, 103 p.
- Naspetti, S., Zanolli, R. (2010): Elaboration and test of new communication arguments. CORE Organic Project Series Report 'Farmer Consumer Partnerships'. Deliverable no. 3. Ancona, Italy. <http://orprints.org/16678/>.
- Padel, S., Gössinger, K. (2008): Farmer Consumer Partnerships. Communicating ethical values: a conceptual framework. CORE Organic Project Series Report 'Farmer Consumer Partnerships', Deliverable no. 1. Aberystwyth/UK and Vienna/Austria. <http://orprints.org/12821/>.
- Thompson P. (2010): The Agrarian Vision: Sustainability and Environmental Ethics, Lexington, The University Press of Kentucky, 323 p.
- Zander, K., Hamm, U. (2010): Consumer preferences for additional ethical attributes of organic food. Food Quality and Preference 21(5): 495-503.

Lessons learned from implementing organic food into European school meals

Kristensen, N. H.¹, Hansen, M. W.², & Nielsen, T.³

Key words: Public procurement, Organic supply chain, Policy, School meal

Abstract

The introduction of organic food offers new dimensions to school meals, and schools offer new dimensions to organic food – when tackled properly. This paper is based on studies of school food practices and policies in Denmark, Finland, Italy and Norway. The embedded food traditions and cultures have had different roles in these countries, why also food related consumption, institutions and markets are quite heterogeneous and dynamic. Whereas school food services are relatively widely embedded in the school systems in Finland and Italy, the Danish and Norwegian school food is predominantly defined by the packed lunch brought from home.

Introduction

The daily meal for school children is a subject that has a considerable public attention in many countries these years. The discussions are often related to the considerations of how to secure pupils a healthy and genuine and tasty meal. The concept of “a proper meal” tends to become an obligatory passage point for this attention, which also qualifies to bridge to other agendas such as food culture, tackling poor or no lunch for school children, etc. (Morgan & Sonino 2008). Especially the upcoming obesity and overweight focus among children has caught attention. On the national level, different policies, cultures and traditions determine the frame for developing school food systems as we will see in this study of four different countries and a number of different local school food schemes within these countries. Also on the local or regional administrative level many different aims and systems occur. This paper briefly presents the character and implications of various organic school food systems, and the embedding of organic food in these systems, by analyzing various factors in be it structural, administrative, regulatory, cultural.

Materials and methods

Four countries have been examined in relation to selected organic school food systems – Italy, Finland, Norway and Denmark. Data have been collected for this study through national data reports that have been conducted by all national partners in the iPOPY project on the basis of tailored data collection and reporting guidelines (Kristensen et al 2007) mapping and analyzing the state-of-art of organic school food schemes in Denmark, Finland, Italy and Norway (Nielsen et al 2009). These data reports have been complementary with qualitative case studies in ten selected

¹ Aalborg University – Copenhagen, Laurrupvang 2, 2750 Ballerup, Denmark. E-Mail: nhk@plan.aau.dk, Internet www.aau.dk

² As above

³ As above

municipalities with experiences in organic school food, and carried out in by individual face-to-face interviews, observations, telephone interviews and literature (including internet) studies. Informants have included key persons in school administration, (food) procurement, strategic departments and in central administrations in municipalities, regions, provinces and states. Informants also represent some of the local institutions and food manufacturing and distribution.

In Italy Bocchi et al (2008) have found that school food is the responsibility of the municipality and since Italy has more than 800 municipalities there are many different systems. There has in recent years been a national focus on quality aspects of the school food, and organic products have had national attention. The food is partly paid by the parents and partly supported by the municipality or the region/state. In Finland the school food is free of charge for all pupils (Mikkola 2008). The system has a top-down approach where especially health and nutritional aspects dominate the way the actors consider the food. The menus are planned according to the 'plate model' (Tikkanen 2009) as the dominating approach towards the planning of the food. The food is often prepared in a municipal kitchen although major external suppliers are also increasingly on the market. In Norway, school food is generally not very high on the national agenda (Løes et al 2008) and the packed lunch is extended by subscription schemes for milk and fruit, which is served in the schools. Parents pay a major part of the costs of the milk scheme. Only a few municipalities offer organic school milk. A minor part of the schools in Denmark has canteen facilities (Hansen et al 2008). At the same time there has been political attention towards school food, and especially in the municipalities near major cities. The meal systems in Denmark are primarily based on parent payments. For some municipalities there are different kinds of municipal support to the canteens.

Results

In *Italy*, the full warm meal system is well established. The operational management of the school meal procurement is decentralized and organized at the local municipal level. In *Finland*, the warm meal system is well established and has a long history just as in *Italy*, but the school meal system is much more centralized. Important decisions about the regulatory framework such as nutritional recommendations, in-house food safety control, or mandatory vocational curriculum for the employees are taken at the national level. In general, *Finland* can be characterized as having a scientific management approach, where *Italy* tends to have strong elements of an artisan approach. In *Denmark*, the additional food system is negotiated at the moment; rather many local initiatives try to extend the school food procurement into the direction of full warm meals. In *Norway*, food procurement is mainly restricted to milk and fruit schemes.

Normally in most European countries equipment and education is tax financed, but in our study we find that when introducing food service systems to public schools, an economic public controversy is introduced to the schools. Finland is one of the exceptions here. This controversy is especially found where user payment is practiced. The controversy is related to the relation between the price and the quality. One of the elements in this is related to the fact that if the (organic) food is too expensive the sale will drop. If the quality in the other hand is too low, or the food is not popular among the pupils, the sale will also drop. In *Denmark*, there is an expectation that the price per meal cannot be above 3 € if a certain level of sale is to be expected. In Italy, the user payment has quite different expressions since Rome has chosen to fix the price on 2 €. Currently, Rome municipality has to pay 3 € for

each meal just in order to cover the food expenses. In Milan on the other hand the parents pay almost all the expenses, so the costs per meal are about 5 €. The focus on reducing costs has diminished the organic share and the quality of the food. The regulatory issue shows some differences in the way that the systems are organized. In Italy and especially in Finland there is a top-down approach towards the implementation of school meals. This means that the state level for Finland and the municipal level for Italy have the major decision-making power. In Denmark and Norway to some extent, there is at the same time a political wish of school meals for all pupils, but also an ideology of the free choice for everyone, which makes the decision-making power more diffuse and decentralized.

Discussion

In the former descriptions it seems as if the two top-down managed systems in Italy and Finland naturally are the most embedded systems. Especially in Finland there is a very articulated, law-based and institutionalized system with the major focus on nutrition and scientific management aligning a so-called 'plate-model' for the content of the school meals. In Italy there is a quite complex system of regulatory units on the four levels: state, province, region and municipality. Much creativity has been in place to assure the organic and local food is served to pupils. On the other hand the involvement of parents and other civil actors are seemingly more reduced in these countries. Organic food can therefore be characterized as socially relatively weak embedded in the Finnish institutions, whereas in Italy the indications of embeddedness is established through manifest laws and regulations.

In relation to the aspect of embeddedness of the systems this study shows that the more formalized, politically prioritized and economically supported systems, the more embedded systems, in terms of how many children use them and how developed the structures are around the food (canteen facilities etc.). On the other hand these top-down regulated systems may lose the civil embeddedness (legitimacy) and the parents may feel decoupled from the decisions. In that sense the systems may become socially disembedded.

Conclusions

The overall conclusions on this study are that organic food has a huge potential in school meals but it is challenged by: "double-embedding" obstacles in Denmark and Norway; "single-embedding" barriers in Italy and by scattered embedding in Finland. It is clear from the studies that the complexity of school food systems, where different countries have various approaches with many actors involved, that a fruitful discussion to address obesity and health problems among children should build on solid analytical knowledge of the relevant aspects and cultural meanings of school meals. More detailed following conclusions as the following has been reported:

- Embedding organic food in public school meals is not done by a simple product replacement. It is necessary to address also legal issues, price premium issues, structural issues, sourcing issues, social issues, etc
- Successful embedding of organic food has to be careful synchronised with other agendas on the local, municipal, (provincial), regional and state level, including nutritional policies, and also European conditions and policies must be taken into consideration.

- Establishing a transition process tailored the relevant social actor-networks is crucial to a successful embedding process. For example high level decision makers can facilitate the process by eliminating barriers (economic, formal, legal, bureaucratic etc).

Acknowledgments

iPOPY was part of ERA-Net, CORE-Organic-I / Danish Ministry of Food.

References

Book in series:

- Bocchi S., Spigarolo R., Marcomini N. & Sarti, V. (2008). Organic and conventional public food procurement for youth in Italy. Bioforsk report 42, Tingvoll, Norway.
- Hansen, S.R., H.W. Schmidt, T. Nielsen, N.H. Kristensen; Bioforsk Report Vol. 3 No. 40 2008, iPOPY discussion paper 1/2008, Organic and conventional public food procurement for youth in Denmark.
- Kristensen NH, Schmidt, H., Rosenlund S., Nielsen T. (2007): Guideline for National Reports. ERA-Net/CORE-Organic. iPOPY working paper.
- Løes, A.-K., M. Koesling, G. Roos, L. Birkeland, L. Solemdal; Bioforsk Report Vol. 3 No. 43 2008, iPOPY discussion paper 4/2008, Organic and conventional public food procurement for youth in Norway.
- Mikkola, M.; Organic and conventional public food procurement for youth in Finland. Bioforsk Report Vol. 3 No. 41 2008, iPOPY discussion paper 2/2008
- Nielsen, T., Nölting, B., Kristensen, N. H. & Løes, A.-K. (2009). A comparative study of the implementation of organic food in school meal systems in four European countries. Bioforsk Report Vol. 4 No. 45; iPOPY discussion paper 3/2009.
- Tikkanen, I (2009): Free school meals, the plate model and food choices in Finland. British Food Journal 111(2) pp.102-119

Book:

- Morgan, K. & Sonnino, R. (2008). The School Food Revolution. Public food and the challenge of sustainable development. London: Earthscan.

Organic food for the youth – potentials and challenges. Knowledge extracted from the iPOPY project.

Løes, A.-K.¹ & Nölting, B.²

Key words: public procurement; Europe; school meals; policy; sustainability

Abstract

Strategies to increase public organic consumption were studied in the project “innovative Public Organic food Procurement for Youth”, iPOPY (2007-2010). Five European countries (Norway, Finland, Denmark, Germany and Italy) were compared, with highly different traditions for the serving of school meals. Organic food is closely linked to healthy eating, and increased attention on public food serving for youth creates a window of opportunity for organic consumption. Initiatives for organic school meal services should combine efforts to establish a general school meal system including complete meals for all pupils, high public financing and administrative support with specific support for organic school food. This is done in Italy, resulting in a remarkably high share of organic food in school lunches, achieved via ambitious public regulations and carefully designed calls for tenders. Further, organic initiatives should be carefully anchored among all stakeholders. Actions to support related agendas such as healthy food and care for the environment often pull in the same direction as actions to support organic consumption. Organic food in schools may be highly useful for teaching about sustainability.

Introduction

To supporting environmentally friendly agriculture and organic food consumption, public institutions should act as a role model and choose organic procurement. Where young people are the main target group of the food serving, this option may also be linked up with food education to promote healthy eating patterns and to establish familiarity and loyalty towards organic products. However, introducing or increasing the use of organic food in schools is a challenge because schools are complex and dynamic organisations, involving a large number of stakeholders and interests. Several hindrances, from lack of funding and personnel resources to school and food cultures with little focus on organic or healthy eating, may hamper the use of organic produce. However, several successful cases exist and may inspire actions in other places.

Little research has been carried out on the implementation of organic food in public serving settings, and even less for schools. The research project “innovative Public Organic food Procurement for Youth” (iPOPY) aimed at increasing the consumption of organic food especially among young people, by revealing efficient strategies and instruments for implementation of organic food in school meals and other public food serving for youth. This paper summarizes results and general conclusions drawn by the project team, emphasising school meals as our main common topic. The research

¹ Bioforsk Organic Food and Farming, Gunnars veg 6, N-6630 Tingvoll, Norway, email: anne-kristin.loes@bioforsk.no, internet www.bioforsk.no

² TU Berlin, Centre for Technology and Society, Fasanenstr. 90, 10623 Berlin, Germany; email: noelting@ztg.tu-berlin.de, internet: www.tu-berlin.de/ztg

question of this paper is how to design school meal systems in order to maximize the consumption of organic food.

Materials and methods: Enquiring organic school meal procurement

The iPOP project adopted an interdisciplinary approach, ranging from nutritional to political science. Development of analytical tools to assess and compare school meal systems on a national or regional level was required. Four explorative work packages (WPs) studied cases and conditions in Denmark, Finland, Italy, Norway and Germany, whereas a separate WP (1) drew the final conclusions. WP2 studied the development and efficiency of organic food policies by interviews and document reading in selected municipalities (totally 10), where a decision to serve organic food in institutions for young people had been made. In WP3, calls for tenders and criteria for selecting suppliers were the main empirical material for supply chain management studies. Material was collected from more than 100 Italian municipalities. The national procedures for certification of mass catering were compared by document reading and interviews. A survey assessed if certifying bodies and caterers would welcome an EU harmonisation of mass catering certification. WP4 studied users' perceptions, attitudes towards organic food and participation in the food service, not only in schools, but also in a music festival, congregation youth groups and military camps serving organic food, by interviews, focus groups and observations. To reveal what the pupils learn about organic food and sustainability, school curricula were examined in four countries. The potential of organic food in relation to health and obesity risks (WP5) was studied by a web-based survey conducted at school level. The main interest was to study the effect of a dedicated organic food policy on the actual school food serving. National reports describing the public regulations and historical background for current school meal systems and their use of organic products structured and summarized the knowledge about the five countries, and facilitated national comparisons.

Results

Finland and Italy have well established school meal systems with complete meals served daily. Finnish school meals are paid by the public. The current organic share is low, only about 3 %. However, organic food is recognised as a means for more sustainable food consumption, for which ambitious aims have been set recently (Mikkola 2010). Hence, the potential for organic school food seems significant in this country.

In Italy, the user payment for school meals is significant. Public demand for certified quality food in school meals has been a strong driver to include organic food in the meals. Regional laws and guidelines demand that school meal ingredients should come from controlled and certified production. In a survey of 185 school canteens in 2006, 40 % (by weight) of the served food was organic and 36 % from otherwise certified supply chains such as local and fair trade food (Spigarolo *et al.* 2010). Carefully designed calls for tenders are a key instrument to achieve these public aims and thereby increase the school food quality. Best practice cases of municipal school food systems have managed to establish a good dialogue between supply chain and municipal actors.

In Denmark and Norway public school food procurement is only additional to lunch boxes brought from home. In Denmark, several municipalities run ambitious projects to combine school food serving and organic consumption. On average for the country,

49 % of the Danish “school milk“ (served in 0.25 litre containers, accompanying the lunch box) is organic. This reflects the high share of organic consumption in Denmark, being about 7 % in 2008. The school meal brought from home-tradition seems to be especially hard to change in Norway, the country of origin of the sandwich lunch.

In Germany, Eastern regions have traditionally served a warm meal in school whereas in Western regions, the children went home for lunch. The situation is now changing as whole day schools are expanding. Similarly to Denmark, the interest in organic school food is high (Nölting *et al.* 2009).

For the assessment of school food systems and their implementation of organic food, five categories were developed, describing the main dimensions of variation in this field (Løes and Nölting, 2011). These categories represent a major result of the project as a whole. Categories 1-3 are generally valid for any school food system, whereas 4-5 are of special importance for the integration of organic food in school meals:

1. Type of school food service. Complete meals, or single food items?
2. Degree of public financing. Costs paid by the public, or user payment?
3. Degree of political and administrative involvement, as reflected by public regulations, specialised school meal administrative personnel etc.
4. Degree of specific support for *organic* school food, e.g. policies, regulations.
5. Development of organic food supply chains adapted to school meals.

Based on the comparisons of the five countries, we believe that the consumption of organic food in schools will be maximised when complete meals are served, without user payment, well embedded in public regulations, with a high share of organic ingredients, in a market with well developed supply chains. This resembles a situation when the performance in all five categories is high. Among the iPOP countries, Finland and Italy come closest to this situation.

Comparing the national curricula of Denmark, Finland, Italy and Norway, organic food was not explicitly included in the learning objectives, but sustainable development was thoroughly emphasised in all countries, commonly as a cross-cutting topic and linked with the importance of educating responsible citizens (Roos and Mikkola 2010). Organic food is well suited as a topic in sustainability education, due to the shared values and the practical experiences organic food education allows for, e.g. school gardening. Young people express positive perceptions of organic food, but ambivalences related to increased consumption e.g. due to high price and limited evidence for organic being better. Pupils seem to be more positive about organic where such food is integrated in the school culture, whereas initiatives from outside may miss a link between the school food and a generally positive impression about organic food. On the other hand, young people do not have settled perspectives on organic food, and will not be strong drivers for this.

Unhealthy eating and inactivity is increasingly causing obesity and other nutrition related disorders among youth, which causes an interest in utilising school food consumption to improve eating habits. Consumers often perceive a link between organic food and individual health, and worksite eating research has confirmed that green caterers serve healthier food. In Denmark, a clear link was found between organic food supply strategies and generally healthier eating agendas in schools. “Organic schools”, aiming at including a certain share of organic in the school food service, provide organisational environments that are more supportive for healthy eating than their non-organic counterparts.

Discussion and conclusion

School food policy interventions must tackle several issues concurrently, from political support and funding to quality standards and links with educational activities. Different actor groups must be addressed specifically, to ensure multiple embedding processes in parallel. Means must be tailored in each case, but public aims for organic consumption will be helpful.

Well established school meal systems, such as in Finland or Italy, are a precondition for high consumption of organic school food. However, the most important factor is a specific support for organic school food, such as in Italy. A large consumption of organic food in schools is best achieved by a context specific combination of the five factors leading to “captive catering” situations, where all or most pupils participate in the (organic) food service. Too flexible systems may reduce the food quality because the demand will be volatile, hampering the planning and development of a stable high quality school food production. A “captive catering” of complete, partially or fully organic meals will increase the volume of food consumed, and the possibilities to link the food consumption to food education.

Increased attention on public food serving for youth creates a window of opportunity for organic consumption. Organic food in schools should be linked to the concept of sustainable development, and embedded as a whole school approach. Sustainable development is a general educational aim, and organic food in schools has a large potential to contribute in the teaching of sustainability.

Acknowledgments

We gratefully acknowledge the funding of iPOPY by the CORE Organic I funding body network, and the engaged work of all researchers and students involved in the project.

All papers and reports from the iPOPY project are found in the open digital archive www.orgprints.org. Search for the keyword “iPOPY”.

References

- Løes A-K., Nörling B. (2011): Increasing organic consumption by school meals – lessons learned in the iPOPY project. *Organic Agriculture* (Springer), DOI 10.1007/s13165-011-0009-0
- Mikkola M. (2010): Role of public catering and use of organic food in educational contexts: Creating centres for sustainable food systems. Tingvoll, Bioforsk (Bioforsk Report Vol. 5 No. 104/2010).
- Nörling B., Reimann S., Strassner C. (2009): Bio-Schulverpflegung in Deutschland. Ein erster Überblick. Berlin, Zentrum Technik und Gesellschaft TU Berlin (ZTG discussion paper 30/09)
- Roos, G., Mikkola, M. (2010): Education about organic food and sustainability in Denmark, Finland, Italy and Norway. Findings from the iPOPY project. Project report no. 9 – 2010 Oslo, SIFO (National institute for consumer research).
- Spigarolo R., Sarti V., Giorgi G. (2010): Organic and conventional public food procurement for youth in Italy. Tingvoll, Bioforsk (Bioforsk Report Vol. 5 No. 109/2010).

Are consumers willing to pay a price premium for specific organic logos?

Janssen, M.¹ & Hamm, U.²

Key words: Organic logos, willingness-to-pay, random parameter logit models

Abstract

Since July 2010, prepacked organic food produced in the EU must be labelled with the new mandatory EU logo for organic food. However, there is a long tradition of voluntary organic certification logos in most European countries. In this paper we analyse the willingness-to pay (WTP) of European consumers for products with different voluntary organic certification logos to make recommendations for actors in the organic sector. Data was collected by means of choice experiments with 1,997 consumers of organic food in five EU countries, based on which a number of random parameter logit models were estimated. According to our results, there were great differences between the tested logos regarding the price premium that consumers were willing to pay compared to organic products without a logo. One to two logos with a considerable additional WTP could be identified per country. It is recommended to display these logos in addition to the mandatory EU logo, at least in a transition period. The additional WTP for the old voluntary EU logo was close or equal to zero in all study countries except Italy. For the new EU logo, it is therefore recommended to provide public financial support for communication campaigns on the new logo.

Introduction

Since July 2010, prepacked organic food produced in the EU must be labelled with the new mandatory EU logo for organic food (Regulation (EU) No 271/2010). It is still allowed to additionally use voluntary organic certification logos (in short 'organic logos') like those which have been on the market for many years in most European countries. With a mandatory EU logo, however, it currently remains unclear whether the use of additional voluntary organic logos is beneficial. From the supply-side perspective, space on product packages as well as marketing budgets are limited. Therefore, it only makes sense to label products with additional voluntary logos if consumers prefer these products over similar products without the additional logo. In the present study we investigated consumers' willingness-to-pay (WTP) for different voluntary organic certification logos in the five EU countries Denmark (DK), Germany (DE), Italy (IT), the United Kingdom (UK) and the Czech Republic (CZ). The objective of the paper is to make recommendations for actors in the organic sector regarding the use and promotion of organic logos.

Materials and methods

Consumer choice experiments were conducted in February and March 2010 with around 400 participants in each of the five study countries. In the choice experiments,

¹ Department of Agricultural and Food Marketing, University of Kassel, Steinstrasse 19, 37213 Witzenhausen, Germany, E-Mail m.janssen@uni-kassel.de, Internet www.agrar.uni-kassel.de/alm.

² As above.

the participants were asked to make buying decisions for apples and eggs. The participants were presented with real products and price tags. The four product alternatives among which the participants could choose looked identically but were marked with different organic labels and prices:

- The most relevant organic logos for each country were chosen so that the tested logos differed across the countries.¹ In all countries, one alternative per choice set was just marked with the word 'organic' without a logo and one alternative carried the old voluntary EU logo. In addition, the following two logos were tested: the respective governmental logo and the Demeter logo in Denmark, Germany and the Czech Republic; the logos of the certification body CCPB and Demeter in Italy; the logos of the Soil Association and the certification body OF&G in the UK.
- Four different price levels were tested. The relative price levels were the same in all countries (1.00; 1.25; 1.50; 1.75). The absolute prices used in the experiments were based on the average market price of organic apples/eggs in the respective survey regions one month before the experiments were conducted (the average market price equalled price level 1.25).

A fractional factorial design with 16 different choice sets was used to systematically vary the price levels across the four product alternatives. The participants were presented with two choice sets each for apples and eggs respectively, i.e. in total each participant made four buying decisions. The participants were also free to refrain from buying any of the offered alternatives ("no-buy option"). In the subsequent structured interviews, the participants were asked to rate the tested labels regarding label awareness on a seven-point scale with "1=this label is completely unknown to me" and "7=this label is well-known to me".

The data was analysed with random parameter (RP) logit models (also called mixed logit models) with the Software NLOGIT.² Separate models were estimated for apples and eggs with alternative specific constant terms and a generic price coefficient. The additional WTP for specific organic logos was determined by dividing the alternative specific constant terms by the price coefficient (see e.g. Hensher *et al.* 2005). As suggested in the literature (see e.g. Rigby *et al.* 2009, Revelt & Train 1998), the price coefficient was estimated as a fixed parameter. The alternative specific constants were checked for a systematic variation around the mean based on the normal distribution. Please note that the price coefficient was estimated based on relative price levels (and not absolute price levels) to make the WTP measures comparable across the different countries. The WTP measures can therefore not be interpreted in monetary terms but only relative to each other.

Results

For most of the tested logos, a significant positive additional WTP was observed compared to organic products without a logo (Table 1). However, the mean price premium that consumers were willing to pay differed considerably. Generally it holds true that the better known a label was, the higher was the WTP:

¹ The selection of the tested logos was based on the results of an inventory study and a study with focus group discussions conducted by the authors of this paper and their partner organisations. In each country, the different kinds of certification logos were included (EU logo, governmental logo if existent, private logo).

² Unlike multinomial logit models, RP logit models are able to account for preference heterogeneity (see e.g. Rigby *et al.* 2009, Hensher & Greene 2003).

- Old EU logo: The additional WTP for the old voluntary EU logo was close or equal to zero in all study countries except for Italy, where this logo had the highest additional WTP of all logos tested in Italy. The old EU logo was unknown to most participants in Germany (2.1)¹ and the UK (1.8), slightly better known in the Czech Republic (3.7) and Denmark (4.2) and very well known in Italy (6.0).
- Governmental logos: In Denmark and the Czech Republic, the governmental logo featured the highest WTP of all logos tested. In Germany, the WTP for the governmental logo and the Demeter logo were both equally high.
- Private logos: The Demeter logo featured a high additional WTP only in Germany where it was also very well-known (6.0), whereas in Denmark, Italy and the Czech Republic, Demeter was the logo with the lowest additional WTP and the lowest level of awareness. In the UK, the additional WTP for the logos of the Soil Association and the certification body OF&G was equally high (but on a relatively low level compared to the logos with the highest WTP in other countries).

Tab. 1: Additional WTP for specific organic logos¹

| Country | Organic logos | Apples | | | | | Eggs | | | | |
|---------|--------------------|--------|---------------------|-----------------|------------------|------------------|------|---------------------|-----------------|------------------|------------------|
| | | N | Mean | SD ² | Min ³ | Max ⁴ | N | Mean | SD ² | Min ³ | Max ⁴ |
| CZ | EU logo (old logo) | 391 | 0.17 ^a | 0.34 | -0.35 | 0.95 | 388 | 0.29 ^a | 0.17 | 0.01 | 0.72 |
| | Governmental logo | 391 | 0.70 ^b | 0.69 | -0.51 | 1.58 | 388 | 0.67 ^b | 0.48 | -0.20 | 1.34 |
| | Demeter logo | 391 | 0.11 ^c | 0.00 | 0.11 | 0.11 | 388 | 0.15 ^c | 0.00 | 0.15 | 0.15 |
| DE | EU logo (old logo) | 386 | 0.01 ^{a,†} | 0.00 | 0.01 | 0.01 | 386 | 0.26 ^a | 0.00 | 0.26 | 0.26 |
| | Governmental logo | 386 | 0.63 ^b | 0.18 | 0.26 | 0.97 | 386 | 1.15 ^b | 0.27 | 0.65 | 1.65 |
| | Demeter logo | 386 | 0.61 ^b | 0.48 | -0.19 | 1.47 | 386 | 1.31 ^c | 0.42 | 0.49 | 1.98 |
| DK | EU logo (old logo) | 394 | 0.17 ^a | 0.05 | 0.04 | 0.37 | 398 | 0.25 ^a | 0.00 | 0.25 | 0.25 |
| | Governmental logo | 394 | 0.65 ^b | 0.31 | -0.03 | 1.12 | 398 | 0.67 ^b | 0.25 | 0.02 | 1.11 |
| | Demeter logo | 394 | 0.17 ^a | 0.21 | -0.28 | 0.89 | 398 | 0.27 ^a | 0.18 | -0.14 | 0.88 |
| IT | EU logo (old logo) | 427 | 1.00 ^a | 0.63 | -0.02 | 1.94 | 422 | 1.05 ^a | 0.79 | -0.33 | 2.14 |
| | CCPB logo | 427 | 0.60 ^b | 0.29 | 0.08 | 1.28 | 422 | 0.69 ^b | 0.45 | -0.19 | 1.62 |
| | Demeter logo | 427 | 0.51 ^c | 0.85 | -0.57 | 2.22 | 422 | 0.47 ^c | 0.64 | -0.62 | 1.91 |
| UK | EU logo (old logo) | 395 | 0.10 ^a | 0.00 | 0.10 | 0.10 | 393 | 0.07 ^{a,†} | 0.00 | 0.07 | 0.07 |
| | Soil Assn. logo | 395 | 0.32 ^b | 0.42 | -0.22 | 1.17 | 393 | 0.34 ^b | 0.41 | -0.29 | 1.14 |
| | OF&G logo | 395 | 0.41 ^b | 0.25 | 0.00 | 0.95 | 393 | 0.45 ^b | 0.35 | -0.22 | 1.11 |

¹ Based on relative price levels (1.00; 1.25; 1.50; 1.75). Reference category: Products labelled with the word 'organic' without a logo.

² SD=Standard deviation. ³ Min=Minimum. ⁴ Max=Maximum.

^{a,b,c} WTP measures with different letters are significantly different from each other (given the same product and country).

[†] Mean WTP not significantly different from zero.

Discussion and Conclusions

According to our findings, consumers were willing to pay a price premium for some of the tested organic logos, i.e. they clearly preferred these logos over other tested logos and over products without a logo. Therefore, it seems advisable to display the

¹ The values in brackets refer to the mean level of awareness measured on a seven-point scale with "1=this label is completely unknown to me" and "7=this label is well-known to me":

CZ: EU logo (3.7), governmental logo (6.1), Demeter logo (1.7), labelling without a logo (5.0)

DE: EU logo (2.1), governmental logo (6.7), Demeter logo (6.0), labelling without a logo (3.9)

DK: EU logo (4.2), governmental logo (6.9), Demeter logo (3.4), labelling without a logo (4.6)

IT: EU logo (6.0), CCPB logo (4.2), Demeter logo (3.8), labelling without a logo (3.1)

UK: EU logo (1.8), Soil Association logo (5.7), OF&G logo (4.4), labelling without a logo (5.5)

preferred and well-known logos in addition to the mandatory EU logo. This holds particularly true for those logos with additional requirements compared to the EU logo in terms of the underlying production standards and/or the control system (these are the governmental logo in Denmark and the Czech Republic, the Demeter logo in Germany, and the logos of the Soil Association and OF&G in the UK). A relatively high WTP was also recorded for the Bio-Siegel in Germany. This logo indicates exactly the same as the new EU logo (namely compliance with EU Regulation 834/2007), which consumers might not be aware of however. In Germany, the Bio-Siegel should therefore be displayed in addition to the mandatory EU logo in a transition period, until the new EU logo is well-known in the population.

Regarding the new mandatory EU logo, the following recommendations can be made: According to our results, for some of the tested logos the additional WTP was close or equal to zero. It might thus not be sufficient to simply launch a new EU logo without substantial communication campaigns financed by public authorities, as it is foreseen at the time of writing. If the policy goal of strengthening the organic sector is to be achieved consumer awareness of the new logo must be raised. Given the low additional WTP and the low level of awareness of the old voluntary EU logo in all study countries except for Italy, it becomes obvious that communication campaigns on the new EU logo should not *per se* refer to the old logo but should rather take into account country specific characteristics of the organic market (e.g. in Germany it should be emphasised that the new EU logo and the German Bio-Siegel are equivalent in terms of the underlying regulations).

Acknowledgments

This publication was generated as part of the CERTCOST Project, agreement no. 207727 (<http://www.certcost.org>), with financial support from the European Community under the 7th Framework Programme. The publication reflects the views of the authors and not those of the European Community, who is not to be held liable for any use that may be made of the information contained. The authors gratefully acknowledge funding from the European Community.

References

- Commission Regulation (EU) No 271/2010 of 24 March 2010 amending Regulation (EC) No 889/2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007, as regards the organic production logo of the European Union. *Official Journal of the European Union*, L84 (31.03.2010), p. 19-22.
- Hensher D. A., Greene W. H. (2003): The mixed logit model: The state of practice. *Transportation* 30(2):133-176.
- Hensher D. A., Rose J. M., Greene W. H. (2005): *Applied Choice Analysis: A Primer*. Cambridge University Press, Cambridge.
- Revelt D., Train K. (1998): Mixed logit with repeated choices: Households' choices of appliance efficiency level. *The Review of Economics and Statistics* 80(1998):647-657.
- Rigby D., Balcombe K., Burton M. (2009): Mixed logit model performance and distributional assumptions: Preferences and GM foods. *Environmental and Resource Economics* 42(3):279-295.

Defining organic consumers

Oates, L.¹, Cohen, M.² & Mann, N.³

Key words: organic consumers, dietary pesticide exposure, dietary assessment

Abstract

Pesticides used in conventional farming pose many potential health risks. Organic farming practices and certifying bodies largely prohibit the use of pesticides and data from residue surveys confirm that organic produce has lower pesticide residues than conventional produce. This suggests that that organic food consumption should result in reduced human pesticide exposure, yet only a few published biomonitoring studies on children have examined this link and there are no standards for distinguishing an 'organic consumer' from a 'conventional consumer'.

The purpose of this study was to develop instruments to distinguish 'organic consumers' from 'conventional consumers' and inform the design of rigorous biomonitoring trials aiming to assess the impact of organic food consumption on pesticide exposure in adults. The 'Organic Food Intake Survey' (OFIS) and the 'Organic Consumption Survey' (OCS) were designed to quantify 'organic' status and identify prospective participants for biomonitoring studies. It is anticipated that this will ensure that results from biomonitoring trials will be robust and relevant to consumers wanting to reduce their exposure to pesticides.

Introduction

According to the 2010 Australian Organic Market Report 61% of households claimed to have purchased some organic food in the previous 12 months. However while the majority (83%) of respondents said they believe in the 'chemical-free' benefits of organics, only around 12% spend more than 50% of their house-hold food-spend on organic options (Kristiansen *et al.* 2010). It appears that despite positive attitudes to organics, most consumers are not yet sufficiently convinced about the benefits of organic food to 'put their money where their mouth is'. Reviews have highlighted that both the number of agricultural toxicants in the environment and rates of toxin-related diseases have increased dramatically since the second world war, with numerous studies attesting to a link between pesticide exposure and human health risks. However, the significance of this for human dietary pesticide exposure remains uncertain. The fact that pesticides are widely utilised in conventional farming but are largely prohibited by organic certifying bodies suggests that organic food consumption should result in reduced human exposure. Data from residue surveys confirms higher levels of pesticide residues in conventional compared to organic produce. However, future research needs to confirm whether, and to what extent, this translates to differences in tissue levels in the bodies of consumers of conventional and organic

¹ School of Health Science, RMIT University, Melbourne, Australia, E-Mail liza.oates@rmit.edu.au, Internet www.rmit.edu.au/welness/organicresearch

² As Above, marc.cohen@rmit.edu.au

³ School of Applied Sciences, RMIT University, Melbourne, Australia, E-Mail neil.mann@rmit.edu.au

produce (Oates & Cohen 2009). Only then can we attempt to draw any meaningful conclusions about the potential health implications of such dietary choices. In order to compare pesticide residues in organic and conventional consumers, researchers must measure body levels of pesticide residues (biomonitoring) rather than intermediate end points such as residues in food. Only a few published reports have attempted this, and so far only in children. Curl *et al.* (2003) reported that children who consumed organic fruit, vegetables and juice had a mean total dimethyl metabolite concentration (a group of organophosphate metabolites) that was approximately nine times lower than children consuming conventional diets. In addition the Children's Pesticide Exposure Study demonstrated that substituting conventional foods with organic foods for 5 consecutive days results in a decrease in urinary organophosphate metabolites to non-detectable or close to non-detectable levels (Lu *et al.* 2008) and a reduction in pyrethroid insecticide exposure of approximately 50% (Lu *et al.* 2009).

In order to achieve adequate sample sizes and minimise the costs of biomonitoring studies, due diligence must be paid to ensure that any differences in pesticide residues can be attributed to the level of organic consumption alone and that the studies therefore have maximum external and internal validity so results can be generalised to the wider population. It is therefore important to clearly distinguish between organic and conventional consumers while ensuring organic and conventional groups are as similar as possible in all other ways. Thus, participants in organic and conventional groups should be matched so that dietary practices are comparable i.e. similar levels of intake from major food groups and any potential sources of non-dietary exposure to pesticides are considered.

Following a review of the scientific literature using MEDLINE, TOXLINE and Cochrane CENTRAL databases it was determined that there is currently no standard method used to quantify a consumer's level of organic food consumption or define an 'organic consumer'. As a result the 'Organic Food Intake Survey' (OFIS) was developed in conjunction with an online 'Organic Consumption Survey' (OCS). The OCS provides a general picture of organic consumers that can be used to set inclusion criteria and identify prospective participants for biomonitoring studies. The OFIS goes on to quantify the overall level of organic consumption (differentiating between certified and 'likely' organic sources) and explores consumption patterns by food group.

Methods

Following ethics approval from RMIT University's Human Research Ethics Committee the OCS and OFIS were piloted on a convenient sample which included both nutritionists and laypersons in April and May 2010. Based on feedback from the pilot study, minor revisions were made to improve the clarity and workability of the survey instruments. The OCS was formally conducted online from August to October 2010 using Survey Monkey. The OFIS remained open from August until the end of 2010 and both surveys were targeted at high-end organic consumers recruited through outlets and websites that sell or promote organic produce. The surveys targeted self-reported organic consumers and asked participants to confirm the following statement before proceeding, "I consider myself to be a regular 'organic consumer' (i.e. I make a deliberate choice to consume at least some organic foods on a weekly basis)". The OCS questionnaire included sections on self-reported organic food consumption and purchasing behaviour; attitudes to organic food; factors affecting chemical exposure and metabolism; and basic demographics. Participants were then invited to complete the OFIS for 3 days and documents were provided electronically for this purpose. Respondents were asked to record everything they ate and drank by the food group

categories: grains, vegetables, fruit, dairy, animal protein, plant protein (legumes, nuts etc) and 'extra' foods and to classify their intake under the headings of 'certified organic', 'likely organic', 'likely conventional' or 'unknown'. The OFIS utilises a modified version of the 'Australian Guide to Healthy Eating' (AGHE) food categories and serving sizes to provide a simple method of data collection that still allows for quantification of organic food intake. Upon return documents were checked by a nutritionist and queries resolved with respondents prior to de-identification and data entry. Data analysis was conducted using SPSS statistical software (version 18).

Results

More than half (58.1%) of the self-reported organic consumers targeted for the OCS reported that most (> 65%) of the food they had eaten in the previous 12 months was prepared from organic produce (either certified or non-certified). (See Table 1) In Australia there are at least eight certification logos in use. As a result consumers may not be clear about whether their produce is certified and this may have resulted in the high non-response rate (10.9%) to this question. The Organic Federation of Australia, the peak industry body, is currently developing a single logo to reduce this confusion.

Tab. 1: Amount of organic food consumed in the past year by self-reported 'Organic Consumers' (n=320)

| | Organic (certified or non-certified) | Certified Organic |
|-----------------------------|--------------------------------------|-------------------|
| Did not answer | 0.6 | 10.9 |
| Almost none (0-10%) | 1.6 | 3.8 |
| A little (10-35%) | 14.4 | 21.6 |
| About half (35-65%) | 25.3 | 27.8 |
| Most (65-90%) | 37.5 | 20.0 |
| Almost all (90-100%) | 20.6 | 15.9 |
| Total | 100% | 100% |

The results of the OCS provided demographic information about self-reported organic consumers as well as food consumption and purchasing behaviours, attitudes to organic food, and factors affecting chemical exposure and metabolism (not reported here). This information can be utilised for the development of inclusion/ exclusion criteria and can be adapted for use during future biomonitoring trials. This information may assist in minimising the likelihood of confounders that could reduce internal or external validity and may also aid in targeting prospective participants who are representative of 'Australian organic consumers'. As self-reported estimates of organic food consumption may be subject to over or underestimation, the addition of the OFIS provided a more robust method for quantifying organic consumption. In addition to quantifying the level of organic intake, the OFIS allows for comparison of dietary records with regard to various food groups. This information may be used in biomonitoring studies to match prospective organic and conventional participants based on dietary consumption patterns (e.g. number of serves of fruit, vegetables grains etc) and to ensure that organic and conventional consumers differ only in their consumption of organic produce rather than overall consumption patterns.

Discussion

Biomonitoring of pesticide residues has been conducted in the USA as part of the National Health and Nutrition Examination Survey (NHANES), although information about the organic or conventional status of foods was not requested. While diet has

been shown to be a significant predictor of pesticide exposure in all age groups, certain foods have a greater impact and factors such as tobacco use, time spent gardening and the use of cytochrome p450-inhibiting medications may also elevate pesticide readings (Riederer *et al.* 2008). These results highlight the importance of accounting for non-dietary sources of exposure and careful collection of dietary data in biomonitoring trials. Response rates to the OFIS were rather low despite attempts to minimise participant fatigue. Furthermore, several other limitations must be acknowledged. As the OFIS only includes data from a three day period, the results may not be completely reflective of usual intake, do not account for seasonal variability and are only relevant for short-lived pesticides and not persistent toxicants such as organochlorines. Furthermore, in an attempt to keep the survey relatively simple, some detail is lost which will restrict evaluation of whether specific foods contribute more to elevated pesticide levels. Finally the nature of dietary surveys is such that eating behaviour may be affected as participants become more conscious of their food. It is intended that the OCS and OFIS will assist in designing more rigorous biomonitoring trials to assess the impact of organic food consumption on pesticide exposure. These instruments can be used in the pre-trial phase to ascertain current trends in consumption and other factors relevant to the population of interest. These are likely to vary from region to region and change over time. While the OFIS can be utilised during a biomonitoring trial phase to quantify organic consumption, large scale biomonitoring trials may require more detail in order to ascertain whether particular foods have an influence on particular pesticide residues. In addition, the OCS may need to be adapted if it is to be utilised during a biomonitoring trial phase, with sections which relate only to current trends and attitudes being deleted and sections exploring other sources of exposure expanded or altered due to changes over time or regional differences. These instruments should thus be viewed as a work in progress.

Conclusions

Very few self-reported organic consumers have a totally organic diet. Based on responses to the OCS and OFIS the authors were able to more clearly define the characteristics of organic consumers. The OFIS provides an instrument that can be used to quantify organic consumption and thereby develop inclusion and exclusion criteria for future biomonitoring trials.

References

- Curl C., Fenske R., Elgethun K. (2003): Organophosphorus pesticide exposure of urban and suburban preschool children with organic and conventional diets. *Environ Health Perspect.* 111:377-382.
- Kristiansen P., Mitchell A., Bez N., Monk A. (2010): Australian Organic Market Report. Biological Farmers of Australia.
- Lu C., Barr D.B., Pearson M.A., Walker L.A., Bravo R. (2009): The attribution of urban and suburban children's exposure to synthetic pyrethroid insecticides: a longitudinal assessment. *J Expo Sci Environ Epidemiol.* 19:69-78.
- Lu C., Barr D.B., Pearson M.A., Waller L.A. (2008): Dietary intake and its contribution to longitudinal organophosphorus pesticide exposure in urban/suburban children. *Environ Health Perspect.* 116:537-542.
- Oates L., Cohen M. (2009): Human Consumption of Agricultural Toxicants from Organic and Conventional Food. *Journal of Organic Systems.* 4:48-57.
- Riederer A.M., Bartell S.M., Barr D.B., Ryan P.B. (2008): Diet and nondiet predictors of urinary 3-phenoxybenzoic acid in NHANES 1999-2002. *Environ Health Perspect.* 116:1015-1022.

Demand elasticities of organic vegetables in Taiwan

Huang-Tzeng, Chang-Ju and Lin, Yu-Ting¹

Key words: Demand equation, market share, price elasticity, income elasticity, conjoint analysis.

Abstract

This paper seeks to understand the sensitivity of consumer demand for organic products to price changes, price changes of substitutes at other safety levels, and to income level. Because there are no official statistics for the organic vegetable market, this study used an online survey based on a design that used choice based conjoint method (CBC) combined with the conditional price method to investigate consumer trade-off between vegetables of different prices, food safety levels, and countries of origin. All four safety levels for agricultural products in Taiwan are included in this study. These levels are organic, Taiwan traceable agricultural products (TAP), good agricultural practice (GAP), and conventional products.

After the market shares ("relative" quantity demanded) of these four products at different prices are calculated, the "relative" demand equations for these products are estimated using regression analysis.

The results of this paper show that the own-price elasticity, cross-price elasticities to TAP and GAP, and income elasticity of organic products are -0.15165, 0.05042, 0.11382, and 0.04046, respectively. The conclusion is that the safer the product, the smaller the own-price elasticity. The small self-price and income elasticities of organic products indicate that the organic consumers are loyal and the organic market is still a niche market in Taiwan. That explains why market shares of organic and conventional products are independent of each other. The negative income elasticities of conventional and GAP products show that they are considered by consumers to be inferior goods.

Introduction

The Taiwan government has determined three categories of safety for agricultural products: organic, TAP (Taiwan traceable agricultural product) and GAP (good agricultural practice). In order of decreasing safety, organic products are considered the safest, followed by TAP, and then GAP.

The organic sector represents only 0.38% of the total agricultural market in Taiwan. To increase demand for organic food, it is necessary to know the sensitivity in consumer demand for organic products to changes in the price of organic and non-organic products, and to income levels.

This paper attempted to generate the data of quantity demanded at specific price levels by investigating consumer preference for vegetables of different prices, food safety levels (organic, TAP, GAP and conventional) and countries of origin, because there are no official statistics on the organic market in Taiwan.

¹ Organic Centre, National I-Lan University, No. 1, Sec.1, Sheng-Nung Road, 260 I-Lan City, Taiwan. E-Mail: cjhuang@niu.edu.tw, Internet: <http://www.organic.or.tw>.

The purpose of this paper is to estimate the (i) own-price-, (ii) substitution-, and (iii) income elasticities for organic products, and some marketing policy suggestions are considered.

Materials and methods

This study conducted an analysis of online survey data obtained from 529 respondents that were approached in supermarkets and open markets, or invited to participate by email. The water convolvulus was used as the representative vegetable in the survey.

Using the choice based conjoint method with hierarchical Bayes method (CBC/HB) as applied to the estimation of conjoint part worths, the utilities of each product (for different prices, safety levels, and countries origin) for each respondent were calculated. Considering that the price varies significantly between products with different safety levels, the conditional price method (Orme 2007) was adopted in the CBC design.

The market shares that meant the share of preference in this paper, of each domestically produced product at the four safety levels were calculated based on the random first choice method. Thereafter, the prices of each product, together with the demographic data and the descriptions of consumption behavior of the respondents were included in the regression analysis to estimate the market share equations of organic, TAP, GAP and conventional products, which can be regarded as the demand equations.

Using the coefficients of the demand equations, the self-price, substitution, and income elasticities were derived.

Results

Table 1 shows the regression results of demand equations. The coefficients describe how the market shares for organic vegetables and the three categories of non-organic vegetables are influenced by the explanatory variables. The demand elasticities in Table 2 are calculated with the mean of all explanatory variables.

Table 1 shows that vegetarian and organic shop consumers are the largest contributors to the organic market share. As the education year increases, the organic market share increases. However, age has a negative influence on organic market share. For the consumers of price-sensitive cluster and married consumers, the market share for organic vegetables reduces to 41.025% and 5.308%, respectively. The demand for organic products is inversely related to the total number of people, number of seniors, number of children, and number of ill people in the household.

Table 1 Regression Results of demand equations of organic, TAP, GAP, and conventional vegetables

| Explanatory variable | Organic | | TAP | | GAP | | Conv. | |
|--|---------|---------|---------|---------|---------|---------|--------|---------|
| | Coef. | t-value | Coef. | t-value | Coef. | t-value | Coef. | t-value |
| Constant | 42.370 | 60.00 | 22.437 | 27.64 | 42.695 | 51.86 | -6.587 | -16.44 |
| Price of organic products | -0.092 | -10.96 | 0.028 | 3.19 | 0.055 | 6.29 | | |
| Price of TAP products | 0.076 | 3.67 | -0.874 | -40.55 | 0.708 | 32.35 | 0.090 | 7.36 |
| Price of GAP products | 0.229 | 6.85 | 1.186 | 34.15 | -1.890 | -53.57 | 0.475 | 24.17 |
| Price of conv. products | | | 0.145 | 4.18 | 0.442 | 12.52 | -0.624 | -31.77 |
| Dummy-male | 3.448 | 32.01 | -0.295 | -2.64 | -5.087 | -44.84 | 1.924 | 30.43 |
| Family income(NT\$10,000) | 0.121 | 10.02 | 0.455 | 36.28 | -0.426 | -33.42 | -0.152 | -21.45 |
| Education years | 0.175 | 16.00 | 0.267 | 23.52 | -0.289 | -25.12 | -0.154 | -23.93 |
| Dummy-married | -5.308 | -38.06 | 8.775 | 60.56 | -3.589 | -25.88 | | |
| Age | -0.062 | -10.73 | -0.062 | -10.37 | -0.036 | -6.14 | 0.158 | 52.78 |
| Dummy-vegetarian | 5.257 | 38.18 | 1.063 | 7.44 | -10.361 | -71.48 | 4.049 | 50.33 |
| Dummy-price sensitive cluster | -41.025 | -408.55 | -6.620 | -63.46 | 39.658 | 374.58 | 7.990 | 135.59 |
| Family size | -0.102 | -2.94 | -0.895 | -24.82 | 0.424 | 13.37 | 0.556 | 27.34 |
| No. senior (≥ 65) | -1.742 | -29.19 | 2.966 | 47.85 | | | -1.193 | -35.99 |
| No. children (≤ 15) | -0.801 | -12.72 | 1.344 | 20.54 | 0.561 | 8.53 | -1.090 | -29.52 |
| No. ill member | -4.767 | -30.59 | 3.511 | 21.69 | | | 1.184 | 12.99 |
| Dummy-place-supermarket and discount market | 2.246 | 15.17 | 0.815 | 5.30 | -4.872 | -31.22 | 1.781 | 20.66 |
| Dummy-place-open market and wholesale market | -1.884 | -14.35 | 1.845 | 13.53 | -5.435 | -39.37 | 5.449 | 70.96 |
| Dummy-place-organic shop | 23.115 | 124.02 | -13.943 | -72.01 | -9.809 | -50.07 | 0.598 | 5.50 |
| Dummy-place-others* | 14.688 | 58.36 | 0.246 | 0.94 | -18.773 | -71.14 | 3.805 | 25.73 |
| Adj-R-Square | 0.4485 | | 0.0607 | | 0.3733 | | 0.1107 | |
| P-value of F-test | 0.0000 | | 0.0000 | | 0.0000 | | 0.0000 | |
| Durbin-Watson | 1.7035 | | 1.7836 | | 1.5950 | | 1.9111 | |
| No. observations | 529 | | 529 | | 529 | | 529 | |

Note: All regression models and coefficients are statistically significant for $p < 0.01$ with F- and t-test.

***Dummy-place-others means purchased on-line or from a farm. The respondents who do not buy vegetables will be denoted with all dummy-place zeros.**

Table 2 shows the demand elasticities for organic vegetables and the three categories of non-organic vegetables. The own-price elasticity, cross-price elasticities to TAP and GAP, and income elasticity of organic products are -0.15165, 0.05042, 0.11382, and 0.25519, respectively. The findings indicate that the higher the safety level of the product, the smaller the self-price elasticity. The negative income elasticities of conventional and GAP products indicate that they are considered inferior goods by consumers. The market shares of organic and conventional products are independent of each other. The GAP is the most desirable substitute for all other products.

Table 2 Demand elasticities of organic, TAP, GAP, and conventional products

| | Organic | TAP | GAP | Conv. |
|---------------|-----------------|-----------------|-----------------|-----------------|
| Organic price | -0.15165 | 0.03962 | 0.05249 | 0.00000 |
| TAP price | 0.05042 | -0.49966 | 0.26803 | 0.25566 |
| GAP price | 0.11382 | 0.50884 | -0.53690 | 1.01488 |
| Conv. price | 0.00000 | 0.05188 | 0.10453 | -1.11170 |
| Income | 0.04046 | 0.13138 | -0.08137 | -0.21829 |

Discussion

To estimate the demand elasticities, we need the data of demand quantity, prices of the object and substitute products, and income. Most countries have no official statistics for the price and demand quantity of organic products. Glaser and Thompson (1998) and Bunte and et. al. (2007) estimated the demand elasticities of organic foods based on the analysis of scanner data for supermarkets. Jonas and Roosen (2008) used the data from a censored system of German household, and Hassan (2009) sourced the market basket data. Since the price of organic vegetables in Taiwan is almost stable, this study used the choice experiment to obtain consumers' reserve prices under different conditions.

Why is the price elasticity of organic vegetables in Taiwan smaller than that of conventional vegetables? The reason may be that the organic consumers are loyal to organic products and not sensitive to the price since the organic market in Taiwan is still a niche market; and the non-organic consumers would not be influenced by the price variation since the organic price are always much higher than others.

The demand functions and demand elasticities estimated in this study are consistent with standard economic theory. This study used experimental methods to understand the preferences of consumers. However, the question of whether consumers are actually willing to pay the higher price to purchase safer products could not be fully answered. Therefore, the possibility exists that the market share of safer products was overestimated.

Conclusions

Since the price and income elasticities of organic products are small and the market share of organic products is independent on the price of conventional products, it is not necessary to reduce organic price to expand the market. It can be expected that the organic market share will grow stably together with the increasing income in the

near future, since the income elasticity of organic products is much higher than that of other products. However, it is urgent to increase the availability of organic products in the market, so that the consumers can buy them.

Many countries lack data on the price and demand quantity of organic products. This study used the CBC/HB method to generate this information. The demand functions and demand elasticities were estimated then based on that data. This is a novel method that can be applied to many countries.

In conclusion, the contributions of this paper include:

- a) The development of a method to estimate the demand equation and demand elasticities of organic products, even in the absence of price and demand quantity data; and
- b) The derivation of not only the own-price and income elasticities of organic products, but also cross-price elasticities with simultaneous consideration of the substitute products at different safety levels.

Acknowledgments

This study was funded by the Council of Agriculture, Taiwan.

References

- Bunte, F., M. v. Galen, et al. (2007). Limits to Growth in Organic Sales Price Elasticity of Consumer Demand for Organic Food in Dutch Supermarkets. The Hague, LEI, Report 7.06.20; ISBN/EAN: 978-90-8615-127-1.
- Glaser, L. and G. D. Thompson (1998). Demand for Organic and Conventional Frozen Vegetables. American Agricultural Economics Association Annual Meeting. Tennessee
- Hassan, D., S. Monier-Dilhan, et al. (2009). "Organic Food Consumption Patterns in France." Pre-Conference Workshop, August 16, 2009, Diet and Obesity: Role of Prices and Policies.
- Jonas, A. and J. Roosen (2008). "Demand for Milk Labels in Germany: Organic Milk, Conventional Brands, and Retail Labels." *Agribusiness* 24(2): 192-206.
- Orme, Bryan(2007), Three Ways to Treat Overall Price in Conjoint Analysis, Sawtooth Software, Inc.

Water quality protection and organic farming development in France

Fleury, Ph.¹ & Vincent A.².

Key words: Organic farming, watershed management, place-based OF development, conversion

Abstract

In France, recent attention has focused on water quality protection with emphasis on organic farming (OF). This paper explores the stakes of water quality protection for the development of OF. This research is based on a survey of 11 case studies involving OF as a potential solution for improving water quality. Five strategies of water institutions towards place-based OF development have been identified: individual support to farmers willing to convert to OF, acquisition of land by local authorities or private companies and environmental leases for farmers, exchange of practices and mutual learning between organic and conventional farmers, local activation to develop awareness of farmers towards OF, establishment of new local supply chains for organic products. The combination of several strategies is frequent. The promising results of these projects invite to revisit the existing theoretical OF growth models. To envisage place-based OF growth, territorial processes have to be considered: visions for the future and development priorities; territorial decision making and governance; current awareness of stakeholders, consumers and inhabitants towards OF; building stakeholder commitment on projects targeting both OF growth and local development.

Introduction

Problem statement and objectives

Water quality deterioration due to the use of synthetic fertilizers and pesticides is a major concern for water management institutions. In France, recent attention has focused on water quality protection at the watershed scale with emphasis on organic farming (OF) development. Indeed, OF is increasingly viewed by institutions and stakeholders (Water Agencies³, Ministry of Agriculture, Ministry of Sustainable Development, Environmental NGOs, etc.) as a relevant solution to the problems of water quality, particularly in water catchments contaminated by pesticides. The organic production method, which excludes the use of manufactured fertilizers and pesticides, is seen as a sustainable way to protect water quality. A watershed represents a topographically defined area that is drained by a stream system. The water quality improvement implies a substantial and spatialised development of OF. This refers to a place-based approach for conversion to OF. The literature on OF growth is scarce (Lamine & Bellon 2009) and existing references are mainly dedicated to individual motivations to convert and to policy instruments supporting conversion.

¹ ISARA-Lyon, Laboratoire d'Etudes Rurales, Agrapole, 23, rue Jean Baldassini, 69364 Lyon Cedex 07. E-mail : philippe.fleury@isara.fr, Internet www.isara.fr

² As Above, E-mail: avincent@isara.fr

³ France and its river network are divided into 6 catchment basins. For each basin a water agency is assigned to manage and protect water resources.

This paper explores the stakes of water quality protection for the future development of OF. The following questions are addressed: what are the different strategies of water institutions towards OF? How do different stakeholders take action to establish positive dynamic conditions for both watershed management and OF development? These elements are discussed in reference to the framework proposed by Michelsen & al. (2001) for successful OF growth.

Materials and methods

A survey-based approach

The current research is based on a survey of case studies involving OF for improving water quality. 11 different case studies have been surveyed across France. We interviewed policy makers, water managers, local elected officials, agricultural advisors and local facilitators. 28 interviews have been carried out. In addition we studied the documents produced for each case study: diagnosis, action plans, etc. We documented: objectives of the project, key moments in the dynamics, stakeholder strategies, controversial matters, initiated actions, place and role of OF, available results in terms of OF growth and water quality. The analysis crosses sociological and geographical concepts: stakeholder analysis, place-based development, collaborative resource management, development and diffusion theories.

Results
Diversity of strategies towards place-based OF development On the basis of the research findings we identified five strategies of water institutions and local authorities towards place-based OF development:

- **Individual support to farmers willing to convert to OF:** conversion diagnosis, financial support for the conversion (through agro-environmental schemes), technical and administrative advices, individual monitoring.
- **Exchange of practices and mutual learning between organic and conventional farmers.** The objective is not to develop OF but rather to set up a network of organic and conventional farmers involved in the implementation of environmental friendly practices in conventional farms (reduction of pesticide use, mechanical weeding, etc). Initially the exchange is often based on the farm equipment and on the know-how of organic farmers. Progressively we observe a mutual learning between farmers to solve some problems like the adjustment of the equipment. This strategy (which implies limited changes in farms) is mobilised to broaden the scope of farmers and to interest farmers who would not so open to OF.
- **Acquisition of land by local authorities or private companies (mineral water) and environmental leases for farmers.** The environmental leasing conditions include authorised and prohibited practices to minimise water pollution. These environmental conditions are often close to OF rules but they could also be more severe especially regarding organic fertilisation. As this strategy is expensive and takes time to progressively acquire different parcels of land, its implementation concerns mainly very sensitive areas next to water catchments.
- **Local activation, information and training sessions to develop awareness of conventional farmers and initiate collective dynamics towards OF:** training sessions, public events i.e. visits of organic farms, support to local experimentation implementing and testing organic farming practices, diagnosis open to all farmers to assess the impact of their practices on water quality.
- **Establishing and structuring new processing and marketing chains for organic products.** This is an innovative strategy linking water quality protection and consumption of organic food. Such projects are supported by some water

agencies and are implemented by cities and local authorities or farmer cooperatives. The objective is to increase and to secure the marketing and the value added of organic products by establishing local supply chains: offering organic food in schools, developing direct selling and face to face relationships between producers and consumers, supplying regional market, etc. The establishment of marketing chains is view as more sustainable and more attractive than agro-environmental schemes to enlarge dynamics towards OF. These projects require the involvement of a large set of stakeholders: farmers, farmer cooperatives, consumers' NGOs, local authorities, water institutions, catering services, extension services, staff in charge of school canteen, private enterprises, consumers.

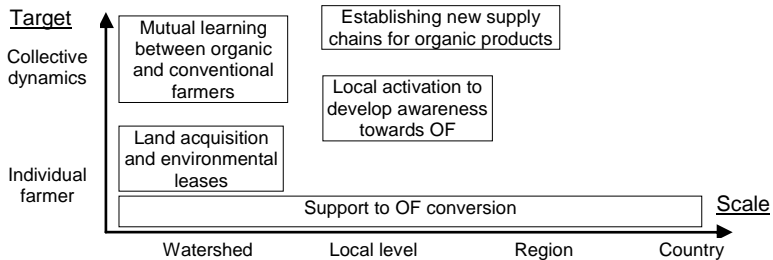


Figure 1: strategies towards place-based OF development for improving water quality

The combination of two or more strategies is frequent, i.e. by associating individual support to farmers and local activation to increase awareness towards OF. For this type of combination, the projects are often led by watershed managers and agricultural extension services. Complex projects combine 3 strategies with special attention to the establishment of new supply chains. Corresponding projects in other European countries (i.e. the famous case of Munich or Mangfall valley in Germany) also combine a large set of strategies including protection of forests and appropriate forest management. These initiatives represent collective efforts to interest and to involve an extensive network of stakeholders and they are often led by local authorities. Protection of water quality and development of OF are considered in an holistic vision for the future of the local territory including environmental, social, economic and political components.

These different case studies are recent and innovative. They are often at the development stage and it is difficult to assess their final impact on water quality¹. Concerning the diffusion of OF, in the rare case studies with available quantitative data we observe a positive impact: i.e. in 3 years of joint action, the organic area increased from 1% to 5% of the total agricultural area.

Discussion and conclusion

Water protection and of growth models

The main approaches to conversion concern the farmers (motivations, decision-making process, individual trajectories) (Lamine & Bellon, 2009). Different theoretical

¹ The complex strategy of Munich has paid with a positive effect on nitrate level in water.

models, as the adoption/diffusion model, have been used and criticised to analyse OF growth (Padel, 2001). Michelsen & *al.* (2001) proposed a path of six steps leading to organic farming growth. The three initial steps relate to the establishment of an organic farming sector: establishment of an organic movement, political recognition and financial support to OF. The following steps concern the ability of OF to conquer three domains: the positive involvement of general farmers' organisation, the food market and finally the establishment of an institutional setting devoted to OF.

Based on the french case studies and existing projects in other european countries, water protection and place-based projects appear as new stakes for successful OF growth. However, projects envisaging OF as a solution to protect water quality and more generally the environment are scarce and emerging. They are complex and require many inter-connected components:

- **Agricultural practices to promote and to implement.** Practices which are not included in the organic regulation could be necessary to take into account some environmental issues.
- **Complementarities and partnerships between organic and conventional farmers.** OF is rarely envisaged as the unique solution. The aim of the project is often to achieve a combination associating both the development of OF and the adoption of more environmental friendly practices in conventional farms.
- **Policy support and development plans in favour of OF** in terms of both conversion of farms and organisation of supply chains.
- **Territorial dialogue and governance to create** dynamics involving environmental and local development organisations, organic and conventional farmers and a broad scope of stakeholders.

Such promising results and the remaining complexity to design new projects invite to revisit the existing theoretical OF development models with a territorial perspective. This territorial perspective will allow to supplement existing models and to envisage place-based processes which are of importance for OF growth: visions for the future and development priorities; territorial decision making and governance; awareness of new stakeholders (i.e. local authorities, environmental managers), consumers and inhabitants towards OF; building stakeholder commitment and contribution on projects targeting both OF growth and territorial development.

Acknowledgments

The authors gratefully acknowledge financial support from the Water Agency "Rhône-Méditerranée-Corse" and from the regional council "Rhône-Alpes".

References

- Leach W. D., Pelkey N.W (2001). Making watershed partnerships work: A review of empirical literature. *J. Water Resources Planning Manage.* 127(6): 378–385.
- Lamine, C., Bellon, S. (2009). Conversion to organic farming: a multidimensional research object at the crossroads of agricultural and social sciences. A review. *Agron. Sustain. Dev.* 29: 7-112.
- Michelsen J. (2001). Recent Development and Political Acceptance of Organic Farming in Europe, *Sociologia Ruralis.* 41: 3–20.
- Padel S. (2001). Conversion to organic farming: a typical example of a diffusion of an innovation? *Sociologia Ruralis.* 41: 40-61.

Benefits Associated With U.S. Organic Farm Sector Expansion, a Ten-Year Assessment

Lohr, L.¹

Key words: Benefits assessment, industry structure, growth trends

Abstract

This case study uses 2007 national data to update a 1997 study of economic, social, and environmental benefits associated with organic agriculture in the United States. Measurable impacts are quantified by comparing indicators of benefits in counties with organic farms and counties without. New indicators of industry structure that are included - number of small family farms, number of farms selling through Community Supported Agriculture, sales of agritourism services, beginning farmer status, and government payments – along with most of the previous measures indicate presence of organic farms is positively correlated with county level benefits.

Introduction

In the decade between 1997 and 2007, the United States organic retail sector grew 462% from \$3.56 billion to nearly \$20 billion in 2007. The U.S. Department of Agriculture estimates there were 11,352 certified farms in 2007 compared with 5,021 in 1997, an increase of 126% (USDA, 2010). A significant number of state and federal government programs and policies have been instituted to support organic farming since 1997 (Greene and Dimitri, 2009). The most significant factor in sector development was the implementation of the National Organic Program in 2002. Since then, conservation payments for organic farming, certification cost-sharing, research funding and technical assistance, and crop insurance specific to organic systems have boosted expansion of production. But do the benefits attributable to the expansion of organic agricultural production justify the public and private sector investments?

In a previous study by Lohr (2005), data from the 1997 U.S. Census of Agriculture and the 1997 Organic Farming Research Foundation producer survey were used to compare counties with organic producers to those without, using benefits analysis. The study concluded that even though organic farmers were not a large percentage of the total number of U.S. farmers, their influence could be causing localized (county) level shifts toward greater sustainability in mainstream agriculture. The current paper assesses the benefits effects of the 10-year expansion.

Materials and methods

Since 2002, the U.S. Census of Agriculture (CA) has reported the numbers of organic farms and their sales by county, so that presence of organic farms is linked directly to the indicator data of interest. Data on 39 variables were collected for 3,079 counties represented in the 2007 CA (National Agricultural Statistics Service, 2009). Watershed data included in the previous benefits study (Lohr, 2005) are no longer reported by the U.S. Environmental Protection Agency, and so are not analyzed for 2007.

¹ ©2011, Lohr Consulting, 2017 N Woodrow St, Arlington, VA, 22207, USA, LohrConsulting@gmail.com

Using the unique five-digit state-and-county identifiers, called FIPS (Federal Information Processing Standards) codes used by the U.S. Census Bureau, all counties in the U.S. are classified as either “with” or “without” organic farms, “with” being defined as having at least one organic farm located interior to the county boundary. In 1997, 1,208 counties (39.2% of all counties at the time) contained at least one organic farm. In 2007, 2,028 counties (64.5% of all counties at the time) had at least one organic farm. The weighted average of 3.3 organic farms in these 1,208 counties in 1997 compares with 18.0 farms per county for 2,028 counties in 2007.

The mean values of selected indicators from the 2007 U.S. Census of Agriculture (National Agricultural Statistics Service, 2009) are calculated for two groups - counties “with” organic farms and counties “without” organic farms. The groups are compared using a t-test for equality of the means under the assumption that as the sample size increases, the t distribution approaches the standard normal distribution (Kmenta, 1986). Higher means are preferred for positively valued attributes, such as hired worker payroll, and lower means for negatively valued attributes, like insecticide use.

Best performance is assigned to the system with the higher county mean if the indicator has a (+) and the lower mean if the indicator has a (-). If the category heading has one of these signs, means for all the indicators in the category should be higher (+) or lower (-) to be best, with exceptions marked. If the difference of the means is not statistically significant at $p=0.05$, then neither system exhibits the best performance. The means of indicators are calculated for all farms in the county, including both conventional and organic, where present.

This test is not a definitive indicator of the superiority of organic or conventional systems; rather, it describes whether counties with organic farms perform statistically differently than counties without. The former might more properly be described as “mixed organic” since there are no counties where production is exclusively organic.

Results

Table 1 compares results of the analyses for 1997 and 2007. A total of 39 social, economic, and environmental indicators are tested. Indicators unique to the 2007 data set are small farmer ownership, beginning farmer status, Community Supported Agriculture farmer participation, agritourism sales, federal conservation and nonconservation payments, and state/local payments.

The 2007 and 1997 mean values for counties with organic farms and the statistically best performing county types – organic and conventional (O), conventional only (C), or not statistically different (NS) – for each indicator are given for each year. All monetary units are in nominal dollars not adjusted for inflation. The conventional means are not presented for reasons of brevity but are available in the full report at www.lulu.com.

In 2007, 18 of 39 indicators favoured counties with organic farms (O), eight favoured counties without organic farms (C), and 13 exhibited no statistical difference. Of the 32 indicators in common between 1997 and 2007, only three in 1997 favoured C. Six indicators were NS. The remaining 23 indicators in 1997 favoured O. Nine indicators favoured O in both 1997 and 2007 – property taxes paid, hired worker payroll, percentage of female farmers, percentage of operators residing on farm, direct to consumer sales, number of workers hired, idled/cover cropped/woodland habitat acreage, insecticide use, and herbicide use.

Table 1. Indicators Tested for Counties With and Without Organic Farms and Best Performing Systems, 2007 and 1997^a

| Indicator | Units | Mean Value Organic Counties 2007 | Mean Value Organic Counties 1997 | Best Performance 2007 | Best Performance 1997 |
|--------------------------------------|-----------------------|-------------------------------------|-------------------------------------|--------------------------|--------------------------|
| Farm Economy (+) | | | | | |
| Total farm sales | \$ per farm | 136,784 | 111,696 | C | O |
| Total farm expenses (-) | \$ per farm | 110,465 | 85,358 | O | C |
| Net return to agricultural sales | \$ per farm | 29,665 | 25,813 | NS | O |
| Market value of land and buildings | \$ per farm valued | 835,311 | 511,250 | C | O |
| Local Economy (+) | | | | | |
| Property taxes paid | \$ per farm paying | 3,366 | 95,000 | O | O |
| Hired worker payroll | \$ per farm hiring | 40,205 | 24,145 | O | O |
| Fertilizer purchased | \$ per farm buying | 15,232 | 8,681 | C | O |
| Agricultural chemicals purchased | \$ per farm buying | 9,500 | 7,306 | C | NS |
| Livestock and poultry purchased | \$ per farm buying | 71,302 | 38,232 | C | NS |
| Commercially mixed feed purchased | \$ per farm buying | 45,782 | 26,763 | C | C |
| Seed, bulbs, and trees purchased | \$ per farm buying | 13,317 | 6,976 | NS | O |
| Custom work, machinery rented | \$ per farm renting | 9,835 | 5,110 | NS | NS |
| Repair and maintenance purchased | \$ per farm buying | 8,265 | 6,268 | NS | O |
| Farm Ownership (+) | | | | | |
| Sole proprietorship | % of all farms | 85.4 | 84.2 | O | C |
| Family held corporation | % of all farms | 4.7 | 5.2 | NS | O |
| Female principal operator | % of all farms | 14.6 | 9.3 | O | O |
| Small farmer | % of all farms | 31.0 | | O | |
| Renting some or all land (-) | % of all farms | 22.9 | 41.5 | NS | NS |
| Operator Characteristics (+) | | | | | |
| Operator lives on farm | % of all farms | 77.5 | 72.1 | O | O |
| Farming principal occupation | % of all farms | 46.0 | 53.4 | NS | O |
| Full-time farming (>165 days) | % of all farms | 60.5 | 65.4 | C | O |
| Years operating present farm | average years | 21.8 | 20.5 | NS | O |
| Beginning farmer (<10 years) | % of all farms | 26.1 | | NS | |
| Rural Development (+) | | | | | |
| Direct to consumer sales | \$ per farm | 7,362 | 5,247 | O | O |
| Agritourism sales | \$ per farm | 19,024 | | O | |
| CSA farms | % of all farms | 0.8 | | O | |
| Worker pay | \$ per worker | 7,206 | 4,122 | NS | O |
| Workers hired | workers per farm | 5.0 | 5.1 | O | O |
| Farms with net losses (-) | % of all farms | 53.1 | 47.8 | C | O |
| Bird and Wildlife Habitat (+) | | | | | |
| Idle or in permanent cover crops | acres | 13,486 | 14,476 | NS | O |
| Idle, cover cropped, or woodland | acres | 28,477 | 27,487 | O | O |
| Land under CRP/WRP | acres | 14,276 | 13,297 | NS | O |
| Chemical Use (-) | | | | | |
| Fertilizer use | acres per farm using | 262.3 | 204.9 | O | NS |
| Insecticide use | acres per farm using | 229.8 | 153.7 | O | O |
| Herbicide use | acres per farm using | 283.1 | 240.1 | O | NS |
| Nematicide use | acres per farm using | 177.9 | 20.2 | O | O |
| Government Payments (-) | | | | | |
| Federal payments - environmental | \$ per farm accepting | 4167 | | O | |
| Federal payments – production | \$ per farm accepting | 8014 | | O | |
| State and local payments | \$ per farm accepting | 4689 | | NS | |

^aBest performance is indicated by t-test between counties with organic and conventional (O) and counties with conventional only (C). Lack of statistical difference is indicated by NS. Blank indicates no data for indicator for that year. Indicators marked by plus (+) are more beneficial if the value is higher. Indicators marked by minus (-) are more beneficial if the value is lower. Monetary units are in nominal dollars not adjusted for inflation.

Discussion

The results indicate that in 2007 as in 1997, counties with one or more organic farms incur statistically greater levels of positive benefits and lower levels of negative impacts than counties without organic farms. However, in 2007 there are fewer indicators for which a significant difference favouring organic is observed. Most of the nonsignificant differences are found among indicators of the operator characteristics and bird and wildlife habitat. The majority of indicators favouring C were in farm economy (due to larger farm sizes) and local economy (due to input purchases).

Counties with organic farms in 2007 exhibit lower farm expenses, higher property value, greater returns from alternative enterprises (direct sales to consumers, agritourism, and CSA participation), and worker pay and employment – indicators associated with more intensively managed, higher valued production systems. These counties also had higher percentages of female owned farms, small family farms, sole proprietorships, and farm residences. These indicators can be linked to greater social consciousness of the organic farming community, particularly given that there was no difference in experience and commitment to farming as an occupation when compared with counties having only conventional farmers. Finally, counties with organic farms dominate counties without in measures of environmental quality (more bird and wildlife habitat and less chemical use) and federal payments (organic farming counties account for lower amounts of payments per participating farm).

Conclusions

After 10 years, organic farming is still leading the way toward social, economic, and environmental sustainability. Results of this analysis indicate that sector expansion has generated benefits for counties with organic and conventional farms, compared with only conventional farms. It appears that government programs to support expansion of organic agriculture in the U.S. are justified.

References

- Greene, C., & Dimitri, C. (2009): Organic Agriculture: Organic Policy. USDA Organic Briefing Room. <http://www.ers.usda.gov/Briefing/Organic/Policy.htm> (accessed 2009-12-29).
- Kmenta, J. (1986): Elements of Econometrics, 2nd edition, Macmillan Publishing Co., New York.
- Lohr, L. (2005): Economic, social, and environmental benefits associated with U.S. organic agriculture. Researching Sustainable Systems - International Scientific Conference on Organic Agriculture, Adelaide, Australia, September 21-23, 2005 http://orgprints.org/4411/4/4411-Lohr_4p_revised-ed.pdf
- National Agricultural Statistics Service. (2009): 2007 Census of Agriculture. Volume 1, Chapter 2: County Level Data. US Department of Agriculture, Washington, DC. Searchable database at http://quickstats.nass.usda.gov/?source_desc=CENSUS (accessed 2009-12-29)
- U.S. Department of Agriculture. (2010): Table 2--U.S. certified organic farmland acreage, livestock numbers, and farm operations, 1992-2008, Economic Research Service, <http://www.ers.usda.gov/Data/Organic/> (accessed 2010-12-01)

Assessing the public goods provided by organic agriculture: lessons learned from practice

Smith, L., Padel, S., Pearce, B., Lampkin, N., Gerrard, C., Woodward, L.¹, Fowler, S.² & Measures, M.³

Key words: sustainability, environment, indicators, benchmarking

Abstract

The role of farms as providers of public goods has long been recognised, and measuring performance in this area is of increasing interest to policy makers, in light of the approaching Common Agricultural Policy reform. The Organic Research Centre has been working on this topic in recent years, through the development of sustainability assessment tools. The latest outcome from this process is a 'Public Goods' assessment tool, developed through a Natural England funded project which aimed to evaluate the benefits accruing from organic management and entering into an Organic Entry Level Stewardship (OELS) agreement. This paper describes the development of the Public Goods (PG) tool, and what has been learned in the process.

Introduction/Problem

The measurement of the 'public goods' provided by agricultural systems, has been viewed as an increasingly important area within the international policy debate (Zander et al. 2007). The approaching Common Agriculture Policy reform has also highlighted the need to identify these benefits, to justify support payments for agriculture (Lampkin, 2010). For organic farming, this question can be viewed as particularly important, as the positive effects in such areas as 'environment' are seen as one of the most important reasons for the financial support given to the sector, and as one of the reasons for consumers' willingness to pay a premium for organic food.

How to identify and measure the public benefits delivered by farming systems, in a valid and practical way, is an issue that the Organic Research Centre has been seeking to address through the development of sustainability assessment tools. The latest outcome from this work is a 'Public Goods' (PG) assessment tool for organic agriculture. This paper describes the development of the Public Goods tool, outlining the interactive processes involving stakeholders and and lessons learned from testing the tool with organic farmers in England.

¹ Authors 1-6: The Organic Research Centre, Elm Farm, Hamstead Marshall, Berkshire, England, E-Mail, laurence.s@organicresearchcentre.com, Internet www.organicresearchcentre.com

² Organic Centre Wales, Institute of Biological, Environmental and Rural Sciences, Aberystwyth University, Ceredigion, Wales, E-Mail, smf@aber.ac.uk, Internet www.organiccentrewales.org.uk

³ The Institute of Organic Trainers and Advice, Cow Hall, Newcastle-on-Clun, Shropshire, United Kingdom, E-Mail, mark@organicadvice.org.uk, Internet www.organicadvice.org.uk

Background

ORC's work in sustainability assessment tools began in 2005 through the Defra project on Quality and Environmental Benchmarking for organic agriculture. This project aimed to develop a tool for organic farms to assess the performance and interaction between ecological, social and financial factors, building on previous work that had devised a sustainability audit to assess farm performance against each of the International Federation of Organic Agriculture Movements (IFOAM) principles (Measures, 2004). The Energy, Emissions, Ecology and Agricultural Systems Integration Project (EASI) continued the work in this area through the development of a detailed tool to compare farms' resource use efficiency and greenhouse gas emissions. The development of the Natural England funded PG tool led on from this work, through designing a tool for use by an advisor, to assess the multifunctional outputs provided by an organic farm, and the benefits that accrue from an Organic Entry Level Stewardship (OELS) scheme agreement (an English support scheme for organic farmers funded through the Rural Development Programme).

Methods and approaches

At first, public goods were identified, against which the tool would assess each farm. The first stage in this process was to establish what was meant by a "public good" through a review of literature. It was found that an externality is defined as a by-product of a process that affects third parties e.g. pollution (RISE, 2009) and 'positive externality' may be said to be a 'public good' if it is non-excludable and non rival (i.e: its consumption by one person does not reduce the amount available to others) e.g. clean air, Cooper et al. (2009).

The literature review was followed by a stakeholder meeting involving researchers, farm advisors and policy makers, to identify the public goods which would ideally be assessed in the tool. Those selected were: soil management, biodiversity, landscape and heritage, water management, manure management and nutrients, energy and carbon, food security, agricultural systems diversity, social capital, farm business resilience, and animal health and welfare. These criteria are similar to those suggested by other authors, e.g: Cooper et al. (2009) suggest that the most significant public goods from agriculture are agricultural landscapes, farmland biodiversity, water quality, water availability, soil functionality, greenhouse gas emissions, carbon storage, air quality, resilience to flooding and fire, food security, rural vitality, and animal health and welfare. Similar criteria are suggested by Kuratorium fur Technik und Bauwesen in der Landwirtschaft, (2009), and National Institute of Statistics of Italy (2001).

A number of key "activities", were then associated with each public good for assessment on farm. In common with the development of the MOTIFS tool (Meul et al. 2008) the choice of activities was influenced by the desire for the data to be of a type that a farmer would have readily available (ie: in their farm records). Care was also taken to maintain a mixture of 'quantitative and qualitative activities', with the aim that the entire data collection and assessment could be completed in no more than 4 hours. Within the tool each activity was marked with scores between 1 (lowest mark – no benefit provided) and 5 (highest score). Some activities were assessed using several questions while others required only one. The scores for each 'public good' were obtained by averaging the scores for all its activities. These were then displayed on a radar diagram allowing farmers to see in which areas they perform well and which areas might be improved (see Figure 1 below). The PG Tool differs from the

EASI approach in that it covers a wider range of sustainability indicators. The length of time for the completion of an assessment is also much less; an EASI assessment takes at least 1.5 days of an advisor's time.

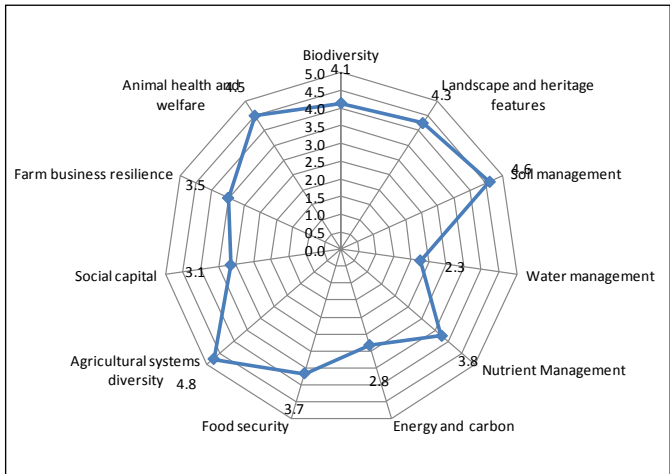


Figure 1: Spider-web diagram depicting results from a Public Goods audit

To assess the suitability and performance of the PG tool in the field a pilot assessment on forty English organic farms was carried out. The aim was to assess whether the tool was user-friendly, whether it was seen as valuable by farmers and advisors in evaluating the provision of public goods on a farm, and whether it would function on a range of farm types. The farms assessed were chosen to cover a spread over the main robust farm types as defined by Defra for the Farm Business Survey (DEFRA, 2010) and were selected with the assistance of the eight advisors who carried out the assessments. The advisors provided written and oral feedback throughout the pilot, and the farmers completed questionnaires and returned them to ORC.

Results and brief discussion:

We encountered a number of challenges in both designing the tool and carrying out assessments. In common with Halberg *et al.* (2005) we found that there was a lack of adequate reference data against which to compare performance. When selecting suitable indicators we also found that there is often a direct conflict between those that are useful, and those for which data are readily available from farm records. This was a particular problem in the areas of energy and water management. As with other studies in this area (e.g: Meul *et al.* 2008) there were also difficulties with the indicator selection process for the 'social pillar' of sustainability, partly due to the methodological challenges of assessing this area (Zander *et al.* 2007). The suitable degree of weighting of single indicators was also problematic; within the tool, all indicators were given the same weight, but this could potentially lead to misinterpretations in view of the final, visual aggregation of results.

It appears that the tool has generally increased farmers' understanding of public goods. Of the 40 farms assessed 12 returned their feedback forms, 9 of those farmers

reported a higher level of knowledge and understanding of public goods after the assessment than prior to it, 8 would recommend the tool to others in its current format and 2 more would recommend it once modified.

Feedback from the advisors was also positive, one advisor comment sums up the response *“Overall it was an interesting exercise and could be a useful tool with some tweaking”*. Another advisor commented on farmers’ reactions to the tool saying *“the farmer’s reaction was, on the whole, very positive. They were interested in the tool and its concept and entered into discussion very freely. The radar diagram was well received with interest not only in the high scores but also the low scores and the reason for them and how they could be improved.”*

Conclusions

The study illustrates that although it is difficult to measure sustainability as a whole, through the right balance of quantitative and qualitative indicators a good overview can be achieved that can facilitate improved understanding of areas of sustainability at the farm level. This was demonstrated through the positive feedback from both farmers and advisors during the pilot phase of the PG tool’s development.

Acknowledgments

The authors would like to thank Natural England and DEFRA for supporting the development of the Public Goods tool and the anonymous referees for their helpful comments.

References

- Cooper, T., K. Hart, et al. (2009). The provision of public goods through agriculture in the European Union, report prepared for DG Agriculture and Rural Development, www.ieep.eu/publications/pdfs/2010/final_pg_report.pdf, (accessed 2009-08-12).
- DEFRA. (2010). Definitions of Terms Used in Farm Business Management. UK, DEFRA.
- Halberg, N., Van der Werf, H. M. G., Basset-Mens, C., Dalgaard, R., de Boer, I.J.M. (2005). Environmental assessment tools for the evaluation and improvement of European livestock production systems. *Livestock Production Science*. 96: 33-50.
- Kuratorium für Technik und Bauwesen in der Landwirtschaft. (2009). Bewertung der Nachhaltigkeit Landwirtschaftlicher Betriebe. Darmstadt, Germany.
- Lampkin, N. (2010). Organic farming support and CAP reform. *The ORC Bulletin*. 102:2-4.
- Measures, M. (2004). Farm auditing for sustainability. www.efrc.com/manage/authincludes/article_uploads/art013.pdf, (accessed 2009-08-12).
- Meul, M., Van Passel, S., Nevens, F., Dessein, J., Rogge, E., Mulier, A., Van Hauwermeiren, A. (2008). MOTIFS: a monitoring tool for integrated farm sustainability. *Agronomy for Sustainable Development*. 28(2): 321-332.
- National Institute of Statistics of Italy (2001) Agri-environmental indicators to describe agricultural sustainability. Ottawa, Canada.
- RISE. (2009). Public goods from private land **Fehler! Hyperlink-Referenz ungültig..** (accessed 2011-03-15).
- Zander, P., Knierim, U., Groot, J.C.J., Rossing, W.A.H. (2007). Multifunctionality of agriculture: tools and methods for impact assessment and valuation. *Agric. Ecos. and Env.* 120: 1-7.

Farm economics, marketing and certification

On the economics of organic grassland and alternative bio-energy systems – A risk modelling approach

Blumenstein, B.¹ & Möller, D.¹

Key words: semi-natural grassland, bio-energy, Monte Carlo-simulation

Abstract

Organic farming enterprises manage their grasslands mostly extensively, often participating in nature preservation schemes. On extensive or semi-natural grassland sites, the profitability of grassland utilisation with customary processing procedures like dairy or suckler cow farming is often realized insufficiently, however. As the global demand for sustainable energy supplies increases, the newly developed IFBB-technique (Integrated Generation of Solid Fuel and Biogas from Biomass) could exhibit an alternative grassland utilisation by using plant cover from extensive grasslands for the generation of renewable energies whilst preserving valuable grassland habitats, without competing against land for food production. A survey amongst farmers in the low mountain range of Vogelsberg, Germany, identified general frameworks of extensive grassland management as well as incentives and objections for an implementation of the IFBB technology at single farm level. Calculations of processing values of grassland in different procedures of animal husbandry, landscape maintenance and bio-energy production indicate that the utilisation of extensively managed grassland in alternative bio-energy systems could exhibit the most favourable land use option for organic semi-natural grassland management. These results are verified by a risk modelling approach.

Introduction and objectives

Organic grassland management in various forms of utilisation is currently often struggling to achieve economic profitability. Therefore on the one hand an estimated middle-term decrease of grassland utilisation for feed of up to 25 % is anticipated e.g. in Germany (Rösch *et al.* 2009). On the other hand the demand for the provision of sustainable and ecologically consistent energy from renewable energy resources increases (Wachendorf *et al.* 2009). The Integrated Generation of Solid Fuel and Biogas from Biomass (IFBB), a bio-energy procedure newly developed at Kassel University, Germany, may offer promising prospects regarding the utilisation of biomasses from semi-natural grassland sites for the generation of biogas (power and heat) and grass pellets for combustion purposes. Unlike the fermentation of biomasses with low digestibility in conventional biogas plants the IFBB procedure is especially suitable for the application of extensive grassland material. Global potentials for the production of biomasses from semi-natural LIHD (low-input high-diversity) grasslands grown on poor soils or areas less favourable for agricultural production that neither compete with food production nor cause ecosystem destruction have roughly been estimated e.g. by Field *et al.* (2008) and Tilman *et al.* (2006) to account for 386 million ha and 500 million ha, respectively, providing a biomass potential of more than 5 % (Field *et al.* 2008) of the global energy consumption in

¹University of Kassel, Faculty of Organic Agricultural Sciences, Department of Farm Management, Steinstr. 19, D-37213 Witzenhausen, blumenst@uni-kassel.de, www.uni-kassel.de/agrar/bwl

2005. In Asia alone an estimated 100 million ha tropical lands, formerly forested but currently out of agricultural production (Houghton *et al.* 1991), in China more than 50 million ha currently unused so called “waste grassland” (Yan *et al.* 2008) could be mobilized for semi-natural grassland utilisation. This paper’s aim therefore is to identify field procedures with a profitable use of organic semi-natural grassland as well as incentives and objections of the implementation of the IFBB procedure at single farm level to begin with in Germany. Modelling the respective risk potential shall support the decision process, what kind of grassland processing is to be preferred.

Materials and methods

The calculation of full costs and processing values of semi-natural grassland management and its utilisation in subsequent procedures is based on the results of expert interviews of 12 organically and conventionally operating farmers interested in sustainable energy issues, located in the grassland based Vogelsberg region, Germany. The conducted survey is the beginning of a series of farm surveys and expert interviews in three European partner regions, Vogelsberg/Germany, Ceredigion/Wales and Tartu/Estonia in order to compile generally valid criteria for the suitability of an implementation process of the IFBB procedure – applicable for any grassland region in agriculturally disadvantaged areas or extensive grassland regions. The data were complemented and operationalized with standard data (KTBL 2010). The calculation of costs was conducted in accordance with the standards of full cost accounting. Returns and single farm and compensatory payments for animal husbandry and landscape maintenance procedures (335 €/ha), bioenergy returns and subsidies (returns on electricity including subsidies: 20,67 ct./kWh; returns on grass pellets, no subsidies: 3,66 ct./kWh) as well as transport costs for bio-energy substrate (grassland) were considered in the calculations. Factor costs were assessed with a wage rate of 15 €/h and costs for land with 75 €/ha a⁻¹, buildings for animal husbandry were charged with half of the costs for new buildings. Risk modelling was performed with a Monte Carlo-simulation (@risk 5.5) by allocating triangular distributions to the parameters grassland yields (t/ha), grassland production costs (€/t dry matter) and market prices for meat (€/kg) and grass pellets (€/t). Yields were adapted to current yield ranges on Vogelsberg semi-natural grasslands, variation in production costs are due to modified mechanisation, market prices vary due to different marketing strategies for meat and the market price fluctuation of wood pellets in 2010. The probability simulation was carried out with 10000 iterations.

Results and discussion

Expert interviews

The expert interviews helped to identify parameters that indicate the suitability of semi-natural grassland regions for the IFBB approach. In the Vogelsberg region farms often display large amounts of surplus grassland, whereas capital and labour are limited production factors. Full time farmers would like to utilise their surplus grassland in an IFBB plant, but are partially restricted by path dependencies, not willing to give up their current farming branches immediately. Moreover, a higher willingness to invest and to carry risks than for the polled part time farmers could be detected. Full time farmers therefore rather imagine operating an IFBB plant than just supplying it with substrate. Part time farmers are more open to reduce their existing farming branches significantly or even abolish them in order to provide additional grassland for the supply of an IFBB plant.

Processing values

The calculation of processing values indicates that grass from organically managed semi-natural grassland sites by trend is used particularly efficiently in the bio-energy procedures IFBB or Dry fermentation (Table 1). This is especially true when considering the results of the expert interviews, that the availability of labour and capital is limited, whereas the factor land is not limited, which is typical for agricultural production in low mountain ranges.

Table 1: Characterisation of extensive grassland utilization in different organic processing procedures (€/t DM)*

| | Suckler cows | Dairy | IFBB | Dry fermentation | Mulching | Composting |
|--|--------------|--------------|---------------|------------------|------------|-------------|
| DM needs from grassland, t DM a⁻¹ | 696 | 480 | 3747 | 3420 | - | - |
| Calculatory farming branch result, € a⁻¹ | 23565 | 15748 | 326016 | 175598 | 180 | -112 |
| Processing value, €/t DM | 34 | 33 | 87 | 51 | 45 | -28 |

*Netto yields 40 dt DM/ha; one bio-energy unit each, suckler cow stock size 116, dairy stock size 120

However, for animal husbandry systems approximations of processing values to bio-energy values can be achieved with suitable marketing strategies and low fixed costs e.g. for buildings. Influencing factors on the profitability of composting are the distance of composting facilities and the disposal costs of „green waste“. Mulching is often prohibited under agro-environmental schemes. The profitability of the IFBB procedure considerably depends on the varying rates of future price increases of solid fuels and distance of grassland sites (affecting transportation costs). The influence of subsidies for bio-energy production on profitability is rather small, since only 15 % of the IFBB earnings come from subsidized power sales and 85 % from unsubsidized solid fuel sales. Since investment needs for bio-energy procedures can be higher than for animal husbandry systems, one solution for farms based on forage production could be the collaborative operation of an IFBB plant, which would drastically reduce the provision of capital assets for each associate. Premium grassland sites could still be used in the existing animal husbandry procedures, whereas extensive surplus grassland could be used as substrate for a collaborative bio-energy plant.

Risk modelling

Risk modelling of suckler cow husbandry and the IFBB procedure in comparison shows that processing values of grassland utilisation in suckler cow husbandry can be similar to its utilisation in the IFBB procedure, however only 4.3 % of probable results lie within 90 % of the probable results of the IFBB procedure (Figure 1). Furthermore the cumulative probabilities are distributed much more broadly than for the IFBB procedure. Therefore with the IFBB procedure not only a more profitable grassland utilisation is achieved, but the considerably lower distribution of probable results implies an also considerably lower risk in using extensive grassland within IFBB.

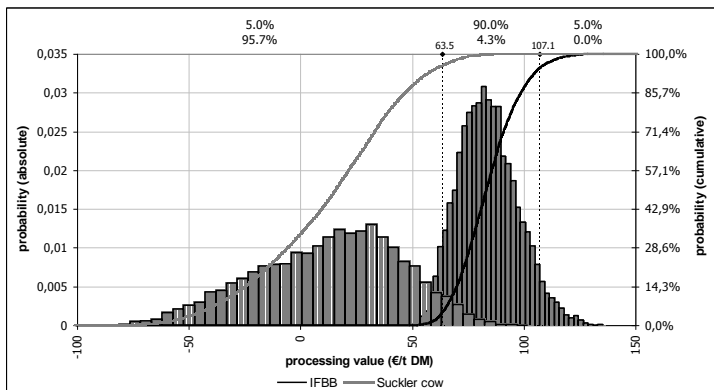


Figure 1: Probability (p) calculations of the processing value (€/t DM) of grassland used in suckler cow husbandry and IFBB procedure in comparison

Conclusions

Model calculations and risk assessment presented in this paper indicate that a comprehensive land use is associated with economic difficulties in the middle term future, even for organic agricultural production. Especially for organic farms with surplus extensive grassland, the IFBB procedure could exhibit an alternative to customary processing procedures, since it represents a new opportunity to produce renewable energy even in areas less favourable for agricultural production without having to rely on intensively produced biogas substrates of conventional biogas technologies. One solution of preserving valuable grassland habitats *and* agricultural practice in low mountain ranges by creating new income possibilities is therefore a combination of organic management of semi-natural grassland and its utilisation in alternative bio-energy systems.

References

- Field, C., Campbell, J.E., Lobell, D.B. (2008): Biomass energy: the scale of the potential resource. *Trends in Ecology and Evolution* 23: 65-72
- Houghton, R.A. Unruh, J., Lefebvre, P.A. (1991): Current land use in the tropics and its potential for sequestering carbon. In Howlett, C., Sargent, C. (eds.): *Technical Workshop to Explore Options for Global Forestry Management*, Bangkok conference proceedings, 211
- KTBL (2010): *Ökologischer Landbau. Daten für die Betriebsplanung*. KTBL, Darmstadt, 824 p.
- Rösch, C., Skarka, J., Raab, K., Stelzer, V. (2009): Energy production from grassland – Assessing the sustainability of different process chains under German conditions. *Biomass and Bioenergy* 33: 689-700
- Tilman, D., Hill, J., Lehman, C. (2006): Carbon-negative biofuels from low-input high-diversity grassland biomass. *Science* 314: 1598-1600
- Wachendorf, M., Richter, F., Fricke, T., Grass, R., Neff, R. (2009): Utilization of semi-natural grassland through integrated generation of solid fuel and biogas from biomass. *Grass and Forage Science*, 64: 132-143
- Yan, L., Zhang, L., Wang, S., Chen, X., Hu, L. (2008): The importance of waste grassland for potential biomass and bio-energy production in China, in: *Multifunctional Grasslands in a Changing World, XXI. International Grassland Congress*, Guangdong

Producing a local, organic diet gives a healthy, sustainable and more climate-friendly diet

Mogensen, L.¹, Kristensen, T.¹, Hermansen, J.¹ & Kristensen, I.S.¹

Key words: Diet, GHG emissions, Local area, Primary production, Sustainable

Abstract

The hypothesis was that a local organic diet, based on the food products that can be produced in a local farming cooperative that is balanced in terms of vegetable and livestock production, can meet human nutritional requirements and reduce greenhouse gas (GHG) emissions. This diet (North European conditions) will include a lower proportion of animal products and more vegetable products, which has a positive effect on both the environment, the climate and the nutritional value of the diet.

A basic scenario was set up where specialized farming activities in a local farming community area were integrated in a joint organization that could produce all the required foodstuffs for a smaller town with 770 inhabitants. The farming system included 180 ha of mainly grass-clover in rotation and a mixed production of milk, meat, breadwheat and vegetables. The GHG emission from the production was 3247 g CO₂/person/day. Scenario 1 added biogas treatment to the basic scenario, which lowered the emission by 982 g CO₂/person/day and the system became self-sufficient in terms of fossil energy. In scenario 2, the animal production was reduced, corresponding to a decrease in the intake of beef meat by a third and an increase in vegetables to maintain the energy intake. This scenario reduced GHG emission by more than half, to 1239 g CO₂-eq./person/day.

Introduction

Organic farming is currently specialised the same as conventional farming is and causes some of the same environmental problems. However, according to the organic principle, organic farming aims to minimise the human impact on the environment by taking advantage of on-site resources, such as livestock manure for fertiliser and feed produced on the farm, and by creating harmony between crop production and livestock production. Our hypothesis was that these goals could be reached by introducing a new type of farming system, where several specialized farming activities in a local farming community area are integrated in a joint organization. In such a joint local farming system, import of feed, manure, straw etc. to the system is avoided, and the system has to find a balance between crop and animal production, utilizing cattle as the motor of the system and accepting that a greater proportion of the crop products is used directly as human food instead of as animal feed, and some of the area is used for energy production. The primary products from this farming system also have to be balanced with the typical requirements of a human diet.

¹ Department of Agroecology and Environment, Faculty of Agricultural Sciences, Aarhus University, P.O. Box 50, DK-8830 Tjele, Denmark, E-Mail Lisbeth.Mogensen@agrsci.dk, Internet www.agrsci.dk

Materials and methods

First we investigated how a local, organically grown diet could be produced. A basic scenario was set up for a system that could produce all necessary foodstuffs for a smaller town with 770 inhabitants, and where by-products and waste was reused. In the basic scenario the composition of the diet represents the present typical Danish food intake (Fagt, 2008). However, all food was assumed to be organically grown and as much as possible locally grown. However, some non-agricultural food items such as fish and beverages might need to be "imported". An important issue was to quantify the losses in the chain from primary product to food intake, as the environmental impact depends on the amount produced at the farm, whereas the nutritional impact depends on the amount eaten by the consumer. The system has a comprehensive production of milk, meat, bread grain, vegetables from outdoor production areas and greenhouse tomatoes and other heat-demanding products (North European). The size of the livestock production was determined by the need for animal products in the human diet and the size of the crop production adjusted to the need for animal feed and crops used directly as food. By-products were recalculated as animal feed. Two different scenarios were set up for producing a healthier, more sustainable and climate friendly local diet for 770 inhabitants. In scenario 1, the production was unchanged but a biogas plant was introduced. Input for biogas production were manure, 50% of kitchen refuse, and 50% of slaughterhouse wasteg. The biogas plant produces electricity and heat, avoiding the input from other sources (calculated as saved CO₂-emission). In scenario 2, the animal production was reduced corresponding to a reduction in the intake of beef meat by a third and the intake of vegetables was increased to maintain the energy intake. The sustainability of the farming system was evaluated by greenhouse gas emissions. Emission of GHG was calculated according to IPCC (2006).

Results

Table 1 shows for the basic scenario the food intake per person per day and the required amount of food leaving the food factory assuming 30% loss in the chain after processing. Input of primary product for processing is given in addition to the necessary primary production in the local system, both per person per day and total per year. The food intake in table 1 corresponds to 80% of the energy intake. The remaining 20% consists of fish (21 g/d), sweets (34 g/d), juice (73 g/d) and beverages (2185 g/d).

The livestock production consisted of 51 dairy cows, mainly fed grass-clover and producing 5500 kg milk per cow per year; bull calves were raised for beef production. Twenty-two sows were housed outdoors, slaughter pigs were raised indoors. Fivehundred hens and 5000 chicken fouraged in the orchard. The crop rotation included 2-3 years with grass clover (73 ha) followed by cereals (64 ha), rapeseed (13 ha), potatoes (4 ha) and vegetables (2 ha). By-products from production of breadwheat, milk and rapeseed was used as feed for livestock.

In scenario 2, meat production was decreased by reducing the number of cows but increasing milk yield from 5500 to 8200 kg/cow/year to maintain milk production and thereby reducing the number of bull calves raised. At the same time the area with vegetables was increased by 1.5 ha. However, due to the reduced livestock production a surplus area of 12.5 ha could be used to produce energy crops as input to the biogas plant.

Tab. 1: Food intake and necessary primary production in basic scenario, (g/person/day) and total production per year for the town (tonnes)

| Foodstuff | Intake | Food ex processing | Input for processing | Primary production | Production per year, t |
|------------------------|-------------|--------------------|----------------------|--------------------|------------------------|
| Milk and milk products | 323 | 461 | 471 | 500 | 280 |
| Cheese | 33 | 47 | 471 | 500 | |
| Cereal and flour | 72 | 103 | 129 | 134 | 89 |
| Bread | 141 | 201 | 176 | 184 | |
| Vegetable (excl pot.) | 157 | 224 | 269 | 280 | 79 |
| Fruit | 204 | 291 | 350 | 364 | 102 |
| Beef meat | 40 | 57 | 62 | 110 ¹⁾ | 31 |
| Pork | 68 | 97 | 106 | 154 ¹⁾ | 43 |
| Poultry | 23 | 33 | 36 | 53 ¹⁾ | 15 |
| Eggs | 17 | 24 | 24 | 26 | 7 |
| Fat | 25 | 36 | 86 | 89 | 25 |
| Potatoes | 102 | 146 | 153 | 195 | 55 |
| Total | 1205 | 1721 | 2332 | 2590 | |

1) Live weight of animal products

Table 2 shows total GHG emission from the local farming system for the basic scenario. The GHG emission related to food processing was not included in the calculation. Total GHG emission in basic scenario was 909.000 kg CO₂-eq/year or 3247 g CO₂-eq./person/day. Of this, 35% comes from methane (CH₄), 42% from nitrous oxide (N₂O) and 23% from CO₂.

Tab. 2: Emission of GHG ex the local farming system, kg CO₂-eq. /year

| | Total kg | | CO ₂ -eq. (1000 kg) | % of CO ₂ -eq. |
|--|--------------------|-------------|-----------------------------------|------------------------------|
| Digestion: Cattle / Pig | CH ₄ | 9031 / 230 | 226 / 6 | 25 / <1 |
| Manure: Cattle / Pig | | 1765 / 1744 | 44 / 44 | 5 / 5 |
| Manure/crops | N ₂ O-N | 261 / 359 | 122 / 168 | 13 / 18 |
| Indirect: Leaching/ NH ₃ | | 110 / 91 | 51 / 43 | 6 / 5 |
| Field / stable | CO ₂ | 100 / 50 | 100 / 50 | 11 / 6 |
| Green house | | 29 | 29 | 3 |
| Total | | | 909 | 100 |

The total GHG emission from the farming system from the three scenarios can be seen in Table 3.

Tab. 3: Emission of GHG, g CO₂-eq./person/day

| Scenario | Basic | 1 Biogas | 2 Biogas, reduced beef |
|------------------------|-------------|-------------|---------------------------|
| CH₄ | 1143 | 1143 | 939 |
| N ₂ O | 1372 | 1372 | 1118 |
| CO ₂ | 732 | 732 | 670 |
| Total from farm | 3247 | 3247 | 2727 |
| Biogas | | -982 | -1488 |
| Total | 3247 | 2265 | 1239 |

Discussion

Some of the assumptions used in the present investigation can be discussed or are subject to some uncertainty. For example it was not taken into account that especially for the improved farming system with low livestock density and thereby low nutrient flow, there could be a lack of some essential nutrients as yield was assumed to be regulated only by N supply. The assumption regarding saved CO₂-emission due to fossil energy being replaced by electricity and heat generated by the biogas plant presume that this production can be utilized etc.

Conclusions

A joint North European local organic farming system including 180 ha and a mixed production of milk, meat, cereals and vegetables could produce 80% of the required food energy in a diet that represents the present typical Danish food intake for 770 inhabitants in a smaller town. The resulting GHG emission was 3247 g CO₂/person/day. If the animal production was reduced corresponding to a decrease in the beef intake by a third and a corresponding increase in the intake of vegetables to maintain the energy intake, with crops from the surplus area used in a biogas plant, the GHG emission could be more than halved, the diet composition became healthier, and the system became self-sufficient in fossil energy.

References

- Fagt, S., Biltoft-Jensen, A., Matthiessen, J., Groth, M.V., Christensen, T., Trolle, E. 2008. Danskernes kostvaner 1995-2006. Status og udvikling med focus på frugt og grønt samt sukker. DTU Fødevarerinstitutionet.
<http://www.food.dtu.dk> (Accessed 2010-8-18).
- IPCC. (2006): Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories programme, Eggleston, H.S., Buendia, L., Miwa, K., Ngara, T., Tanabe, K. (eds.): Published. IGES, Japan.
<http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm> (Accessed 2010-10-29).

Ecopreneurship in Aquaculture

– The adoption of organic fishfarming methods

Lasner, T.¹ & Hamm, U.²

Key words: Organic aquaculture, ecopreneurship, adoption of innovations

Abstract

The gap between limited wild fish resources and the increasing demand for seafood grows from year to year. Modernising the aquacultural sector seems to be the only possibility to close the gap between decreasing wild catch and increasing demand for seafood. An intensification of aquacultural production methods are often connected with environmental problems; one solution can be seen in the adoption of organic production techniques. However, so far fishfarmers' willingness to convert their farms to organic is low. By using a sociological approach with in-depth interviews and qualitative content analysis, the aim of the presentation is the analysis of underlying reasons why only a few fishfarmers have converted their farms to organic aquaculture. The main hindering factors for a conversion of fishfarms were fears of conventional fishfarmers that they would be excluded from their local fishery community and strong prejudices against organic production methods. Interestingly, there were no fears that organic fish would not find a market or would not receive a sufficient price premium.

Introduction

Overfishing the oceans endangers the natural regeneration capacity of marine resources worldwide. Simultaneously, the demand for seafood grows from year to year. Especially in Europe, the gap between seafood production and the increasing demand of consumers is huge. The sociologist Ogburn called such a gap between different developments a 'cultural lag' (Ogburn 1964). The European Commission tries to overcome the cultural lag by a reform of the Common Fisheries Policy. The main objective of the reform is an intensification and growth of the European aquacultural production (EU-Commission 2009). However, an increase of the aquacultural production is often accompanied by environmental problems based on current production methods: sedimentation, change in bio-geochemistry, pathogen transmission, inter-breeding with wild organisms, introduction of alien species, and indirect ecosystem pressures such as high energy costs are critical points of current aquacultural production methods (Bergleiter *et al.* 2009, Huntington *et al.* 2006).

One possibility to overcome the cultural lag and to reduce the pollution output of aquacultures at the same time can be seen in an ecological modernisation. The central protagonist in an ecological modernisation is the ecological orientated entrepreneur (ecopreneur). The ecopreneur reduces the pollution output of his venture and generates simultaneously profit. A fishfarmer using organic production methods is an ecopreneur par excellence. The production of organic fish means to use methods, which focus on animal welfare as well as their environmental compatibility.

¹ University of Kassel, Department of Agricultural and Food Marketing, Steinstrasse 19, 37213 Witzenhausen, Germany, E-Mail t.lasner@uni-kassel.de, Internet www.uni-kassel.de/agrar/alm

² As above

Although Germany is worldwide a major importer of organic aquacultural products, only 18 German fishfarmers converted their farms to organic by 2009 to participate in the small but growing market (Lasner *et al.* 2010). The aim of this presentation is to reconstruct the individual process of adoption or rejection of organic production methods to analyse the underlying reasons why only a few fishfarmers have converted their farms to organic aquaculture.

Materials and methods

In a first step information on the international and on the national market structure for organic seafood were collected to acquire an overview on the current situation of organic fishfarming (Lasner *et al.* 2010, Bergleiter *et al.* 2009). There were only a few quantitative studies on this topics. However, quantitative research methods are rarely able to disclose the complexity of adoption processes. To understand the motivations for the adoption of innovations, individual perception-acting systems have to be disclosed (Rogers 2003). An in-depth analysis of the decision-making-process of ecopreneurs allows a detailed view of how bottom-up ecological modernisation starts. Therefore, an interview-concept consisting of a classical expert interview with a large narrative part was designed. In opposition to common interviews, qualitative research methods are systematic and embedded in a thematic framework. The used thematic framework was orientated to the theories of ecopreneurship (Schaper 2005) and innovation adoption (Rogers 2003). The interview concept included narrative stimuli and questions about the individual adoption process, i.e. communication channels used by the fishfarmers, reactions inside the social network (family, village community and colleagues) to the decision to convert, barriers within the decision-making-process, access to tangible resources, funding, perception of the market opportunities, perception of the advantages and disadvantages of organic production methods. Eight in-depth interviews with ecopreneurs of organic aquaculture (adopters) in Germany were conducted. In addition, ten conventional fishfarmers who rejected an ecological modernisation of their aquaculture were interviewed. After the transcription of the recorded face-to-face interviews, the individual decision-making-process of every interviewed fishfarmer was carried out by using content analysis method (Flick 2002). Following that procedure the different perspectives of adopters and rejectors were elaborated and compared with each other. By sampling detailed decision-making information of adopters and rejectors of an ecological modernisation, the presentation gives an integrated view of the development of organic aquaculture on a microscopic level. Finally typologies of the interviewed fishfarmers were developed to abstract a characterisation of adopters and rejectors and to identify supportive and impedimental influences within the decision-making-process.

Results

The first results of the content analysis indicate the typical development of the adoption and rejection of organic production methods. For the interviewed fishfarmers the process is activated by an external economical confrontation. The increased population of the fish predator cormorant reduced the fishfarmer's production volume in the 1990s. At the same time, the increasing international competition, changing customer demand and stricter requirements from the environmental agencies challenged the former production methods of the adopters. Especially, the economical situation for the carp producing fishfarmers were tightened by the EU East Enlargement in 2004. From the interviewed carp farmers' perspective, countries like Poland, Hungary, and the Czech Republic occurred as new competitors in

conventional carp production. Furthermore, younger consumers have a negative image of the carp, which led to marketing problems for conventional carps. From the interviewed trout farmers' point of view trout producing fishfarmers are challenged by increasing imports from countries such as Denmark in which conventional trout production was 'industrialised' in the 1990s.

The awareness of these challenges is a similarity between adopters and rejectors of organic production methods. However, the strategies to overcome these conflicts differ. For the ecopreneurs these challenges activate the search for a possibility to strengthen their competitiveness by the adoption of organic production methods. Results of the present content analysis point to three types of ecopreneurs with different motives to convert to organic production: the intellectual idealist, the traditional conserver and the economic pragmatist. The intellectual idealist has no background in fisheries. In his former career, he had nothing to do with initial production, but was always very sensitive for environmental issues. His decision to show that practical environmental protection and earning money at the same time must not be incompatible based on biographical crucial experiences. By learning by doing, he has no contact to advisors, only the strong belief in doing the right thing. The traditional conserver feels the pressure of the changing market situation on his traditional way of fish production. He wants to keep the tradition alive and is normally a laggard in the adoption of technical innovations. Consequently, he does not feel comfortable with the economic need to intensify his fish production by technical modernisation, especially when thinking about animal welfare. For him organic aquaculture is a possibility to keep his small business alive by standing close to the traditional fishfarmers' profession. For the economical pragmatist organic aquaculture is a direct reaction to the changing customer demand. Thereby the idea of organic aquaculture is not important for him, he just produces what the market needs. The economical pragmatist is the only type who safeguards his channels of distribution before he decides to convert. In common, all ecopreneur types got in touch with the idea of organic production methods for the first time by visiting an organic agricultural farm. Impressed by this experience the ecopreneurs wanted to transfer the idea of organic agriculture into aquaculture. Thereby, the persuasion that organic production methods are an alternative to current conventional methods were supported by the fishfarmers' family, who was open for 'green' ideas in general. Beside enquiring their families the ecopreneurs were on their own. To consider about the conversion to organic production let them become outsiders or intensified their already existing image of a green madcap in their local fishery community. Interestingly, the ecopreneurs contacted an organic farmer organisation not before the end of the decision-making-process to convert to organic so that the organic farmer organisations played an insignificant role for the decision process. One reason for that was that there were no or only a few persons in the farmers' organisations having knowledge on fishfarming methods and that there were no doubts about marketing opportunities.

In contrast there are two types of rejectors: the fatalistic postponer and the technical entrepreneur. The fatalistic postponer as a typical rejector of organic fishfarming has strong prejudices: For him organic aquaculture is just a fiction of green idealists to discredit conventional fish. He fears that consumers perceive organic fish to have a better quality than conventional fish. The fatalistic postponer adheres rigidly to traditional production methods. His persistence strategy is accompanied by a diffuse feeling of fatalism that there is no future for the domestic aquaculture. In opposition, the technical entrepreneur is similar to the economical pragmatist. He recognises the cultural lag in the national aquacultural sector as well. But he perceives the demand

for organic fish as too low for a business opportunity for a large number of fishfarmers. To intensify his production by adopting technical innovations seems to be a better form of modernisation for him. In common, both rejectors types rarely have contact to ecopreneurs, although organic fishfarms might be in the near of their farms.

Conclusions

The interviewed ecopreneurs are pioneers of organic aquacultural methods. Economic uncertainty and strong prejudices to organic methods hinder conventional fishfarmers to follow the example of the ecopreneurs. It is remarkable that unlike the agricultural sector there were no doubts that organic fish can be marketed for premium prices. Interestingly, the consulting services of organic farmer organisations rarely influenced the decision-making-process of the ecopreneurs. Organic farmer organisations should therefore advance their engagement in the aquacultural sector to enlarge their role in the adoption process of organic production methods. Using the start-up experience gained by the ecopreneurs is important to convince conventional fishfarmers of the advantages of organic aquaculture and to reduce uncertainty. As for the pioneers of organic aquaculture, the contact to an organic farm close-by can be seen as an important factor for the ecopreneur's decision-making. Presentations of the principles of organic aquaculture by simultaneously using an established network of archetypical organic fishfarms would support the contact between ecopreneurs, conventional fishfarmers and organic farmer organisations. Furthermore, a communication strategy should aim at the integration of the ecopreneurs into the fishery community as role models for an ecological modernisation.

Acknowledgments

Our gratitude and appreciation are conveyed to the Heinrich Böll Foundation for the support of the study.

References

- Bergleiter S., Berner N., Censkowsky U. and Julià-Camprodon, G. (2009): Organic Aquaculture 2009 – Production and Markets. Naturland e.V. und Organic Services, Munich.
- EU-Commission (2009): Green Paper – Reform of the Common Fisheries Policy, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0163:FIN:EN:PDF>.
- Flick U. (2002): An Introduction to Qualitative Research. Sage, London et al.
- Huntington T.C., Roberts H., Cousins N., Pitta V., Marchesi N., Sanmamed A, Hunter-Rowe T., Fernandes T.F., Tett P., McCue J. and Brockie N. (2006): Some Aspects of the Environmental Impact of Aquaculture in Sensitive Areas. Report to the DG Fish and Maritime Affairs of the European Commission, http://ec.europa.eu/fisheries/documentation/studies/aquaculture_environment_2006_en.pdf
- Lasner T., Hamm U., Aas M. und Oberle M. (2010): Marktanalyse für ökologische Aquakulturerzeugnisse. Abschlussbericht BLE, <http://orgprints.org/17160/>
- Ogburn W. F. (1964): On Culture and Social Change. Selected Papers. Chicago Press, Chicago.
- Rogers E. M. (2003): Diffusion of Innovations. 5th ed. Free Press, New York.
- Schaper M. (2005): Making Ecopreneurs: Developing Sustainable Entrepreneurship. Ashgate Publishing, Aldershot.

The drivers of the conversion in organic farming (OF): a review of the economic literature.

Geniaux, G.¹, Latruffe, L.², Lepoutre, J.³, , Nauges, C.⁴, Napoléone C.⁵, Sainte
Beuve, J.⁶, & Sautereau, N.⁷

Key words: conversion to organic farming, drivers of conversion, discrete choice model.

Abstract

We reviewed the studies, mainly in economy, to identify the drivers of the farms' conversion in organic farming (OF). The scientific documents were selected by requesting the international bibliographic databases (Web Of Knowledge, Organic Eprint) to identify articles, and by crossing main articles quoted in the recent economic literature in the field of the drivers of conversions. We have organised the review in two groups, one focused on motivations for conversion and values associated with the choices of OF, and the other on the observable drivers. This category of drivers was split in internal factors (linked to the farmer and the farm) and external factors (such as public policies, localization, etc).

Introduction

The conversion of farms into organic farming (OF) is an important phase for the perennity of the structures and more globally for the development of the organic sector. Relevant knowledge of its drivers is at stake for research and for public action. We have mainly focused our analysis on economic works aiming at identifying the drivers of conversions. In this perspective we analyzed a hundred of documents (scientific articles and reports) which allow us to (i) describe motivations and drivers explaining conversion to OF and (ii) identify the future tracks to be explored in economic research on OF. The scientific documents were selected by requesting the international bibliographic databases (Web Of Knowledge, Organic Eprint) to identify articles in the field of the drivers of conversions, and by crossing main articles quoted in the recent economic literature on OF. Most of the micro-economic modellings make the hypothesis that the choice of conversion is based on the maximization of an expected utility under constraints of price, income or rules. However, numerous studies showed the importance of non-economic motivations in the decision to convert to OF (Koesling et al. 2008), and particularly for the pioneers of OF (Padel, 2001).

¹ INRA SAD, Ecodéveloppement, Site Agroparc, 84914, Avignon, France, E-Mail ghislain.geniaux@avignon.inra.fr

² INRA, UMR 1302 SMART, 35000 Rennes, France, E-Mail Laure.Latruffe@rennes.inra.fr

³ INRA SAD, Ecodéveloppement, Site Agroparc, 84914, Avignon, France

⁴ INRA, UMR 1081 LERNA, 31000 Toulouse, France, E-Mail, celine.nauges@toulouse.inra.fr

⁵ INRA SAD, Ecodéveloppement, Site Agroparc, 84914, Avignon, France, E-Mail cnapoleone@avignon.inra.fr

⁶ INRA, UMR 1302 SMART, 35000 Rennes, France,

⁷ INRA SAD, Ecodéveloppement, Site Agroparc, 84914, Avignon, France, E-Mail natacha.sautereau@avignon.inra.fr

Actually, the discrete choice models have little explanatory power for this type of decision. Furthermore, as objective factors can have a different effect according to the motivations of the farmers, we observe very heterogeneous results on variables such as farm size for example. To correctly analyze the drivers of conversion, it is important to distinguish the motivations of the conversion and the internal or external characteristics of the farms.

1/ Motivations for conversion and values associated with the choices of OF.

It is commonly acknowledged that non-economic factors such as political and ideological perspectives, and sensitivity to environmental problems may induce a farmer to convert to OF. Läpple (2010) finds that Irish drystock farmers who expressed a higher level of environmental concern were more likely to adopt organic technology (OT) in 2008. Similarly, Genius *et al.* (2006) show that Cretan farmers who expressed great concern about environmental problems were more likely to convert to OF. The same finding is reported by Burton *et al.* (2003) for horticultural farmers surveyed in 1996 in the United Kingdom.

We have separated the motivations in five main groups: ***the agronomic challenges*** (Wernick & Lockeretz 1977, Fairweather 1999, Midmore *et al.* 2001, Niemeyer & Lombard 2003, Padel 2008), ***the sanitary motivations*** (Salamon 1997, Padel 2001) ***the ethical questions*** (Conacher & Conacher, 1982, Darnhofer *et al.* 2005, Clarke *et al.* 2008), ***the environmental considerations*** (Burton *et al.* 1999 ; Latruffe & Nauges 2010) and the ***economic motivations*** (Hall & Mogorodoy 2001, Flaten *et al.* 2006, Padel, 2008, Darnhofer *et al.* 2009, Cranfield *et al.* 2010).

These studies give a more precise image of the complexity of the decision of conversion according to the importance of the various motivations. It presents however several drawbacks coming from the nature of the methods of data collection. Samples are generally very small, often below 100 observations. It leads to collect information only on farms that have already adopted OF or on farms in conversion and to study the factors of conversion from descriptive univariated statistics. The interactions between the objective characteristics of the farms and the motivations in the process of decision cannot be then studied with adequate statistical treatments. These interactions are likely not to be relevant outside the territory, the sector and the concerned period. However, some studies using larger samples exist, for example Koesling *et al.* 2008 or Latruffe and Nauges, 2010. Other works use an objective observable variable as proxy for motivations: for ex., Latruffe and Nauges, 2010 used the amount of agri-environmental subsidies received by the farmer as a proxy for his environmental concern.

2/ Observable drivers

2.1. Farm and farmer's characteristics (internal factors)

We expect the size of the farm -at the time it was operated under conventional practices- to influence the decision to convert to OF. Evidence from the literature shows that the sign of the effect depends on the study area: Pietola and Oude Lansink (2001), for a sample of Finnish farms, and Gardebroek (2003) for Dutch dairy farms, find that farmers with large land areas are more likely to switch to OF. By contrast, Läpple (2010) for a sample of drystock farms in Ireland and Latruffe and Nauges (2010) for a sample of French farms, find that farmers operating on smaller farms are more likely to adopt OF.

Better educated farmers are usually found more likely to convert, as shown among others by Genius *et al.* (2006) for a sample of Cretan farmers and Gardebroek (2003) for a sample of Dutch dairy farms.

To our knowledge, Kumbhakar *et al.* (2009) and Latruffe and Nauges (2010) are the only studies which consider technical inefficiency as a potential factor driving adoption of OF. Latruffe and Nauges (2010) find that the probability of conversion does depend on technical efficiency preceding the conversion, but that the direction of the effect depends on farm size.

OF is generally perceived to be riskier than conventional farming, as organic farmers are restricted in the use of chemical pesticides and fertilizers that could help them in reducing production risk (Gardebroek *et al.* 2010), so we would expect more risk averse farmers to be less likely to adopt the OT. Using data from a sample of Spanish farms specialized in the production of arable crops, Serra *et al.* (2008) find evidence that both conventional and organic farmers are risk averse. Both groups are found to exhibit decreasing absolute risk aversion but organic farmers have preferences that are very close to constant absolute and relative risk aversion. Gardebroek (2006), using a Bayesian random coefficient model, finds that organic arable farmers were less risk averse than the conventional ones in the Netherlands from 1990 to 1999.

2.2 External factors

Even if the theory indicates that the higher the subsidies to OF, the greater the probability of adoption should be, there is little empirical evidence on the magnitude of the effect. Pietola & Oude Lansink (2001) find that the probability of switching to OF increases at an increasing rate with increasing premium subsidies to the OF for Finnish farms during 1994-1997. Tzouvelekas *et al.* (2001), in a study of the olive-growing sector in Greece make a similar analysis. Kumbhakar *et al.* (2009), for a sample of Finnish dairy farms also find evidence that higher subsidies increase the probability of OF adoption. Finally, it is recognized that information provided about new technologies (by other farmers, media, meetings, farmers' unions, extension officers, etc) usually positively correlates with adoption of these technologies (Knowler & Bradshaw 2007).

Conclusion

It emerges that factors susceptible to explain the conversion to OF are numerous and that they play on the decisions of conversion through an important range of motivations, widely exceeding the only economic drivers. The decisions of conversion are connected to variables such as attitudes and opinions, not always observable. The use of such variables as explanatory factors in econometric models may raise methodological problems (endogeneity for ex.). Furthermore, the contexts in which the farmers evolve condition the way the motivations and the various observable factors play on the decisions, which limits the transferability of the results between countries, regions and periods.

As a result 1) factors driving conversion are often specific of the region/territory under consideration and of the production 2) few observable variables have unambiguous impact whatever the type of farming or region (age, educational level).

Actually, it seems important to develop works and to enhance collaborations on : (i) comparative studies based on counterfactual method, (ii) econometric works on the effect of the conversion on agricultural employment and on farms profitability, as well as on the role of technical efficiency in the decision of conversion. We need to take into account the spatial distribution of the farmers (effects of neighborhood, localization of markets, etc.). Therefore it is a necessity for research teams to get important and homogeneous databases both for conventional and organic farms. It is all the more important to create networks of teams on these fields, that the integration of specific information on OF farmers in the agricultural inventories is an extending practice (Italy 2000, France 2010).

References

- Burton M., Rigby D., Young T. (2003): Modelling the adoption of organic horticultural technology in the UK using Duration Analysis. *Australian Journal of Agricultural and Resource Economics* 47(1), p. 29-54.
- Clarke, N., Cloke, P., Barnett, C., and Malpass, A. (2008). The spaces and ethics of organic food. *Journal of Rural Studies*, 24(3):219–230.
- Conacher, A. and Conacher, J. (1982). *Organic farming in Australia*. Dept. of Geography, University of Western Australia.
- Cranfield, J., Henson, S., and Holliday, J. (2010). The motives, benefits, and problems of conversion to organic production. *Agriculture and Human Values*, 27(3) :291-306
- Darnhofer, I., Schneeberger, W., and Freyer, B. (2005). Converting or not converting to organic farming in Austria: Farmer types and their rationale. *Agriculture and Human values*, 22(1):39–52.
- Fairweather, J. R. (1999). Understanding how farmers choose between organic and conventional production: Results from New Zealand and policy implications. *Agriculture and Human Values*, 16: 51-63
- Gardeboek C. (2006): Comparing risk attitudes of organic and non-organic farmers with a Bayesian random coefficient model. *European Review of Agricultural Economics* 33(4), p. 485-510.
- Genius M., Pantzios, C., Tzouvelakas, V. (2006): Information acquisition and adoption of organic farming practices. *Journal of Agricultural and Resource Economics* 31(1), p. 93-113.
- Hall, A. and Mogyorody, V. (2001). Organic farmers in Ontario: An examination of the conventionalization argument. *Sociologia Ruralis*, 41(4):399–322.
- Koesling, M., Flaten, O., and Lien, G. (2008). Factors influencing the conversion to organic farming in Norway. *International Journal of Agricultural Resources, Governance and Ecology*, 7(1):78–95.
- Kumbhakar S.C., Tsionas E.G, Sipiläinen T. (2009): Joint estimation of technology choice and technical efficiency: an application to organic and conventional dairy farming. *Journal of Productivity Analysis* 31, p.151–161.
- Läpple D. (2010): Adoption and abandonment of organic farming: An empirical investigation of the Irish drystock sector. *Journal of Agricultural Economics* 61(3), p. 697-714.
- Latruffe L., Nauges C., (2010): Technical efficiency and conversion to organic farming: the case of France. Mimeo Toulouse School of Economics, LERNA.
- Midmore, P., Padel, S., McCalman, H., Isherwood, J., Fowler, S., and Lamkin, N. (2001). Attitudes towards conversion to organic production systems: a study of farmers in england. Unpublished final report to MAFF, Institute of Rural Studies, University of Wales, Aberystwyth.
- Padel S. (2008): Values of organic producers converting at different times: results of a focus group study in five european countries. *International Journal of Agricultural Resources, Governance and Ecology*, 7(1), p. 63–77.
- Padel, S. (2001). Conversion to organic farming: A typical example of the diffusion of an innovation? *Sociologia Ruralis*, 41(1):40–61.
- Pietola K., Oude Lansink A. (2001): Farmer response to policies promoting organic farming technologies in Finland. *European Review of Agricultural Economics* 28(1), p. 1–15.
- Tzouvelekas V., Pantzios C.J., Fotopoulos C. (2001) : Technical efficiency of alternative farming systems: The case of Greek organic and conventional olive-growing farms. *Food Policy* 26, p. 549-569.
- Wernick, S. and W. Lockeretz (1977) Motivations and practices of organic farmers. *Compost Science* 77 (6), 20-24.

The full reference list is available from the authors.

Technical and allocative efficiency of organic marketing choices: Influence of gender and participatory research

Lohr, L.¹

Key words: efficiency, farm performance, stochastic frontier

Abstract

We develop measures of technical and allocative efficiency of producers in marketing certified organic products. A stochastic output distance frontier and the associated revenue share equations are estimated using U.S. data on organic producers. Participation in on-farm research significantly improves technical, but not allocative, efficiency. Gender has significant effects on allocative, but not technical, efficiency.

Introduction

Organic farmers develop marketing strategies to maximize total farm income by selling products through both conventional and organic channels. Surveys of U.S. organic farmers conducted by the Organic Farming Research Foundation (OFRF) indicate that conventional markets account for the major share of farm income. By 2001, 61% of revenue was from organic products sold through conventional channels (Walz 2004).

Our objective is to measure organic farmers' technical and allocative efficiency of marketing organic products. Technical efficiency measures how effectively a farmer uses inputs to produce outputs. Allocative efficiency measures the ability of a farmer to produce revenue from the inputs used. Experimentation with new practices is common among organic farmers to adapt technologies to the local agroecology. Participation in collaborative research permits the transfer of technical information from scientist to farmer, with potential efficiency-enhancing outcomes.

Materials and methods

Using duality theory, a multiple input and output distance function is used to derive measures of allocative efficiency in marketing decisions. The procedure relies on the stochastic frontier approach to estimate the output distance function and associated revenue share equations.

The producer uses a set of inputs $x \in \mathcal{X}$ to produce a vector of output $y \in \mathcal{Y}$. The reference technology is represented by an output correspondence mapping $P: \mathcal{X} \Rightarrow P(x) \subseteq \mathcal{Y}$, where the output set $P(x)$ represents the set of all feasible vector of outputs given a vector of inputs x . The output distance function is

$$(1) D_o(y, x) = \min[\theta : (y/\theta) \in P(x)]$$

where $D_o(y, x) \leq 1$ and $0 < \theta \leq 1$. If observed output is on the boundary of the production set and is efficient, the distance function is equal to 1. Farmers whose output choices are not efficient are located below the frontier and the distance function

¹ Lohr Consulting, 2017 N Woodrow St, Arlington, VA, 22207, USA, LohrConsulting@gmail.com

is less than 1. The difference between θ and 1 is how far the organic operation falls short of “best practice” production.

To estimate technical and allocative efficiency we formulate a dual output distance function and system of revenue shares for the p th producer as:

$$\ln 1 = \ln D_o(y_p, x_p) + v_p - u_p$$

$$(2) \quad \frac{R_{op}}{R_p} = \frac{\partial \ln D_o}{\partial \ln y_{op}} + v_{op} + A_{op}$$

$$\frac{R_{cp}}{R_p} = \frac{\partial \ln D_o}{\partial \ln y_{cp}} + v_{cp} + A_{cp}$$

where $D_o(y_p, x_p)$ is the short-run output distance function. Actual revenue is $R_p = R_{op} + R_{cp}$ which depends on revenue from conventional markets R_{op} and revenue from organic markets R_{cp} . In stochastic frontier analysis the firm is constrained to produce at or below the deterministic production frontier, a condition recognized by inclusion of a composite error term consisting of two random variables.

The first element in the composite error, v_p , is a symmetric noise term reflecting random factors driving the output distance function. The second element is the impact of inefficiency in firm operations and environmental conditions that reduce output.

Technical efficiency is estimated as $TE_i = \exp(-\hat{u}_p)$, which is between 0 and 1, with 1 indicating 100% technical efficiency. Allocative inefficiency for the i th output is

$$(3) A_{ip} = \alpha_{ipa} + \alpha_{ipb}Z_b + \alpha_{ipc}Z_c$$

where Z is a vector of nonstochastic variables we specified and the parameters to be estimated are represented by α_{ipa} , α_{ipb} , and α_{ipc} .

Empirical application of the output distance function requires a flexible functional form. Morrison Paul, Johnston, and Frengley (2000) proposed a translog distance function for the p th producer. We use maximum likelihood estimation for the system of equations represented by the translog output distance function and the revenue share equation. We use data from the third and fourth OFRF biennial organic producer surveys for the analysis (Walz 1999; Walz 2002).

In the sample of 662 farms, mean farm organic income is \$53,149, about 41% of average total farm income. Average farm size is 136 acres, with 4.5 managers and full-time employees and 4.4 part-time employees, and 25% of farms hiring no labor. About 81% of the sample is male. Participation in on-farm research is bimodal, as 77% of farmers contributed no resources. The second largest share of farmers (13%) maximizes commitment to collaborative research by providing all seven resources possible (land, financial support, labor, materials, research advice, and publishing and distribution of results). Farmers with over 100 acres commit an average of 1.53 resources compared with 1.17 resources from producers with less than 20 acres.

Results

Table 1 shows the mean technical efficiency of the sample of organic farmers, overall and by involvement in on-farm research. The estimated mean efficiency is 0.73 across the complete set of 662 organic producers, which means that the farms are attaining 72.5% of the hypothetically best practice output that could be achieved. The efficiency

estimates are significantly higher for farms that engage in research collaborations, 84.7% technically efficient compared with 69.9% efficient.

Tab. 1: Technical Efficiency of Organic Producers, Overall and by Research Participation

| Variable | Obs | Mean | Standard Deviation | Minimum | Maximum |
|----------------------------------|------------|--------------|--------------------|--------------|--------------|
| Technical Efficiency | 662 | 0.725 | 0.094 | 0.632 | 1.000 |
| By Research Participation | | | | | |
| No Involvement | 502 | 0.699 | 0.038 | 0.630 | 0.913 |
| Positive Involvement | 160 | 0.847 | 0.073 | 0.643 | 1.000 |

*** Within category comparison is statistically different at the 0.10 level.**

Table 2 shows the allocative inefficiency, or difference between hypothetical and actual revenue shares, due to marketing constraints on organic farmers, with the mean inefficiency at 14.8%. Female farmers were distinguished from male farmers by a significantly higher level of inefficiency in obtaining revenue from input use, consistent with more marketing constraints being reported by female farmers.

Tab. 2: Allocative Inefficiency of Organic Producers, Overall and by Gender

| Variable | Obs | Mean | Standard Deviation |
|------------------------------|------------|--------------|--------------------|
| Allocative Efficiency | 662 | 0.148 | 0.002 |
| By Gender | | | |
| Male Farmers | 536 | 0.147 | 0.00004 |
| Female Farmers | 126 | 0.151 | 0.00004 |

*** Within category comparison is statistically different at the 0.10 level.**

Discussion

This result could be related to the intensely local nature of field agroecology and microclimates. The on-farm research itself contributes to a farmer's ability to respond to these conditions with changing input mixes. Collaboration with researchers encourages the exchange of ideas to address production and marketing constraints.

The revenue mix of organic producers is systematically inefficient as both male and female producers rely too heavily on revenue from organic markets relative to conventional outlets. However, female farmers are significantly more likely to suffer revenue loss from inefficiencies in finding and obtaining access to organic markets, and in difficulty establishing marketing networks.

Conclusions

These results support the National Institute of Food and Agriculture's emphasis on directing funding to collaborative efforts among researchers, agricultural educators, and producers. Programs encouraging farmer-participatory research are extremely important in promoting improvements in technical. Awareness of specific gender

barriers in marketing choices should lead to enhanced training and support for female organic farmers trying to enter or expand their markets.

Within the organic sector, technical efficiency measures confirm that there are high performers and low performers. The 90th percentile exhibits efficiency above 0.91, and the 10th percentile averages 0.65. High performers are more experienced organic farmers than the low performers (averaging 13 years versus 8 years) and exhibit much higher involvement in on-farm research projects. The implication is that farmers require experience to develop technical skill in organic farming methods but also need active engagement with the research and extension community to reach the highest levels of technical efficiency. Working with applied researchers can improve farmers' skills in innovating efficiency-enhancing adaptations for their operations beyond the particular research project.

Acknowledgments

The author thanks the Organic Farming Research Foundation for the data.

References

- Lohr, L., & Park, T.A. (2002): Choice of insect management portfolios by organic farmers: lessons and comparative analysis. *Ecol. Econ.* 43:87–99.
- Morrison Paul, C.J., Johnston, W.E. & Frengley, G.A.G. (2000): Efficiency in New Zealand sheep and beef farming: the impacts of regulatory reform. *Rev. Econ. Stat.* 82:325–37.
- Walz, E. (1999): Final Results of the Third Biennial National Organic Farmers' Survey. Organic Farming Research Foundation, http://ofrr.org/publications/pubs/3rdsurvey_results.pdf, (accessed 2010-05-25).
- Walz, E. (2004): Final Results of the Fourth National Organic Farmers' Survey. Organic Farming Research Foundation, http://ofrr.org/publications/pubs/4thsurvey_results.pdf, (accessed 2010-05-25).

Important attributes to pre-purchasing evaluation relating to organic food in urban China

Chen, J.1

Key words: Urban Chinese consumers, organic foods, dimensions, pre-purchase evaluation

Abstract

This paper aims to investigate the attributes important to consumers in the People's Republic of China during their pre-purchase evaluation of organic foods. The data was collected through randomly distributed self-administrated questionnaires with consumers at major supermarkets in four selected Chinese cities. The finding of this study reveal that 'Certification relating to the quality of organic food', and 'the overall quality of organic food' have been rated as the most important items for Chinese consumers to purchase organic food. The factor analysis results also suggest that 'Certification', 'Social status', 'Sensory appeal', 'Value for money' and 'Country of Origin' are important factors during their pre-purchase evaluation relating to organic food.

Background and Research Aims

In the last decade, there has been significant increasing interest in organic food. Current studies examining consumers' awareness of organic food have been well developed in North America and Western Europe. Organic foods are perceived as being more nutritious and healthier, safer, and environmentally friendly than conventional food. Thus, consumers are willing to pay a premium price for them (Krystallis *et al.* 2006). Even in newly emerging markets, consumers are willing to pay a higher price for higher quality, taste, and 'safe' certified foods (Grannis *et al.* 2001). Research has also revealed that some of the reasons for the non-purchase of organic food include consumers' perceptions of it being expensive, limited in availability and product range and even unsatisfactory in appearance (Radman 2005). Misleading labelling and certification, low profile distribution channels, and lack of perceived value have been cited as barriers influencing the purchase of these products (Gallagher and McEachern 2003). One study also found that Norwegian consumers trust locally produced organic foods as being safer than relatively cheaper imported organic foods (Storstad and Bjørkhaug 2003).

China has experienced dramatic economic growth in the last twenty years, and is developing an affluent urban middle class for the domestic organic food market. Over the recent period the Chinese organic food sector has grown faster than the worldwide average. Sales of Chinese organic products have increased by up to 30 percent, mainly in eastern China. Demand is also increasing for imported organic products. Large international retailers like Wal-Mart and Carrefour have significantly increased sales of organic food products, even though they are more expensive. The recent increases in income levels have raised issues regarding food safety and food nutrition

¹Jue Chen: Ph. D. candidate, Faculty of Business and Enterprise, Swinburne University of Technology, Melbourne, Australia, Email juchen@swin.edu.au

in China, It has been reported that Chinese consumers are losing confidence in locally produced milk after a series of scandals involving food safety. Only a handful of studies in relation to organic food consumption have been conducted in Asian countries such as Japan, Taiwan, India and Thailand. Very few studies of this nature have been undertaken in China, a fast growing economy where organic foods are increasingly being marketed. Little is known or understood about Chinese consumers' attitudes towards organic products or their purchase behaviour. This research aims to investigate the attributes that are important to consumers in urban China during their pre-purchase evaluation of organic foods.

Research Methods

Organic foods are relatively new products, primarily available in large supermarkets in major Chinese cities. The data for the present study was collected at major supermarkets in four selected Chinese first tier and second tier cities: Beijing, Shanghai, Shenzhen and Chengdu over a period of one month. These four cities are geographically dispersed, i.e. located in the east, west, north and south of China and are economically and politically prominent, are considered to be the main engines of China's phenomenal economic development. Consumers are more likely to be aware of organic foods. All participating supermarkets had organic food sections. Shoppers were randomly approached at the main entrance of the supermarkets to participate in a questionnaire administered by trained personnel. Only shoppers who were aware of the term 'organic foods' were permitted to participate in the survey. A small gift of organic food (nuts or vegetables) was offered in appreciation of their time to answer the questions. The trained personnel were instructed to seek out demographic variation where possible and the questionnaire was presented to consumers entering these supermarkets throughout the day during the trading hours of the stores. Five hundred questionnaires were distributed in each city, hence a total of two thousand questionnaires were administered. Finally, nine hundred and eighty valid questionnaires were obtained. Twenty-three items were elicited to ascertain the important aspects in relation to the pre-purchase evaluation of organic food in urban China. These items have been obtained from previous literature and two focus group discussions in China. The answers of the questions use a five point Likert scale.

Results

The results which emerged in terms of gender breakdown had a response of 59 percent from females and 41 percent from males. These results confirm previous findings that women are more likely to purchase organic food. Also they indicate that women are the main food purchasers. The education level of the respondents showed that 10.1 percent of the total participants had a postgraduate degree, 61.1 percent of the total participants had bachelor or diploma degree. Only 28.8 percent of the participants had high school or lower level of education. These results are also in line with previous studies where most of the affluent people who purchase organic food are well educated. Regarding occupation, 34.6 percent of respondents were white collar employees. This result appears to concur with previous studies in relation to organic food consumers being both well educated and higher income earners. The socio-demographic profile seems to significantly influence consumers purchasing organic food. When asked 'How much extra are you willing to pay for organic food as compared to conventional food?', 59.3 percent of respondents said they were willing to pay an extra 20 percent to 50 percent, only 0.7 percent of respondents would like to pay great than 100 percent. On the other hand 28.6 percent of respondents said they

'don't want to pay extra'. When asked 'Where would you prefer to buy organic food from?', 70 percent of respondents prefer to buy organic food in a supermarket, 10.3 percent of respondents prefer to purchase organic food from specialty stores, while only 2.7 percent prefer to purchase through on-line or catalogue sales. These findings confirm that 'organic' is still a new concept, and organic food products are mainly available in Chinese supermarkets. Out of the twenty-three items of the customised scale in the questionnaire, twenty-one were given mean ratings above '3' (neutral rating). This suggests that on the whole, the ratings given by Chinese respondents to the various items of important attributes for the purchase of organic food were generally higher in rating. The 'Certification relating to the quality of organic food', and the 'overall quality of organic food' have been rated the most important, followed by 'Enforcement relating to the quality of organic food', 'Information about the nutritional value of organic food', 'food safety in relation to organic food', and 'Correct labeling of organic food'. These results indicate Chinese consumers are very much concerned about food safety issues and that they are somewhat suspicious of the quality of organic food products and their certification.

Further, an exploratory factor analysis was conducted to elicit attributes related to the collected data. The purpose of exploratory factor analysis (EFA) is to identify the smallest number of meaningful latent variables amongst a larger set of measured variables. A total of 58.41 percent of the variance explained by the customised scales. Four items were deleted due to cross loadings and low loadings. The remainder of the 19 items with loadings higher than 0.4 are presented. The items that have high loadings in the first dimension are 'certification', 'enforcement', 'food safety', 'information', 'government regulation' and 'correct labeling'. Hence this dimension was titled '*Certification*'. The reliability test produced a Cronbach's Alpha of 0.845, indicating a high internal consistency. The second dimension can be interpreted as '*Social status*', which embraces 'social status', 'face saving', and 'package', and the Cronbach's Alpha was 0.615. The third dimension was named as '*Sensory appeal*', and the items comprise 'smell', 'taste', and 'appearance', and the Cronbach's alpha was 0.619. The fourth dimension was labelled '*Value*', combining items 'availability' and 'price', the Cronbach's Alpha was 0.538. The last dimension was interpreted by '*Country of origin*' since the items included are 'country of origin', 'produced in China', 'brand' and 'awareness', the Cronbach's Alpha was 0.730.

Although ideally, the Cronbach's alpha should be above .7, they are quite sensitive to the number of items in the scale. With scales fewer than ten items, it is common to find low Cronbach values. Therefore, the internal consistencies of all scales in this study are acceptable and adequate. The results suggest that there are five factors, namely certification, social status, sensory appeal, value for money and country of origin, they are important to consumers when deciding about the purchase of organic food in China. Most of the attributes are also consistent with previous studies.

Conclusion

This is one of the very few studies in China relating to consumer buyer behavior of organic food. It was also the first national survey in China. It provides valuable insights into global consumer behavior in terms of organic foods and it also builds a new body of knowledge with regard to the future potential of organic food business in China. Beneficiaries of this study include various stakeholders in China and globally such as consumers, vendors both local and international and government agencies. The research findings reveal that 'Certification relating to the quality of organic food' and 'overall quality' are the most important items in the consumer decision making process

for the pre-purchase evaluation of organic food in China. Like many western consumers, Chinese consumers are also motivated by food safety issues related to personal health and environmental concerns. However, Chinese consumers are more suspicious of the quality of food purchased and have high expectations in the improvement of overall organic food certification and inspection as well as policy enforcement. They are also eager to understand more about organic food and what this industry is all about. Furthermore, there are five factors which are important to consumers of organic food in China and these include 'Certification', 'Social status', 'Sensory appeal', 'Value for money' and 'Country of origin'. There are several implications that can be derived from our findings.

Firstly, there is much confusion amongst Chinese consumers and the food scandals have damaged consumers' confidence. There is a lack of trust in the 'certification relating to the quality of organic food' as well as doubt in overall organic food quality in China. Government agencies and industry need to be aware of the necessity to regulate the organic food market. They need to enhance the inspection and certification of organic food labelling as well as ensure the labelling and logos of organic food are a sign of quality. Secondly, China is described as being in the highly collectivist category with high power distance, status is important to indicators of power and achievement. Organic food can demonstrate the purchasers' status. Thirdly the awareness of organic food in China is still very low. There needs to be an increase in the availability of distribution channels and there is a need to publicise the overall quality process of organic food related to food safety issues. Fourthly, the expensive nature of organic food is obviously always a barrier to purchase. However there is a need to educate consumers to understand that the value of organic food is related to its price. Improving the awareness of organic food products is by far more critical. Finally, well educated, higher income families are more likely to purchase organic food and therefore income and education still seem to affect the consumption of organic food which is consistent with previous studies.

Acknowledgments

This is a working paper based on the author's doctorate dissertation

References

- Gallagher, K & McEachern, M (2003): A review of the 'consumer interest' in organic meat, *International Journal of Consumer Studies* vol. 27, no. 5, pp. 381-394.
- Grannis, J, Hine, S & Thilmany, D (2001): 'Marketing premium food products in emerging economies: The case of Macedonian cheese', *Journal of International Food & Agribusiness Marketing*, vol. 13, no. 2/3, p. 59.
- Krystallis, A, Fotopoulos, C & Zotos, Y (2006): Organic consumers' profile and their willingness to pay (WTP) for selected organic food products in Greece, *Journal of International Consumer Marketing*, vol. 19, no. 1, pp. 81-106.
- Radman, M (2005), Consumer consumption and perception of organic products in Croatia, *British Food Journal*, vol. 107, no. 4, pp. 263-273.
- Storstad, O & Bjørkhaug, H (2003), Foundations of production and consumption of organic food in Norway: common attitudes among farmers and consumers?, *Agriculture and Human Values*, vol. 20, no., p. 151.

Characteristics of price and demand for organic vegetables in the Japanese food retailing market

Takada,N¹.,Taniguchi,Y².

Key words: organic retailing,organic vegetables,price variation,price premium,
price elasticity of demand

Abstract

This study examined the level and the variations of the prices of several organic vegetables to see if they were too high or unstable as many conventional retailers claim. We found that the prices of organic vegetables were, on average, about 70% more expensive, and 30% more volatile compared to the conventional products. While the prices and income alone could not explain the demand for organic products well, the results of the estimation suggested the price elasticity was large in general, and the recent economic decline had negatively affected the demand.

Introduction

High price premiums and uneasy access to organic products have long been the major obstacles for many consumers to purchase organic products (Tokyo Metro. Gov. 2001; Agri. Prom. Assoc. 2000; IFOAM Japan 2003). Thus, unlike the United States or many countries in Europe, organic foods are not yet omnipresent in today's food market in Japan (Willer and Kilcher 2009). However, little is known about actual characteristics of supply as well as consumer behaviours with regards to organic products. Therefore, in this study, we attempted to examine the levels of price, their variations, and their relations to the demand for organic vegetables sold in retail stores.

Materials and methods

To see the characteristics of prices and sales of organic vegetables, we calculated the mean prices, the coefficients of variation ("c.v." hereafter), and the organic price premiums. The data were obtained from "the Price and Sales Trends of Fresh Foods Survey³", which was conducted monthly with 130 stores that handle fresh foods in 15 major cities, with the average response rates ranging from 68.8% to 85.4%. We used monthly average data starting from Jan. 2004 to Dec. 2009. Then, we examined the consumer responses to the price variations by regression analyses using the sales volume of organic product as dependent variables, and the prices of organic, conventional, reduced-input products, income, and a dummy indicating economic downturn as independent variables. All data other than income was obtained from the above mentioned survey. Monthly "living expenditure" data from the *Family Income and Expenditure Survey* of the Statistics Bureau were used as the proxy for income. Product items that we examined are: cabbage, cucumber, burdock, daikon, onion, tomato, carrot, eggplant, Welsh onion, potato, green pepper, and spinach. The

¹ School of Food, Agricultural and Environmental Sciences, Miyagi University, 2-2-1, Hatatate, Taihaku-ku, Sendai, Miyagi, Japan, Email: f0832039@myu.ac.jp

² As Above. Email: taniy@myu.ac.jp

³ Available at MAFF website: URL http://www.maff.go.jp/j/tokei/kouhyou/seisen_doukou/index.html

estimating equation was in the log-linear form and parameters were estimated by OLS.

$$\ln Y = \alpha_0 + \alpha_1 \ln(\text{price}^{\text{organic}}) + \alpha_2 \ln(\text{price}^{\text{reduced-input}}) + \alpha_3 \ln(\text{price}^{\text{conventional}}) \\ + \alpha_4 \ln(\text{expenditure}) + \alpha_5 \text{Dummy}(D=1 \text{ after Sept. 2008}, D=0 \text{ otherwise})$$

Results

1. Prices, Premiums, and the Variations of Price and Quantity of Selected Items

The mean and c.v. of price and quantity of 12 vegetables for three different production methods – conventional, reduced-inputs,¹ and organic – are shown in Table 1.² As perceived by retailers, organic vegetables were found to be much more expensive than conventional counterparts. The simple average of prices of the organic vegetables examined was 9.40 USD/ kg, which is about 70% higher than the conventional products.

Organic vegetables showed larger variations in both the price and quantity compared to conventional items, but fluctuated less compared to reduced-input products. The average c.v. for price was 0.19 for organic products, which was about 1.5 times more than that of conventional products, but about 0.9 times less than that of reduced-input products. Cabbage, cucumber, burdock, Welsh onion, and green pepper showed bigger variations with more than 0.20 of c.v., while onion, carrot, potato and spinach showed relatively small fluctuations. As for the quantity, organic products (average c.v.=0.66) fluctuated more than conventional products (average c.v.=0.25) but less than reduced-input products (average c.v.=0.71).

Table 1: The Mean Prices, Quantities, and the Coefficients of Variation of 12 Organic, Conventional, and Reduced Input Vegetables (Unit: USD/ KG, KG/Month)

| | | Cabbage | | Cucumber | | Burdock | | Daikon | | Onion | | Tomato | |
|----------|------------------|---------|------|----------|------|---------|------|--------|------|-------|------|--------|------|
| | | mean | c.v | mean | c.v | mean | c.v | mean | c.v | mean | c.v | mean | c.v |
| Prices | organic (USD) | 2.70 | 0.24 | 6.50 | 0.25 | 11.10 | 0.27 | 2.40 | 0.17 | 4.00 | 0.11 | 10.30 | 0.19 |
| | organic/ conv | 1.69 | 1.14 | 1.33 | 1.25 | 1.56 | 3.00 | 1.50 | 1.13 | 1.90 | 1.22 | 1.72 | 1.90 |
| | organic/ reduced | 1.35 | 1.20 | 0.88 | 1.25 | 1.10 | 1.00 | 1.00 | 0.43 | 1.33 | 0.73 | 1.07 | 1.27 |
| Quantity | organic (USD) | 5.00 | 0.48 | 1.00 | 0.66 | 1.00 | 0.71 | 4.00 | 0.35 | 7.00 | 0.56 | 1.00 | 0.77 |
| | organic/ conv | 0.05 | 3.20 | 0.02 | 2.28 | 0.14 | 3.09 | 0.05 | 1.35 | 0.09 | 3.73 | 0.02 | 2.41 |
| | organic/ reduced | 0.71 | 1.23 | 0.50 | 0.93 | 0.50 | 1.09 | 0.57 | 0.35 | 0.35 | 1.30 | 0.20 | 1.28 |

| | | Eggplant | | Carrot | | Welsh onion | | Potato | | Green pepper | | Spinach | |
|----------|-----------------|----------|------|--------|------|-------------|------|--------|------|--------------|------|---------|------|
| | | mean | c.v | mean | c.v | mean | c.v | mean | c.v | mean | c.v | mean | c.v |
| Prices | organic (USD) | 7.30 | 0.17 | 5.40 | 0.13 | 11.60 | 0.26 | 4.40 | 0.12 | 13.10 | 0.29 | 11.60 | 0.14 |
| | organic/conv | 1.22 | 1.21 | 1.74 | 1.00 | 1.93 | 2.36 | 1.63 | 1.20 | 1.70 | 1.26 | 1.55 | 0.67 |
| | organic/reduced | 0.95 | 0.81 | 1.23 | 0.87 | 1.33 | 0.79 | 1.29 | 0.75 | 1.32 | 1.61 | 1.21 | 0.64 |
| Quantity | organic (USD) | 1.00 | 0.56 | 5.00 | 0.45 | 1.00 | 1.03 | 5.00 | 0.75 | 1.00 | 0.92 | 2.00 | 0.67 |
| | organic/conv | 0.05 | 1.22 | 0.12 | 2.81 | 0.04 | 4.29 | 0.10 | 3.95 | 0.08 | 3.83 | 0.09 | 2.09 |
| | organic/reduced | 0.50 | 0.81 | 0.50 | 1.00 | 0.33 | 1.05 | 0.36 | 1.44 | 0.50 | 0.93 | 0.67 | 0.57 |

2. Demand Analysis

¹ “Reduced-Input” products are defined by those products that are cultivated by using less than half of the pesticides or chemical fertilizers normally used by conventional farmers.

² The currency was converted from JPY to USD at the conversion rate of 1.00 USD = 100 JPY.

The results of the regression analyses were shown in Table 2. Overall, the variables used in this estimation alone did not explain the demand for organic vegetables well; suggesting the existence of large omitted factors, possibly such as lifestyle preference and consumer's proximity to the stores. However, the coefficients of several variables were found to be significant and deserve attention. First of all, we can see that the demand for organic vegetables tend to be elastic to own prices. Three out of 5 items, namely, onion, tomato, and spinach, whose prices were tested significant for $P < 0.05$ had the price elasticity of demand greater than 1. Income elasticity was less obvious, as income (living expenditure) was found to be effective in only two items: daikon and carrot. Nevertheless, we can point the fact that the demand of both items was found elastic to income with the elasticity greater than 1. As against our expectation, we could not find strong evidence that the conventional and reduced-input products act as "substitutes" of the organic products. Only two items, green pepper and cucumber, had a statistically significant coefficient of prices for either conventional or reduced-input products. While green pepper suggested conventional products were "substitutes" of the organic products by the positive sign of the coefficient, cucumber indicated reduced-input products were "complementary goods" by the negative sign of the coefficient. The dummy representing the periods that were under the economic depression was found to affect the demand in four items. As we expected, three out of four items had negative sign; suggesting the recent decline in Japanese economy had restrained the consumption of organic products. However, cabbage had the positive sign, which indicated the existence of unknown factors that had prompted the consumption during the same period.

Table 2: Results of Regressions and Estimated Coefficients

| | | Cabbage | Cucumber | Burdock | Daikon | Onion | Tomato |
|------------------------|----------------|-------------|--------------|----------------|----------------|----------------|-----------------|
| Ajusted R ² | | 0.20 | 0.11 | 0.25 | 0.18 | 0.19 | 0.38 |
| Variance ratio | | 3.81** | 2.44** | 5.42*** | 3.72** | 4.04** | 7.37*** |
| Intercept | | -35.61 | -6.92 | -7.70 | -28.46** | 15.25 | 19.27 |
| Prices | Conventional | -0.46 | 0.82 | -1.55 | 0.59 | 0.91 | 0.19 |
| | Reduced inputs | 0.61 | -1.59** | 0.32 | -0.20 | 0.12 | 0.44 |
| | Organic | 0.61 | -0.05 | -0.91** | -0.66** | -2.66** | -1.63*** |
| Expenditure | | 2.84 | 1.13 | 1.93 | 2.74** | -0.26 | -1.04 |
| Depression (dummy) | | 0.60*** | -0.18 | -0.11 | -0.13* | -0.31** | -0.51** |
| | | Eggplant | Carrot | Welsh onion | Potato | Green pepper | Spinach |
| Ajusted R ² | | 0.13 | 0.20 | 0.08 | 0.11 | 0.15 | 0.18 |
| Variance ratio | | 1.70 | 4.44** | 1.54 | 2.86** | 2.51** | 3.94** |
| Intercept | | 15.52 | -38.73 | 2.68 | 15.42 | 35.64 | 40.98 |
| Prices | Conventional | 1.34 | -0.11 | -1.41 | -0.38 | 1.56** | 0.14 |
| | Reduced inputs | 0.14 | -0.72* | 0.09 | -1.14* | -1.01 | -0.11 |
| | Organic | 0.44 | 0.67 | -1.75* | 0.06 | -0.83* | -2.15** |
| Expenditure | | -2.43 | 3.59** | 1.59 | -0.47 | -2.92 | -2.21 |
| Depression (dummy) | | 0.28 | -0.10 | -0.19 | -0.36** | -0.23 | -0.09 |

* significant for $P < 0.10$, ** significant for $P < 0.05$, *** significant for $P < 0.01$

Discussion

Price premiums for organic products calculated in this study suggested that the prices were often set at much higher levels than most Japanese consumers would be willing to purchase. In earlier studies, the Japanese consumers' willingness to pay for organic vegetables was estimated to be in the range of 10-30% higher than the conventional

counterparts (Sato, *et al.* 2005; Sawaragi, *et al.* 2002). To our surprise, reduced-input products were most unstable in terms of price and quantity supplied. Though reduced-input products are easier to produce and thus, more suitable for mass-production and mass-distribution, the calculation suggested it was not necessarily true. Nevertheless, the supply of organic products was much more volatile compared to conventional products. From the results of the regression analyses, we found that the price and income elasticity of demand for organic vegetables tend to be high, and the recent economic decline had seemingly affected the demand negatively. However, the relationships between the demand for organic products and the products made by other cultivation methods showed mixed results. The estimation results also showed that the variables included in the calculation alone could not explain the demand for organic products well, suggesting the existence of large unknown factors that were omitted from the equation. One reason for this difficulty would be the fact that organic products are often wholesaled at fixed prices regardless of the supplied quantity, so the demand-and-supply relationships are not well reflected in the data. However, the biggest reason would be the limited availability of data. If more stores handle organic produce and more quantity is supplied, consumer behaviour would better be analyzed.

Conclusions

This study attempted to examine the characteristics of prices and demand of organic vegetables in the Japanese food retailing market. We found that the prices of organic vegetables were, on average, about 70% more expensive, and 30% more volatile compared to conventional products. In order to increase the demand, it is necessary for the industry to make more efforts to reduce the cost of production and distribution so as to lower the prices. Fluctuations of both quantity and price organic products were less than reduced-input products. Shifting the priority from reduced-inputs to organic products as differentiated items might benefit retailers. As for the demand analysis, we need to take caution in interpreting the estimation results. However, following tendencies were worth noted: the price elasticity of demand for organic products were large; and the recent economic decline had negatively affected the demand.

References

- Agri. Prom. Assoc. (2000): The Survey of the Production, Distribution, and Consumption of Environmentally Friendly Agricultural Products. Tokyo.
- IFOAM Japan (2003): Overview of Organic and Reduced Input Products Market. GMI. Tokyo.
- Sato, M., M. Sakagami, Y. Suzuki, K. Ueta, and H. Takatsuki. (2005): An economic analysis of consumers' preference toward organic vegetables with special reference to the local organic material circulation and certification labels. *Environmental science*. 18(3): 243-255.
- Sawaragi, S., T. Kusube and M. Naito. (2002): The Possibility of Promoting Bio-recycling System by Green-consuming Action. *Journal of the Japan Society of Waste Management Experts*. 13 (2): 71-78.
- Tokyo Metro. Gov. (2001): Results of the Questionnaire "Green Consumer." Tokyo.
- Willer, H. and L. Kilcher. (Eds.) (2009) *The World of Organic Agriculture. Statistics and Emerging Trends 2009*. FIBL-IFOAM Report. IFOAM, Bonn; FiBL, Frick; ITC, Geneva.

Analysis of regulatory framework affecting sensory properties of organic products

Schmid, O.¹

Key words: standards, organic products, sensory properties, impact

Abstract

In the EU funded research project Ecropolis (www.ecropolis.eu) the Research Institute of Organic Agriculture (FiBL) made a comparative analysis of relevant sensory related requirements in regulations and standards for mainly processed organic products. A potential impact matrix of standards requirements on sensory properties of organic food has been elaborated. Furthermore a new typology has been developed in mapping the impact of standards related to standardisation versus differentiation on one hand and freshness/authenticity and long shelf life on the other hand.

Introduction

This paper is based on a report on the analysis of the regulatory framework affecting sensory properties (Schmid, 2009), conducted 2009 in the EU funded project Ecropolis with research partners, SME's and SME-associations from six European countries (CH, DE, FR, IT, NL, PL). The main purpose of this project is to provide and exchange sensory information on organic food, in particular for organic associations, producers, processors, retailers and wholesalers. The EU legislation for organic production and private standards define production methods and ingredients as well as additives and processing aids, which could have a direct effect/impact on the sensory properties of organic products, in particular on structure, taste, odour and colour, but also e.g. on shelf life. Also indirect impacts are possible; e.g. when a standards restriction leads to the use of other additives and processing methods, which affect sensory properties differently.

Materials and methods

The analysis was mainly focussing on processing requirements and their direct or indirect potential impact on the sensory properties for the following product groups: apple, cookies, yoghurt, salami, plant oil, fruit juice and tomato juice. The following steps were done: 1. Analysis of the potentially sensory-relevant requirements mainly in processing, in particular differences between the EU Regulations for organic production and national governmental rules, international rules (Codex Alimentarius, IFOAM, Demeter International), private standards and guidelines of associations or companies. 2. Identification of potential standards impacts of the differences found related to sensory properties (based on literature). 3. Describing product profiles of the selected product groups in fact sheets. 4. Developing a potential impact matrix to be used to compare sensory product profiles in experimental and consumer testing later in the project.

¹ Research Institute of Organic Agriculture FiBL, Ackerstrasse, 5070 Frick, Switzerland, E-Mail otto.schmid@fibl.org, Internet www.fibl.org

Results

In production standards, both in the EU Regulation for organic production as well as in private standards, only few or no restriction were found, which have a direct or indirect impact on taste. In processing, by the fact that only very few additives can be used for organic food - based on EU Regulations (EC) 834/2007 and (EC) 889/2009 – some acids, preservatives or thickeners as well as flavour enhancers cannot be used, which have an impact on taste. Most differences are found in processing standards of private organisations (e.g. Bio Suisse, Demeter, Bioland), which restrict clearly some processing methods and exclude additionally several additives. Some companies have internal quality Codes of Practice for their producers, which influence taste, which go beyond the restrictions by the EU regulation and organic label organisations.

The comparison of five private national standards in France, Germany, Italy and Switzerland and three international standards (IFOAM, Codex Alimentarius and Demeter International) revealed several sensory-relevant differences of processed organic products related to: the use or non-use of ingredients in particular with flavour and colour compounds; the use or non-use of specific thickeners in particular for milk-products and vegetable/fruit products; the use or non-use of nitrate/nitrites in meat products; the use or non-use of natural flavours (e.g. for yoghurts, juices or bakery products); the use of organic yeast (mainly for bakery products); as well as the exclusion of some processing methods like high-temperature processing of oils or of milk. These differences impact not only sensory properties but as well the character of the products regarding standardisation, differentiation and shelf life (see Table 1).

This impact of standards is here explained with the example of yogurts: The comparison of milk processing standards relevant for yoghurts showed: Ingredients of agricultural origin: little differences found. Few standards restrict the use of starch-based compounds (used as thickener). Colouring ingredients: mostly allowed except Bio Suisse. Extracts from flavour-rich compounds <. acceptable in most private standards except Bio Suisse; Ingredients of non-agricultural origin: no relevant differences. Additives: Thickeners: only few standards do not allow the use of plant based thickeners (alginates etc.) as thickener in milk products; Processing aids and other substances: Several standards require the use of flavours only from name-giving substance (possibly organic). The use of natural flavours is not allowed by two standards. Processing methods: Two standards restrict the homogenisation of milk for yoghurt, one standard does exclude it. These different requirements for yoghurt influence potentially the taste, appearance and odour in many ways, in particular through the choice of ingredients, thickeners and flavours as well as homogenisation. For each of the standards differences also the impact on shelf-life and freshness was estimated based on literature and expert opinion. These differences were linked to a typology, where the standards requirements are mapped in four different segments: along the horizontal axis the impact on standardisation of quality versus differentiation of quality and on the vertical axis the potential impact on long shelf life of products and vice versa on the freshness/authentic product character (see Fig. 1).

Discussion

The analysis of standards requirements and their potential impact on product properties revealed also significant differences for other product groups (Schmid, 2009). This leads to the fundamental question, if organic products should always be the same like conventional ones or should they have an own sensory and quality profile?

Tab. 1: Potential direct impact matrix of selected standards requirements on factors influencing sensory properties and shelf life

| | Issues | Criteria | Direct impact on sensory properties | | | | Other impact e.g. shelf life |
|---|-------------------------------------|--|-------------------------------------|---------|-------|----------------------|---------------------------------|
| | | | Tex- ture | flavour | | Ap- pear- ance | |
| | | | | taste | odour | | |
| Use or non-use and origin of ingredients | Organic and non-organic ingredients | Organic ingredients | xx | xx | xx | xx | |
| | | Non-organic ingredients | x | xx | xx | xx | |
| | | Functional ingredients | xx | x | x | x | |
| | | Sugar use | - | x | - | - | x |
| | Non-agricultural | Use salt and water, | - | xx | - | x | Shelf life |
| | Other issues | Colouring ingredients | - | - | - | xx | |
| | | Extracts for flavour | - | xx | xx | - | |
| Use of additives | Restrictions | Less or no sulfites, nitrates/nitrites | - | xx | x | (x) | |
| | Use or non-use | Ascorbic acid | - | (x) | - | X | |
| | | Antioxydants | - | (x) | - | x | |
| | | Colorants | - | - | - | xx | |
| Use of proces- sing aids and other sub- stances | Other substan- ces | Ion exchange resins | - | xx | - | xx | |
| | | Use or non-use of natural flavours | - | xx | xx | - | |
| | | Use or non-use of organic yeast | (x) | x | x | - | |
| | | Use or non-use of bacterial starters | - | x | x | - | |
| Pro- ces- sing met- hods | Restrictions | Heat/pressure restrictions | xx | xx | - | x | Shelf life |
| | Non-use/ prohibiti on | Irradiation | - | - | - | - | Shelf life |
| | | Micro-waves | - | - | - | - | Shelf life |
| | | No or reduced homogenisation | xx | x | - | xx | |
| | Other issues | Reconstitution | x | xx | x | - | |
| | | Over-processing (e.g. double pasteurisation) | (x) | x | - | - | Shelf life |

* weak potential impact

** strong potential impact

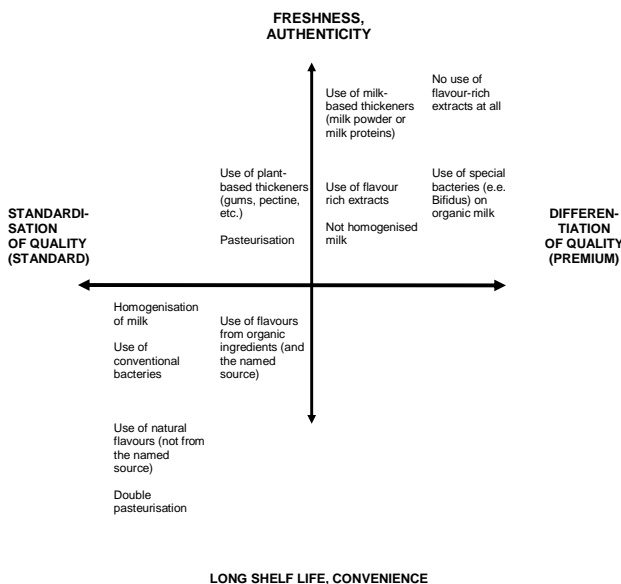


Figure 1: Typology of differently processed organic yoghurts linked to differentiation/standardisation as well as to freshness/long shelf life

Conclusions

Processing standards have different impacts on sensory properties, on shelf-life, freshness/authenticity and the standardisation of organic products. When making sensory testing or product promotion it is important to take into account the typology of products related to their standards requirements. However a key determining role for the sensory quality and profile of a product still remains to the individual processor/operator and his/her skills, experiences and care within a given framework.

Acknowledgments

The author likes to thank all project partners for their support. This work was done with financial support from the European Commission. The views expressed are those of the author and does not necessarily reflect the views of the European Commission, nor do they in any way anticipate the Commission's future policy in this area.

References

Schmid, O. (2009): Analysis of regulatory framework affecting sensory properties. Comparative report on specific sensory related requirements in regulations and standards for organic production. Deliverable No. 1.1 of ECROPOLIS Project. Research Institute of Organic Agriculture FiBL, Frick, Switzerland.

Nanomaterials in food and agriculture: The big issue of small matter for organic food and farming

Paull, J.¹

Key words: nanotechnology, nanoparticles, nanofood, regulation, organic certification.

Abstract

Nanotechnology is the study of very small matter, of materials where one dimension is less than 100 nanometres. Surveys reveal that consumers are generally ignorant of nanotechnology, are concerned of its risks versus benefits, expect labelling of products incorporating nanotechnology, and a big issue for respondents is particularly the use of nanotechnology in food. Organic standards of Australia, Canada, Demeter-International and the UK's Soil Association exclude nanomaterials, however a general nanotechnology exclusion across the organics sector is lacking.

Introduction

Nanotechnology is the study of small matter. The US EPA's new "working definition" of "nanoscale material" is: "An ingredient that contains particles that have been intentionally produced to have at least one dimension that measures between approximately 1 and 100 nanometers" (Jordan, 2010, p.6). A nanometre is a billionth of a metre. Small matter can behave differently from big, and, at the nanoscale materials can exhibit novel and unpredicted properties, and that is a major aspect of the motivation behind the US government budgeting US\$1.8 billion for nano-research in 2011. The National Nanotechnology Initiative (NNI, 2010, p.1) states that: "unique phenomena enable novel applications ... Unusual physical, chemical, and biological properties can emerge in materials at the nanoscale. These properties may differ in important ways from the properties of bulk materials and single atoms or molecules".

A set of new properties and behaviours can be exciting from a scientific perspective, however regulations on the use of materials have not caught up with this scientific development, and the potential risks and toxicities of nanomaterials will likely take decades to evaluate. This suggests the wisdom of taking a precautionary approach.

The nanotechnology industry is moving quickly from promise to reality. The cover of Ed Regis' 1995 book *Nano!* hailed nanotechnology as "the astonishing new science that will transform the world". Global nanotechnology sales for 2009 were valued at US\$11.7 billion (McWilliams, 2010). This rapid advance has engaged diverse industry sectors, including food and agriculture, in what is essentially a regulatory vacuum.

The Woodrow Wilson Center has identified 1015 nano consumer products on the market (PEN, 2010). Of these the biggest category is "Health and fitness" (N=605). There are 98 products in the "Food and beverage" category. Nano-silver is the most commonly identified nonmaterial, used for its antimicrobial properties (N=259). The USA is the lead producer of items in their inventory (N=540). This inventory relies on

¹ Institute of Social and Cultural Anthropology, University of Oxford, Oxford, UK,

E-Mail john.paull@anthro.ox.ac.uk, john.paull@anu.edu.au,

Internet www.scientificcommons.org/john_paull

self-declared marketing claims, and so it presents an underestimate of the total nano-offerings in the consumer marketplace. According to Jordan (2010) there is already at least one agricultural pesticide on the US market that includes nanomaterials.

The implementation of nanotechnology has proceeded in advance of both government regulation and social sanction. This paper examines attitudes of the public to nanotechnology. Is the use of nanotechnology in food and agriculture a big issue and if so what are appropriate and available responses?

Materials and methods

Data from surveys of consumer attitudes to nanotechnology are compared and contrasted. Results from eight national random sample surveys of adult subjects, over a five year period, are examined. Four of these surveys were conducted in Australia, 2005 (N=1000), 2007 (N=1000), 2008 (N=1100), 2009 (N=1100) (MARS, 2010), and four were conducted in USA, 2006 (N=1014), 2007 (N=1014), 2008 (N=1003), 2009 (N=1001) (HRA, 2006, 2007, 2008, 2009).

Results

For Australian subjects, knowledge of “nanotechnology” steadily increased over the five years (2005-2009) with those who had “heard of the term” increasing from 51% to 74%. However most subjects (88% in 2009) stated that they were uninformed about nanotechnology; they were either unaware of the term (26%), or they “don’t know what it means” (29%), or they “don’t know how it works (33%)” (MARS, 2010).

For US subjects the awareness of nanotechnology was low and witnessed only “minor shifts” over the period 2006 to 2009. In 2009, 68% of subjects had heard “little or nothing” about nanotechnology (HRA, 2009). Awareness in 2006 was 69% of respondents knowing “little or nothing” (42% “nothing”; 27% “little”) (HRA, 2006).

Despite this self-declared lack of knowledge, Australian subjects were generally positive about the prospects of nanotechnology and this was stable across the five year period, with an average 83% of respondents stating they were “excited” or “hopeful”, compared to on average 13% stating they were “alarmed” or “concerned” (MARS, 2010). However, this positive attitude to nanotechnology applied “except for uses associated with food or some skin applications” (MARS, 2010, p.3). In each of the four surveys food was the big and the exceptional issue: “caution was often expressed about nanotechnology applications in food products” (MARS, 2010, p.9). Support for nanotechnology “Food packaging that monitors environmental conditions to prevent food spoilage” fell significantly from 74% (2005), to 70% (2009). Support for nanotechnology “Changing nutrients and vitamins in food” fell significantly from 49% (2005), to 32% (2009). The support (32%) for nanotechnology ‘enhanced’ food was comparable to levels of support for GM food (27%) and cloning (31%) (MARS, 2010).

Of five issues of concern, the one that attracted the greatest level of support (81%) was “food labelling should provide information about any nanotechnology used”; of those concerned, 58% were “greatly concerned” and 23% were “mildly concerned”. The proposition that “because nanotechnology is so new there might be problems for public safety or worker safety” attracted concern from 80% respondents, of whom 35% were “greatly concerned” and 45% were “mildly concerned” (MARS, 2010).

For US subjects the percentage of subjects who agreed with the proposition that the benefits of nanotechnology outweigh the risks was initially 20% or less, for each of the years 2006 to 2008. The “initial impressions” of US subjects in 2008 were that 20% took the view that “Benefits outweigh risks”, and this rose to 30% for “informed impressions” after respondents were read a statement of potential benefits and risks (HRA, 2008). The corresponding figures in 2006 were 15% rising to 26% (HRA, 2006); and in 2007 18% rising to 30% (HRA, 2007); figures were not reported for 2009.

For US respondents, 12% agreed with the proposition that “I would use food storage containers enhanced with nanotechnology”; others would “need more information” (73%) or “would not use” (13%). Only 7% of respondents agreed with the proposition that “I would purchase food enhanced with nanotechnology”; others would “need more information” (62%) or “would not purchase” (29%) (HRA, 2007).

Discussion

These results suggest, firstly, that consumers are ahead of the regulators, and, secondly, that there is a general congruence between the attitudes of respondents in both the USA and Australia. Nanomaterials in food is the big issue for consumers, however, they are mostly ‘in the dark’ about what nanotechnology is and how it is being incorporated into products, there is no mandated labelling, and broad ranging nano-specific regulations do not appear immanent. Despite the consumer concern and lack of regulation, the market is ahead of both consumers and regulators, and it is rapidly commercialising research and incorporating nanomaterials into consumer products, including food and food-related products.

The US Department of Agriculture (USDA) sees nanotechnology ushering in an era of “fundamental” and “revolutionary” changes across a broad and diverse spectrum of their domain. They state that “Nanotechnology has enormous promise to bring about fundamental changes and significant benefit” (NNI, 2010, p.13). The National Institute of Food and Agriculture of the USDA state that “Nanoscale science, engineering, and technology have demonstrated their relevance and great potential to enable revolutionary improvements in agriculture and food systems, including plant production and products; animal health, production, and products; food safety and quality; nutrition, health, and wellness; renewable bioenergy and biobased products, natural resources and the environment; agriculture systems and technology; and agricultural economics and rural communities” (NNI, 2010, pp.14-15).

The wariness of survey respondents to nanotechnology in general, and nanofood in particular, is corroborated by the US EPA’s conclusion: “Size can influence toxicity ... Shape may also influence exposure and toxicity. We still have a lot to learn” (Jordan, 2010, p.7). Despite the optimism of the USDA, the potential for unknown health and safety issues remains unresolved and unpredictable. The ramifications of ingesting, inhaling or dermally absorbing nanomaterials is unlikely to be known for decades.

Australia, Canada, Demeter-International, and the UK’s Soil Association exclude nanomaterials in their organics standards, however most national organics standards, including those of the USA, do not address this issue. The *Australian National Standard for Organic and Bio-Dynamic Produce* appears to have been the first organic standard to exclude nanotechnology. The Australian Standard of 1 July 2007 stated that: “Products or by-products ... that are manufactured/produced using nanotechnology, are not compatible with the principles of organic and bio-dynamic agriculture and therefore are not permitted under the Standard” (OIECC, 2007, p.5).

The Soil Association was also an early adopter of a nano-exclusion from its organics standard, and operationalised the exclusion by providing the dual test of prohibiting: “ingredients containing nanoparticles” where “the mean particle size is 200 nm or smaller” and “the minimum particle size is 125 nm or smaller” (SA, 2008, p.93).

Conclusions

At least four conclusions can be drawn that pertain to the organics sector. Firstly, the sector has yet to find a collective voice on nanotechnology, and, in this, it is behind (a) the handful of certifiers who have already excluded engineered nanomaterials and (b) the ‘wisdom of the crowd’ as revealed by surveys over five years and two continents. Sector-wide exclusions of synthetic fertilisers and pesticides, GMOs, cloning and irradiation offer precedents for a nanotechnology exclusion. For the organics sector, the issue is not about toxicology, it is about philosophy and principle - and when and how to ‘meet and greet’ new synthetic cryptic chemical additions to the food stream.

Secondly, surveys reveal that there is a demonstrated constituency for no-nano food; this presents an opportunity for the organics sector. Thirdly, a no-nano stance from the organics sector carries with it the attendant responsibility of maintaining a watching brief on nano developments and their infiltration into the food and agriculture sectors, so that an exclusion is actively maintained in practice, and not just ‘in the standard’.

Fourthly, the tardy response of the organics sector to nanomaterials indicates that the timeliness with which the sector can respond to new technologies needs attention. A few individual certifiers have responded, but the collective response of the sector has been lacking. The rate of technological change is escalating, and the organics sector needs a mechanism geared to meet this escalation in a timely manner, proactively and prospectively, and preferably consensually and collectively.

References

- HRA. (2006). *Report Findings*. Washington: Peter D. Hart Research Associates Inc (HRA).
- HRA. (2007). *Awareness of and Attitudes Toward Nanotechnology and Federal Regulatory Agencies, A Report of Findings*. Washington: Peter D. Hart Research Associates Inc (HRA).
- HRA. (2008). *Awareness of and Attitudes Toward Nanotechnology and Synthetic Biology, A Report of Findings*. Washington: Peter D. Hart Research Associates Inc (HRA).
- HRA. (2009). *Nanotechnology Synthetic Biology & Public Opinion*. Washington: Hart Research Associates Inc (HRA).
- Jordan, W. (2010). *Nanotechnology and Pesticides*: Pesticide Program Dialogue Committee, Office of Pesticide Programs, US EPA (29 April).
- MARS. (2010). *Australian Community Attitudes Held About Nanotechnology - Trends 2005 to 2009* (commissioned by Department of Innovation, Industry, Science and Research (DIISR)). Sydney: Market Attitude Research Services Pty Ltd (MARS).
- McWilliams, A. (2010). *Nanotechnology: A Realistic Assessment* (NANO31D, July). Wellesley, MA: BBC Research.
- NNI. (2010). *DRAFT National Nanotechnology Initiative Strategic Plan 2010 (1 November)*. Arlington, VA: National Nanotechnology Initiative (NNI).
- OIECC. (2007). *National Standard for Organic and Bio-Dynamic Produce, Edition 3.3, 1 July 2007*. Canberra: Organic Industry Export Consultative Committee (OIECC).
- PEN. (2010). *Nanotechnology Project Analysis*. Washington, DC: Project on Emerging Nanotechnologies (PEN), Woodrow Wilson International Center for Scholars.
- SA. (2008). *Soil Association Organic Standards, January 2008*. Bristol: Soil Association (SA).

Compliance with the New USDA-NOP pasture rule: Monitoring progress in small-holder vs. corporate dairies

Baker, B.¹, Delate, K.², Turnbull, B.³ & Cwach, D.³

Key words: Livestock, grazing, ruminants, grass-fed, citizen action

Abstract

Organic dairy products are considered one of the main “gateway” products into organic eating, leading to a 1,000% increase in the number of organic dairy cows in the U.S. over the last 10 years. Once primarily the domain of small-scale family operations, a number of large corporate organic dairies have entered the market. The corporate operations tended to maintain lactating cows in dry lots without access to pasture. These operations have a lower cost structure and greater market leverage than the smaller, pasture-based organic dairy farms. In response to calls for the enforcement of the pasture access rule, the USDA-NOP issued a final rule in February 2010, that required ruminants obtain a minimum 30 percent dry matter intake from pasture for at least 120 days to be certified organic. This paper discusses the community process involved in obtaining this rule; the various approaches taken by family farms vs. corporate farms to comply with the new rule; comparison of US requirements for access to pasture with organic standards in the European Union and Canada; and the future challenges to see that compliance maintains consumer confidence and meets the expectation for organic agriculture to benefit animal welfare.

Introduction

Organic agriculture is a systems approach. Animals in organic farming systems are connected to their ecosystem (IFOAM 2005). In particular, ruminant animals that evolved to graze are expected to have access to pasture. While this requirement is universally recognized in organic standards throughout the world, it has been a challenge to determine how much access is sufficient to make a given farm ‘organic.’

The United States has regional differences in farm size and production practices. Dairy farms in the Northeast and Upper Midwest—two traditional dairy producing regions—tend to be smaller scale, reliant on owner-operator labor, and market through farmer-owned cooperatives, with some exceptions. The larger producers tend to be vertically integrated, located in the Western states and rely on wage labor for most work performed.

When the US Department of Agriculture (USDA) National Organic Program (NOP) rule was finalized in 2000, the standard required access to pasture for ruminants, but did not provide any specific quantitative rule as to what was sufficient. While some dairy farmers provided continuous access to pasture for lactating animals during the growing season, others provided access to pasture only to dry cows and heifers, and not to lactating animals. Efforts to enforce the pasture rule against such operations

¹ Alfred State College Institute for Sustainability, Alfred, NY, USA 14802

² Iowa State University, Depts. of Agronomy & Horticulture, 106 Horticulture Hall, Ames, Iowa, USA 50011

³ Iowa State University, Dept. of Agronomy, 2104 Agronomy Hall, Ames, Iowa, USA, 50011

were not always successful. Recognizing the problem, USDA hosted a pasture symposium at a National Organic Standards Board (NOSB) meeting in State College, PA (USDA 2006). Researchers compared pasture-based with confinement systems. One of the methodological problems was to establish minimums for what could be considered 'pasture access' (PA).

In 2007, a 10,000-head California dairy lost its organic certification for continuous confinement of dairy cattle, but other feedlot dairies continued to be certified as organic (Guptill 2009). The larger corporate organic dairies had lower costs of production and put small-scale family farmers at an economic disadvantage (McBride and Greene 2009). A coalition of consumer and farmer groups petitioned the USDA to establish a clear and enforceable rule that defined PA. As a result of citizen action, the NOSB recommended, and the USDA proposed, a minimum of 30% pasture Dry Matter Intake (DMI) over a minimum period of 120 days to maintain organic certification (USDA 2010).

Stocking Density or Nutritional Value?

Unlike the EU and Canadian organic standards, the USDA-NOP regulations do not prescribe stocking densities (Tab. 1). At the same time, Canada and EU regulations do not require a minimum number of days on pasture. The Canadian Organic Standard recognizes the differences between Canada's agro-climatic regions and considers feed production capacity, stock health, nutrient balance and environmental impacts (CGSB 2006). The EU organic standard requires stocking densities shall ensure the "developmental, physiological and ethological needs of animals" (EC 2007). In addition, the regulations call for preserving environmental quality by limiting the number of livestock to minimize overgrazing, soil erosion, and manure pollution (EC No. 834/2007). Although these rules do not provide explicit stocking rates, they do take stocking rate into consideration.

Tab. 1: Pasture Access Requirements for Dairy Cattle

| Standard | Stocking Densities | Time on Pasture | Minimum DMI from Pasture |
|----------|--------------------------|---|--|
| Canada | 0.13 ha / animal unit | Permanent access to pasture for herbivores; the certification body can approve exceptions based on physiological state, inclement weather conditions and state of the land. | 30% of total forage intake during the grazing season following sexual maturity |
| EU | 4.5 m ² /head | Permanent outdoor access, preferably on pasture, with exceptions for weather, soil conditions and human and animal health laws. | Not Specified |
| USDA NOP | Not specified | 120 Days | 30% of total DMI intake on average over the course of the grazing season |

Sources: CGSB 2006, EC 2007, EC 2008, and USDA 2010.

In the US, stocking rates will vary depending upon geographic location and weather patterns, but a general guideline for a productive, well-managed pasture in the Midwest would be a stocking rate of 0.8 to 1.2 ha per cow/calf pair throughout the year (Leu 2011). Stocking rates will also vary depending upon the amount of dry matter intake from sources other than pasture, allowing an increase in stocking rates with cattle receiving supplemental grain or hay rations. Alternatively, cattle on an entirely pasture-based ration may require a lower stocking rate. Management-intensive rotational grazing systems may also allow for higher stocking rates.

Pasture Access in the US, EU and Canadian Organic Regulations

The issuance of the new pasture rule elicited strong support from the organic consumer community and general acceptance by organic livestock producers. Some certifiers have expressed exasperation regarding their ability to monitor all the requirements underlying the new rule. Pasture must be “managed as a crop” which will require record-keeping on any additional seeding, soil amendments and/or organic-compliant treatments applied to pasture ground. The precluding of “feed-lots” in the new rule has been challenged by a large dairy operation.

European regulations require ‘permanent access to pasture’ for all livestock except for bees (EC 2007), arguably exceeding the 120 day minimum. Regarding PA, the EU does not clearly define a minimum dry matter requirement but rather simply that livestock have “permanent access to pasture” (EC 2007). The regulations call for permanent access to open air, preferably pasture, except in cases of inclement weather, or in situations protecting animal and human health. The maximum amount of concentrate that can ever be fed dairy cows is 50% of dry matter intake during the first three months of lactation and 40% throughout the rest of the year. For livestock raised for meat, concentrate can only constitute a maximum of 30% of the daily dry matter intake. Thus, European ruminants would conform to the 120 day rule.

Canadian regulations state that livestock production is a “land-related activity” and combines elements of the EU and U.S. rules. The Canadian standards include both a maximum stocking density as well as a 30% minimum DMI requirement during the grazing season (CGSB 2006). However, there is no minimum number of days specified for PA.

Discussion

Although the USDA-NOP rules does explicitly require stocking rates, stocking density is taken into consideration as proper stocking densities need to be observed in the US to ensure adequate animal nutrition while maintaining the 30% dry matter intake rule. EU and Canadian requirements do not require an explicit number of grazing days; with enough consideration given to environmental factors, the results would be approximately the same as the US regulation. However, both Canada and the EU permit exceptions to their requirements of permanent access. How those exceptions are consistently applied may be a challenge as organic dairy production expands.

Implementation of the pasture rule poses a serious challenge to existing dairy farms of all sizes, but certification bodies in the Northeast and Upper Midwest have been enforcing the 30% DMI, 120 day rule from the date of rule finalization in 2010. Temperature is not a limiting factor for dairies in the South or West, but available land and water may make it difficult to meet the 30% DMI from pasture requirement.

Conclusions

The original pasture rule was considered unenforceable because it lacked specific metrics for compliance. Rather than undertake a stocking density approach like the EU and Canada, the US instead chose to base the requirement on the nutritional value received by ruminants. Validation as to whether these approaches are equivalent will take more research. In the meantime, many US farmers of all scales and in all regions will need to adjust their practices to comply with the NOP pasture standard. The adjustments will require adding land for more extensive production, more intensive management where additional land is not possible and a reduction of herd size. It is not clear whether farms with larger herds or located in areas with less predictable weather will be able to meet the requirements without incurring prohibitively increased costs.

Acknowledgments

The authors thank Miles McEvoy of the USDA National Organic Program, Sarah Flack, organic farm inspector and consultant, and Ron Rosmann, organic farmer. Opinions expressed are those of the authors only.

References

- Canadian General Standards Board (CGSB) (2006): Organic Production Systems General Principles and Management Standards, Gatineau, Canada, as amended through October 2008.
- European Commission (2007): Regulations on Organic Production-EC 834/2007.
- European Commission (2008): Laying down detailed rules for the implementation of organic production and labelling of organic products with regard to organic production, labelling and control. EC 889/2008.
- Guptil, A. (2009): Exploring the conventionalization of organic dairy: trends and counter-trends in upstate New York. *Agriculture and Human Values* 26:29-42.
- International Federation of Organic Agriculture Movements (IFOAM) (2005): Principles of Organic Agriculture, http://www.ifoam.org/about_ifoam/principles/index.html, (accessed 30 January 2011).
- Knaus, W. (2009): Dairy cows trapped between performance demands and adaptability. *Journal of Science of Food and Agriculture* 89:1107-1114.
- Leu, B. Iowa State University Field Livestock Specialist, Fairfield, Iowa. Personal communication. 2011-01-26.
- McBride, W.D., Greene C. (2009): Characteristics, Costs, and Issues for Organic Dairy Farming. USDA Economic Research Service, Washington, D.C.
- US Department of Agriculture (USDA) (2006): Organic Dairy Pasture Symposium Proceedings, State College, PA, 2006-04-18/19.
- US Department of Agriculture (USDA) (2010). National Organic Program: Access to Pasture. 75 Federal Register 7154-7195.

Farm animal welfare legislation and standards in Europe and world-wide – a comparison with the EU regulatory framework

Schmid, O.¹ & Kilchsperger, R.²

Key words: animal welfare, standards, European Union, international, comparison

Abstract

In the EU funded research project EconWelfare (www.econwelfare.eu) the Research Institute of Organic Agriculture (FiBL) made a comparison of legislation and private animal welfare standards in Europe and of third countries exporting to the EU. The focus was on cattle, pigs and poultry as well as transport and slaughter. National legislations for farm animal welfare in SE, CH (and partly in DE and UK) were clearly beyond the EU rules. The legislation in AR and NZ were comparable with the EU, whereas the animal welfare legislation in AU, CA, BR and in few areas below the EU. In CN and US many areas are not ruled at all compared with the EU regulatory framework. Private animal welfare standards in Europe beyond the EU legislation showed many differences; they can be clustered on four different levels. The animal welfare rules in the organic regulations worldwide showed fewer differences. A better harmonisation of animal welfare standards and better consumer information would be desirable. For upgrading animal welfare standards more emphasis should be given to animal-related criteria and indicators.

Introduction

The paper is based on an analysis of Animal Welfare (AW) standards and initiatives in selected EU and third countries as part of the EU funded project EconWelfare “Good animal welfare in a socio-economic context” (Schmid & Kilchsperger, 2010). The project aimed at giving scientific support for the development of the European Community Action Plan on the Protection and Welfare of Animals for 2006-2010, which aims to improve animal welfare with different instruments. One option is to introduce a labelling and/or information system for consumers indicating the level of animal welfare which different legislations and private standards do guarantee.

Materials and methods

An analysis of relevant legislation, standards and initiatives in Germany, Spain, Italy, the Netherlands, Poland, Sweden, the United Kingdom and Macedonia was made. Criteria for selection of the standards were: market relevance, specific contribution to AW issues. In these countries 7-14 different AW initiatives (standards and others) were clustered and assessed, in total 84 initiatives (Kilchsperger, Schmid & Hecht, 2010). A comparative analysis was made between the AW legislation of the EU itself with the legislation and private standards in the above mentioned EU countries as well as with the actual national legislation from Switzerland, Australia, Brazil, Canada, China, New Zealand and the United States. The focus was on cattle, pigs and poultry

¹ Research Institute of Organic Agriculture FiBL, Ackerstrasse, 5070 Frick, Switzerland, E-Mail otto.schmid@fibl.org, Internet www.fibl.org

² Ferme Combe d'Humbert, Sonvilier, Switzerland, rahelfelice@hotmail.com (associated with FiBL)

as well as transport and slaughter. In third countries at least two experts provided additional detailed information on the implementation of animal welfare. In addition in the selected European countries a more in depth analysis of 15 private AW standards, of which 6 organic private standards, was made in comparison with the EU legislation (general and organic one). Already existing assessments on (dis)advantages of animal welfare standards found in literature were taken into account (summarised in Ferrari et al., 2010). AW criteria developed in the EU project WelfareQuality were used to categorize the requirements.

Results

The comparison of the AW legislation in selected EU member states (Schmid & Kilchsperger, 2010; Ferrari et al., 2010) showed that one group of countries do not really differ from EU animal welfare legislation: Italy and Spain and to a large extent Poland, Macedonia are in an adaptation process. Another group of countries have in some areas a few additional requirements like UK and NL. Mainly the Swedish and partly the German AW legislation go in several aspects beyond EU law:

- Dairy cows: additional and stricter requirements are in SE legislation regarding feeding, drinking, accommodation, calving, breeding and mutilations.
- Pigs: more strict requirements for feeding and accommodation (space requirements) are found in SE, DE, NL and partly UK legislation.
- Poultry: more space allowance in non-cage and enriched cage systems in SE and partly in DE (however criticised by conventional farmer's organisations).
- Transport and slaughter: mainly DE, SE and partly UK have a few additional requirements beyond the EU legislation.

Much more distinguishable aspects beyond the EU legislation were found in the analysed private AW standards in Europe, however on different levels and of different detailness. Some were of major and other of minor relevance (from an ethological point of view). The aspects were grouped into specific aspects like accommodation, feeding, health care. The main differences are summarised below, which were found in at least 5 standards (*first number indicates the total number of differences, the second figure the more relevant ones based on literature and expert opinions*):

Cattle (70/20): tethering restricted, more space and light requirements, slatted floors forbidden or limited, specific bedding requirements, outdoor access, more specific feeding requirements (e.g. roughage), longer weaning periods, provision of calving pens, adequate anaesthesia for castration and non-allowance of certain surgical practices.

Pigs (51/16): availability of litter, slatted floors forbidden or restricted, possibilities for investigation and manipulating activities, provision of roughage, no hormonal treatments, adequate anaesthesia for castration and limitation of certain surgical practices as well as more space allowance.

Poultry (48/17): more light requirements, more perches and nests, access to dust baths, outdoor run and pasture, lower indoor and outdoor stocking densities, better access to fresh water, restrictions in breeding (mainly broilers) as well as higher frequency of regular visits.

Transport of animals (28/9): interdiction of sedatives/tranquilisers (not allowed in organic husbandry), provision of bedding material for the youngest in transport vehicles, more drinking, resting and feeding possibilities before transport, adequate pathway/ramps design, the separation of unfamiliar groups, reduced length of journey.

Slaughter of animals (39/9): more lairage requirements (start of lairage, space, lighting, floors etc.), the avoidance of group mixing, the non-use of electric stimulation, time between stunning and bleeding, specific education of the staff.

The analysis of AW standards indicated that in Europe basically four development lines towards improved AW beyond EU legislation can be observed.

Tab. 1: Different AW levels beyond EU legislation in private standards

| Development lines | Advantages | Disadvantages | Examples |
|---|--|---|---|
| A. Further development of highest AW level | Important niche drivers and pioneers (e.g. for introducing more animal-based indicators. High potential for cooperation with much broader actor network | Generally in a niche market. Limited by the number of farmers, Needs high consumer willingness to pay a higher price. | Neuland (DE), Freedom Food (UK) |
| B. High animal welfare in the EU rules for organic farming | Integrate of high animal welfare rules in organic legislation combined with high sustainability rules. Additional requirements possible in private organic standards beyond EU organic regulation | Generally in a niche market. Reorientation towards more animal-based criteria necessary Problem of higher costs of organic production. | EU Regulations 834/2007 and 889/2008. Beyond EU organic rules: Bioland (DE) KRAV (SE), Soil, Association (UK), Demeter. |
| C. Middle level approach to upgrade animal welfare standards | Potential for strong uptake through big market power. Important for harmonisation on international level - pressure on governments. | Rather top-down approach with little farmer involvement. Generally no financial incentives for farmers. Strong dependency from supermarkets | Internationally: GLOBALG.A.P. AW as part of retailer social corporate responsibility In addition local initiatives. |
| D. Modest improvement of basic AW | Allows a large number of farms to participate, Important starting point to raise awareness | On a relative low AW level. Still too much top-down | Codes of practise, often linked to quality assurance |

The overall assessment of the animal welfare requirements in EU third Countries of the main animal groups showed significant differences: CH is in several aspects beyond EU rules, AR and NZ have many comparable rules, AU, CA are in several aspects slightly below the EU and China and USA have many main aspects not

regulated in their national legislation. Several non-EU countries have legislation for slaughter, comparable or only differing in minor aspects with the EU framework (CH, AR and BR and partly AU, partly CA for cattle and pigs, China only for pigs, NZ for pigs and poultry). In addition an overall assessment of the legal requirements for organic animal welfare legislation was made, taking the EU regulations EC 834/2007 and EC 889/2008 as reference. It showed that for CH, AR, AU, BR, CA and NZ the AW rules are comparable, whereas the rules of China and USA are on some points slightly below the EU rules for organic animal production.

Discussion

The already existing differences and levels of AW legislation and standards between EU countries and important trade partners outside the EU (can) affect the competitiveness of the animal productions sectors within the EU. However the country analysis showed also that there are different conceptional approaches how to regulate AW. Third countries make often use of Codes of Practice. Several countries like AU, CA and US until now have left the AW legislation to their member states and to the private sector. As the selected third countries are important trading partners of the EU, it is important to find ways to better reconcile these different approaches.

Conclusions

The analysis has shown that there is a need for AW harmonisation mainly on international level. As this might difficult more information could be provided to consumers and market actors about AW differences. For the further development of AW standards it is desirable to put stronger emphasis on animal-related criteria and indicators. Organic standards should take a lead in this approach. As in many countries the way to improve AW by legislation is very limited (farmer resistance, competitiveness), other complimentary instruments like private standards and labelling systems, financial incentives, information and training should be considered.

Acknowledgments

The authors would like to thank all project partners and experts that carried out the documentation in their country. This report was produced with financial support from the European Commission. The views expressed are those of the authors and do not necessarily reflect the views of the European Commission, nor do they in any way anticipate the Commission's future policy in this area.

References

- Ferrari P. et al. (2010): Report on (dis-) advantages of current animal welfare standards for animals, based on the main findings of EU and national research projects. EconWelfare project report D2.3. www.econwelfare.eu
- Kilchsperger, R., Schmid, O., Hecht, J. (2010): Animal welfare initiatives in Europe. Technical report on grouping method for animal welfare standards and initiatives. EconWelfare project report D1.1. www.econwelfare.eu
- Schmid, O., Kilchsperger, O. (2010): Overview of animal welfare standards and initiatives in selected EU and third countries. EconWelfare project report D1.2. www.econwelfare.eu

An evaluation of the EU new organic import regulation from the perspective of the third country stakeholders

Miran, B.¹, Abay, C.¹, Karahan Uysal Ö.¹, Boyacı M.¹, Stolze M.², & Huber B.²

Key words: EU organic import regulation, third countries, stakeholder evaluation

Abstract

This paper reports on the results of a stakeholder workshop on evaluation of the EU's new regulation on imports of organic products from third countries, organized under a EU FP7 project, CERTCOST³ (Economic analysis of certification systems for organic food and farming). The results point out positive expectations from the new regulation, particularly by the traders. However, the stakeholders emphasized that further communication of information on the aims and tools of the new regime to the target groups and transparent implementation was needed.

Introduction

One of the main tasks in the CERTCOST project was evaluation of the EU new import regulation (EC 834/2007) which is an important subject both from the standpoint of the EU and the third countries (Huber 2008, Neuendorff & Huber 2009, MOAN 2010, Pierce 2010). Under this task, the new import regime was evaluated in a series of national workshops in countries exporting organic products to the EU (TR and CH) and in an international workshop held in Brussels. During the workshops, stakeholders evaluated the subject against a list of evaluation criteria (e.g. implementation, reduction of trade barriers, implications for exporting countries, EU administrative implications). Based on the results of the national and international stakeholder workshops, it is aimed to provide an in-depth understanding of the strengths, weaknesses and cost implications of the new import regime. The objective of this paper is to present the summary results of the workshop held in 27 October 2010 in İzmir Turkey, which was the first one of the series of workshops mentioned above. The results of the workshops held in Switzerland and Brussels in January 2011 have also corroborated the results of the İzmir workshop.

Materials and Methods

The issues to be discussed during the import regime evaluation workshops were determined through an internet survey conducted in June 2010. As a result of the internet survey, six major issues were identified as being the most relevant for discussion along both the national and the European workshops. During the Turkish

¹ Ege University, Faculty of Agriculture, Department of Agricultural Economics, 35100 Bornova, İzmir, Turkey, E-Mail bulent.miran@ege.edu.tr, Internet www.ege.edu.tr

² Research Institute of Organic Agriculture FiBL, Ackerstrasse, 5070 Frick, Switzerland, E-Mail Matthias.stolze@fibl.org, Internet www.fibl.org

³ This publication was generated as part of the CERTCOST Project, agreement no. 207727 (<http://www.certcost.org>), with financial support from the European Community under the 7th Framework Programme. The publication reflects the views of the author(s) and not those of the European Community, who is not to be held liable for any use that may be made of the information contained.

workshop the experiences and opinions of the stakeholders on each of the six issues determined were collected through focus group discussions and a survey applied to the stakeholders.

Workshop participants were selected among representatives of the major groups of actors involved in activities affected by the implementation of the EU's organic import regime in Turkey. These stakeholders included CBs, organic trade companies, governmental authorities, accreditation institution and relevant NGOs.

Results

General results from the Turkish national workshop can be summarized as follows:

Issue 1: Common interpretation of "equivalency" and "compliance" according to Articles 33(1) and 32(1) of Regulation (EC) No 834/2007

According to the stakeholders, in the regulation, there is no clarification on "under which conditions equivalency and compliance methods are relevant, or should be preferred respectively?" The stakeholders stated that the difference between the aims of these two approaches was not very clear. They mentioned that, according to their understanding, the local (national) regulation was kind of assumed to be inexistent in the compliance approach. However, they were not sure about this assumption. Furthermore, the stakeholders think that compliance would be difficult to fulfill under different country conditions. It is also found to be unclear whether it would still be needed to apply for inclusion in the lists of recognized CBs for equivalency/compliance after inclusion in the Third Country List as well. It is concluded that, the equivalency and compliance concepts were needed to be further clarified.

It is found to be unclear to the stakeholders whether compliant products would be preferred to the equivalent ones in the market. Costs and buyer (consumer- trader) preference/ sensitivity are expected to be the determining factors on this matter.

Issue 2: Procedure for CBs requesting for inclusion in the list of recognized control bodies and control authorities for equivalence/ Procedure for third countries requesting inclusion in the list of third countries

In Turkey, there are no control authorities. Two of the total of 16 CBs authorized by the Ministry have applied for inclusion in the list of recognized CBs for equivalency in 2009. Among the favorable aspects of the application procedure, the stakeholders mentioned that the route followed for accreditation according to 45011 made the CBs ready for most of the requirements by the Commission. Online application and e-mailing facility was also found helpful. On the other hand, with respect to difficulties, the stakeholders stated that the application procedure was not very clear, especially to the third country CBs since they were not familiar with the system and the terminology. Besides, they highlighted the importance of transparency in application and evaluation processes. The stakeholders mentioned that, once recognized, a more practical way of renewal should be formulated than restarting the application each five years. Another issue of concern among the stakeholders was about repeated controls. They were worried that they would be inspected a third time by the EU after those of the Turkish Ministry of Agriculture and Rural Affairs and the Turkish Accreditation Agency. According to the stakeholders, this would make the system even more complicated and costly, especially in terms of labor requirement. The stakeholders think that assistance was needed for a smoother and more efficient application process for Turkish CBs. Cooperation among CBs especially involving those CBs with European

background is viewed as the most promising strategy. The stakeholders also underlined that assistance should have been organized by Turkish public authorities. They mentioned that the EU could make the application process more user-friendly for third country CBs. It was also stated that the Turkish Ministry of Agriculture could monitor the improvements of the system in the EU, and provide a road map.

Turkey's application for the Third Country List was in 2003. Recently improvement has been accomplished and the inclusion is expected in the near future. The stakeholders agreed that, this would be an advantage for the CBs operating in Turkey.

Issue 3: Impact on the quality of controls in third countries / Effectiveness and Efficacy of the control system

According to the stakeholders, the new import regime would have positive effects on the quality of the organic control system in third countries. Besides, it is believed that the work loads and thus costs of the exporters would decrease. However, influence on the operating costs of the CBs can not be assessed by the stakeholders yet. Representatives of the CBs have pointed out that, in the new system, lack of control over export procedure by CBs might weaken the control system. They suggested clear guidelines should be put forward to avoid negative effects. The stakeholders also suggested formation of a monitoring system among CBs for auto-control to avoid distrust to Turkish organic products.

Issue 4: Coordination by the Commission to ensure harmonized procedures / Establishment of principles encouraging the harmonization of standards

The stakeholders emphasized that Turkish regulation was considerably harmonized with the regulation of the EU. However, they suggested that, diversity of the countries' conditions such as local applications, local additives, etc. must be considered by the EU regulation. Harmonization of the EU import procedures brought about by the new regulation is viewed quite positively by the stakeholders. It is believed that, not only organic regulations but also standards such as national food and trade regulations for conventional products should have been harmonized with the EU standards.

Issue 5: Guaranteeing fair competition for products produced in and outside the EU (equal requirements)

According to the stakeholders the new regulation improved the situation with regard to fair competition, as it provided more and wider options to reach the EU market for third country firms. Since import permit procedure by Member States will disappear, the stakeholders stated that an important complication would be eliminated, and it would become easier to access to the EU market. According to the stakeholders, this would create further competition among exporters. The number of the CBs to be recognized from a third country is expected to be a critical factor for trade. Therefore, transparency is deemed crucial. Besides, the EU – non-EU label is expected to be a matter of competition. The stakeholders agreed that Turkey should create trust in its products. They also pronounced that a possible perception bias with respect to equivalent and compliant products might cause unfair competition. The stakeholders suggested that the European consumers should be accurately informed to avoid this

Issue 6: Reduction of trade barriers/ easier access to EU

The stakeholders believed that, the new regulation would facilitate the entrance in the EU organic market. The removal of import permit is expected to accelerate the foreign trade. The cost of EU market accession is supposed to be decreased by less paper

work. According to the stakeholders, importers in the EU would be able to access increased number of exporters. All these factors are expected to increase the organic export volume of Turkey to the EU. On the other hand, the competition in the market is expected to reduce the price levels. The stakeholders suggested that the third country companies should develop strategies to adopt themselves to the emerging new conditions.

Discussion and Conclusions

Turkey is in special position with respect to exports to the EU. The countries' organic agricultural production system is harmonized to that of the EU to a great extent and inclusion in the Third Country List is expected soon. Entrance in the list of Third Country List for equivalency would mean that the countries' national organic agricultural system would be recognized by the EU. On the other hand, the compliance and equivalence list approach for CBs brought about by the EU new organic import regulation aims at improving the organic agricultural control system in countries where the underlying system of controls is weak.

The fact that the import permits by member states would disappear and therefore the bureaucratic procedures will be reduced is expected to both accelerate the accession of third countries to the EU organic market; and enable the importers in the EU to work with a higher number of exporters. However such an improvement could create uncertainty from the stand point of the production and investment for producers and exporters in the third countries.

A more user friendly application procedure and a transparent evaluation process for inclusion in the lists of recognized CBs are considered necessary. Establishment of a platform among CBs operating in the country both for resolution of their common problems and for controlling each others practices is deemed to have vital importance for improvement and maintenance of the quality in organic production in the third countries. It is considered unnecessary to repeat the application procedure for inclusion in the lists of equivalency and compliance for CBs for each five years, as they would already be inspected regularly. It is suggested that a CB could stay in the list unless a problem occurs with its documents/practices. Besides, it is found to be unclear how would the EU manage the regular controls in terms of financial and personnel resources.

References

- Huber B. (2008), Opportunities and risks of the revised European import regime, 16th IFOAM Organic World Congress Modena, Italy, June 16-20, 2008, <http://orgprints.org/12781>, (accessed 2010-06-12).
- MOAN (2010), 5th Annual Meeting, Tunis Hammamet, Tunisia, 07-09 June 2010, Meeting Report, http://www.ifoam.org/about_ifoam/around_world/eu_group-new/workareas/regulation/pdf/MOANoutputreportTunisia_final.pdf, (accessed 2010-10-5).
- Neuendorff J., Huber B. (2009), The new import regulation; More reliability for imported organic products? Camilla M., Schlüter M. IFOAM EU Group (eds.): The New EU Regulation for Organic Food and Farming: (EC) No: 834/2007, IFOAM Publishing, Brussels, p.41-44.
- Pierce J. (2010), Importing Organic to the EU, Past, Present and Future: A Third Country Perspective, Proceeding 4th European Organic Congress, Rome, June 21-22 2010, http://www.organic-congress-ifoameu.org/4th_Congress,_Rome/Congress_material.aspx, (accessed 2010-10-5).

Non compliance in organic certification: determinants for Italy

Gambelli, D.¹, Solfanelli, F.², & Zanolì, R.³

Key words: organic certification, non compliance, count data models, Bayesian networks, Italy

Abstract

Organic certification is based on controls on operators, and verify if they are compliant with respect to organic regulations. Control procedures are a transaction cost that affect organic farming relative competitiveness. Here we propose an analysis aiming at increasing the efficiency in the individuation of key risk factors in the organic certification process. The study refers to Italian organic farmers and represents an attempt to implement a risk based inspection scheme based on a statistical approach.

Introduction

Certification is a distinctive feature of organic farming, and a concrete tool to assure that organic production rules are fulfilled. However, organic certification costs represent an important competitive disadvantage for organic farming. An improvement in the efficiency of control procedures of organic control bodies may help in reducing this transaction cost, providing a basis for a general increase in organic farms competitiveness. Here we present the results of a study for risk based inspections aiming at facilitating the individuation of the main risk factors of non compliances for organic operators. The study is part of the EU research project CERTCOST. The general aim is to individuate key factors that are more likely to be associated to non compliances, using both parametric and non parametric approaches. Only non compliances that generate sanctions are considered, and classified according to their severeness. A general description of the sanction distribution for 2008 is provided, and the main outcomes of the statistical analyses are discussed, also in terms of potential further research in this field.

Materials and methods

Data are taken from a dataset developed in the CERTCOST EU Project, and are based on data from certification bodies from different European countries. Italian data are provided by ICEA, the main Italian certification body, and for 2008 consists of 9.351 farmers, of which 1219 also have a processing activity. The dataset contains information on structural-managerial characteristics (e.g. farm size, crops types, livestock types, product type), control data (type and number of controls) and sanctions data (type and number of sanctions). Explanatory variables have been discretised or dichotomised. Since no information is available about the type and severity of non-compliances, we use sanctions data as a proxy. Following Accredia

¹ Università Politecnica delle Marche, via Brecce Bianche 12, 60131 Ancona, Italy, E-Mail d.gambelli@univpm.it

² As Above, E-Mail f.solfanelli@agrecon.univpm.it

³ As Above, E-Mail r.zanoli@univpm.it

guidelines, for each operator we have deduced the type of non-compliance encountered from the resulting sanctions. Sanctions have been grouped and recoded into two general categories: moderate sanctions, referring to irregularities, i.e. less severe non-compliances, and severe sanctions, referring to infringements, i.e. most severe non-compliances. See Tab. 1 for a description of sanctions type distribution. On average, nearly 11% of the Italian farms were sanctioned in 2008. Almost 75 % of the sanction imposed was less severe (slight and moderate sanctions), while the rest (25%) were enclosed in the most severe group (severe and extreme).

Tab.1: Distribution of sanctions by type, IT 2008.

| Nr. of sanctions imposed on a farm | Number of operators | | |
|---|----------------------------|-------------------------|--------------|
| | Moderate sanctions | Severe sanctions | Total |
| 0 | 8.779 | 9.153 | 8.605 |
| 1 | 430 | 147 | 545 |
| 2 | 118 | 46 | 167 |
| 3 | 13 | 4 | 14 |
| >4 | 11 | 1 | 20 |
| Total sanctions | 751 | 255 | 1.006 |

Source: CERTCOST database - ITALY 2008

Here we present results arising from two approaches: a parametric approach based on binary choice models, and a probabilistic approach based on Bayesian Networks (BN). The binary choice model here used is a logit model, based on logistic distribution, and allows to explain the presence of sanctions detected as function of a set of explanatory variables (Greene 2008). The logistic distribution has been preferred to the standard normal distribution as it has shown a better management of the extremely sparse data on sanctions in the sample. The unrestricted model consists of a wide explanatory variable set, with 46 variables referring to crop and livestock types (e.g. cereals, poultry, etc) , structural variables (e.g. utilisable arable area (UAA), livestock units activity, etc) and specific risk factors (occurrence of sanctions in the previous year). A backward stepwise procedure has been followed, testing for statistical significance of the single coefficients (at least 5% significance required) and eliminating those that proved to be not relevant. Finally, we have performed a LR test to consider the validity of the restricted model. The BN approach (Horvitz et al., 1988) builds up a network of connections among variables, and the links among variables are measured in terms of conditional probabilities. More specifically BNs are used to determine the conditional probability of non-compliance given a set of "evidences", i.e. the actual occurrence of the event that a certain variable assumes a given value. For instance, we can infer the probability of getting an infringement if a farmer cultivates a specific crop. The impact of evidences on the network has been designed using the PC algorithm, while conditional probabilities have been computed through the expectation maximisation procedure of Hugin 7.0 software. For both models, variables have been discretised or dichotomised.

Results

Results from logit regression and BN are summarised in Tab 2 and show the variables that have been found as relevant impact on the risk of moderate and severe sanctions. For the logit model, only variables resulting from the restricted model

resulting from the stepwise estimation are listed (the final restricted model has passed the LR constraint test). For the BN model only variables showing a sensible impact on the probabilities of sanctions are considered. + and – signs are respectively meaning a positive or negative impact of the variable on the probability of a farmer to get at least one sanction. Labels in bold indicate variables that are relevant for both models.

Tab. 2: Variables affecting sanctions risk: results from logit regression, ICEA data 2008. Variables are dichotomised, unless differently specified

| | Moderate Sanctions | | Severe Sanctions | |
|---------------------------------|--------------------|-----|------------------|-----|
| | logit | bbn | logit | bbn |
| <i>Crop and livestock types</i> | | | | |
| Cereals | | + | | + |
| Citrus | | - | | - |
| Dried pulses | | + | | + |
| Fresh vegetables | | | + | |
| Fruit | - | | | |
| Grapes | + | | + | |
| Grassland | + | | + | |
| Green fodder | + | + | | |
| Industrial crops | - | | + | |
| Olives | | | | - |
| Poultry | + | | + | |
| <i>Structural factors</i> | | | | |
| Conventional UAA | - | | + | + |
| GMO-risk crops (maize, soya) | - | + | | + |
| Livestock Units <10 | | | + | |
| Crop structure complexity* | + | + | + | + |
| Nr of products (nr) | | + | | |
| Processor | + | | - | |
| UAA (ha) | | + | | + |
| <i>Sanctions</i> | | | | |
| Moderate Sanctions in 2007 | + | + | + | |
| Severe sanctions in 2007 | | | + | + |

*a Shannon index has been used for the logit models as a proxy of crop structure complexity, while the number of crops has been used for BN models;

Discussion

Results from Tab 2 indicate that among crop and livestock type category, logit and BN individuate different group of variables as relevant, with the only exception of “Green fodder”, which is considered as a risk factor for moderate sanctions in both models. Also, while many risk factors are common for both moderate and severe sanctions, some variables are only relevant for one sanction type: “Fresh vegetables”, “Fruit”, “Olives”. For what concerns the structural risk factors, “Conventional UAA” and “Crop structure complexity” are significant in both models, with the second one found as relevant for both the moderate and severe sanction risk. Controversial results are found for “GMO-risk crops” in the moderate sanction models. Finally, almost univocal

results are found for moderate and severe sanctions issued in 2007: it is interesting to note how the risk of moderate sanctions is not affected by the occurrence of severe sanctions in 2007, while some evidence from the logit model indicate that 2007 moderate sanctions increase the risk of severe sanctions. The occurrence of sanctions in 2007 can be interpreted as a proxy of the farmers' individual effect, like farmers' attitude to fraud, managerial errors, geographical aspects, etc. Unfortunately the scientific literature on these aspects is extremely scarce. Gambelli and Solfanelli (2009) have performed similar analysis for moderate sanctions using a dataset of Italian farm from another certification body, testing different farm types risk of non-compliances. Similar results are found in particular for what concerns the key role of the sanctions issued in the previous years. Also, the negative effect on sanctions risk of citrus and olives and the positive one of livestock related crops (grassland, green fodder, mais) are confirmed in both studies.

Conclusions

The approach we have used for this study show encouraging results and can be considered as complimentary tools for understanding risk patterns in the organic certification schemes. It is necessary to consider that results cannot be generalised and should be considered relevant only for the specific control body that provided the dataset. Further work is needed, in particular for what concerns the analysis of different combination of variables and the elaboration of more powerful econometric models. For what concerns the first aspect, it is reasonable to suppose that some variables could be considered at risk only when combined with other. For what concerns the second aspect, the incorporation of the time dimension and the use of count data models, which also explain the actual number of sanction detected, could be considered as interesting options to consider. However, the general approach focussing on a standardisation of sanction types and the use of probabilistic models can be considered a promising step towards the definition of a risk based inspection systems that could improve efficiency in the organic sector.

Acknowledgments

This publication was generated as part of the CERTCOST project, agreement no. 207727 (<http://www.certcost.org>), with financial support from the European Community under the 7th Framework Programme. The publication reflects the views of the author(s) and not those of the European Community, who is not to be held liable for any use that may be made of the information contained

References

- ACCREDIA (2009): Directives for accreditation of Bodies, http://www.accredia.it/extsearch_documentazione.jsp?area=7&ID_LINK=57&page=13&IDCTX=168&id_context=168
- CERTCOST www.certcost.org
- Gambelli, D., Solfanelli, F. (2009), Una Rete Bayesiana per migliorare l'efficienza della fase di ispezione del processo di certificazione biologica, Cresimanno M., Schifani G. (eds) Agricoltura Biologica: sistemi produttivi e modelli di commercializzazione e consumo, proceedings of the IV GRABIT Workshop, Palermo, p 91-96.
- Greene, W. H. (2008) Econometric Analysis, Prentice Hall, upper Saddle River - N.J., 1178 p.
- Horvitz, E.J., Breese, J.S. & Henrion, M., 1988. Decision theory in expert systems and artificial intelligence. International Journal of Approximate Reasoning 2, 247-302.

Modelling risk-based inspections in EU organic certification: data requirements and analysis tools

Gambelli, D.¹, Solfanelli, F.², Zorn, A.³, Lippert, C.⁴, Dabbert, S.⁵ & Zanolì, R.⁶

Key words: Organic Certification, Risk-based Inspections, Risk Modelling, Discrete-choice Models, Bayesian Networks

Abstract

A Risk Based Inspection (RBI) scheme is a planning tool used to develop the optimum plan for the execution of inspection activities. Organic certification system could benefit from the implementation of RBIs in terms of higher effectiveness, i.e. trustability, and lower transaction costs for organic operators. Data from certification bodies provide basic information about non-compliances and structural aspects of organic operators. Here we propose a methodological approach to risk analysis modelling, based on discrete choice models and Bayesian networks, both aiming at the identification of key risk factor in the organic certification process in the European Union.

Introduction

The goal of Risk Based Inspections (RBIs) is to develop a cost-effective inspection and maintenance programme that provides assurance of acceptable integrity and reliability. RBIs use the findings from a formal risk analysis – according to defined criteria - to guide the direction and emphasis of the inspection planning and the physical inspection procedures. A risk-based approach to inspection planning in the organic certification system should consider two aspects: the improvement in the analysis of the probability of a fraud or non-compliance to be detected, and the economic evaluation of a higher efficiency and effectiveness of the certification system.

Here we particularly focus on the first aspect, and discuss some methodological proposals based on discrete choice models and Bayesian networks (BN) to analyse the probabilities of non-compliances with respect to the rules and regulation of the organic farming practices. The aim is to provide tools to support inspections and to focus efforts onto the most critical categories of organic operators, both farmers and

¹ Università Politecnica delle Marche, via Brecce Bianche 12, 60131 Ancona, Italy, E-Mail d.gambelli@univpm.it

² Università Politecnica delle Marche, via Brecce Bianche 12, 60131 Ancona, Italy, E-Mail f.solfanelli@univpm.it

³ Universität Hohenheim Institut für Landwirtschaftliche Betriebslehre 410a, 70593 Stuttgart, E-Mail Alexander.Zorn@uni-hohenheim.de

⁴ Universität Hohenheim Institut für Landwirtschaftliche Betriebslehre 410a, 70593 Stuttgart, E-Mail Cristian.Lippert@uni-hohenheim.de

⁵ Universität Hohenheim Institut für Landwirtschaftliche Betriebslehre 410a, 70593 Stuttgart, E-Mail Stephan.Dabbert@uni-hohenheim.de

⁶ Università Politecnica delle Marche, via Brecce Bianche 12, 60131 Ancona, Italy, E-Mail r.zanolì@univpm.it

processors. The implementation of a codified RBI approach becomes particularly relevant if it can be harmonised at the level of general elements a system should contain, and then applied to certification systems of different countries. Therefore we also discuss some relevant issues concerning the availability of standardised control data from the European organic certification bodies.

Materials and methods

In operative terms, modelling harmonised RBIs for the organic system means to explain the probability of detection of non-compliances conditional to a set of risk factors, or variables. Two aspects are therefore involved: a harmonised dataset of relevant information for organic certification systems, and a set of methods to properly assess relevant risk functions. For what concerns the first aspect, from the perspective of a harmonised RBI a first crucial issue is that the central term non-compliance is not clearly defined in the EU regulation. Non-compliances are classified as irregularities and infringements (REG 2091/91) though no explicit definition is provided. From the analysis of REG 834/2007, however, we can conclude that irregularities refer to non compliances concerning documental/formal aspects and temporary violation of Reg 834/2007, while infringements refer to non compliances concerning violation with long term effects (also documental/formal). In this research we have collected data from certification bodies in Italy, Denmark, Germany, Switzerland, Check Republic and United Kingdom. A wide range of structural variables are available for each country, like land area, livestock, type of crops etc, and they have been homogenised as well, using Eurostat classifications where applicable.

Results

Information on non compliance and related sanctions is stored by control bodies of each country according to different definitions and schemes, and no detailed information on the type and severity of non compliances encountered is available in an electronic format for all of them. Therefore, we have used the type of sanctions, for which data are available in detail, as an indicator of relevant non-conformities and of their degree of severity. Following the approach of Accredia (Italian accreditation body) for defining which sanction shall be associated to each type of non compliance, and thanks to the support of ICEA and IMO qualified staff, we have provided a homogenised classification of sanctions for all countries, and have grouped similar sanction types into four classes, corresponding to irregularities and infringements (Tab. 1).

Tab. 1 Scheme for homogenisation of sanctions and non-compliances

| Homogenised sanction type | Type of non compliance | Nr of country specific sanctions types | | | | | |
|---------------------------|------------------------|--|----|----|----|----|-----|
| | | CH | CZ | DE | DK | IT | UK* |
| Slight | Irregularities | 5 | 1 | 3 | 4 | 1 | 1 |
| Moderate | | 4 | 1 | 1 | 3 | 1 | 1 |
| Severe | Infringements | 5 | 1 | 1 | 3 | 1 | 1 |
| Extreme | | 2 | 1 | 2 | 2 | 2 | 1 |

* Non-compliances

Note that for UK no data on sanctions are available, but differently from other countries, non-compliances are codified in terms of severity, which allowed us to use the same classification used for sanctions, though of course they are not directly comparable. A common database has been produced, merging data from each country, that includes 84386 operators, both pure farmers, pure processors and mixed farmer/processors. The database contains more than 900 variables, though with many missing values as not all data are available for all countries. Structural variables have been used to specify hypotheses concerning relevant risk factors, which can be summarised as indicated in Tab. 2.

Tab. 2 Variables hypothesized to be related to risk factors

| Risk factor category | Variables |
|---|--|
| General risk aspects (all operators) | Operators who got sanctions in the past; operators with other certification schemes; operator experience as organic |
| Structural/managerial aspects (farmers) | Size (UAA, Livestock units), size related indexes (e.g. UAA < 10 ha), processing activity, non organic land/livestock, production complexity (e.g. number of crops/species), crops and livestock types (Eurostat classification) |
| Structural/managerial aspects (processors) | Number of products, turnover, farming activity, product types. |

Discussion

In terms of RBIs, we are interested to assess the probability of detecting non-conformities when a set of “risk variables” takes specific values. Different results can be obtained: an impact evaluation of single risk factors, and the impact evaluation of different combination of variables (farm types) jointly considered. The aim is to discriminate between low and high-risk operators. Discrete choice models (particularly Logit and Poisson models, cf. Greene, 2008) and Bayesian networks (Horvitz *et al.*, 1988, Jensen 1996) are used to model non-compliances probabilities.

Logistic models estimate the probability of a sanction to be detected ($Y=1$), given a set of explanatory variables \mathbf{x} and a set of coefficients β , as:

$$prob(Y=1 | \mathbf{x}) = \frac{e^{\mathbf{x}'\beta}}{1 + e^{\mathbf{x}'\beta}}, \text{ hence considering a binary probability}$$

while Poisson models estimate the probability of detecting a discrete number of sanction ($Y=y_i$) as follows:

$$prob(Y = y_i | \mathbf{x}_i) = \frac{e^{-\lambda_i} \lambda_i^{y_i}}{y_i!}, \text{ where } \ln \lambda_i = \mathbf{x}_i' \beta$$

BNs have an alternative approach based on conditional probabilities and can be interpreted as a model of the interactions among a set of variables, where each variable has a finite set of mutually exclusive states. Information about the actual state of one or more variables (evidences) can be used also to evaluate the probabilities of different variable configurations, i.e. to simulate what the probability of a specific state

of the network would be. For instance, given two variables A and B, and an evidence set e, BNs can compute the probability that A and B assume respectively the states a, b:

$$prob(A = a, B = b | e) = \frac{prob(A = a, B = b)}{prob(e)}$$

The econometric approach allows testing statistically the relevance of risk factors, and their impact on the probability of non-compliances, while the BN approach provides an estimate of the impact of different combinations of risk factors on the probability of non-compliances.

Conclusions

Harmonised RBI is crucial to guarantee integrity, improve efficiency and reduce the cost of inspections: a growing body of small “organic” farmers and growers are refusing certification and inspection schemes and selling on alternative short supply-chains – this creates further confusion among consumers. A set of econometric and statistical tools allow to identify the critical risk factors to be considered for detecting non compliances, hence providing a scientific support to the focussing of control activities towards more risky cases. Such modelling approach requires however a great effort in data collection and harmonisation. Clear and uniform criteria for classifying non-compliances and better data and information systems are required to successfully implement RBIs on a larger scale.

Acknowledgments

This publication was generated as part of the CERTCOST project, agreement no. 207727 (<http://www.certcost.org>), with financial support from the European Community under the 7th Framework Programme. The publication reflects the views of the author(s) and not those of the European Community, who is not to be held liable for any use that may be made of the information contained

We wish to thank Samanta Rosi Belliere, Institute for Ethical and Environmental Certification-ICEA and Elizabeth Rueegg, Institute for Marketecology – IMO, for their support.

References .

- ACCREDIA (2009): Directives for accreditation of Bodies issuing declarations of conformity of agricultural processes and products and food-stuffs produced by organic agriculture methods according to EC Regulations n. 834/2007 and following integrations and modifications, http://www.accredia.it/extsearch_documentazione.jsp?area=7&ID_LINK=57&page=13&IDCTX=168&id_context=168
- CERTCOST www.certcost.org
- Greene, W. H. (2008) *Econometric Analysis*, Prentice Hall, upper Saddle River - N.J., 1178 p.
- Horvitz, E.J., Breese, J.S. & Henrion, M., 1988. Decision theory in expert systems and artificial intelligence. *International Journal of Approximate Reasoning* 2, 247-302.
- Jensen, F.V. (1996) *An introduction to Bayesian Networks*. University College London Press.

Environmental and socioeconomic impact of organic coffee certification in Central America as compared with other certification seals

Soto, G.¹, Hagggar, J.², Le Coq, J.F.³, Gonzalez, C.⁴, Soto, A.⁵ Casanoves, F.⁶,
Corrales, E.⁷, De Melo, E.⁸, Jerez, R.⁹ & Quilo, A.¹⁰

Key words: Comparison coffee certification, Central America Coffee, Organic coffee

Abstract

806 farmers were surveyed in Nicaragua, Costa Rica & Guatemala, using COSA® format to determine the socio economic and environmental impact of coffee certification. 40 farmers from each certification (organic, fair trade (FT), Rainforest Alliance (RA), CAFE Practices (CP) and Utz Certified) were interviewed and compared with 80 non-certified farmers on each country. Results showed better performance of environmental indicators (Carbon footprint) in organic farms. Economic impacts were affected by farm altitude and size. RA and CP certified farms were in general larger farms (> 10 has), with higher production costs and but higher productivity resulting in greater income per hectare. Utz, Organic and FT were smaller farms, with lower production costs and lower productivity. Guatemala did not show differences in certified vs conventional sales prices for any seal. Although organic farms had on average the best coffee price they had one of the lowest income due to low productivity.

Introduction

Coffee production is the major commercial activity in the Central American region among small landowners. Organic and Fair Trade coffee started in the region in the mid 1990's, with a peak during the coffee crisis (2001-2004) (Ponce 2004). Other certifications, such as Utz certified, Rainforest Alliance (RA) and CAFE Practices (CP) were also established in the region to improve farmers' socioeconomic conditions and environment protection. In spite of all the investment, the increase in the conventional coffee price has caused a decrease in the number of organic coffee farmers (Hagggar & Soto 2010). Farmers are stepping out of the activity, switching to conventional production systems. Previous studies have evaluated the impact of coffee certification on agricultural practices and environmental impacts in Costa Rica (Quispe 2007), and Nicaragua and Honduras (Giovannucci & Potts 2008). These studies have shown the positive environmental impact of organic farming. Based on farmers' perception, organic coffee lowest productivity is due to low investment, confusion between organic

¹ Centro Agronómico Tropical de Investigación y Enseñanza, CATIE, Costa Rica.
gabisoto@catie.ac.cr. Internet www.catie.ac.cr

² As above jhagggar@gmail.com

³ CIRAD, France. jflecoq@cirad.fr. Internet www.cirad.fr

⁴ CATIE, cgonzalez@catie.ac.cr

⁵ University of Costa Rica

⁶ CATIE, casanoves@catie.ac.cr

⁷ As above ecorrale@catie.ac.cr

⁸ As above edemelo@catie.ac.cr

⁹ As above jerezni@yahoo.com

¹⁰ As above aleuqco1@gmail.com

and abandoned coffee, and recent certification restrictions in chicken manure (a major source of nitrogen) (Haggar & Soto 2010). This research seeks to understand the impact of the different certifications in the environment and the well being of the coffee farmers in the region.

Materials and methods

806 farmers from Costa Rica, Nicaragua and Guatemala were surveyed by coffee technicians of ANACAFE in Guatemala, and CATIE researchers in Nicaragua and Costa Rica. Surveys covered topics such as production costs and productivity for the 2008-2009 harvest. The survey used was developed by COSA® and adapted to local conditions by the local coffee specialist from CATIE and CIRAD, France.

Results

There was a strong correlation between farm size and seal in Nicaragua and Guatemala, where larger farms (>10 has) were certified RA and CP, while small farms (< 3 has) were certified organic and fair trade, or no-certified ($p < 0.001$). Average Utz farms have more than 10 has in Guatemala and less than 10 has in Costa Rica and Nicaragua. In Costa Rica the size – certification relationship was not observed.

Environmental impacts. Different size farm's carbon footprint was calculated in Nicaragua and Costa Rica. Organic farms showed the smaller footprint compared with conventional and RA certified farms. In all cases 80 to 90% of the footprint is linked to the organic or synthetic nitrogen fertilizer and the N_2O emissions.

Table 1. Coffee farm carbon footprints under different certifications schemes in Nicaragua and Costa Rica (n = number of farms used for each analysis).

| Country | Certification | Carbon footprint (kg CO ₂ e kg coffee cherries ⁻¹) | Farm size (ha) | n |
|------------|---------------|---|----------------|----|
| Costa Rica | Rain Forest | 0.38 | 1 to 11 | 22 |
| Costa Rica | Organic | 0.11 | 10 to 20 | 2 |
| Nicaragua | Rain Forest | 0.21 | 25 to 100 | 8 |
| Nicaragua | Conventional | 0.20 | 25 to 100 | 16 |
| Nicaragua | Organic | 0.05 | < 5 | 23 |
| Nicaragua | Conventional | 0.13 | < 5 | 29 |

Socio-economic impacts. Production costs: The main cost on all farms in Nicaragua was labour (Fig. 1), accounting for 50 to 55% of total cost, with the exception of organic and Utz, where labour cost represented 80% of the total cost. Little investment was observed in pesticides (including herbicides). The second main cost in all systems was fertilizers. These data include all costs related to the production, including transportation and use of synthetic and organic fertilizers such as compost or chicken manure for organic farmers (Fig. 2).

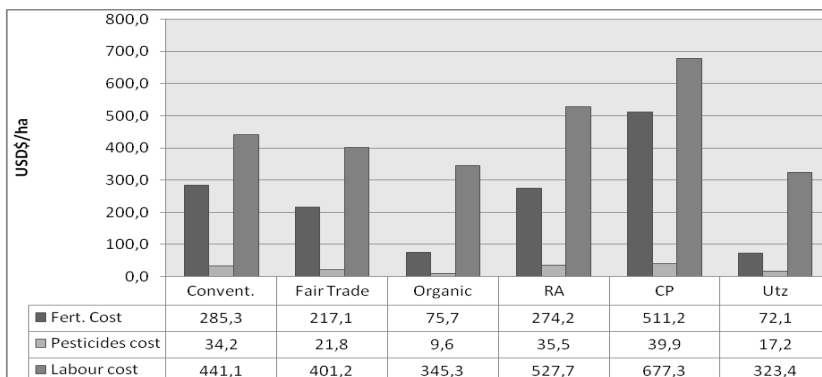


Fig.1. Fertilizer, pesticides and labour cost production for certified farmers in Nicaragua during the 2008-2009 harvest.

When compared the different certification systems, organic farmers are the ones that invest less on fertility management. The limited investment of organic farmers in fertilizers may be one of the reasons for its low productivity (488 kg/ha), as compared with CP in Nicaragua (1541 kg/ha) or RA (1035 kg/ha).

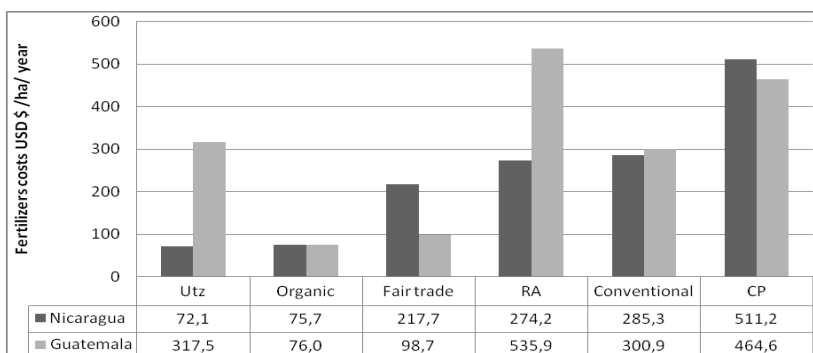


Fig. 2. Fertilizers costs (USD\$/ha) for conventional and certified coffee farms in Nicaragua and Guatemala (2008-2009), based on data provided by farmers.

Organic coffee sale prices per 46 Kg bag were higher in Costa Rica and Nicaragua than any other certification or conventional coffee price ($p > 0,001$). No statistical difference was observed in coffee prices among the different certifications in Guatemala (Fig 3). In Guatemala the Utz price was higher than in Costa Rica and Nicaragua. Utz price in Nicaragua was even lower than the conventional. The sample of Utz certified farms in Nicaragua was below the 800 masl, what could explain the lower sale price observed. Although organic farming has the higher market price in Nicaragua and Costa Rica, there was not statistic difference in profit when compared with conventional or fair trade coffee. This is due to the lower productivity of the organic coffee in all countries. The most profitable systems were RA and CP in all three countries, probably directly related to farm size and investment capability.

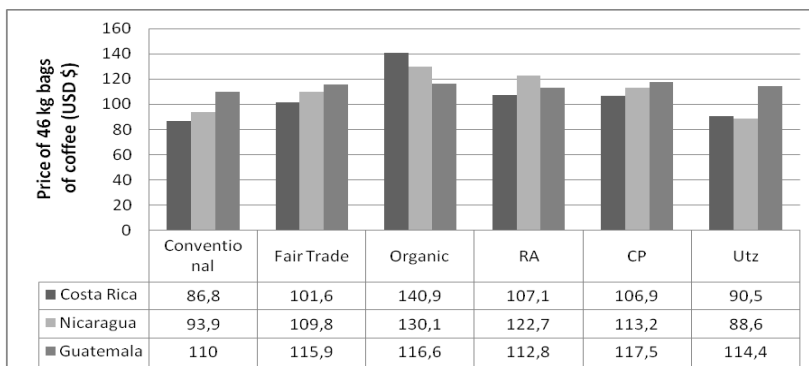


Fig. 3 Coffee prices received by farmers per 46 Kg bags of green certified and conventional coffee per country for the 2008-2009 harvest as informed by farmers.

Discussion

Larger, RA and CP certified farms have the highest profit in the region. Small farms with low investing capability can compensate for this situation with the higher prices of the organic coffee. However, when the conventional price is high, the premium cannot compensate for the differences in productivity. So it is vital to improve productivity in organic farms. This could be achieved with more scientific research, better training, but specially by improving the investing capability of these farmers.

Carbon Footprint in all organic farmers was lower than in conventional or RA certified farms due to the different sources of Nitrogen used.

Acknowledgments

This research was possible to the 806 farmers which willingly took their time to respond our questions. As well as to the financial support of the EU-CIRAD-(CAFNET-CATIE) project.

References

- Giovannucci D., Potts J. (2008): Seeking sustainability. COSA Preliminary Analysis of Sustainability Initiative in the Coffee Sector. IISD. 48 p.
- Haggar J., Soto G. (2010): Análisis del Estado de la Caficultura Orgánica en Centro América. Coordinadora de Comercio Justo en América Latina (CLAJ) Report. 60 p.
- Ponce S. (2004): Standards and sustainability in the coffee sector: a global value chain approach. International Institute for Sustainable Development Report.
- Quispe J. (2007): Caracterización del impacto ambiental y productivo de las diferentes normas de certificación de café en Costa Rica. MSc Thesis CATIE, Costa Rica.

Costs of certification of organic operators

Stolze, M.¹, Moschitz, H.¹, Hartmann, M. & Huber, B.¹

Key words: organic farms, organic processors, certification, transaction costs

Abstract

Even though thousands of operators opt for the organic control systems implying that they assess a positive balance of costs and benefits, hitherto almost no information is available on the monetary expenditures and the private transaction costs of organic operators in the context of control and certification. The analysis of four electronic control records and a survey of organic operators in Germany, Switzerland, Czech Republic and the UK concluded that the most relevant factors determining the duration of the control are type of control, the number of sanctions, farm complexity and farm size. While the inspection fee is the most relevant monetary expenditure for organic operators, the time of the actual inspection visit is in most cases lower than 20% of the total time operators spent a year in the context of organic certification. The most relevant perceived workload for farmers and processors is the time required for the preparation of the control.

Introduction

While there is some literature on certification and underlying institutions in the food sector (e.g. Hatanaka *et al.* 2005, Jahn *et al.* 2005, Schulze and Spiller 2006), detailed scientific analyses regarding certification costs for organic food and farming are quite scarce. A worldwide survey of certification fees - which covers only a part of all relevant costs - conducted in 2001 (Rundgren 2001) estimated farms' share of total certification fees to be in the range of 3% of the farms' total turnover. The financial burden from organic certification services is estimated to amount to 1.5% of organic retail turnover. But this estimation only considers the monetary expenditures of certification. While for the majority of organic operators, this is probably the most important share of the total costs, very little information exists so far on other potentially significant burdens like operator's workload for preparing the control visits and documentation obligations.

Thus, the aim of this paper is to analyse i) the certification fees of organic operators (farmers and processors) and ii) to estimate the time organic operators require apart from the actual control visit in the context of certification. The research work presented here is conducted as part of the FP7 project CERTCOST.

Materials and methods

The workload connected to certification is a significant part of the costs next to cash-based costs like the certification fee and the expenses for the control. Organic operators spend a considerable amount of time, in order to satisfy the requirements, especially the documentation requirements laid down in Council Regulation (EC) No 834/2007 and in private organic standards. Examples for non-monetary (opportunity

¹ Research Institute of Organic Agriculture FiBL, Ackerstrasse, 5070 Frick, Switzerland, E-Mail matthias.stolze@fibl.org, Internet www.fibl.org

costs) are time for information search, time spent for control visits and their preparation or time required for requests on derogation (Zorn *et al.* 2009). Some of these costs can be assigned to organic production exclusively (e.g. time spent on organic control visits), others serve different areas of an operation (e.g. documentation of incoming goods) and would also be carried out on a conventional farm (Zorn *et al.* 2009).

The challenge of analysing operators' costs of organic certification is that not all the data needed is publicly available in the required quality and degree of detail. Research presented in this paper therefore is based on two different data sources:

1. Electronic control reports from the years 2007, 2008 and 2009 retrieved from four control bodies in Germany, Switzerland, Czech Republic and from the UK. These control reports contain structural information about all the organic operators certified by the control body as well as information about the duration of the control visit and the inspection fee. In this paper, only information from 2008 will be presented.
2. A survey of organic operators accomplishes the electronic control reports for a subset of operators with information that was not available from the control reports. Two types of semi-structured questionnaires were prepared, one targeted at farms, and another one targeted at processors/packers or importers. The questionnaire included detailed questions about the tasks involved in preparing the control and certification, such as the time spent for informing oneself about possible changes in the standards, asking for special allowances or preparing all required documents. Data collection was done between September 2009 and March 2010 through interviews with selected operators conducted by control bodies. In total, 379 organic operators from Germany, Switzerland, Czech Republic and from the UK were surveyed (203 farmer, 106 farmer with processing, 70 processors) on information from 2008.

Data analysis was done through descriptive statistics and using linear regression models. Data on inspection fees from the control reports and the subset of data from the organic operator survey were tested for consistency using the Kruskal-Wallis-Test (non-parametric method for testing mean values from several samples). The two data sets (control reports and operator survey) showed high degree of consistency.

Results

The analysis of the control reports from four European control bodies (DE, CH, UK, CZ) showed that for farmers the average inspection fee amounts around 400 Euro per farm with slightly lower fees identified in the Swiss control reports whereas in the UK, the average inspection fee amounts more than 600 Euro (see Table 1). According to the analysed control reports from Germany, Switzerland and in the Czech Republic, the average inspection duration is approximately three hours per farm. Again, the UK control reports show for farms higher average inspection duration (4.26 hours) compared to the costumer records from Germany, Switzerland and from the Czech Republic. On-farm processing leads to both higher control duration and higher inspection costs. Regression analysis showed that farm size, type of control, the number of sanctions and the farm type as a measure for farm complexity have an impact on the duration of the control visit.

The analysis of the control reports of German and Swiss control bodies showed that the control visit of processors requires slightly more time than controlling farmers. The inspection fee in both countries amount on average around 760 Euro. However, the average inspection fee calculated from the UK control reports is considerably higher than in the other costumer records from the other countries.

Tab. 1: Average inspection fee and inspection duration of organic operators 2008 (fee per operator; duration per control)

| | Germany | | Switzerland | | UK | | Czech Republic | |
|------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|----------------|-------------|
| | Fee | Hours | Fee | Hours | Fee | Hours | Fee | hours |
| | Euro | h | Euro | h | Euro | h | Euro | h |
| Farms | 425 | 2.71 | 364 | 3.04 | 611 | 4.26 | 419 | 3.15 |
| n | 1545 | 1706 | 2476 | 2633 | 1971 | 2209 | 725 | 745 |
| Farms with processing | 529 | 4.05 | 391 | 3.38 | 626 | 4.86 | n.d. | |
| n | 118 | 121 | 2032 | 2164 | 139 | 167 | | |
| Processors | 758 | 4.68 | 761 | 3.59 | 2331 | 4.02 | 290 | 1.72 |
| n | 402 | 451 | 651 | 672 | 1464 | 1812 | 285 | 306 |

n.d.: no data

Source: own calculation based on costumer records from four control bodies

Conversion to Euro based on average exchange rates of the year 2008 based on European Central Bank (2010)

The cash based cost of the inspection fee are only a part of the total costs of certification of an organic operator. Additional transaction costs result from the time organic operator spent on documentation obligations, information search, preparation of the control visit, advice with respect to certification and requests for derogation. The analysis of the control reports and the survey of organic operators show that the share of the actual control visits is only about 15-20% of the total operator's workload with respect to certification and control. The most relevant perceived workload is the time spent for preparation of the control visits which takes a share of up to 60% of the total farmer's workload for certification. Contrarily to the situation in the UK, Germany and Switzerland, in the Czech Republic organic farmers and processors spent up to 40% of the perceived workload for certification on information procurement.

Discussion and Conclusion

From the analysis of four electronic control reports from German, Swiss, Czech and UK control bodies showed a quite broad range in the inspection fees and control duration for farmers of 364 to 611 Euro per farm and year corresponding to 2.71 to 4.26 hours per control. The most relevant factors determining the duration of the control are type of control, the number of sanctions, farm complexity and farm size. With respect to the latter, most European control bodies use the farm size as one variable for calculating the inspection costs (Organic Rules and Certification 2010). On-farm processing leads to both higher control duration and higher inspection costs.

As far as organic processors are concerned, the average inspection fees vary considerably from 290 Euro per processor in the Czech Republic up to 2331 Euro for processor in the UK. The differences in the inspection fees are mainly due to different organic turnover and business size. Potential for reducing inspection fees are more or less limited to reducing either the number of controls or the time spent for on-farm controls. This could be achieved through the introduction of e.g. risk based certification systems.

While the inspection fee is the most relevant monetary expenditure for organic operators, the time of the actual inspection visit is in most cases lower than 20% of the total time operators spent a year in the context of organic certification. The most relevant perceived workload for farmers and processors is the time required for the preparation of the control. Organic operators from the Czech Republic invest quite some time in information search about organic certification. This might be a result of a high share of newcomers in the organic business. Indeed, the organic sector in the Czech Republic showed quite considerable growth rates (European Commission 2010). Easy accessible and comprehensive information about how organic control and certification works might be an effective tool for reducing private transaction costs caused by uncertainty about the certification procedure and certification system of operators which just started an organic business.

Acknowledgments

This publication was generated as part of the CERTCOST Project, agreement no. 207727 (<http://www.certcost.org>), with financial support from the European Community under the 7th Framework Programme. We are grateful to the project partners who provided substantial support in generating the two data sources.

References

- European Central Bank (2010): Monthly exchange rates 2008, <http://sdw.ecb.europa.eu/browse.do?node=2018794> (accessed 2010-11-21).
- European Commission (2010): An analysis of the EU organic sector. European Commission DG Agriculture and Rural Development, Brussels.
- Hatanaka, M., Bain, C., Busch, L. (2005): Third-party certification in the global agri-food system. *Food Policy* 30(3):354–369.
- Jahn, G., Schramm, M., Spiller, A. (2005): The Reliability of Certification: Quality Labels as a Consumer Policy Tool. *Journal of Consumer Policy* 28(1):53-73.
- Organic Rules and Certification (2010). Certification by country, <http://organicrules.org/view/CountryCertification/> (accessed 2010-07-15).
- Rundgren, G. (2001). What cost is organic certification? *The Organic Standard*, (7): 7-12.
- Schulze, H., Spiller, A. (2006): Checklist governance? Zur Prüfungsqualität von Zertifizierungssystemen im Agribusiness. Contribution at the 46th Annual Conference of the German Society of Economic and Social Sciences in Agriculture in Giessen, Germany, October 4-6, 2006.
- Zorn, A. Lippert, C. Dabbert, C. (2009): Economic Concepts of Organic Certification. Economic analysis of certification systems for organic food and farming CERTCOST Deliverable 5, Hohenheim.

Smallholders

Organic agriculture networks in Argentina. A case study

Grasa, O.¹ & Ghezán, G.²

Key words: Organic cereals, oilseeds and beef, Techno-economic networks

Abstract

Argentina has increased the area of organic production, number of farmers and organic market along the last two decades. Nevertheless, in the last two years exports have been decreased. It is said that organic networks could face periods of crisis. This paper improves knowledge about beginning, evolution and current work of a production and distribution networks in organic sector, applying the concepts and methodology of Techno-economic networks.

Introduction

Argentina is the second largest country in the world in the area dedicated to organic products. Moreover, organic land is 3% of the total Argentine agricultural area (FIBL-IFOAM, 2010). In the last decade, organic land in Argentina went up from 2.7 million hectares in 2000 to 3.9 million hectares in 2009. However, permanent grassland accounted about 90% of the total organic land in 2009, and the number of organic farmers has levelled off in about 1700 farmers. The export of organic products increased from 30 million tons in 2000 to 125 million tons in 2009 (+316 %). External market represents about 96% of the value of the total production and was estimated in u\$s150 million in 2007. The Europe Union (EU) is the most important market for Argentine organic products (60%) followed by the United State of America (USA) (21.5%). In 2009, there was a decrease in exports of organic products for the very first time. However, organic land and the number of organic farmers increased. This is explained, on the one hand, the introduction of land which had been in transition into full organic production (i.e. big sheep farms in the Patagonia region), and on the other hand, small beekeepers have started certification processes in Formosa.

Nowadays the Argentinean organic agriculture sector has advantage and disadvantages. The advantages are: 1) the global market keeps growing and Argentina can sell products in off-season to the main markets; 2) Argentine export sector has a large tradition and a complete certification system and equivalent standards. The disadvantages are: 1) the small size of domestic market, 2) the little information that organic farmers have about the commercial process and 3) the insufficient and disorganized policies (Volonté 2003, Fundación Export.Ar 2009).

The lack of information and knowledge about a specialty market like organic products is resolved by farmers through networks. Farmers join and construct networks in order to achieve information about products, technology, price and standards (cf. Lockie and Kitto 2000, Raynolds 2004). This paper shows how farmers construct their own networks through a case study (*Pampa Orgánica*: one of the most successful

¹Grasa, Oscar. Unidad Integrada Balcarce (FCA UNMDP-EEA INTA) and Research Area of Argentinean Organic Production Movement (MAPO). Argentina. oagrasa@balcarce.inta.gov.ar.

² Ghezán, Graciela. Unidad Integrada Balcarce (FCA UNMDP-EEA INTA), Ruta 226, Km 73.5, Argentina, gghezan@balcarce.inta.gov.ar.

networks in the Argentine organic sector). By doing so, the aim of this research is to understand the beginning, evolution and current work of an organic network in Argentina.

The first section of this paper shows the methodology. The second section presents *Pampa Orgánica* case study. And the last section points out some conclusions.

Materials and methods

As theoretical framework, concepts of techno-economic networks (Callon 1991), such as translation, coordination, alignment, convergence and irreversibility, are applied in this piece of work. The methodology used to understand the evolution of the networks was based on Amblard et al. (1996).

This research is part of a large analysis about organic networks in Argentina. Due the lack of space, this paper focuses on one of the three case studies selected. In order to understand the features of production-distribution and market of the Argentinean organic sector, secondary data was collected from Organic Organizations, web pages, references and reports from National Agri-food Health and Quality Service (SENASA). Then, primary data was collected through personal interviews to 6 qualified people from the organic sector. These interviews were used to select 3 case studies which illustrate the heterogeneity of the organic sector: *Pampa Orgánica* -an organic cereal and meat network-; San Isidro -an organic sugar (sugar cane juice) network; and Coopsol -an organic and fair trade honey network-. Then, 9 semi-structured interviews per case (on average) were carried out. In those interviews were collected information about productive and commercial issues; motivation, expectations and achievements of taking part in the network. By using Atlas Ti software package, it was possible to break up the interviews texts and make charts and graphs which illustrate the data.

Results and Discussion

The *Pampa Orgánica* group is made up of 12 extensive organic farmers of cereals, oilseeds and beef with 24,000 hectares of organic land spread along the Pampas region. The outstanding feature of this network is its heterogeneity. There is a wide range of area size, management styles, geographical location and commercialization system in the group.

The average size of the farms is 1,900 has. Moreover, 86% of the area is certified as organic production while the remaining 14% is under conventional production system. In this network there are farmers participating with more than 1,500 hectares, other have between 500 and 1,500 hectares, and also some of them with less than 500 hectares. Besides, there are farms specialized in agricultural production, in livestock production system and with mixed production systems. Regarding to management systems, in the group are non-professional owners, technical owners (Agriculture science professional) and also external managers in charge of technical and commercial decisions. All organic farms are certified and their farmers have experience in organic foods.

Pampa Orgánica is connected with Argentinean Organic Agriculture Movement (MAPO) and National Institute for Agricultural Technology (INTA). While all of *Pampa Orgánica* members are part of MAPO, they interact with INTA in research aspects.

Thus, INTA has 4 organic demonstrative plots and, also, it supports the group paying up to 50% of the fees of the group coordinator.

Nowadays, 70% of the group turnover is accounted by livestock products, whereas the remaining 30% is accounted by agricultural products. Three farmers are vertically integrated (15% of the total organic land) with an oil mill, a bakery chain, and an international meat trader. Usually, some members sell the grain to a leading trading company and meat to meat processor authorized to export Hilton beef quota.

The group allows its members to share experiences, technology and to find solution to common problems of their farms based on a common language related to organic agriculture. Thus, they take decisions from different translations generated through their interactions.

From the beginning, *Pampa Orgánica's members* defined that the group should be focus on finding solutions to technical problems, putting aside discussions about commercial issues. They arrived to this decision since few of them are well aware of better techniques and are members of Regional Consortiums for Agricultural Experimentation groups (CREA¹). The resolution of not integrating commercial activities was based on their previous failed experience. Subsequently, it is achieving alignment around the technical problems.

The group stimulates discussion by using a methodology based on periodical meetings in their farms and at MAPO they organise seminars with different experts to learn about technology in organic farming. Although these activities are developed without any legal framework, *Pampa Orgánica's members* agree to share their time and knowledge in these different meetings. This is a step forward in coordination.

When alignment and coordination is reached, convergence is achieved. *Pampa Orgánica* is defined itself as a sphere of discussion and debate about solutions to technical problems and a place to support their members. A primary effect of the convergence was the selection of the professional advisers as spokespersons. They are the responsible to spread the technical knowledge through the group.

From the beginning, the group has compiled a list of technical problems to sort out. In the very first place are weed control, followed by plagues, availability of organic inputs, soil fertility and finally the availability of seeds. The group, supported by INTA, has made advances (above all in the weed issue). However, it is far from being completely solved. It means that the lack of solutions in the future could turn weak the translations and reduce the level of irreversibility of this network.

As described before, *Pampa Orgánica* group has decided not to share commercialization of their products and focus on exchanging commercial information. However, on the one hand, three members have already vertical integrated the commercialization of their products. On the other hand, the size of the Argentinean Organic Sector is small and farmers have close links with brokers, who have previous knowledge about forthcoming sales from their clients (the farmers). Then, contracts are not widely used as it could be expected for specialities. This does not mean that changes in the sector or the entry of new farmers to the *Pampa Orgánica* would modify the idea of including the commercial issue within the group. This would

¹ CREA is a private sector association made up by farmers, which main goal is to promote technological development (www.aacrea.org).

generate competing translations, which could reduce the level of irreversibility of this network. It means they would lose their focus on technical issues.

Although the members of *Pampa Orgánica* emphasize that they are linked by strong bonds, which allows robust translations, it was observed a lack of coherence to resolve technical problems. This can be a potential problem for the current work of this group affecting the level of irreversibility. Other aspects related to the better understanding of the members are the heterogeneity of agro-ecological landscapes. These differences increase the exchange of technical knowledge among the members, favouring the alignment. However, the differences between farms and their distance geographical location imply difficulties to share knowledge (i.e. a farmer from the North of Buenos Aires can have completely different problems than a farmer in the Southeast of Buenos Aires).

Conclusions

This paper has shown from the empirical evidence that networks with a strong alignment can achieve greater convergence. The case of *Pampa Orgánica* is aligned around technical issues and strong bonds. Besides, the group is very engaged with the institutional context (INTA. MAPO). This allows the group to persist through time. Even though they managed to resolve few technical problems, most of them are still unsolved. In the future this situation of the lack of solutions could reduce the level of irreversibility of this network.

Although *Pampa Orgánica* group has decided not to integrate the commercialization, it does not mean that in the future this issue would be an important part of the agenda as a group. This would increase competition translations affecting the irreversibility of this network.

References

- Amblard H., Bernoux P., Herreros G., Livian Y. (1996): Les nouvelles approches sociologiques des organisations. Éditions Du Seuil.
- Callon M. (1991): Techno-economic networks and irreversibility. In Law J. (ed): A sociology of monsters. Essays on power, technology and domination. p. 132-161
- FibL-IFOAM (2010): World of organic agriculture. Statistics and emerging trends 2010.
- Fundación Export.Ar (2009): Análisis de la situación de la demanda internacional, competencia y exportaciones argentinas. www.exportar.org.ar (accessed 2010-03-15).
- Lockie S., Kitto S. (2000): Beyond the farm gate: Production-consumption networks and agri-food research. *Sociologia Ruralis* 4, 1: 3-19.
- Raynolds, L. (2004): The globalization of organic agro-food networks. *World Development* 32, 5: 725-743.
- Volonté, R. (2003): Estudios Agroalimentarios. Fortalezas del Sector Agroalimentario. Documento 6: Productos Orgánicos. IICA. www.iica.org.ar (accessed 2009-08-7)

Organic tea production in China

Qiao Y.¹, Wang D.², Meng F.¹, Fu Sh.²

Key words: Development trend, Trade, small householders, Fair trade

Abstract

Organic tea is most important cash products in China, which also initiated organic agriculture development in 1990. The situation and trend of production, sale, export and production organization of organic tea was analysis in this paper. The results shows that in 2008 the production area of organic tea is around 28000 hm², accounting 1.75% of total tea production. The organic tea production is 20000 tons. More than 600 enterprises are involved in the organic tea production. In 1990s, the average growth rate of organic tea production area is about 75-400% and most of them were exported. From 2000 to 2008, the growth rate decrease to 15.38% to 45.45%, but the production is still stably increasing. For the organic sale domestically, it emerged around the year of 2000, it is growing quickly with the growth rate of 15-50%, from 2005, the domestic organic tea sale is larger than the quantity of organic tea exported. Data of year 2008 from ECOCERT China shows that 85% of organic tea was exported to EU countries; around 13% of organic tea was export to US, 57.55% exported tea is organic black tea, organic green tea is 20.36% followed by white tea and jasmine tea. During organic tea production, most bases are organized by the companies with their own or rented lands without small householders involved, Organic tea farmer association or company contracted with tea farmers is only accounting for 10-20%. From the above analysis of production and potential market, organic tea production will continue growing in China.

Introduction

China has 45% of world's total tea growing area and more than 80 million tea farmers and 50 million tea traders across the country (IFAD, 2005). In 2004, the tea production area is about 1.26 million hectares, increasing 21.1% comparing with year 1980; the production is 0.835 million tons with 1/3 for exportation (data from WWW.CCTV.COM). In the international tea market, black tea is mainly from Indian, Sri lanka, Kenya. China produces all kinds of tea, since 1993, the exported tea is mainly green tea.

Organic tea certification in Lin'an Zhejiang Province was the mile stone of organic tea production in 1990. From then inspection and certification for export products was conducted by international certifiers such as IMO (Switzerland), ECOCERT (France), BCS (Germany), JONA (Japan) and OCIA (United States) according to standards of the destination market (e.g. EU regulation, NOP and JAS). Local certification is conducted by domestic certifiers first by OFDC, OTRDC. By the end of 2009, 22 organic certifiers have been accredited by CNAS.

¹ College of Resources and Environmental Sciences China Agricultural University , No. 2 Yuanmingyuan Xilu Haidian District, Beijing, China, E-Mail qiaoyh@cau.edu.cn

² Organic Tea Research and Development Center (OTRDC), Tea Research Institute of China Academy of Agricultural Sciences 1# Yunqi Road, West Lake District, Hangzhou City, Zhejiang Province, ecowang@126.com

Materials and methods

Literature review and data collection from main certifiers in China such as OTRDC, ECOCERT China etc.

Results

1. General production of organic tea

By the end of 2008, the total tea production area is 1.6million hm^2 , the production area of organic tea is around 28000 hm^2 , accounting 1.75%. The organic tea production is 20000 tons. More than 600 enterprises are involved in the organic tea production. Figure 1 shows the organic tea production area and quantity. According to incomplete statistics, the organic tea production grows year by year. From 1996 to 1999, the growth rate is from 75% to 400%, with tremendous increase. From 2000 to 2008, the growth rate decrease to 15.38% to 45.45%, the production is still stably increasing. The average growth rate is about 25%. By the end of 2008, the organic tea production area reached 28000 hm^2 .

The main tea production area is in the south of China from Qinling mountain and Huaihe River. Zhejiang is the largest organic tea production province from organic tea area and also farms/enterprises involved, followed by Hubei, Jiangsu, Yunnan, Sichuan, Jiangxi, Fujian and Anhui Province. Also in the south of Sha'anxi, Gansu, and also in Shandong organic tea production also locates in this region.

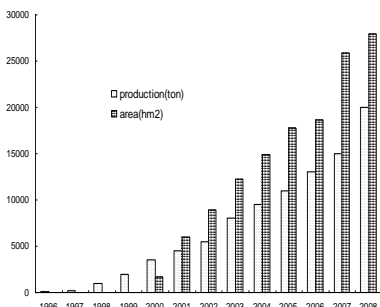


Fig. 1 Organic tea production in China during 1996-2008.

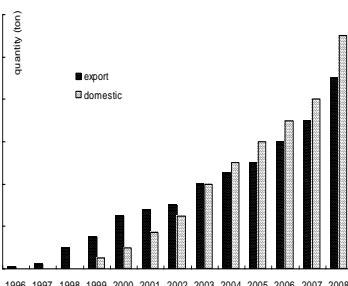


Fig. 2 Organic tea export and domestic sale in China during 1998-2008.

2. Export and domestic sale of organic tea

Organic farming development is foreign organic market oriented. So at the very beginning of organic farming from 1990 to 2000, nearly 100% organic products were produced for export, we could also see the trend from organic tea sale in figure 2. The export organic tea also increased stably, the growth rate could be 50% to 400% before 2000, but the growth rate decreased to around 10-30% afterwards. For the organic sale domestically, it emerged around the year of 2000, it is growing quickly, the growth rate is around 15-50%, larger than that for export organic tea, from 2005, the domestic organic tea sale is larger than the quantity of organic tea exported.

Almost all of the exported organic farms are certified according to EU and NOP regulations, 1/10 of the tea farms also apply for JAS certification. So the destination

export countries are EU countries, USA and Japan. Data from ECOCERT shows that 930 tons of organic tea certified in 2008, the export organic tea is 533 tons.

85% of organic tea was exported to EU countries; around 13% of organic tea was export to US, the detail information can be seen in table 1. The tea varieties include green tea, black tea, Olong tea, white tea and Pu'er tea due to due to different tea fermentation period. Jasmine tea is still green tea with the flavour or flower of jasmine. The certified organic tea also includes these kinds of tea varieties. Table 1 shows that 57.55% exported tea is organic black tea, organic green tea is 20.36% followed by white tea and jasmine tea.

Table 1 Organic tea export of China to different countries (ton)*

| Country | Black tea | Green tea | Jasmine tea | White tea | Total (ton) | Percentage (%) |
|----------------|-----------|-----------|-------------|-----------|-------------|----------------|
| Canada | | 0.48 | | | 0.48 | 0.09 |
| Spain | | 4.95 | | | 4.95 | 0.93 |
| UK | | 27.16 | | | 48.64 | 9.12 |
| USA | 0.61 | 4.57 | 28.17 | 33.57 | 66.93 | 12.55 |
| Netherlands | 72.00 | | | | 72.00 | 13.5 |
| India | 1.00 | 71.47 | | 4.53 | 75.48 | 14.15 |
| Germany | 233.92 | | | 29.50 | 263.42 | 49.38 |
| Total (ton) | 307.53 | 108.62 | 28.17 | 89.08 | 533.41 | 100 |
| Percentage (%) | 57.65 | 20.36 | 5.28 | 16.70 | 100.00 | |

* The data is from ECOCERT 2008.

3. Organization of small householders and fair trade organic tea

During organic tea production, most bases are organized by the companies with their own or rented lands, According to information from the organic tea enterprises and certifiers, it is easy for the organic company to control the organic quality of tea farms. The company would like to invest the new equipment and facilities, The production and processing can be industrialized for the market competition. But in these kind of organization, almost no small householders are involved, the companies only hire labour to work on the farm and pay salaries to them.

Organic tea farmer association or company contracted with tea farmers is only accounting for 10~20%. Normally tea production area is very small for each small householder. When Export Company wants to develop organic tea production, they will contact with the administrative village to help them firstly to select suitable tea garden with good condition, normally on the hill away from conventional paddy field, and then organize the tea farmers to involve in the organic operation. The development of organic tea production need to organize the small householders to set up a farmer cooperatives or associations, by this way, the tea products could have competition and easy to operate and certify as organic. This is the development trend of organic tea production in China.

In China, fair trade is just at the very beginning influenced by the international trade. By the end of 2008, there were about 7 organic traders and 6 organic producers, the organic fair trade tea producers locates in Jiangxi Wuyuan (2), Hubei Province (2), Yunnan Province (1) and Fujian Province(1) (Chen Wu, 2009). Normally it was required by importers and organized by the exporters and producers. There was a visible community development dimension linked to the FLO certification because part

of the premium should be directed not to individual farmers but allocated to improvements at community (village) level.

Discussion and Conclusion

The organic sector in China as a whole is developing rapidly and includes a large variety of cash crops including tea in sub-tropical and temperate provinces (Kledal P.R. et al, 2007). The initial development was promoted by export companies for foreign market demanding and collaborating directly with local authorities to facilitate the conversion of villages and households.

Organic tea is most important cash products in China, in 2008 the production area of organic tea is around 28000 hm², accounting 1.75% of total tea production. There is great potential for convert conventional tea to organic. Although the growth rate decrease from 75-400% to 15-45% from 2000 to 2008, but the production is still stably increasing. For the sale of organic tea, the market is stable for exportation, and domestic market is growing quickly with the growth rate of 15~50%, from 2005, the domestic organic tea sale is larger than the quantity of organic tea exported. From the above analysis of production and potential market, organic tea production will continue growing in China.

Chinese government needs to set up and implement some policies to facilitate the development of organic tea. In finance, the industry policies include subsidies, reduction of tax and certification expense etc. under the green box policy from WTO to secure the good and stable development of organic farming. Subsidies could consider the factors of yield, certification fee, and management expense and conversion period to ensure profit before organic conversion. The organization of small households is also an important factor to affect the benefit of organic agriculture, Now the central and local government is promoting the specialized farmer organization, the specialized farmer organization will be a good style to organize the small farmers and cooperate with trade company for sustainable organic development.

Acknowledgments

This work was supported financially by IIED(International Institute for Environment and Development) through Ford Foundation project, We thank Dr. James Keeley to organize this project and it is also supported by Key Beijing Discipline of Ecology (XK10019440).

References

- Chen Wu, Sustainable development of Chinese Tea (report) Social Resource Institute, 2009.
- IFAD. 2005. Organic Agriculture and Poverty Reduction in Asia: China and India Focus Thematic Evaluation. Document of the International Fund for Agricultural Development, IFAD Report No. 1664. Rome.
- Kledal, P.R., Yu-Hui, Q., Egelyng, H., Yunguan, X., Halberg, N., Xianjun, L. Country report: organic food and farming in China. In: Willer, H., Yussefi, M. (Eds.), The world of organic agriculture e statistics and emerging trends 2007. IFOAM and FiBL, 114-119.

Organic pineapple farming in Ghana - A good choice for smallholders?

Linda Kleemann¹

Keywords: private voluntary standards, organic certification, GLOBALGAP, value chain analysis

Abstract

As consumer demand for organic food grows, organic certification is increasingly promoted in many developing countries. Organic products earn a premium price on the market compared to conventional varieties. Hence, organic production is often seen as a valuable alternative for developing countries with many smallholders. Using value chain analysis for the case of the pineapple sector in Ghana, this paper tries to shed light on the feasibility and profitability of organic small-scale production. Even though smallholders tend to have quality problems with their fruit and large farms benefit from economies of scale, production for the export market is a realistic option for both organic and conventional smallholders. The results indicate that organic production is more profitable for smallholders than conventional production and price premiums from the retail level are fully passed on to farmers. Even more, organic production also adds value further up the value chain.

Introduction

The world market for fresh pineapple has been growing rapidly during the past years. Like other tropical fruit, pineapple is grown predominantly in developing countries. Production of conventional pineapple is mostly dominated by big transnational companies that own large-scale plantations. As a consequence, it is difficult for small farmers to participate profitably in the market. However, not only did the demand for pineapple in general increase over time, but organically grown pineapple have also become more popular among consumers. Nevertheless, the market for organic pineapple is still a niche market, which is not yet controlled by a few big companies. Like other organic products, organic pineapple earns a premium price on the market compared to conventional varieties. Hence, the shift from conventional to organic production might be an opportunity for small and middle-sized farmers to reap higher returns from their investments. Pineapple is well suited for this analysis because it is a homogeneous high value crop, compared to, for instance, coffee where a lot of different varieties and quality grades prevail. Using the Ghanaian pineapple sector as a case study we employ value chain analysis to study the profitability of organic small-scale production in a developing country context.

Materials and methods

Since organic certification change requires costly adjustments of the land, for example, several aspects of the market need to be considered when trying to determine its profitability. One aspect is the size of the price premium and if it can

¹ Kiel Institute for the World Economy, Telephone: +49-431-8814249, E-mail: linda.kleemann@ifw-kiel.de

persist over time. A second important aspect when studying the profitability of organic production is what percentage of the organic price premium received by retailers is actually passed on to the producers themselves and if costs differ for the two production techniques. The first aspect is studied in Kleemann and Effenberger (2010). In this paper we focus on the second aspect. Using value chain analysis for Ghanaian pineapple we study the differences between conventional and organic fruit production and marketing. Ghana is a case in point because pineapple is one of its most important non-traditional export crops and it is the leading supplier of organic pineapple to the European market. In a first step we analyze if smallholders, both conventional and organic, can be re-integrated in the Ghanaian pineapple export sector. In the second step we track price premia for organic pineapple along the value chain.

We use both secondary data from prior studies and from the International Trade Centre, and primary data from interviews with small-scale farmers, cooperatives, and medium- and large-scale producer-exporters in Ghana in 2009 and 2010. Costs and retail prices at destination country are from a survey of importers, traders, wholesalers and retailers and the author's own study in supermarkets between January and August 2009.

Results

Even though smallholders tend to have quality problems with their fruit and large farms have advantages compared to smallholder cooperatives due to economies of scale, production for the export market is feasible for both organic and conventional smallholders (Table 1). This result holds irrespective of the variety produced. Sea and land transport costs are not significantly different, but the large variation in profit differences along the value chain points towards differences in marketing and risk. Contrary to initial expectations, production costs are generally lower for smallholders. Consequently the re-integration of smallholders into the export value chain is not hindered by high smallholder production costs. Both organic and conventional small farms and exporters could benefit from a higher percentage of export sales. Besides, contractual relations of smallholder cooperatives with exporters are successfully managed in other countries. In Ghana, the re-establishment of trust and closer coordination between exporters and smallholders are necessary for successful re-integration.

Secondly, our results demonstrate that, in comparison with conventional smallholders, certified organic production is more profitable for smallholders and price premiums on the retail level are fully passed on to farmers (Table 2). Even more, organic pineapple can add value at each stage of the value chain, both to farmers and further up the chain. In detail, for smallholder production of SC pineapple, the profitability of organic production is superior both in terms of production costs and the price premium received.

In addition, organic methods might also have wider social and environmental benefits, which are not explicitly addressed in this study, but are shown to exist by Fließbach *et al.* (2007) and others.

Table 1: Farmer's profits and post farm-gate operations in USD per kg

| | conventional | organic | % difference |
|---------------------------------|--------------|---------|--------------|
| Average farm gate profit | 0.03 | 0.09 | 200 |
| Average farm gate price | 0.116 | 0.195 | 68.1 |
| Total cost at port | 0.482 | 0.557 | 15.6 |
| FOB price ² | 0.490 | 0.590 | 22.4 |
| Estimated exporter profit (FOB) | 0.008 | 0.033 | 325 |
| Shipping | 0.302 | 0.302 | 0 |
| Price at import | 1.070 | 1.590 | 48.6 |
| Cost for transport | 0.018 | 0.018 | 0 |
| Marketing cost for importer | 0.130 | 0.130 | 0 |
| Wholesale price | 1.300 | 1.890 | 45.4 |
| Estimated profit for importer | 0.082 | 0.153 | 86.6 |
| Marketing cost at retail | 0.310 | 0.310 | 0 |
| Retail price | 1.680 | 2.240 | 33.3 |
| Estimated profit for retailer | 0.070 | 0.040 | -42.8 |

Notes: ¹ Administrative costs cover all costs at port except the handling of the good, e.g. phytosanitary checks. ²FOB (Free on Board) is the price of traded goods at the port of origin, excluding the cost of sea-freight and insurance. It includes transport to the harbor, customs' costs, export administrative costs, and unloading at the port.

Table 2: Price premia of organic over conventional along the value chain

| | % | USD per kg |
|--------------------------|-----|------------|
| farm gate for export | 68% | 0.079 |
| farm gate for local sale | 5% | 0.013 |
| FOB | 20% | 0.100 |
| at import | 49% | 0.520 |
| at wholesale level | 59% | 0.590 |
| at retail level | 33% | 0.560 |

Source: own calculations

Discussion

The analysis is set up with a development perspective. Organic production might be a valuable alternative for developing countries with many smallholders. More research is needed in order to verify if production for niche markets in general is a more profitable alternative for small farmers in developing countries than mainstream markets. In particular smallholders' lack of access to financial as well as qualified human capital poses important barriers for upgrading. This is due to the high initial investment not

only in buying the necessary equipment, but also in learning how to produce the product according to new standards. Organic production is often claimed to be easier to learn for small-scale farmers in developing countries, because it is related more closely to traditional methods. Since, however, full-on organic production is quite demanding, further investigations into the learning processes are needed to verify this claim. In our analysis we have assumed that the initial compliance costs and training (for GLOBALGAP and organic certification) are not borne by the smallholders. This is usually the case and Raynolds (2004) amongst others shows that under different circumstances smallholders would not be able to receive organic certification.

Conclusion

As the demand for organic products is growing, this paper has tried to shed light on the profitability of organic small-scale production in the pineapple sector using Ghana as a case study. In a first step we have found out that smallholders, both conventional and organic, can be re-integrated in the Ghanaian pineapple export sector. Secondly, our results demonstrate that, in comparison with conventional smallholders, certified organic production is more profitable for smallholders and price premiums on the retail level are fully passed on to farmers. Overall, our results suggest a positive effect of switching from conventional to organic production when competing on the global market for pineapple.

The analysis has introduced the vertical dimension of the price transmission in the organic pineapple market. While the results tell us already what part of the premium is forwarded to producers, it has not been possible to investigate how changes in prices at the retail level are translated into changes in farm gate prices and if prices are transmitted symmetrically or asymmetrically. Future research might focus on this question.

References

- Bolwig, S., Gibbon, P., and Jones, S. (2009): The economics of smallholder organic contract farming in tropical Africa. *World Development* 37(6): 1094-1104.
- Fließbach, A., Oberholzer, H.-R., Gunst, L., and Mäder, P. (2007): Soil organic matter and biological soil quality indicators after 21 years of organic and conventional farming. *Agriculture, Ecosystems and Environment* 118: 273-284.
- Fold, N., and Gough, K.V. (2008): From smallholders to transnationals: The impact of changing consumer preferences in the EU on Ghana's pineapple sector. *Geoforum* 39 (2008): 1687-1697.
- Kleemann, L., and Effenberger, A. (2010): Price Transmission in the Pineapple Market – What Role for Organic Fruit? Kiel Working Paper No.1626, Kiel Institute for the World Economy, June 2010.
- Maertens, M., and Swinnen, J.F. (2009): Trade, Standards, and Poverty: Evidence from Senegal. *World Development* 37 (1): 161-178.
- Raynolds, L.T. (2004): The Globalization of Organic Agro-Food Networks. *World Development* 32 (5): 725-743.
- Rieple, A., and Singh, R. (2010): A value chain analysis of the organic cotton industry: The case of UK retailers and Indian suppliers, forthcoming in *Ecological Economics*.
- Teisl, M., Roe, B., and Hicks, R.L. (2002): Can Eco-Labels Tune a Market. *Journal of Environmental Economics and Management* 43: 339-359.
- United Nations Conference on Trade and Development (UNCTAD) (2008): Private-Sector Standards and National Schemes for Good Agricultural Practices: Implications for Exports of Fresh Fruit and Vegetables from sub-Saharan Africa. Experiences of Ghana, Kenya, and Uganda. UNCTAD/DITC/TED/2007/13. United Nations, New York and Geneva.

Economic feasibility of organic agriculture for small scale farmers in Sri Lanka

Karandana, P.¹

Key words: organic, paddy, vegetable, economic, Sri Lanka

Abstract

Even though organic agriculture is motivated by more than economic objectives, for example health and environmental sustainability, continuation is low if there is no economic gain for small scale farmers. This field level research was conducted in order to study the economic feasibility of organic farming for small scale farmers. Primary data and secondary data were gathered from paddy, vegetable, and home garden farmers and other key informants. Cultivation of paddy by organic techniques was feasible from an economic point of view, and even without a premium price, it can achieve same cost benefit ratio as conventional paddy ($p < 0.10$) in non-intensive cropping areas. Low cost of production, family health, environmental concerns, price premiums, and willingness to test traditional techniques were identified as the contributory factors for the conversion to organic from conventional system. The priority order of each factor was different for paddy and vegetable. Family health concern was the major consideration for the management of organic home gardens. Unavailability of information, technical support, extension facilities, lower access for organic inputs, irregular supply for the market and access to price premiums were identified as the major factors limiting the promotion and expansion of organic farming among the small scale farmers.

Introduction

The demand for organic food is steadily increasing both in the developed and developing countries with an annual average growth rate of 20–25% (Pretty, 2000). Organic agriculture, without doubt is one of the fastest growing sectors of agricultural production (Green, Dimitri, 2003). In Sri Lanka, agriculture is dominated by small holders as over 64 percent of farming families cultivate holdings of less than 0.8 acres. According to a survey conducted by the Sri Lanka Nature Forum (SLNF) in 2008, the total land occupied under the organic agriculture is 25,355.03 hectares. This is 1.08% of total cultivated lands. Out of the total extent of organic farming, only 0.81% has been certified as organic (Mahaliyanaarachchi, 2003). This is not sufficient to fulfil the rapidly increasing local and global organic demand. The general objectives of the study were to study economic feasibility, factors affecting conversion, and limiting factors for organic agriculture among small scale farmers in Sri Lanka. Most of the small scale farmers are reluctant to convert their lands in to organic agricultural practices because of the view that organic agriculture is not economically feasible for the small scale farmers. This study is focused on examining the economic feasibility of few agricultural crops which are managing under small scale conditions. Even though a few governmental, non-governmental, and private organizations have been

¹ Karandana Padmi, Sri Cer, 546/3, Wata Mawatha, Gangodawila, Nugegoda, Sri Lanka, Email: padmilps@gmail.com, sricert@sltnet.lk

dedicated to promoting organic agriculture among small scale framers, the expansion of the sector is low. Improper awareness on economic feasibility and other factors have badly affected the expansion of organic farming among small scale farmers. This study will identify and clarify these factors.

Materials and methods

Total number of farmers taken in to account in this study were 140. This included 105 organic farmers and 35 conventional farmers. Out of 105 organic farmers, there were 35 paddy farmers, 20 vegetable farmers and 50 home gardening farmers. Surveys and key informant interviews were used as data collection tools. Paddy farmers were selected from Hambantota district while the vegetable and home gardeners were respectively selected in Ratnapura and Badulla districts of Sri Lanka. In addition, input records and yield records were collected by referring to the farmer field record books. All the farmers are keeping their records by using the format provided by SriCert as it is a certification requirement. The conventional paddy farmers were asked to keep their records in the same type of record book. A key informant interview was conducted targeting organic agriculture activists who have both local and foreign experiences.

Results

The cost of production and income factors of conventional and organic farming can be compared below.

Table 1: Economic analysis of organic paddy with conventional system

| Category | Organic(Rs./Ac) | Conventional(Rs./Ac) |
|--|------------------|----------------------|
| Cost of Production | | |
| Land preparation(labor and machinery) | 9,300.00 | 9,200.00 |
| Seed paddy | 3,200.00 | 3,600.00 |
| Fertilizer/Organic matter | 2,500.00 | 6,000.00 |
| Weed Management | 1,600.00 | 4,000.00 |
| Pest Management | 300.00 | 4,500.00 |
| Harvesting | 7,100.00 | 7,000.00 |
| Total Cost of Production | 24,000.00 | 34,300.00 |
| Income | | |
| Yield | 1,575.00 | 2,250.00 |
| SD | ±13.78 | ±5.82 |
| Minimum Paddy Price | Rs.50/kg | Rs.20/kg |
| Income (premium price for organic) | 78,750.00 | 45,000.00 |
| Income (without premium price for organic) | 31,500.00 | 45,000.00 |
| Net Farm Income(with premium) | 54,750.00 | 10,700.00 |
| Net Farm Income(without premium) | 7,500.00 | 10,700.00 |
| Cost Benefit Ratio (with price premium) | 3.2812.00 | 1.3235.00 |

| | | |
|--|------------------|------------------|
| Cost Benefit Ratio (without price premium) | 1.3125.00 | 1.3251.00 |
|--|------------------|------------------|

Yield of paddy was 1575 kg per acre in organic systems and 2250kg per acre in conventional systems as presented in table 1. The standard deviation of the organic sample was higher than which of the conventional meaning the variation in yields was higher among the organic farmers than the conventional farmers. The significance of the yield between organic and conventional was tested by using the Z test and the yield difference was significant. The average yield reduction under organic systems was 30%.

The cost benefit ratio of organic paddy cultivation as an investment is more profitable than conventional paddy cultivation when the price premium is concerned. The calculated cost benefit ratio without considering the price was more or less similar and Z test was used to compare them at 10% significance level. The two figures were not significantly different. Hence as investment the organic farming is same as which of conventional farming even without considering the premium price.

Table 2: Average cost and income distribution of the vegetable farmers (n=20)

| Item | Rs./Ac | SD |
|-----------------------------------|------------------|----------------|
| Average Cost of Production | 21,865.00 | ± 15.28 |
| Average Income(Rs./Ac) | 35,500.00 | ±27.38 |

The records of the organic vegetable producers and organic home gardeners showed positive net incomes. As most of the farm inputs were produced by the farmers' labour, the value was calculated by using their records. Organic production of vegetables was economically feasible even without an organic price premium. There was a significant variation in production costs and income for vegetable growers due to differences in cultivated area, type of crops, utilized resources, and cultivation practices.

Table 3: Limitation index for the promotion and expansion of organic agriculture

| Factor | Percentage | Score |
|------------------------------------|------------|----------|
| Input problems | 23% | 2 |
| Organic matter | 57% | 1 |
| Fertilizer subsidy | 43% | 2 |
| Knowledge and information | 62% | 1 |
| Lack of technical knowledge | 55% | 1 |
| Lack of technical support | 28% | 2 |
| Research and extension | 17% | 3 |
| Market | 15% | 3 |
| Price | 16% | 2 |
| Supply | 72% | 1 |

| | | |
|----------------------|------------|----------|
| Certification | 12% | 3 |
|----------------------|------------|----------|

The surveyed farmers were asked to identify limitations to organic conversion based on their experiences. Responses were ranked by frequency as shown in Table 2. The most frequently mentioned limitations were knowledge and information than the input and market limitations. The market access and availability of inputs have been limited by the knowledge and information.

Table 4: Farmers attitude on economic feasibility of organic farming

| Farmers attitude | Paddy | Vegetable | Home garden |
|--|--------------|------------------|--------------------|
| Economically viable | 28% | 22% | 73% |
| Economically viable if there is a premium price | 64% | 58% | 0% |
| Economically not viable | 8% | 20% | 27% |

Farmers had different attitudes regarding the economic viability of organic paddy, vegetables and home gardens as presented in Table 3. Most of the paddy and vegetable farmers are focused on the organic price premium as they are engaged in market-oriented production. Most farmers are not calculating their cost of production. They do not economically evaluate their cost benefit ratio and other economical parameters. Their attitude is depending on their gross income, not their net income or cost benefit ratio. Organic home garden production is seen as economically viable because the value of family labour is not considered by the farmers.

Discussion

This discussion is based on the analyzed data in Tables 1-4. It represented the records maintained by the farmers on their cost of production and income. As the cost of production is low for organic agriculture it reduces the risk of farmer (Stonehouse, 2000). The economic feasibility can be calculated with the price premium and without the price premium. All the farmers in the sample have received a 150% price premium as the project coordinating organization has helped them link with the market. Hence the present economic feasibility is highly dependent on the premium price. Without this mediation, they would not receive such a high premium price. Without the price premium, there was no significant difference between the cost benefit ratio of organic paddy and conventional paddy cultivation. While this is important from an investment perspective, most farmers are focused on gross returns, not the cost benefit ratio. The majority, 64%, feel that organic paddy is only economically viable with the premium price.

For vegetables, economical feasibility can be achieved even without premium price for organic. However premium price can be expected even in the village level as nowadays people are more concerned about health than before. Most farmers recognized the economic value of home garden systems. In addition to the economic benefits, there are environmental and social benefits which were not captured by this study.

The major limiting factor to organic conversion is knowledge and extension. Market factors were not identified as a major constrain.

Conclusions

Cultivation of paddy by organic techniques was feasible from an economical point of view. Even without a premium price, it can achieve same cost benefit ratio as conventional paddy ($p < 0.10$) in non intensive cropping areas of Sri Lanka. Through the cultivation of vegetables and home gardens by using organic agronomic practices farmers can get feasible net farm income. Low cost of production, family health, environment concern, premium price and willingness to test traditional techniques were identified as the major contributory factors for the conversion in to organic from conventional system. The priority order of each factor was different for paddy and vegetable while the family health concern was the major consideration for the management of organic home gardens. Unavailability of proper technical knowledge, technical support, extension facilities, lower access for organic inputs, irregular supply for the market and access to price premiums were identified as the major factors limiting the promotion and expansion of organic farming among small scale farmers.

Acknowledgments

Dr.L.P.Rupasena, Deputy Director/Research, Hector Kobbakaduwa Agrarian Research and Training Institute and Mr.Thilak Kariyawasam President of LOAM and Mr.Ajantha Paliawadana, Operational Manager, SriCert and Dr.Amanda Kiessel, Program Manager, Sewalanka Foundation for their guidance to conduct this study.

References

- Bengtsson, J., Ahnstrom, J., Weibull, A. (2005): The effects of organic agriculture on biodiversity and abundance: a meta-analysis. *Journal of Applied Ecology*. 42:261-269.
- Green C., Dimitri, C., (2003): *Organic Agriculture: Gaining Ground*, USDA Economic Research Service, Washington, 34p.
- Mahaliyanaarachchi, R.P. (2003): The impact of the behavioural patterns of vegetable consumers in marketing activities. *Sabaragamuwa University Journal*, Sri Lanka, 3(1):63-74.
- Pretty, J. (2000): The real costs of modern farming. *Agriculture Systems*, Institute of Agriculture, Canada, p. 113–136.
- Stonehouse, D.P., (2000), *Risk of Farming*, University of Guelph, Canada. Pages 23-31.

Organizational patterns of small-scale farmers access certified organic agriculture (COA) : Cases in China

Liu Y.1

Keywords: organization pattern; small-scale farmers; certified organic agriculture (COA); China

Abstract

Increasing consumer interest in organically grown food has opened new market opportunities for small-scale farmers in China. Meanwhile, concerns have been raised about significant risks including high transactional costs and marginalization brought by globalized organic markets and their impacts on Chinese small-scale farmers. This paper contributes to the understanding of how Chinese small-scale farmers organize to access COA and identifies some factors influencing the organizational patterns in the context of Chinese organic agriculture. It documents that organization patterns in seven cases across China were initiated with different local background and history, involving firm + farmers, cooperative + farmers, firm+ cooperative + farmers with the perspective of property relation. On the basis of the analysis of factors influencing organizational patterns, it argues that Chinese small-scale farmers' way of collective organizing can be a reasonable basis for their access to COA.

Introduction

The market for certified organic food has mainly been supported by consumers in developed countries with 2006 sales reaching nearly US\$ 40 billion based on approximately 31 million hectares (Yussefi and Willer, 2007). A number of developing countries have taken advantage of these market potentials to increase and diversify exports of organic produce. For example, the certified organic area in China amounted to 3.11 million hectares with an output of 2.8 million tons and 2,647 kinds of organic products at the end of 2006 (Li, 2007). This trend is inspiring for poor farmers in developing countries as organic farming can earn them higher incomes and create employment.

However, there are significant risks for small-scale farmers in converting to organic agriculture such as the lack of prior understanding of organic aims and methods, the need for technical support and financial input, and guaranteed organic markets. The objective of this study is to contribute understanding of how small-scale farmers organize to access certified organic agriculture (COA) in the context of China. Specifically, this paper will provide understanding of factors playing roles in farmers' organization patterns in China on a local scale.

¹Information Institute, Beijing Academy of Agriculture and Forestry Sciences. Beijing, China.
Email: yxliu76@hotmail.com

Methods and materials

Based on the objective to analyze empirical organization patterns of small-scale farmers' access to the COA, the study was designed as a multiple case study (Yin, 2003), consisting of seven cases from China. General details of the case sites are presented in Table 1. Case areas were selected based upon the following criteria: (1) that farms were certified by an accredited organisation, and (2) that farmers should be small-scale producers or family farmers. Key stakeholders were interviewed and contextual data were collected from relevant organisations such as cooperatives, certification bodies and firms.

Results and discussion

Organizational patterns

The organization patterns of small-scale farmers' access COA can be mainly divided into three types according to property relations.

(1) Firm + farmers

In this pattern, organic farmers are organized by a firm with contracts. The firm, renting the land from village or farmers, is responding the product processing and marketing. Farmers engage in organic production with price stability and market access as the key advantages. The primary incentives for firms are to stabilize the supply of raw material, to improve the quality of products and to obtain government support. This pattern is found in the cases of Xiedao Organic Firm in Beijing, Tongtai Organic Pear Firm in Qingdao, Shandong Province. But, the disadvantage of this type of pattern is that firm and farmers are not effectively bound by their contracts, if any.

(2) Cooperative + farmers

In this pattern, organic farmers are organized by the cooperative, with the provision of agricultural inputs, such as fertilizers, seeds and machinery, and with technical aids for farmers to overcome some difficulties in the conversion of organic production. The cooperative play a vital role in pooling information on price disparities to support farmers as they reach out to more distant under-supplied markets. In addition, the cooperative may help farmers achieve efficiency in collection and transport. In this pattern, farmers can share the costs of packaging, storage, handling, transport and technical services that quality produce requires and capture more of the value of their produce. This pattern is found in the cases of "Shenzelin Cooperative" and "Chaoheguoye Cooperative", Beijing suburb. However, the disadvantage of this type is that the management ability of cooperative is poor to help farmers earn more benefits.

(3) Firm+ cooperative + farmers

In the type of organization pattern, the cooperative links farmers and firm like bridge. The firm, which contracts the cooperative, is in charge of processing and marketing organic products. Organic farmers are organized by a cooperative, who playing a pivotal role in organizing and controlling production, saving the firm monitoring and organizational costs, and is responsible for organizing conversion of farmers' production. Contractually, the firm agrees to purchase the cooperatives organic products according to the agreement whilst the village cooperative is responsible for ensuring that organic standards are followed, fulfilling required and specified product standards and timeliness of supply of products. This pattern is found in the case of

“Yanminghu” Firm, Liaoning Province. But the disadvantage of this type is that the farmers earn less benefit with lower prices for firms’ maximum benefits.

Factors influencing the organization patterns

All kinds of social, economical and agri-ecological aspects factors may influence the organization patterns that allow small-scale farmers’ access the COA. The current study focuses on the following aspects: land rights and government involvement.

(1) Land rights

Two kinds of land transfer right policies maybe regarded as one of the most important factors to influence small-scale farmers’ access COA. One is “Zhuanbao” (Brandt et al., 2002), literally “passing on a contract” refers to the transfer of land use right between two households and is comparable to the notion of a land rental. “Fanzudaobao” (Tang, 2006), another transfer right, indicates that village collective intensively rent the land by signing contracts with farmers and then transferring the use right of large and mass land to contractor such as collective unit or farmers. In the above three patterns, firms or cooperatives benefit from these two kinds of land transfer right policy with avoidance of the limit of small scale land and of the high risk of transaction cost and gaining the competence to intensify organic farming.

(2) Governmental involvement

Another factor to influence farmers’ access COA is governmental involvement mainly in two aspects: organic certification fees and organic policies, which are initiated by the government to help farmers overcome barriers to produce organic products.

Organic certification fees are one of high risks and costs of organic conversion that Chinese small-scale farmer are unable to contemplate such conversion individually and there is a need for considerable financial support from governments. The case in Beijing illustrates that subsidy is one of the stimulus to promote organic production. Organic subsidies were initiated by the Beijing government in 2005 with the aim to promote the food security, covering organic fertilizer, biological pesticide, insecticidal light, and etc. Among that, the total amount of subsidy to organic certification from 2005 to 2007 exceeds 882 thousand US dollars. Each organic certified firm in Beijing can get the subsidy which is 3,000 US dollars per year, as organic certification fee. The number of organic certified firms in 2004 was twenty; however, reaching 220 on June, 2007, growing to more than 10 times its earlier size.

Besides the subsidies, a series of institutions to guarantee the local organic development have been established in the case of Wanzai, Jiangxi Province, which is on “the Programming to Develop the Organic Industry in Wanzai County” established by the local county government. To date, the certified organic area is about 4,300 ha accounting for 18.6 percent of the total agrarian area in this county.

Conclusion

The current study analyzes three types of organization patterns of Chinese small-scale farmers’ access the COA: firm + farmers, cooperative + farmers, firm+ cooperative + farmers. From this study, it is difficult to know the ratio of organizational patterns of organic farmers in China, but different organization patterns were initiated with different local context including history, environment, land size, involvement of collective units, and professional quality of farmers. On the basis of the analysis of

factors influencing organizational patterns, it argues that Chinese small-scale farmers' way of collective organizing can be a reasonable basis for their access to COA. The organizational patterns suitable for the organic development in China are worth to be analyzed further.

References

- Brandt, L., Huang, J., Li, G., Rozelle, S., 2002. Land rights in rural China: facts, fictions and issues. *The China Journal* 47, 67-97.
- Li, X., 2007. The developing state and the prospect of organic agriculture (in Chinese). In: *Proceeding of the International Conference of Organic Farming in a Global Perspective*, Beijing, China, 17-18 October.
- Tang, X., 2006. Research of the transfer of land rental management right (in Chinese). Available from:
<http://www.lunwenwang.com/Freepaper/Economicalpaper/realestatepaper/200608/Freepaper_1059_4.html>.
- Yin, R.K., 2003. *Case study research: design and methods* (Third edition). Sage Publications, Thousands Oaks.
- Yussefi, M., Willer, H., 2007. Organic farming worldwide 2007: Overview & main statistics. *The world of organic agriculture: Statistics & emerging trends 2007*, International Federation of Organic Agriculture Movements (IFOAM), 9–16.

Table 1. Case study site characteristics

| Case Location | Interviewees | Production system | No. of interviewees | Latitude | Longitude | Period of data collection |
|----------------------------|---|-------------------|---------------------|-----------------|-------------------|---------------------------|
| Chaoyang, Beijing | Farmers in "Xiedao" Firm | Crop-livestock | 10 | Ca. 39°60" N | 116°49" E | August 2007 |
| Dunhua, Jilin Province | Farmers in "Yanminghu" Firm, and village leader | Soybean-corn | 50 | 43°37"-43°47" N | 128°24"-128°46" E | July 2007 |
| Wanzai, Jiangxi Province | Farmers in organic Firms, and county leader | Crops | 25 | 28°11" N | 114°44" E | August 2007 |
| Qingdao, Shandong Province | Farmers in "Tongtai" Firm | Pear | 20 | 35°35"-37°09" N | 119°30"-121°E | August 2007 |
| Daxing, Beijing | Farmers in "Shenzelin" Farmer Cooperative | Pear | 15 | Ca. 39°60" N | 116°49" E | August-September, 2008 |
| Miyun, Beijing | Farmers in "Chaoheguoye" Farmer Cooperative | Pear | 28 | Ca. 39°60" N | 116°49" E | August-September, 2008 |

Impact of large-scale conversion to organic farming on food production and food security for resource poor farmers in India

Panneerselvam, P¹, Hermansen, J.E², Halberg, N³, & Murali Arthanari, P⁴

Key words: Organic farming; Large-scale organic conversion; Food security; Marginal and small farmers; India

Abstract

This study assessed how a conversion from conventional to organic production would impact on the purchasing power of marginal and small holders in Tamil Nadu and Madhya Pradesh and how this would impact on the total food production in these states. In addition a situation was considered in which fertilizers subsidies was discontinued and the farmers had to carry the full cost of fertilizer. The study indicated that adoption of large-scale organic conversion would improve the purchasing power of marginal and small farmers with reduction in input cost, and without any major negative impact on the food production. Regarding total food production where around 62% of the area (1.9 million ha) in Tamil Nadu was converted to organic farming the overall state food production was 5% lower in the organic than in the conventional situation. Similarly, around 30% of the area (3.0 million ha) in Madhya Pradesh was converted to organic, which gave a 2% lower overall state food production. It is concluded that conversion to organic farming helps in reducing debts and improving the purchasing power of the farmers without impairing overall food supply and thus leading to improvement in overall food security.

Introduction

Global food supply is claimed to be sufficient to meet the present needs but an estimated 1.02 billion people throughout the world remains undernourished and same number of people are obese (FAO 2009). India is self sufficient in food production but home to 231 million (175 million in rural areas) undernourished people, which tops in the world. This highlights both the quantitative and qualitative shortcomings of the present global food system, and it can be argued that food security as a matter of fact has to do more with food distribution than food production.

India is the land of small farmers, 81 percent of the farms having less than two hectares. Small farmers are often resource poor, lacking access to productive resources and not able to buy expensive inputs without risk of being indebted. Hence, marginal and small holders need low cost technology which uses on farm resources to come out of the cycle of poverty and food insecurity. Therefore, it is important that the policy initiatives apart from addressing the food production in total, should also take into account the food security and sustainability aspects of the marginal and small farmers of rural India. This needs scientific studies aimed at identifying and evaluating

¹ International Centre for Research in Organic Food Systems (ICROFS), Blichers Allé, PO Box 50, DK-8830 Tjele, Denmark. Email: ppanneerselvam8477@gmail.com, Niels.Halberg@agrsci.dk

² Department of Agroecology and Environment, Aarhus University, Blichers Allé, PO Box 50, DK-8830 Tjele, Denmark. email. John.Hermansen@agrsci.dk

³ See footnote 1

⁴ Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, India. agronmurali@yahoo.co.in

the alternative options available for sustainable farming which is the objective behind the present study. Therefore, an attempt was made to simulate a large-scale organic scenario (up-scaled from part of results from Panneerselvam *et al.* 2011) to see how a conversion from conventional to organic production would impact on the purchasing power of marginal and small holders and how this would impact on the total food production of two states Tamil Nadu and Madhya Pradesh in India

Materials and methods

Land use and socio-economic situation

The study was conducted in two Indian states viz., Madhya Pradesh and Tamil Nadu. Around 70 per cent of the populations are depending either directly or indirectly on agriculture in each state. Major crops are rice, wheat, maize, chickpea, pigeon pea, soybean, groundnut, mustard and cotton in Madhya Pradesh, and rice, sorghum, pearl millet, maize, pigeon pea, black gram, green gram, groundnut and sesame in Tamil Nadu. In Tamil Nadu, marginal and small farm types accounted for 90 per cent of total farm holdings, contributing 62 per cent of total food grain production of the state. On the other hand in Madhya Pradesh, marginal and small holdings constituted 70 per cent of the cultivated land area, producing 30 per cent of total food grain output. The intensity of fertilizer use was higher in marginal and small farms than medium and large farms. Thus, marginal and small farmers together constituted 88 per cent and 60 per cent of total indebted farm holdings in Tamil Nadu and Madhya Pradesh respectively. They were largely dependent on private lenders (at almost 30 percent interest rate) for their credit needs.

Data collection and calculation

A previous paper (part one of this research) stated that input cost and yield were significantly different between organic and conventional farming (Panneerselvam *et al.* 2011). Hence these two factors were considered as the primary attributes for up scaling the regional organic scenario. Five years average areas (2003-2008) of each crop were calculated from Agriculture at a glance (Anonymous 2009). The area under each crop in marginal and small farm types was extracted based on their share in the total area. The yield and variable cost for organic agriculture used in this study was derived from earlier studies (Panneerselvam *et al.* 2011, Ehyorn *et al.* 2007). Based on these studies, the ratio of crop yield and variable cost between organic and conventional production was calculated. The yield ratio is simply the proportion of organic: non organic yield reported by the studies. For example, the yield ratio of 0.80 means organic yield is 80 percent of conventional yield obtained from the same crop from a given area. Assumed changes in cropping pattern more suitable for organic production were adjusted in the organic scenario. The total production both from medium and large farm types as well as the marginal and small farm types was named as baseline production at state level. Production from small and marginal farm types was calculated for the organic situation. Production from medium and large farm types was as same as baseline, since the aim of the study was to test the consequences of converting only the marginal and small farm types. Organic production from marginal and small farm types was added to the medium and large farm production, and named as Organic Production at State level.

Variable cost, interest rate on variable cost, crop value and gross margin were calculated for marginal and small farm types in baseline and organic farming situation.

Also, a hypothetical situation of fertilizer subsidies discontinued by the Government was considered (as happened in Ethiopia where fertilizer subsidies were withdrawn from 1998 (Araya & Edwards 2006)). In this situation the cost of fertilizer subsidies were added to input costs. In Tamil Nadu, marginal and small farms applied 174 and 140 kg NPK/ha respectively, whereas it was 44 kg in marginal and 34 kg in small farms in Madhya Pradesh. Fertilizers subsidy statistics were obtained from the Indian Institute of Management fertilizer use and subsidy report (Sharma & Thakker 2009). A sensitivity analysis was performed assuming different premium price of organic sales on 10 or 20 %. This was based on the price premium 10 % for non-certified organic products in Tamil Nadu and 20 % for certified organic products in Madhya Pradesh were found in part of this project (Panneerselvam *et al.* 2011).

Results and Discussion

Reducing production cost, increasing the purchasing power and avoiding the risk of crop failure would address the issues of food insecurity among marginal and small farmers much more than mere an increase the total food production. The estimated crop value (Rs/holding) was lower in organic than conventional scenario when no price premium was assumed, both in Tamil Nadu and Madhya Pradesh (Table 1). However, the organic holdings had higher crop value when a price premium of 10 % was available. The organic farms had higher gross margin than conventional farms even at no premium. This was due to the input cost reduction in organic households. The conventional farms will be much affected in a situation of no fertilizer subsidy assuming that this cost would be carried by the farmers the variable cost in baseline would becomes 200 to 224 percent of organic cost. Hence, conventional farms would be even more vulnerable while organic farmers had lower risk of being indebted in case of crop failure.

Table 1 Estimated economic difference between baseline and organic (Rs/holding)

| | | Tamil Nadu | | Madhya Pradesh | |
|---|----|--|--|---|--|
| | | Difference over baseline at Marginal farm (0.4 ha) | Difference over baseline at small farm (1.39 ha) | Difference over baseline at marginal farm (0.51 ha) | Difference over baseline at small farm (1.44 ha) |
| Crop value at 0, 10 and 20 percent price premium | 0 | -445 | -1546 | -514 | -1452 |
| | 10 | 246 | 854 | 24 | 68 |
| | 20 | 938 | 3258 | 563 | 1589 |
| A. Present situation | | | | | |
| Variable costs | 0 | -678 | -2357 | -631 | -1781 |
| Input cost plus 0 or 15 or 30 percent interest rate | 15 | -780 | -2711 | -725 | -2047 |
| | 30 | -882 | -3064 | -820 | -2316 |
| Gross margin 1 at 0, 10 and 20 percent price premium | 0 | 438 | 1520 | 306 | 864 |
| | 10 | 1128 | 3921 | 845 | 2385 |
| | 20 | 1820 | 6325 | 1383 | 3905 |
| B. Hypothetical situation of no fertilizer subsidy | | | | | |
| Variable cost: input cost plus cost of fertilizer subsidy plus 0 / 15/ 30 percent interest rate | 0 | -2001 | -6953 | -1249 | -3527 |
| | 15 | -2301 | -7995 | -1437 | -4057 |
| | 30 | -2601 | -9038 | -1624 | -4585 |
| Gross margin at 0, 10 and 20 percent price premium | 0 | 2156 | 7492 | 1110 | 3133 |
| | 10 | 2848 | 9895 | 1648 | 4654 |
| | 20 | 3539 | 12299 | 2187 | 6174 |

Note: crop value = yield * price, Gross margin = crop value –Variable cost

The differences of gross margin in organic were higher by Rs 1128 and 3921 in marginal and small farm holdings, respectively in the situation of 10 percent price premium for non-certified organic products as observed in the organic project area in Tamil Nadu (Panneerselvam *et al.* 2011). These were due to higher production costs in the conventional system and a price premium for organic products. The differences of gross margin in organic were much higher by Rs 2848 in marginal farm and Rs 9895 in small farms in Tamil Nadu at 10 percent premium in the hypothetical situation of no fertilizer subsidy. This can be used to meet out the food expenditure 9 and 31 person months in marginal and small farms, respectively in Tamil Nadu. Similarly, the higher gross margin in organic can be used to meet out the food expenditure 7 and 20 person months in marginal and small farms, respectively in Madhya Pradesh. Monthly per capita food expenditure was Rs 315 for rural people in Tamil Nadu and Rs 232 in Madhya Pradesh (Anonymous 2007).

Table2: Estimated production (thousand tones) at baseline and at organic conversion of all marginal and small holders farm

| | Tamil Nadu | | | Madhya Pradesh | | |
|-------------|------------------------------------|-----------------------------------|-----------------|------------------------------------|-----------------------------------|-----------------|
| | Baseline production at state level | Organic production at state level | % over baseline | Baseline production at state level | Organic production at state level | % over baseline |
| Food grains | 7294 | 6699 | 92 | 12927 | 12349 | 95 |
| Cereals | 7056 | 6299 | 89 | 10358 | 9275 | 89 |
| Pulses | 237 | 399 | 168 | 2568 | 3074 | 120 |
| Oilseeds | 1163 | 1378 | 118 | 5634 | 5731 | 102 |
| Total food | 8457 | 8077 | 95 | 18561 | 18080 | 97 |

The above said benefits of organic conversion can be seen at household level. However, the question is what would be the impact of large scale conversion to organic farming on regional food production? Our results suggest that overall food production in organic scenario would be approximately 5 percent lower in Tamil Nadu and 2 percent lower in Madhya Pradesh (Table 2). Nevertheless, this reduction from organic conversion on marginal and small farms could be probably be more than compensated by to the improvement in the gross margin (with low cost of production) for 90 percent of these families (7 million marginal and small holders) in Tamil Nadu and 70 percent of families (5 million marginal and small holders) in Madhya Pradesh. Moreover, due to the assumed land use changes the production of pulses and oil seeds were found to be higher in the organic than the base line scenario. This organic conversion integrating more legumes, crop diversification and lower cost of production was found to be helpful for reducing the consequences of crop failure which is frequent in Indian agriculture.

Conclusions

It is concluded that conversion to organic farming helps in reducing debts and improving the purchasing power of the farmers without impairing overall food supply and thus leading to improvement in overall food security. Moreover, organic conversion integrating more legumes, crop diversification and lower cost of production was found to be helpful for reducing the consequences of crop failure which is frequent in Indian agriculture. Though the study addresses short perspectives of large scale conversion to the organic farming, more research is needed to understand the long term impact of organic conversion on food production, food security and poverty reduction.

Acknowledgments

We thank International Centre for Research in Organic Food System (ICROFS) for funding this research through the GlobalOrg project

References

- Anonymous. (2007): Household Consumer Expenditure among Socio-Economic Groups: 2004 – 2005. National Sample Survey 61st Round. Report No. 514(61/1.0/7), Ministry of Statistics and Program Implementation, Government of India.
- Anonymous. (2009): Agricultural statistics at a glance 2009. Directorate of Economics and Statistics, Ministry of agriculture, Government of India. http://dacnet.nic.in/eands/latest_2006.htm, (accessed 2010-04-26).
- Araya H., Edwards S. (2006): The tigray experience: A success story in sustainable agriculture. Third World Network Environment and Development series 4. TWN: Penang pp 45. In: Vaarst M 2010. Organic farming as a development strategy: Who are interested and who are not? Journal Sustainable Development. 3:38-50.
- Eyhorn F., Ramakrishnan M., Mäder P. (2007): The viability of cotton-based organic farming systems in India. International Journal of Agricultural Sustainability. 5: 25-38.
- Food and Agricultural Organization. (2009):The state of food insecurity in the world, <ftp://ftp.fao.org/docrep/fao/012/i0876e/i0876e.pdf>. (accessed 2010-09-13)
- Panneerselvam P., Hermansen J., Halberg N. (2011): Food security of small holding farmers: comparing organic and conventional systems in India. Journal of Sustainable Agriculture 35: 48-68
- Sharma V.P., Thaker H. (2009): Fertilizer subsidy in India: who are the beneficiaries? Indian Institute of Management, Ahmedabad, India. WP No. 2009-07-01. <http://www.indiaenvironmentportal.org.in/files/fertilizer%20subsidy.pdf>, (Accessed 2010-07-10)

Organic Agriculture: A Tool for Improving Small Farmers' Livelihood in Bangladesh

Sarker, M.A.¹, Hoque, M.², Nanseki, T.³ & Itohara, Y.⁴

Key words: Organic Agriculture, Livelihood Improvement, Tool & Small Farmers.

Abstract

Poverty, food security and sustainability are major challenges for improving livelihood of the small farmers in Bangladesh. Small farmers require an effective tool to combat against those challenges. Proshika (a leading NGO in Bangladesh) has introduced this tool (organic agriculture) to small farmers in Bangladesh and providing them all sorts of capital assets to operate it properly. The empirical data for the study was collected by personal interviewing from smallholders organic farmers from three project villages of Proshika under Madhupur Sub-district of Bangladesh. Results of the study showed that utilizing these sorts of capital assets in organic agriculture small farmers in Bangladesh has attained significant livelihood improvement.

Introduction

Bangladesh is the poorest country in South Asia with nearly 156 million people (World Fact Book, 2009). Agriculture is the lifeblood of the economy and livelihoods of the majority of the population in this country. A study by the World Bank (2005) showed 53% of the country's rural population are living below the poverty line. Among them small farmers (having less than 1.0 ha land) who make 88.5% of the country's farming community (BBS, 2008) are more vulnerable to various risks and shocks, in attempting to realize the potential of agriculture to enhance their livelihood. In addition, the prices of farming inputs have been increasing in recent years, thereby increasing crop production costs and leading small farmers into debt (Sarker, 2002). Consequently, the income of small farmers has declined in recent years. In this context, the issue of improvements to the livelihood of small farmers is currently central to the on going debate regarding rural development, poverty reduction, and environmental management in Bangladesh. Researchers like Willer and Yussefi (2007) recommended that organic agriculture is useful to poorer as it can give purposeful socio-economic and ecologically sustainable development. Thus the study was attempted to validate the argument that organic agriculture is likely to benefit the small farmers in improving their livelihood through increasing productivity and income and promoting environmental sustainability. More specifically, this paper addresses two related questions. First, does organic farming serve as a tool in improving livelihood of participating small farmers? Second, if organic farming can contribute in improving livelihood of small farmers, what factors are associated with this livelihood improvement process?

¹ Lecturer (Agricultural Science), Teachers' Training College, Mymensingh, Bangladesh

² As Above

³ ⁴Professor, Faculty of Agriculture, Kyushu University, 6-10-1 Hakozaki, Fukuoka, Japan

⁴ ⁴Professor, Faculty of Agriculture, Kyushu University, 6-10-1 Hakozaki, Fukuoka, Japan

Materials and methods

The present study was designed based on the concept of DFID. Proshika's organic agriculture extension (OAE) program provides a number of capital assets to small farmers in operating their organic farms, with the aim of improving livelihoods. By making use of these capital assets provided by Proshika's OAE program, in addition to their own resources, Proshika farmers are engaged in organic agriculture to overcome from poverty and to achieve improvements in their livelihoods. On the other hand, Organic farmers without any affiliation to Proshika have lack of capital assets, and they have no access to aid institutions such as Proshika. Thus, empirical data for the study was collected through personal interviewing of 150 small organic farmers from three villages of Tangail district among which 90 were Proshika farmers (experimental group) and 60 were individual organic farmers (control group). Collected data were analysed with SPSS 17 version.

Results

Tab. 1: Improvements in livelihood of small farmers following adoption of organic agriculture

| | Status of livelihood improvement | | | | χ^2 statistics |
|--------------------|----------------------------------|-------|----------|-------|---------------------|
| | Not improved | | Improved | | |
| | f | % | f | % | |
| Proshika farmers | 38 | 42.22 | 52 | 57.78 | 4.0* |
| Individual farmers | 36 | 60.00 | 24 | 40.0 | |
| All farmers | 74 | 49.3 | 76 | 50.7 | |

* significant for $P < 0.05$

Discussion

Results revealed that 51% of the respondent small farmers experienced improvements in their livelihood by adopting organic agriculture. However, more Proshika farmers (57.78%) experienced improvements in livelihood via organic agriculture compared to individual farmers (40%); this difference is statistically significant.

Tab. 2: Modeling results of livelihood improvements of small organic farmers

| Variables | Description of variables | Livelihood outcomes | |
|--|---|---------------------|--------|
| | | Estimat or | Wald |
| Age of household head (X_1) | Value of 1 if farmer's age is < 35 years (otherwise, 0) | 1.917 | 2.2* |
| Gender (X_2) | Value of 1 if farmer is male (otherwise, 0) | 3.134 | 8.9*** |
| Education of household head (X_3) | Number of years of formal education | .443 | 5.9 |
| Farm size (X_4) | Amount of land under cultivation (ha) | 6.509 | 2.7* |
| Family labor (X_5) | Value of 1 if 3 or more workers in the family (otherwise, 0) | 3.015 | 6.1** |
| Years involved in OF (X_6) | Number of years involved in OF | .259 | .5 |
| PROSHIKA membership (X_7) | Value of 1 if an active member of Proshika (otherwise, 0) | .323 | .1 |
| Access to credit (X_8) | Value of 1 if trained in OF (otherwise, 0) | 3.105 | 9.4*** |
| Access to market with premium prices (X_9) | Value of 1 if farmer has received OF-related information (otherwise, 0) | 2.802 | 3.5** |
| Access to information (X_{10}) | Value of 1 if farmer has received credit to undertake OF (otherwise, 0) | 1.072 | 1.6* |
| Access to training (X_{11}) | Value of 1 if farmer has received assistance in marketing organic produce (otherwise, 0) | 1.864 | 2.6* |
| Access to information on sustainable use of natural resources (X_{12}) | Value of 1 if received information on the sustainable use of natural resources (otherwise, 0) | -.468 | .2 |
| Constant | | -11.26 | 7.4 |
| -2 log likelihood | | 56.91 | |
| Cox and Snell R^2 | | 0.634 | |
| Neglekerke R^2 | | 0.846 | |
| Chi-square statistic | | 150.6 | |

***significant for $P < 0.01$; ** significant for $P < 0.05$; * significant for $P < 0.1$

These results demonstrated that Proshika's OAE program is contributing to improvement in the livelihood of small farmers in rural Bangladesh. Accordingly, binary logit model was used to identify the significant factors associated with livelihood improvement of small farmers. The result of binary logit model yielded a -2 log-likelihood value of 56.91 and a likelihood ratio (χ^2) of 150.60, greater than the critical

chi-square (χ^2) values ($\chi^2_{0.01, 16}$) of 32.0 and ($\chi^2_{0.05, 16}$) of 26.3 at the 1% and 5% levels of significance, respectively. The study also revealed that, access to credit, access to the market with premium prices, access to information, and access to training showed significant positive relations with improved livelihood for smallholders. These factors represent financial capital, physical capital, social capital, and human capital, respectively. Among the household-level variables, binary model revealed that farm size and number of workers in the family are influential in terms of improving the livelihood of small farmers. This result reflects the fact that larger farms and families having more workers can devote more land to organic agriculture, thereby ensuring greater income for the household and improved livelihood.

Conclusions

The findings of this study indicate that organic agriculture has significant role in improving livelihood of the small farmers in rural Bangladesh. Many of the small farmers have increased their income after switching to organic agriculture as promoted by Proshika, which considerably contributed to improved well-being of the practitioners' household. Thus, it can be concluded that organic agriculture has some pro-small farmer impact to support their livelihood improvement. However, small farmers need some capital assets to smooth operation of this organic cultivation with view of livelihood improvement and these sorts of capital assets should be provided them through formal institutions either GOs or NGOs. At the same time special attention is needed to improve farmers' capacity that will ultimately contribute in attaining sustainability of improving their livelihoods. In this regard a National Organic Farming Policy should be taken by the Government of Bangladesh.

References

- BBS. (2008): *Statistical Pocket Book of Bangladesh 2008*. Planning Division, Ministry of Planning, Government of the People's Republic of Bangladesh.
- Sarker, M. A. H. (2002): Indigenous Fine Aromatic Rice Production: Bangladesh Perspective. Paper presented in RDA/ARNOA International Conference "Development of Basic Standard for Organic Rice Cultivation, 12-15 November, 2002, RDA and Dankook University, Korea.
- Willer, H. and Yussefi, M. (2007). *The World of Organic Agriculture-Statistics and Emerging Trends 2007*. International Federation of Organic Agriculture Movements IFOAM, Bonn, Germany and Research Institute of Organic Agriculture FIBL, Ackerstrasse, Switzerland.
- World Bank. (2005): 'Reaching the Rural Poor'. *A Renewed Strategy for Rural Development*. Washington DC, USA: The World Bank.
- World Factbook. (2009): The online world factbook. Central Intelligence Agency (CIA), United States of America. Available at, <https://www.cia.gov/library/publications/the-world-factbook/geos/bg.html> (accessed on November 11, 2009).

Farmers' attitudes and level of knowledge on organic farming in the ilocos region, Philippines

Pastor, F.¹, Legaspi, N.², Agbigay, L.³, Pastor, C.D.⁴, Salas, M.A.⁵, Cacatian, M.⁶ & De Padua M.V.⁷

Abstract

This study focused on the assessment of attitudes and knowledge and the factors that affects these. This study was conducted in Region 1, Philippines. An interview schedule was used to gather all necessary information. Farmer respondents were stratified into two, those who have not tried OF (NOF), and those who have experiences in OF, either partially or discontinued. T-test was used to differentiate NOF from TOF, while Pearson correlation was used to determine which of the socio-demographic characteristics significantly affect their attitudes and knowledge towards OF. Results showed that most of the farmers in both regions are aware of OF. However, there are TOF respondents practicing organic techniques but unaware that such is organic in nature. Statistics showed that NOF and TOF respondents are significantly different with regards to their attitudes on some attributes of OF. Although both groups are generally uncertain of the negative and agreeable of the positive attributes of OF, TOF respondents appeared to be more optimistic. There are noted demographic factors that have influences on technical knowledge and some aspect of OF. Reasons for non-adoption and discontinuance of OF is the economic impact during conversion period. These are realities of OF and hence, these can be some possible entry points for promotional activities on OF in the country.

Key words: organic farming, attitudes, assessment, knowledge, awareness

Introduction

Organic farming/agriculture is not a new program of the Philippine government. There have been lots of related programs implemented since the time of the Green Revolution until now to avert the negative impacts brought about by inorganic farming. In fact, the Executive Order 481 known as the Promotion and Development of Organic Agriculture in the Philippines (now known as RA 10068 or the Organic Agriculture Act of 2010) has been promulgated to address the concern on degradation of our ecosystem and environment and while addressing the goals of food security and safety, increases productivity and alleviates poverty. Furthermore, through this law, concerned agencies provides support such as financial grant, trainings and equipment to collaborating agencies and interested entities that could be agents of accelerating the adoption and promotion of organic agriculture in the country. But despite of these promotional activities and the proven benefits of organic agriculture/farming, farmers' adoption seems still very slow. Studies show that there are various factors that influence the conversion process to organic farming. Beckie (2000) in his study on comparing the farmers' perception of the factors influencing their decision for organic farming, concludes that organic farming is adopted as a

¹ Mariano Marcos State University, 2906 Batac, Ilocos Norte, Philippines

²⁻⁶ Same above

⁷ Don Mariano Marcos Memorial State University, Bacnotan, La Union, Philippines

result of environmental, health, economic, philosophical/spiritual and labor factors. Current status of organic farming in the Philippines could be affected by one or in combination of these factors. This necessitates evaluation of the factors affecting the attitudes of farmers on organic farming.

Methodology

a. Procedure/data collection

Target farmer respondents were from the 4 provinces of Ilocos Region (Ilocos Norte, Ilocos Sur, La Union and Pangasinan). A total of 200 farmer respondents were interviewed. From these respondents, non-organic farmers (NOFs) were distinguished from those farmers who tried organic farming (TOFs) partially or discontinued. These two types of respondents were used as the subjects for the entire analysis.

b. Instrumentation, research design and statistical analysis

An interview schedule was used in gathering the necessary information which mainly focused on a) demographic variables; b) attitudes on the common attributes of organic farming and c) knowledge on technical, socio-economic, health/environment, and accreditation/certification aspect of OF. T-test was used to differentiate NOF from TOF, while Pearson correlation was used to determine which of the socio-demographic characteristics significantly affect their attitudes and knowledge towards OF. The general assessment on the attitude and knowledge of respondents were based on a five-point Likert's scale: For attitudes, 1 is strongly disagree and 5 is strongly agree; while for knowledge, 1 is very low knowledge and 5 is very knowledgeable.

Results and Discussions

1. Demographic and socio-economic characteristics of NOF and TOF respondents

Results revealed that both NOF and TOF respondents in the Ilocos Region have comparable demographic and socio-economic characteristics. Most of the farmers have an average age of 48.59 (TOF) to 49.08 years, male, married, with an average household size of 5.11 to 5.12, religiously affiliated with Roman Catholic, Ilocanos, with 23.03 to 23.14 average year in farming and with an average farm size of 0.96 to 1.14 hectares. However, the annual income of TOF respondents is significantly higher (P116,886.52) than NOF respondents (P71,234.01). This finding shows that farmers who tried organic farming but discontinued are more financially able than NOF respondents. This suggests that, farmers of lower income are more hesitant to adopt organic farming because they can not afford to take the risk particularly if such practice has no assurance of good income, unlike farmers with high income, they are likely to be more resilient in case farming income fails or decreases.

2. Attitudes of farmers (NOF and TOF) on the attributes of organic farming

The extent to which a technology has been disseminated can also be measured by the attitude of the target clientele toward it. The attitudes of NOF and TOF farmers towards some attributes of organic farming are distinguishable as revealed by statistical results (Table 1). With the experiences of TOF respondents, they agree with both negative and positive attributes of OF, unlike NOF who are uncertain. One of the distinguishable differences between NOF and TOF respondents is the difficulty to meet all the inputs required on the organic farm. NOF respondents are uncertain of

this while TOF respondents are agreeable. Because of their experiences, they know for a fact that they have difficulty in producing their own organic inputs.

Very notable also is their uncertainty if there is a high demand for organic products in the market. This is indicative of the absence of an organized market support system for organic product in the region. There might be some who are producing organic products but are not recognized because there is no identified market for such products hence; these are being sold along with the conventionally-produced farm products. Because of this, organic producers cannot demand a higher price for their produce, and this might be one of the reasons why they are uncertain if conversion to organic farming does give economic rewards.

Table 1. Knowledge level of NOF and TOF respondents on matters regarding organic farming in Region 1

| STATEMENT | NOF (n=89) | TOF (n=111) | t-test |
|---|------------|-------------|----------|
| A. Attitudes | 3.38 (u) | 3.67 (a) | -0.287** |
| B. Knowledge | | | |
| 1. Technical aspect | 2.84 (mk) | 3.37 (mk) | -0.53** |
| 2. Socio-economic aspect | 2.54 (lk) | 3.07 (mk) | -0.53** |
| 3. Environment/health aspect | 3.47 (k) | 4.21 (vk) | -0.74** |
| 4. Accreditation/certification/support aspect | 2.26 (lk) | 2.87 (mk) | -0.61** |

Legend: Attitudes: u-uncertain, a-agree; Knowledge: 1.00 to 1.79 – very low knowledge (vl); 1.80 to 2.59 – low knowledge (lk); 2.60 to 3.39 – moderately knowledgeable (mk); 3.40 to 4.19 – knowledgeable (k); 4.20 to 5.00 –very knowledgeable (vk);

3. Level of knowledge of NOF and TOF respondents on matters regarding organic farming

Generally, results show that level of knowledge of NOF respondents is significantly lower than TOF respondents as far as technical, socio-economic, environment/health and accreditation aspect of organic farming are concerned. However, NOF and TOF respondents have low knowledge particularly with the technicalities of biopest control and crop rotation. Some farmers are practicing crop rotation but have very limited knowledge on its notable advantages particularly in improving soil fertility and its ability to control outbreaks of pests.

With regards to the socio-economic aspects of organic farming, NOF farmers have significantly lower level of knowledge than TOF farmers except on matter regarding the preparation of organic inputs as laborious and time consuming wherein both are moderately knowledgeable. This is one of the bottlenecks of TOF respondents who have already experienced OF. In fact, this one of the mentioned reasons for discontinuance. Once this situation or information is cascaded to their fellow farmers, it is even more difficult to widen OF adoption.

With the consideration of environment and health aspect of organic farming, NOF farmers are knowledgeable while TOF farmers are very knowledgeable. These higher levels of knowledge for both groups of farmers can be attributed to the organic movement in the country. The environmental and health benefits of organic farming are the most popular storylines from broadcast, print and other form of media. Likewise, this is the most known justifications for people to consume organic products.

4. Relationship of Socio-demographic factors with attitudes and knowledge of Farmers on Organic Farming

Correlation analysis showed that socio-economic and demographic characteristics of both NOF and TOF farmers have no significant influences on their attitudes towards some attributes of organic farming. However, some of these characteristics have

significant influences on the level of knowledge of both groups of farmers on some technical and other aspects of organic farming.

For NOF farmers, religion and educational attainment have significant impacts on their level of knowledge as far as crop rotation and biopest control are concerned. These two attributes of organic farming are quite too technical and thus more educated farmers tend to know more about these. Likewise NOF farmers with higher educational attainment tend to be more informed with the socio-economic attributes of organic farming. This could be attributed to the attitudes of farmers wherein they are mostly concerned of the economic returns of a certain technology. This shows that education can have a very significant bearing to the adaption of a certain technology. For TOF farmers, income can have significant impact on their level of knowledge on crop rotation. It is also noted that farmers engaged longer in farming tend to have better knowledge on crop rotation, green manuring and the use of traditional varieties. Relatively, farm size can be a significant factor influencing their level of knowledge on biopest control, and environment and health aspect of organic farming, whereas household size affects their knowledge on indigenous practices.

Conclusions & Recommendations

Most of the notable reasons for non adoption or discontinuance of organic farming are: laborious and time consuming, slow effect, unsustainable government support, low yield or lower income, lack of technical knowledge and assistance, pest problems. Considering these results, there are many possible entry points of promotional activities that could help if the government is really serious enough in advocating OF in the country. For instance, some farmers have low technical knowledge on matters regarding OF and this can have significant effect on their proper understanding about OF. With this reality, it can be helpful if we have to intensify more information, education and communication (IEC) drive so that we can educate and give them the proper view regarding the long term and significant contributions of organic farming. With this, we can probably establish a more positive attitude of farmers regarding organic farming. Likewise, if there are research results or any previous documentations of the long term and sustainable benefits of organic farming that could be shown to them can be of great help. If non, R&D and off- farm demos or touring them to known successful organic farms can be of great support to them. There are also needed supports demanded by the farmers in order for them to be encouraged/convinced in adapting organic practices. The government must find ways that these demands can be granted and extended.

REFERENCES

- Beckie, M. A. (2000) Zero Tillage and Organic Farming in Saskatchewan: An Interdisciplinary Study of the Development of Sustainable Agriculture. Ph D. Thesis Saskatoon: Division of Extension, University of Saskatchewan.
- Lampkin, N. H. and S. Padel (1994) Organic Farming and Agricultural Policy in Western Europe: An Overview In Lampkin, N. H., Padel S., (Ed.), *The Economics of Organic Farming*, CAB International, Oxon, UK. pp. 437-456.
- Marshall, G. (1993) Organic Farming in Australia: An Economist's Perspective. Proceedings from the AIAS Organic Agriculture Conference, 17 June 1993, pp. 61-68.
- Sterrett, S., G. E. Groover., D. B. Taylor, and K. Mundy. 2005. Describing Organic Agricultural Production in Virginia Results of the 2004 Farm Survey Virginian's Rural Economic Analysis Program, Department of Agricultural and Applied Economics, College of Agriculture and Life Sciences, Virginia Tech.

Food quality and food processing

Product quality of rocket (*Eruca sativa* L.) as a function of light intensity and nitrogen supply

Athmann, M.¹ & Köpke, U.²

Key words: farmyard manure, calcium ammonium nitrate, growth, differentiation

Abstract

The influence of light intensity, nitrogen supply and fertilizer type on parameters related to crop growth and differentiation was investigated for rocket (Eruca sativa L.) in factorial field trials. Full sunlight vs. shading, low vs. high N supply and farmyard manure vs. mineral fertilization resulted in higher values for parameters related to morphological and chemical differentiation (e.g. dry matter content, ascorbic acid, glucosinolates) and lower values for parameters related to growth (e.g. single leaf area). Hence, the biological value of the product was increased. This approach in product quality assessment can be used to explain differences between organic and mineral fertilization based on plant physiological processes. It is discussed whether this concept can fulfil the requirements for a comprehensive model as a basis for quality investigations in Organic Agriculture.

Introduction

Traditionally, in Organic Agriculture (OA) product quality has primarily been described as a function of environmental factors. Crop production methods, especially fertilization, have been oriented towards a balanced equilibrium of growth promoting factors (water, humus and nitrogen) on the one hand and light and warmth as factors that enhance morphological and chemical differentiation on the other hand (Schaumann 1972, Koepf no year).

This understanding of quality is well in accordance with theories from plant ecology describing allocation of photosynthates in plants as a function of the ratio of nutrient to energy supply (carbon-nutrient-balance theory: Bryant *et al.* 1983, Coley *et al.* 1985, and growth-differentiation-balance hypothesis: Herms & Mattson 1992). A comprehensive concept of product quality as a function of environmental factors originally developed by Schaumann (1972) and Koepf (no year), amended by these concepts is given in Tab. 1. A similar approach is used by Brandt & Mølgaard (2001) as a basis for discussing possible differences in food quality of organic and conventional produce. Bloksma *et al.* (2007) defined 'integration', i.e. an optimum balance of growth and differentiation, as a prerequisite for high product quality.

Due to its complexity and therefore lacking practicality, this integrated approach in quality assessment has not been widely applied. At the same time, comprehensive models as a basis for quality investigations in Organic Agriculture are urgently requested, mainly to define quality claims as compared to products from conventional agriculture (e.g. Kahl *et al.* 2010).

¹ Institute of Organic Agriculture, University of Bonn, Katzenburgweg 3, D-53115 Bonn, Germany, Email mathmann@uni-bonn.de, Internet www.iol.uni-bonn.de

² As Above

Tab. 1: Product quality as a function of natural and anthropogenic influences according to Schaumann (1972) and Koepe (no year), modified and amended

| Parameters | Unilateral influence of | |
|----------------------------|---|--|
| | water, humus, nitrogen | light and warmth |
| Plant development | Growth enhanced Delayed ripening | Differentiation enhanced Premature ripening |
| Plant morphology | Shallow roots Large, thin leaves | Deep roots Small, thick leaves |
| Defense strategy | Outgrowth | Secondary metabolites |
| Composition | | |
| Dry matter content | Low | High |
| Ratio of | | |
| - C-/N-based compounds | Low | High |
| - Sec./primary metabolites | Low | High |
| Taste, aroma | Low | High |

The objective of the study presented here was a) to describe product quality as a function of light intensity and nitrogen supply and b) to discriminate mineral fertilization and farmyard manure (FYM) with the same parameter set.

According to the concept in Tab. 1, common challenges to high product quality in agriculture in temperate climates, such as fungal infections and low contents of aromatic compounds and secondary metabolites, are considered basically as the result of a shift in the equilibrium between nitrogen and light towards the nitrogen side. Since with organic manuring nitrogen supply is limited to natural sources, this shift was assumed to be smaller than with mineral fertilization, with a positive effect on the integration of crop growth and differentiation and subsequently on product quality.

Materials and methods

In 2008 and 2009, field trials with rocket (*Eruca sativa* L.) were carried out at the experimental station 'Wiesengut' in Hennef/Sieg, Germany, in a four-factorial split-plot design with four field repetitions. Factors were light intensity (100% photosynthetically active radiation PAR; 55% PAR), N supply (low; high), fertilizer type (FYM; mineral: calcium ammonium nitrate, potassium chloride and triplesuperphosphate). Light intensity was varied using shading nets. High N supply was orientated at practice recommendations. Amounts of mineral and organic fertilizer were calculated to yield the same N availability with both fertilizer types at the same levels of N supplies respectively, leading to about 60 kg of mineral N fertilizer in both years and 58 t (2008) and 47 t (2009) of FYM for high N supply. Low N supply was 50% of these amounts.

The quality assessment was based on plant morphological parameters and chemical compounds related to growth and differentiation. In total, 26 parameters were analysed. In this paper, selected parameters are presented. Leaf area and leaf length were measured for 10 plants per plot using Matlab routines. Dry matter content was determined gravimetrically (105°C) for an aliquot of about 100 g per plot. Carbon and nitrogen were measured according to Dumas/Merz. Nitrate was determined photometrically. Ascorbic acid (both L-ascorbic acid and L-dehydroascorbic acid) and glucosinolates were determined with HPLC. Data were submitted to ANOVA followed

by Tukey-test at $\alpha = 0.05$. A detailed description of the experiment, the parameters analyzed and the methods of analysis is given in Athmann (2010).

Results

In both years, parameters could be classified in two groups according to factor effects (Tab. 2). Full sunlight vs. shading and/or low vs. high N supply and/or the two organic manure types vs. mineral fertilization resulted in lower single leaf area, leaf length, and nitrate as well as in higher dry matter content, C/N-ratio, and contents of ascorbic acid and glucosinolates.

Tab. 2: Results for selected parameters of rocket quality assessment

| | Parameter | 100% PAR vs. 55% PAR | | N low vs. N high | | Fy. manure vs. mineral | |
|-----------------|-----------------------------|-------------------------|------|---------------------|------|---------------------------|------|
| | | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 |
| Morph. | Single leaf area | +11 | -13* | -31* | -15* | -35* | -5 |
| | Leaf length | -9 | -16* | -18 | -15* | -23 | -3 |
| | Dry matter % | +19 | +18* | +20 | +12* | +7 | +8* |
| Compositio n | Nitrate ¹ | -136 | -74* | -53* | -21 | -108 | -7 |
| | C/N | +11* | +17 | +12 | +7 | +9 | +6 |
| | Ascorbic acid ¹ | +29 | +18 | +10 | +22* | +18* | +21* |
| | Glucosinolates ¹ | +18 | +3 | +5 | +28* | -9 | +24* |

Values are percentage increase or decrease.

¹: on a fresh matter basis. PAR: photosynthetically active radiation.

* : significant (Tukey-Test, $\alpha = 0.05$).

Discussion

The factor effects on the two parameter groups are in accordance with the quality concept in Tab. 1. Single leaf area and leaf length indicate cell enlargement and therefore growth. These parameters were reduced by full sunlight vs. shading, by low vs. high N supply and by FYM vs. mineral fertilization, while dry matter content as an indicator for chemical differentiation was increased. With respect to the chemical composition, full sunlight vs. shading, low vs. high N supply and FYM vs. mineral fertilization increased the C/N ratio and the ratio of secondary to primary metabolites (higher glucosinolate, higher ascorbic acid and lower nitrate contents).

Thus, increased light intensity and decreased N supply both led to the expected shift from growth towards morphological and chemical differentiation. Even at the same level of N supply, organic vs. mineral fertilization had a similar effect: the balance of light and nitrogen was also shifted away from growth, differentiation was promoted. In this study, the promotion of differentiation processes by either higher light intensity or lower N supply or organic instead of mineral fertilization resulted in attributes connected to higher biological value of the product (high ascorbic acid, high glucosinolate and low nitrate contents).

Conclusions

In contrast to most other investigations on product quality, in this study the effects of different fertilizer types were analyzed and interpreted as the result of a different balance of light and nitrogen and a different impact on growth and differentiation. The consideration and investigation of product quality as a function of light intensity and nitrogen supply forms a good basis for a quality concept to define quality claims as compared to products from conventional agriculture. For further elaboration, the model has to be applied to other crops, too. Similar experiments with other vegetables, cereals and potatoes have to be carried out to define suitable quality parameters related to growth and differentiation. Furthermore, investigations should be extended to regions with high light intensities and on soils poor in nutrients. Due to many positive effects of organic manuring on soil structure and soil life, also on sites where not light, but nutrients are limiting, positive effects of organic vs. mineral fertilization on product quality are to be expected.

Acknowledgments

We thank Software AG Stiftung, Darmstadt, Mahle Stiftung, Nuremberg, and Cusanuswerk, Bonn, Germany, for financial support of the project. Chemical analyses by Dieter Zedow, IOL, University of Bonn, and Uwe Ammermann, Department of Crop Sciences, University of Goettingen, Germany, are kindly acknowledged.

References

- Athmann M. (2010): Produktqualität von Salatrauke (*Eruca sativa* L.) und Weizen (*Triticum aestivum* L.): Einfluss von Einstrahlung, Stickstoffangebot, Düngungsart und Hornkieselapplikation auf Wachstum und Differenzierung. Ph.D. Thesis, University of Bonn, Germany
- Bloksma J., Northolt M., Huber M., van der Burgt G.J., van de Vijver L. (2007): A new food quality concept based on life processes. In: Cooper J., Niggli U., Leifert C. (eds.): Handbook of organic food safety and quality. Woodhead Publishing, Cambridge, England, p. 53-73.
- Brandt K., Mølgaard J.P. (2001): Organic agriculture: does it enhance or reduce the nutritional value of plant foods? J. Sci. Food Agric. 81: 924-931
- Bryant J.P., Chapin F.S., Klein D.R. (1983): Carbon/nutrient balance of boreal plants in relation to vertebrate herbivory. Oikos 40: 357-368.
- Coley P.D., Bryant J.P. and Chapin F.S. (1985): Resource availability and plant antiherbivore defense. Science 230: 895-899.
- Hermes D.A., Mattson W.J. (1992): The dilemma of plants: to grow or defend. Q Rev Biol 67:283-335.
- Kahl J., van der Burgt G.J., Kusche D. et al. (2010): Organic food claims in Europe. Food Technology 3: 38-46.
- Koepf, H.H. (no year): Research in biodynamic agriculture: Methods and results. Michael Field's Agricultural Institute, East Troy, Wisconsin. Biodynamic Farming and Gardening Association Inc., P.O. Box 550, Kimberton, PA 19442, USA, 78pp.
- Schaumann, W. (1972): Die Bildung der Pflanzenqualität als Ergebnis der Wirkungen von Sonne und Erde. Lebendige Erde 4: 2-8.

Differences in fatty acid and antioxidant profiles of milk from German biodynamic and conventional low- and high-input systems in summer and winter

Kusche, D.¹ and Baars, T.¹

Key words: system-comparison, product quality, organic milk, fatty acid profile

Abstract

Milk quality at different biodynamic and conventional dairy farms was evaluated in two seasons. Bulk milk samples were taken bimonthly on 6 occasions on 24 farms. The farms were grouped in four system groups, each of six farms: biodynamic low- (BLI) and high-input (BHI) and conventional low- (CLI) and high-input (CHI). Current feeding, pasture and performance of the cows were recorded. The fatty acid (FA) profiles, as well as α -tocopherol and β -carotene were analysed. Both LI systems fed their cows in summer essentially with grass and in winter with hay, while both HI incorporated different shares of grass (clover), maize silages and concentrates. Milk from the lower intensified systems (BLI, BHI and CLI) could consistently be differentiated from CHI in both seasons based on several FAs (PUFA, OBCFA, n3 and CLA) and AOs (α -tocopherol and β -carotene). BLI and CHI showed the most contrasting differences due to the highest intake of grass res. hay (BLI) and the renunciation of maize and grass silages and high levels of concentrates compared to the TMR based diet (CHI). A further intensification of organic systems will decrease the FA profile of organic milk. This represents a threat to an organic "plus" in product quality.

Introduction

One of the four IFOAM principles of organic agriculture is the principle of health: "Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible." Consumers assume organic food to be healthier. In recent studies milk from organic and from low-input systems showed specific fatty acid (FA) and antioxidant (AO) profiles compared to conventional systems. The incidence of eczema in two-year-old infants was lower in children consuming organic dairy products, like their mothers during pregnancy and breastfeeding (Kummeling *et al.* 2008). Milk fat composition might play an important role. In this study we evaluated how milk quality was affected by different farming systems in summer and winter: low input (LI) versus high-input (HI) in both biodynamic (B) and conventional (C) systems. The main question of this system comparison was if we could differentiate the milk from different organic and conventional systems and which management factors were responsible for the differences in milk quality?

Materials and methods

Farms, system groups and feeding: On 24 farms in Germany (Franken/Hohenlohe und Allgäu/Bodensee), divided in four groups (BLI, BHI, CLI and CHI) of each six farms,

¹ Department for Biodynamic Agriculture, Kassel University, Nordbahnhofsstr. 1a, 37213 Witzenhausen, Germany; daniel.kusche@gmx.de, www.agrar.uni-kassel.de/bdl

bulk milk samples were taken bimonthly from May 2008 to March 2009. Animal breed, current feeding, pasture access and milk performance of the cows were recorded. Based on farmer's information and the milk yield control data the average daily feed intake was estimated and the ration of the cows was calculated with MilliWin 7.0. *Sampling:* Bulk tank milk samples were taken at each sampling day on all 24 farms and transported at 5°C in electric cooling boxes. Samples for the analysis of FAs were deep-frozen at -21°C within 24 hours. Fresh cooled milk was delivered within 24 hours for the analysis of AO and main milk compounds. In May as well as in November a milk sample of one BLI farm was missed (total n = 142). *Analysis of FA and AO:* Lipid extraction, preparation of FA methyl esters as well as analysis by gas chromatography was performed according to Kraft *et al.* (2003). High performance liquid chromatography was used for the analysis of AO according to Schweizerisches Lebensmittelhandbuch (2005). *Statistics* were performed by jmp 8.0 using an ANOVA with a Post hoc Tukey test or a Dunn's test prior to statistical requirements.

Results

Each group was characterised by a specific management profile. BLI used mainly local, double purpose breeds, the cows were fully grazed in summer and hay fed during winter and received the lowest concentrate input.

Table 1: Average estimated composition of the dry matter ration of the four system groups in summer (n=71) and winter (n=71) in kg DM cow⁻¹ day⁻¹

| | | System group / Farming style | | | | P | SEM |
|--------|-----------------------|------------------------------|--------|--------|-------|-------|------|
| | | BLI | BHI | CLI | CHI | | |
| n | | 17 | 18 | 18 | 18 | | |
| SUMMER | Fresh grass | 11.9 a | 4.9 c | 9.3 b | 1.5 d | <.001 | 0.59 |
| | Grass-(clover) silage | 0.0 b | 5.7 a | 0.0 b | 6.1 a | <.001 | 0.50 |
| | Maize silage | 0.0 c | 1.9 b | 0.0 c | 4.0 a | <.001 | 0.30 |
| | Hay | 1.9 ab | 1.7 b | 2.8 a | 0.3 c | <.001 | 0.17 |
| | Grass cobs | 0.2 bc | 0.6 ab | 1.0 a | 0.0 c | <.001 | 0.09 |
| | Concentrates | 0.9 c | 1.6 bc | 2.9 b | 4.5 a | <.001 | 0.27 |
| WINTER | Hay | 11.8 a | 1.6 b | 11.1 a | 0.3 b | <.001 | 0.65 |
| | Fresh grass | 0.3 | 0.0 | 0.0 | 0.0 | 0.398 | 0.08 |
| | Grass-(clover) silage | 0.0 b | 8.9 a | 0.0 b | 7.7 a | <.001 | 0.55 |
| | Maize silage | 0.0 c | 2.8 b | 0.0 c | 5.0 a | <.001 | 0.37 |
| | Straw | 0.0 | 0.2 | 0.0 | 0.2 | 0.098 | 0.04 |
| | Grass cobs | 0.7 b | 0.5 b | 1.7a | 0.0 b | <.001 | 0.12 |
| | Concentrates | 1.3 c | 2.5 bc | 3.0 b | 4.4 a | <.001 | 0.21 |

a-c = means within row without common superscript differ after a Post-hoc Tukey test, B = Biodynamic; C = Conventional, HI = High-input; LI = Low-input, p = p-value, SEM = Standard error of the mean

CHI mainly used indoor-fed cows and modern milking breeds and fed silages including maize and concentrates in highest levels. CHI represents in terms of feeding and performance a standard system of conventional dairy production.

BHI mainly used high yielding milking breeds, mixed roughage of fresh grass (in summer) and silages including maize and intermediate levels of concentrates. CLI used double purpose breeds and partly pasturing during summer and fresh cut grass indoors and in winter hay, with intermediate to high levels of concentrates and grass cobs.

Table 2: Selected fatty acid and antioxidant concentrations in the milk of the four systems groups in summer (n=71) and winter (n=71), FAs in mg g⁻¹ fat and AOs in µg l⁻¹ milk

| | | System group / Farming style | | | | P/CHI ² | SEM |
|--------|---------------|------------------------------|----------|---------|---------|--------------------|-------|
| | | BLI | BHI | CLI | CHI | | |
| n | | 17 | 18 | 18 | 18 | | |
| SUMMER | SFA | 686.13 | 702.17 | 689.87 | 697.57 | 0.279 | 3.19 |
| | MUFA | 266.28 | 260.96 | 269.89 | 270.22 | 0.645 | 2.88 |
| | PUFA | 47.59 a | 36.88 b | 40.26 b | 32.22 c | <.001 | 0.89 |
| | OBCFA+ | 41.81 a | 37.81 bc | 37.02 b | 34.99 c | <.0002 | 0.46 |
| | Omega 3 FA | 16.64 a | 12.18 b | 11.89 b | 8.79 c | <.001 | 0.41 |
| | CLA | 16.61 a | 11.29 b | 14.91 a | 7.37 c | <.001 | 0.60 |
| | α-tocopherol+ | 985 a | 832 ab | 695 b | 658 b | <.0002 | 30.01 |
| | β-carotene | 159 a | 136 ab | 120 bc | 99 c | <.001 | 4.68 |
| WINTER | SFA+ | 731.14 | 714.29 | 718.19 | 716.82 | 0.176 | 4.16 |
| | MUFA+ | 230.68 | 251.74 | 241.52 | 251.33 | 0.112 | 3.80 |
| | PUFA+ | 38.93 a | 35.35 ab | 40.81 a | 32.13 b | <.0002 | 0.69 |
| | OBCFA+ | 42.62 a | 35.80 b | 36.79 b | 34.95 b | <.0002 | 0.51 |
| | Omega 3 FA+ | 14.52 a | 10.27 b | 12.74 a | 8.17 b | <.0002 | 0.38 |
| | CLA | 9.01 a | 8.81 a | 10.14 a | 6.36 b | <.001 | 0.30 |
| | α-tocopherol+ | 605 b | 842 a | 439 c | 722 ab | <.0002 | 23.96 |
| | β-carotene | 124 a | 137 a | 83 b | 118 a | <.001 | 4.97 |

^{a-c} = means within row without common superscript differ after a Post-hoc Tukey test or after a Dunn's test in which chi² was interpreted (<0.0083 = *; <0.002 = **; <0.0002 = ***) marked in the tables by +; B = Biodynamic; C = Conventional, HI = High-input; LI = Low-input, P = p-value, SEM = Standard error of the mean; SFA = Saturated Fatty Acids; MUFA = Mono Unsaturated Fatty Acids; PUFA = Poly Unsaturated Fatty Acids; OBCFA = Odd Branched Chain Fatty Acids; CLA = Conjugated Linoleic Acids; FA = fatty acids

Throughout the year highest concentrations of Poly Unsaturated Fatty Acids (PUFA), Odd Branched Chain Fatty Acids (OBCFA), Omega 3 (n-3) and Conjugated Linoleic Acids (CLA) were found in BLI and were lowest in CHI while the levels of Saturated and Mono Unsaturated fatty acids were similar within all groups. BHI and CLI had an intermediate position partly similar to each other or for some compounds similar to BLI or CHI. In summer both B milks had the highest levels of α-tocopherol and β-carotene, whereas in winter higher levels were found in both HI systems and for β-carotene, which was also high in BLI. Milk performance levels were higher in conventional

systems and ranged from 7890 in CHI, 7335 in CLI, 6308 in BHI to 4828 kg cow⁻¹ year⁻¹ in BLI.

Discussion and conclusion

In this system comparison the groups BLI, BHI and CLI could consistently been differentiated based on relevant FAs (PUFA, n3, CLA) in the milk from the standard conventional system CHI in both seasons. However, the differentiation level was higher in summer. BLI milk showed consistently the highest concentrations of relevant FAs, intermediate were BHI and CLI and lowest throughout the year was CHI. This could be explained by the intensity and feeding management of the four system groups, breeds had low impact on the FA profiles. In summer BLI farms had the highest share of grass in the ration compared to the other groups and no maize, silages or higher concentrates were given which would have detrimental effects on the FA and AO profiles. These results were in accordance with other studies (a.o. Butler *et al.* 2008). α -Tocopherol and β -carotene were higher in both B milks in summer due to highest levels of AOs in fresh grass and in grass cobs. Both compounds were in winter milk higher in HI systems due to the higher concentrations of AOs in silages compared to hay which was used in the LI systems. It was not always possible to differentiate BHI from CLI based on the FA and AO profiles of the milk. A consistent differentiation of organic and common conventional milk product quality, as represented by CHI, should be possible on the basis of the FA profiles. Especially as long as an orientation on low-input of concentrates and grass based feeding were practiced in the organic systems. An orientation on intensive conventional feeding practices (total mixed ration: incorporating high levels of maize and concentrates) in organic systems decreased the FA quality, which could be a unique selling preposition for organic milk. Public health effects of the consumption of milks from different systems needs to be further evaluated. We concluded, an organic “plus” in product quality of milk might get lost if intensification of organic dairy production systems prevails. Extensive, grass based and quality oriented production systems could be an interesting future option for organic dairy production.

References

- Butler G., Nielsen J.H., Slots T., Seal C., Eyre M.D., Sanderson R. and Leifert C. (2008): Fatty acid and fat soluble antioxidant concentrations in milk from high- and low-input conventional and organic systems: seasonal variations. *J. Sci. Food Agric.* 88:1431-1441.
- Kraft J., Collomb M., Möckel P., Sieber R. and Jahreis G. (2003): Differences in CLA isomer distribution of cow's milk lipids. *Lipids* 38:139-144.
- Kummeling I., Thijs C., Huber M., van de Vijver L.P.L., Snijders B.E.P., Penders J., Stelma F. and van Ree R. (2008): Consumption of organic foods and risk of atopic disease during the first 2 years of life in the Netherlands. *Brit. J. Nutr.* 99:598-605.
- Schweizerisches Lebensmittelhandbuch (2005) Kapitel 62 Vitamine, Untersuchungsmethoden, 1.2.1 Bestimmung der Vitamine A und E mittels Umkehrphasen-HPLC. <http://www.slmb.admin.ch/slmb/index.html>, (accessed 2010-12-29).

Nitrate and Chlorophyll Contents in Organically Cultivated Chinese Cabbages

Sang Mok Sohn¹

Key words: nitrate, ADI, chlorophyll, outer leaf, Chinese cabbage

Abstract

An average Korean ingests 3.4 times the Acceptable Daily Intake of nitrate, 97% of which is from vegetables. This study analyzed the contents of nitrate and chlorophyll in organic Chinese cabbages, a favourite vegetable for Koreans, with a view to lowering the daily intake of nitrate. We found that in organically cultivated cabbages, the further out the leaf was located, the more significant was the increase in the nitrate content, with the midrib and leaf blade showing positive relationships of $r=0.789^{**}$, and $=0.659^{*}$, respectively. The content in the midrib increased by as much as 79-fold, ranging from 40 ppm for the innermost leaf to 3,177 ppm for the outermost one. In the leaf blade, the content increased as much as 87-fold (3,449 ppm compared with 40 ppm for the innermost leaf). Our findings also suggest that it is advisable to discard one-third of the outermost leaves before eating Chinese cabbages, since the outer leaves with known high content of chlorophyll also are high in nitrate.

Introduction

Because of their high level of nitrate intake from vegetables, which account for 85% of daily nitrate intake, a Korean takes in more nitrates than a Westerner who is predominantly oriented toward meat-based foods. The reported proportion of nitrate coming from vegetables in a few countries include 72.4% in Germany, 75.0% in the United States, 89.9% in Japan, and 97.3% in Korea (Sohn et al. 1999).

Daily nitrate intake of an average Korean exceeds by 3.4 times the FAO/WHO ADI (Acceptable Daily Intake) (219 mg), because Koreans ingest large amounts of vegetables in their daily diet (Sohn, 2000).

This study is aimed at presenting the basic data on the contents of nitrate and chlorophyll of certified organic Chinese cabbage, the favourite vegetable of Koreans, to minimize its contribution to daily nitrate intake.

Materials and methods

Certified organic Chinese cabbages were sampled from the organic food sections of six supermarkets in Seoul. Midribs and leaf blades of each leaf were separated and numbers were given starting with inner leaves and moving towards the outer leaves. Fresh samples were squeezed after grinding, and nitrate concentrations were measured by RQflex by Merck. The total chlorophyll was added to chlorophyll a and chlorophyll b measured by UV Spectrophotometer at 663 nm and 645nm, respectively.

Results

¹ Research Institute of Organic Agriculture, Dankook University, Cheonan 330-714, Republic of Korea, E-Mail smsohn@dankook.ac.kr, Internet www.rioa.or.kr

As shown in Fig. 1, nitrate content significantly increased as the number of the leaf increased. In the case of the midrib and leaf blade, the nitrate level increased, depending on the position of the leaf, with a high correlation ($r=0.789^{**}$ and $r=0.659^{**}$, respectively).

With regard to the midrib, the innermost leaves, specifically the first through fifth, showed nitrate levels from 40 to 113 ppm; the 21st to 25th leaves had nitrate levels from 563 to 1,786 ppm, while leaves from position 45 and beyond continued the sharp increase, with values ranging from 1,298 to 3,177 ppm.

For the leaf blade, nitrate content varied from 40 to 97 ppm for the first through fifth leaves, from 119 to 965 ppm for positions 21 through 25, and from 522 to 2,887 ppm for position 46 to the outermost leaf. Similarly, for the midrib, the nitrate content from the innermost to the outermost leaves ranged from 40 ppm at minimum to 3,177 ppm at maximum, an increase of almost 80-fold. Our findings show that depending upon the leaf's position, when a whole leaf is eaten, the intake of nitrate from a small inner leaf is significantly lower than from a large outer leaf. To be specific, the total nitrate content was 2.6 mg in the smallest inner leaf weighing 3 g, while the total nitrate was 375 mg in the largest outer leaf weighing 132 g.

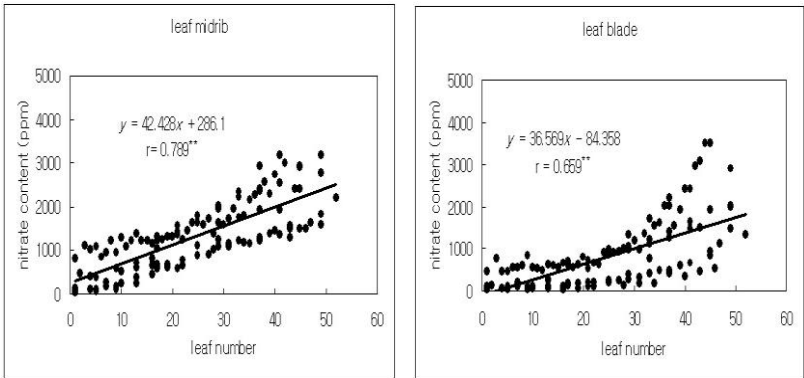


Fig. 1. Differences in nitrate contents in Chinese cabbages by leaf age in 120 samples

The chlorophyll content depended on the position of the leaf, increasing as the age of the leaf increased (Fig. 2). In the midrib, chlorophyll content ranged from $101\mu\text{g/g}$ at minimum to $40,726\mu\text{g/g}$ at maximum. In the leaf blade, chlorophyll content ranged from $409\mu\text{g/g}$ at minimum to $40,726\mu\text{g/g}$ at maximum. Regarding the relationship between nitrate and chlorophyll, the nitrate content increased while the chlorophyll content increased negligibly. In the case of the leaf blade, as the chlorophyll content increased, the nitrate content increased noticeably.

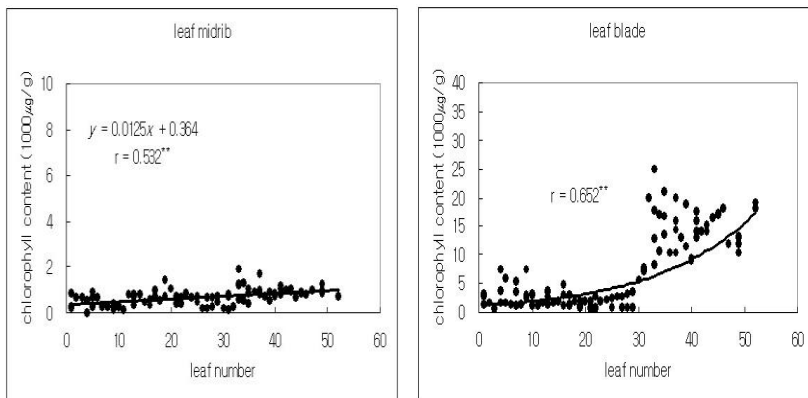


Fig. 2: Differences in chlorophyll contents in Chinese cabbages by leaf age in 120 samples

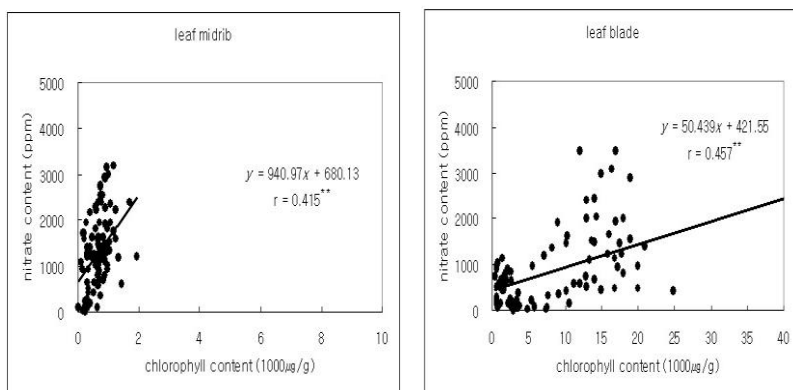


Fig 3: Relationships between nitrate and chlorophyll content in Chinese cabbage in 120 samples.

Discussion

Our findings show that the further outward a leaf was located, the higher the nitrate contents it represented, which was consistent with the reports by Sohn & Kim (1996), Sohn & Yoneyama (1996), Sohn et al. (1999), Sohn and Alley (1997) which found that an outer leaf contained a higher level of nitrate contents. It seems that the more outward the leaf is located, the higher the nitrate content is, since, as a cell grows, a small fluid pouch where nitrate is accumulated is enlarged, and, the older the nitrate reduction enzyme is, the more its vitality generally declines, and the more outward the leaf is located, the higher the nitrate contents are.

When it comes to the relationships between the contents of nitrate and chlorophyll, the nitrate contents significantly increased while the chlorophyll contents increased negligibly in the case of the midrib. In the case of the leaf blade, the more the chlorophyll contents increased, the more noticeably the nitrate contents tended to increase.

Conclusions

It is advisable to eat inner leaves of Chinese cabbages rather than outer leaves to minimize the daily intake of nitrate. It is also recommended that 1/3 of Chinese cabbage leaves with high concentrations of nitrate be discarded before consumption. Our findings also show that the lower the content of chlorophyll was, the lower the content of nitrate was. Therefore, it is strongly recommended that green leaves be discarded in order to lower daily intake of nitrates. By the same token, it is essential to check dried outer leaves of Chinese cabbages for their nitrate contents before eating them as the primary base for vegetable soups, a favourite local delicacy in the wintertime.

References

- European Food Safety Authority (2008): Nitrate in vegetables - Scientific Opinion of the Panel on Contaminants in the Food chain. http://www.efsa.europa.eu/EFSA/efsa_locale-1178620753812_1178712852460.htm (accessed 2010-11-23)
- Food Navigator (2002): Vegetable nitrates may be linked to cancer, new research. <http://www.foodnavigator.com/Legislation/Vegetable-nitrates-may-be-linked-to-cancer-new-research> (accessed 2010-11-23)
- Scharpf, H.C. (1991): Nutrient Influences on the Nitrate Content of Vegetables. The Fertilizer Society, 3-9.
- Sohn (2000): Development of Reduction Technology for Nitrate Accumulation in Vegetables. Ministry of Agriculture and Forestry, 315 Pages
- Sohn S.M., Kim Y.H., Yoon J.Y. (1999): Nitrate Content of Korean Organic Vegetables. Journal of Korean Society of Organic Agriculture 7(2):125-151
- Sohn S.M., Yoneyama T. (1996): Nitrate in Vegetables; Physiology, Accumulation in Plant and Intake by Human. Agriculture & Horticulture 71(11):1179-1182
- Sohn S.M., Yoon D.H. (1996): Nitrate Content of Chinese Cabbage during Storage and Cooking Condition. Journal of Korean Society of Organic Agriculture 5(1):101-110
- Sohn, S.M. and Alley, M.M. (1997): NO₃--N Accumulation in Vegetables and Soil Profiles Due to Excessive Organic Fertilizer Application. 1997 Annual Meetings of ASA /CSSA /SSSA at Anaheim/CA, Oct. 26-31, 1997, USA

Influence of nutrient management on the grain quality, cooking and eating quality of rice in Taiwan

Kesarwani, A.¹, Chen, S.S.² and Lee, J.F.³

Key words: rice, Taiwan, organic, cooking, amylose

Abstract

The strategy of rice marketing largely depends upon the cooking and eating quality, if the amylose and crude protein is concern. Few studies detailed rice cultivars with relation to nutrient management influence on eating and cooking quality. With these concerns, organic and chemicals as inputs with their influence on grain quality and physiochemical properties were studied as a part of long term experiment in Taichung District Agricultural Improvement Station, Taiwan 2008, first crop, of 3 rice cultivar, japonica (TK-9, TK-8) & indica (TCS-10). Results indicated that brown rice and milled rice are significantly higher in japonica cultivars (TK-8, TK-9) than in indica (TCS-10), but no significant interaction was found between cultivar and treatments. Same trend follow in physiochemical properties with no significant variation attributed to nutrient treatments with cultivar for protein, amylose and gel consistency but the values were significantly varied among cultivars. Amylose content statistically highly influenced by treatments (e.g. 14.36% and 13.17% in conventional and organic, respectively) in TCS-10 but protein content and gel consistency found no differences with treatments. Negative correlation between protein and gel consistency ($r = -0.21$) showed inverse relation that play crucial in the cooking and eating quality.

Introduction

Interest in organically produced food is increasing throughout the world in response to concerns about conventional agricultural practices, food safety and human health concerns (Gregory 2000), animal welfare considerations (Harper and Makatouni 2002) and concern about the environment (Wandel and Bugge 1997,). Organic rice is perceived by consumers as healthier, tastier, safer and better than conventional grown rice (Champagne *et al.* 2007). The preference of rice based on the taste, appearance and texture which vary region to region and individuals like sticky (more amylose content) rice or aromatic elongated rice (Martin *et al.* 1997). Different varieties of the same crop may differ in nutrient composition, and their nutrient content may also vary with fertilizer regime, growing conditions and season (among other things).¹The objective of the study was to compare the grain quality and physicochemical

¹Department of Agronomy, College of Agriculture and Natural Resources, National Chung Hsing University-40227, Taichung, Taiwan, R.O.C., E-mail: gekesar@gmail.com

²Department of Post Modern Agriculture, Ming Dao University, Chang Hwa county, Taiwan, R.O.C., E-mail: organic@mdu.edu.tw, Internet [www. http://atoap.page.tl](http://atoap.page.tl)

³ Taichung District Agricultural Improvement Station (TDAIS), COA, Changhua County, Taiwan, R.O.C., E-mail: lijiafen@tdais.gov.tw, Internet www.tdais.gov.tw

properties of milled rice from different cultivars under the influence of organic and chemical inputs.

Materials and methods

Three commercial paddy cultivars (*japonica* subspecies), Tai Keng-8, Tai Keng-9 and *indica* cultivar Taichung Sen-10 of 2008 first crop harvest used throughout this study. The harvest was collected as a part of long term project since 1995 in Taichung District Agricultural Improvement Station, Taiwan. The experimental design was a randomized complete block with three replications. The plots were fertilized with different organic and chemical sources every 2 seasons annually since 1995. Chemical treated plots were fertilized with recommended dose of fertilizers as 120:60:40 of N: P₂O₅: K₂O kg/ha & organic plots with rapeseed meal (commercially purchased.) while pest control was succeeded by tea seed meal and *Bacillus thuringiensis* application. Harvested rice was air-conditioned dried (12-13% moisture), dehusked and milled for the grain quality analysis. The protein content determined by using NIR technique (American Association of Cereal Chemists 2000) method No. 39-11. Amylose content was determined by Juliano's simplified assay (Juliano 1971). Gel consistency of rice starch was measured by the method describe by Cagampang *et al.* 1973. Data were analyzed using analysis of variance (ANOVA) to know the effect of fertility and cultivars in mean values from replicate runs of each treatment using SAS general linear model (SAS Institute, Cary, NC). Duncan's multiple range test (at P<0.05) was done to separate and for the comparison of sample means. Correlation coefficients (*r*) were obtained between physiochemical properties using Pearson's correlation coefficient (*r*).

Results

Table 1 & 2 lists the milling and physio-chemical properties influenced by nutrient sources. But interaction with cultivars was null and non-significant except in amylose where chemical treatments shown higher amylose content than organic treatments (table 2).

Milling properties

The *japonica* cultivars recorded significantly higher brown rice (%) than *indica* (TCS-10), ranged from 77.12 % to 81.81% in different varieties; usually *indica* variety milling rate around 70%, depend on varieties. The lowest milled rice recorded in TCS-10 with significant interaction of cultivars and treatments also. The proportion of whole grain as "head rice" recovery ranges from 66.11% to 73.31% among different varieties where, the long grain *indica* varieties are usually lower (about 60%) in head rice rate. The mean values of milled rice and head rice were found significantly higher in TK-8 as compared to other cultivars (table 1).

Physiochemical properties

Generally, the protein content of milled rice is relatively lower and especially in *japonica* cultivars. In table 2 also protein content varied from 6.03% to 6.80% but with no differences; while *indica* variety (TCS-10) recorded higher protein content (6.80%) in organic samples as compared to *japonica* cultivars. Higher amylose content and soft gel consistency were recorded in the TCS-10 (14.36% and 95.67%, respectively); amylose (%) was greatly influenced by treatments and found significantly higher than grown in organic treated plots (14.36%).

Tab.1: Milling properties of organic and conventional rice cultivars practice^a

| treatments | Cultivar | Brown rice (%) | Total milled rice (%) | Head rice (%) |
|--------------|----------|-------------------------|--------------------------|----------------------------|
| conventional | TK-9 | 81.33±0.74 ^a | 73.84±0.32 ^{ab} | 70.08±0.88 ^b |
| | TK-8 | 81.81±0.09 ^a | 75.25±0.28 ^a | 73.31±0.88 ^a |
| | TCS-10 | 77.12±0.77 ^b | 67.07±3.52 ^d | 66.65.33±3.18 ^c |
| organic | TK-9 | 81.17±0.86 ^a | 71.89±1.08 ^{bc} | 67.92±0.97 ^{bc} |
| | TK-8 | 81.57±0.17 ^a | 73.68±0.14 ^{ab} | 70.35±0.49 ^b |
| | TCS-10 | 78.13±0.61 ^b | 69.55±0.62 ^{cd} | 66.11±0.79 ^c |

Probability value (Pr>F)

| | | | |
|-------------|--------|------------------|------------------|
| parameter | <.0001 | 0.0003 | 0.0003 |
| varieties | <.0001 | <.0001 | <.0001 |
| treatments | ns | ns | ns |
| vrtty*treat | ns | ns | ns |

^a Means of 3 replicates. Values followed by the same letter in similar column are non-significant at P<0.05 level

ns=non significant

Tab. 2: Response of physiochemical properties in different rice cultivar under organic and conventional practice

| treatments | Cultivar | Amylose(%) | Crude protein(%) | Gel consistency (%) |
|--------------|----------|--------------------------|-------------------------|-------------------------|
| conventional | TK-9 | 12.00±0.17 ^c | 6.31±0.20 ^{ab} | 95.00±1.0 ^a |
| | TK-8 | 14.03±0.06 ^{ab} | 6.38±0.25 ^{ab} | 94.33±2.08 ^a |
| | TCS-10 | 14.36±1.31 ^a | 6.03±0.10 ^b | 95.00±3.61 ^a |
| organic | TK-9 | 12.00±0.26 ^c | 6.44±0.39 ^{ab} | 97.00±3.60 ^a |
| | TK-8 | 13.37±0.25 ^{ab} | 6.36±0.22 ^{ab} | 95.33±2.08 ^a |
| | TCS-10 | 13.17±0.29 ^b | 6.80±0.49 ^a | 95.67±3.21 ^a |

Probability value (Pr>F)

| | | | |
|-------------|---------|-----------|-----------|
| parameter | 0.0009 | ns | ns |
| varieties | 0.0002 | ns | ns |
| treatments | 0.0392* | ns | ns |
| vrtty*treat | ns | ns | ns |

Correlation coefficient (r)

| | Amylose (%) | Crude protein (%) | Gel consistency (%) |
|--------------------|-------------|-------------------|---------------------|
| Amylose (%) | 1.00 | -0.14 | 0.032 |
| Crude protein(%) | -0.14 | 1.00 | -0.21 |
| Gel consistency(%) | 0.032 | -0.21 | 1.00 |

^a Means of 3 replicates. Values followed by the same letter in similar column are non-significant at P<0.05 level, *Mean values are significant different at P<0.05 level; ns=non significant; Gel consistency hard (25 to 40 mm), medium (41 to 60 mm) and soft (>60 mm)No significant variation recorded in gel consistency among treatments and varieties. A Pearson correlation coefficient was computed (table 2) and found negative correlation (r= -0.21) between gel consistency and protein content indicating that higher the protein content, the

smaller the gel consistency. However, amylose with gel consistency recorded slight positive correlation while negative correlation with protein content which shows the poor interaction with other physiochemical factors of rice.

Discussion

No significant effects on grain quality and physicochemical properties were attributed to source of fertilizers except the amylose content. Most *japonica* varieties had higher head rice recovery rate than *indica* varieties. The longer the grain length, the lower the head rice rate resulted (Horisue and Hsieh, 1992). Cooking and eating characteristics are largely determined by the starch property that makes up 90% of milled rice. Amylose content, gel consistency and protein content highly influence them, and rice which consist high amylose cook dry, are less tender and become hard upon cooling, while low amylose rice cook moist and sticky (Juliano, 1965; and Onate et al., 1964). Similarly, other research also shown increase in protein content would increase chewiness and hardness of cooked rice (Champagne et al., 2007). The higher protein content in organic samples defines the availability of N through organic sources.

Conclusions

The results of the present study shown that the influence of organic and chemical treatments is non-significant on the different rice properties. *Japonica* cultivars recorded higher head rice and milled rice than *indica* cultivar, while no variation caused by nutrient sources. Amylose content was significantly influenced by cultivars & fertilizers application; and negative correlation between gel consistency and crude protein signifies the effect on eating quality of rice. Therefore, there is further investigation needed of other chemical properties which also determine the eating and cooking qualities.

Acknowledgments

We wish to thank the Taichung District Agricultural Improvement Station, Taiwan, R.O.C for providing these 3 rice cultivars.

References

- American Association of Cereal Chemists (2000): Approved methods of analysis. 10th ed. St. Paul, Minn.: American Association of Cereal Chemists.
- Cagampang, G.N., C.M. Perez and B.O. Juliano (1973): A gel consistency for eating quality of rice. J. Sci. Fd. Agri. 24: 1589-1594.
- Champagne, E., H.L. Garbeer, B.T. Vinyard, and A.M. McClung (2007): Effects of organic fertility management on physicochemical properties and sensory quality of diverse rice cultivars. Cereal Chem. 84:320-327.
- Gregory, N.G. 2000. Consumer concerns about food. Outlook on Agriculture. 29(4): 251-257.
- Harper, G.C. and Makatouni, A. (2002): Consumer perception of organic food production and farm animal welfare. British Food J. 104(3/4/5): 287-299.
- Juliano, B. O. (1971): A simplified assay of milled-rice amylose. Cereal Science Today 16:334-360.
- Juliano, B.O. (1965): Relation of starch composition, protein content and gelatinization temperature to cooking and eating qualities of milled rice. Food Technol. 19: 1006-1010.
- Onate, L.U., A.M. del Mundo and B.O. Juliano (1964): Relationship between protein content and eating quality of milled rice. Philippine Agri. 47:441-444.
- Wandel, M. and Bugge, A. (1997): Environmental concern in consumer evaluation of food quality. Food Quality and Preference 8 (1): 19-26.

Development of simple processed products using paprika leaves

Kim, Y.¹, Kim, K. M.², Kim, Y. S.³, Kim, G.C.⁴ & Kim, J. S.⁵

Key words: Paprika leaves, Simple processed products

Abstract

As households eat home-made food less and eat out more, the demand of restaurants and school meal catering service providers for pre-processed foods which can be quickly cooked and served is rising. Through the use of simple processed food products, the food processing should be simplified, the labour time and cost should be cut, and food safety should be ensured. As a simple processed food item that fits the aforementioned requirements, we have developed paprika leaves pickled in soy sauce which can be handily used by meal catering service providers. We analyzed changes in the chromaticity, pH, saltiness, sweetness, hardness, and total cell count of paprika leaves pickled in the mixture of soy sauce and seaweed broth in varying ratios through the aging process, and conducted sensory test.

Introduction

While the traditional Korean diet uses a large variety of vegetables in forms of *guk* (soup), *saengchae* (sliced root vegetable salad), *muchim* (seasoned vegetable salad), and *jeon* (Korean-style pancake), processing vegetable ingredients takes time and produces significant food waste. Operators of cafeterias of schools, hospitals, and large institutions as well as restaurants are seeking for ways to maintain the freshness and high quality of some seasonal vegetables for a longer period of time. They also need to simplify the cooking process cutting labour costs and ensure food safety by using simple processed products. This study developed a simple processed product using paprika leaves that can be conveniently used in meal catering for large institutions.

Materials and methods

Ingredients → Washing (3 times) → Draining (small drainer, 2 portions) → Making and boiling immersion liquid → Cooling (70℃) → Bottling (paprika leaves + immersion liquid) → Sealing

Figure 1: Process of soy sauce-pickled paprika leaves

- To make the base of the soy sauce-based immersion liquid, boil seaweed and dried

¹Korean Food & Culture Division, National Academy of Agricultural Science, RDA, Suwon, 441-853, Republic of Korea, E-Mail: kimyoung@korea.kr, Internet: www.naas.go.kr

²As above

³As above

⁴As above

⁵As above

shrimps in water for 40 minutes and cool the broth for 20 minutes.

- Insert paprika leaves in a sterilized bottle, pour immersion liquid, with varying ingredient ratios(Tab.1), which is boiled and cooled to 70°C, and store the bottled paprika leaves at room temperature for a day, and then let it age in a fridge (at 4°C).

Tab. 1: Immersion liquid composition for pickled paprika leaves(PL)

| Treatment | Control | PL-20 | PL-40 | PL-60 |
|--------------------------------|----------------|--------------|--------------|--------------|
| Paprika leaves | 100 | 100 | 100 | 100 |
| Soy sauce:seaweed broth | 20:60 | 20:60 | 40:40 | 60:20 |
| Vinegar | 10 | 10 | 10 | 10 |
| Sugar | 10 | 10 | 10 | 10 |

Results

Paprika leaf color change during aging:

- Among color properties, lightness(L) is the highest in PL-60 and the other samples show similar values. PL-20 which has the same soy sauce content as that of the control, where seaweed broth is replaced by water, shows lower redness(a) and yellowness(b) than the control does.

- While color changes were detected in the samples during the aging period, the degree of changes seems insignificant (Tab. 2).

Tab. 2: Paprika leaf color change during fermentation

| Color | Storage time (day) | Control | PL-20 | PL-40 | PL-60 |
|-----------------------|---------------------------|-------------------|-------------------|-------------------|-------------------|
| L (lightness) | 0 | 0.15±0.02 | 0.16±0.03 | 0.13±0.03 | 0.26±0.02 |
| | 7 | 0.22±0.03 | 0.23±0.03 | 0.24±0.02 | 0.34±0.02 |
| A (redness) | 0 | -0.16±0.04 | -0.26±0.01 | -0.08±0.06 | -0.08±0.09 |
| | 7 | -0.12±0.03 | -0.23±0.04 | -0.11±0.02 | -0.15±0.05 |
| B (yellowness) | 0 | -0.13±0.02 | -0.20±0.05 | -0.10±0.01 | -0.19±0.04 |
| | 7 | -0.07±0.02 | -0.17±0.03 | -0.11±0.02 | -0.18±0.03 |

pH, saltiness, and sweetness change of paprika leaves during aging:

- Paprika leaves' pH during the early stage of aging was 4.36-4.59 and went up slightly on the seventh day.

- Saltiness was PL-20 which is lower than that of the control, and increased with the quantity of soy sauce

- Sweetness also tends to go up with the quantity of soy sauce and the aging time elapsed (Tab. 3).

Tab. 3: Paprika leaves' pH, saltiness, and sweetness changes during aging

| | Storage time (day) | Control | PL-20 | PL-40 | PL-60 |
|-------------------------|--------------------|-------------------|-------------------|-------------------|-------------------|
| pH | 0 | 4.52± 0.00 | 4.36± 0.01 | 4.59± 0.01 | 4.36± 0.01 |
| | 7 | 4.58± 0.03 | 4.42± 0.06 | 4.63± 0.04 | 4.74± 0.05 |
| Salinity(%) | 0 | 0.80± 0.01 | 0.66± 0.01 | 1.49± 0.01 | 2.06± 0.01 |
| | 7 | 0.87± 0.02 | 0.71± 0.02 | 2.00± 0.01 | 2.66± 0.01 |
| Sweetness (Brix) | 0 | 3.40± 0.00 | 4.03± 0.06 | 5.23± 0.06 | 8.57± 0.06 |
| | 7 | 6.31± 0.07 | 7.91± 0.08 | 9.02± 0.04 | 12.70±0.14 |

Changes in hardness and total cell count during aging:

Paprika leaves got softened with time. The total cell count in the early stage of aging was not high but increased with time (Tab. 4).

Tab. 4: Changes in hardness and total cell count during aging

| | Storage time (day) | Control | PL-20 | PL-40 | PL-60 |
|--------------------------------------|--------------------|-------------------|-------------------|-------------------|-------------------|
| Hardness (g) | 0 | 103.9±12.1 | 117.9±13.2 | 137.7±17.4 | 133.5±18.6 |
| | 7 | 93.8±2.8 | 102.6±7.1 | 124.5±6.2 | 118.3±3.0 |
| Total cell count (Log CFU/mL) | 0 | 1.51±0.00 | 1.74±0.00 | 1.53±0.00 | 1.54±0.00 |
| | 7 | 2.41±0.05 | 2.40±0.06 | 2.31±0.04 | 2.30±0.05 |

Sensory characteristics of pickled paprika leaves during aging:

- Sensory test was conducted by 10 panels who enjoy *jangaji* (Korean style pickles) using a scale of 1-9.
- The mark for color was the highest for the control in the early aging period and the mark for scent was higher as the soy sauce content was higher.
- The mark for sour flavor tends to get higher as the aging period is longer. The mark for overall acceptability was 5.0 except for PL-60 (Tab. 5).

Tab. 5: Sensory properties of pickled paprika leaves during aging

| Sensory properties | Storage time (day) | Control | PL-20 | PL-40 | PL60 |
|-----------------------|--------------------|------------|----------|----------|----------|
| Color | 0 | 6.0±1.25 | 5.3±1.42 | 5.9±0.74 | 5.3±1.49 |
| | 7 | 5.9±1.37 | 5.8±1.40 | 5.7±1.25 | 4.8±1.03 |
| Flavor | 0 | 5.1±0.99 | 4.8±1.69 | 5.3±1.34 | 5.2±1.75 |
| | 7 | 5.0±1.70 | 4.4±1.65 | 5.3±1.70 | 5.3±1.25 |
| Saltiness | 0 | 5.7±1.16 | 5.4±1.17 | 4.7±1.34 | 4.9±1.45 |
| | 7 | 4.9±1.29 | 4.8±1.81 | 5.9±1.20 | 4.5±1.96 |
| Sourness | 0 | 4.9±1.10 | 4.7±1.77 | 5.0±1.41 | 4.9±1.52 |
| | 7 | 5.1±0.88 | 5.1±1.20 | 5.6±1.35 | 4.8±1.48 |
| Sweetness | 0 | 5.0 ± 0.67 | 5.4±1.26 | 4.9±1.60 | 4.9±1.60 |
| | 7 | 5.1±1.52 | 5.2±1.55 | 6.0±1.15 | 5.3±1.06 |
| Toughness | 0 | 5.4±0.84 | 4.7±1.25 | 4.9±1.79 | 5.3±1.70 |
| | 7 | 4.8±1.48 | 5.5±1.58 | 4.9±1.73 | 5.1±1.52 |
| Overall Acceptability | 0 | 5.5±1.08 | 5.1±1.10 | 5.6±1.65 | 5.1±1.66 |
| | 7 | 5.3±1.34 | 5.0±1.56 | 5.4±1.65 | 4.6±1.90 |

Discussion

This study shows that the most appropriate soy sauce content in the immersion liquid for pickled paprika leaves is 20%-40%(v/v) considering the dish's physicochemical and sensory properties. However, changes in product quality and properties should be observed for longer aging periods.

Conclusions

Through this study, we could confirm the possibility of pickled paprika leaves as a simple processed food product. In the years to come, further analysis of the substances contained in paprika leaves and development of diverse food products using paprika leaves should be done.

References

- Kim, J. A. & Cho, M. S. (2009): Quality changes of immature green cherry tomato pickles with different concentration of soy sauce and soaking temperature during storage. Korean J. Food Culture 24(3):295-307.
- Kim, J. H. & Kim, J. K. (2008): Effect of maturation solution composition on the physicochemical properties of onion jangaji. Korean J. Food Preserv. 15(6):816-823.

Physiochemical and Functional Characterization of Conventional or Organic Pear

J.H. Park1, S.H .Nam*2, J.H. Seong3, Y.S. Cho4, J.H. Choi5, J.J. Choi6, K.J. Choi7 and H.S. Hwang8

Key words : Conventional or organic pear, Physicochemical properties, Functionality, Sensory evaluation

Abstract

Many people are aware of personal health and the environment. This has resulted in increased attention to organic agricultural products. In order to maintain and increase the confidence of consumer on organic agricultural foods, scientific data and practical examples are required. So far, main focus of previous research on organic pears has been on yield, diseases, and nutrition values. In this study, we compared the physiochemical and functional properties of conventional or organic pears

Introduction

This study was to give the consumer the information related to many beneficial functions as well as to obtain scientific data about environmental friendly harvested agricultural products. Many agricultural products were cultivated conventional or environmental friendly and investigate their physical properties, functional compounds or physico-chemical functions. Conventional or organic pear contained higher amount of minerals, free amino acid, total phenol, or antioxidant activity.

Materials and methods

Organic or conventional pears was harvested Shingo property on October at Jeonnam Bosung(Organic certification number 15-10-1-55). Pear was physiochemically analyzed on moisture, acidity, sugar content by AOAC method. Color was measured with colour Hunter machine (JC801). Free sugar and amino acid composition was measured by HPLC method. Antioxidant activity was detected by DPPH assay and nitric oxide scavenging activity was determined by the method of Sreejayan and Rao (1997). Anti-lipid peroxidation was measured using the chemiluminescence-measuring device HP-CLA

-
- 1 Pear Research Station, NIHHS, RDA, Naju 520-821, Korea E-Mail tealove@korea.kr
 - 2 Chonnam Agricultural Research & Extension Services, Korea E-Mail namsh100@korea.kr
 - 3 Pear Research Station, NIHHS, RDA, Naju 520-821, Korea E-Mail bird@korea.kr
 - 4 Pear Research Station, NIHHS, RDA, Naju 520-821, Korea E-Mail agridream@korea.kr
 - 5 Pear Research Station, NIHHS, RDA, Naju 520-821, Korea E-Mail jjc5910@korea.kr
 - 6 Pear Research Station, NIHHS, RDA, Naju 520-821, Korea E-Mail pearchoi@korea.kr
 - 7 Chonnam Agricultural Research & Extension Services, Naju 520-715, Korea E-Mail kjchoi@korea.kr
 - 8 Pear Research Station, NIHHS, RDA, Naju 520-821, Korea E-Mail hae0323@korea.kr

Results

Organic pears showed better physiochemical properties but no difference on color. Compared to conventional pears, organic pears contained higher amount of fructose, sorbitol as a free sugar, and aspartic acid, threonine, isoleucine, lysine, and histidine as a free amino acid. Organic pear showed higher antioxidant activity and anti-lipid peroxidation than conventional pears.

Table 1. Physiochemical properties of conventional or organic pears

| Agricultural Product | Moisture (%) | Soluble Solides (%) | Acidity | Hardness | Color Value of Hunter | | |
|----------------------|--------------|---------------------|---------|----------|-----------------------|------|------|
| | | | | | L | a | b |
| Conventional | 85.5 | 12.9 | 0.15 | 652 | 66.0 | 9.2 | 46.0 |
| Organic | 86.5 | 13.2 | 0.16 | 713 | 64.0 | 10.1 | 46.4 |

Table 2. Functional characterization of conventional or organic pears

| Agricultural Product | Reducing sugar content (%) | | | | Functions(%) | | |
|----------------------|----------------------------|-------------------|---------|-------------------|-------------------|-------------------------|-------------------------|
| | Glucose | Fructose | Sucrose | Sorbitol | Antioxidant | Nitric oxide scavenging | Anti-lipid peroxidation |
| Conventional | 1.00 | 3.62 ^b | 0.10 | 1.58 ^b | 25.1 ^b | 22.6 | 26.8 ^b |
| Organic | 1.18 | 4.09 ^a | 0.13 | 1.87 ^a | 33.8 ^a | 22.5 | 35.5 ^a |

Table 3. Free amino acids composition of conventional or organic pear

| Agricultural Product | Content of free amino acid(mg100g) | | | | | | | | | | | | |
|----------------------|------------------------------------|-----|------------------|------------------|------------------|-----|------------------|-----|-----|------------------|------------------|------------------|-----|
| | Asp ¹⁾ | Thr | Ser | Glu | Ala | Val | Ile | Leu | Met | Phe | Lys | His | Arg |
| Conventional | 1560 ^b | 103 | 410 ^a | 225 ^a | 290 ^a | 233 | 169 ^b | 211 | 95 | 106 ^b | 123 ^b | 210 ^b | 60 |
| Organic | 1675 ^a | 168 | 328 ^b | 193 ^b | 253 ^b | 250 | 203 ^a | 203 | 113 | 151 ^a | 148 ^a | 249 ^a | 51 |

Discussion and Conclusion

Organic pears showed better physiochemical properties but no color. Organic pears contained higher amount of total free sugar with 7.27% than that of conventional pear with 6.30%. Organic pears contained higher amount of free amino acids such as aspartic acid, threonine, isoleucine, phenylalanine, lysine, histidine. Organic pears showed higher antioxidant activity and anti-lipid peroxidation

References

- Caris V.C. and Borel P. (2004): Influence of organic versus conventional agricultural practice on the antioxidant microconstituent content of tomato and derived purees. *J. Agric. Food Chem.* 52: p. 21-26.
- Mary A.L. (2001): Nutritional Quality of Organic Versus Conventional Fruits, Vegetables, and Grains. *The J. of Alter. and Comp. Med.* 7(2): p. 161-173.

Fruit quality, antioxidant capacity and nutrients between organic and conventional kiwifruit in Korea

Cho, H.¹, Cho, J.², Cho, Y.³ & Park, J.⁴

Key words: organic, kiwifruit, fruit quality, antioxidative capacity, nutrient

Abstract

Organic kiwifruits were smaller fruit size but had higher magnesium and dry matter content than conventional, meanwhile, fruit soluble solid content was similar to conventional. There were no significant difference in polyphenol contents and antioxidative capacity between organic and conventional although there were considerable variations among sample orchards. Several minerals were also similar levels in both systems.

Introduction

Korean kiwifruits are produced in southern coastal area between N33° to 35° and E126° to 128° such as Jeonnam, Gyeongnam and Jeju. These areas have enough rainfalls (annually 1,300 to 1,500mm) for kiwifruit growth and the temperature is suitable (annual avg. 13 to 14°C, winter temp. 0-2°C in January). Major soil types are loam or sandy loam in these areas. Generally, the organic cultural practices are clearly different from conventional (Cook *et al.* 2004). Besides basic organic practices such as no biocides and synthetic fertilizers in organic kiwifruit production, Korean organic kiwifruit growers do not use commercial growth promoters for better fruit size as conventional growers do and they tend to apply more organic compost and plant extracts formulas from wild herbs during growing season (unpublished farm survey data, 2010). Meanwhile, the quality of agricultural produces from the different production systems can be influenced by the farming system (Bordeleau *et al.* 2002). It is still arguable but significant number of data support that organically produced fruits and vegetables were higher in nutrients such as minerals as well as dry matter content (Woese *et al.* 1997, Heaton 2001, Bordeleau *et al.* 2002). Secondary nutrients ('phytonutrient'), involved in plant immune system (Bordeleau *et al.* 2002), were also higher in organically grown vegetables (Brandt and Molgaard 2001). These nutrients are being closely related to the consumers' choice (Heaton 2001). This study was performed to compare the fruit quality of kiwifruits from organic and conventional production system.

Materials and methods

¹ Fruit Research Institute of Jeollanamdo Agricultural Research and Extension Services, 15-2 Daeyari 2gu, Wando-up, Jeonnam 537-807, Republic of Korea, E-Mail cometch@korea.kr

² Department of Horticulture, Chonnam National University, 300 Yongbong-dong, Bukgu, Gwangju city, Republic of Korea, E-Mail fruit1020@naver.com

³ Fruit Research Institute of Jeollanamdo Agricultural Research and Extension Services, 15-2 Daeyari 2gu, Wando-up, Jeonnam 537-807, Republic of Korea, E-Mail aktis@korea.kr

⁴ As above, E-mail parkjo63@korea.kr

5 commercial organic kiwifruit (*Actinidia deliciosa* cv. 'Hayward') orchards were chosen in Jeonnam and Gyeongnam province. These orchards have been fully grown and managed organically at least for 5 years up to 20 years after conversion and kiwifruit vines were 20 to 32 years old. Equally, 5 neighboring conventional orchards with the same cultivar at similar age were chosen nearby the organic orchard with similar cultural environment and practices except organic practices. Kiwifruits were sampled randomly from 10 different vines in the central part of each orchard in early November when the fruit soluble solid content reached 7°Bx. For fruit characteristics such as fruit weight, dry matter content, soluble solid content and fruit firmness, each 60 fruits from 5 different orchards were investigated right after harvest. For fruit oxidative capacity and other functional characteristic, each 3 to 5 fruits from 5 different orchards were taken to analyze. Total phenol compound was determined with 'Folin-Ciocalteu reagent according to Ferraris *et al.* (Ferraris *et al.* 1987). Electron donating ability (%) in fruit measured with reducing ability of the samples to 1,1, diphenyl-2-picryl hydrazyl (DPPH). Ethanol and water were used as solvent for sample extractions. 1 ml of 1.5 x 10⁻⁴M DPPH solution was added into 4ml of extracted aqueous, and the mixed solutions were shaken for 30 minutes at room temperature before the absorbance was measured at 520nm (Yamaguchi *et al.* 1999). The electron donating ability (%) was determined as 100 of electron donating ability - {(absorbance with the aqueous/absorbance without the aqueous) x 100}. Carbohydrate was analyzed by 'Anthrone methods' as described by Trevelyan & Harrison (Trevelyan and Harrison 1952) by dissolving 0.2 g. of anthrone in 100 ml of H₂SO₄, made by adding 500 ml of conc. acid to 200 ml of water. Integral Antioxidant Capacity (IAC) was measured by photochemiluminescence (Besco *et al.* 2007).

Results and Discussions

Fruit size did not differ between organic and conventional kiwifruit (Tab. 1). Soluble solid content and fruit hardness did not make any difference between both systems. However, the dry matter content of organic kiwifruit was higher than conventional. When this result was compared with the previous study in the US (Hasey *et al.* 1995), the soluble solid content showed similar result but the fruit firmness of organic kiwifruit of the previous study was better unlikely this study. These results are similar to the case with apple ('Golden delicious')(Bordeleau *et al.* 2002). Nonetheless, higher dry matter content of organic kiwifruits is considered very meaningful in terms of overall favour because higher dry matter content of kiwifruit is highly linked to better consumers' taste (Burdon *et al.* 2004).

Tab. 1: Fruit weight, soluble solids, dry matter and hardness of organic and conventional kiwifruit

| Farming system | Fruit weight (g) | Soluble solid content (°Bx) | Dry matter content (%) | Fruit firmness (kg/50mm) |
|----------------|------------------|-----------------------------|------------------------|--------------------------|
| Organic | 84.0±3.3 | 10.0±0.96 | 17.2±0.40 | 3.9±0.2 |
| Conventional | 90.3±6.4 | 9.3±6.4 | 16.2±0.59 | 4.1±0.3 |
| | n.s | n.s | * | n.s |

*Significant for P<0.05, n.s: none significant. Mean±standard error.

The content of total polyphenols, known for its antioxidative role, was not significantly

higher in organic kiwifruit than conventional in both flesh and skin (Tab. 2). The oxygen radical absorbance capacity was also similar in both organic and conventional kiwifruit analyzed by using 2 solvents (water and ethanol) (Tab. 2). Although no significant differences were found in the functionality of organic kiwifruit in this study more samples and controlled environments could bring the difference between organic and conventional kiwifruit as avg. organic fruits were showing the higher tendency of polyphenols and oxygen radical absorbance capacity (ORAC).

Tab. 2: Content of polyphenols and oxygen radical absorbance capacity (ORAC) between organic and conventional kiwifruit

| Farming system | Total polyphenols (mg/100g) | | ORAC (%) | |
|----------------|-----------------------------|-----------|-----------|-----------|
| | Flesh | Skin | Water | Ethanol |
| Organic | 2.4±0.99 | 16.3±3.18 | 41.3±6.08 | 63.2±8.33 |
| Conventional | 2.3±0.51 | 14.4±2.18 | 34.7±8.66 | 62.1±7.18 |
| | n.s ^z | n.s | n.s | n.s |

^zn.s: none significant. Mean±standard deviation

Tab. 3: Nutrients content between organic and conventional kiwifruit (mg/100g)

| Farming system | Ca | Mg | K | Zn | Na | B |
|----------------|------------|-----------|------------|----------|-----------|----------|
| Organic | 162.2±14.1 | 106.9±3.7 | 168.7±16.6 | 3.0±0.22 | 55.9±4.17 | 2.9±0.20 |
| Conventional | 155.4±11.3 | 94.7±3.7 | 156.7±11.9 | 3.1±0.33 | 64.1±3.77 | 2.8±0.22 |
| | n.s | * | n.s | n.s | n.s | n.s |

*Significant for P<0.05 , n.s: none significant. Mean±standard deviation

From the analysis on mineral content of organic and conventional kiwifruit, only magnesium content of organic kiwifruits was significantly higher than conventional and other minerals were similar to conventional (Tab. 3). This could be related to more compost and plant extract application in organic orchards because the soil analysis on the whole orchards of this study have shown higher soil magnesium content in organic orchards although the data was not different significantly (organic vs. conventional : 4.20 vs. 3.46 cmol⁺/kg, unpublished data, 2010).

Conclusions

Although Korean organic kiwifruits showed similar fruit size, soluble solid content and firmness these could be improved by introducing some better practices such as summer and autumn girdling which are widely used in New Zealand. At the present cultural condition, higher dry matter content of organic fruits is considered critically important point for consumer preference. Although organic kiwifruits did not show significant differences statistically in polyphenols and antioxidative capacities the potential increase with those capacities might be achieved by the introduction of

organic cultural practices such as better light receptance, reducing vegetative growth and girdling. Higher magnesium content in organic kiwifruit could be related to the fertilization practices but it needs further efforts to any draw conclusion at the moment.

Acknowledgments

This study was carried out with the support of "Cooperative res. prog. for agri. sci. and tech. development (Project No. PJ0072692011)" of RDA, Korea.

References

- BESCO, E., BRACCIOLI, E., VERTUANI, S., ZIOSI, P., BRAZZO, F., BRUNI, R., SACCHETTI, G. & MANFREDINI, S. (2007): The use of photochemiluminescence for the measurement of the integral antioxidant capacity of baobab products. *Food chemistry*. 102:1352-1356.
- BORDELEAU, G., MYERS-SMITH, I., MIDAK, M. & SZEREMETA, A. (2002): Food Quality: A comparison of organic and conventional fruits and vegetables. *Ecological Agriculture*, Den Kongelige Veterinær-og Landbohøjskole. The royal veterinary and agricultural university, Frederiksberg, Denmark.
- BRANDT, K. & MOLGAARD, J. (2001): Organic agriculture: does it enhance or reduce the nutritional value of plant foods? *Journal of the science of food and agriculture*. 81:924-931.
- BURDON, J., MCLEOD, D., LALLU, N., GAMBLE, J., PETLEY, M. & GUNSON, A. (2004): Consumer evaluation of. *Postharvest biology and technology*. 34:245-255.
- COOK, A., HUNT, L. & FAIRWEATHER, J. (2004): Results from a survey of organic kiwifruit growers: problems and practices that affect production, Lincoln university, Canterbury, NZ.
- FERRARIS, L., ABBATISTA-GENTILE, I. & MATTA, A. (1987): Variations of phenols concentrations as a consequence of stresses that induce resistance to *Fusarium wilt* tomato. *Journal of plant disease protection*. 94:624-629.
- HASEY, J. K., JOHNSON, R. S., MEYER, R. D. & KLONSKY, K. (1995): An organic versus a conventional farming system in kiwifruit. *Acta hort*. 444:223-228.
- HEATON, S. (2001): Organic farming, food quality and human health. A review of the evidence, Soil association, Bristol, UK.
- TREVELYAN, W. E. & HARRISON, J. S. (1952): Studies on yeast metabolism. 1. Fractionation and microdetermination of cell carbohydrates. 50:298-303.
- WOESE, K., LANGE, D., BOESS, C. & BOGL, K. (1997): A comparison of organically and conventionally grown foods-results of a review of the relevant literature. *Journal of the science of food and agriculture*. 74:281-293.
- YAMAGUCHI, F., YOSHIMURA, H., NAKAZAWA, H. & ARIGA, T. (1999): Free radical scavenging activity of grape seed extract and antioxidants by electron spin resonance spectrometry in an H₂O₂/NaOH/DMSO system. *Journal of agricultural food chemistry*. 47:2544-2548.

Triticum spelta – source of antioxidants

Fatrcová-Šramková, K.¹, Máriássyová, M.² & Lacko-Bartošová, M.³

Key words: Triticum spelta, antioxidant activity, organic product

Abstract

The objective of the study was to evaluate the antioxidant properties of eight Triticum spelta varieties grown under ecological system and six organic products made from T. spelta obtained directly from trade network in Slovak Republic. Antiradical activity of ethanol extracts was determined by the DPPH radical scavenging method. Reduction power of extracts was evaluated spectrophotometrically by the phosphomolybdenum method.

Introduction

The *Triticum spelta* is one of the oldest cultural cereals. It is used for baking, brewing, production of pasta, supplied animal fodder as well as a number of regional specialities. Cereal grains contain a wide variety of biologically active compounds, including dietary fiber, microelements, sterols, phenolic compounds, peptides, vitamins -which have antioxidant properties (Zieliński 2008, Adom *et al.* 2005).

Numerous studies have found significant antioxidant properties in *T. spelta* grain including chelation of Fe²⁺ and Cu²⁺ and scavenging capacities against numerous free radicals. Phenolic compounds were detected in *T. spelta* bran and flour. These phenolic compounds are believed to contribute to the proposed health benefits of *T. spelta* grain and grain fractions - reduce risk for chronic diseases, including cancer and heart disease (Miller *et al.* 2000). The antioxidant potential and bioavailability of cereal antioxidants may depend on the species and varieties of grains, fractions of the grain (bran, flour, or whole grain), and processing conditions.

The overall objective was to identify potential *T. spelta* varieties for the development of whole wheat functional foods and to provide new data regarding the antioxidant properties of *T. spelta* products.

Materials and methods

Spelt varieties were grown under organic system (without chemical treatment and fertilization) in the south Slovakia, pre crop was peas. Variants were replicated four times. Eight varieties of *T. spelta* were: Bauländer Spelz (old spelt variety originated from the selectin of Landsorten), Rubiota (registered in Czech Republic, originated from individual selection of Fuggers Babenhauser Zucht.), Altgold (Swiss variety,

¹ Department of Human Nutrition, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture in Nitra, Tr. A. Hlinku 2, 949 01 Nitra, Slovakia, E-Mail katarina.sramkova@gmail.com

² GetWellt, a.s., Hlavná 561, 951 78 Kolinany, Slovakia, E-Mail mariassy.magda@gmail.com

³ Department of Sustainable Agriculture and Herbology, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture in Nitra, Tr. A. Hlinku 2, 949 01 Nitra, Slovakia, E-Mail magdalena.lacko-bartosova@uniag.sk

originated from parental varieties Oberkulmer and Sedmeier), Ostro (originated from the parental varieties Oberkulmer Rotkorn and Steiners Roter Tiroler), Holstenkorn (originated from the crossing Steiners Roter Tiroler x Bauländer Spelz), Schwabenkorn (registered in 1978, selection from Tiroler Spelz), Rouqujn (Belgian variety, originated from the crossing (Lignee 24 x Ardene) x Altgold) and Franckenkorn (originated from spelt cultivars (Rouquin x Altgold) x Altgold).

Six sorts of organic products were obtained from retail sale. The samples were milled and ground to pass through a 0.5 mm. The fine flour was extracted with 90% ethanol (1:20, w/v) at 80 °C for three hours. Extracts were filtered and used for tests. Antiradical activities of ethanol extracts were determined using the free DPPH radical. The modified method by Brand-Williams *et al.* (1995) was adapted. Amount of 1.5 ml ethanol extract was added to 2.5 ml DPPH solution (0.025g.l⁻¹ methanol). In the reference sample 1.5ml of methanol was used instead of the extract and all spectra were measured against methanol. Decrease of absorbance was measured 10 min after stirring at 515.6 nm using spectrophotometer UV-1601 (Shimadzu, Tokyo, Japan). The antiradical activity of individual extracts expressed as the percentage of inhibition of DPPH using the equation:

$$\% \text{ inhibition} = [(A_0 - A_t)/A_0] \times 100,$$

where A_0 is the absorbance of the DPPH solution at $t = 0$ minute,

A_t is the absorbance of the DPPH solution with extract at $t=10$ minutes.

Reduction power of compounds was evaluated spectrophotometrically by the modified method according to Prieto *et al.* (1999). This method is established on reduction of Mo (VI) to Mo (V) with an effect of reduction parts in the presence of phosphor under formation of green phosphomolybdenum complex. Absorbance of solution was measured at 705 nm (UV-1601, Shimadzu, Tokyo, Japan). Reduction power of compounds (RP_{AA}) expressed as quantity of ascorbic acid (mg.l⁻¹) necessary to achieve the same effect as sample was calculated using the equation:

$$RP_{AA} = (A_{705 \text{ nm}} - 0.0011) / 0.00236.$$

The statistical processing of the data obtained from all studies was implemented by means with StatgraphicS 5 software. Experimental results were expressed as means and standard deviation (SD). A statistical analysis was performed with Student's t-test. Confidence limits were added at $P \leq 0.05$.

Results and discussion

The antioxidant properties of eight *T. spelta* varieties were determined. The results obtained for analyzed cereal samples are shown in Fig. 1.

The average reduction power *T. spelta* varieties was $(172.9 \pm 2.6) \text{ mg.l}^{-1}$, ranging from 165.4 mg.l^{-1} (Bauländer Spelz) to 186.8 mg.l^{-1} (Rouquin).

The antiradical activity was in the particular samples in range from 51.66 to 56.55 % (average $54.31 \pm 0.70 \%$). In present investigations, great variability regarding reduction power, but not antiradical activity in selected *T. spelta* varieties was found.

Mikulajová *et al.* (2007) found a good correlation between antiradical activity and contents of phenolic compounds in wheat genotypes (measured by DPPH method). Based on these findings, it was possible to deduce a significant contribution of phenolics to the antioxidant effects of cereals and pseudocereals.

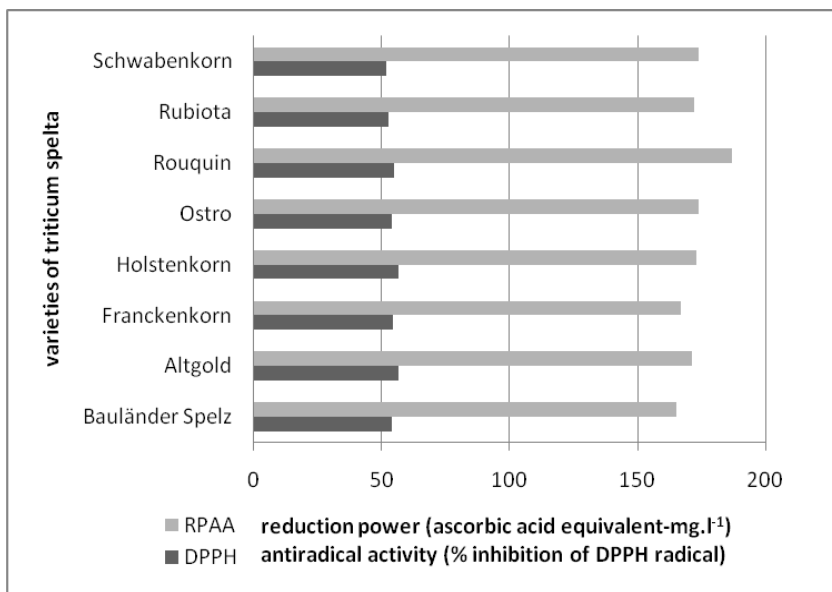


Figure 1: Antiradical activities and reduction power of *T. spelta* varieties

Tab. 1: Antiradical activity (DPPH) and reduction power (RP_{AA}) of selected *T.spelta* organic products

| Products | DPPH (% of inhibition) | RP _{AA} (mg.l ⁻¹) |
|--|---------------------------|---|
| T. spelta groats | 49.51 ± 0.57 | 148.90 ± 2.30 |
| Whole <i>T. spelta</i> groats | 56.63 ± 0.42 | 166.90 ± 2.90 |
| T. spelta bread | 71.57 ± 0.43 | 205.30 ± 4.20 |
| <i>T. spelta</i> grain “kernotto” | 50.97 ± 1.21 | 130.90 ± 1.10 |
| Dehulled <i>T. spelta</i> wheat | 51.22 ± 0.67 | 150.60 ± 0.80 |
| Superfine <i>T. spelta</i> flour | 55.60 ± 0.58 | 210.30 ± 2.30 |

Values are presented as mean of 3 parallels ± standard deviation

DPPH has been widely used to evaluate the free radical scavenging capacity of different cereals and cereals products (Gorinstein *et al.* 2008 ; Mikulajova *et al.* 2007; Miller *et al.* 2000.; Yu *et al.* 2002). In this study, the radical DPPH scavenging capacities of the 6 cereal products were measured and compared to each other.

The order of *T. spelta* products according to antiradical activity: *T. spelta* bread > whole *T. spelta* groats > superfine *T. spelta* flour > dehulled *T. spelta* > *T. spelta* grain “kernotto” > *T. spelta* groats. Puffed spelt bread contain 70 % organic spelt, organic rice and salt.

The order according to reduction power: superfine *T. spelta* flour > *T. spelta* bread > whole *T. spelta* groats > dehulled *T. spelta* > *T. spelta* groats > *T. spelta* grain "kernotto".

The typical diet contains a mixture of hundreds of antioxidant compounds, and composition changes daily depending on foods consumed (Miller *et al.*, 2000).

Conclusions

Some spelt cultivars such as Altgold and Holstenkorn which exhibited high scavenging activities toward DPPH radicals and Rouguin with high reduction power would be potent antioxidant natural ingredients. The antiradical activities of ethanol extracts of spelt products were comparable with antiradical activities of ethanol extracts of spelt varieties except spelt bread. This product contains not only spelt, but rice too. The results of the present study demonstrate that certain wheat spelt products contain relatively higher reduction power than others (spelt bread and superfine spelt wheat flour).

More research is needed to adequately determine the composition of the products, to identify the antioxidant compounds and to evaluate the potential human health promoting or disease preventing effects of cereal products.

Acknowledgements

This work has been supported by the projects KEGA 301-035SPU-4/2010 and ECOVA 26220120015 – under the Operational Programme Research and Development financed by European Fund for Regional Development.

References

- Adom K., Sorrels M. &, Liu, R. (2005): Phytochemicals and antioxidant activity of milled fractions of different wheat varieties. *J. Agric. Food Chem.* 53: 2297-2306.
- Brand-William W., Cuvelier M. E., & Berset C. (1995): Use of a free radical method to evaluate antioxidant activity. *Lebensmittel-Wissenschaft und Technologie*, 28: 25-30.
- El-Sayed, M. Abdel-Aal, Rabalski, I. (2008): Bioactive Compounds and their Antioxidant Capacity in Selected Primitive and Modern Wheat Species. *The Open Agric. Journal.* 2: 7-14.
- Gorinstein S. *et al.* (2008): Comparison of composition and antioxidant capacity of some cereals and pseudocereals. *Int. J. Food Sci. Technol.* 43: 629-637.
- Mikulajová A. *et al.* (2007): Total phenolic contents and antioxidant capacities of cereal and pseudocereal genotypes. *J. Food Nutr. Res.* 46:150-157.
- Miller H.E., Rigelhof F., Marquart L., Prakash A. & Kanter M. (2000) Whole-grain products and antioxidants. *Cereal Foods World* 45: 59-63.
- Prieto P., Pineda M. & Aquilar M. (1999): Spectrophotometric quantification of antioxidant capacity through the formation a phosphomolybdenum complex. *Anal. Biochem.* 269: 337-341.
- Yu I., Perret J., Davy B., Wilson J. & Melby C. I. (2002): Antioxidant properties of cereal products. *J. Food Sci.* 67: 2600-2603.
- Zieliński H. *et al.* (2008): Antioxidant properties of spelt bread. *Pol. J. Food Nutr. Sci.* 58: 217-222.

Organic cultivation of the potato cultivars Mayan Gold and Mayan Twilight – yield analysis and secondary plant substances

Trautz, D.¹, Hillebrand, S.², Schliephake, U.¹, Herrmann, M.E.¹, Burmeister, A., Fleischmann, P., Hüsing, B.¹

Keywords: solanum phureja, yield, secondary plant substances, carotenoide

Abstract

To determine the yield potential and total phenolic content of two Solanum phureja varieties bred by SCRI (Scottish Crop Research Institute) a field test was conducted in 2010. Mayan Gold and Mayan Twilight were cultivated under northern German climate conditions at an organically managed farm in Osnabrück (University of Applied Sciences, Waldhof). Plant diseases, yield, carotenoid content and phenolic content were analyzed. Both cultivars showed a low yield between 5,70 t/ha⁻¹ (Mayan Gold) and 4,39 t/ha⁻¹ (Mayan Twilight). The two potato varieties offered no higher anthocyanin- and carotinoid content than accepted potato varieties like Marabel.

Introduction

Potatoes are an important staple food providing from 5 % to 15 % of dietary calories for various populations around the world (Thompson 2009). Improvement of potatoes for health benefits could be of great value and likely impact the emerging global crisis resulting from epidemic increase in chronic disease (WHO 2003). Secondary plant substances as phenolic compounds and carotenoids originating from fruits and vegetables have been linked to health preventive effects and reduced risks of cancer or cardiovascular disorders (Werries 2007). Researches concerning blue and red fleshed potatoes in Osnabrück (2006 – 2009) showed a high content of total phenolic compounds and antioxidant capacity in the pigmented potatoes based on the presence of phenolic acids and anthocyanins (Hillebrand 2009). Wild potato species, such as *S. phureja* can reach high carotenoid levels in the tuber. The two diploid Phureja cultivars Mayan Gold and Mayan Twilight bred by the SCRI (Scottish Crop Research Institute) in 2001 and 2008 shows a deep yellow potato flesh. Tuber flesh colour was found to correlate with total carotenoids content in potato tuber (Othmann 2009). Quantitative results by Ducreoux *et al.* 2004 of *S. phureja* (cv. Mayan Gold) demonstrate a tuber carotenoid content of typically 20 µg carotenoid g⁻¹ DW. Aim of the research project is a comparison of blue, yellow and deep yellow flesh potatoes related to their content of secondary plant substances and therefore a health promoting benefit. The focus layed on Mayan Gold and Mayan Twilight because of their deep yellow tuber flesh and the fact that no information could be found of total

¹ University of Applied Sciences Osnabrück, Oldenburger Landstrasse 24, 49090 Osnabrück
Email: b.heusing@hs-osnabrueck.de, www.hs-osnabrueck.de

² Carolo Wilhelmina Universität Braunschweig, Institut für Lebensmittelchemie, Schleinitzstrasse 20, 38106 Braunschweig Email: s.hillebrand@tu-braunschweig.de, www.tu-braunschweig.de

phenolic content and their potential yield. Both cultivars can advance the biodiversity of German agricultural landscape.

Materials and methods

To determine the potential yield and the total phenolic content of two new potato varieties (Mayan Gold and Mayan Twiligh (*S. phureja*)) in organic cultivation a field experiment (randomized block design with four replications, 24 m²/plot) was conducted in 2010 at an organically managed farm in Osnabrück (Waldhof) with a mean temperature of 9.1°C and 760 mm of rainfall. Date of planting was 29 April 2010 (distance in row 30 cm), harvest on 02 September 2010. Assessed parameters were total yield, starch content, total phenolic- and carotenoid content. The starch content was measured by underwater weight (5 kg) using the GRIFFT Starch Scale Type 25. For quantification of the phenolic content the potatoes were analyzed by using the Folin-Ciocalteu reagent (Singleton and Rossi 1965). The content of carotenoid was determined by HPLC (450 nm). Statistical analyses were done by ANOVA 2.3.

Results

Both cultivars revealed a low yield in 2010. The best result achieved Mayan Gold with an average of 5.7 t ha⁻¹ followed by Mayan Twiligh with 4.4 t ha⁻¹. Significant differences in total yield and the marketable tuber size of 25 – 60 mm between Mayan Gold and Mayan Twiligh were obtained (Tab. 1). The cultivars determined no significant differences in starch content. Table 2 shows the phenolic content of Mayan Gold and Mayan Twiligh in comparsion to yellow and blue flesh potatoes. Both *S. phureja* cultivars had a higher level in phenolic content as Verity (white flesh) and Belana (yellow flesh) but a lower content as the blue flesh potatoes.

Table 1: Tuber sorting (t/ha⁻¹), average of total yield (t/ha⁻¹) and starch content (%) of Mayan Gold (MG) and Mayan Twiligh (MT), Osnabrück 2010

| | <25 mm (t/ha- 1) | 25 – 60 mm (t/ha- 1) | Erwinia carotovora Phytoph- thora (t/ha-1) | Rejected (other diseases) (t/ha-1) | Total yield (t/ha- 1) | Starch content % |
|--------------------------|---------------------------|----------------------------------|--|---|--------------------------------|------------------------|
| MG | 0.41 | 3.98 | 1.06 | 0.26 | 5.70 | 14.9 |
| MT | 0.24 | 2.66 | 1.30 | 0.19 | 4.39 | 13,9 |
| Tukey GD 5% | 0.3 | 0.88 | 0.52 | 0.10 | 1.26 | 1.59 |
| Level of significance | n.s | (*) | n.s | n.s | (*) | n.s. |

Table 2: Comparison of phenolic-, anthocyanin- and carotenoid content of different potato varieties

| Variety/Tuber flesh colour | phenolic content (mg 100 g ⁻¹ fw) | anthocyanin content (mg/100g ⁻¹ fw) | carotenoid content (µg g ⁻¹ dw) |
|--|--|--|---|
| Mayan Gold (deep yellow) | 56.9 ¹ | 3.4 ¹ | 8.9 ¹ |
| Mayan Twilight (deep yellow) | 57.5 ¹ | n.d. ¹ | 9.9 ¹ |
| Laura (deep yellow) | 63.4 ¹ | 2.3 ¹ | 14.8 ¹ |
| Verity (white) | 36.9 | - | Range from 5.2 (Bintje) – 15.6 (Marabel) ² |
| Belana (yellow) | 31.9 | - | |
| Blauer Schwede (blue) | 78 ³ | 37.7 ³ | - |
| Herrmanns Blaue (blue) | 83 ³ | 23.8 ³ | - |
| Vitelotte (deep blue) | 208 ³ | 113.1 ³ | - |
| ¹ Burmeister <i>et al.</i> 2010, ² Breithaupt 2002, ³ Hillebrand <i>et al.</i> 2010 | | | |

Discussion

First cultivations of the Mayan varieties in 2008 - 2009 provided yields about 20 – 25 t ha⁻¹. The low results in 2010 are explained by high temperatures and water stress in June (8.1 mm instead of 72.5 mm long term average) that had a negative effect on tuber growth. The amount of tubers with a size under 25 mm was relatively high. Due to the fact that Mayan Gold showed better results in marketable tuber size and total yield than Mayan Twilight, this variety seems to have a higher potential yield. High rainfalls in August (264 mm instead of 78.4 mm long term average) advanced an infection of the tubers with *Erwinia carotovora* subsp. *atroseptica* and *Phytophthora infestans* which increased crop loss. (Nitsch 2003) As a result the yield was low and the exterior quality of the *S. phureja* cultivars often not satisfactory. Differences in phenolic content are caused by a lower level of anthocyanin content compared to blue potato varieties. The measured carotenoid content in both *phureja* cultivars is half of the content mentioned by Ducreux *et al.* (2004). This could be affected by the different locations, terms of cultivation and degree of ripeness (Werries 2007). With respect to potato carotenoids, qualitative as quantitative data in literature are confusing (Breithaupt 2002). It is to be clarified what impact each of the mentioned parameters have on the amount of the carotenoid content und what kind of analytic method is to be used.

Conclusions

Because of the adverse climate conditions in 2010 Mayan Gold and Mayan Twilight could not reach their potential yield. Further field tests will be done in 2011 and 2012. Good results were demonstrated in carotenoid content as well as in phenolic content but due to the deep yellow potato flesh the carotenoid content was not as high as expected. Both parameters have to be analysed again with special attention to the environmental influences.

Acknowledgments

This research project is part of the FAEN project (Forschungsverbund Agrar- und Ernährungswissenschaft Niedersachsen), and is supported by the Ministry of Science and Culture of Lower Saxony.

References

- Breithaupt, E., Bamedi, A. (2002): Carotenoids and Carotenoid Esters in Potatoes (*Solanum Tuberosum* L.): New Insights into Ancient Vegetable. *J. Agric. Food Chem.* 50: 7175 – 7181
- Burmeister, A., Bondiek, S., Apel, L., Kühne, C., Hillebrand, S., Fleischmann, P. (submitted): Comparison of carotenoid- and anthocyanin profiles of raw and boiled *Solanum tuberosum* and *Solanum phureja* tubers. *J. Food Comp. Anal.*
- Hillebrand, S., Storck, H., Hüsing, B., Schliephake, U., Trautz, D., Herrmann, M.-E., Winterhalter, P. (2009): Effect of thermal processing on phenolic content in a blue-fleshed potato (*Solanum tuberosum* L.) variety. 44. Conference of the Deutschen Gesellschaft für Qualitätsforschung (DGQ). Freising 2009. Abstract in: Pflanzenphenole für die Gesundheit von Pflanze, Mensch und Tier. p. 93-95. 2009.
- Hillebrand, S., Hüsing, B., Storck, H., Tiemann, I., Schliephake, U., Gromes, R., Trautz, D., Herrmann, M.-E., Winterhalter, P. (2010): Bestimmung phenolischer Inhaltsstoffe in pigmentierten Kartoffelsorten (*Solanum tuberosum* L.). *Dt. Lebensm.-Rundsch.* 106: 85-92.
- Nitsch, A. (2003): Kartoffelbau. Agrimedia GmbH. Bergen/Dumme. 344 p.
- Othman, R. (2009): Biochemistry and genetic of carotenoid composition in potato tubers. *Ph.D. Thesis*. Lincoln University New Zealand. New Zealand.
- Singleton, V. L. and Rossi, J. A. (1965): Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. *Am. J. Enol. Vitic.* 16: 144-158.
- Thompson, M. D. et al. (2009): Functional food characteristics of potato cultivars (*Solanum tuberosum* L.): Phytochemical composition and inhibition of 1-methyl-1-nitrosourea induced breast cancer in rats. *Journal of food Composition and Analysis*. Volume 22. Issue 6. September 2009. p. 571-576. International Year of the Potato.
- Werries, A. (2007): Validierung von HPLC-Methoden zur Bestimmung von Polyphenolen und Carotinoiden in Möhren, Weizen und Mais unterschiedlicher Herkunft. *Ph.D. Thesis*. University of Kassel/Witzenhausen. Germany.
- World Health Organization (2003): Report of the joint WHO/FAO expert consultation on diet, nutrition and the prevention of chronic diseases. <http://www.fao.org/docrep/005/ac911e/ac911e00.htm> (accessed 2010-11-22).

Livestock

Combined pig and energy crop production – crop damage and animal behaviour

Kongsted, AG¹, Jørgensen, U², Sørensen, J³ & Horsted, K.⁴

Key words: Energy crops, pigs, crop damage, animal behaviour

Abstract

Organic free-range pig production of today has some disadvantages in terms of nutrient hotspots and poor possibilities for the pigs to perform behavioural temperature regulation. Combining perennial energy crop and pig production might compose a new concept for free-range production with low nitrate leaching and high standards for animal welfare. The aim was to investigate the 1) tolerance of different energy crops to pigs foraging and 2) behaviour of pigs in an area with established energy crops. In total 72 growing pigs were included. The paddocks were divided into different zones representing different types of crops (willow, Miscanthus, grass). Only minor damages on the established energy crops were observed. Behavioural observations showed high preferences for excretory behaviour in zones with willow compared to zones with grass or miscanthus. Environmental temperature influenced the pigs preference for location. At high temperatures there was a clear preference for areas with willow. In conclusion, there are indications that a combined production of energy crop and pig production will improve animal welfare and reduce nitrate leaching compared to the current practice in organic free-range production with pigs on open grasslands.

Introduction

In Denmark and other EU countries, organic free-range production of pigs is characterised by open grasslands and high stocking densities, e.g. 1.4 animal unit per hectare in DK. This system has some disadvantages in terms of nutrient hot spots (Eriksen 2006) and poor working environment due to muddy paddocks in autumn and winter. All though the system has some clear animal welfare benefits compared to indoor housing, the poor possibilities for shadow seeking might constitute a threat to the well-being of the pigs in hot seasons, especially in pre-farrowing sows (Buckner *et al.* 1998). Finally, the barren grassland contrasts with the favourable habitat of pigs, that is, wooded and bushy areas adjacent to grassland (Graves 1984).

Perennial energy crop plantations represent an environment that offers the pig variation and protection from the sun. Energy crops like eg. willow, poplar and miscanthus have a deep root system with high water and nutrient uptakes (Jørgensen *et al.* 2005). Combining perennial energy crop and pig production might compose a new concept for free-range pig production with low nitrate leaching, good working conditions and high standards for animal welfare.

¹ Aarhus University, Dept. of Agroecology and environment, Faculty of Agricultural Sciences. Blichers Allé 20, 8830 Tjele, Denmark, E-mail anneg.kongsted@agrsci.dk, Internet <http://agrsci.au.dk>

² As above, E-mail uffe.jorgensen@agrsci.dk

³ As above, E-mail klaus.horsted@agrsci.dk

⁴ As above (master student), E-mail janni.Sorensen@hotmail.com

The specific aim of this study was to investigate the tolerance of different energy crops to pigs foraging and rooting and the pigs utilisation of the area (preferred sites for excretory behaviour, resting, rooting etc.) and how this is influenced by stocking density and season.

Materials and methods

In total 72 growing pigs were included. In the experiment two treatments (high and low stocking density) were replicated over two seasons (spring 2009, autumn 2009). Each season, 36 pigs were randomly assigned to three experimental paddocks of 0.07 hectare and three paddocks of 0.22 hectare. The paddocks were divided into zones representing different types of crops or usage as shown in Figure 1. The energy crops were established in May 1996. Two varieties of willow were planted in zones divided by areas planted with grass and miscanthus. Willow was planted in rows with a plant density of 1.1 plants per m².

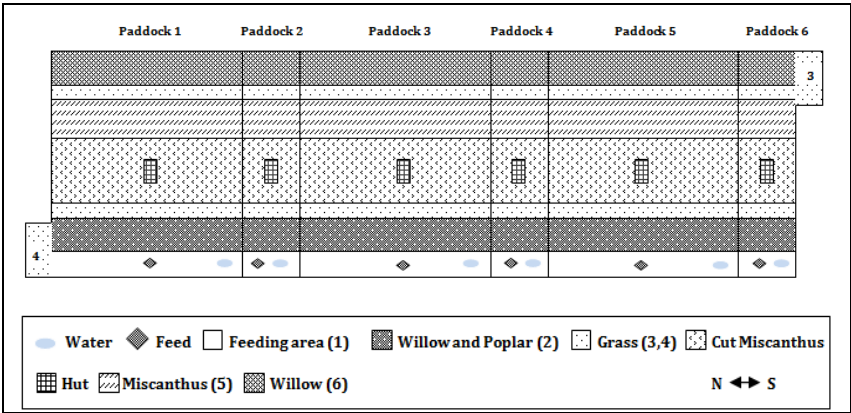


Figure 1: Illustration of the experimental paddocks. Each paddock was divided into zones with different types of vegetation or usage.

In spring, the pigs were introduced to the paddocks at approximately 50 kg live weight and the stocking densities corresponded to 0.6 AU and 1.9 AU per hectare. In autumn, the pigs were introduced at approximately 30 kg and the stocking densities corresponded to 0.8 AU and 2.5 AU per hectare. According to the Danish legislation 1.4 AU is allowed per hectare. The pigs were fed according to indoor recommendations plus 10% and slaughtered at 100 kg live weight.

Crop damages and behavioural elements were registered weekly over the entire experimental period. The pigs were observed two days a week. In spring from 8 am to 1.30 pm the first day and from 2 - 7.30 pm the second day. In autumn from 8 - 3.30 am the first day and from 4 - 7.30 pm the second day. The following behavioural elements were recorded as scan samples at 2-min intervals: Manipulating energy crops, rooting, eating, grazing, resting, and other activities. Furthermore, excretory behaviour was recorded as all occurrences. The location of the pigs was recorded for each behaviour according to the zones illustrated in Figure 1. Each group of pigs was observed for a period of 15 minutes, six times per week. Chi-square tests were used

to investigate whether the observed distribution of behaviour differed significantly from the estimated distribution. Crop damages were assessed visually on a scale from 0-10.

Results

The pigs caused only minor damages on the well established energy crops and these were mainly related to pigs biting some of the roots and branches. However, the pigs ate most of the new sprouts from newly harvested willow and Miscanthus.

More energy crop damage was observed at the higher animal density but still the damages did not severely affect the crops, and no plants or shoots died during the experiment. The rooting behaviour did not cause deep holes in the soil that could seriously disturb the subsequent energy crop harvesting.

The most frequent behaviours were resting and rooting that represented 54 % and 19 % of all observations, respectively. Table 1 shows the estimated and the observed proportion of observations in each zone for resting, rooting and excretory behaviour. Observed values are total values for all paddocks. There was no major effect of animal density.

Table 1: Observed (obs.) and estimated proportion (%) of observations in the different zones

| | Feed. area | Willow + popl. | Gras s1 | Cut ² Misc. | Misca nthus | Gras s2 | Willow |
|------------------------|---------------|-------------------|------------|---------------------------|----------------|------------|--------|
| Estimated ¹ | 9 | 15 | 8 | 17 | 29 | 10 | 12 |
| Resting | | | | | | | |
| Obs., spring | 8 | 18 | 2 | 38 | 16 | 7 | 11 |
| Obs., autumn | 7 | 40 | 5 | 13 | 16 | 3 | 15 |
| Rooting | | | | | | | |
| Obs., spring | 15 | 17 | 10 | 14 | 20 | 13 | 11 |
| Obs., autumn | 36 | 10 | 7 | 11 | 13 | 12 | 12 |
| Excretory | | | | | | | |
| Obs., spring | 9 | 53 | 1 | 0 | 28 | 0 | 9 |
| Obs., autumn | 6 | 44 | 2 | 3 | 18 | 3 | 24 |

¹ Estimated value is equal to the proportion of the area of each zone

² Including the hut

There were significant effects of season on the distribution of behavioural elements in the different zones. The observed distribution of behaviour in zones differed significantly from the estimated for resting and excretory behaviour in both seasons and for rooting in autumn. The zone with cut Miscanthus included the hut. In spring, the pigs preferred to rest inside the hut (37 % of all resting observations), whereas in autumn the pigs preferred to rest in the willow and poplar zone (40 % of all resting observations). The majority of excretory behaviour was performed in the zone with willow and poplar adjacent to the feeding area and in the zone with uncut Miscanthus.

The pigs' preference for location was influenced by temperatures. At very low temperatures (< 0 °C, only registered in spring), the pigs preferred to stay in the huts (83 %), whereas at high temperatures (> 15 °C) the pigs preferred to stay in the two

zones with willow (e.g. 80 % in spring). Registered temperatures were in average 10.3 °C (-1 °C - 18 °C) and 10.9 °C (3 °C - 18 °C) in spring and autumn, respectively.

Discussion

Access to shadow seeking or wallowing is essential for the welfare of outdoor pigs. It was clear that the pigs in the current study benefitted from the possibility for shadow seeking in the forest-like areas with willow. Especially prefarrowing sows are exposed to heat stress due to a high heat production (Buckner *et al.* 1998). It is likely that access to areas with willow will improve the welfare of prefarrowing/lactating sows. However, we do not know whether sows and piglets will cause more damages to the energy crops than growing-finishing pigs. Further studies are needed before it is possible to conclude whether energy crop plantations are suitable for piglet production also.

In accordance with previous studies with pigs on open grasslands (Eriksen 2006) and pigs in semi-natural environments (Stolba & Wood-Gush 1989), the pigs did not deposit the manure randomly in the present study. Results of soil samplings (data not shown) support the behavioural results with highest concentrations of soil inorganic N in zones with willow, and indicate lower nitrate leaching than found in the usual grassland system (Sørensen 2010).

Conclusions

The results from this study indicate that it is possible to combine growing-finishing pig and energy crop production without serious crop damages. Only, pigs should not be held on newly harvested willow or in miscanthus in the period of sprouting in spring. Behavioural studies indicate that a combined production will improve animal welfare and reduce nitrate leaching compared to the current practice in organic free-range production with pigs on open grasslands. Further larger-scale studies are needed to illuminate whether energy crop plantations are suitable for piglet production also.

References

- Buckner, L.J., Edwards, S.A., J.M. Bruce (1998): Behaviour and shelter use by outdoor sows. *Appl. Anim. Behav. Sci.* 57: 69-80.
- Eriksen, J, Hermansen, J.E., Strudsholm, K., Kristensen, K. (2006): Potential loss of nutrients from different rearing strategies for fattening pigs on pasture. *Soil use and man.*, 22: 256-266.
- Graves, H.B. (1984): Behaviour and ecology of wild and feral swine (*Sus Scrofa*). *J. Anim. Sci.*: 58: 482-492.
- Jørgensen, U., Dalgaard, T., Kristensen, E.S. (2005). Biomass energy in organic farming – the potential role of short rotation coppice. *Biomass and Bioenergy* 28: 237-248.
- Stolba, A, Wood-Gush, D.G.M. (1989): The behaviour of pigs in a semi-natural environment. *Anim. Prod.* 48: 419-425.
- Sørensen, J. (2010): Nitrogen distribution and potential nitrate leaching in a combined production system of energy crops and free range pigs. Master of Science Thesis. Aarhus University, Denmark. 59 pp.

Effect of protein supplementation of ewes and grazing management on performance of organic lambs

Gekara, J., Basweti, E., Kotcon, J., Minch, M., Eddy, J., Mata, D. & Bryan, W.¹

Key words: Organic lamb, parasites, protein, grazing

Abstract

*This experiment determined the effect of a supplemental protein diet fed to ewes during the periparturient period (3 wk before and 2 wk after lambing), creep grazing of lambs and herbage allowance on ewe and lamb performance and fecal egg counts (*Haemonchus contortus*). Beginning in March 2007, 32 pregnant ewes were offered a 12% crude protein supplement and 32 were offered an 18% crude protein supplement. After lambing (~April 1), ewes and their lambs were assigned in mid-April to four replicates of four treatments, two forage allowances (2.5x or 1.5x the daily forage dry matter intake) with or without creep-grazing. Animals grazed paddocks for 7 days and each paddock was rested for 35 days. Sheep were weighed, feces sampled for egg counts, and scored for body condition (ewes only) and anemic status (FAMACHA score). The experiment was repeated in 2008. The number of eggs in lamb feces increased many fold from June to July. Effects of treatments on lamb fecal egg counts were small and not consistent. Many lambs had to be treated for internal parasites by August. Liveweight in October (26.5 kg) never reached levels (32 kg) normally reached by lambs on the organic farm. The grazing management used resulted in heavy infestation of lambs on all treatments, no treatment was effective in controlling parasitism in lambs. These treatments warrant testing under less challenging conditions.*

Introduction

Adult *Haemonchus contortus* reside in the gastrointestinal tract of the sheep. Eggs are excreted in the feces onto pasture. Under optimum weather conditions the eggs hatch and the resulting larvae develop into the third stage (L₃), the infective stage, within 4 to 6 days. Once infective larvae (L₃) are ingested, they develop to L₄ which begin feeding in the gastrointestinal tract, mature to the adult stage, and start laying eggs (Skinner & Todd 1980, Hendrix 1998). Young lambs are highly susceptible whereas older sheep develop immune system responses that allow them to tolerate low levels of infection. Expression of immunity requires elevated levels of metabolizable protein because many components of the immune system (immunoglobulin, muco-proteins and products of inflammatory cells) are proteinaceous in nature; in addition, metabolizable protein is needed for protein synthesis to balance losses that occur during parasite infections (Houdijk *et al.* 2000). Thus, protein nutrition ought to enhance the immune functions of the periparturient ewe, and, by extension that of the lamb.

An organic strategy for controlling nematode parasitism in grazing lambs is to avoid exposure to high levels of infective larvae while maintaining effective immune systems through adequate nutrition. Exposure of lambs to infective nematode larvae can be reduced by allowing the lambs to graze ahead of the ewes (creep-graze) and by

¹ Davis College of Agriculture, West Virginia University, P. O. Box 6108, Morgantown, WV, 26506, E-Mail jkotcon@wvu.edu, Internet <http://www.caf.wvu.edu/plsc/>

increasing herbage allowance (how high in the vegetation animals graze). There are no reports examining the immune response of lambs born of protein-supplemented ewes, and how grazing management may affect that response.

The objective of this experiment was to determine the effect of a supplemental protein diet fed to ewes during the periparturient period (3 wk before and 2 wk after lambing), creep grazing of lambs and herbage allowance on organic lamb performance and fecal egg counts.

Materials and methods

The experiment was carried out in 2007 and 2008 on the West Virginia University Organic Research Farm, Morgantown, WV, certified in 2003. The experimental design was a randomized complete block with one factor during the periparturient period (high and low dietary CP) and two factors during the spring grazing period (high and low forage allowance; creep and no creep grazing). During the periparturient period 64 pregnant ewes were divided into two groups. Three weeks before the projected lambing date (April 1) and two weeks after that date one group was assigned a high (18%) and the other a low (12%) CP diet fed at the rate of 275 g/head/d, on a DM basis. Whole grain maize and soybeans supplemented 1.8 kg/head/d first cut hay (10% CP). Hay and supplement were fed one-half in the morning and one-half in the evening. In mid-April two ewes from the high CP group and two from the low CP group were assigned, with their lambs, to each of four spring grazing treatments. These treatments were two forage allowances with and without creep grazing. Forage allowances were a) high, 2.5 x estimated daily DM intake and b) low, 1.5 x estimated daily DM intake. Forage DM allowance was based on 4% of body weight (average 60 kg/ewe). There were four field replications, resulting in 16 groups of animals, each group consisting of four ewes and their lambs. Permanent pastures used in this experiment were tall fescue (*Festuca arundinacea* L.), and mixed swards of orchardgrass (*Dactylis glomerata* L.), Kentucky bluegrass (*Poa pratensis* L.), and other cool season grasses; legumes were predominantly red clover (*Trifolium pretense* L.) and white clover (*T. repens* L.), with some forbs. Ewes were scored for body condition by lumbar palpation at weighing. Fecal samples were taken directly from the rectum of each ewe and lamb at time of weighing. Fecal egg counts were determined using a modified floatation method (Christie & Jackson 1982). The immune status of animals was monitored using a FAMACHA[®] chart at weighing (Bath *et al.* 1996). Those animals considered severely anemic (FAMACHA score of >3) or in danger of succumbing to the effects of haemonchosis were treated with Moxidectin or Fenbendazol at the recommended dosage.

Each group of animals was assigned six paddocks. There were two grazing cycles, cycle 1: from mid-April to May and cycle 2: from June to July when lambs were weaned. During each grazing cycle animals grazed each paddock once for 7 days, in the same order, completing a cycle in 42 d. At the conclusion of cycle 1, animals returned to the paddock grazed first in cycle 1. Each paddock had been rested for 35 d before grazing in cycle 2. After grazing, each paddock was cut with a brush hog. Sward height was determined immediately before grazing each paddock using a pasture plate (Rayburn & Rayburn 1998). In 2007 herbage DM was estimated from the sward height and the size of the paddock adjusted to provide the required forage allowance for the succeeding 7 d. In 2008 paddock size was maintained at 825 m² for the high forage allowance treatment and 500 m² for the low forage allowance treatment. At the conclusion of cycle 2 lambs were weaned, ewes and lambs then grazed separate areas that had been rested for at least 56 d and all animals were

moved to a new area every 3 d or less, based on the work of Veglia (1915). Analyses of variance were performed using the GLM procedure of SAS. Treatments were CP, forage allowance and creep, with two levels each. Response variables were ewe and lamb weight, FAMACHA score and fecal egg count, and ewe body condition score.

Results

For ewes, periparturient protein supplementation had no effect ($P>0.10$) on liveweight, body condition score (BCS) and FAMACHA score. Ewes with creep grazing had higher ($P<0.05$) BCS than ewes without, but there was no effect on liveweight or FAMACHA score. Ewes with high forage allowance weighed more ($P<0.01$) than those on low forage allowance, but effects on BCS and FAMACHA score were not significant. The difference in ewe liveweight in July could be attributed to less available forage. This drop can be explained by ewes on lower available forage not being able to eat enough forage at a time of year when forage growth is limited. The treatments had no effect ($P>0.10$) on fecal egg counts of *Haemonchus* and other strongyle nematodes of interest. Egg counts were highest in late May/early June and dropped nearly 10-fold in July. Ewes, lambs of which were able to creep-graze, tended to have fewer *Strongylus* eggs in April and May in the feces than ewes with lambs present at all times.

All treatments had small, mostly insignificant effects on lamb performance (Table 1). After the first grazing cycle (June) FAMACHA scores were below 3 (the level above which treatment for internal parasites is recommended), but by the end of the second cycle (July) scores were above 3. Lambs on the creep and high protein treatments were a little less anemic than those with no access to creep grazing or born of ewes supplemented with a lower concentration of protein. The number of *Haemonchus contortus* and *Strongylus* eggs in lamb feces increased many fold from June to July. However, effects of treatments on lamb fecal egg counts were small and not consistent. Many lambs had to be treated for internal parasites in July and August. Some of them died. Liveweight in October (average 29 kg in 2007 and 24 kg in 2008) never reached levels (32 kg) normally reached by lambs on the organic farm that are raised with our standard grazing management.

Discussion

Most work reported in the literature has concentrated on the immune response to gastrointestinal parasites of periparturient ewes fed supplemental protein. Laurence *et al.* (1951) and Brunsdon (1964) showed that a high level of dietary protein benefited animals with established parasitic infections resulting in an improvement in their clinical condition, a reduction in fecal egg count and increased resistance to re-infection compared to animals on a basal diet. However, our study showed few benefits to ewes, and no consistent effect passed on to lambs from several management practices intended to improve nutritional status of ewes and their lambs. The treatments compared in this experiment should be tested under less challenging conditions to determine if they may reduce infections. The grazing management we used (7 days of grazing and 35 days of rest for each paddock) resulted in heavy infestation of lambs on all treatments. On the WVU Organic Farm we have raised 9 crops of lambs (9 years) and used a standard grazing management of 3 days grazing and 56 days pasture rest for each paddock. Lambs avoid heavy infections because they are moved before nematodes develop to the infective stage. In 2010, we had to treat three of just over 80 lambs with this standard management for internal parasites.

Conclusions

We conclude from this experiment the treatments were not effective in controlling parasitism in lambs that were challenged with high levels of infective larvae.

Table 1: Effect of forage allowance, creep grazing and periparturient protein supplementation of the ewes on lamb performance.

| | June | Liveweight (kg) | |
|-------------------------|------|-----------------|---------|
| | | July | October |
| Forage allowance | | | |
| High | 19.7 | 24.5 | 27.3 |
| Low | 19.0 | 21.8 | 26.0 |
| P= | 0.20 | 0.0003 | 0.22 |
| Creep Grazing | | | |
| With | 19.6 | 23.2 | 26.3 |
| Without | 19.1 | 23.1 | 27.0 |
| P= | 0.43 | 0.97 | 0.46 |
| Protein | | | |
| High | 19.7 | 23.8 | 28.2 |
| Low | 19.0 | 22.5 | 25.1 |
| P= | 0.22 | 0.06 | 0.003 |

Acknowledgments

Funding from USDA CREES NE IPM is acknowledged.

References

- Bath G.F., Malan, F.S., Van Wyk, J.A. (1996): The "FAMACHA®" Ovine Anaemia Guide to assist with the control of haemonchosis, in: Proceedings of the 7th Annual Congress of the Livestock Health and Production Group of the South African Veterinary Association, Port Elizabeth, 5-7 June 1996, p. 5.
- Brunsdon, R. B. 1964. The effect of nutrition on the establishment of persistence of *Trichostrongyle* infestation. New Zealand Vet. J. 12:108-111
- Christie, M., Jackson, F. (1982): Specific identification of strongyle eggs in small samples of sheep feces. Res. Vet. Sci. 32:113-117.
- Hendrix, C. M. 1998. Introduction to nematodes; nematodes that infect domestic animals. Page 108-142 in Diagnostic Veterinary Parasitology, 2nd ed. C. M. Hendrix, ed. Mosby Inc., St. Louis, MO
- Houdijk, J. G., Kyriazakis, I., Jackson, F., Huntley, J. F., Coop, R. L. (2000): Can an increased intake of metabolizable protein affect the periparturient relaxation in immunity against *Teladorsagia circumcincta* in sheep? Vet. Parasitol. 91:43-62.
- Laurence, G. B., Groenewald, J. W. , Quinn, J. I. , Clark, R. , Ortlepp, R. S., Bosman, S. W. (1951): The influence of nutritional level on verminosis in Merino lambs. Ondestepoort J. Vet. Res. 25:121-132.
- Rayburn, E. B., Rayburn, S. B. (1998): A standardized plate meter for estimating pasture mass in on-farm research trials. Agron. J. 90:238-241.
- Skinner, W. D., Todd, K. S., Jr. (1980): Lateral migration of *Haemonchus contortus* larvae on pasture. Am. J. Vet. Res. 41:395-398.
- Veglia, F. (1915): The anatomy and life-history of *Haemonchus contortus* (Rud.). Union S. Africa Dept. Ag. Rpts. Dir. Vet. Res. 3&4:347-500.

Resource requirements for farm conversion to organic livestock farming: A study in India

Subrahmanyeswari, B1 & Mahesh Chander²

Key words: conversion, organic livestock, resources, registered farmers, India

Abstract

The registered organic farmers with the Uttarakhand Organic Commodity Board, convinced with the benefits of organic agriculture which is compatible with their socio-economic situation and traditional values and beliefs, aspire to venture into organic livestock farming too. This however, needs structural changes to meet organic inputs for livestock production, standards and certification requirements for organically produced livestock products. Moreover, the shift to organic methods requires considerable investment in human capital in terms of knowledge and know-how of organic techniques that fits into regional agro-ecological situation and also in securing the product and process quality the consumer expects and pays for. These registered organic farmers were studied in terms of awareness, knowledge and training needs along with the infrastructural, technical and financial resources required to raise the farms as per the organic animal husbandry standards set by NSOP (India) which resemble the IFOAM standards. The organic promoting agencies and other development agencies should pay attention to the resource requirements as perceived by organic farmers. Besides, focusing on community level resources might encourage other farmers to enter into organic farming systems, thus, increasing the prospects for organic livestock production for local consumption initially.

Introduction

In Uttarakhand, the Northern state of India, farmers could market organic crop produce and are in a phase of converting livestock production systems to organic methods. Small-scale holdings, where livestock essentially integrated with crop farming under subsistence farming operations with low input low output production systems, are making the prospects for organic livestock farming bright, alongside organic crop production in India (Chander *et al.* 2007). Hence, these registered organic farmers have been studied in terms of resources required to raise the farm as per the organic animal husbandry standards set by NSOP, India which resemble the IFOAM standards.

Materials and methods

A total of 180 registered organic farmers were taken randomly from a total 18 villages of 3 purposively selected districts from Uttarakhand (77°34' and 81°02'E longitude and 28°43' to 31°27' latitude) the first state declared as organic in India. Farmers were studied in terms of farmers' profile, attitude, awareness and knowledge towards organic animal husbandry standards set by NSOP of India. The data regarding

¹ Associate Professor, Department of Veterinary & A.H.Extension, NTR College of Veterinary Science, Gannavaram-521102, Andhra Pradesh, India. Email eswariext@gmail.com.

² Principal Scientist & Head, Division of Extension Education, Indian Veterinary Research Institute, Izatnagar, Bareilly-243122, Uttar Pradesh, India. Email drmahesh.chander@gmail.com

resource requirement in terms of human capital resources, farm infrastructural & technical changes along with financial resources were also collected. The information was collected through personal interview and analyzed using suitable statistical techniques like frequency, percentage, attitude scale developed using Likert method of summated ratings, awareness and knowledge schedules.

Results

The average age of organic farmer was 42.4 yrs and the average experience in organic farming was 3.8 years. Nearly three fourth of the farmers were receiving better income after adopting organic crop production practices (table1). The 'role of Diversified Agricultural Support Project (DASP) and Uttarakhand Organic Commodity Board (UOCB) and reliable and stable income' in organic farming were the major motivational factors as revealed by more than three fourth of the respondents (table 1).

Table 1: Profile of registered organic farmers (n=180)

| | | F | % |
|----|--|-----|---------|
| 1. | Age in years - 37 to 51yrs | 89 | (49.44) |
| 2. | Land holding - Marginal | 122 | (67.78) |
| 3. | Farming Experience in organic system - 3-6 years | 140 | (77.78) |
| 4. | Previous farming practices- Traditional | 115 | (63.89) |
| 5. | Improved economic status of organic farmers | 115 | (63.89) |
| | Farming goals | | |
| 1. | To continue successfully traditional livestock farming practices | 159 | (88.33) |
| 2. | To protect soil fertility through recycling of nutrients | 148 | (82.22) |
| | Motivational factors | | |
| 1. | Role of DASP and UOCB | 161 | (89.44) |
| 2. | For a stable and reliable income | 139 | (77.22) |

In a study by Lien *et al.* (2003) in Norway on organic dairy farmers, it was revealed that sustainable and environmentally friendly farming was among top five goals, whereas, profit maximization ranked low. Relatively low ranking of profit maximization has also often been found in previous studies of farmers' goals (Bergevoet *et al.* 2004).

Attitude, awareness and knowledge of organic farmers about organic animal husbandry standards

Attitude of farmers play role in influencing the acceptance or rejection of any innovative idea. The low to medium awareness and knowledge levels of farmers about the organic animal husbandry standards might be the reason for the indecisiveness of 33 percent farmers towards organic animal husbandry standards. However, it is quite clear that no single farmer was with unfavorable attitude, which indicates their affinity towards organic livestock farming (table 2).

Table 2: Attitude, awareness and knowledge of farmers towards organic livestock farming (n= 180)

| S.No | Attitude of organic farmers | F | % |
|------|-------------------------------------|-----|---------|
| 1. | Neutral / undecided (35-49) | 59 | (32.80) |
| 2. | Favorable (49-63) | 121 | (67.20) |
| | Awareness of organic farmers | | |
| 1. | Low (0-12) | 138 | (76.67) |
| 2. | Medium (12-24) | 42 | (23.33) |
| | Knowledge of organic farmers | | |
| 1. | Low (0-8) | 87 | (48.33) |
| 2. | Medium (8-16) | 74 | (41.11) |

Resource requirement at farmer level

Human capital resources

Organic livestock farming is a knowledge intensive system where the success of farmer depends on the selection of suitable breed, species specific housing and feeding, health care on preventive management aimed at improved welfare of animals in the long run.

Training & information needs of farmers to convert to organic livestock farming

Primary focus should be on good extension to coach and support likely converters instead of general promotion to stimulate conversion and farmers are more likely to remain motivated during difficult parts of the 'early adopter' process (Mathur 2007). Training being an important extension service, farmers who are in the process of conversion to organic livestock farming were enquired for the needed training areas.

Infrastructural resources

Among the infrastructural facilities required to be changed, 65 per cent of farmers mentioned that their existing animal housing structures need to be changed (table 4). Measures to be taken for rejuvenation of Common Property Resources (CPRs) like common grazing land existing in the villages which are diminishing day by day, was perceived by 84 per cent of farmers, whereas, 75 per cent of the respondents felt that there should be provision of proven bulls for the breeding purpose, which was recommended by organic standards as well. Wider community support in the form of social acceptance was expressed by 43.33 per cent of the farmers which may add to the promotion of organic farming.

Table 3: Infrastructural & financial resources required at farmer level

| S.No | Resources at farmer level | n=180 |
|----------------------------------|--|---------------------|
| Infrastructural resources | | F % |
| 1. | Modification housing/ building structures | 117 (65.00) |
| 2. | Common grazing land / common property resources | 152 (84.44) |
| 3. | Community wise stock of proven bulls for natural breeding purpose | 135 (75.00) |
| 4. | Wide support / community acceptance | 78 (43.33) |
| 5. | Replacement of stock | 81 (45.00) |
| Financial resources | | |
| 1. | For replacement of existing livestock | 81 (45.00) |
| 2. | For changing housing pattern | 117 (65.00) |
| 3. | Market support during conversion period | 180 (100.00) |
| 4. | Feed and fodder supply on subsidy | 102 (56.62) |
| 5. | Bio-pesticides supply through subsidy | 82 (45.56) |
| 6. | Creation of local/domestic market outlets | 117 (65.00) |

Discussion & Conclusions

The farming systems followed by farmers before conversion to organic systems were the outcome of thousands of years of experience with exposure to a range of natural conditions and other manipulations, which farmers had tried out and have been transmitted for generations together. Moreover, the ecofriendly traditional farming practices which are not faded away from the memories of Indian farmers and their value system and beliefs might be the reason for favorable attitude by majority. Though, farmers were with appreciable level of awareness on organic farming practices in general, they might not be oriented and trained much on organic animal husbandry standards due to small livestock holdings and lack of commercial aspects of livestock farming. For successful continuation of organic agriculture and to convert to organic livestock systems, farmers' basic level of knowledge plays a role. Keeping in view of the effectiveness of farmer to farmer learning experiences and also where adoption of organics is more effectively achieved by identifying lead farmer groups rather than trying to convert entire communities as stated by Mathur (2007), UOCB was playing an appreciable role in focusing on farmer groups rather than whole communities at a time. However, household and community level organic rural and rural-urban markets and networks contribute to improving food quantity, quality and diversified food availability, moreover, food quality is not only issue for wealthy

consumers, wherein, rural and urban consumers with relatively low purchasing power all over the world give high importance to quality issues as stated by Zundel and Kilcher (2007), further support the need of community level resources in the creation of markets. Conversion is a prolonged learning process that involves challenges in meeting standards; certification and marketing, wherein, reliable institutional support systems that can provide technology, know-how, and marketing are most important (Mathur 2007). Hence, in order to encourage organic farmers who are currently involved in crop sector and in the process of conversion to switch over to organic livestock production, should be well supported and provided with the resources in the order of importance as perceived by them. Moreover, focusing on community level resources might encourage other farmers also, to enter into organic livestock farming systems.

Acknowledgments

We thank officials of UOCB, the organic farmers and the Director, Indian Veterinary Research Institute, Izatnagar for facilitating the research work towards the PhD dissertation submitted by the first author.

References

- Bergevoet R.H.M, Ondersteijn C.J.M, Saatkamp H.W, Van Woerkum C.M.J, Huirne R.B.M (2004): Entrepreneurial behaviour of Dutch dairy farmers under a milk quota system: goals, objectives and attitudes. *Agricultural Systems* 80: 1-21.
- Chander Mahesh, Sanjay Kumar, R.S. Rathore, Reena Mukherjee, Kondaiah N, Pandey H.N (2007): Organic vis- a- vis Conventional livestock production potential in India. In: Papers submitted to the International Conference on Organic Agriculture and Food Security, FAO, Rome, Italy, 3-5 May 2007, pp.48-49.
- Lien G, Flaten O, Ebbesvik M, Koesling M, Valle P.S (2003): Risk and risk management in organic and conventional dairy farming: Empirical results from Norway. *International Farm Management Congress*.
- Mathur S (2007): Contribution of organic agriculture to poverty reduction in Asia and Latin America. Background Paper for the International Conference on Organic Agriculture and Food Security, 3-5 May 2007, FAO, Rome, Italy.
- Twarog S (2006): Organic Agriculture: A Trade and Sustainable Development opportunity For Developing Countries, UNCTAD Trade and Environment Review. pp. 140- 193.
- Vaidya S, Partap T (2007): Organic farming offering opportunity of income security among small farmers of India: a country wide study. In: Papers submitted to the International Conference on Organic Agriculture and Food Security, FAO, Rome, Italy, 3-5 May 2007, pp. 53-54.

Organic beef cattle development in central Thailand

Putsakum, M.¹, Wongpichet, S.² & Kantanamalakul, J.³

Key words: Organic beef cattle, Organic livestock standard.

Abstract

This research aimed to study the current status, the possibility and the suitable systems for organic beef cattle productions. Samples were the groups of organic beef cattle farmers who have registered with the Department of Livestock Development (DLD) and the organic livestock extension officers in the Central region. A literature review, farmer interviews and a participatory seminar were conducted. The results showed that organic livestock productions have been increased every year. In 2009, there were 282 organic livestock farmers who have registered with the DLD in the Central region. Within these groups, there were 103 organic beef cattle farmers that produced 1,832 organic beef cattle. The results from interviews showed that levels of organic beef cattle productions in Suphanburi province and Lopburi province were the level 1 and 2. In addition, the participatory seminar showed that farmers could produce beef cattle under the organic livestock production requirements in TAS 9000-2005 except the conversion period. The successful factors are knowledge and understanding the methods of production, price motivation, the farmers' group network, and the government's policy. The suitable systems of organic livestock production for Thai farmers should be Thai native beef cattle and crossbred cattle production, pastured system, integrated farming system and farmers' network formation.

Introduction

The beef cattle production system in Thailand is a mixed crop-livestock one. Therefore, this former system can be easily developed into organic livestock production system. However, a small number of organic beef cattle farms are found. This may due to the organic livestock production system which is unclear. Although the National Bureau of Agricultural Commodity and Food Standards, Ministry of Agriculture and Cooperatives, has launched "Thai Agricultural Standard (TAS) on Organic Agriculture Part 1: The Production, Processing, Labelling and Marketing of Organic Agriculture", and "Thai Agricultural Standard (TAS) on Organic Agriculture Part 2: Organic Livestock" since 2003 and 2005, respectively. Therefore, the study of the current status and the suitable system of organic beef cattle production were necessary for production development and organic livestock policy framework.

¹ Organic Agriculture Development Thailand, Sukhothai Thammathirat Open University, PakKret, Nonthaburi, 11120, Thailand, E-Mail mputsakum@yahoo.com

² School of Agricultural Extension and Cooperatives, Sukhothai Thammathirat Open University, PakKret, Nonthaburi, 11120, Thailand, E-Mail sirilag@hotmail.com

³ School of Agricultural Extension and Cooperatives, Sukhothai Thammathirat Open University, PakKret, Nonthaburi, 11120, Thailand, E-Mail kee39@yahoo.com

Materials and methods

The samples were the groups of organic beef cattle farmers who have register with the Department of Livestock Development (DLD), and the organic livestock extension officers in the Central region. Data was collected by reviewing literatures, using unstructured interview form and a participatory seminar. For on-farm interview, the groups of farmers in Suphanburi province and Lopburi province were chosen. The questionnaire consisted of the questions about farmers' backgrounds, production managements, problems and suggestions. For the participatory seminar, the participants were 33 beef cattle farmers and 11 organic livestock extension officers in Central region. The participants were divided into 4 groups (3 groups of farmers and a group of officers). The seminar was discussed about how to meet the organic livestock standard requirments, the supporting factors for organic beef cattle production, what the suitable systems and methods for organic beef cattle production are, and their problems. All data were analyzed for 1) the current status of organic livestock production in Thailand, 2) the possibility to produce organic livestock under the Thai Agricultural Standard (TAS) on Organic Agriculture Part 2: Organic Livestock (TAS 9000-2005), National Bureau of Agricultural Commodity and Food Standards, Ministry of Agriculture and Cooperatives, and 3) the suitable systems and methods for farmers who are producing organic livestock.

Results

The results from the literature review showed that organic livestock productions have been increased every year since the National Bureau of Agricultural Commodity and Food Standards, Ministry of Agriculture and Cooperatives, has launched "Thai Agricultural Standard (TAS) on Organic Agriculture Part 2: Organic Livestock (TAS 9000-2005)" in 2005. In 2009, 3,252 organic livestock farmers have registered with the Department of Livestock Development (DLD), whereas in 2008 there were only 3,087 registered farmers. In the Central region, there were 282 farmers that had registered with the DLD. Within these groups, 103 farmers raised 1,832 organic beef cattle. These groups of farmers were classified into 4 practical levels. Level 1 is the beginning level that farmers reduce the use of chemical substances, and do not understand the organic agricultural production. Level 2 is that farmers have the willingness to produce organic livestock, reduce the use of chemical substances, has a mixed crop-livestock production system, and do not understand the organic livestock standard and the production techniques. Level 3 is the conversion stage which the production is following the organic standard, but do not certify as the organic livestock. And level 4 is certified as the organic livestock. However, there were only two farms (swine and bee farms) that have been certified under the TAS 9000-2005.

The results from the interview about the current situation of organic beef cattle productions in Suphanburi province and Lopburi province showed that levels of productions were level 1 and level 2.

There are 7 items of the organic livestock production requirements in the TAS 9000-2005, which are the livestock sources, the conversion period to organic livestock production, feedstuffs, the livestock health management, the livestock management, recording, and the environmental management. The results from the participatory seminar showed that farmers could produce beef cattle under the TAS 9000-2005 except for the conversion period to organic livestock production. Organic extension officers thought that farmers could produce beef cattle under the TAS 9000-2005 in

term of the livestock sources. For the remaining organic livestock production requirements, some officers thought that farmers could follow the requirement, but some thought they could not.

The participants suggested that the organic livestock standard should be revised in term of the conversion period to organic livestock production that the calf should be brought after weaning at 8-12 months of age.

The supporting factors that will affect the successful of organic production are knowledge and understanding the methods of organic beef cattle production, price motivation, the farmers' group network, and the government's policy.

The suitable organic beef cattle production systems for Thai farmers should be Thai native beef cattle and Thai native crossbreds cattle production, pasturage system, integrated farming system and farmers' network formation.

The problems of organic beef cattle production are the lack of organic feeds, organic breeders, money capitals and organic markets.

Conclusions

To increase organic livestock production in Thailand, the organic livestock standard should be revised in term of the conversion period to organic livestock production. The government organizations should support the whole network of organic food chain and empower the groups of farmers, including livestock producers, organic feed producers and small-scale processors.

References

- Department of Livestock Development (2009): Livestock Statistic in Thailand 2009. http://www.dld.go.th/ict/stat_web/yearly/yearly52/index52.html.
- Department of Livestock Development (2009): Organic Livestock Development Plan along the Sufficiency Economy Philosophy 2010. Ministry of Agriculture and Cooperatives, 64p.
- National Bureau of Agricultural Commodity and Food Standards (2003): Thai Agricultural Standard (TAS) on Organic Agriculture Part 1: The Production, Processing, Labelling and Marketing of Organic Agriculture. The Royal Gazette Vol.120 Section 79D, dated 23 July B.E. 2546 (2003).
- National Bureau of Agricultural Commodity and Food Standards (2005): Thai Agricultural Standard (TAS) on Organic Agriculture Part 2: Organic Livestock. The Royal Gazette Vol.122 Section 38D, dated 17 May B.E. 2548 (2005).
- National Bureau of Agricultural Commodity and Food Standards (2009): Thai Agricultural Standard (TAS) on Organic Agriculture Part 1: The Production, Processing, Labeling and Marketing of Organic Agriculture. The Royal Gazette Vol.126 Section 187D, dated 28 December B.E. 2552 (2009).

Evaluation of organic Sudangrass silage for feed value, silage quality and palatability in Korea

Kim J. D.¹, Shim, K. S.², Lee, H. J.³, Jeon, K. H.⁴, Lee, M. H.⁵, Youn, Y. Y.⁶, Oh, E. Y.⁷, and Lee, H. W.⁸

Key words: Corn Silage, Corn grain, Crushed rice, Total digestible nutrients (TDN), Lactic acid

ABSTRACT

The main nutritional problem of sorghumxsudangrass hybrid (Sorghum bicolorxSorghum sudanese) silage is low quality and palatability. This experiment was conducted to evaluate whether organic corn grain and crushed rice addition of sorghumxsudangrass hybrid silage increases forage quality of the silage. The sorghumxsudangrass hybrid silages with added corn grain and crushed rice were similar to conventional corn silage in moisture content. However organic sorghumxsudangrass hybrid silage had low pH values. Silage added with gain and byproduct had higher crude ash, acid detergent fiber (ADF) and neutral detergent fiber (NDF) contents than control corn silages, while its non-fiber carbohydrate (NFC) and total digestible nutrients (TDN) showed the opposite results. Lactic acid, butyric acid and lactic percentage of total organic acid (L/T) of sorghumxsudangrass hybrid silages were higher than those of corn silage, but acetic acid was higher than control. In vitro dry matter digestibility (IVDMD) of corn silage was higher than other sorghum silages. Feed intake of sorghumxsudangrass hybrid silage added with crushed rice was highest among silages. Therefore, these data indicate that crushed rice and corn grain added sorghumxsudangrass hybrid silage could be recommended as the most effective treatment for increasing silage quality and palatability.

Introduction

Sorghumxsudangrass hybrid can be one of the most popular annual summer forage crops because it is cultivated as a following crop in double cropping systems in Korea. However, sorghumxsudangrass hybrid is difficult to make good silage from grass due to the high moisture content at harvest. Sorghumxsudangrass hybrid is also difficult to preserve as direct-cut silage because the high moisture content causes excessive fermentation during ensiling. It is often not possible to wilt the forage or harvest to the desired dry matter content. If the forage is too wet, absorbent materials can be added to increase the ability of the ensiled mixture to hold water. Agricultural products or byproducts can be added at the time of ensiling to minimize losses of effluent and they

¹ Division of Animal Husbandry, Cheonan Yonam College, Cheonan 330-709 Korea, E-mail. yasc@yonam.ac.kr, Internet. www.yonam.ac.kr

² As Above

³ As Above

⁴ As Above

⁵ As Above

⁶ As Above

⁷ As Above

⁸ Dept. of Agricultural Science, Korea National Open University, Jongro-ku, Seoul 110-791 Korea. E-mail. kyowon@knou.ac.kr, Internet. www.knou.ac.kr

have the additional advantage of increasing forage quality and feed intake. The main nutritional problems of sorghum×sudangrass hybrid silage are low quality and feed intake. Agricultural products or byproducts as a silage additive may increase forage quality and feed intake of sorghum×sudangrass hybrid silage. This experiment was conducted to evaluate the effect of corn grain and crushed rice as an additive on forage quality of sorghum×sudangrass hybrid silage.

Materials and Methods

Fresh sorghum×sudangrass and corn (*Zea mays*) hybrids were obtained from Animal Husbandry Extension Farm of Cheonan Yonam College (Cheonan, Korea). The sorghum×sudangrass hybrid was harvested at first heading stage, and corn was harvested at yellow stage. Sorghum×sudangrass and corn hybrids ensiled whole or chopped to a theoretical length of 3cm using a small forage chopper.

The experiment was a randomized complete block design. The three treatments used were: corn silage as a control (T1), sorghum×sudangrass hybrid silage added with corn grain (T2) and, sorghum×sudangrass hybrid silage added with crushed rice. The samples were weighed and dried for 72 h by forced-air drying oven at 65 °C. The dried samples were reassembled and ground through a Wiley mill using a 1mm screen.

The pH was measured with a pH meter after macerating a 10-g sample of silage in 100 ml of distilled water. Lactic acid, acetic acid and butyric acid were measured by high liquid chromatography and gas chromatography. The crude protein (CP) was determined by the Kjeldahl method (AOAC, 1990), ADF and NDF were measured by the method of Goering and Van Soest (1970), and IVDMD was determined by the method of Moore (1970), respectively. Values of non-fiber carbohydrate (NFC) and total digestible nutrients (TDN) were calculated for forage samples from equation. Corn and sorghum×sudangrass hybrid silages were provide by fresh form, and offered as libitum to dairy cattle. During the experiment period, individual feed intake was measured during 10 minutes.

Data were analyzed with analysis of variance (ANOVA) procedures using the SAS Statistical Software Package (1999). The mean separation among treatment means for hybrid, planting date, and harvest stage was obtained by using the Least Significant Difference (LSD) test. Effects were considered in all statistical calculations for P-value < 0.05.

Results and Discussions

An attempt was made of evaluated the feed value of using corn grain and crushed rice as additive of sorghum×sudangrass hybrid silage (table 1). There is no difference in moisture and crude protein (CP) contents between corn and sorghum×sudangrass hybrid silages ($p>0.05$). Corn silage was lower than other sorghum×sudangrass hybrid silages for ether extract (EE), NDF and ADF contents, while its NFC and TDN contents showed the opposite results.

Sorghum×sudangrass hybrid silage added with corn grain and crushed rice lowered pH values effectively, while the control corn silage had a high pH value. There is no significant difference in total organic acid. However, sorghum×sudangrass hybrid

silage added with byproducts had higher lactic acid and lactic acid percentage of total organic acid than corn silage (Table 2).

| Treatment | Moisture | CP | EE | CA | NFC | NDF | ADF | TDN | WSC |
|----------------------|----------|-----|------|------|------|------|------|------|-------|
| Corn silage | 72.2 | 9.0 | 2.8 | 6.0 | 31.0 | 52.0 | 37.0 | 62.4 | 6.06 |
| Sudangrass silage I | 76.6 | 9.1 | 3.4 | 8.7 | 23.0 | 59.1 | 44.0 | 57.0 | 7.59 |
| Sudangrass silage II | 74.5 | 8.1 | 2.0 | 9.4 | 30.7 | 54.1 | 43.8 | 56.3 | 10.50 |
| Mean | 74.4 | 8.8 | 2.7 | 8.0 | 28.3 | 55.0 | 41.6 | 58.6 | 8.05 |
| LSD(0.05) | NS | NS | 0.32 | 0.16 | 2.86 | 3.87 | 3.72 | 3.14 | 1.14 |

Table1.The chemical composition of corn and sudangrass silage for organic forage(%)

Sudangrass silage I=added with corn gain, Sudangrass silage II=added with crushed rice, CP=crude protein, EE=ether extract, CA=crude ash, NDF=neutral detergent fiber, ADF=acid detergent fiber, NFC=non-fiber carbohydrate, TDN=total digestible nutrients, WSC=water soluble carbohydrate.

Table 2 also summarizes the palatability of silage for dairy cattle. *In vitro* dry matter digestibility (IVDMD) of corn silage was higher than sorghum×sudangrass hybrid silages. The fresh and dry matter intake of sorghum×sudangrass hybrid silages added with crushed rice was higher than others among all the treatments.

Sorghum×sudangrass hybrid silage added with corn grain and crushed rice can be recommended as the most effective treatment for increasing forage quality and palatability of sorghum×sudangrass hybrid silage.

Table 2. The organic acid, *in vitro* dry matter digestibility (IVDMD) and feed intake of corn and sudangrass silage for organic forage

| Treatment | pH (1:10) | Organic acid (%) | | | | | IVDMD (%) | Feed intake (kg/animal/10 min.) | | |
|----------------------|--------------|------------------|--------|---------|-------|------|--------------|------------------------------------|------|-------|
| | | Lactic | Acetic | Butyric | Total | L/T | | Fresh | DM | index |
| Corn silage | 3.65 | 8.17 | 6.78 | 0.07 | 15.02 | 54.4 | 60.1 | 2.74 | 0.52 | 2 |
| Sudangrass silage I | 3.51 | 11.80 | 2.53 | 1.81 | 16.13 | 73.1 | 54.6 | 3.13 | 0.42 | 2 |
| Sudangrass silage II | 3.56 | 9.96 | 2.31 | 1.70 | 13.97 | 71.4 | 54.8 | 3.55 | 0.55 | 1 |
| Mean | 3.57 | 9.98 | 3.87 | 1.19 | 15.04 | 66.3 | 56.4 | 3.14 | 0.50 | |
| LSD(0.05) | 0.09 | 1.19 | 0.73 | 0.18 | NS | 2.24 | 2.84 | 1.26 | 0.11 | |

Sudangrass silage I=added with corn gain, Sudangrass silage II=added with crushed rice, L/T=lactic acid percentage of total organic acid, DM=dry matter

References

- AOAC. (1990): Official method of analysis. 15th ed. Washington, DC.
- Kim, J.D., C.H. Kwon, C.N. Shin, C.-H. Kim and D.A. Kim. (2005): Effect of location, year and variety on forage yield and quality of winter rye. *Asian-Aust. J. Anim. Sci.* 18(7):997-1002.
- Kwon, Chan Ho, Jong Duk Kim, Su Gon Kim and Chang-Hyun Kim. (2006): Effect of corn grain addition on forage quality and production cost of sorghum silage. *Chinese J. of Grassl. Sci.* 16(Suppl.): 59-61
- Filya, I. (2003): The effect of *Lactobacillus buchneri* and *Lactobacillus plantarum* on the fermentation, aerobic stability, and ruminal degradability of low dry matter corn and sorghum silages. *J. Dairy Sci.* 86(11): 3575-3581.
- Goering, H.K., and P.J. Van Soest. (1970): Forage fiber analysis. *Agric. Handbook 379*, U. S. Gov. Print. Office, Washington, D. C.
- McDonald, P. 1981. *The biochemistry of silage*. John Wiley and Sons Ltd. England.
- Seo, S. Kim W.H., Kim J.G. (2006): Production and utilization of whole crop barley and whole crop rice in Korea. *Chinese J. of Grassl. Sci.* 16(Suppl.): 274-279.
- Ward, J. D. (2001): Chemical composition, ensiling characteristics, and apparent digestibility of summer annual forages in a subtropical double-cropping system with annual ryegrass. *J. Dairy Sci.* 84(1): 177-182.

Performance and bone mineral density of laying hens fed with organic diets

Jeong, Y. D.¹, Hassan, M. R.², Jee, H. J.³, Ryu, K. S⁴

Key words: Organic diet, ME, CP, performance and laying hens

Abstract

This study was undertaken to investigate the effect of organic dietary ME and CP on the performance of laying hens. In a 2x3 factorial arrangements, 600 Brown nick laying hens were randomly divided into 6 groups with 4 replications having 25 birds in each group and were assigned to organic dietary ME (2,750, 2,775 and 2,800 kcal/kg) and CP (16 and 17%) respectively. Performance of laying hens were non-significantly affect on the level of ME and CP, but the egg production and egg mass were higher in 2750 kcal/kg ME & 16% CP level. Total protein content in blood was significantly higher ($P<0.05$) in ME 2,750 kcal/kg and 17% CP. Total cholesterol and triglycerides tend to reduce with the increasing level of CP in the diet. Thereafter, bone mineral density (BMD) and bone breaking strength (BBS) were remarkably higher in ME 2,775 kcal/kg than the 2,750 & 2,800 kcal/kg ME diet ($P<0.05$). BMD and BBS were inclined to increase by decreasing dietary CP content. All of the egg quality parameters showed higher in ME 2,775 kcal/kg, wherein egg yolk was significantly colored in 2,775 & 2,800 kcal/kg ME and 17% CP level ($P<0.05$). As a result, the performance and blood composition were maximized in 2,750 kcal/kg ME and 16% CP diet, but bone characteristics and egg quality parameters were higher in 2,775 kcal/kg ME and 16% level of CP.

Introduction

The organic poultry industry is small at present but is likely to expand in the future due to a strong demand from consumers for organic foods. The scarcity of organic feedstuffs in several regions, protein sources in particular, requires that the diets used in organic poultry production. Therefore, it becomes important to find high-quality protein feed ingredients from alternative sources of organic diets. As there is limited access to organic protein feed ingredients available on the market, probably a wide variety of ingredients will be needed to achieve the required level of sulphur AAs in the diet. Today it is possible to use up to 10% conventional feed ingredients, for example, corn gluten meal and potato protein, both relatively rich in methionine (Jonsson *et al.* 2011). However, European Economic Community council regulation indicates that organic poultry should be fed 100% organically produced feed stuffs from January 2012. Thus, there is an urgent need for the development of new high-quality feed ingredients to assure organic egg and meat production for the future. The challenge for nutritionists will be to obtain well-balanced feed without any conventional raw materials, and to minimise additional costs. Therefore, this

¹ Department of animal science, College of Agriculture & Life Sciences, Chonbuk National University, Jeonju, 561-756, Republic of Korea, E-Mail gumsa007@naver.com

² As above. E-Mail mdrakibulhassan@gmail.com

³ Organic research division, National academy of Agricultural Science, Rural development administration, Suwon, 441-707, Republic of Korea, E-Mail hijee@korea.kr

⁴ Department of animal science, College of Agriculture & Life Sciences, Chonbuk National University, Jeonju, 561-756, Republic of Korea, E-Mail seon@jbnu.ac.kr

study was undertaken to evaluate the levels of ME and CP in diets on the performance and bone mineral density of laying hen fed with organic diets.

Materials and methods

A 22-wks trial (*from 24 to 46 weeks*) was conducted with 600 Brown nick laying hen were reared under organic diet feeding condition. Each group was placed in 6.57 m² (0.26 m²/hen) pens having with egg box and perch. In a 2x3 factorial arrangements, laying hens were randomly divided into 6 groups having 25 birds in each group and were assigned to diet containing ME (2,750, 2,775 and 2,800 kcal/kg) and CP (16 and 17%) respectively. The hens were fed on one of 6 different diets according to Table 1.

Tab. 1. Experimental diet composition

| Ingredients | (%) | | | | | |
|-----------------------------|------------------|-------|-------|-------|-------|-------|
| Corn | 66.08 | 63.98 | 66.64 | 64.56 | 67.23 | 65.14 |
| Soybean meal | 21.13 | 21.64 | 19.24 | 19.79 | 17.38 | 17.93 |
| Corn gluten meal | 1.74 | 3.32 | 3.01 | 4.55 | 4.24 | 5.78 |
| Limestone | 9.44 | 9.42 | 9.42 | 9.42 | 9.42 | 9.42 |
| Calcium phosphate | 0.87 | 0.89 | 0.92 | 0.91 | 0.94 | 0.92 |
| Salt | 0.37 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 |
| L-Lysine | - | - | 0.02 | 0.03 | 0.05 | 0.07 |
| DL-Methionine | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 |
| Vitamin premix ¹ | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |
| Mineral premix ² | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| Total | -----100.00----- | | | | | |
| Chemical composition | | | | | | |
| ME(kcal/kg) | 2,750 | 2,750 | 2,775 | 2,775 | 2,800 | 2,800 |
| CP(%) | 16 | 17 | 16 | 17 | 16 | 17 |
| Lysine(%) | 0.74 | 0.78 | 0.74 | 0.78 | 0.74 | 0.78 |
| Methionine(%) | 0.32 | 0.34 | 0.32 | 0.34 | 0.32 | 0.34 |
| Calcium(%) | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 |
| Sodium(%) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| Available phosphate(%) | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 |

¹Containperkg: vit. A, 12,000,000IU; vitD₃, 5,000,000IU; vitE, 50,000mg; vitK₃, 3,000mg; vitB₁, 2,000mg; vitB₂, 6,000mg; vitB₆, 4,000mg; vitB₁₂, 25mg; biotin, 150mg; pantothenic acid, 20,000mg; folic acid, 2,000mg; nicotinic acid, 7,000mg.

²ContainperKg: Fe, 66,720mg; Cu, 41,700mg; Mn, 83,400mg; Zn, 66,720mg; I, 834mg; Se, 250mg.

Breeding procedures were maintained in accordance with the organic guidelines (No. 2006-20, NAQS). Day light was provided less than 14 hours in addition with artificial light. Egg mass, feed conversion, egg quality, egg shell breaking strength, shell color, albumin height, haugh units and yolk color were measured in each month. Blood sample (n=10/group) were used to determine the contents of total protein, albumin, cholesterol, triglycerides and High density lipoprotein (HDL). All of these assays were performed using a biochemical analyzer (ADVIA 1650; JEOL, Japan). Bone mineral density (BMD) and breaking strength (BBS) of the tibia (n=5/group) was also measured by using Bone Densitometer (pDEXA, Norland Medical Systems Inc., USA) and Texture Analyser (TA. HD. plus, Stable Micro Systems, UK). All the data were subjected to ANOVA using SAS (Version 9.1, SAS Institute, 1998) statistical program. The statistical significance differences were determined with Duncan's new multiple range test (P< 0.05).

Results and discussion

Performance of laying hen was non-significantly effects on the organic dietary ME and CP level, but the egg production and egg mass were higher in 2,750 kcal/kg dietary ME & 16% CP level. Although there was no significant effects on feed intake and FCR but higher value obtained by supplying 2,800 kcal/kg of dietary ME & 17% CP level. Moreover, there was no significant interaction between ME & CP levels on the performance. Similarly, In organic feeding environments, no significant variation in number of egg production was

obtained by Elwinger, *et al.* (2008). In another investigation, Yu *et al.* (2008) found that egg production, egg weight and egg mass were higher (P less than 0.05) in hens receiving diets with 2,800 kcal/kg of ME/kg of feed than those of 3,080 and 3,360 kcal of ME/kg of diets. Harms *et al.* (2000) also recommended that egg production was not affected by dietary energy levels. In contrast, Gunawardana *et al.* (2008) mentioned that protein had a significant effect on egg production, egg mass, feed intake, feed conversion and egg weight. As dietary energy increased from 0 to 238 kcal of ME/kg, then feed intake decreased linearly. The results of the present study were slightly different with other studies may be due to the attributed to the strain of chicken used in this experiment.

Tab. 2. Effect of various levels of organic dietary ME and CP on blood composition in laying hens

| Traits | Treatments | | | | | Pooled SEM | Statistical analysis (P-value) | | |
|---------------------------|-------------------|-------------------|--------------------|-------------------|-------------------|------------|--------------------------------|----|-------|
| | ME(kcal/kg) | | | CP (%) | | | ME | CP | ME×CP |
| | 2,750 | 2,775 | 2,800 | 16 | 17 | | | | |
| Total protein (g/dl) | 5.59 ^a | 5.15 ^b | 5.38 ^{ab} | 5.04 ^b | 5.24 ^a | 0.07 | <0.05 | NS | |
| Albumin (g/dl) | 1.33 | 1.32 | 1.31 | 1.29 | 1.35 | 0.02 | NS | NS | |
| Total cholesterol (mg/dl) | 114.75 | 97.45 | 107.60 | 112.73 | 100.46 | 4.45 | NS | NS | |
| Triglyceride (mg/dl) | 1159.7 | 930.4 | 1050.4 | 1153.5 | 940.1 | 68.22 | NS | NS | |
| HDL (mg/dl) | 37.85 | 37.30 | 36.05 | 37.33 | 36.80 | 0.71 | NS | NS | |

^{a,b} Means within a row with different superscripts differ ($P < 0.05$). NS, Not Significant.

Total protein content in blood was significantly different ($P < 0.05$) among the levels of ME & CP in the diet (Table 2). The albumin levels in blood inclined with the CP content but declined with the ME concentration. Consequently, total cholesterol and triglyceride content in blood was non-significantly higher in 2,750 kcal/kg ME and 16% CP content. Moreover, HDL content in blood was non-significant across the levels of ME and CP, but decreased the HDL by increasing ME and CP levels in the diet. Similarly, Yu *et al.* (2008) estimated that the lower level of ME and higher level of CP had increased the albumin content in blood, whereas the total cholesterol have shown opposite direction with the level of albumin and triglyceride. Although the result of the present findings agrees with the above studies but the study has been restricted that the effect of ME in the diet on internal metabolism. Therefore, we suggested that the studies should be considered among the level of ME & CP in the diet on the internal metabolisms of laying hen.

Tab. 3. Effects of various levels of organic dietary ME and CP on the bone mineral density (BMD) and bone breaking strength (BBS) in laying hen

| Traits | Treatments | | | | | Pooled SEM | Statistical analysis (P-value) | | |
|--------------------------|--------------------|--------------------|--------------------|--------|-------|------------|--------------------------------|----|-------|
| | ME (kcal/kg) | | | CP (%) | | | ME | CP | ME×CP |
| | 2,750 | 2,775 | 2,800 | 16 | 17 | | | | |
| BMD (g/cm ²) | 0.236 ^b | 0.268 ^a | 0.224 ^b | 0.251 | 0.235 | .005 | P<0.015 | NS | NS |
| BBS (ka) | 21.27 ^b | 26.89 ^a | 21.69 ^b | 24.12 | 22.44 | 8.63 | NS | NS | NS |

^{a,b} Means within a row with different superscripts differ ($P < 0.05$). NS, Not Significant.

BMD and BBS were non-significantly affected among the ME & CP levels, but higher in 2,775 kcal/kg ME & 16 % CP (Table 3). The results of this study were partially agreed with the findings of Fanatio *et al.* (2008) who reported that the value of BMD in broiler was increased with the levels of dietary ME concentrations. Eterrier *et al.* (1998) also demonstrated that low energy diet did not improve bone quality in broilers. Thus, the results from this study suggested that intake of the CP (16%) led to a positively effects on BMD and BBS although it had the similar levels of feed intake.

Tab. 4. Effects of various feeding organic-dietary ME and CP on egg quality in laying hens

| Traits | Treatments | | | | | Pooled SEM | Statistical analysis (P-value) | | |
|---|-------------------|-------------------|-------------------|-------------------|-------------------|------------|--------------------------------|----|-------|
| | ME(kcal/kg) | | | CP(%) | | | ME | CP | ME×CP |
| | 2,750 | 2,775 | 2,800 | 16 | 17 | | | | |
| Egg shell color | 27.26 | 27.46 | 26.60 | 27.75 | 26.86 | 0.31 | NS | NS | NS |
| Albumin height (mm) | 6.94 | 7.39 | 7.13 | 7.20 | 7.11 | 0.08 | NS | NS | NS |
| Haugh unit | 80.64 | 83.49 | 82.16 | 82.71 | 81.49 | 0.56 | NS | NS | NS |
| Yolk color | 8.45 ^b | 8.96 ^a | 8.95 ^a | 8.70 ^b | 8.87 ^a | 0.05 | <0.01 | NS | <0.05 |
| Egg shell breaking strength (kg/cm ²) | 4.71 | 4.72 | 4.61 | 4.60 | 4.75 | 0.08 | NS | NS | NS |

^{a,b} Means within a row with different superscripts differ (P<0.05). NS, Not Significant.

Egg shell color, breaking strength and albumin height was unaffected by the levels of dietary ME and CP in laying hens (Table 4). Though, diet has no significant effect on haugh unit but higher in 2,775 kcal/kg and 16% level of CP. Egg yolk color was significantly influenced with the increasing levels of ME & CP content. All the egg quality parameters were found better in 2,775 kcal/kg ME and 16% CP comprising diet except yolk color and breking strength which rises with the CP. Similarly, Yu *et al.* (2008) recommended that dietary ME have not significantly effect on egg shell breaking strength, shell color, shell thickness and haugh unit except yolk color. Haugh unit was linearly decreases with the ME (Wu *et al.* 2005) but Nahashon *et al.* (2007) found that the level of ME (2,800, 2,900 kcal/kg) was significantly unaffected on Haugh unit. These differences may have been caused by differences in ME and CP content in the diet.

Conclusions

In conclusion, the aspects of the performance and blood composition were maximized in ME 2,750 kcal/kg, and 16% CP, but the bone characteristics and egg quality parameter were higher in 2,775 kcal/kg ME and 16% CP than the ME 2,750 kcal/kg and 17% CP.

References

- Elwinger K., Tufvesson M., Lagerkvist G. and Tauson R. (2008): Feeding layers of different genotypes in organic feed environments. *British Poultry Science* 49(6): 654-665.
- Fanatico A. C., Pillai P. B., Hester P. Y., Falcone C., Mench J. A., Owens C. M. and Emmert, J. L. (2008): Performance, livability, and carcass yield of slow- and fast-growing chicken geno types fed low-nutrient or standard diets and raised indoor or with outdoor access. *Poultry Science* 87:1012-1021.
- Gunawardana P., Roland Sr. D. A., and Bryant M. M. (2008): Effect of Energy and Protein on Performance, Egg Components, Egg Solids, Egg Quality, and Profits in Molted Hy-Line W-36 Hens. *Journal of Applied Poultry Research* 17:432-439.
- Jonsson L., Wall H. and Tauson R. (2011): Production and egg quality in layers fed organic diets with mussel meal. *Animal* 5(3): 387–393.
- Jalal M. A., Scheideler S. E. and Marx, D. (2006): Effect of bird cage space and dietary metabolizable energy level on production parameters in laying hens. *Poultry Science* 85:306-311.
- Nahoshon S. N., Adefope A., Amenyenun A. and Wright D. (2007): Effect of varying concentrations of dietary crude protein and metabolizable energy on laying performance of pearl grey guinea fowl hens. *Poultry Science* 86:1793-1799.
- Wu G., Bryant M. M., Voitle R. A. and Roland Sr. D. A. (2005): Effect of dietary energy on performance and egg composition of Bovans white and Dekalb white hens during phase 1. *Poultry Science* 84:1610-1615.

Increasing ranging area improved laying hens' welfare and affected egg production and quality

Oliveira, D. G¹, Leite, R. M². & Khatounian, C. A.³

Key words: organic egg production; LayWel project; Yamaguishi; egg production in the tropics, organic egg standards

Abstract

An experiment was conducted to study the effect of increased range area on the welfare of laying hens, their productive performance and egg quality. The birds were submitted to three different treatments: 3m² of range area per bird, 1,8m² range area per bird and no range area. Each plot consisted of a flock of circa 105 birds, replicated 7 times, totaling 2310 Isa Brown hens, all belonging to the commercial organic operation called Yamaguishi Vila, in Jaguariuna, Brazil. Hen welfare was assessed with the LayWel project parameters. Bird productive performance was assessed by laying rate, feed consumption, feed conversion and egg weight. Egg quality parameters included albumen height, yolk height and yolk color. Increasing range area reduced feed consumption and laying rate, but increased albumen height. According to Laywel project criteria, welfare scores were very good in all treatments, but hens with no range area had the least good situation.

Introduction

Brazilian organic regulations require at least three square meters of outdoor range area per laying hen, in order to guarantee birds welfare (<http://www.prefiraorganicos.com.br/>). This means a maximum of 3333 birds per hectare. Within the shed, the maximum density is 6 birds per square meter. However, these requirements did not result from extensive research, but rather from common sense and empirical considerations. In order to comply with the Brazilian organic regulations, egg producers should have additional need for land area, which is a constraint in most peri-urban areas where eggs are produced. This frequently limits the conversion of egg producing systems to organic management.

The new regulations also outlaw some traditional ethologically-based egg production systems, such as the Yamaguishi system. In the Yamaguishi practice, hens are kept always in the shed, without any access to outdoor range area, but the shed density is of two hens per square meter. Mobile roofs are managed so that the birds have access to sun light from within the shed. In addition, there is a concern with flocks size to reduce social stress. Typically, flocks of circa 100 hens plus five to six cocks are raised in individualized pens, during their whole life cycle.

Although the requirements for range area are generally considered positive, there are also some sanitary problems that may hamper organic egg production, particularly under rainy climates. Given access to range are, hens venture in the open area even when wet conditions would rather be to keep them indoors.

¹ BSc. Agromonist, diegogresp@gmail.com

² BSc. Vet. Doctor, Villa Yamaguishi, romeu@yamaguishi.com.br

³ PhD. Prof. of Agroecology, University of Sao Paulo, armenio@esalq.usp.br

In order to generate experimentally solid results upon which to build norms, an experiment was conducted in a commercial operation, comparing the present Brazilian legal requirements with the prescriptions of the Yamaguishi system.

Materials and methods

The experiment involved 2310 laying Isa Brown hens with 18 weeks of age, at Vila Yamaguishi operation in Jaguariúna, Brazil, latitude: -22° 42' 20"; longitude: 46° 59' 09", and altitude 584 meters a.s.l. The treatments were: 3m²; 1,8 and 0 m² of range area per bird. The range area had about 50% plant coverage, mostly *Eleusine indica* and *Cyperus rotundus* when the experiment started. The birds were divided in 21 flocks of circa 105 hens and 5 cocks, each treatment being replicated seven times. Shed bird density was 2 birds/m² in all treatments. The roof was mobile, opened daily from 7:00 am to 11:00 am for all treatments, except in raining days.

Feed was formulated with maize, soybean meal, wheat bran and minor ingredients, to achieve 16.5% crude protein and 2650 kcal.kg⁻¹. It was served around 4:00 pm in amounts calculated so as to avoid waist in the feeder, averaging 100g per bird per day. Birds also received 20g per head per day of fresh greens, mainly vegetable refuse and weeds.

The experiment started on 12/11/2009. The egg-laying rate was measured from February 08 to May 25, totaling 87 days. Egg weight and the feed conversion were measured every day from March 15 to May 25. Egg quality was assessed for 11 weeks, from March 16 to May 25. Every week one egg per pen was randomly chosen, the eggs were broken in a plain surface where yolk and albumen height were measured with a micrometer. The yolks were used to visually assess pigmentation with the Roche yolk color fan. Bird welfare was assessed every two weeks during the experimental period, totaling 11 welfare assessments. From each pen four randomly taken birds were scored. Welfare scores were based on parameters of the LayWel project (<http://www.laywel.eu/>). These parameters are based on the bird's feather coverage, since stress conditions increase plucking. Poorer feather coverage implies poorer welfare conditions. The statistical significances were determined by Student's t test, using paired data.

Results

The feed consumption and the egg-laying rate were significantly lower ($P<0,01$) for the birds with 3m²/bird of range area (Table 1). The egg weight and feed conversion were not affected by range area.

Egg quality and LayWel welfare scores were influenced by range area (Table 2). Egg from hens with access to 3m² had higher albumens ($P<0,01$) than eggs from the two other treatments. Confined hens presented lower welfare scores ($P<0,01$) than the those with 1,8m² or 3m² per bird. However, in all treatments welfare scores were far above the minimum considered acceptable by the LayWel project, which is 12. Statistical differentiation was possible only because of the high number of birds involved in the experiment.

Tab.1: Productive performance

| Range area per bird | Egg-laying rate % | | Egg Weight (g) | | Feed | | kg feed: kg eggs | |
|------------------------|--------------------|-------|--------------------|------|--------------------|------|-------------------|------|
| | mean | SEM** | mean | SEM | g/bird/day | SEM | mean | SEM |
| 3m ² | 77.7 ^{a*} | 0.81 | 60.48 ^a | 0,19 | 103.6 ^a | 0,90 | 2.25 ^a | 0,03 |
| 1,8m ² | 84.5 ^b | 0,69 | 60.30 ^a | 0,16 | 109.9 ^b | 0,86 | 2.24 ^a | 0,03 |
| None | 83.6 ^b | 0.68 | 60.28 ^a | 0,16 | 109.0 ^b | 0,64 | 2.24 ^a | 0,03 |

* In each column, values followed by the same letter do not differ statistically, P<0.01.

**Standard error of the mean

Tab. 2: Egg quality and LayWel evaluation score

| Range area height (mm) per bird | Yolk Colour Welfare score*** | | Yolk height (mm) | | Albumen | |
|---------------------------------------|---------------------------------|------|-------------------|------|-------------------|-----|
| | mean | SEM | mean | SEM | mean | SEM |
| 3m ² | 10.9 ^{a*} | 0,18 | 17.5 ^a | 0,12 | 8.53 ^a | |
| 0,21 | 23.93 ^b | 0,03 | | | | |
| 1,8m ² | 10.6 ^a | 0,19 | 17.7 ^a | 0,15 | 7.50 ^b | |
| 0,10 | 23.91 ^b | 0,03 | | | | |

Discussion

In an experiment comparing broilers with and without access to outdoor area, Hellmeister Filho (2002) did not observe statistical difference in feed consumption. Similar results were obtained by Takahashi (2006) in intensive and semi intensive broiler production systems. However, in our study our results showed the greatest range area was connected with the lower feed consumption and lower egg-laying rate. We believe this was due to serving feed late in the afternoon, when hens with access to greatest range areas did not have as much digestive space for feed as their counterparts on reduced or no range area. Comparing egg weight of caged and free range hens, Karsten *et al.* (2010) did not observe statistically significant differences, similarly with our results.

Bestman & Wagenaar (2003) studies showed positive correlation between feather condition and the range areas, though Hegelund *et al.* (2006) did not obtain an evident correlation in his study with five different breeds. Free birds have more opportunity to find their thermal comfort and better density condition, resulting in less stress and less aggressive behavior.

As for yolk pigmentation, we expected darker eggs from the treatments with range area, since pigments from picked leaves should contribute to carotenoid hen status. However yolk color was not affected by range area. We believe that the lack of response was due to the paprika use in our feed formula, which may have overdone plant consumption, masking any influence.

Ewing (1963) related that the albumen height is not affected by the diet. Brunelli *et al.* did not show alteration in Haugh unit related to feed. The Haugh unit is a score of egg

quality that lists the albumen height and the egg weight. Though Samli *et al.* (2006) saw significant difference in the Haugh unit between two different treatments, he assigned this difference to the protein quality and the lipid concentrations that were the difference between the two treatments feed. We speculate that higher albumens in our experiment may be associated with lower laying intensity.

Conclusions

Birds with access to range area presented statistically higher welfare scores than confined ones, but the absolute difference in the scores was little. That implies that ethologically sound confined systems are also possible.

Range area did not influence feed conversion in egg, although laying intensity was lowered by increased range area. Increased range area improved egg quality in terms of albumen height, but did not affect other quality parameters.

References

- Bestman, M.W.P & J.P. Wagenaar. Farm level factors associated with feather pecking in organic laying hens. *Livestock Production Science* 80: 133–140, 2003.
- Brunelli, S.R., Pinheiro, J.W., Fonseca, N.A.N., Oba, A., Silva, C.A. Farelo de germen de milho desengordurado na dieta de poedeiras comerciais de 28 a 44 semanas de idade. *R. Bras. Zootec.*, v.39, n.5, p.1068-1073, 2010.
- Ewing, W.R. Poultry nutrition. 5.ed. Pasadena: Ray Ewing Co., 1963. 1475p.
- Hegelund, L., Sorensen, J. T., Hermansen, J. E. Welfare and productivity of laying hens in commercial organic egg production systems in Denmark. 2006. *NJAS* 54-2, 2006.
- Hellmeister Filho, P. Efeitos de fatores genéticos e do sistema de criação sobre o desempenho e o rendimento de carcaça de frangos tipo caipira. 2002. 77f. Tese (Doutorado) - Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo, Piracicaba, SP.
- Karsten, H.D., Patterson, P.H., Stout, R., Crews, G. Vitamins A, E and fatty acid composition of the eggs of caged hens and pastured hens. *Renewable Agriculture and Food Systems*: 25(1); 45–54. 2010.
- LAYWEL. Welfare implications of changes in production systems for laying hens, <http://www.laywel.eu/>.
- Samli, H.E.; Senkoylu, N.; Akyurek, H. *et al.* Using rice bran in laying hen diets. *Journal Central European Agriculture*, v.7, n.1, p.135-140, 2006.
- Takahashi, S.E., Mendes, A.A., Saldanha, E.S.P.B., Pizzolante, C.C., Pelicia, K., Garcia, R.G., Paz, I.C.L.A., Quinteiro, R.R. Efeito do sistema de criação sobre o desempenho e rendimento de carcaça de frangos de corte tipo colonial. *Arq. Bras. Med. Vet. Zootec.* v.58, n.4, p.624-632, 2006.

Satisfaction and attitude survey of organic goat milk acceptance in Thailand.

Danviriyakul, S.¹, Seilsuth, S.¹, Nongyao, C.¹, Kittipongpysan, S.¹ & Rakkumsuk, T.²

Key words: organic goat milk, satisfaction and attitude survey

Abstract

A consumer test and questionnaire conducted with the purpose of ascertaining the satisfactory and acceptability of organic goat milk and related products in Thailand was carried out at metropolitan area in March 2010. The results revealed that 1) only 60% have previously consumed goat milk and related products. 2) Recognition of organic goat milk characteristics is low, but the rate for desirable goat milk consumption is high for nutritious reasons (73.1%). 3) The overall evaluation for both pasteurized and canned/sterilized goat milk as well as taste and smell satisfaction were found moderately acceptable. 4) After having experienced drinking goat milk, they were likely to buy it for their own use and household consumption, and most of them (>75%) intended to introduce it to other consumers. Respondents who were inexperienced goat milk drinkers expressed a desire to drink it once a day at the most similar to the group with uncertain frequency. 5) The inconvenient access to the products is the main reason to deny it as well as strong smell and dislike of flavor. Most convenient place to buy the product was at the supermarket (42.6%) or convenient store (34.1%). 6) Pasteurized goat milk (63.8%) is mostly accepted products followed by ice cream (28.6%) and sterilized goat milk (26.7%). A reasonable price for pasteurized goat milk in 200cc bottles and sterilized goat milk in 180cc cans should be 15-20 baht (50-65c); although they preferred the organic goat milk price should be nearly the same as normal goat milk prices. 7) Goat milk should be positioned as a functional drink. Its nutritious value and quality should be presented via television promotion as well as promoted as a derived product such as soap and skin emollient, in order to expand the organic goat milk market.

Introduction

Goats have historically been raised for several decades in Thailand, mostly among the Muslim community and nutrition values of their products are recognized, leading to large populations in many areas. Goats are herbivorous animals and select the most hygienic forage without feces or urine contamination. Goat raising can easily be adapted to the organic producing system. However, organic goat production and market development have lagged behind dairy cattle husbandry. Organic agriculture in Thailand mainly produces vegetable, rice, baby and sweet corn as well as tropical fruit for exporting. The agri-by-products remained abundant: such as straw and stover (e.g. leaves and stalks of corn, sorghum or soybean plants) shall be fed to ruminants such as dairy goats. Ozawa *et al.* 2009 have provided a basis to estimate future goat milk consumption possibilities if promotion methods are introduced. Ransome *et al.* 1998 found that milk promotion in schools may be especially beneficial to preadolescent females and inner city students, particularly in relation to milk nutrition.

¹ Faculty of Agriculture and Life Sciences, Chandrakasem Rajabhat University, Bangkok, Thailand. correspondent: seilsuth@gmail.com

² Faculty of Veterinary Medicine, Kasetsart University, Kamphaengsean, Nakhon Pathom, Thailand.

Dube & Cantin 2000 found that milk was particularly related to an emotional appeal while an informational appeal tended to be more influential to food consumption levels. However, there are limited studies on the acceptance of goat milk in Thailand and no attention has been paid to organic goat milk and on the referring market. The objective of this study is to estimate the satisfaction and acceptance of organic goat milk and determine effective goat milk promotion criteria.

Materials and Methods

A questionnaire was conducted in March 2010, in order to determine customer recognition of goat milk and goat milk products. More than 500 questionnaires were used after a goat milk drinking test. The purposive sampling included students as a young generation group, office personnel as representatives of the working age and the older generation. The questionnaire contained 3 parts with several items, such as: Part 1: general background of the respondents and recognition of goat milk and organic product, Part 2: drinking experience and impressions, intention to drink and purchase goat milk, retail publicity of goat milk products as well as knowledge of goat milk benefits and Part 3: satisfaction assessment of products including pasteurized and sterilized goat milk.

Results and Discussion

Respondent attributes and recognition

58.7% of the respondents were female most of them younger than 20 years (29.6%). Over 54.1% of the respondents were residing in their single family followed by a group living with their parents or relatives. Most of them, 43.6% had a monthly household income over 30,000 baht (1,000\$). Their education was mostly on an under-graduated level (40.5%). Only 47.4% of respondents recognized organic products and most of them had no knowledge about the organic producer or commercial/sale agency (81.8%). Most people recognized organic products as free-of-chemicals products (27.1%), produce under natural circumstances (25.1%), under environmental awareness (20.2%), under the balance of the ecology (9.0%) and produce from non genetically modified organisms (3.3%). However, the respondents trusted the guarantee of the organic certified bodies such as farmer groups or Co-operative institutes (28.6%), government institutes (27.1%), primary producers (17.7%) and a few on the private sector (4.6%). In addition, 61% of the respondents had never experienced or consumed organic products in the past, the rest of them (39%) mostly recognized diverse products such as organic vegetables (46.5%), organic rice (25.9%), organic milk (11.1%), organic fruit (9.4%) and organic meat or eggs (3.7%).

Satisfaction with goat milk products

38.3 % of the respondents had previously bought and consumed goat milk. Among them, 54.5% were uncertain about the frequency of drinking it, however 11% wanted a daily consumption, followed by 10.1% wanting it for 2-3 times a week. More than once a day and once a month were similar (7.1%), once a week (5.6%) and more than one time per month (4.0%), respectively. Most considered benefits of goat milk products to satisfy most customer's needs were that they are highly nutritious (40.8%), good for health (36.2%), good alternatives for cow's milk allergic persons (9.2%), allergy ailments (6.6%) and highly digestible (5.0%). Most of the respondents (42.6%) preferred to buy the goat milk products at a supermarket, followed by convenient stores, such as 7-Eleven (34.1%), modern trade stores (8.7%), general stores or

street-side shops (4.8%), exhibition fairs (3.7%), corners in the hospital (2.3%) and home or office delivery as a membership (1.9%).

The main goat milk products for which a need to be retailed was seen, ranged from pasteurized milk (63.8%), ice cream (28.6%), canned or sterilized milk (26.7%), drinking yogurt (17.6%), cheese (8.1%), blended bakery products (7.3%), to smoothie milk beverages (3.5%). Most of these respondents considered to buy goat milk products for their own consumption (47.6%), for their own and household consumption (29.4%) and for their family members (20.7%), respectively. The number of family members is 4-5 in average. The person that influences the purchase of goat milk products was mainly the respondent person (74.6%) and the rest would be their family members.

Table 1: Selected satisfaction and attitude of respondents on organic goat milk products

| criteria | male | female | ≤20yr | 21–30yr | 31–40yr | 41-50 yr | ≥51 yr |
|---|------|--------|-------|---------|---------|----------|--------|
| Motives to purchase goat milk products (more than one answer, %) | | | | | | | |
| Good for health/nutritious | 28.9 | 44.2 | 21.6 | 14.8 | 11.1 | 16.0 | 9.6 |
| New –fresh products | 4.8 | 10.7 | 4.0 | 2.9 | 2.9 | 4.2 | 1.5 |
| Certified brand | 5.2 | 9.4 | 5.8 | 2.1 | 2.3 | 2.7 | 1.7 |
| Taste and smell | 4.2 | 5.8 | 3.7 | 2.1 | 0.8 | 1.9 | 1.5 |
| Safety product | 4.6 | 7.7 | 3.5 | 2.7 | 1.9 | 2.5 | 1.7 |
| Natural product | 6.8 | 11.9 | 6.6 | 3.5 | 2.1 | 4.4 | 2.1 |
| Ease to access | 2.7 | 3.6 | 2.3 | 1.1 | 1.1 | 1.1 | 0.6 |
| Reasonable price | 3.7 | 3.5 | 2.3 | 2.3 | 0.2 | 1.5 | 0.8 |
| Desirable retailed goat milk products (more than one answer, %) | | | | | | | |
| Pasteurized milk | 26.4 | 37.4 | 16.6 | 11.7 | 10.4 | 16.8 | 8.3 |
| Sterilized milk | 12.5 | 14.2 | 6.7 | 6.0 | 5.6 | 5.2 | 3.3 |
| Yogurt | 4.6 | 13.0 | 3.3 | 4.3 | 3.3 | 4.5 | 2.3 |
| Ice cream | 10.2 | 18.4 | 10.0 | 7.2 | 2.9 | 4.4 | 4.1 |
| Convenient access for goat milk products (%) | | | | | | | |
| Supermarket | 15.8 | 26.8 | 13.1 | 8.7 | 5.6 | 8.9 | 6.3 |
| Convenience store | 16.6 | 17.5 | 11.2 | 6.9 | 5.6 | 6.9 | 3.5 |

Attitude and Acceptance

In the evaluation of goat milk by respondents, their satisfaction for pasteurized milk in 200cc bottles ranged from least to most (1-9 scale). The whole impression was — , smell characteristics 1.78 and taste 0 indicating the modest satisfaction in all criteria. In addition, for sterilized or canned milk, the mean for those characters were 6.3 and 1.7 , respectively, stated the modest satisfaction as well. When averaged the volume (200cc), most of the respondents (30.7%) expressed it as too small for canned milk, but were satisfied with this volume for pasteurized milk in the bottle. When asked after the experience of drinking goat milk, most respondents would answer that they would like to drink it once a day

(30.9%) and a smaller number (14.6%, 9.4%) more than once a day or once a week, respectively. However, the number of uncertain frequency was 27.1%. The prominent reasons for purchasing goat milk products were: “nutritious” (73.1%), followed by “natural” (18.7%), “fresh and new product” (15.5%), “certified product” (14.6%), “safety product” (12.3%), “desirable taste and flavor” (10.0%), “reasonable price” (7.2%) and “ease to purchase” (6.3%). However, the respondents expressed reasons for no desire to drink goat milk including: “can not be purchased easily” or “less distribution of products” (51.0%), “dislike taste / flavor” (42.5%), “high price” (15.3%), “not fresh” (7.5%), “no certified guarantee” (11.0%) and “safety concern” (5.0%). They suggested the beneficial information should be presented by mass media via television (78.2%), internet (28.6%), by subscriber magazine (19.1%) and leaflet (14.9%). After tasting, 75.4% of the respondents expressed their intention to introduce it to other consumers, but 3.5% denied that and 21.1% were reluctant to convince. As an acceptable price for pasteurized 200cc bottles and canned milk, more than half of the respondents preferred 15-20 baht (50-65c). Also, they preferred the organic goat milk price should be nearly the same as normal goat milk. In addition, the majority of respondents desired the derived products such as organic soap/shower wash (38.3%), lotion/skin emollients (35.0%), facial nourishments (16.3%) and shampoo (7.1%), respectively.

Conclusion

Closely to half of the respondents recognized organic products and most of them had no knowledge about the organic producer or commercial/sale agency. However, only 38.3% were experienced in goat milk drinking. Overall evaluation as well as taste and smell acceptance were modest. Impressions of goat milk by those respondents was mainly concerning nutritious values and health promoting abilities, indicating the product position should be a functional drink or health food. Television would be a strong media to promote organic goat milk and products. A focus should be put on the distribution of the products and on a better access. The suggestions on non-food and other related products indicated possibilities for the future expansion of organic goat milk.

Acknowledgement

The work described in this paper is under a project on Research and Development of Goat Milk Quality and Management for Organic Livestock. Acknowledgement is gratefully given to government financial support by the Institute of Research and Development, Chandrakasem Rajabhat University, Bangkok, Thailand.

References

- Dube L., Cantin I. (2000): Promoting health or promoting pleasure? A contingency approach to the effect of informational and emotional appeals on food liking and consumption. *Appetite*. 35:251–262.
- Lu C.D., Gangyi X., Kawas J.R. (2010): Organic goat production, processing and marketing: Opportunities, challenges and outlook. *Small Ruminant Research*. 89: 102–109.
- Ozawa T., Mukuda K., Fujita M., Nishitani J. (2009): Goat milk acceptance and promotion methods in Japan: The questionnaire survey to middle class households. *Animal Science Journal*. 80:212–219
- Ransome K., Rusk J., Yurkiw M., Field C.J. (1998): A school milk promotion increases milk consumption and improves the calcium and vitamin D intakes of elementary school students. *Canadian Journal of Diet Practical Research*. 59:190–198.

Agro-ecology and environment

The relationships between organic farming and agroecology

Bellon, S.¹, Lamine¹, C., Ollivier, G.¹, de Abreu, L. S.²

Key words: Agroecology – Alternative agriculture – Organic food and farming – Comparative analysis - Interdisciplinarity

Abstract

While acknowledging an extension of agroecology in the organic sector and a growing influence of agroecology in the academic world, we explore their relationships. These relationships cannot be reduced to an opposition between a scientific field and a practical domain. A Brazilian case study based on the analysis of researchers and social actors trajectories exemplifies the diversity of existing relations, whether inclusive or exclusive. With a literature review, this allows characterising the specific attributes of both organic agriculture and agroecology. We discuss them in the light of current challenges for organic farming research and development.

Introduction

Both organic farming (OF) and agroecology (AE) claim they can contribute to many challenges faced by agriculture today. Among these are the interrelated challenges of providing food security and preserving the environment. Apart from common objectives, both OF and AE also refer to ecology and question the prevalent technological model designed during the XXth century. However, albeit AE can be considered as scientifically rooted and equipped for a holistic study of agroecosystems, at least three main interpretations of AE are possible: as a scientific field, as a social movement or as an agricultural practice (Wezel *et al.*, 2009). Likewise, diversity also exists within organic farming, which cannot be summarised into a set of certified practices (Sylvander *et al.*, 2006).

Since there is a continuous confusion about both terms (Francis, 2009), we intend to contribute to clarify the relationships between OF and AE, while opening a debate and suggesting guidelines for research agendas. Our analysis starts with the extension of AE in various arenas, based on literature reviews. The following section addresses the relationships between OF and AE, based on interviews with stakeholders and case studies. The third section intends to generalise the previous analyses. The discussion opens avenues for further research work.

Materials and methods

Our approach combined 3 methods: (i) scientometric analysis based on Web of Science (WoS); (ii) case studies and comparisons among regions and countries (Wezel *et al.*, 2009); (iii) direct interviews with Brazilian actors involved in research and training in OF and AE (Abreu *et al.*, 2009). The scientometric analysis, developed in Ollivier *et al.* (2011), was done to analyse the dynamics of AE and OF domains as well as the publications co-using both terms.

¹ INRA SAD, Ecodevelopment Research Unit (UR 767), Site Agroparc, 84143 Avignon Cedex 9 France E-Mail bellon@avignon.inra.fr

² EMBRAPA Environment, Jaguariuna, Sao Paulo, Brazil

Results

Extension and influence of AE in agricultural sciences

Fig 1. shows a growing number of publications related to AE since 2004, after a rather stable period.

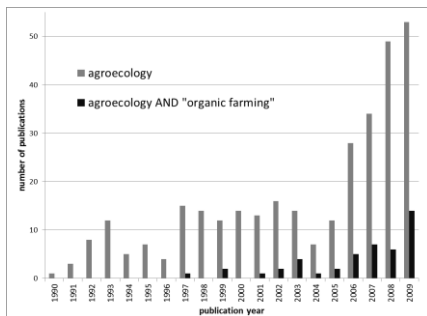


Figure 1: Dynamics in AE and their crossing over with OF (Source: Web of Science)

In spite of this recent extension, the corpus is still limited in AE (around 370 references), as compared with OF (Ollivier *et al.*, 2011). WoS notices mentioning both OF and AE represent 15% of the AE literature and 1% of the OF one. Document co-citation analysis point out the variety of addressed topics. They can be aggregated in 4 main categories: (i) definitions of AE, (ii) enhancing biodiversity, (iii) transition studies, (iv) agroecosystems studies. Many reference books are cited documents in AE, reflecting a process of knowledge building.

Main authors in AE are also influential in the field of alternative agricultures, including OF. For instance, Altieri, one of the leading authors in AE, is the 14th most cited author in OF after 2003 (Ollivier *et al.*, 2011). Other leading authors in AE consider it as an «umbrella» for alternative agricultures, or view OF as an «area of practice» for AE. Guthman (2000) assessed OF practices in the light of AE principles, arguing that in many cases organic practices fall quite short of agro-ecological ideals. Likewise, Altieri & Nicholls (2003) suggested that AE would rescue OF from an industrialisation model. Such positions reflect the conventionalisation debate in OF, and show the importance of organic values, rules and regulations in shaping organic production (Luttikholt, 2007). However OF is not only questioned but also utilised by AE, e.g. to support conversion issues where OF remains a key-reference (Gliessman, 2007).

Development of agroecology in Brazil

The Brazilian trajectory of AE can be described through three main phases: (i) emergence of social movements against the industrialisation of agriculture, (ii) structuration of social groups and economic organisations, (iii) institutionalisation of AE (Brandenburg, 2002). The author mentions the same phenomena and phases regarding OF. Indeed, the last phase of institutionalisation links AE and OF with a law (n° 10.831/2003) acknowledging AE under the umbrella of organic production. In this law, participatory guarantee systems and the political dimension of AE were considered as important to support small farmers and foster rural communities.

On the scientific side, AE is gaining in importance. AE was officially recognised in 2006 as a scientific framework by the Brazilian Agricultural Research Corporation (EMBRAPA). In 2009 the VIth congress of AE gathered close to 4000 participants; it was organised by the Brazilian Association of Agroecology (ABA), created in 2004. On the civil society side, the National Articulation of Agroecology (ANA) appeared in 2002 as a space for convergence of social movements, networks and organisations.

The case of Brazil shows the complexity of relationships between AE and OF and the diversity of visions they encompass.

Interviews with Brazilian scientists and actors of the civil society enabled to distinguish three trajectories corresponding to specific visions: (i) actors coming from NGOs and social movements who got involved in policy making and maintained or developed strong links with scientific communities, (ii) research or extension workers involved in social movements and policy making through participatory research projects mostly anchored in AE, (iii) scientists interested in OF and AE as research fields and much less involved in social movements and policy making. The two first types of actors claim a political vision of AE which is considered far beyond OF ("OF is at best a stage along the way to AE in the process of transition", as said an interviewee). The third category of actors claims a scientific and "objective" version of AE which is seen as close to OF. The types of farms (family farms vs. all farms), the relationships to markets and consumers (short food chains vs. all types of food chains), the key scholars and the research methods (participatory approach vs more classical research projects) can also be distinguished in these competing visions of AE.

General relationships between OF and AE

Some commonalities appear between OF and AE. Both promote a "closed system" approach, use multiple and diverse crops or animals, rely on biological processes for building soil fertility and controlling pests and diseases, support transition pathways towards ecologically-based agricultural systems (Abreu *et al.*, 2009). They are also both a suited way to introduce practical systems research into academia. Some differences can however be identified (Table 1).

Table 1 : Comparative analysis of central attributes in OF and AE

| | Organic Farming | Agroecology |
|-------------------------------|--|--|
| Definition | System of farm management and food production | Various e.g. Interdisciplinary study and design of agricultural and food systems (Gliessman, 2007) |
| Initial paradigms | Soil fertility (and soil sciences) | Ecology (and entomology) |
| Key concepts | Farming system ; Value chain | Agroecosystem; Food sovereignty |
| Reference models | Mixed livestock-cropping | Traditional multistratified systems |
| Agricultural forms associated | Biological, Biodynamic, Organic | Alternative, Sustainable agriculture, Integrated Pest Management |
| Key actors | Farmers, processors, consumers | Diversified small farmers |
| Technologies | Use of natural substances and processes; no GMOs | Nutrient cycling; biological crop protection; possibly chemical inputs |
| Food | Quality, content, health | Agri-food systems, sovereignty |
| Biodiversity | Impact oriented (effect of practices on biodiversity) | Resource oriented, enhancing agrobiodiversity |
| Regulations | Historical recognition, IFOAM principles, and national rules | No international standards acknowledged |
| Certification | Mostly third-party | Participatory guarantee systems |

Discussion

The case of Brazil showed a combined movement of institutionalisation of both OF and AE, which also occurs in other latin-american countries (Nelson *et al.*, 2009). In most European countries, AE is not yet as institutionalised as OF, despite a growing influence of AE on agricultural sciences. However, in many countries, various scholars extended their research from OF to AE, both in research or in education. In the case of France, the Institute for Agricultural Research (INRA) recently mentioned AE as one

of its main priorities. However, it is mainly in some professional or in civil society organisations that AE is mobilized as a way to express an opposition to mainstream agriculture, and sometimes to organic movements and definitions. This phenomenon is rather recent, while in Brazil AE has been for long an available frame for alternative agricultures' networks. Further comparative analyses would probably confirm the fluidity which exists between OF and AE, since their frontiers and contents are evolving, despite the specificity of conceptual attributes which we assessed.

More generally and beyond the academic arenas (see Fig.1), AE becomes a catchword in many public and private organisations. In some civil society organisations, the reference to AE allows enhancing the importance of key values (such as quality of life and work; social justice) which are *de facto* also present in the organic movements (but not in the organic legal rules) as well as the notion of food system (producers/consumers links and relocalization of food production and consumption) which is considered by many as neglected in OF.

Conclusions

OF is still a reference, due to its history (almost a century), its principles for action (set of rules) and codified practices (regulations), its controls and certification, its growing economic importance and its identification by consumers. AE which is gaining importance in the academic world and in many social movements has to strengthen its identity as an action-oriented interdisciplinary project. This entails (i) deepening relationships between AE and OF as built in literature, in social movements and in individual curricula and (ii) developing beneficial convergences through cross-fertilisation. In this respect, research efforts should contribute to the design of dynamic agricultural models embedded in social-ecological systems.

References

- Abreu, L. S. de, Lamine C., Bellon S. (2009). Trajetórias da Agroecologia no Brasil: entre Movimentos Sociais, Redes Científicas e Políticas Públicas. VI Congresso Brasileiro de Agroecologia. II Congresso Latino-americano de Agroecologia, Curitiba, BR, Nov. 9-12 nov.
- Altieri M. A., Nicholls C.I. (2003). Agroecology rescuing organic agriculture from a specialized industrial model of production and distribution. *Ecology and Farming* 34: 24-26.
- Brandenburg A. (2002). Movimento agroecológico: trajetória, contradições e perspectivas. *Revista Desenvolvimento e Meio Ambiente* nº6, July-Dec 2002, Ed UFPR.
- Francis C. (2009): Education in Organic Farming and Food Systems. In Francis, C. (ed): Organic Farming: The Ecological System. *Agronomy Monograph* 54. ASA/ CSSA/SSSA, p. 283-299.
- Gliessman, S.R. (2007). Agroecology: the ecology of sustainable food systems. CRC Press, Taylor & Francis, New York, USA, 384 p.
- Guthman J. (2000). Raising organic: An agro-ecological assessment of grower practices in California. *Agriculture and Human Values* 17: 257-266.
- Lutikholt L. (2007). Principles of organic agriculture as formulated by the IFOAM. *NJAS – Wageningen Journal of Life Sciences* 54:347-360.
- Nelson E., Scott S., Cukier J., Leiva A. (2009). Institutionalizing agroecology: successes and challenges in Cuba. *Agriculture and Human Values* 26: 233-243.
- Ollivier G., Bellon S., Penvern S. (2011). Thematic and citation structure dynamics of Organic Food & Farming research. *Ifoam-Isolar Congress KOWC* (submitted)
- Sylvander B., Bellon S., Benoit M. (2006). Facing the organic reality : the diversity of development models and their consequences on research policies. *JOC* Odense, DK, May 30-31, 58-61.
- Wezel A., Bellon S., Doré T., Francis C., Vallod D., David C. (2009). Agroecology as a science, a movement and a practice. A review. *Agron. Sustain. Dev.* 29, Number 4: 503-515.

Use of agro-ecological methods by Asian smallholder farms and relation to organisation of certified organic cash crop production

Halberg, N.¹, Qiao, Y², Vaheesan³ & Zoysa, K.⁴

Key words: Cross-disciplinary, agro-ecology, smallholder, developing countries, organic principles

Abstract

Production of certified organic products is growing in Asia and may link smallholder farmers with high value markets through contract production with exporting companies. However, little is known of the extent to which such arrangements facilitate the use of organic principles. The relation between type of organisation and use of agro-ecological methods among export oriented small scale organic farmers was studied in two case areas in China and one in Sri Lanka using qualitative interviews and a cross sectional survey of 200 households in each area. The organic farmers used significantly more agro-ecological and soil conservation methods such as intercropping, insect traps, green manure compared with non-organic. However, the degree of involvement of farmers in training, development of agro-ecological methods and crop diversity varied between the cases. In two case areas involvement of local public extension officers or NGO staff led to a continuous development of organic production methods. In the third case area the local company only engaged in organic tea cultivation with little involvement of other agents.

Introduction

Demand for and import of certified organic products increase in Northern Europe. For the sake of maintaining long term consumer loyalty to imported organic products it is important that consumers are better informed of the production forms and whether the price premium support sustainable farming praxis. A number of studies of organic cash crop production in developing countries have documented potential economic benefits for smallholder farmers (Lyngbæk *et al.* 2001; Giovannucci 2005; Panneerselvam *et al.* 2011) and that some forms of organic farming actively promotes crop diversification (Lyngbæk *et al.* 2001; Parrot *et al.* 2006, Panneerselvam *et al.* 2011). However, the documentation of the degree of compliance with principles of organic agriculture (E.g. Ifoam, 2005) and – more specifically – the use of agro-ecological methods in compliance with the ecology principle is scarce (Bellon *et al.* 2005; Parrot *et al.* 2006; Eyhorn *et al.* 2007). The aim of this paper was to assess the use of agro-ecological methods by farmers linked with export chains of certified organic products in Asia under different forms of organisation.

¹ International Centre for Organic Food Systems, Blichers Allé 20, P.O. Box 50, DK-8830 Tjele, E-Mail: Niels.Halberg@icrofs.org Internet www.icrofs.org

² China Agricultural University, Beijing

³ Helvetas, Colombo, Sri Lanka

⁴ Tea Reasech Institute, Kandy, Sri Lanka

Materials and methods

We recorded data on agricultural praxis, farm economics and livelihood in three cross sectional surveys of approximately 2*100 organic and non-organic households in each of two case areas in China and one in Sri Lanka. The household head and the mother of the household were interviewed by trained local staff in local language and following a pre-tested questionnaire in July (China) and September (Sri Lanka) 2006. Under the topic "use of agro-ecological methods" farmers were asked if they applied mulching, crop residue return or green manure, used intercropping, trap crops or physical or pheromone traps against pests and/or practiced agro-forestry, crop rotation, contour cropping and had terraces and hedgerows.

Information on the organic and conventional market links, the certification praxis and cost, price premiums and organisation of the organic production was gathered from key stakeholders in private and public sectors. This information and the interpretation of household interviews were double checked at verification workshops with farmers and extension workers in the case areas in November 2006. Quantitative survey data were tested statistically for differences between organic and non-organic households using Propensity Score matching methods (Caliendo & Koepeinig 2005).

Results

The organic farmers in Kandy, Sri Lanka and in Wuyuan, Sichuan, China were organised around a major tea exporting company. Both companies had –partly– initiated the process of conversion and controlled the market links. The smallholder farmers had approximately 0.5ha land each of which less than 0.25ha would be planted with tea. In the Kandy case area an NGO had originally promoted organic ideas and agro-ecological cultivation methods and trained staff facilitated development together with the company. The two tea projects were also Fair Trade (FLO) certified, under which rules farmers should participate in an association, which will determine the use of the price premium. This resulted in significant capacity building and agro-ecological development in the Kandy case area. Contrary, the farmers in the Wuyuan area knew little of the FLO association and there were almost no training or sensitisation in organic agriculture (OA) principles and agro-ecological methods. Wuyuan farmers cultivated other crops, paddy, using conventional methods.

In the third case, Jiaohu, Sichuan, China, the town administration in collaboration with private companies inspired local farmers to produce certified organic ginger responding to a market opportunity. Due to a need for growing ginger in a crop rotation all the land had to be converted to organic and a number of villages were converted 100% in year 2000. This led to contracts with other companies for different organic products from these villages, such as soy beans and strawberries that were freeze dried and shipped to US market. The town office for agriculture controlled and organised the certification and the contracts with a number of companies. They also organised training and development of agro-ecological methods such as pest mitigation in different crops and use of organic inputs.

In all three case areas the organic farmers used in average more agro-ecological methods than the non-organic ($p < 0.001$) and also used more soil conservation methods (Table 1). The organic farms in Jiaohu applied 21 tonnes livestock manure per ha in average, which was significantly more than the 12 t ha^{-1} in non-organic

households even though the livestock production was not different in the two groups. Thus, on a farm level scale the non-organic farmers had an unused source of manure, which suggest a risk of nutrient loss. Moreover, the organic farmers in Jiaohu used legumes as green manures after harvest of rice on 21% of their land and experimented with other agro-ecological methods such as insect traps. They also diversified into new organic crops. In the Wuyuan case area there was little development of organic methods and since only the tea was converted to organic the overall difference to non-organic households was small. Especially so, because the location of the organic tea was chosen in areas, where the non-organic tea used little chemical input anyway. Field boundaries in paddy land however, showed clear signs of herbicide use in paddy fields also in organic farms. Among the non-organic households interviewed in Wuyuan and Jiaohu 39 respectively 26 percent responded that one of their family members had needed medical attention due to pesticides intoxication within the last 3 years. This amplifies the potential benefits of OA for improvement of farmers' health and the local environment.

Table 1. Use of agro-ecological methods, manure and fertiliser in organic and conventional small farms in China and Sri Lanka

| | Jiaohu | | | Wuyuan | | | Kandy | | |
|--|--------|-------|-------|--------|-----|-------|-------|-----|-------|
| | Non-O | O | P<= | Non-O | O | P<= | Non-O | O | P<= |
| Number of agro-ecological methods used | 5.1 | 7.5 | 0.001 | 3.4 | 4.5 | 0.001 | 3.9 | 5.7 | 0.001 |
| Number of Soil conservation methods used | 4.2 | 4.9 | 0.01 | 2.7 | 3.6 | 0.001 | 3.4 | 3.9 | n.s. |
| Percent land with legumes | 4 | 21 | 0.01 | 0 | 0 | n.a. | 15 | 28 | n.s. |
| Percent area with synthetic pesticides applied | 40 | 0 | n.a. | 52 | 34 | n.a. | 0 | 0 | n.a. |
| Total manure used, tonnes per hectare | 12.4 | 21.10 | 0.01 | 3.4 | 3.9 | n.s. | 0.04 | 1.7 | 0.001 |

The P-value indicates significant differences when comparing the organic and non-organic farms, "n.a."= not applicable, "n.s."= not significant. O= organic farms

Discussion

The role of private companies in securing market access to smallholders in these three case areas was clearly very important and both tea companies in the two case areas (Wuyuan, China; Kandy, Sri Lanka) had a high degree of control of the market chain and the certification process. However, the smallholder farmers expressed remarkable differences between the case areas in their degree of ownership to the organic principles and initiatives for further development. In the two cases demonstrating a continuous development of agro-ecological practices and involvement of farmers either an NGO plus a farmer association (Kandy) or the local public office of agriculture (Jiaohu) were involved as intermediaries between the commercial company and the farmers. The public extension staff in Jiaohu played a key role in introducing market links, and organic production methods for new crops. The same involvement was not apparent in the other case areas. Such a public or civil society involvement may be a necessary complementary factor for successful market oriented organic production based on organic principles and agro-ecological methods.

Conclusion

The study shows that it is possible to organise organic cash crop production for world markets in a way where smallholder farmers are economically competitive and at the same time adopt agro-ecological methods. However, the form of organisation of the production and marketing influences the degree of local ownership to organic principles and involvement in development of organic praxis building on agro-ecological principles. Moreover, the degree of facilitation by the contracting companies, NGO's or the public extension service influences the adoption of such methods and this is not always taken seriously by the involved companies. The form of organisation and alignment with organic principles should be discussed more in the organic sector.

Acknowledgement

The study was supported by the Asian Development Bank Institute, Tokyo and the Danish Ministry for Food and Agriculture. The opinions expressed in the paper are the responsibility of the authors alone.

References

- Bellon S., Santiago de Abreu L., Valarini. P. J. (2005): Relationships between social forms of organic horticultural production and indicators of environmental quality: A multidimensional approach in Brazil. In Köpke, U. et al. (eds): Researching sustainable systems. Proceedings of ISOFAR. Adelaide, sept. 2005.
- Caliendo M., Koepeinig S. (2005): Some Practical Guidance for the Implementation of Propensity Score Matching. German Institute of Economic Research, Berlin, Discussion Paper no. 485, 29 pp.
- Eyhorn F., Ramakrishnan M., Mäder P. (2007): The viability of cotton-based organic farming systems in India. *International Journal of Agricultural Sustainability*. 5: 25-38.
- Lyngbæk A. E., Muschler R. G., Sinclair F. L. (2001): Productivity and profitability of multistrata organic versus conventional coffee farms in Costa Rica. *Agroforestry Sys.* 53:205-213.
- Panneerselvam P., Hermansen J., Halberg N. (2011): Food security of small holding farmers: comparing organic and conventional systems in India. *Journal of Sustainable Agriculture* 35: 48-68
- Parrot N., Olesen J. E., Høgh-Jensen H. (2006): Certified and non-certified organic farming in the Developing World. In Halberg N., Knudsen M. T., Alrøe H. F., Kristensen E. S. (Eds): *Global Development of Organic Agriculture: Challenges and Prospects*. CAB International. Chp 6, 153-176.

Organic farming for Resource conservation under soybean-wheat for rain-fed conditions of lower Himalayas, India

¹Sharma, P., Singh, P., Prasad, R., & Arya, S. L.

Key words: organic farming, soybean, resource conservation, soil erosion, vermicompost

Abstract:

Various organic, inorganic and integrated nutrient management practices in rain fed degraded agriculture lands were compared in terms of productivity and soil erosion susceptibility in rain fed agriculture lands. Field experiment using different combinations of compost, vermicompost, inorganic fertilizers, and biofertilizers under soybean-wheat showed that soybean yields were highest under inorganic fertilizers during first cropping year, while significantly higher yields were obtained subsequently under organic and integrated treatments in combination with biofertilizers, Rhizobium and Piriformospora indica. The yields of wheat crop and the net annual returns under soybean-wheat were highest under integrated treatment of vermicompost, inorganic fertilizer and biofertilizer. Vermicompost application resulted in maximum build up of soil organic carbon and soil moisture, and minimized the run-off % and soil loss due to improved soil texture, infiltration and root growth.

Introduction

Organic agriculture has been a traditional practice in rain fed agriculture lands in India, but the higher production needs have resulted in a major shift to chemical farming during last few decades (Sharma 2010). The excessive and indiscriminate use of agro-chemicals are placing pressure on the soil, leading to severe land and environmental degradation, and declined soil productivity (Reganald *et al* 1987, Pimentel *et al* 2005). Organic farming is the most potent weapon in fighting against unabated soil degradation and imperilled sustainability of agriculture in tropical and sub-tropical regions of India, particularly those under the influence of arid, semiarid and sub-humid climate (Ramesh *et al* 2005). There is an urgent need to develop a good package of organic practices, aimed at improving soil health while sustaining high production levels. Therefore, effect of nutrient management practices on productivity, soil erosion and soil health has been studied under soybean-wheat rotation.

¹ Central Soil & water Conservation Research & Training Institute, Research Centre, Chandigarh, India. Email: psharma1956@yahoo.com.

Materials and methods

A field experiment was started in 2007 at a sloppy and erosion prone agriculture land (1% slope) located at research farm of CSWCR&TI, Chandigarh, India (altitude of 370m above msl, latitude of 30°- 44' North and longitude of 76°-51' East), annual rainfall of more than 1100 mm (rain intensity 20-110mm/24 hrs, mostly during monsoon months July-September followed by relatively dry winter and summer). The soil was mixed hyperthermic, Udic Ustocrept, well drained, moderately eroded, deeply sandy loam (sand silt and clay at 62, 28 and 10 percent, soil pH 8.2., average organic carbon 0.26 %). The following main nutrient treatments with plot size, 7x6 m in split plot design were replicated thrice: a) Control (no nutrients added); b) 100% recommended nutrients through inorganic fertilizers (IF); c) 100% recommended nutrients through compost (C); d) 100% recommended nutrients through vermicompost (VC) ; e) Integrated inorganic fertilizers and compost (50:50); f) Integrated inorganic fertilizers and vermicompost (50:50). The sub-treatments included: i) Un-inoculated; ii) Inoculated with selected biofertilizers, *Rhizobium* & *P. indica*, for Soybeans, and *Azotobacter* and *P. indica* for wheat. Soybean (cropping period July-October) was rotated with wheat (cropping period November-April). Vermicompost was produced using crop residues and animal dung (50:50) and earthworms *Eisenia foetida*, while compost was prepared through natural decomposition of these organic residues in large heaps as practiced by farmers. Soil organic carbon was analysed as per Walkley and Black (1934), applying standard correction factor 1.32. Runoff was monitored for all the rain storms by collecting 1/40th of the run off volume generated within 24 hours in drums (Ramser samplers, capacity 200 litres) installed in pits at lower side of each plot. For soil loss, a well-mixed sample of suspended sediment was filtered, dried and weighed.

Results

Soybean yields improved gradually during three years, with significant effects of nutrient source in the first year, and of biofertilizers during all the years (Table 1). During first year, 100% inorganic and 100%vermicompost with biofertilizers treatments had the highest soybean yields, while during subsequent years, significantly higher yields were obtained under 100% organic and integrated treatments in combination with biofertilizers (Table 1). The soil organic carbon percentage as seen after three cropping years, was maximum and significantly higher in 100% vermicompost treatment (0.55%), as compared to integrated vermicompost treatment (0.46%), 100% compost (0.42%) and control (0.26%). Frequent rains during soybean crop resulted in high soil profile moisture in all the treatments, while the moisture levels declined due to receding monsoons at harvest stage. A significantly higher soil moisture was observed in deeper soil profile (60-90cm) in 100% vermicompost treatments at harvest stage, indicating better soil infiltration and moisture conservation on vermicompost application.

Table 1: Effect of various treatments on soybean grain yields during 2007-09.

| Nutrient (N) | Soybean grain yields (Mg.ha ⁻¹) | | | | | | | | |
|------------------|---|------|------|---------|------|------|---------|------|------|
| | Inoculation with biofertilizer (BF) | | | | | | | | |
| | 2007 | | | 2008 | | | 2009 | | |
| | No BF | + BF | Mean | No BF | + BF | Mean | No BF | + BF | Mean |
| Control | 0.43 | 0.47 | 0.45 | 1.15 | 1.34 | 1.25 | 1.51 | 1.68 | 1.60 |
| 100% IF | 0.75 | 0.66 | 0.71 | 1.18 | 1.26 | 1.22 | 1.42 | 1.48 | 1.45 |
| 100% C | 0.35 | 0.47 | 0.41 | 1.35 | 1.61 | 1.48 | 1.85 | 1.91 | 1.88 |
| 100%VC | 0.37 | 0.74 | 0.56 | 1.28 | 1.39 | 1.34 | 1.64 | 1.73 | 1.69 |
| C +IF | 0.63 | 0.56 | 0.60 | 1.23 | 1.48 | 1.36 | 1.76 | 2.02 | 1.89 |
| VC +IF | 0.53 | 0.59 | 0.56 | 1.43 | 1.48 | 1.46 | 1.47 | 1.71 | 1.59 |
| Mean | 0.51 | 0.58 | | 1.27 | 1.43 | | 1.61 | 1.76 | |
| LSD(0.05) | N = 0.10 N XBF = 0.14 | | | BF=0.15 | | | BF=0.11 | | |

Run-off % and soil loss was invariably minimum during the middle stage of the soybean, due to active growth, water uptake and higher evapotranspiration. An annual decline in average run-off % and soil loss (average of all the storms during the soybean crop) was observed in all the treatments (Figure 1). Among different treatments, 100% vermicompost had minimum average run off and soil loss, possibly due to better soil texture, root growth and faster infiltration of collected rain water. The succeeding wheat yields and the annual net returns, as determined with equal value given to both organic and chemical farming products, were highest under integrated treatments of vermicompost or compost, inorganic fertilizers and biofertilizers, followed by inorganic fertilizers.

Discussion and conclusion:

The results show that the application of organic nutrient sources in conjunction with biofertilizers can result in improved crop yields and soil health under soybean-wheat rotation. Lesser run off and better moisture storage in deeper soil profiles on vermicompost application are very useful for the succeeding wheat crop taken under moisture stress conditions of dry winter. Kannan *et al.*, 2005 have also reported a maximum decline in soil bulk density, and increase in soil organic carbon and water holding capacity on vermicomposts application as compared to different organic and

inorganic nutrient sources. Appropriate organic farming systems using vermicompost, biofertilizers and suitable crop rotations can provide eco-friendly solutions to reduce soil erosion, improve soil and water conservation, thereby sustaining soil productivity under moisture stress conditions of rain-fed agriculture lands in India.

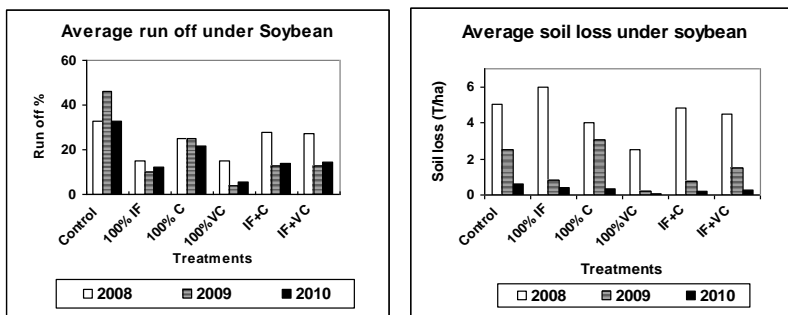


Figure 1: Average run off and soil loss (Years 2008-10) under different treatments in soybean.

Acknowledgements: We are grateful to Dr.V.N.Sharda, Director, Central Soil and Water Conservation Research & Training Institute, Dehradun for providing encouragement and support for carrying out these studies. The technical assistance provided by Mr.Harish Sharma is gratefully acknowledged.

References:

- Kannan, P., Saravanan, A., Krishna Kumar, S. and Natarajan, S.K. (2005) Biological properties of soil as Influenced by different organic manures. *Research Journal of Agriculture and Biological Sciences* 1(2): 181-183, 2005.
- Pimentel, D., Hepperly, P., Hansen, J., Douds, D., and RITA Seidel, R. (2005) Environmental, Energetic, and Economic Comparisons of organic and conventional farming Systems. *Bio Science* 55, 573-582.
- Ramesh, P., Singh,M. and Subbarao, A. (2005) Organic Farming: its relevance to Indian context. *Current Science* 88: 561-568.
- Reganold,, J.P., Elliott, L.F. and Unger,Y.L. (1987). Long-term effects of organic and conventional farming on soil erosion. *Nature* 410:926-930.
- Sharma, P. (2010) Organic Farming: Status and Potentials for resource conservation in Northern India. In: Yadav,R.P., Tiwari, A.K., Sharma, P., Singh,P., Arya,S.L., Bhatt, V.K.,, Prasad,R. and Sharda,V.N, (eds.) *Emerging Trends in watershed management*, Satish serial Publishing House, Delhi, India. Chapter 24, pp 305-324.
- Walkley, A. and Black. I. A (1934). An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Sci.*, 37:29-37.

Impact of organic cultivation and agro ecosystem diversity on natural populations of amphibians and fungi in Sri Lankan agricultural landscapes

Palihawadana, A.¹

Key words: indicators, biodiversity, monitoring, amphibians, fungi, organic

Abstract

*Observation of selected amphibian and fungi was carried out in Hiniduma area in the wet zone of Sri Lanka over a one-year period. Plots in four different ecosystems were considered for the study: conventional tea plots, organic tea plots, organic home garden plots, and secondary forest. Eight species of amphibians including one tree frog (*Polypedates cruciger*), one toad species (*Bufo melanosictust*) and six species of *Phyllautus* were observed through the study. Eight species of fungi were observed in this study. None of the fungi species were observed in the conventional tea land. The variation in the number of amphibian species and fungi species observed in the different plots can be used as an indicator of cultivation practices and diversity in agro ecosystems.*

Introduction

In conventional agriculture, biodiversity is usually neglected and not regarded as a factor of production. In contrast, organic agriculture encourages the incorporation of biodiversity for pest control and soil fertility improvement. Comparative studies of natural species in conventional agriculture land plots and organic agriculture land plots have shown interesting results and led to the development of indicator species to monitor organic conversion and agro biodiversity.

Indicator species are plants and animals that by their presence, abundance, lack of abundance, or chemical composition, demonstrate some distinctive aspect of the character or quality of an environment. In Sri Lanka 52 species of *Phyllautus* (Manamendra-Arachchi and Pethiyagoda 2005) and 335 fungi (*Agaricus*) species (Pegler 1986) are reported and most of them are present in the wet zone. According to reports from Sri Lankan and Indian researchers (Bhatti, S.K and U.S Bhatti. 1989) and farmers, synthetic agrochemicals have a particularly strong effect on natural populations of amphibians and beneficial fungi species. Studies have revealed, farmers report seeing dead amphibians with severe skin lesions within hours of spraying fields with agrochemicals (De Silva and Dawundasekera 2010).

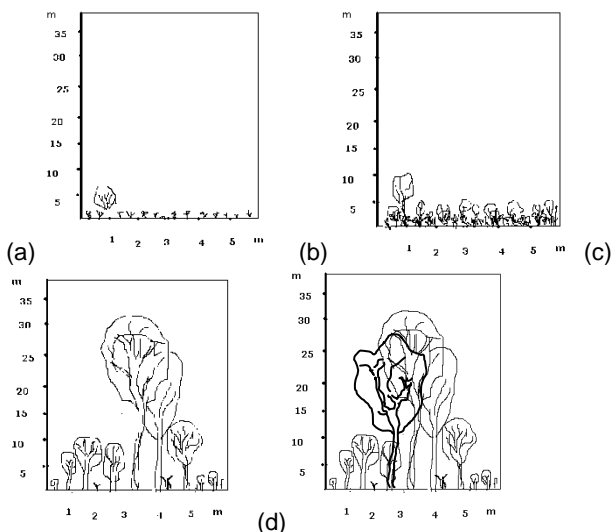
With the rapid development and expansion of organic agriculture in tropical countries it is important to develop easy and low-cost methodologies to monitor agro ecosystems without depending on high-tech laboratory testing. This study seeks to develop systems based on the documentation of indicator species observations to monitor and evaluate agro ecosystems in tropical organic agriculture.

¹ Palihawadana Ajantha, Operation Manager, SriCert, 546/3, Wata Mawatha, Gangodawila, Nugegoda, Sri Lanka, Email: sricert@slt.net.lk

Materials and methods

Identification of selected amphibian and fungi species was carried out from 2007 June to 2008 June in Hiniduma estate in the wet zone of Sri Lanka. Fungi were identified using the morphology of the fruiting bodies (Pegler, D.N. 1986) and amphibian were identified by their call and adult individual morphology (R. Senanayake, Ajantha Paliawadana, et al 2009). Four plots of five meters by five meters were demarcated in each of four ecosystems: conventional tea, organic tea, organic home garden, and secondary forest. The 16 plots were categorized and selected based on cultivation practices and vegetation types. Vegetation was documented using the physiognomic classification and cross sections were drawn. The conventional tea plots were cultivated as monocultures and were treated regularly with agrochemicals including synthetic fertilizers and herbicides. Copper sulphate was applied for blight control seven times during the assessment period. The plots in the other three ecosystems had not been treated with synthetic external inputs for more than five years. In each plot one meter by one meter temporary ponds were constructed using polypropylene to attract breeding adults. The ponds were naturally filled with rainwater.

Figure 1: Representative cross sections of (a) conventional tea plots, (b) organic tea plots, (c) organic home garden plots, and (d) secondary forest plots



Sampling was carried out three to four days per week in the day time between 9 am and 11 am and in the night between 7 pm and 9 pm. Visual and audio counts were recorded for amphibians and visual counts of fruiting bodies were recorded for fungi for a period of one year.

Results

Eight species of amphibians including one tree frog (*Polypedates cruciger*), one toad species (*Bufo melanostictus*) and six species of *Phyllautus* were observed through the study. The only species observed in the conventional tea land was *Phyllautus popularis*. The tree frog species, *Polypedates cruciger*, and the toad species, *Bufo melanostictus* were observed in all plots except for the conventional tea plots. Three species were recorded in the vegetation of organic tea plots. In both the organic home garden plots and the secondary forest plots, seven species of amphibians were observed. It was also observed that the *Phyllautus* species recorded in the secondary vegetation plots and in the organic home garden plots prefers more shade and moisture.

Table 1: Cumulative number of 8 amphibian species observed in plot vegetation

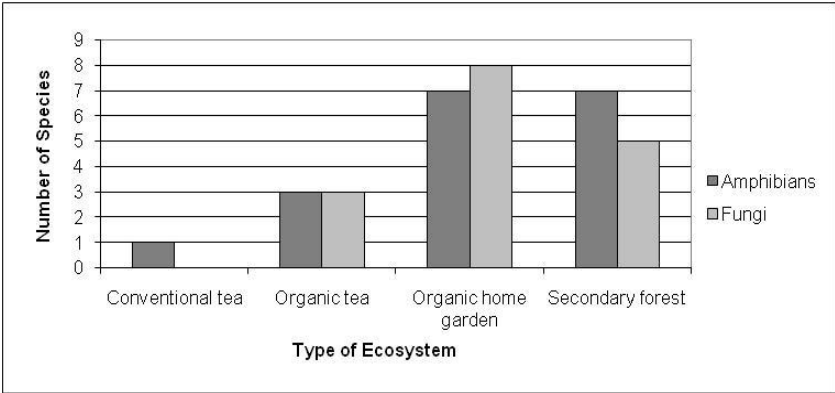
| Name of the species | Number of visual observations /yr | | | |
|-------------------------------|-----------------------------------|-------------|---------------------|------------------|
| | Conventional tea | Organic tea | Organic home garden | Secondary forest |
| <i>Phyllautus popularis</i> | 156 | 0 | 0 | 0 |
| <i>Phyllautus hoipolloi</i> | 0 | 0 | 80 | 92 |
| <i>Phyllautus stictomerus</i> | 0 | 0 | 130 | 85 |
| <i>Phyllautus reticulatus</i> | 0 | 0 | 90 | 82 |
| <i>Phyllautus folicola</i> | 0 | 0 | 65 | 67 |
| <i>Phyllautus a</i> | 0 | 53 | 4 | 3 |
| <i>Polypedates cruciger</i> | 0 | 4 | 91 | 86 |
| <i>Bufo melanostictus</i> | 0 | 6 | 9 | 10 |

Eight species of fungi (*Agaricus*) were observed in this study. No fungi species were observed in the conventional tea plots during this one-year study period. Three species were observed in the organic tea plot. Five species were observed in secondary vegetation. Eight species of fungi were observed in the organic home garden.

Table 2: Cumulative number of fruiting bodies of 8 fungi species observed in plots

| Name of the species | Number of visual observations /yr | | | |
|--------------------------|-----------------------------------|-------------|---------------------|------------------|
| | Conventional tea | Organic tea | Organic home garden | Secondary forest |
| Lentinus stigosus | 0 | 44 | 76 | 61 |
| Lentinus similis, | 0 | 31 | 46 | 42 |
| Achizophyllum commune | 0 | 53 | 60 | 44 |
| Lentinus squarrosulus | 0 | 0 | 76 | 70 |
| Piuteus brunneopictus | 0 | 0 | 17 | 15 |
| Lentinus conatus | 0 | 0 | 51 | 0 |
| Marasmiellus samonicolor | 0 | 0 | 58 | 0 |
| Coprinus fibrillosus | 0 | 0 | 89 | 0 |

Figure 2: Number of amphibian and fungi species observed in plot vegetation



Amphibian species were not attracted to the temporary ponds in the conventional tea plots. No amphibians were observed in these ponds during this one-year study period. In the organic tea plots temporary ponds attracted four amphibian species, ponds in the secondary vegetation plots attracted five amphibian species, and ponds in the home garden plots attracted six species of amphibian. Average pH values of the temporary ponds ranged from 6.2 to 6.7 with no correlation between pH and plot type.

Discussion

More species of amphibians and fungi were observed in the organic tea plots than in the conventional tea plots, which suggest that conversion to organic agricultural systems can increase natural biodiversity. This is consistent with earlier work on the correlation between organic practices and biodiversity (Hole et al. 2005). The absence

of fungi species in the conventional tea plots suggests that the ecosystem functions provided by beneficial fungi are not being provided. Amphibians require water to breed, but no amphibian species were observed in the temporary ponds in the conventional tea plots. Some studies suggest that amphibians can sense harmful chemicals and avoid breeding in contaminated waters (De Silva 2009). Treating large areas with agrochemicals could have a significant long term impact on amphibian populations.

The study also shows that diversified agro ecosystems, like the organic home garden plots, have the potential to support more natural biodiversity than simpler systems, like the organic tea plots. More mature, diversified systems tend to offer more microhabitats that support natural species diversity.

Conclusions

Conversion to diversified organic production systems could help restore natural biodiversity and provide important ecosystem functions in agricultural landscapes. Amphibian species and fungi species can be used as an indicator of cultivation practices and diversity in Sri Lankan agro ecosystems. The documentation of selected species could serve as a low-cost method of monitoring and evaluating cultivation practices and agro biodiversity in tropical organic agriculture. Further studies are needed to assess the relationship between cultivation practices, agro ecosystem diversity and natural biodiversity and the potential of indicator species for monitoring tropical organic systems.

Acknowledgments

Mr. Thilak Kariyawasam of LOAM, Mr. Lorenzo Peris of ICEI, Dr. Amanda Kiessel of Sewalanka, Padmi Karandana of SLNG and Hasanika Piyasena of SriCert for the support given to me to conduct this study.

References

- Bhatti, S.K and U.S Bhatti. (1989). Entry of Toxic Environmental Elements in Frogs. Proceedings of the First World Congress of Herpetology.
- De Silva, A. (2009). Amphibians of Sri Lanka: A Photographic Guide. Publish by thein Kndy
- De Silva, A. and D.M.N.P.K. Dawundasekera. (2010). "Cases of Possible Direct Effects of Pesticides on Amphibians and Reptiles in Plantation Agriculture" The Biological Diversity of Mihintale: With Special Reference to its Herpetofauna. *Lyriocephalus*. 7(1-2):181
- Hole, D. G., Perkins, A. J., Wilson, J. D., Alexander, I. H., Grice, P. V. & Evans, A.D. (2005). Does Organic Farming Benefit Biodiversity? *Biol. Conserv.* 122:113–130.
- Manamendra-Arachchi, K. and R. Pethiyagoda. (2005). "Sri Lankan Shrub Frogs of the Genus *Philautus*." *The Raffles Bulletin of Zoology*. Supplement No. 12: 163-303
- Pegler, D.N. (1986). Reference for Agaric Flora of Sri Lanka Royal Botanic Gardens KEW.
- R.Senanayake, Ajantha Palihawadana et al (2009) A Field key for the Identification of Amphibians at Hiniduma ,Rainforest Rescue International

A meta-analysis comparing environmental impacts of organic and conventional farming in Europe

Tuomisto, H. L.¹, Hodge I. D.², Riordan, P.¹ & Macdonald, D. W.¹

Key words: life cycle assessment, nitrogen, phosphorus, energy use, greenhouse gas emissions

Abstract

Organic farming has been promoted as, inter alia, reducing the environmental impacts of agriculture. This study used meta-analysis of 51 studies to compare the environmental impacts of organic and conventional farming in Europe. The results show that organic farming practices generally have positive environmental impacts when measured per unit of area, but not necessarily per product unit. The variation of the results between different studies is wide. Conventional systems that use specific practices for improving environmental quality tend to have higher environmental benefits also when expressed as per unit of area. Environmental performance of organic farming could be improved by developing yields without causing harm on the environment.

Introduction

Organic farming aims at improving human and animal health, providing environmental benefits and producing high quality food by relying on local resources, recycling, re-use and efficient management of materials and energy, instead of using synthetic fertilisers, pesticides and genetically modified crops. Many individual studies have compared the environmental impacts of organic and conventional farming, but the overall impacts across different studies have not been systematically tested. This study uses meta-analysis to provide comprehensive information about the environmental benefits of organic farming. The results of systematically selected peer-reviewed studies comparing environmental impacts of organic and conventional farming in Europe are evaluated.

Materials and methods

The ISI Web of Knowledge (www.isiwebofknowledge.com) database was used for literature search. The search was performed on 26th September 2009 with no restriction on publication year. The following search term combinations were used: (organic AND conventional AND farming) OR (organic AND conventional AND agriculture). The papers included in this study were selected based on the following criteria: i) the study was related to European farming systems, ii) the study compared organic and conventional farming and provided quantitative results on at least one of the following aspects: soil organic carbon, land use, energy use, GHG emissions, eutrophication potential, acidification potential, nitrogen leaching, phosphorus losses or ammonia emissions, iii) the paper was published in a scientific peer-reviewed

¹ Wildlife Conservation Research Unit, Department of Zoology, University of Oxford, The Recanati-Kaplan Centre, Tubney House, Abingdon Road, Tubney, Oxon OX13 5QL, UK, Contact email: htuomist@gmail.com

² Department of Land Economy, University of Cambridge, Cambridge CB3 9EP, UK

journal in English, and iv) the authors had access to the paper. This filtering resulted in 51 papers that were used in the meta-analysis (Benayas *et al.* 2009). Response ratios for each indicator were calculated using the following formula: [Response ratio = impact of organic farming / impact of conventional farming – 1]. The normality of the data was tested by using the Kolmogorov-Smirnov test. Not all impact ratios were normally distributed, therefore, a Wilcoxon Signed Rank test was used to determine whether the median response ratios were significantly different from zero. Since biodiversity impacts have been systematically reviewed before (Hole *et al.* 2005, Bengtsson *et al.* 2005), biodiversity impacts were not included in the meta-analysis, but the studies published after 2005 were reviewed and compared to the findings of Hole *et al.* (2005).

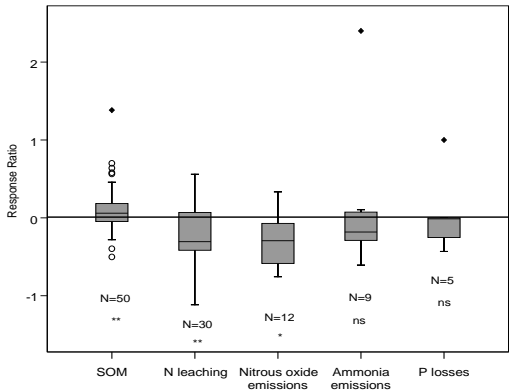
Results

Median values of response ratios showed that, generally, organic farming is associated with environmental benefits when compared to conventional farming when measured per unit of field area, but due to lower yields, not necessarily per unit of product (Figure 1). Organic systems had generally higher soil organic matter (SOM) content and lower nitrogen leaching, nitrous oxide emissions, ammonia emissions and phosphorus losses per unit of field area. Nitrous oxide emissions and ammonia emissions were 14 % (Wilcoxon Signed Rank Test: $N = 5$, $Z = -1.214$, $P > 0.05$) and 21 % (Wilcoxon Signed Rank Test: $N = 5$, $Z = -0.944$, $P > 0.05$) higher, respectively, from organic farming when measured per unit of product. LCA studies showed that organic livestock production requires 80 % more land than conventional production (e.g. Basset-Mens *et al.* 2007). Energy use was 22 % lower in organic farming compared to conventional farming per unit of product. The median response ratios showed 2 % higher greenhouse gas (GHG) emissions, 4 % higher eutrophication potential and 16 % higher acidification potential from organic farming per product unit. However, the variations of the response ratios between different studies were wide (Figure 1). The major explanations for the variation of the results between different studies were: i) a wide range of different type of farming practices used, especially, in conventional farming systems, ii) the research method used (e.g. modelling study or experimental field investigation), and iii) differences between products.

The main explanation for SOM contents in organic systems was that organic systems had higher organic matter inputs. Some cases reported higher SOM content in organic systems even though the organic matter inputs were similar in the systems compared. In some cases, SOM contents in conventional systems were higher. This is explained by higher yields, and therefore, higher crop residue leftovers, which can compensate the lower external organic matter inputs. Lower nitrogen and phosphorus losses from organic farming per unit of area were mainly due to the lower levels of nutrient inputs applied and lower stocking levels in organic farming. Higher nitrogen leaching levels from organic systems in some cases were explained by poor synchrony between the nutrient availability and crops' nutrient intake. A further analysis of the meta-analysis data showed that modelling studies tend to find lower relative nitrogen leaching from organic farms compared to field investigation studies.

The higher land use in organic systems was due to lower livestock and animal yields per unit of area and land area requirements for fertility building crops. Higher energy inputs in conventional farming were mainly due to the high energy need for production and transport of non-organic fertilisers, especially synthetic nitrogen fertilisers.

A Non-LCA impacts



B LCA impacts

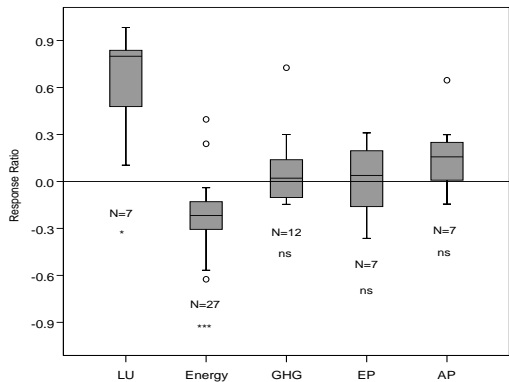


Figure 1: Response ratios for A) non-LCA (Life Cycle Assessment) impacts: soil organic matter (SOM), phosphorus (P) losses, nitrogen (N) leaching, nitrous oxide emissions per unit of area and ammonia emissions per unit of area, and B) LCA impacts: energy use, greenhouse gas emissions (GHG), acidification potential (AP), eutrophication potential (EP) and land use (LU). (Line through the box: median; upper and lower sides of the boxes: upper and lower quartiles; tiles: extreme values, O, ♦: outliers 1.5-3 and over 3 box lengths from the upper or lower edge of the box, respectively; positive values: impacts from organic farming are higher, negative values: impacts from organic farming are lower, N=number of cases in the sample, ns=not significantly different from zero (Wilcoxon Signed Rank test $P>0.05$); * $P<0.001$; ** $P<0.01$; * $P<0.05$; Z-values: SOM = -2.457, N leaching = -2.643, Nitrous Oxide emissions = -2.045, Ammonia emissions = -1.125, P losses = -0.674, LU = -2.521, Energy = -3.652, GHG = -0.880, EP = 0.000 and AP = -1.690)**

There were clear differences in the median response ratios of GHG emissions between different product groups. Organic olive and beef had lower GHG emissions whereas organic milk, cereals and pork had higher GHG emissions compared to conventional products. In most cases organic milk production had higher GHG emissions compared with conventional systems, because of higher methane emissions. Eutrophication potential per unit area was generally lower in organic systems due to their lower nutrient inputs, but higher per product unit due to lower animal and crop yields as compared to conventional systems. Acidification potential from organic farming per product unit was generally higher due to lower crop and animal yields, but in some cases it was lower due to lower protein content in livestock feed or lower animal density in buildings, use of catch crops in winter and use of solid manure. However, conventional systems using targeted practices for reducing ammonia emissions were found to have lower acidification potential than organic systems. Biodiversity review showed that organic farms generally have higher biodiversity than conventional farms, but the benefits are not always guaranteed.

Discussion

As organic farming in Europe requires more land and has often higher environmental impacts per unit of product compared to conventional farming, large scale conversion to organic farming could provide environmental benefits only at the expense of reducing food production. It is also important to recognise the opportunity costs of land use (Berlin & Uhlin 2004). In order to assess the consequential environmental impacts of different systems, the opportunity costs of the extra land requirements should be taken into account. If less land was used for agriculture, more land could be used for other purposes such as wildlife conservation, biofuel production or forestry. Therefore, reference units product output or surface area may lead to misinterpretations if used alone. Both land area and product output have to be considered when systems are compared. The results also showed a wide variation between the impacts from different conventional farming systems. Conventional systems that used best practices for reducing environmental impacts, while producing high yields, tend to lead to the lowest environmental impacts often even on the area basis (e.g. Torstensson *et al.* 2006). In order to improve the environmental performance of organic farming, the main challenge of organic farming research is to improve yields without causing harm on the environment.

Acknowledgments

We thank Holly Hill Charitable Trust for funding the project.

References

- Benayas, J.M.R., Newton, A.C., Diaz, A., Bullock, J.M. (2009): Enhancement of Biodiversity and Ecosystem Services by Ecological Restoration: A Meta-Analysis. *Science* 325:1121-1124
- Bengtsson J., Ahnstrom J., Weibull A. C. (2005): The effects of organic agriculture on biodiversity and abundance: a meta-analysis. *Journal of Applied Ecology*, 42:261-269
- Berlin D., Uhlin H-E. (2004): Opportunity cost principles for life cycle assessment: toward strategic decision making in agriculture. *Progress in Industrial Ecology* 1:187-202
- Hole D.G., Perkins A.J., Wilson J.D., Alexander I.H., Grice F., Evans A.D. (2005): Does organic farming benefit biodiversity? *Biological Conservation* 122:113-130.
- Torstensson G., Aronsson H., Bergstrom L. (2006): Nutrient Use Efficiencies and Leaching of Organic and Conventional Cropping Systems in Sweden. *Agron J.* 98:603-615.
- Basset-Mens C.H.M.G. & van der Werf (2007). "Methods and data for the environmental inventory of contrasting pig production systems." *Journal of Cleaner Production* 15(15): 1395-1405.

Life cycle assessment of organic and conventional soybean production in Northeast and Northwest China

Qiao Y.¹, Luo Y. , Zeng G. Wu W. & Halberg N.²

Key words: Life Cycle Assessment, Organic/Conventional Soy, Environmental Impact, China

Abstract

The main organic products in China –soybean was studied with life cycle assessment method, DNDC model, on site survey(northeast and northwest region) etc to quantify impact of resource depletion and environmental pollutions, to identify the environment hotspot in the life cycle. The result showed that in the two case study areas, in both cases soil N balance is negative in conventional production system and it is good for organic soybean production system. In terms of environmental performance, LOS is most environment-friendly option followed by LCS and EOS whose environmental aggregate environmental impact index are 0.072 and 0.071 in Jilin case Northeast China, transportation is the Hotspot during the soybean production life cycle. Due to diesel consumption in soybean production in Xinjiang Case, LCS has the most significant environment impact (0.117) and organic production is also as high as or even higher than that of LCS, EOS in Jilin case. Resource depletion, acidification and global warming potential contributed about 30% each to the aggregate index of total environment impact.

Introduction

Researches on the environment of organic agriculture have been conducted and indicated that organic farming can maintain soil fertility, improve bio-diversity and reduce the negative impact of eutrophication of water bodies etc. (Stolze M. 2000, Birgitte H. 2001), but most of them only considered one or two environment factors and only farming production instead of integrated environment impact assessment and whole products chain. Life Cycle Assessment(LCA)as a new tool was introduced from industry area to agriculture recently which could comprehensively and quantitatively assess the environment load and resource depletion for the whole life cycle.(Yang, 2002). LCA case studies focus on the identification of hotspot of different agricultural production system mainly in European countries (Christel C. 2000, Brentrup F. 2004). In China, Wang M. (2006) used LCA method to assess the environment impact of wheat production in China North plain, no one conducted the research to compare the organic and conventional production style with LCA in China.

Materials and methods

DunHua County of JiLin province (traditional soybean production area in Northeast China) and Xinyuan County of Xinjiang Autonomous Region (new major area for

¹ College of Resources and Environmental Sciences China Agricultural University , No. 2 Yuanmingyuan Xilu Haidian District, Beijing, China, E-Mail qiaoyh@cau.edu.cn

² International Centre for Research in Organic Food Systems (ICROFS) P.O. box 50, Blichers Allé 20, DK-8830 Tjele, Denmark, , E-Mail Niels.Halberg@agrsci.dk

soybean production in Northwest China) was selected for the study. Farmland started organic operation from the year of 2000 in Jilin Province and 2007 in Xinjiang Autonomous Region. LCS(Locally-Consumed Conventional Soybean), LOS (Locally-Consumed Organic Soybean) and EOS (Exported Organic Soybean to Europe only for Jilin case which operated for years). Life cycle assessment method was used to quantify impact of resource depletion and environmental pollutions, to identify the environment hotspot in the life cycle. Case study was conducted based on investigation, model and sample analysis.

Data of agricultural inputs in Jilin Province were obtained directly from farmers who filled in questionnaires for the season 2006-2007, including 29 organic growers and 14 conventional growers. Transportation data and fertilizer information were got from consulting with Trade Company and retailer. Data of agricultural inputs in Xinjiang case were obtained directly from the experiments carried out in 2008-2009. Many database and references data have been used for transportation system and agriculture inputs production system. This study only took consideration of global warming, resource depletion, eutrophication, acidification and ecological toxicity as impact categories for LCA. Normalization references is special for Chinese situation (Yang 2002), due to lack of emission data for resource depletion and ecological toxicity, this two categories normalization referred to world environmental impact per capita(Huijbregts M.,2003).

Results

DNDC(De Nitrification &De Composition) model is a process-orientated simulation tool of soil carbon and nitrogen based on biogeochemical cycles which can calculate N and C emission through inputting related parameters. The DNDC model has been used since 1989, and has been validated throughout China by using experimental data(Qiu J., 2005).

Tab. 1: N-balance of soy from DNDC Model

| Area | style | N input(kg/ha) | | | | N output(kg/ha) | | | | | Balance N(kg/ha) |
|----------|-------|-----------------|----------|----------|-------|------------------|-------------------|------------------|----------------|------------------|---------------------|
| | | fertilizer | fixation | deposits | seeds | uptake | NO ₃ - | N ₂ O | N ₂ | N ₂ O | |
| Jilin | LOS | 100.2 | 139.4 | 11.4 | 3.6 | 223.4 | 1 | 5.4 | 14.1 | 0.4 | +10.3 |
| | LCS | 46.1 | 138.3 | 11.4 | 3.7 | 248.8 | 0.8 | 4.3 | 11.2 | 0.3 | -65.9 |
| Xinjiang | LOS | 120 | 138.5 | 4.2 | 11.0 | 251.1 | 2.0 | 0.2 | 0 | 0.8 | +19.6 |
| | LCS | 107.1 | 131.9 | 4.2 | 11.0 | 264.3 | 6.6 | 0.3 | 0.2 | 0.9 | -18.1 |

The simulation result indicated that soil N balance is negative in conventional production system with 65.9kg/ha.a deficiently in Jilin case and 18.1 kg/ha.a deficiently for Xinjiang case, this is because of its lower input of N (only chemical fertilizer applied) but higher output from yield. For the organic soybean production system, N supply is from compost, more N will stay in the soil with positive balance of 10.3 kg/ha.a in Jilin case and 19.6 kg/ha.a for Xinjiang case (Tab. 1).

Tab. 2 shows us Life cycle aggregate environmental impact index of soybean. For Xinjiang case in Northeast China LCS has the most significant environmental impact followed by LOS, because the farmers in Xinjiang case use a lot of machine with diesel for soybean production which deplete more energy resource. For Jilin case in Northeast China, EOS and LCS has similar environment impact and LOS can reduce negative environmental impact by 33.36% and 30.94% comparing with EOS and LCS. It is noticeable that ecological toxicity potential accounts for 8.26% of environmental impact. The result indicates that transportation of products abroad imposed a lot negative environment impact. Resource depletion, acidification and global warming potential contributed about 30% respectively to the aggregate index.

Tab. 2 Life cycle aggregate environmental impact index of soybean

| Case study area | Jilin in Northeast China | | | Xinjiang in Northwest China | |
|---------------------|--------------------------|-------|-------|-----------------------------|-------|
| Impact Category | EOS | LOS | LCS | LOS | LCS |
| Resource Depletion | 0.023 | 0.016 | 0.019 | 0.021 | 0.029 |
| Global Warming | 0.023 | 0.016 | 0.018 | 0.020 | 0.025 |
| Eutrophication | 0.005 | 0.004 | 0.006 | 0.007 | 0.020 |
| Acidification | 0.022 | 0.019 | 0.022 | 0.025 | 0.037 |
| Ecological toxicity | 0.000 | 0.000 | 0.006 | 0.000 | 0.006 |
| Aggregate Index | 0.072 | 0.054 | 0.071 | 0.074 | 0.117 |

Discussion

The purpose of organic agriculture is to increase or at least maintain soil fertility which is related to land use in agriculture produce. According to soil samples from 11 fields, it was found that comparing with 18.6 g/kg Soil Organic Carbon in the conventional field, organic field is as high as 21.3g/kg. and the model simulation also indicate a positive balance of N in organic field while a negative balance in conventional field. It is clear that soil quality is protected by organic production. Mila L. (2006) suggested that land use related impact assessment development is necessary when comparing different types of agricultural technologies (eg. conventional, organic.). He has tried to integrate life support function of land into LCA and defined Soil Organic Matter as indicator for assessment, but these indicators still did not apply yet.

The significance of transportation in life cycle of soybeans can be determined by comparing LOS and EOS. Based on the analysis, substituting organic soybeans consumed locally in China can reduce CO₂ emission and energy consumption by 46.9% and 33.1% respectively. This conversion can also decrease acidification and eutrophication risk by 19.3% and 46.3%. LOS would therefore not only decrease resource depletion, but also meet the pollute reduction requirements. Several studies have conducted the same conclusion. Comparison of transport-related energy consumption of imported and British apples were conducted and indicated that the energy consumption is 6.5-27.2 times greater than that of Britain produce (Sarah S. et al. 2007).

Conclusions

LCA method combining with DNDC and investigation were employed to assess the environmental impact of soybeans of different life cycle (EOS, LOS and LCS) in China

northeast and northwest region based on the inventory of production, transport and agriculture input production. The results revealed that in both cases soil N balance is negative in conventional production system and it is good for organic soybean production system. In terms of environmental performance, LOS is most environment-friendly option followed by LCS and EOS whose environmental aggregate environmental impact index are 0.072 and 0.071 in Jilin case Northeast China, transportation is the Hotspot during the soybean production life cycle. Due to diesel consumption in soybean production in Xinjiang Case, LCS has the most significant environment impact (0.117) and organic production is also as high as or even higher than that of LCS, EOS in Jilin case. Resource depletion, acidification and global warming potential contributed about 30% each to the aggregate index of total environment impact.

Acknowledgments

This work was supported financially by ICROFS through the GlobalOrg project, the National Key Technology R&D Program in the 11th Five-Year Plan of China (2007BAC15B05), and the Key Beijing Discipline of Ecology (XK10019440).

References

- Birgitte H, Hugo F A, Erik Steen Kristense. (2001) Approaches to assess the environmental impact of organic farming with particular regard to Denmark, Agriculture Ecosystems and Environment. 83: 11–26
- Brentrup F, Kuster J, Lammel J, et al. (2004b) Environmental impact assessment of agricultural production systems using the life cycle assessment (LCA) methodology the application to N fertilizer use in winter wheat production system. *Europ. Agronomy*. 20: 265–279
- Christel Cederberg, Berit Mattsson. (2000) Life cycle assessment of milk production — a comparison of conventional and organic farming *Journal of Cleaner Production*. 8: 49–60
- Huijbregts M A J., Breedveld L, Huppes G, et al. (2003) Normalization figures for environmental life-cycle assessment The Netherlands (1997/1998), Western Europe (1995) and the world (1990 and 1995), *Journal of Cleaner Production*. 11: 737–748
- Mila L. Canals a, G.M. Burnip, S.J. Cowell. (2006) Evaluation of the environmental impacts of apple production using Life Cycle Assessment (LCA): Case study in New Zealand *Agriculture, Ecosystems and Environment*. 114: 226–238.
- Qiu J., Wang L., Tang H., et al. (2005) Studies on the Situation of Soil Organic Carbon Storage in Croplands in Northeast of China, *Agricultural Sciences in China*. 4(1): 101–105
- Sarah S, Mike B, Roland C, et al. (2007) The Relative Importance of Transport in Determining an Appropriate Sustainability Strategy for Food Sourcing A Case Study of Fresh Produce Supply Chains, *Int J LCA*. 12 (6): 422–431
- Stolze M, Piorr A., Häring A. et al. (2000) The environmental impact of organic farming in Europe: Economics and Policy, University of Hohenheim, Germany.
- Wang M., Bao Y., Wu W., Liu W. (2006) Use LCA method to assess the environment impact of wheat production in China North plain. *Journal of Agriculture Environment Science (in Chinese)*. 25(5):1127–1132.
- Yang Jianxin, Per H Nielsen. (2002) Chinese life cycle assessment factors, *Journal of Environmental Sciences (in Chinese)* 13(2): 205–209

Analysis on Heavy Metal Concentrations in Organic Production Base of Ili District, Xinjiang Province

Li, H.¹, Yang, J., Qiao, Y., Meng, F., Guo, Y. & Wu, W.

Key words: heavy metals, agricultural soil, Ili district, China organic standard

Abstract

According to the national organic standard of China (GB/T 19630.1-2005), soil environment quality of the organic production base shall meet the Grade II standard of environmental quality standard for soils (GB 15618-1995). Therefore the evaluation of soil quality is very important in the establishment of organic production base. 574 soil samples were collected from plough layer (0-20 cm) of arable fields in eight counties of Ili district, Xinjiang province. Cr, Pb, As, Hg and Cd concentrations in the agricultural soils were analyzed. The results showed that the average concentrations of the Cr, Pb, As, Hg and Cd were 45.76, 30.28, 8.02, 0.021 and 0.36 mg kg⁻¹ respectively, they were lower than the Grade II standard of GB 15618-1995, except Cd. While in some sampling sites, the Cd concentration was higher than the threshold value established in the environmental quality standard for soils. Generally the concentrations of heavy metals in the agricultural soils of Ili district, Xinjiang province meet the requirements of organic production base for soil environmental quality. But the Cd concentration should be paid more attention in some specific sites.

Introduction

Ili Kazakh autonomous prefecture is a rare green region in Xinjiang province and even in the whole western regions of China, therefore, the establishment of ecological base in Ili district can optimize the advantage of its agricultural resources. Nowadays, the issue of food safety has attracted more and more attention because of the severe environmental contamination and the enhancement of people's health consciousness. Some chemical pollutants especially heavy metals in soil may contaminate crop during production processes (Wong et al., 2002). Through food ingestion, heavy metals also have the risk to exposure to human (McLaughlin et al., 1999). As for Cr, Pb, As, Hg and Cd, these elements have no function in the body and have harmful effects when ingested above recommended intake levels (Fang et al., 2010). Furthermore, environmental quality standard for soils has been established in China to protect the soil environment (State Environmental Protection Administration of the People's Republic of China, 1995, GB 15618-1995). Ili valley as the most important grain production base in the northwest China, the soil environmental quality was worth to be evaluated. In this study, soil samples were taken to analyze the levels of Cr, Pb, As, Hg and Cd and evaluate the environmental quality of the agricultural soils from Ili district, Xinjiang province.

¹College of Resources and Environmental Sciences, China Agricultural University, Beijing 100193, China, E-mail lihuafen@cau.edu.cn

Materials and methods

Ili valley is located at north Xinjiang province (latitude N 42°14'16"~44°50'30", longitude E 80°09'42"~84°56'50"), where is favorable for agricultural crop production. In this study more than 574 soil samples were collected from plough layer (0-20 cm) of arable field in eight counties of Ili district. The collected soils were air-dried, sieved to <2 mm, and homogenized. The subsamples of the homogenized soils were further ground and passed through a 0.149-mm sieve.

Ground soil samples were digested with 8 mL of high-purity HNO₃/HCl (1:3 v/v) in a microwave oven for the analysis of Cd, Pb and Cr (Mars 5, CEM Corporation, USA). The concentrations of Pb and Cr in the digestion solution were determined by flame atomic absorption spectrophotometer (TAS-990), while Cd by graphite furnace atomic absorption spectrophotometer (GF-990). For the As and Hg, the ground soil samples were digested with 5 mL of high-purity HNO₃/HCl (1:3 v/v) and 5 mL of deionized water in a 100 °C water bath (General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China and Standardization Administration of the People's Republic of China, 2008). The concentrations of As and Hg in the digestion solution were determined by atomic fluorescence spectrophotometer (AFS-920, Beijing Titan Instruments Co., Ltd).

A certified reference material (soil ESS-1, GSBZ50011-88) and blank were included for quality assurance. The recovery of Cr, Pb, As, Hg, Cd were 87~95%, 89~115%, 95~105%, 90~109%, 85~105% respectively throughout the analysis procedure.

China established national standard for organic production (General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China and Standardization Administration of the People's Republic of China, 2005, GB/T 19630-2005), according to the organic standard, the soil environment quality of the organic production base shall meet the Grade II standard of environmental quality standard for soils (Table 1, Grade II standard of GB 15618-1995). pH values of the soil in Ili district ranged from 7.3 to 8.4, therefore the strict threshold values regulated for the soils of pH 6.5-7.5 were referred for evaluation in this study.

Table 1 Soil environmental standards for organic production base (mg kg⁻¹)

| Elements | Cr | Pb | As | Hg | Cd |
|------------|-----|-----|----|-----|-----|
| pH 6.5-7.5 | 200 | 300 | 30 | 0.5 | 0.3 |
| pH >7.5 | 250 | 350 | 25 | 1.0 | 0.6 |

Results and Discussion

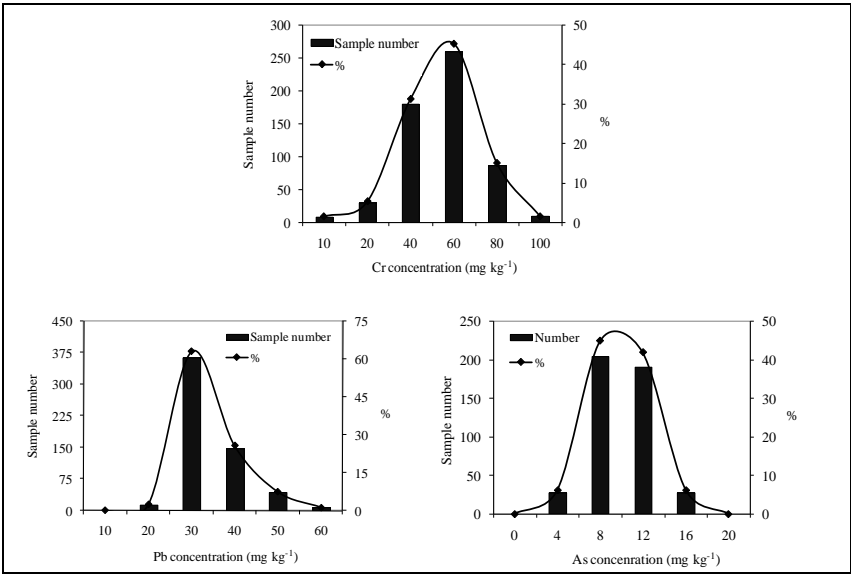
Statistics describing the concentrations of Cr, Pb, As, Hg and Cd is presented in table 1. The concentrations of Cr Pb As Hg and Cd in the soils ranged from 3.89 to 95.30, 14.96 to 53.80, 2.08 to 14.86, 0.004 to 0.104 and 0.012 to 1.299 mg kg⁻¹ respectively. The average concentrations of Cr, Pb, As, Hg in the agricultural soils were all below the threshold values that were established in Grade II standard of GB 15618-1995, whereas Cd was above the threshold value (Table 2). The average concentrations of Pb, Hg and Cd were 56.1%, 23.5% and 200%, respectively, higher than the background values (China National Environmental Monitoring Centre, 1990), suggesting a net cumulative trend in the agricultural soils, especially Cd.

Table 2 Statistics of element concentrations in the agricultural soils of Ili district and the background values of Xinjiang province (mg kg⁻¹)

| Element (No.) | Min | Max | Mean | 50% value | CV (%) |
|---------------|-------|--------|-------|-----------|--------|
| Cr (574) | 3.89 | 95.30 | 45.76 | 45.67 | 35.82 |
| Cr* | 18.40 | 119.10 | 49.30 | 47.60 | - |
| Pb (574) | 14.96 | 53.80 | 30.28 | 29.93 | 20.51 |
| Pb* | 4.20 | 50.40 | 19.40 | 19.00 | - |
| As (455) | 2.08 | 14.86 | 8.02 | 7.95 | 31.02 |
| As* | 1.40 | 39.50 | 11.20 | 10.10 | - |
| Hg (360) | 0.004 | 0.104 | 0.021 | 0.016 | 66.34 |
| Hg* | 0.001 | 0.235 | 0.017 | 0.014 | - |
| Cd (370) | 0.012 | 1.299 | 0.36 | 0.331 | 62.55 |
| Cd* | 0.016 | 1.634 | 0.12 | 0.101 | - |

*the background value of Xinjiang province (China National Environmental Monitoring Centre, 1990).

The 90% confidence interval of Cr was 20-80 mg·kg⁻¹; the 85% confidence interval was 20-40 mg kg⁻¹ for Pb; 80% As in 4-12 mg kg⁻¹; 85% Hg in 0.01-0.04 mg kg⁻¹ and 60% Cd in 0.00-0.40 mg kg⁻¹ (Figure 1).



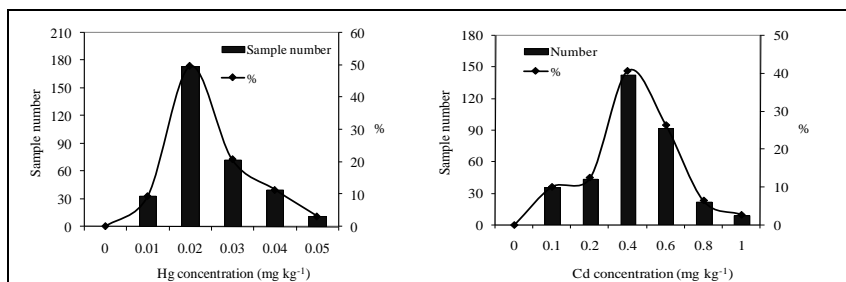


Figure 1: Statistics of heavy metal concentrations in the agricultural soils of Ili district

Conclusions

The concentrations of Cr, Pb, As and Hg in soils comply with the environmental requirements for organic production base regulated by the national standard of organic products, whereas the Cd concentration in some area should be paid more attention during the selection of organic production base.

Acknowledgments

We thank the National Science & Technology Pillar Program of China (2007BAC15B05) for financial support.

References

- China National Environmental Monitoring Centre (1990): The background concentrations of soil elements in China. China Environmental Science Press, Beijing.
- Fang Y. L., Zhang A., Wang H., Li H., Zhang Z. W., Chen S. X., Luan L.Y. (2010): Health risk assessment of trace elements in Chinese raisins produced in Xinjiang province. Food Control 21: 732-739.
- General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China and Standardization Administration of the People's Republic of China (2005): GB/T 19630-2005 China organic products standard. Standards Press of China, Beijing.
- General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China and Standardization Administration of the People's Republic of China (2008): GB/T 22105-2008 Soil quality - Analysis of total mercury, arsenic and lead concentrations – Atomic fluorescence spectrometry. Standards Press of China, Beijing.
- McLaughlin M. J., Parker D. R., Clarke J. M. (1999): Metals and micronutrients - food safety issues. Field Crop Res. 60: 143-163.
- State Environmental Protection Administration of the People's Republic of China (1995). GB 15618-1995 Environmental quality standard for soils. Standards Press of China, Beijing.
- Wong S. C., Li X. D., Zhang G., Qi S. H., Min Y.S. (2002). Heavy metals in agricultural soils of the Pearl River Delta, South China. Environ. Pollut. 119: 33-44.

Conversion to agroecological practices: the case of family farmers of Ubatuba, Sao Paulo, Brazil

Souza, M.C.M.1, Otani, M.N.2, Oliveira, M.D.M. 3, Moreira, S.R.4, Castro, C.E.5,
Turco, P.H.N.6 & Marchiori, A.7

Key words: family farmers, agroecological practices, conversion, Ubatuba

Abstract

The purpose of this article is to identify the main motives for family farmers' conversion to agroecology in Ubatuba, a tourist resort town located on the Northern coast of the state of Sao Paulo, Brazil. To that end, it portrays socio-cultural aspects of this population, caught between conflicts related to land use and recent environment preservation laws. Their adoption of agroecological horticultural systems has been fostered by local agencies in recent years in order to promote sustainable development. The unique dynamics of diverse legal constraints and cultural and agroecological environments calls for different technical and market strategies, which can be built and transferred by means of networks between growers and researchers.

Introduction

Cradled between mountains and beaches, Ubatuba is a tourist resort town of approximately 80,000 inhabitants in the Northern coast of Sao Paulo State. It is 250 Km away from Sao Paulo, the state capital, and 320 Km far from Rio de Janeiro. Around 83% of its 712 Km² territory is part of the Sea Mountain Range State Park, the largest continuum of protected Atlantic Forest in Brazil. This paper aims to provide a bird's eye view of the agricultural scenario in Ubatuba by focusing on a socio-cultural setting of family farmers in agroecological transition, in order to identify their main motives for conversion.

Traditional agriculture had been carried out for centuries by local communities, composed by former fishermen and growers, before some migration waves arrived in Ubatuba since the 1960s, which gradually occupied arable land with conventional agriculture. This process became particularly pronounced in the 1970s, when the Rio-Santos Highway was built, bringing new migrants, who learnt conventional farming techniques from those of the first waves. Since the 1980s, the enforcement of legal and environmental standards has set tight restrictions to the use of agricultural land in the Sea Mountain Range State Park area. Various institutional conflicts have been observed between growers – under the umbrella of agricultural agencies – and environment authorities. More recent than agricultural occupation, environmental

¹ IEA – Instituto de Economia Agricola, Av Miguel Stefano 3.900, Sao Paulo – SP, Brazil 04301-903, E-mail mcmsouza@iea.sp.gov.br , www.iea.sp.gov.br

² As above.

³ As above.

⁴ DDD – Departamento de Descentralização do Desenvolvimento, Av. Barão de Itapura, 1481, Campinas, Sao Paulo, Brazil 13012-970, E-mail silviamoreira@apta.sp.gov.br

⁵ As above.

⁶ As above.

⁷ CATI / Casa de Agricultura de Ubatuba, Praça Prof. Teodorico de Oliveira 38, Ubatuba, Centro, São Paulo, Brazil 11680-000, E-mail antonio_marchiori@terra.com.br

regulation collides with ancient land use. Legal issues surrounding agriculture and environment are polemic, particularly in view of proposed changes set forth in Brazil's new Forest Code currently under review.

Besides its traditional fishing, Ubatuba was one of the major horticultural suppliers in Sao Paulo State from the late 1960s to the late 1970s. Among important crops, such as cassava and banana, ginger played an important role, mainly in exports. The decline of the Green Revolution model has become evident since the early 1980s. After a number of problems generated by conventional agriculture, local demand for the adoption of agroecological practices in horticulture – including green manure to improve the soil and pesticide-free cultivation – has recently begun to be fostered and monitored by local public agencies and NGOs in order to promote sustainable development.

Materials and methods

The study collected primary data using in-depth interviews and semi-structured questionnaires with an intentional sample of 22 family farmers of Ubatuba in agroecological transition. The sample represents nearly 14% of the total number of farmers (Torres *et al.* 2009). Sample members were chosen according to parameters such as social and cultural diversity and conformity to agroecological practices, as proposed by local public agents based on Brazilian organic rules. Sample growers are spread throughout Ubatuba's territory, as follows: 27% in the North (traditional communities), 18% in the Center (outsiders) and 55% in the South (traditional communities and outsiders). The purpose of the interviews was to identify different social and cultural groups, according to their life stories, values and interests. Those differences are important to identify not only the growers' reasons to shift to agroecology, but also their specific needs for research and outreach as well as support of public policies, under the roof of the Economic Sociology approach (Fligstein 2002). For further details see Otani *et al.* (2011).

Results and Discussion

When adopting new agricultural practices, growers evaluate natural and social constraints in order to adapt growth strategies to their reality. The family farmers aimed at introducing or preserving alternative agriculture take several rational dimensions into consideration, their relations with nature being one of them (Brandenburg 1999).

Ubatuba's natural areas break into distinct regions, giving rise to diverse cultural and agricultural practices. The amount of land occupied by agriculture gradually increases from North to South. Environmental restrictions prevail in the North, where most traditional growers and legally protected areas, such as the Sea Mountain Range Park, are located.

The central part of Ubatuba presents a flatter terrain when compared to the mountainous north, most of which is not under environmental protection: farms are larger and agriculture more diversified. Besides banana and cassava, which are predominant in the Northern small plots, crops such as beans, lettuces, carrots, beets, cabbages, eggplants, okras, yams, gingers, basil, parsleys, peppers along with native fruits are also found in their farming systems. Both urban and agricultural areas are more frequent in Central and Southern Ubatuba, where a stronger pressure from tourism and real estate competition can be observed.

Southern Ubatuba is also more diversified than its Northern part: besides the vegetable crops, there is a large production of shellfish and flowers, such as anthuriums and other ornamentals in small farms, allowing the region to supply landscaping plants to local homes and markets in São Paulo. Handcrafted arts and crafts are also sold.

At least two different broad cultural groups were identified as adopters of agroecological practices, according to the different regions, cultures and motives. The first one comprises *traditional* growers (45%), considered as organic by default, since their agricultural farming and fishing practices were developed by their ancestors. Local communities, known as *caicaras* and *quilombolas*, are a mix of cultures descending from local Indians, African slaves as well as Europeans. Concentrated both in the North (27%) and South (18%), their current predominant technology reproduces ancient knowledge. Most of their production is locally consumed, but their small production scales are not large enough to supply their families' needs. They are all inclined to adopt agroecological practices, an example illustrative of which is their abandonment of burn-and-slash techniques. Enlarging their cropping areas is a difficult step for them due to strict environmental legal constraints. Besides, the shortage of labour is becoming increasingly critical, as new generations want to change their life style and move to urban areas.

The second broad cultural group is represented by the *outsiders* (55%), subdivided into *three* different categories, according to migration flows and motives to shift to agroecology. The first migrants were Brazilian of Japanese descent (14%), who has occupied arable lands since the early 1960s. Located in Southern Ubatuba, although they had started farming their crops conventionally, some decades later they became eager to convert to agroecology due to accidents in the family, poisoning by pesticides to name one.

With the new highway of the 1970s, the second type of migrants (27%) came and also cropped their land under a conventional agriculture basis. Concentrated around urban areas in Central (9%) and Southern (18%) Ubatuba, they have learned their chemically intensive cropping systems from the Nippon-Brazilian migrants who had preceded them.

Two reasons fostered the interest of these groups of the 60s and 70s in agroecology. First, increasing local demand for direct sales of pesticide-free vegetables from tourists, restaurants, markets, supermarkets and lodgings, such as hotels and bed & breakfasts, gave them the strongest motivation for agroecological conversion (100%). The second reason is that their chemically intensive farming had led to health hazards, such as pesticide poisoning and the death of close relatives. Incidentally, buyers of their produce do not ask for any organic certification in reason of the trust built by means of direct sales: consumers and growers know each other.

The third wave of migrants (14%) went to Ubatuba in the 1980s. Most (9%) are in the Central region while 5% are in the South. More educated, stressed with the life style of urban cities, their motivation is the search for an alternative, 'greener' way of life. They are strongly committed to agroecological practices. Unlike the typical local farmers, even those who are not land owners cultivate areas where biodiversity is not only a philosophy, but also as a source of personal satisfaction. They may be classified as ideologists, as defined by Goodman & Goodman (2001).

Agroecological practices such as the use of lime and compost are being stimulated by projects of both local and state bodies of agriculture along with various NGOs that

provide training and capacity building in agroecology in the Northern coast of Sao Paulo, where they are located. However, there is a need to promote more integrated actions.

Conclusions

The diversity of growers' cultures, legal constraints and agroecological environments shows a particular dynamics and calls for different technical and market strategies, which can be built and transferred by means of networks of growers and researchers. The process of agroecology knowledge construction is being developed together by growers, who, linked to their land, are more responsible for the preservation of traditional culture, as well as of nature. It mainly depends on technical solutions which are locally developed by farmers, NGOs and local agents to be successfully adopted.

The case of Ubatuba shows the influence of the cultural origin on current farming systems and on the motives behind the agroecology paradigm shift. Results show that the original population of *caicaras* and *quilombolas* tend to reproduce long-standing traditions, but add innovations to lessen environmental impact. The first and the intermediate migrant waves are increasingly more concerned with agroecology motivated by health concerns and new market demands. The last migrant group is more ideological and already converted to agroecological practices.

Third party certification is not required since 90% of growers sell locally. Consumers are aware that growers are converting their crops to agroecology. Motivations such as problems with pesticide poisoning, the emergence of new markets and other reasons, such as ideology, concur to strengthen not only the demand for agroecology, but also to a relation of trust among them.

Nevertheless, there are still bottlenecks, the root of which relates to the lack of leaders with the necessary social skills to solve the local conflicts and develop sustainable farming systems, thereby impairing the implementation of consistent public policies in the long run. Furthermore, there is still a lack of local public policies integrating agricultural and environmental issues to reduce social problems.

Acknowledgments

Authors thank to CNPq - Research and Development National Council for financing, family farmers and Jose Carlos Santos from Casa de Agricultura for local support.

References

- Brandenburg A. (1999): Agricultura Familiar, ONGs e Desenvolvimento Sustentável. Curitiba, Editora da UFPR, 325 p.
- Fligstein N. (2002): The Architecture of Markets: an Economic Sociology of Twenty-First-Century Capitalist Societies. Princeton, Princeton University Press, second printing, 274 p.
- Goodman D., Goodman M. (2001): Sustaining Foods: organic consumption and the socio-ecological imaginary. Elsevier Science, Social Sciences. 1:97-119.
- Otani M. N. *et al.* (2011): Caracterizacao Sociocultural dos Agricultores Familiares de Ubatuba, Estado de Sao Paulo. Sao Paulo, Informaçoes Econômicas. 27(2):17-28.
- Torres A J *et al.* (2009): Projeto LUPA 2007/08: censo agropecuário do Estado de São Paulo. São Paulo, IEA/CATI/SAA, 381 p.

Feeding the world with a climate friendly agriculture: the story so far

Wright, J.¹

Key words: Climate change, agroecological, global production

Abstract

In recent years, financial millions have been spent on studying the impacts of climate change on global food production, and even more on forecasts of whether the world can feed itself in 2050. However, none of this work has actually looked at whether a form of agriculture that is 'climate friendly', that is, that has low GHG emissions and that may even sequester carbon, is able to produce sufficient food to feed the growing population. Based on the available literature, the only way to address this issue is by drawing on the handful of attempts that assess whether sustainable agricultural systems can feed the world. This paper assesses what we know so far, and makes suggestions as to why more work on this issue has not been done, and whether we are actually asking the wrong question anyway.

Introduction

At the Meeting of Experts in Rome, June 2009, there was a general consensus that, in order to feed nine billion by 2050, food and feed production would need to rise by 70%. Within this, cereals would need to rise by 33% to 3 billion tonnes and meat production by 43% to 470 million tonnes. These projections were based not only on population growth; the aim was also to raise average food consumption to 3130 kcal per person per day in order to eliminate hunger (Bruinsma 2009). Globally, 90% of the growth in crop production will need to come from intensification of existing cultivated land, and this is now seen as being feasible as long as land use practices become more sustainable (Bennett & Carpenter 2005). Although climate change is predicted to have an overall negative impact on agriculture, this will be tempered by the increases in yields in carbon-rich environments, and the IPCC concludes that the world can feed itself for the rest of the century, mainly through higher production in industrialised countries compensating for losses in less industrialised countries (Parry *et al.* 2004). Concurrent with these predictions, a growing body of knowledge exists on agricultural emissions, much of which is produced by, or based on the work of, the IPCC. The main types of agricultural green house gas (GHG) emission are carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Agriculture currently contributes between 10-14% of global anthropogenic GHG emissions, although this figure rises to 30%+ if land clearance for agriculture is included. Predictions on future emissions are based on current trends of agricultural intensification and dietary changes. However, the latest IPCC report (Smith *et al.* 2007) provides figures for the mitigation potential in each climatic region, and suggests that there is the global technical potential to offset all current agricultural emissions. The main agricultural management approaches that can be manipulated for mitigation purposes are: cropland management, grazing land

¹ Centre for Agroecology and Sustainable Food Systems, Coventry University, Priory Street, Coventry, CV1 5FB, UK, E-Mail j.wright@coventry.ac.uk

management, restoration of cultivated organic soils, and restoration of degraded lands.

Materials and methods

The review upon which this paper is based covered peer-reviewed journals and publications, and grey literature including government documents, conference papers and NGO publications. A snowballing approach was used to identify obvious key sources, and then to follow up on leads, citations and recommendations through internet and academic resources as well as direct communication with key individuals. The thematic sectors reviewed were agriculture and agri-economics, land use, climate change and food security. The vast majority of data sources in terms of quantity, relevance and accessibility of documents came from English-speaking and industrialised regions.

Results

Overall, no studies were found that address the core issue of feeding nine billion through a low-emissions production approach. A bulk of research evidence and documentation exists on feeding the projected population, including under the impacts of climate change, and another bulk on current and future GHG emissions and approaches for their mitigation. The reasons why these two issues have not yet been fully considered together is suggested as being fourfold: 1) The sectoral and disciplinary nature of development: net emissions reduction in agriculture requires a specialist knowledge of agronomic and ecological processes that is not particularly prevalent amongst those working on food security and climate change; 2) The drivers of research on emissions reduction are largely economic and technology focussed, resulting in relatively more studies on, for example, the potential for and impact of biofuels than the potential for encouraging soil processes that lock up carbon; 3) Compared to other industries, the agricultural sector is not seen as a major emitter of GHGs and therefore of lesser importance when investing in emissions reductions; and 4) Agricultural mitigation approaches are perceived as being highly complex and locally specific, which makes them difficult to extrapolate to larger scales of working.

Based on the available literature, the currently most feasible to assess whether a low-emissions agriculture can feed nine billion is by drawing on the handful of attempts that assess whether sustainable agricultural systems can feed the world. The best internationally defined bodies of sustainable, whole farm systems are the certified and non-certified organic, agroecological and biodynamic farming movements. Yet especially for industrialised regions, organic farming has only recently woken up to the issue of energy challenges for the future, and therefore organic farms do not necessarily employ sustainable energy management systems. Organic farms have also been criticised as playing into the industrial, high-fossil energy dependent food system, and organic commodities may be similarly associated with a high overall GHG footprint. Nevertheless, the majority of mitigation activities proposed by the IPCC and other authors are the cornerstones of organic agricultural practice, and therefore these productions systems arguably serve as the best widespread examples we have of low emissions agriculture to date. A scoping study by Erb *et al.* (2009) concluded that feeding the world in 2050 with organic crops and livestock was probably feasible, although this would require a high growth in cropland area, of 20% (the same percentage as with an industrialised farming system). Another study, by Fairlie (2007) concluded that both vegan organic and permaculture systems could feed a nation (in

this case the UK). The most widely accepted study is that of Badgley *et al.* (2007), that found that organic methods could produce sufficient food on a per capita basis to sustain the current population and larger. This paper however did not project to 2050, and it has received criticism from proponents of industrial agriculture (e.g. Avery, 2007). Other studies have focused on yield comparisons, and indicate that organic or ecological agriculture can achieve significant yield gains over both traditional and industrialised agriculture and especially in resource-poor regions of the world. These all indicate that an organic style of agriculture, as a proxy low emissions agriculture, can feed the world if a change in diets and land use is accepted.

Two major studies have attempted to address the issue of organic farming and climate change. The first, from the FAO, calculates that the minimum scenario for a conversion to organic farming would mitigate 40% of global agricultural GHG emissions, and that another 20% of emissions would be reduced by abandoning synthetic fertilisers. The second, commissioned by the Soil Association, concludes that the global adoption of organic farming would offset 11% of all GHG emissions.

Discussion and conclusions

The assumptions underlying this whole issue are that climate change is upon us and the global population will increase by about 30% by 2050. Even if both these are true, other key factors are not givens and these place the enquiry into question. The first factor concerns the way the discourse is couched, with debate attempting to 'solve the problem' of how to feed nine billion. This rather top-down and paternalistic perspective could instead be turned on its head by electing a more empowering enquiry into how communities, cities and whole countries and regions can be enabled to feed themselves? Such an enquiry would imply consideration of the food sovereignty approach, that is, the right of peoples to define their own food, agriculture, livestock and fisheries systems, and this would have implications for developing the methodology, means and decision-making structures over how to reduce emissions and at what scales.

The second factor concerns the productivist approach to food security. Feeding nine billion is not simply a question of increasing food availability from current levels in proportion with population growth. Food security is equally concerned with, and dependent on, accessibility and adequacy, and global food predictions are de facto inadequate to ensure food security at the level of the human being. We know that there is already a global food surplus yet over 1 billion goes hungry, and that over 2.7 million deaths annually are attributable to low fruit and vegetable intake (WHO 2003). Therefore the composition (quality) of available food is just as important as the quantity, and this needs to be factored into forecasts.

Yet global projections and models focus on two food components: cereals and livestock, and the food system currently depends on 12 animal species to provide 90% of animal protein consumed globally, and 4 crop species to provide 50% of the plant-based calories (Bennett & Carpenter 2005). Compare this with standard dietary recommendations that promote an intake of at least 33% of fruit and vegetables, and another 33% coming from carbohydrates (cereals but also roots and tubers), and the remaining 33% comprising limited amounts of protein, dairy, fats and sugars. The cause of this omission in projections is partly because fruit and vegetables are not treated as commodity crops and therefore do not feature significantly in the FAOstats and other databases.

Distribution and equity impacts are also important; over-consumption of, for example, an unlimited amount of livestock products should not necessarily be a development goal or one that is factored into food forecasting. Further, evidence shows that taking a singular focus on maximising yields and volumes at the expense of other agro-ecological or socio-economic factors tends to put land, agrobiodiversity and smallholders out of production over the long term, in this sense negating any short term yield gains. Finally, we know that the food system is leaky: between 30-40% of food is wasted prior to consumption, from post-harvest to post-retail. More cost-effective over the long term would be to prioritise reducing these inefficiencies, net losses and wastage, and to factor these efforts into food forecasting, rather than continue deleterious attempts to force productivity at the expense of the bigger picture.

The third key contextual factor concerns scale and the current global focus on reducing emissions. In agriculture, this focus is only one side of the coin, albeit the more popular one as it opens the way for the development of more technologies. The other less heralded but equally important side is carbon sequestration and carbon capture, the technology for which has existed for millennia, in nature. Because of the complex interactions between agricultural practices and effects, as well as the lack of statistics on land use intensity and the fact that intensive and extensive subsystems are often practiced on the same farm, measuring both emissions and capture is a challenge on any scale above local (Bellarby *et al.* 2009) as is extrapolation of results into global food prediction models.

Yet the most exciting and potentially problem-solving evidence is coming from anecdotal and grey literature, from small scale examples of how farming systems can be turned around to be high-sequestering and high-yielding through agro-ecological innovations, such as the holistic grazing management systems of southern Africa and Australia, and the reclamation of desert lands in Jordan (Harvey 2008, ProAct Network 2008). In this sense, the overarching question could perhaps be better focused away from “how can we feed the world?” to “how can we feed the soil?”

Acknowledgments

This paper is drawn from Wright J. (2010) Feeding Nine Billion in a Low Emissions Economy, Simple Though not Easy. A Review of the Literature for the Overseas Development Institute. ODI, London. While the views represent the author's own, the work would not have been possible without the foresight of Dr Steve Wiggins at ODI and Sam Bickersteth at Oxfam.

References

- Avery A. (2007) "Organic abundance" report: fatally flawed. *Renewable Agriculture and Food Systems* 22: 321-323
- Badgley C., Mohntader J., Quintero E., Zakem E., Chappell M.J., Aviles-Vazquez K., Samulon A., Perfecto I. (2007): Organic agriculture and the global food supply. *Renewable Agriculture and Food Systems* 22, 2:86-108
- Bellarby J., Foereid B., Hastings A., Smith P., (2008): Cool Farming: climate impacts of farming and mitigation potential. Greenpeace International, Amsterdam.
- Bennett E., Carpenter S. (2005): Scenarios for Ecosystems Services, Rationale and Overview. Chapter 5. Scenarios Assessment of the Full Report. Millennium Ecosystem Assessment. Island Press, Washington DC. <http://www.millenniumassessment.org/en/Scenarios.aspx>
- Bruinsma J. (2009): The Resource Outlook to 2050, How Much Do Land, Water and Crop Yields Need to Increase by 2050? Paper presented at the FAO Expert Meeting, 24-26 June 2009, Rome on How to Feed the World in 2050. FAO, Rome
- Erb K-H., Haberl H. Krausmann F., Lauk C., Plutzar C., Steinberger J.K., Müller C., Bondeau A., Waha K., Pollack G. (2009): Eating the Planet: Feeding and Fuelling the World Sustainably, Fairly and Humanely – a Scoping Study. Social Ecology Working Paper 116. Institute of Social Ecology, Vienna.
- Fairlie S. (2007): 'Can Britain Feed Itself?' The Land, Issue 4, Winter 2007/08. Chapter 7, Somerset.
- Harvey G. (2008): The Carbon Fields: how our countryside can save Britain. GrassRoots, Somerset.
- Parry M.L., Rosenzweig C., Iglesias A., Livermore M., Fischer G. (2004): Effects of climate change on global food production under SRES emissions and socio-economic scenarios. *Global Environmental Change*, 14: 53-67.
- ProAct Network (2008): The Role of Environmental Management and Eco-Engineering in Disaster Risk Reduction and Climate Change Adaptation. Case Study: Jordan Valley Permaculture Project. www.proactnetwork.org
- Smith P., Martino D., Cai Z., Gwary D., Janzen H., Kumar P., McCarl B., Ogle S., O'Mara F., Rice C., Scholes B., Sirotenko O. (2007): Agriculture. In Metz B., Davidson O.R., Bosch P.R., Dave R., Meyer L.A. (eds.): *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- WHO (2003): Diet, Nutrition and the Prevention of Chronic Disease. Report of the joint WHO/FAO expert consultation. WHO Technical Report Series, No. 916.

Resilience to a changing climate: carbon stocks in two organic farming systems in Africa

Koopmans¹, C.J., Bos¹, M. M. & Luske¹, B.

Key words: Climate change mitigation, adaptation, biodiversity, ecosystem services

Abstract

Our changing climate poses challenges to sustainable agriculture. Here we present two case studies on climate change mitigation of agricultural systems. In Egypt, desert soils were reclaimed for arable land through a combined approach of irrigation and compost application. The use of organic fertilizers is inherent to organic agriculture and builds upon soil quality with high water-holding capacity. In Congo, cocoa farmers adopted agro forestry practices promoted by organic premiums, which included shade management. Shade management is a tool for biodiversity conservation and contributes to higher resilience through less soil erosion and better soil fertility. In Egypt, the use of compost lead to a total carbon sequestration of almost 30 t C/ha in the course of 30 years of land use. In Congo, shade management increased the amount of stored carbon from 17 t C/ha in poorly shaded plantations to over 60 t C/ha in more densely shaded plantations. These studies illustrate the multifunctionality of sustainable agricultural practices and underline the benefits of organic principles, in particular for regions that are vulnerable to the adverse effects of climate change.

Introduction

The changing climate leads to increased fluctuations in rainfall and drought, which poses a serious threat to the food security in vulnerable regions (Adger et al. 2003). Regions that are particularly vulnerable are those where adverse effects of climate change intensify environmental threats that result from existing socio-economic and environmental processes. Examples are arid and semi-arid regions where desertification as a result from land-use intensification accelerates through increased drought severeness (Lal 2004), and rainforests where the negative effects of deforestation and forest degradation are worsened by increased rainfall that results from climate change (Verchot et al. 2007). Adapting agricultural production systems to such changes is one of the major challenges of sustainable agriculture.

In arid and semi-arid regions, soil fertility is low and needs high investments that make soils suitable for agriculture. The application of compost is a means of soil improvement to enhance soil structure and soil organic matter. Thus, the production of compost is one of the agricultural methodologies approved by the UNFCCC for emission reduction projects as part of the Clean Development Mechanism.

The effects of climate change in the humid tropics are more extreme and less predictable fluctuations in drought and rainfall. In agro forestry systems, perennial tree

¹ Louis Bolk Institute, Department of Agriculture, Hoofdstraat 24, NL-3972 LA Driebergen, The Netherlands, c.koopmans@louisbolk.nl

crops are in varying degrees intercropped with shade trees, such as fruit and timber trees. Shade trees contribute to resilient production systems through the facilitation of more efficient nutrient cycling, natural pest control, and income diversification for smallholder farmers. In addition, such systems are an adaptation to climate changes in that soils are less vulnerable to erosion and desiccation.

In this paper we present the results from two studies on the role of resilient agriculture in climate change mitigation in two vulnerable regions of Africa. First, the effect of compost application on soil carbon sequestration is quantified for an arable production system on reclaimed desert soils in Egypt. Second, the effect of different types of shade management on carbon storage in organic cacao agro forestry systems is quantified in the Democratic Republic of Congo. Shade management is promoted by organic certification, but can vary strongly between certified cacao farms. The results are discussed in the context of multifunctional agricultural resilience in food-insecure regions.

Materials and methods

Climate change mitigation through compost production and application on desert soils

This part of the study took place at the Sekem farm in Egypt, which is the first certified organic farm in the Arabic region. Since the start in the 1970s, a combination of compost, green manures and irrigation is being used to turn desert soils into fertile agricultural soils. Over the years, the farm expanded in size and created a mosaic of arable fields with different ages. The annual average compost application rate amounts to 47 m³ per hectare. Sekem developed a large scale windrow composting site which turns organic waste fractions into compost. The organic waste consists of chicken and cow manure, rice straw and green waste from Sekem itself, nearby farms and irrigation canals.

To investigate the effect of organic farming on carbon sequestration in desert soils, soil properties of eight fields (3 desert sites and 5 arable fields) were analysed in 2009. The arable fields were similar in terms of crops and compost application, but differed in age (1, 4, 5 and 2 fields of 30 years old). The fields and desert locations were sampled in three line transects. Each transect consisted of five sample locations where samples were taken at three depths (0-10 cm, 10-30 cm and 30-50 cm) and analysed for chemical and soil physical characteristics.

Climate change mitigation in organic cacao agroforestry

In the province of North-Kivu, eastern Democratic Republic of Congo, the ESCO company assures that all farmers have access to training in cacao agroforestry and shade management. Shade tree and cacao seedlings are distributed as part of the programme. In 2010, over 100 randomly selected cacao farms were visited to estimate the carbon stored in these agroforestry systems. Based on field experiences by field officers, shade management was a priori categorized into 5 different levels of shade tree density (see table 2). In each cacao plantation, trees were counted and measured in marked quadrates. In a 10x10m quadrate, the circumference of all trees smaller than 100cm circumference at breast height (CBH) were measured. In a 25x25m quadrate the circumference of all trees larger than 100cm CBH were measured. From the CBH measurements, the Above Ground Biomass (AGB) was calculated using the allometric equation recommended by the UNFCCC for carbon stock estimations in broad-leaved humid tropical forests (UNFCCC, 2009). For carbon stock estimations, the UNFCCC recommends using a 0.3 root:shoot ratio for

estimating belowground biomass (BGB) and a 50% carbon content to calculate carbon stocks from AGB and BGB.

Results

The soil in the desert surrounding the Sekem farm contained 3,9 tons C/ha in the upper 50 cm. The carbon stocks in the arable fields of the Sekem farm were for all ages (1, 4, 5 and 30 years) significantly higher (table 1). The one year old agricultural soil contained 7,2 tons C/ha, the 4 and 5 year old fields 18,1 and 16,9 tons C/ha, and the 30 year old fields 28,3 tons C/ha. This increase in carbon stocks over time represents a carbon sequestration potential of 3,2 t/ha/year of CO₂ equivalents.

Table 1. Carbon stocks (tons C/ha) in a desert site and nearby organically managed arable fields of different ages in Egypt.

| Land use | Years in use | 0-10 | 10-30, | 30-50 | Total |
|--------------|--------------|------|--------|-------|-------|
| Desert | 0 | 1.0 | 1.7 | 1.2 | 3.9 |
| Arable field | 1 | 4.2 | 2.0 | 1.1 | 7.2 |
| | 4 | 7.4 | 8.1 | 2.6 | 18.1 |
| | 5 | 10.0 | 6.1 | 0.8 | 16.9 |
| | 30 | 17.5 | 9.3 | 1.5 | 28.3 |

The 100 agro forestry systems differed widely in the shade management category assigned by the field officers (table 2). As expected by the categorization, agro forestry systems of category V had highest density of adult shade trees, whereas category I had lowest density of adult shade trees. Cacao tree density was highest in category IV. The total carbon stocks were highest in the agro forestry systems of category V and lowest in agro forestry systems of category I.

Table 2. Carbon stocks (tons C/ha) in cacao agro forestry systems with different types of shade management in the eastern Democratic Republic of Congo.

| Shade management category* | Adult shade trees (n/ha) | Carbon stock in aboveground tree biomass (tons C/ha) |
|---|--------------------------|--|
| I. Scarce shade trees. | 16 | 17 |
| II. young, heavily pruned shade trees. | 25 | 22 |
| III. young pruned as well as in tact shade trees. | 26 | 34 |
| IV. large in tact shade trees that remain from previous rainforest cover. | 29 | 30 |
| V. large in tact shade trees that remain from previous rainforest cover and smaller, younger shade trees. | 49 | 60 |

*Shade management categories were *a priori* defined based on field experience of the field officers.

Discussion and conclusion

In the Egyptian desert, the organic farming practice of applying organic fertilizers lead to fertile arable soils, and additionally sequestered almost 30 tons of carbon per hectare over a 30 year time-span. At the moment mitigation and carbon credit generation due to soil carbon sequestration is discussed internationally, as the permanency of the sequestration is insecure. Also within the organic sector it is discussed, as it may only be effective on large scale farms, which may have the side effect that small scale farmers are excluded. However, raising carbon stocks in soils also have multiple benefits, such as resilience to droughts and heavy rains, soil biodiversity and in general, improved soil fertility. The composting site of the Sekem farm already generates carbon credits as windrow composting is an acknowledged method to reduce greenhouse gas emissions.

The eastern Democratic Republic of Congo is currently undergoing rapid deforestation and forest degradation, followed by agricultural expansion. Our study shows that shade management is a form of resilient agro forestry that can preserve carbon stocks that amount to a multitude of that in more intensive forms of land use, such as arable land. To date, there are no economic incentives available for farmers to preserve the valuable shade tree stands on their land. Although agro forestry and shade management are widely acknowledged practices that can be used as tools in biodiversity conservation, climate change mitigation and overall land use sustainability, the trees preserved in shade management are as yet underappreciated by carbon markets and international climate negotiations. Current shade management in the study area exceeds all shade requirements by certification schemes. Organic farming standards only recommends shade management, without concrete guidelines for tree density and management. Other payment mechanisms (e.g., Payments for Ecosystem Services, Voluntary Carbon Standards) should be considered to support cacao farmers in their shade management.

The two case studies illustrate the mitigation potential of two important means of resilient farming in two very different African regions. Linking climate change mitigation to agricultural resilience, including climate change adaptation, can be a valuable multifunctional approach for sustainable and organic agriculture, particularly in sensitive regions.

References

- Adger W.N., Huq S., Brown K., Hulme M. (2003): Adaptation to Climate Change in the Developing World. *Progress in Development Studies* 3: 179-195.
- Lal R. (2004): Soil Carbon Sequestration Impacts on Global Climate Change and Food Security. *Science* 304: 1623-1627.
- Luske B. & Kamp J. van der, (in press): Carbon sequestration potential of reclaimed desert soils in Egypt. *Louis Bolk Institute & Soil and More International*, The Netherlands.
- Luske B. (2010): Reduced GHG emissions due to compost production and compost use in Egypt; Comparing two scenarios. *Louis Bolk Institute*, The Netherlands.
- United Nations Framework Convention on Climate Change (UNFCCC), (2009): Simplified baseline and monitoring methodology for small-scale agroforestry – afforestation and reforestation project activities under the clean development mechanism. UNFCCC, AR-AMS0004 / Version 02. Sectoral Scope: 14, EB 47.
- Verchot L.V., Noordwijk M. van, Kandji S., Tomich T., Ong C., Albrecht A., Mackensen J., Bantilan C., nupama K.V. & Palm C. (2007): Climate change: linking adaptation and mitigation through agroforestry. *Mitigation and Adaptation Strategies for Global Change* 12: 901-918.

Nitrous oxide emission from livestock compost applied arable land

Seo, Y.^{1*}, Cho, B.¹, Kang, A.¹, Jeong, B.¹ & Jung, Y.²

Key words: Nitrous oxide, Greenhouse gas, Chinese cabbage, Livestock compost

Abstract

Agriculture activities account for 58% of total anthropogenic emissions of nitrous oxide (N₂O) with global warming potential of 298 times as compared to carbon dioxide (CO₂) on molecule to molecule basis. Quantifying N₂O from managed soil is essential to developing national inventories of greenhouse gas (GHG) emissions. Accumulated N₂O emission during cultivation of Chinese cabbage after applying livestock compost was greater than that for chemical fertilizer. Greater N₂O Emission factor for livestock compost was observed than that for chemical fertilizer possibly due to lump application of livestock compost before crop cultivation compared with split application of chemical fertilizers and enhanced denitrification activity through increased carbon availability by organic matter in livestock compost.

Introduction

Nitrous oxide (N₂O) is a potential greenhouse gas and a catalyst destructing ozone layer in the stratosphere that emitted from agricultural land after applying compost and/or chemical fertilizer through nitrification and denitrification (Singh & Tyagi 2009). The global warming potential of N₂O is 298 times greater than CO₂ based on a 100 yr time horizon (IPCC 2007). Agricultural activities are the biggest anthropogenic source of N₂O, 2.8 Tg N yr⁻¹ out of total 6.7 Tg N yr⁻¹ (Singh & Tyagi 2009). The default value for N₂O emission factor has been changed from 0.0125 to 0.01 (IPCC 2006) of N applied to agricultural fields.

Livestock compost has been used to supply nutrients to crops instead of chemical fertilizers in organic farming (Lee *et al.* 2006). Therefore, the objective of this study was to compare N₂O emission from livestock compost applied upland field with that for chemical fertilizer, urea by cultivating Chinese cabbage (*Brassica campestris* L.) in spring and autumn for two years.

Materials and methods

The study was conducted at the Gangwon Agricultural Research & Extension Services field in Chuncheon (N 37° 57' 15.9" E 127° 46' 26.6"), Korea from 2009 to 2010. The soil in the field is classified to Yonggye series (fine loamy, mixed, mesic Typic Dystrudepts) and the selected soil properties are shown in Table 1. Chinese cabbage was cultivated with application of livestock compost before transplanting. Chemical composition of the compost on wet weight basis is shown in Table 2.

¹ Gangwon Agricultural Research & Extension Services, Udu 402, Chuncheon, Korea, E-Mail seoysh@korea.kr, Internet www.ares.gangwon.kr

² Kangwon National University, Chuncheon, Korea, E-Mail soilskorea@hanmail.net, Internet www.kangwon.ac.kr

Table. 1: Soil chemical properties of the field used in the study

| pH | EC dS/ m | OM g/kg | P ₂ O ₅ mg/kg | Ca cmol ⁺ /kg | K | Mg | Sand % | Silt | Clay |
|-----|----------------|------------|--|-----------------------------|------|------|-----------|------|------|
| 5.9 | 0.47 | 21 | 584 | 3.5 | 0.63 | 0.87 | 54 | 18 | 28 |

Table. 2: Chemical composition (%) of the livestock compost used in the study

| Organic matter | T-N | P ₂ O ₅ | K ₂ O | CaO | MgO |
|----------------|-----|-------------------------------|------------------|-----|------|
| 27 | 1.5 | 1.6 | 0.27 | 2.3 | 0.51 |

The application rate of the livestock compost was determined by standard nitrogen fertilization rate for Chinese cabbage, 320 kg/ha and nitrogen content of the compost, 1.5%. To examine the effect of over-fertilization on N₂O emissions, twice amount of livestock compost or urea was also incorporated into the soil of the field. Lee *et al.* (2006) reported that some organic farmers applied greater amounts of livestock compost than recommended level. Nitrous oxide emissions from livestock compost were compared with those from conventional chemical fertilizer, urea.

Nitrous oxide was collected using static chambers, the most commonly used tools worldwide (Saggar *et al.* 2009), and determined by gas chromatograph (Varian GC 450). Gas samples were taken twice a week. Parkin (2008) reported that sampling at 1-4 d intervals resulted in cumulative N₂O emissions with a precision of $\pm 10\%$.

Results and Discussion

Emission flux of N₂O for livestock compost showed greater emission in the early growth stage of Chinese cabbage than in the later stage (Fig. 1). In the autumn when warmer and more humid than spring, N₂O emission showed sharp increase just after transplanting, thereafter dramatic decrease to almost zero in late autumn and winter. Greater N₂O emission was observed for livestock compost than chemical fertilizer at the early growth stage possibly due to application of total amount of compost once while split application of chemical fertilizer.

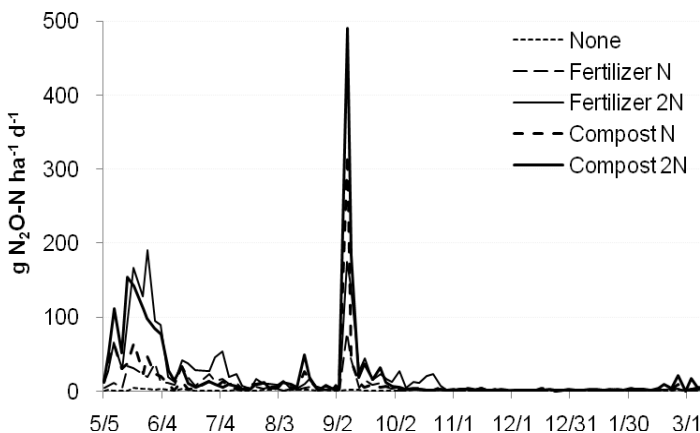


Figure 1: N_2O emission flux of Chinese cabbage transplanted on May 4 for spring cultivation and September 4 for autumn cultivation in 2010. Fertilizer and compost denote chemical fertilizer, urea and livestock compost, respectively.

Accumulated N_2O emission during cultivation of Chinese cabbage for livestock compost, 0.90 for autumn and 1.9 kg $\text{N}_2\text{O-N ha}^{-1}$ for spring, was greater than that for chemical fertilizer, 0.68 for autumn and 1.39 kg $\text{N}_2\text{O-N ha}^{-1}$ for spring (Fig. 2). As a result, N_2O emission factor for livestock compost, 0.0030 for autumn and 0.0066 for spring, was also greater than that of chemical fertilizer, 0.0019 for autumn 0.0041 for spring (Table 3). Increased carbon availability by organic matter in livestock compost can attribute to enhanced denitrification activity (Barton & Schipper 2001). A laboratory study showed 100-300 g $\text{N}_2\text{O-N ha}^{-1}$ during 16 days after applying pig slurry at a rate of 50 Mg ha^{-1} (Sommer *et al.* 1996).

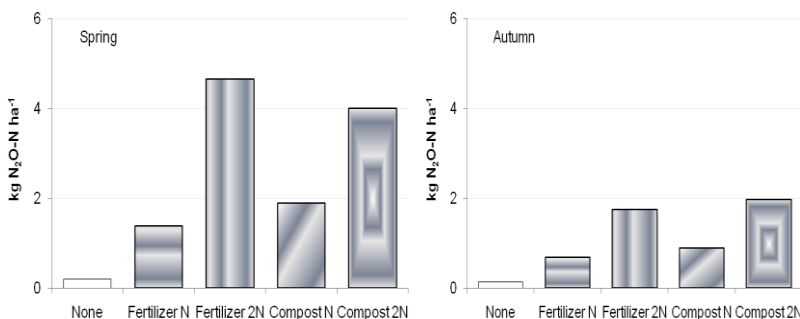


Figure 2: N_2O emission for Chinese cabbage cultivated in spring (left) and autumn (right) in 2010. Fertilizer and compost denote chemical fertilizer, urea and livestock compost, respectively.

Table. 3: N₂O emission factor for livestock compost and chemical fertilizer

| Treatment | N fertilization kg/ha | N ₂ O emission factor | |
|---------------|--------------------------|----------------------------------|--------|
| | | Spring | Autumn |
| None | 0 | | |
| Fertilizer N | 320 | 0.0041 | 0.0019 |
| Fertilizer 2N | 640 | 0.0077 | 0.0028 |
| Compost N | 320 | 0.0066 | 0.0030 |
| Compost 2N | 640 | 0.0074 | 0.0036 |

Conclusions

Accumulated N₂O emission during cultivation of Chinese cabbage for livestock compost (0.90-1.9 kg N₂O-N ha⁻¹) was greater than that for chemical fertilizer (0.68-1.39 kg N₂O-N ha⁻¹). In addition, N₂O emission factor for livestock compost (0.0030-0.0066) was also greater than that of chemical fertilizer (0.0019-0.0041). Since environment factors including temperature and precipitation greatly affect greenhouse gas emissions from soils, N₂O emission data should be collected more than three years to develop N₂O emission factor.

Acknowledgments

This study was carried out with the support of "Cooperative Research program for Agricultural Science & Technology Development (Project No. PJ006783202006)". Rural Development Administration, Republic of Korea.

References

- Barton L., Schipper L. A. (2001): Regulation of nitrous oxide emissions from soils irrigated with dairy farm effluent. *J. Environ. Qual.* 30:1881-1887.
- Intergovernmental Panel on Climate Change (IPCC) (2006): 2006 IPCC guidelines for national greenhouse gas inventories. Vol. 4. Agriculture, forestry and other land use. Eggleston H. S., Buendia L., Miwa K., Ngara T., Tanabe K. (eds.) Hayama, Japan, 682p.
- IPCC (2007): Climate change 2007. Mitigation of climate change: Contribution of working group III to the fourth assessment report of the Intergovernmental Panel on Climate Change. Metz B., Davidson O., Bosch P., Dave R., Meyer L. (eds) Cambridge University Press, New York, 851p.
- Lee Y-H., Lee S-G., Kim S-H., Shin J-H., Choi D-H., Lee Y-J., Kim H-M. (2006): Investigation of the utilization of organic materials and the chemical properties of soil in the organic farms in Korea. *Korean J. Organic Agric.* 14:55-67.
- Parkin, T. B. (2008): Effect of sampling frequency on estimates of cumulative nitrous oxide emissions. *J. Environ. Qual.* 37:1390-1395.
- Saggar S., Luo J., Gilttrap D. L., Maddena M. (2009): Nitrous oxide emissions from temperate grasslands: Processes, measurements, modelling and mitigation. In Sheldon A. I., Barnhart E. P. (eds.): Nitrous oxide emissions research progress. Nova Science Publishers, Inc., New York, p. 1-66.
- Singh S. N., Tyagi L. (2009): Nitrous oxide: Sources, sinks and mitigation strategies. In Sheldon A. I., Barnhart E. P. (eds.): Nitrous oxide emissions research progress. Nova Science Publishers, Inc., New York, p. 127-150.
- Sommer S. G., Sherlock R. R., Khan R. Z. (1996): Nitrous oxide and methane emissions from pig slurry amended soils. *Soil Biol. Biochem.* 28:1541-1544.

Influence of the cultivation technologies on CO₂ Emission

Moudrý, J.¹, jr., Jiroušková, Z.², Moudrý, J.³ & Konvalina, P.⁴

Key words: System of Farming, Emission, CO₂

Abstract

Under both, organic and conventional farming systems, there was a monitoring study carried out focused on the evaluation of the influence of potato and wheat cultivation method on the CO₂ emission production. The evaluation was carried out using the SIMA Pro software. The results achieved has proven that the emission production differences between the both farming systems result from high rates of synthetic manures (the emission share of 72% is related to conventionally grown wheat), which the yield achieved compensates partially only. The total emission load recorded under the organic farming systems is 58% lower for wheat and 38% lower for potatoes.

Introduction

In recent years the climate change have become a very discussed issue. As a most evident part of this change is temperature rise of most continents, water pollution and higher intensity of meteorological events (Metelka a Tolasz 2009). Food production itself contributes to greenhouse gases emission production by 10 - 12%. However, this number does not include emission of wood felling and excessive grazing (Anonymus 2010). This work is aimed to show possible changes to production methods of the two model crops (potatoes, wheat) as a potential instrument of greenhouse gases emission reduction and alleviate the climate change thereby. Wheat is the most common grain crop and the wheat conventional yield-oriented cultivation methods are markedly dependant on exogenous synthetic inputs (mineral manures, morpho-stimulators, pesticides). In Central Europe region the farming method of potatoes, as a root crop, is predominantly dependant on high dung rates. Under conventional farming systems there are additionally applied further potatoes mineral fertilisers and pesticides rates. The organic farming principles do not allow the application of any synthetic agents and thus the yields decrease therefore, but the environmental emission load considerably decreases as well.

Materials and methods

For the comparison of the greenhouse gases emission load were chosen two model crops – potatoes and wheat. Based on a questionnaire survey the data from 70 farms (40 conventional and 30 organic farms) was obtained and typical crop rotation models designed. These designed rotation were used for further comparison with the technology principles standards (Kavka 2006) and finally two model crop rotations (a conventional

¹ University Of South Bohemia In Ceske Budejovice, Faculty Of Agriculture, Department Of Plant Production and Agroecology, Studentska 13, Ceske Budejovice, 37005, Czech Republic, E-Mail JMoudry@zf.jcu.cz, Internet www.zf.jcu.cz

² As Above

³ As Above

⁴ As Above

and an organic one) were designed for the conditions of the Czech Republic. The calculation of CO₂ emission was carried out using the SIMA Pro software. This application is connected to the Ecoinvent database and is used for the simulation of given product life cycle according to the ISO 14044 standard. Within this study the application was used as a tool for the evaluation of production input and output data of chosen crops. As a function unit was given the amount of 1 kg of production. Inputs and outputs were related to area unit of 1 ha. The yield per one hectare was given as the output, technological operations, fertiliser and sowing/seeding rates were given as the inputs. Monitored greenhouse gases emission is expressed in relation to their impact on the climate change by the equivalent CO_{2-eqv} ($\text{CO}_{2-eqv} = 1 \times \text{CO}_2 + 23 \times \text{CH}_4 + 298 \times \text{N}_2\text{O}$).

Results and discussion

First results of the greenhouse gases emission calculations conform to achieved results by Dorninger and Freyer 2008, who found for conventionally grown wheat CO_{2-eqv} values of 0,361 kg/kg of grain, whereas for biowheat reached this value 0,132 kg of CO_{2-eqv}/kg, which makes 36,4 %. For organically grown wheat was recorded emission of 0,185 kg CO_{2-eqv}/kg of grain, which makes 41,9 % compared to 0,442 kg of CO_{2-eqv}/kg of grain of conventionally grown wheat. The differences between our result and results recorded by Dorninger and Freyer in 2008 are predominantly influenced by the yield difference between conventional and organic farming systems in Austria and the Czech Republic. The main factor of up to twice as high difference of emission load between conventional and organic production is synthetic nitrogen fertilisers production, which contributes to the emission production in conventional systems by 72%.

In the used farming model biowheat follows a clover plant in the crop rotation. It is evident, that every sustainable farming system needs to be based on leguminous plant implied in the crop rotation to keep its production and environmental attributes. Ploughing is another important emission load factor. The emission production would be far less if minimisation technologies or non-ploughing sowing were substituted for conventional ploughing operations. Dorninger and Freyer 2008 even stated, that the emission reduction resulting from using non-ploughing sowing practices equals to implementation of organic farming system. Lower yields per area unit reached within organic farming disadvantage this farming system because of higher resultant unit loads. For example, CO_{2-eqv}/kg emission value recorded for biowheat yields is 38% higher when compared to conventional production. However, the model takes into account actual yield level in the Czech Republic, which is low because of insufficient agricultural technologies used by most of organic farmers. According to many authors (Lackner 2008) the average European yield reached about 80% (61 – 100%) of conventional yield. According to literature sources emission for conventionally grown potatoes makes 0,091 kg of CO_{2-eqv}/kg of tubers and 0,056 kg of CO_{2-eqv}/kg for organic production, which is 62 %. Dorninger and Freyer 2008 calculated the emission load 0,081 kg of CO_{2-eqv}/kg of tubers for conventional farming system and 0,035 kg of CO_{2-eqv}/kg for the organic farming, this makes 42,92 %. Lackner 2008 estimated that the emission load for conventionally grown potatoes makes 0,124 kg of CO_{2-eqv}/kg of tubers and 0,044 kg CO_{2-eqv}/kg for organic production (GEMIS database sources), which makes 31%. This author published potatoes yields in the EU reaching the level of 72% (60-90%). Fritche and Erbele 2007 published numbers of 0,199 kg of CO_{2-eqv}/kg for conventional and 0,138 kg of CO_{2-eqv}/kg for organic potatoes, i.e. 69% emission share, but their calculation includes transport and storage emission values. According to Dorninger and Freyer 2008 regional haulage in Bavaria contributes to overall numbers by 0,060 – 0,076 kg of emission CO_{2-eqv}/kg of grain, the export from the EU (Poland, Spain) to Bavaria produces 0,253 and 0,359 kg CO_{2-eqv}/kg respectively, so this corresponds to overall field production.

Tab.1: CO₂ eqv emission production/kg per 1 kg of wheat grown within various farming systems

| Operation | Conventional system | Organic system |
|---------------------------------|---------------------|----------------|
| Mineral fertilizers application | 0,0127 | - |
| N | 0,3190 | - |
| K ₂ O | 0,0079 | - |
| P ₂ O ₅ | 0,0114 | - |
| Organic fertilizer application | - | 0,0065 |
| Milled phosphates | - | 0,0268 |
| Fallow | 0,0092 | 0,0141 |
| Ploughing | 0,0209 | 0,0320 |
| Rolling | 0,0025 | - |
| Pesticides application | 0,0028 | - |
| Planting | 0,0031 | 0,0047 |
| Seeding | 0,0255 | 0,0354 |
| Rotary tiller | - | 0,0141 |
| Weeder | - | 0,0109 |
| Harvest | 0,0265 | 0,0406 |
| TOTAL | 0,4420 | 0,1850 |

* emission of dung and pesticides are not concerned

Tab.2: CO₂ eqv emission production/kg per 1 kg of potatoes grown within various farming systems

| Operation | Conventional system | Organic system |
|--------------------------------|---------------------|----------------|
| Mineral fertilizer application | 0,0017 | - |
| N | 0,0419 | - |
| K ₂ O | 0,0007 | - |
| P ₂ O ₅ | 0,0028 | - |
| Organic fertilizer application | 0,0003 | 0,00039 |
| Dung | N.d. | N.d. |
| Fallow | 0,0026 | 0,0028 |
| Ploughing | 0,0044 | 0,0064 |
| Cultivation | 0,0026 | 0,0038 |
| Planting | 0,0015 | 0,0022 |
| Seeding | 0,0242 | 0,0271 |
| Hilling | - | 0,0009 |
| Earthing up | 0,0011 | 0,0032 |
| Pesticides | 0,0024 | 0,0013 |
| Tops removal | 0,0080 | 0,0012 |
| Harvest | 0,0047 | 0,0069 |
| TOTAL | 0,0908 | 0,0561 |

* emission of dung and pesticides are not concerned

As an extreme example of highly emissive transport can be pointed the air transport of strawberries from the South African Republic, which produces emission of 12 kg CO₂-eqv /kg of strawberries. It is evident, that the environmental quality of any production (evaluated according to CO₂-eqv values) decreases with rising transport distance. Among another emissive factors affecting the environment within food production belong storage, food processing and kitchen preparation. According to Teufel and

Wilgemann 2008 primary production, processing and transport make app. 45% of total emission load, the rest fall on storage and kitchen preparation. According to Frische and Eberle 2007 preparation of 1 kg of chipped potatoes using conventionally grown potatoes contributes to emission load by 5,738 kg CO_{2-eqv} and 5,568kg CO_{2-eqv} when used biopotatoes.

Conclusions

Recorded results are fully consistent with several global researches. The Rodale Institute's Farming Systems Trial, an American research aimed to compare the effects of organic and conventional farming systems, proved that nationwide implementation of organic farming in the USA would lead to 25% reduction of CO₂ thanks to the carbon sequestration (LaSalle, 2010). The same extent of CO₂ reduction mentions the report published by the Worldwatch Institute, which states, that this reduction can be achieved if particular changes in the agricultural technology were applied, for example sequestration of carbon in the soil thanks to ploughing minimisation and application of lower fertilizer rates.

Within organic farming the production of emission expressed in g of CO₂ eqv./kg of production is lower when compared to conventional farming systems, where the major factor of environmental load fall on mineral fertilizer production. Their substitution using leguminous plants in the crop rotation rapidly reduces emission of CO₂. Primary agricultural production is not the major emission producer, these are transport, primary production processing into products, their storage and kitchen preparation. This is why a sustainable farming system has to be based on environmentally friendly regional production combined with immediate consummation of natural and fresh food.

Acknowledgments

This study is a partial output of the projects EUS-M00080-SUKI, VZ: MSM 6007665806 and NAZV Q1111B154.

References

- Dorninger, M. , Freyer, B. (2008): Aktuelle Leistungen und zukünftige Potentiale der Ökologischen Landwirtschaft für den Klimaschutz in Österreich, IFOL, BOKU Wien, 36 p.
- Ekologické zemědělství může pomoci čelit klimatickým změnám (2010): BIO – info: <http://www.bio-info.cz/vzdelavani/video-klima-a-potraviny>. (accessed. 2010-09-23).
- Frise, U.R., Eberle, U. (2007): Treibhausgasemissionen durch Erzeugung und Verarbeitung von Lebensmitteln – Arbeitspapier - Aktualisierte Version, Berlin, 13 p.
- LaSalle, T. (2008): Regenerative Organic Farming. Rodale Institute, Pennsylvania, 13 p.
- Lackner, M. (2008): Sozialökologische Dimensionen der österreichischen Ernährung. Eine
- Metelka, L. Tolasz, R. (2009): Klimatické změny: fakta bez mýtů. Univerzita Karlova. Centrum pro otázky životního prostředí, Praha, 40 p.
- Scherr, S., Sthapit, S. (2008): Worldwatch Report: Mitigating Climate Change Through Food and Land Use. Worldwatch Institute, Washington, 50 p.
- Szenarienanalyse, Social Ecology, Working paper 103, Klagenfurt, 59 p.
- Teufel, J., Wilgemann K. (2008): Umweltauswirkungen von Ernährungsgewohnheiten. Freiburg, 15 p.

Spiders as important predators in Korean rice fields

Kim, S.T.¹, Lee, S.Y.², Jung, J.K.³ and Lee, J-H.⁴

Key words: spiders, biological control, organic farming, community structure, diversity, rice

Abstract

Arthropod pest management in organic farming often depends on biological control. Spiders are prominent predators in agroecosystems. This study was conducted to identify the structures of spider communities that are associated with rice for future use as biological control agents in organic rice farming. A total of 1,396 spiders of 46 species belonging to 14 families were sampled and identified. Lycosid and linyphiid spiders were dominant, particularly Pirata subpiraticus and Ummeliata insecticeps, respectively. Spider diversity was higher in paddy fields than in levees, and dominance was higher in levees than in paddy fields. The ratios of web builders vs. hunters were about 1:1 in paddy fields and 1:4 in levees. The seasonality of rice field spiders increased with rice growth. To maximize the potential of spiders as potential biological control agents against pest species in organic farming, we must understand and maintain the complexity of spider communities.

Introduction

Organic farming relies on practices such as crop rotation, green manure, composting and biological control to maintain soil productivity and to control pests on arable land. Despite the recent growth of organic agriculture, there has been a lack of research-based information on which to base a greater understanding of the mechanisms operating in organic farming systems (Geoff *et al.* 2007). Arthropod pest management in organic farming often depends on biological control, especially the use of natural enemies, to reduce pest populations. Spiders are prominent predators in agricultural contexts. Lower pest densities have been attributed to spider activity in Asian rice fields (Kiritani 1979). Spiders make up 90% of the beneficial arthropod community in conventional Korean farming, which uses synthetic fertilizers and pesticides (Lee *et al.* 1997). This study was conducted to identify the structures of spider communities associated with rice, which is the main crop grown in Korea, for future use as biological control agents in organic rice farming.

Materials and methods

Five study regions were chosen along latitude, and five non-sprayed fields that varied in size, rice variety and climate were selected in each region (Table 1). Spiders were

¹ Research Institute for Agriculture and Life Science, Seoul National University, 151-921 Seoul, Korea. E-mail: stkim2000@hanmail.net

² Entomology Program, Department of Agricultural Biotechnology, Seoul National University, 151-921 Seoul, Korea. E-mail: hongdan@snu.ac.kr

³ As above, E-mail: jk82811@snu.ac.kr

⁴ As above, E-mail: jh7lee@snu.ac.kr

sampled during four rice growth stages (seedling, tillering, shooting-blooming and ripening; 20, 55, 80 and 105 days after transplanting, respectively) in 2009. Battery-powered suction devices (four hills in paddy fields and 0.5 m² in levees) and sweep nets (39 cm in diameter, swept five times at an angle of 180°) were used to collect spiders. Spiders were identified at the species level following Namkung (2003). Combined data were analyzed for a comprehensive understanding of community structure. Diversity and dominance were calculated by Simpson's diversity index ($1-D = 1 - \sum [n_i(n_i-1)/N(N-1)]$ (where N is the total number of organisms and n is the number of organisms of a species) and Simpson's dominance index ($D = \sum p_i^2$ (where p_i is the proportion of individuals in the i th species) (Simpson 1949).

Table 1. Environmental data for the five study regions

| Region | Longitude | Latitude | Annual mean temperature (°C) | Annual precipitation (mm) | Annual mean relative humidity (%) |
|------------------------------|------------|-----------|------------------------------|---------------------------|-----------------------------------|
| Cheolwon, Gangweon-do | 127°15'01" | 38°12'08" | 12.10 | 1599.1 | 70.06 |
| Icheon, Gyeonggi-do | 127°28'28" | 37°17'08" | 13.18 | 1401.5 | 64.58 |
| Yeongdong, Chungcheongbuk-do | 127°46'03" | 36°09'49" | 13.54 | 1010.7 | 65.51 |
| Gimje, Jeollabuk-do | 126°51'10" | 35°48'44" | 14.84 | 1136.1 | 70.93 |
| Haenam, Jeollanam-do | 126°34'18" | 34°33'03" | 15.17 | 1277.7 | 72.45 |

Results

A total of 1,396 spiders of 46 species belonging to 14 families were sampled and identified (Table 2). Of these, 771 spiders of 21 species belonging to nine families were collected in paddy fields and 625 spiders of 40 species belonging to 14 families were collected in levees. Five dominant families made up 92% of the spiders collected in paddy fields and 93% in of the spiders collected in levees (Figure 1a). Five dominant species made up 82% of the spiders collected in paddy fields and 77% of the spiders collected in levees (Figure 1b). The species diversity of paddy fields ($1-D=0.7731$) was higher than that of levees ($1-D=0.6923$), while dominance was higher in levees ($D=0.2359$) than in paddy fields ($D=0.2279$). The ratios of web builders vs. hunters were about 1:1 in paddy fields and 1:4 in levees. The seasonality of the abundances of spiders increased with rice growth (Figure 2).

Table 2. Spiders collected along a latitudinal gradient in Korean rice fields

| Family | Scientific name | Paddy fields | | | | | Levees | | | | |
|---------------------|------------------------------|--------------|---------|----|--------|--------|---------|----|----|--------|--------|
| | | GI | YE | IC | C H | H A | GI | YE | IC | C H | H A |
| Theridiidae* | Achaearanea oculiprominentis | | | | | 1 | | | | | |
| | Coleosoma octomaculatum | | 1 | 1 | 2 | | | | 2 | | |
| | Enoplognatha abrupta | 46 | 2 | 4 | 5 | 3 | 4 | | 10 | 5 | 3 |
| | Paidiscura subpallens | | | | | | | | | 1 | |
| Linyphiidae* | Bathypantes gracilis | | | 1 | | | | | 5 | | |
| | Erigone koshiensis | | | | | | | | | 17 | |
| | Gnathonarium dentatum | 2 | 3 | 9 | 5 | 9 | | | 1 | 8 | |
| | Hylyphantes graminicola | | | | | | | | | 1 | |
| | Neriene oidedicata | | | | | | | | 1 | | |
| | Ummeliata insecticeps | 76 | 19 | 9 | 2 | 65 | 3 | 5 | 4 | 12 | 20 |
| Tetragnathi dae* | Pachygnatha clercki | 9 | 2 | 26 | 8 | 3 | | | | 5 | |
| | Pachygnatha quadrimaculata | | | | | 7 | | | | | |
| | Pachygnatha tenera | | | | | | | | 1 | | |
| | Tetragnatha maxillosa | 8 | 2 | 4 | 9 | 3 | 1 | | | | 1 |
| | Tetragnatha vermiformis | | 1 | | 1 | 2 | | | | | |
| Araneidae* | Argiope bruennichi | | | 1 | | | | | | | |
| | Hypsosinga sanguinea | | 1 | | | | | | | | |
| | Larinioides cornutus | 3 | | | 2 | 2 | | | | | 3 |
| | Neoscona adianta | 2 | | 2 | | 1 | | | | | 1 |
| Lycosidae | Arctosa kwangreungensis | | | | | | 1 | | | | |
| | Arctosa stigmosa | 2 | | | | | | | | | |
| | Lycosa coreana | | | | | | | | 3 | | |
| | Pardosa astrigera | | | | | | | 1 | | | 1 |
| | Pardosa laura | | | | | | 14 3 | 30 | 29 | 45 | 35 |
| | Pirata subpiraticus | 29 | 17 9 | 46 | 5 | 51 | | 7 | 1 | 1 | 7 |
| | Trochosa ruricola | 8 | | | | 3 | 9 | | | | 6 |

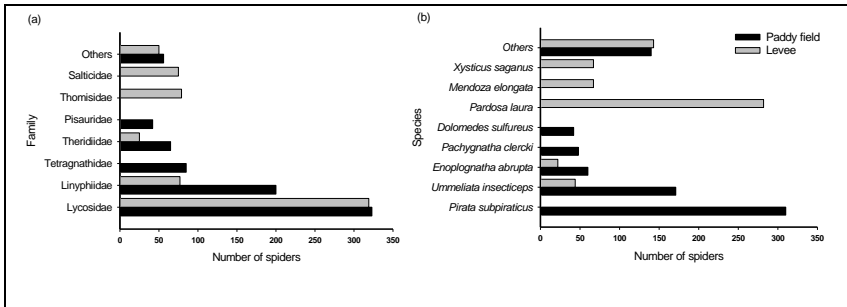
| | | | | | | | |
|--------------------|---------------------------------|-----------|----------|----------|-----------|-----------|-----------|
| Pisauridae | Dolomedes sulfureus | 31 | 3 | 3 | 5 | 2 | 2 |
| Zoridae | Zora nemoralis | | | | | 1 | |
| Ctenidae | Anahita fauna | | | | | | 1 |
| Hahniidae* | Hahnia corticicola | | | | | 4 | |
| Clubionidae | Clubiona japonicola | | | | | | 4 |
| | Clubiona kurilensis | | 6 | | 15 | 1 | 1 |
| Corinnidae | Phrurolithus sp. | | | | | 1 | 3 |
| Gnaphosidae | Drassodes serratidens | | | | | 1 | |
| | Drassyllus biglobus | | | | | 1 | |
| | Gnaphosa kompirensis | | | | | 9 | |
| | Zelotes asiaticus | | | | | 1 | 3 |
| Thomisidae | Ebrechtella tricuspidata | | | | | 1 | |
| | Ozyptila nongae | | | | | 5 | 1 |
| | Xysticus hedinii | 1 | 5 | 2 | 8 | 3 | |
| | Xysticus saganus | | | | | 49 | 18 |
| Salticidae | Evarcha albaria | | | | | 2 | |
| | Mendoza canestrinii | 1 | 4 | | | 3 | |
| | Mendoza elongata | | | | | 67 | |
| | Myrmarachne formicaria | | | | | 1 | 1 |
| | Sibianors pullus | | | | | 1 | |

web builders*, ^{no mark}hunters; GI Gimje, YE Yeongdong, IC Icheon, CH Cheolweon, HA Haenam

Discussion

The Lycosidae and Linyphiidae are dominant spider families that are the most important biological control agents in temperate agroecosystems (Wise 1993). These two families also dominated our samples from Korean rice fields. Different spider species vary in their responses to insect pests. *Pirata subpiraticus*, which are wandering diurnal spiders, and *Ummeliata insecticeps*, which build sheet-webs, are the dominant spider species in Korean rice fields. These species are known to be effective for suppressing populations of planthoppers and leafhoppers, which are the main insect pests in rice fields. Orb weavers such as the families Araneidae and Tetragnathidae, which often inhabit rice tops, are effective for the control of lepidopteran and orthopteran insect pests (Shepard *et al.* 1987). Species richness was approximately two-fold higher in levees than in paddy fields, indicating that levee management must be included when considering the use of spiders to control insect pests in rice fields

Figure 1: Dominant families (a) and species (b) of Korean rice field spiders



Conclusions

Spiders are important predators that play important roles in suppressing pest populations in agricultural ecosystems (Riechert and Lockley 1984). Spiders also contribute greatly to biodiversity in agroecosystems and are important components of natural pest control programs (Symondson *et al.* 2002). The suppressive effects of spiders differ according to foraging strategies, which vary between web builders (sit and wait foraging strategy) and hunters (pursue and kill foraging strategy) (Uetz 1992). Web builders and hunters have synergic suppressive effects on pest species populations due to their different vertical distributions in intra-hills. To maximize the biological control effects of spiders on pest species populations in organic farming, we must understand and maintain the complexity of spider communities.

Acknowledgments

This study was supported by the Rural Development Administration (#20090101-030-121-001-01-00) of South Korea and partly by the Brain Korea 21 Project, Seoul National University.

References

- Geoff Z., Geoff M.G., Stefan K., Mark R.W., Steve D.W., Eric W. (2007): Arthropod Pest Management in Organic Crops. *Annu. Rev. Entomol.* 52:57-80.
- Kiritani K. (1979): Pest management in rice. *Annu. Rev. Enomol.* 24: 279-312.
- Lee J.-H., Kim K.H., Lim U.T. (1997): Arthropod Community in Small Rice Fields associated with Different Planting Methods in Suwon and Icheon. *Kor. J. Appl. Entomol.* 36: 55-66.
- Namkung J. (2003): The Spiders of Korea, 2nd. ed. Kyo-Hak Publ. Co., Seoul, 648 p.
- Riechert S.E., Lockley T. (1984): Spiders as Biological Control Agents. *Annu. Rev. Entomol.* 29: 299-320.
- Shepard B.M., Barrion A.T., Litsinger J.A. (1987) Helpful Insects, Spiders, and Pathogens. International Rice Research Institute, Los Baños, 136p.
- Simpson E.H. (1949): Measurement of diversity. *Nature* 163: 688p.
- Symondson W.O.C., Sunderland K.D., Greenstone M.H. (2002): Can generalist predators be effective biological control agents? *Annu. Rev. Entomol.* 47: 561-59.

Ecological traits of weed flora as affected by different soil moisture condition

Hwang, Jaebok¹ & Yun, Eulsoo & Jung, Kiyoul & Park, Changyoung & Choi, Youngdae & Nam, Minhee

Key words: dominant weed, ecology, occurrence, species diversity, weed community

Abstract

The study focused on the survey of weed population as affected by different soil moisture which can be utilized in order to understand weed ecology and its possible control for sustainable agriculture. Weed assessment that were reported in here was surveyed in 2009 and 2010. Soil samples were taken from each study plot to assess the impact soil moisture on the occurrence and abundance of dominance weed species. Soil water of poorly drained field ranged from 10.2~18.2% moisture content (MC) and somewhat poorly drained field which has 11.8~14.3% (MC). The presence of weeds in the survey area composed of 19 species belonging to 12 families. Among 12 families, 6 weed species were belong to Compositae (31.6%) was the biggest family, Cruciferae and Rubiaceae have 2 species each with 10.5% and 10.5%, respectively. In 2009, the weed flora that were gathered in the soil with MC of 11.8~14.3% were *Youngia japonica* which had the highest summed dominance ratio (SDR) (97.0%), followed by *Coryza Canadensis* (92.1%), *Galium spurium* (35.3%) and *Hemistepta lyrata* (28.4%) while in the soil with MC of 10.2~18.2% *Artemisia princeps* recorded the highest SDR (100%) followed by *Stellaria alsine* (55.2%), *Youngia japonica* (38.3%) and *Nasturtium officinale* (28.5%). Weed population data in 2010 recorded *Stellaria alsine* had the highest SDR (86.8%) followed by *Alopecurus aequalis* (77.7%), *Astragalus sinicus* (68.7%) and *Youngia japonica* (46.3%) in soil with MC of 11.8~14.3% while *Stellaria alsine* the highest SDR (93.7%) followed by *Alopecurus aequalis* (78.6%), *Nasturtium officinale* (31.3%) and *Youngia japonica* (30.4%) in soil with 10.2~18.2%. Simpson's index was calculated to 0.12~0.23, which showed that weed occurrence with different soil moisture in paddy-upland rotation between years was variable. Similarity coefficient between years was 43.0% in 2009 and 74.2% in 2010, which indicates that weed flora diversity were low because of the moisture content in the agro-ecosystem.

Introduction

Insufficient weed control is considered to be the main factor main restriction for converting to Organic Farming. Currently, there is no efficient weed control in organic farming which resulted to the decrease of floral and faunal diversity. Products derived from organically grown crops is not only to open new market opportunities but also coupled with best practices in weed control that are generally more economical and ecologically sustainable. The efficiency of weed control in organic farming mainly depends on the site specific weed pressure and the competitiveness of the weeds. Land-use of the reclaimed paddy-upland rotation has been strongly recommended for

¹ National Institute of Crop Science, Department of Functional Crop, Functional Cereal Crop Research Division, 20th, Miryang, Gyeongnam, 627-803, Korea, E-Mail hjb0451@korea.kr, Internet www.rda.go.kr

paddy use for rice cultivation and also for upland vegetables, fruit trees and other cash crops. Weeds are one of the plants that can be easily adapted to environment. Weeds are plants that thrive best in an environment cultivated by man. The only characteristic common to all weeds is their excellent adaptation to the disturbed environment in which they are growing. In Korea the condition belongs to a monsoon climate, therefore weeds grow very fast most especially before and after rainy season in summer combined with high temperature and humidity. Hence, the two years study aimed to provide baseline information on weed diversity in paddy-upland rotation with sloping bench terrace at different soil moisture content.

Materials and methods

Soil profile investigation of experiment site

Physical properties or soil profile in experimental site was investigated according to soil survey manual and guidelines by observing and describing soil profile in the pit measured at 1x1x1.2m. Soil texture was classified based on guidelines set by USDA texture triangle. Particle size distribution data was also analyzed by pipeting method and bulk density was measured by core method using auger-hole method.

Sampling method and collection of weeds

In each other soil moisture content, ten quadrats measuring 50x50cm were randomly selected. Collection of weeds was done in paddy-upland rotation with sloping bench terrace. The bases of classification were used to easily identify the weeds. Simpson index and Similarity coefficient were determined dominance by dry weight.

Ecological parameters

Analysis of the population indices of the study area was done by quadrat method. Density (D), relative density (RD), coverage (C), relative coverage (RC), height (H) relative height (RH), and frequency relative frequency (RF) were determined. Summed dominance ratio was computed as: $(SDR) = (RD + RC + RH + RF) / 4(\%)$ and Phytograph index (PI) was calculated as $(RD + RH) (RC + RF) / 400$.

Discussion

Morphological characteristics of soil profile

Soil profile were differentiated by five layers such Ap1, Ap2, Ag, Bg and BCg (Table 1). Weeds are very sensitive to soil moisture condition and they have different absorbance capacity. Air spaces was also variable between poorly drainage ranged in 10.2~18.2% MC and in 11.8~14.3% MC categorized as somewhat poorly drained soil Air spaces play an important role most especialy in root respiration but also in absorbing volume of water from rain.

Table 1. Soil physical properties of soil in the experimental site.

| Drainage class | Soil profile | Soil depth (cm) | Available moisture (%) | Three phases (% v/v) | | | Pore space ratio (%) |
|--------------------------|--------------|-----------------|------------------------|----------------------|--------|---------|----------------------|
| | | | | Solid | Liquid | Gaseous | |
| Poorly drainage | Ap1 | 0-10 | 18.2 | 44.5 | 40.2 | 15.3 | 55.5 |
| | Ap2 | 10-20 | 12.5 | 58.6 | 25.9 | 15.5 | 41.4 |
| | Ag | 20-24 | 10.2 | 61.2 | 24.1 | 14.6 | 38.8 |
| | Bg | 24-35 | 12.1 | 60.3 | 22.3 | 17.4 | 39.7 |
| | BCg | 35-+ | 9.7 | 60.4 | 25.0 | 14.5 | 39.6 |
| Somewhat poorly drainage | Ap1 | 0-10 | 14.3 | 45.4 | 34.8 | 19.8 | 54.6 |
| | Ap2 | 10-19 | 12.2 | 55.4 | 28.7 | 15.8 | 44.6 |
| | Ag | 19-26 | 11.8 | 58.9 | 26.0 | 15.1 | 41.1 |
| | Bg | 26-32 | 10.7 | 60.1 | 24.2 | 15.7 | 39.9 |
| | BCg | 32-+ | 10.1 | 58.0 | 26.0 | 16.0 | 42.0 |

Summed dominance ratio (SDR) and Phytograph index (PI) of weed species

According to the analysis of SDR, a total 16 species were observed in 10 plots of somewhat poor drainage in 2009. *Y. japonica* had the highest SDR (97.0) and followed by *C. canadensis* (92.1), *G. spurium* (35.3) and *H. lyrata* (28.4) (Table 2).

According to the analysis of SDR, a total 16 species were observed in 10 plots of poor drainage in 2009. *A. aequalis* had the highest SDR (100.0) and followed by *S. alsine* (55.2), *Y. japonica* (38.3), *N. officinale* (28.5) and *C. canadensis* (20.9).

According to the analysis of SDR, a total 14 species were observed of somewhat poor drainage in 2010. *S. alsine* had the highest SDR (86.8) and followed by *A. aequalis* (77.7), *A. sinicus* (68.7), *Y. japonica* (46.3) and *C. canadensis* (35.6). According to the analysis of SDR, a total 12 species were observed of poor drainage in 2010. *S. alsine* had the highest SDR (93.7) and followed by *A. aequalis* (78.6), *N. officinale* (31.3), *Y. japonica* (30.4) and *A. princeps* (25.7).

Table 2. Summed dominance ratio (SDR) and Phytophag index(PI) between soil moisture with following year.

| Species | 2009 | | | | 2010 | | | |
|--------------------------------|------------------|------------------|------|-------|------|------|------|------|
| | SDR | | PI | | SDR | | PI | |
| | Sd ¹⁾ | Pd ²⁾ | Sd | Pd | Sd | Pd | Sd | Pd |
| <i>Youngia japonica</i> | 97.0 | 38.3 | 94.1 | 13.6 | 46.3 | 30.4 | 19.1 | 6.0 |
| <i>Conyza canadensis</i> | 92.1 | 20.9 | 84.2 | 3.7 | 35.6 | 24.1 | 7.8 | 3.2 |
| <i>Galium spurium</i> | 35.3 | 3.3 | 12.5 | 0.1 | 23.6 | - | 2.2 | - |
| <i>Hemistepta lyrata</i> | 28.4 | - | 7.9 | - | 35.6 | 6.0 | 5.8 | 0.2 |
| <i>Artemisia princeps</i> | 23.3 | 4.5 | 5.4 | 0.1 | - | 25.7 | - | 2.4 |
| <i>Ixeris dentata</i> | 21.3 | 9.7 | 4.5 | 0.9 | 21.2 | 5.4 | 1.4 | 0.1 |
| <i>Alopecurus aequalis</i> | 18.0 | 100.0 | 3.2 | 100.0 | 77.7 | 78.6 | 60.3 | 61.7 |
| <i>Equisetum arvense</i> | 12.7 | 7.7 | 1.6 | 0.4 | 5.0 | - | 0.1 | - |
| <i>Bothriospermum tenellum</i> | 10.9 | - | 1.2 | - | 6.5 | 9.4 | 0.3 | 0.2 |
| <i>Galium pogonanthum</i> | 8.4 | - | 0.7 | - | - | - | - | - |
| <i>Rorippa indica</i> | 6.9 | - | 0.5 | - | - | - | - | - |
| <i>Nasturtium officinale</i> | 5.3 | 28.5 | 0.3 | 7.6 | 21.5 | 31.3 | 3.2 | 5.7 |
| <i>Geranium sibiricum</i> | 5.2 | 10.4 | 0.3 | 0.8 | 25.7 | 9.5 | 3.1 | 0.3 |
| <i>Mazus japonicus</i> | 4.7 | - | 0.2 | - | 11.4 | - | 0.8 | - |
| <i>Gnaphalium affine</i> | 4.6 | - | 0.2 | - | 15.1 | 10.2 | 0.7 | 0.6 |
| <i>Stellaria alsine</i> | 3.9 | 55.2 | 0.1 | 29.8 | 86.8 | 93.7 | 75.2 | 87.5 |
| <i>Persicaria sieboldii</i> | - | 16.5 | - | 2.3 | - | - | - | - |
| <i>Murdannia keisak</i> | - | 3.8 | - | 0.1 | - | - | - | - |
| <i>Astragalus sinicus</i> | - | - | - | - | 68.7 | 22.3 | 37.4 | 3.2 |
| Total | 16 | 12 | 16 | 12 | 14 | 12 | 14 | 12 |

¹⁾ Somewhat poorly drainage, ²⁾ Poorly drainage

Simpson index, Similarity and Dissimilarity

The smaller the values recorded in Simpson index means the water was decreased, and 2009 was lower than 2010. But the ranged was from 0.12 to 0.23 (Table 3). Similarity coefficient between weed floras in somewhat poor drainage and poor drainage of 10 plots was 43.0% in 2009 and that in somewhat poorly drainage and poorly drainage of 10 plots was 74.2% in 2009 (Table 4). Weed community was likely to be correlated with the degree of soil water in paddy-upland rotation with sloping bench terrace.

Table 3. Simpson's dominance and diversity indices calculated by weeds observed between soil moisture with following year.

| Drainage class | Year | Simpson index | Diversity index |
|--------------------------|------|---------------|-----------------|
| Somewhat poorly drainage | 2009 | 0.18 | 0.82 |
| | 2010 | 0.12 | 0.88 |
| Poorly drainage | 2009 | 0.23 | 0.77 |
| | 2010 | 0.18 | 0.82 |

Table 4. Similarity and dissimilarity coefficient of weed species between soil moisture with following year.

| Year | Similarity coefficient | Dissimilarity coefficient |
|-------------------------------------|------------------------|---------------------------|
| 2009(Somewhat poorly drainage-Poor) | 43.0 | 67.0 |
| 2010(Somewhat poorly drainage-Poor) | 74.2 | 25.8 |

Conclusions

1. Soil water of poor drainage ranged from 10.2~18.2% to more than 11.8~14.3% in somewhat poorly drained soil.
2. *Y. japonica* had the highest SDR (97.0) followed by *C. canadensis* (92.1), *G. spurium* (35.3) and *H. lyrata* (28.4) of poorly drained soil in 2009. *A. aequalis* had the highest SDR (100.0) followed by *S. alsine* (55.2), *Y. japonica* (38.3), *N. officinale* (28.5) and *C. canadensis* (20.9) of poorly drained soil in 2009.
3. Lower values of Simpson index as water decreases, and similarity coefficient between weed floras in somewhat poorly drained soil and poorly drained soil was 43.0% and 74.2% in 2009 and 2010, respectively.

References

- Neuhoff D. 2010. Weed management and biodiversity in organic farming. International symposium in Small-holders and weed control in organic agriculture.
- J.D.Wulforst and Anne K. Haugestad. 2004. Organic agriculture in a global perspective. Ecological justice and global citizenship.

Effects of long-term organic management on major pests and coccinellid predators in the peach fields

Ding-wu Zhang, Min Dong, Xiang-ge Du

Organic Agricultural Technology Research Center, China Agricultural University, P.R.China, E-mail duxge@cau.edu.cn

Key words: Organic management, Pests, Predators, Dynamics, Abundance

Abstract

*We studied the effects of organic management on abundance of major pests, *Lyonetia clerkella*, *Adoxophyes orana*, *Crapholitha molesta*, *Myzus persicae* and coccinellid predator in five organic managed peach fields, from 2004, the first year of organic management, to 2009. The abundance of *Lyonetia clerkella*'s larvae and adult in last five years of organic management (OM) were significantly lower than the first year of OM, and there is no significant difference among last five years of OM. The abundance of *Adoxophyes orana* was significantly lower in last three years than first three years of organic management. The abundance of *Crapholitha molesta*'s larvae and adult were significantly lower in the fifth year and sixth year of OM than first four years. The green peach aphid density index was significantly lower in the last three years of OM than the first year and third year of OM. The coccinellid predator abundance significantly increased in the second year of OM than the first year of OM and was significantly lower in last three years of OM than the first two years of OM. Our study suggests there is lower pest abundance in the longer year of OM, and the abundance of pests will be more balanced after long-term organic management in the peach fields. Our results also showed organic management can resume and increase the abundance of coccinellid predator in the peach fields.*

Introduction (description of the project / activity)

Organic farming is reported to increase the diversities of many organisms in the agricultural landscape, including, for example, carabid beetles (Pfinner & Niggli 1996), vascular plants (Hyvönen & Salonen 2002) and birds (Freemark & Kirk 2001). Organic agricultural methods also increase the abundance and density of many species and organism groups compared with conventional methods. For example, the application of herbicides in conventional farming systems will, by their nature, decrease weed abundances. This may have subsequent deleterious effects on insects and birds, which depends on these plant species (Chiverton & Sotherton 1991). Similarly, the use of pesticides will not only decrease pest insects but also the predators that feed upon them (Winston 1997). Potential pests, i.e. pest butterfly species, aphids, herbivorous insects and plant-feeding nematodes, there was higher abundances in the conventional farms but there was no significant difference (Bengtsson et al., 2005). However, few studies paid more attention to the effect of long-term organic management on major pests and predator abundance.

Adoxophyes orana, *Crapholitha molesta*, *Lyonetia clerkella* and Green peach aphid (GPA), *Myzus persicae*, are major pests, and coccinellid predators are major natural enemies of GPA in the peach orchards (Zhang, et al., 2003). The objective of our

study were to answer if there are significant difference in the abundance of these major pests and GPA predators between different years of organic management (OM) and if the abundance of them were significantly differences after several years of OM.

Methods and materials (where applicable)

Five organic managed (OM) peach fields were selected for our study from 2004, the first year of organic management, to 2009. Five peach trees per field were randomly sampled and tagged for observation. Green peach aphid (GPA), *Myzus persicae*, *Adoxophyes orana*, *Crapholitha molesta*, and *Lyonetia clerkella* were the focus of our study. The larvae of *Adoxophyes orana*, *Crapholitha molesta*, *Lyonetia clerkella*, and the adult of coccinellid predators were monitored by visual observation (Koss et al., 2005) on 60 randomly marked shoots per tree. Aphid density was recorded in classes (0 absence of aphids; 1 1-10 aphids/leaf; 2 11-20 aphids/leaf; 3 21-30 aphids/leaf; 4 31-40aphids/leaf; 5 >40 aphids/leaf) as aphid density index (ADI) and all nymphal stages and adults were counted on the seven apical leaves of these 60 marked shoots per tree. Peach shoots, were randomly selected and marked before the first observation each year. Observations and sampling were carried out through six years at fortnightly intervals from April 29 to October 14, but to August 5 for GPA and coccinellid predators, which encompasses the season during which GPA and coccinellid predators are active in the peach trees.

Comparisons of abundance of pests, coccinellid predators and GPA ADI among different OM years were made with a repeated measures analysis of variance (rmANOVA). All statistical analyses were performed using the statistical package SPSS 10.0 for Windows (SPSS Inc, 1999). The data were normalized by transformation according to the equation $y = \text{before analysis}$ (Snedecor and Cochran, 1989).

Results

The analysis of data showed there was significant effect of OM years on abundance of pests (Figure 1, Figure 2, Figure 3 and Figure 4). The abundance of *Lyonetia clerkella*'s larvae and adult in the first OM year were significantly higher than last five years of OM, and there is no significant difference among last five years of OM (Figure 1). The abundance of *Adoxophyes orana*'s larvae and adult in last three years of OM were significantly lower than first three OM years, and no significant difference among last three OM years (Figure 2). The abundance of *Crapholitha molesta*'s larvae and adult changed largely from first year to fourth year of OM, but the abundance was significantly lower in the fifth year and sixth year of OM than first four years (Figure 3).

The GPA ADI was significantly lower in the fourth year of OM in comparison to the first year and the third year of OM. The GPA ADI was significantly lower in the last three years of OM than the first year and third year of OM. The coccinellid predator abundance significantly increased in the second year of OM and was significantly lower in last three years of OM than the first two years of OM (Figure 4).

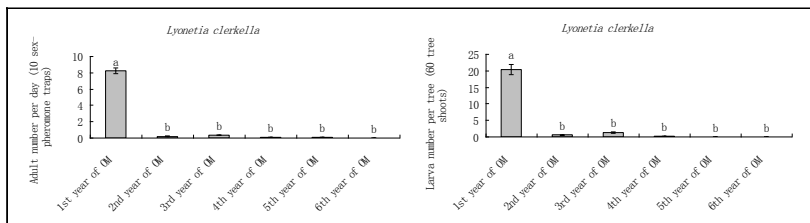


Figure 1: *Lyonetia clerkella*'s larva number per tree (60 shoots per tree were observed) and adult number per day (10 sex-pheromone traps) in organic managed peach fields in different OM year (2004, 1st year of OM, to 2009, 6th year). Error bars are \pm SE. Different letters indicate significant differences between different years (rmANOVA, $P < 0.05$).

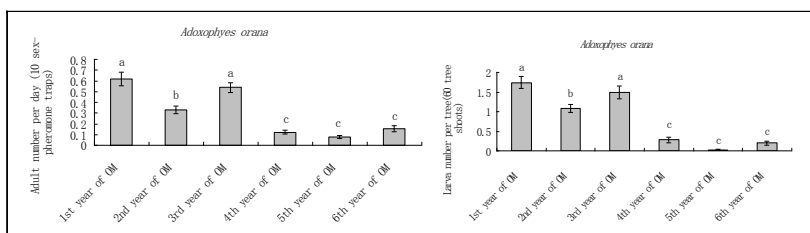


Figure 2: *Adoxophyes orana*'s larva number per tree (60 shoots per tree) and adult number per day (10 sex-pheromone traps) in organic managed peach fields in different OM years (2004-2009). Error bars are \pm SE. Different letters indicate significant differences between different years (rmANOVA, $P < 0.05$).

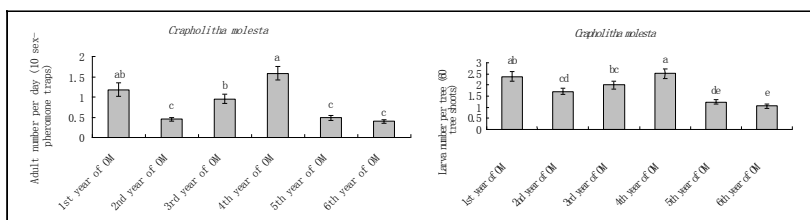


Figure 3: *Crapholitha molesta*'s larva number per tree (60 shoots per tree) and adult number per day (10 sex-pheromone traps) in organic managed peach fields in different OM year (2004-2009). Error bars are \pm SE. Different letters indicate significant differences between different years (rmANOVA, $P < 0.05$).

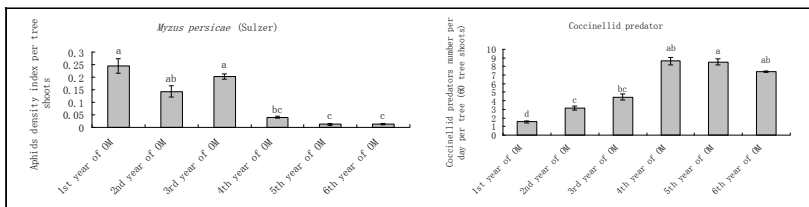


Figure 4: Aphids density index per tree shoot (seven apical leaves per tree shoots were observed, 0 absence of aphids; 1 1-10 aphids/leaf; 2 11-20 aphids/leaf; 3 21-30 aphids/leaf; 4 31-40aphids/leaf; 5 >40 aphids/leaf) and coccinellid predators number per tree (60 shoots per tree) in organic managed peach fields in different OM year (2004-2009). Error bars are \pm SE. Different letters indicate significant differences between different years (rmANOVA, $P < 0.05$).

Conclusions

Six-year study suggests that there is lower pest abundance in the longer year of organic management, and the abundance of pests will be more balanced after long-term organic management in the peach fields. Our results also showed long-term organic management can resume and increase the abundance of coccinellid predator in the peach fields.

References

- Bengtsson, J., Ahnström, J. & Weibull, A.C. 2005. The effects of organic agriculture on biodiversity and abundance: a meta-analysis. *Journal of Applied Ecology* 42: 261–269.
- Chiverton, P.A. & Sotherton, N.W. 1991. The effects on beneficial arthropods of exclusion of herbicides from cereal crop edges. *Journal of Applied Ecology* 28: 1027–1039.
- Freemark, K.E. & Kirk, D.A. 2001. Birds on organic and conventional farms in Ontario: partitioning effects of habitat and practices on species composition and abundance. *Biological Conservation* 101: 337–350.
- Hyvönen, T. & Salonen, J. 2002. Weed species diversity and community composition in cropping practices at two intensity levels: a six year experiment. *Plant Ecology* 154: 73–81.
- Pfanner, L. & Niggli, U. 1996. Effects of bio-dynamic, organic and conventional farming on ground beetles (Col. Carabidae) and other epigeic arthropods in winter wheat. *Biological Agriculture and Horticulture* 12: 353–364.
- Snedecor, G.W. & Cochran, W.G. 1989. *Statistical Methods*, 8th edn. Ames: Iowa State University Press.
- SPSS Inc. 1999. *SPSS Base 10.0 for Windows User's Guide*. Chicago: SPSS Inc.
- Winston, M.L. 1997. *Nature Wars. People Vs. Pests*. Cambridge: Harvard University Press.
- Zhang, A.S., Feng J.G., Yu, Y., Zhang, S.C. & Li, Z.H. 2003. The population dynamics and community structure of major pests and their natural enemies in peach orchards. *Entomological Journal of East China* 12 (2): 65–71.

Bioassay study of fenugreek extract's allelopathic effects on the germination and growth of crops and weeds

Azizi, G.¹, Jahani Kondori, M.², Alimoradi, L.³ & Siah-marguee, A.⁴

Key words: allelopathy, Fenugreek, Soybean, Sesame, Pigweed, Velvetleaf

Abstract

*In order to study the effect of the extract from parts of different fenugreek (*Trigonella gracum* on germination of several crops and weeds, an experiment was conducted with completely randomized design and 3 replications. The following four species were included: soybean (*Glysin max*), sesame (*Sesamus indicum*), pigweed (*Amaranthus retroflexus*) and velvetleaf (*Abotilon teophrasti*). The extract of different Fenugreek parts (leaf, stem, seed, pod and the whole plant at four levels (control, 4, 8, 32 and 64 g powder/1000 ml distilled water) was evaluated. The results indicated that plants showed different reactions to concentrations of different extracts. Not only Fenugreek extract reduced seedling growth of different species, but also inhibited seed germination. A significant negative correlation was observed between germination percentage and different concentrations of organs. A regression slope minimum was obtained in stem extract. Root and shoot lengths showed a significant negative correlation with extract concentrations, in all species, except soybeans. In general, velvetleaf was the most sensitive to the Fenugreek allelochemical.*

Introduction

During the last decade, society has experienced a growing tendency towards organic farming due to pollution of environment, soil and water (Fogelberg 2001). As it apparent, in recent decade, herbicide and chemical material are used in expanded utilization. Now a days, Application of allelopathic plants are considered (Inderjit and keating 1999). With good management of these plants, use herbicides will decrease (Ture and Tawaha 2002). Effects of allelochemicals included inhibition and delay in germination, seed turgid, declining in radicle and stem development, increasing in seed radicle number and decreasing in total dry matter (Jackulski and Rudnic 1994). The purpose of this study was investigation of allelopathic effects of *trigonella gracum* on several crops and weed germination.

Materials and methods

In order to study the allelopathic effect of organ extract of *trigonella gracum* on germination of several crops and weeds, an experiment was conducted in completely randomized design with three replications. Factors included of 4 species of Soybean (*Glysin max*), Sesame (*Sesamus indicum*), Pigweed (*Amaranthus retroflexus*) and Velvetleaf (*Abotilon teophrasti*) and the extract of different Fenugreek organs (leaf,

¹ Payam Noor University of Sabzevar, Iran, E-Mail azizi40760@gmail.com

² ferdowsi University of Mashhad, Iran, E-Mail mrkondori@yahoo.com

³ Azad University of Mashhad, Iran, E-mail lealimoradi@yahoo.com

⁴ Azad University of Gorgan, Iran, E-mail siahmarguee@yahoo.com

stem, seed, pod and total organs in 4 levels (check, 4, 8, 32 and 64 g powder/1000 ml distilled water). For preparing the extract, different fenugreek organs was grinded. Then 10 gr powder was added to 100^{cc} water and passed it from sieve after 48h. In last stage , for access to favorite treatment, stock solution was diluted. Extracts was applied to the seeds on filter paper in Petri dishes. The germinated seeds were counted daily for assigning the germination percentage and germination rate. Radicle and plumule length were measured in different treatments. Statistical analysis was done by using software MSTAT-C , Excel and LSD test were used to compare the means.

A) Figures

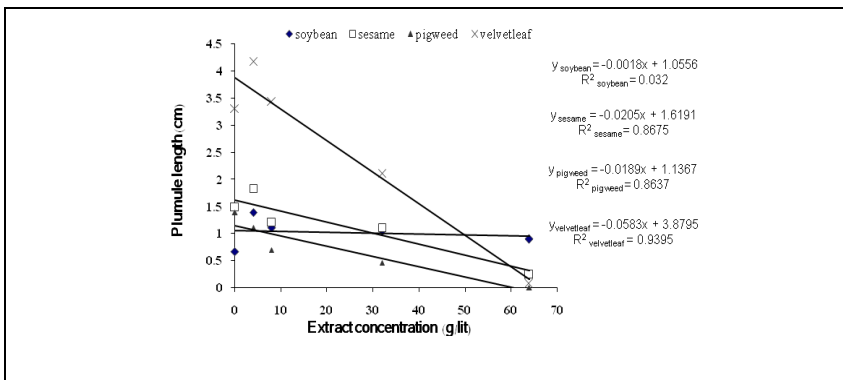


Figure 1: Correlation between different concentrations of fenugreek extracts and plumule length of some crops and weeds

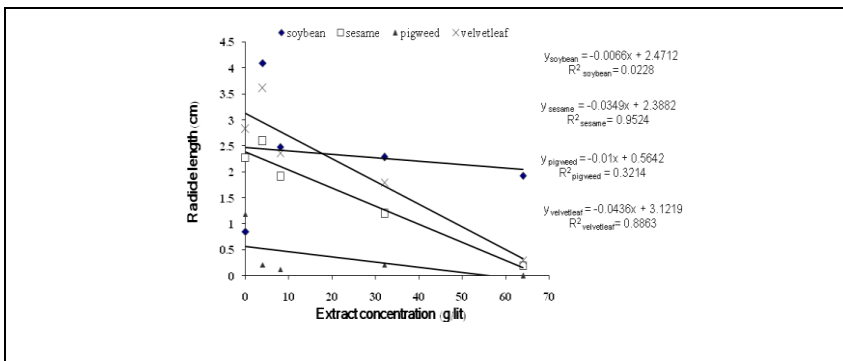


Figure 2: Correlation between different concentrations of fenugreek extracts and radicle length of some crops and weeds

B) Tables

Tab. 1: Percentage and germination rate of different species in different extract concentration of fenugreek organs

| velvetleaf | | pigweed | | sesame | | soybean | | Concentration (gr/lt) | organ |
|------------|-------------|---------|-------------|--------|-------------|---------|-------------|-----------------------|---------------------------|
| rate | percent age | rate | percent age | rate | percent age | rate | percent age | | |
| 4.39 | 55 | 2.07 | 35 | 13.56 | 100 | 7.74 | 91.67 | 0 | Leaf fenugreek |
| 2.98 | 33.33 | 0.31 | 11.67 | 10.11 | 96.67 | 3.24 | 93.33 | 4 | |
| 2.17 | 58.33 | 0.74 | 15 | 6.76 | 95 | 4.56 | 93.33 | 8 | |
| 0.54 | 25 | 0 | 0 | 5.93 | 98.33 | 3.34 | 70 | 32 | |
| 0 | 0 | 0 | 0 | 5.37 | 100 | 0.67 | 23.33 | 64 | Stem fenugreek |
| 4.56 | 54.8 | 2.02 | 34.1 | 13.56 | 100 | 7.76 | 91.67 | 0 | |
| 2.01 | 33.33 | 0.62 | 11.67 | 10.65 | 98.33 | 4.99 | 86.67 | 4 | |
| 2.61 | 36.67 | 1.03 | 23.33 | 11.28 | 100 | 5.31 | 80 | 8 | |
| 1.03 | 21.67 | 0.13 | 3.33 | 7.77 | 100 | 5.41 | 100 | 32 | Seed fenugreek |
| 1.36 | 31.67 | 0 | 0 | 6.09 | 100 | 4.94 | 98.33 | 64 | |
| 4.40 | 55.1 | 2.04 | 35 | 13.56 | 100 | 7.66 | 86.67 | 0 | |
| 3.93 | 53.33 | 1.05 | 21.67 | 16.41 | 100 | 5.06 | 86.67 | 4 | |
| 1.04 | 15 | 0.22 | 3.33 | 13.13 | 75 | 3.31 | 56.67 | 8 | Pod fenugreek |
| 2.76 | 51.67 | 0 | 0 | 7.5 | 81.67 | 2.21 | 60 | 32 | |
| 0.04 | 1.67 | 0.04 | 1.67 | 2.91 | 33.33 | 2.66 | 66.67 | 64 | |
| 4.47 | 58.33 | 2.05 | 35.3 | 13.56 | 100 | 8.08 | 95 | 0 | |
| 5.44 | 71.67 | 0.56 | 11.67 | 12.82 | 100 | 5.62 | 100 | 4 | Total organs of fenugreek |
| 3.90 | 70 | 0.89 | 18.33 | 10.51 | 95 | 5.8 | 96.67 | 8 | |
| 0.56 | 20 | 0 | 11.67 | 9.17 | 98.33 | 6.10 | 91.67 | 32 | |
| 0.12 | 5 | 0 | 0 | 2.91 | 58.33 | 6.06 | 86.67 | 64 | |
| 4.39 | 55 | 2.03 | 34.8 | 13.56 | 100 | 7.71 | 88.33 | 0 | |
| 3.65 | 45 | 1.57 | 33.33 | 12.56 | 100 | 6.83 | 93.33 | 4 | |
| 4.14 | 48.33 | 0.74 | 16.67 | 11.71 | 93.33 | 6.64 | 93.33 | 8 | |
| 0.41 | 10 | 0.2 | 5 | 9.15 | 98.33 | 4.65 | 88.33 | 32 | |
| 0.04 | 1.67 | 0 | 0 | 4.62 | 91.67 | 3.08 | 76.67 | 64 | |
| | | | | | | | | 5.519 | (percentage) LSD |
| | | | | | | | | 0.585 | (Rate)LSD |

The means in each column was compared with LSD test ($P < 0.05$)

Tab. 1: Radicle and plumule length of different species in different extract concentration of fenugreek organs

| velvetleaf | | pigweed | | sesame | | soybean | | Concentration (gr/lt) | organ |
|------------|---------|---------|---------|---------|---------|---------|---------|-----------------------|---------------------------|
| radicle | plumule | radicle | plumule | radicle | plumule | radicle | plumule | | |
| 2.28 | 3.31 | 1.18 | 1.39 | 2.56 | 1.52 | 0.86 | 0.67 | 0 | Leaf fenugreek |
| 3.62 | 4.40 | 0.47 | 1.48 | 2.10 | 1.9 | 2.02 | 0.73 | 4 | |
| 4.38 | 4.68 | 0.31 | 1.46 | 0.6 | 1.51 | 5.04 | 1.27 | 8 | |
| 1.11 | 0 | 0 | 0 | 1.11 | 1.11 | 3.39 | 0.96 | 32 | |
| 0 | 0 | 0 | 0 | 0.56 | 0.79 | 0.26 | 0 | 64 | Stem fenugreek |
| 2.81 | 3.32 | 1.19 | 1.40 | 2.57 | 1.53 | 0.87 | 0.66 | 0 | |
| 2.83 | 4.02 | 0 | 0 | 3.12 | 1.46 | 4.72 | 1.14 | 4 | |
| 1.90 | 2.07 | 0.08 | 0.68 | 1.37 | 0.48 | 1.81 | 1.01 | 8 | |
| 1.79 | 4.46 | 0.1 | 0.37 | 0.58 | 0 | 1.9 | 1.56 | 32 | Seed fenugreek |
| 0.08 | 0.33 | 0 | 0 | 0.19 | 0.23 | 1.9 | 0.84 | 64 | |
| 2.81 | 3.30 | 1.17 | 1.38 | 2.55 | 1.51 | 0.85 | 0.68 | 0 | |
| 2.47 | 5.03 | 0.21 | 1.14 | 3.8 | 2.08 | 3.91 | 1.84 | 4 | |
| 0.12 | 0.66 | 0.04 | 0.24 | 1.21 | 0.51 | 0.27 | 0 | 8 | Pod fenugreek |
| 2.48 | 1.83 | 0 | 0 | 1.64 | 1.61 | 0.27 | 0 | 32 | |
| 1.33 | 0 | 0 | 0 | 0 | 0 | 1.59 | 0 | 64 | |
| 2.83 | 3.33 | 1.17 | 1.41 | 2.57 | 1.54 | 0.87 | 0.65 | 0 | |
| 4.01 | 0.77 | 0.17 | 0.87 | 1.02 | 1.19 | 4.01 | 0.77 | 4 | Total organs of fenugreek |
| 3.14 | 5.14 | 0.13 | 0.78 | 3.89 | 2.43 | 3.73 | 1.70 | 8 | |
| 1.47 | 1.32 | 0.78 | 0.59 | 1 | 1.33 | 3.16 | 2.14 | 32 | |
| 0.1 | 0 | 0 | 0 | 0.03 | 0 | 3.44 | 3.08 | 64 | |
| 2.82 | 3.31 | 1.18 | 1.39 | 1.19 | 1.39 | 0.86 | 0.67 | 0 | |
| 5.11 | 5.79 | 0.23 | 1.73 | 2.9 | 2.52 | 5.8 | 2.42 | 4 | |
| 2.38 | 4.64 | 0.06 | 0.3 | 2.49 | 1.1 | 1.57 | 1.53 | 8 | |
| 2.14 | 2.92 | 0.2 | 1.3 | 1.64 | 1.46 | 2.71 | 0.53 | 32 | |
| 0 | 0 | 0 | 0 | 0.18 | 0.23 | 2.42 | 0.54 | 64 | |
| | | | | | | | | 0.485 | (plumule) LSD |
| | | | | | | | | 0.557 | (Radicle)LSD |

The means in each column was compared with LSD test ($P < 0.05$)

Results

The results showed that different crops had different responses to extract of fenugreek organs. This plant has allelopathic effect and reduced the seed germination and the number of germinated seed in each day. With increasing the concentration of different organ extract of fenugreek, the percentage and germination rate decreased significantly (from 0 to 64%). The leaf extract of fenugreek has the highest reduction in germination percentage and germination rate (91, 74%) and pod extract has the lowest reduction (9, 25). Soybean germination did not follow the same trend in different extract of stem and mix of the total organs (table1). In sesame the highest and lowest of inhibition effects on germination percentage of germination rate was observed, (98% and 8 %) respectively. The seed and pod extract had the highest

negative effect on germination rate. In pigweed with increasing the concentration extract from 0 to 64%, the highest decreasing in germination percentage and germination rate in stem and pod extract and the lowest effect of allelopathy in pod and mixed organ was obtained. Seed, pod and mixed organs had the highest negative effect on percentage and growth rate of velvetleaf (table 1).

Fenugreek extract not only reduced seedling growth of different species, but also inhibited seed germination, whereas in all species with increasing the concentration extract of different organs of Fenugreek from 8 to 64, radicle and plumule was decreased. The different organs of Fenugreek had the stimulating effect in low concentration and inhibition effect in higher concentration in all of the species (table 2). There was negative correlation between different extract levels and radicle and plumule length in different crop and weed species. This result was observed in all species except for soybean (Figures 1 and 2).

Discussion

Fernańdez-Aparicio *et al.* (2008) showed a decrease in *Orobanche crenata* infection due to an allelopathic interference on the parasitic life cycle at the level of germination. Inhibition of *O. crenata* seed germination by allelochemicals released by fenugreek roots is suggested as the mechanism for reduction of *O. crenata* infection.

Jabeen and Ahmed (2009) designed an experiment to determine the allelopathic effects of three different weeds, *Asphodelus tenuifolius* Cavase, *Euphorbia hirta* Linn, *Fumaria indica* Haussk on the growth of maize. The weed powders toxicity and their inhibitory effects on germination and growth of maize crop were observed. It was observed that *Asphodelus tenuifolius* and *Fumaria indica* inhibited germination percentage of maize.

Conclusions

The results indicated that crop and weed species responses to allelopathic substances were different due to the species nature and amount of allelopathic substances of fenugreek parts.

In all species, the highest allelopathic effect was observed for seed and leaf extracts. In general, velvetleaf was more sensitive and soybean more tolerant, than other species to allelopathic substances. Further experiments need to be conducted for practical utilization of fenugreek as weed inhibiting plant by using this plant in the intercropping systems.

References

- Fernańdez-Aparicio, M., Emeran A. A., Rubiales D. (2008): Control of *Orobanche crenata* in legumes intercropped with fenugreek (*Trigonella foenum-graecum*). *Crop Prot.* 27: 653–659.
- Fogelberg F. (2001): Research on pest control and pesticide reduction in Sweden, Denmark and the Netherlands. Dept. Agricultural Engineering. Swedish University of Agricultural Sciences
- Inderjit K., Keating L. (1999): Allelopathy: Principal and Practice. John Promises for Biological Control in: *Advance in Agronomy*, (eds). Sparks, D. I., Academic Press. 67:141-231.
- Jabeen N., Ahmed M. (2009): Possible allelopathic effects of three different weeds on germination and growth of maize (*Zea mays*) cultivars. *Pakistan J. Bot.* 41: 1677-1683.
- Jackulski D., Rudnic F. (1994): Matural effects between species of cereals in the course of germination *fragmenta agronomic.* Vol.11:89-94.
- Ture, M.A., Tawaha A.M. (2002): Inhibitory effects of aqueous extracts black mustard on germination and growth of lentil. *Pakistan J. Agron.* 1:28-30.

Influences of crop rotation in energy crops and biogas slurry application on earthworm populations

Wolfrum, S.¹, Thoma-Rademacher, M.¹, Papaja, S.¹, Reents, H. J.¹, Kainz, M.¹,
Hülsbergen, K. J.¹

Key words: energy crops, crop rotation, biogas slurry, earthworms

Abstract

*To explain the influence of crop rotation and biogas slurry manuring on earthworm populations, a field experiment of the organic experimental station Viehhausen was tested. Two different crop rotations with and without biogas slurry applications were sampled in spring 2010. While biogas slurry showed a small but not significant impact on biomass, it was able to increase the abundance of earthworm populations. Different abundance through manuring was significant for both, the crop rotation with a high percentage of legumes and the standard crop rotation containing cereals and legumes. Earthworm abundance and biomass was not affected by different crop rotations. The abundance and biomass of the earthworms showed no significant reaction to interactions of biogas slurry and crop rotation, too. However, the tested crop rotations showed differences in earthworm species composition. Considering experiences from other authors, this might be due to different intensity of ploughing and legumes. Within the adult specimen the most abundant species in all plots was endogeic *Aporrectodea caliginosa*.*

Introduction

Within the last years the numbers of biogas plants rapidly increased. From the view of a crop-producing farm, a biogas plant offers several advantages. Biogas slurry provides a mobile N-resource, which can be used as a development stage specific fertilizer and thus might produce an increase in yield and product quality. Simultaneously N-exports from the farm are reduced. Analog to animal producing farms closed N-cycles are possible. Nevertheless, because some assimilated C is brought back to the field, a change in humus content will be most likely. However, information on the possible impacts of these systems are rarely available.

For that reason in 2004/05, a field experiment regarding the effect of crop rotations for biogas-production to yield and soil properties was established at the organic experimental station Viehhausen. The five different crop rotations in the experiment mirror different strategies for energy and food production or soil conservation. A special focus of the experiment lies on the development of soil biodiversity. This paper describes the results of a first assessment of earthworms as indicators for soil health and soil biodiversity. We tested whether there is a positive impact of biogas slurry or crop rotation on earthworm abundance and biomass and which of these factors is more important.

¹ Chair for Organic Agriculture and Agronomy, Life Science Center Weihenstephan ,TU München, Alte Akademie 12, 85354 Freising, Germany, E-Mail sekretariat.oekolandbau@tum.de, Internet www.wzw.tum.de/oekolandbau/

Materials and methods

The Viehhausen experimental farm is located in the Bavarian “Tertiärhügelland” about 30 km north-east of Munich, 480 m N.N., Ø 797 mm precipitation, Ø 7,5 °C. Soils are Cambisols or Luvisols. The experiment is designed as a two factorial trial, which examines the effects of 5 main crop rotations. Considering sub variations a total of 10 different rotations is applied to the plots. Each main rotation plot is 576 m². Standard slurry from a nearby renewables biogas plant (Analysis 2009: DM 6,1 %; N=3,5 kg/m³; C= data not available) is brought back onto the plots depending on harvested biomass and crop requirements. Each rotation is treated with and without biogas slurry. All treatments are replicated four times on subplots of 6 m x 12 m. The experiment contains four field blocks in order to have all different crops in the rotations on the site each year. Details are shown in Tab. 1.

Tab. 1: Crops and biogas slurry applications 2010 on investigated rotations. Sampled plots are in bold letters.

| Crop Rotation | Biogas slurry | 1. Block | Slurry application (m ³ /ha) | 2. Block | Slurry application (m ³ /ha) | Catch Crop | 3. Block | Slurry application (m ³ /ha) | 4. Block | Slurry application (m ³ /ha) |
|----------------|---------------|----------|---|-----------------|---|------------|----------|---|-----------|---|
| 6.2 | yes (mG) | Clover | 60 | Winter | 80 | Clover | Clover | 0 | Clover | 30 |
| | no (oG) | Grass | 0 | Wheat | 0 | Grass | Grass | 0 | Grass | 0 |
| 7.1 (Standard) | yes (mG) | Clover | 0 | Winter | 40 | Forage | Maize | 60 | Triticale | 50 |
| | no (oG) | Grass | 0 | Wheat | 0 | Rye (E) | | 0 | WPS | 0 |

Due to limited resources, only two crop rotations in one block were sampled in spring 2010. On both fields, winter wheat was grown during the sampling period. For each treatment four replications were sampled. In each replication two subsamples, 32 in total, were collected and aggregated. Earthworms were sampled with a combination of an expellant (Allylisothiocyanate solution) and hand sorting procedure according to the BioBio project standards (Dennis et al. 2010) which were adapted from Pelosi et al. (2009). Based on linear models (*abundance/biomass ~ rotation * slurry application*) ANOVA statistics were calculated with the statistics software package R 2.11.1.

Results

A total number of 524 earthworms were collected. 81% of the specimens were juvenile earthworms, which were not identified to species level.

Tab. 2: Results earthworm abundance and biomass (6.2 = clover grass rotation; 7.1 = standard rotation; mG = with biogas slurry; oG = without biogas slurry)

| Variations | | Abundance (specimen/m ²) | | | Biomass (g/m ²) | | |
|------------|-----|--------------------------------------|-----------------|-----------|-----------------------------|-------------|----------|
| | | mean | sd | * | mean | sd | * |
| 6.2mG | n=4 | juvenil | 151 ± 51 | | 24.3 | 9.1 | |
| | | adult | 53 ± 38 | | 33.1 | 26.4 | |
| | | total | 204 ± 14 | ab | 57.4 | 24.0 | a |
| 6.2oG | n=4 | juvenil | 115 ± 40 | | 19.6 | 6.7 | |
| | | adult | 25 ± 6 | | 20.6 | 13.3 | |
| | | total | 140 ± 38 | a | 40.1 | 19.7 | a |
| 7.1mG | n=4 | juvenil | 211 ± 40 | | 20.6 | 6.2 | |
| | | adult | 35 ± 26 | | 22.1 | 16.7 | |
| | | total | 246 ± 59 | b | 42.6 | 15.8 | a |
| 7.1oG | n=4 | juvenil | 113 ± 16 | | 13.3 | 3.2 | |
| | | adult | 25 ± 25 | | 12.4 | 14.0 | |
| | | total | 138 ± 33 | a | 25.7 | 11.6 | a |

* different letters show significant differences (ANOVA, post hoc Tukey-HSD test, p < 0,05)

Within the adult specimen, we found four different species. Tab. 2 shows detailed results for the sampled variations.

For the four treatments ANOVA showed a significant difference in earthworm abundances ($F(3,12) = 7,054$, $p < 0,01$). Differences were mainly due to different biogas slurry application ($F(1) = 18.936$, $p < 0,001$). There was no significant effect of crop rotation and no significant effect of interaction of rotation and slurry application. Manuring increased earthworm abundance in rotation 6.2 by 46 % and in 7.1 by 79 %. ANOVA showed no significant differences between the variation according to biomass of the collected earthworms ($F(3,12) = 1,998$, $p > 0,1$). However, there was a tendency for higher biomass in the manured variations.

Especially the biomass of adult earthworms was higher in the plots of rotation 6.2 (increase of 61 %) and 7.1 (increase of 79 %) with slurry application. The biomass of all specimen and especially the adults was generally lower in the plots of rotation 7.1.

The dominant earthworm species in all samples was *Aporrectodea caliginosa*. Biogas slurry application favoured the abundance of endogeic *Aporrectodea caliginosa* in both crop rotations (see Fig. 2). The anecic species *Lumbricus terrestris* had higher abundance and share of biomass in crop rotation 6.2 (see Fig. 3).

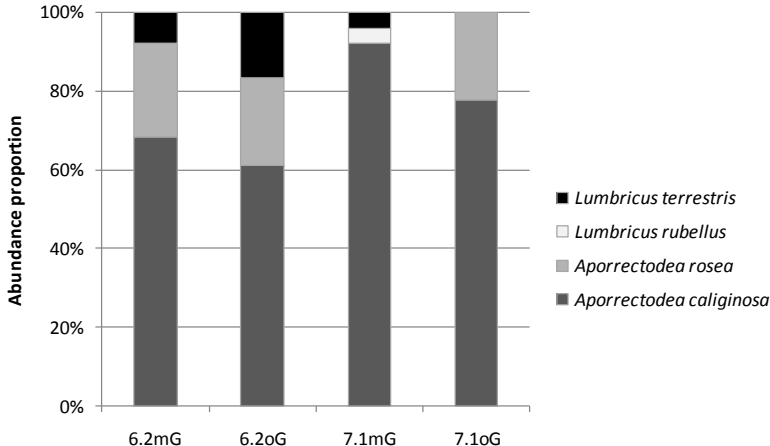


Fig. 1: Species composition of adult specimen

Discussion

The results of this study are in line with the result of other authors (e. g. Petz 2000) which indicate a positive impact of biogas slurry manuring on earthworms. This can be explained by improved direct food availability through organic material in the slurry on the one hand and increased plant growth - and thus indirectly by improved food availability - on the other hand. Because of the loss of C during fermentation biogas slurry has a low C/N ratio and is thus a good and easily degradable food resource for soil organisms. The unexpected low impact of the different crop rotations can be explained partly by low yields of clover grass in 2009. The resulting negative impact on organic material, which could serve as food resource for the earthworm populations, might have masked the expected positive effect of a high clover grass proportion in the crop rotations on earthworm numbers. The reason for the higher

abundance and biomass of *Lumbricus terrestris* in rotation 6.2 is the positive influence of reduced tillage during the three years of clover grass in the rotation that especially benefits the anecic earthworms (Eriksen-Hamel et al. 2009).

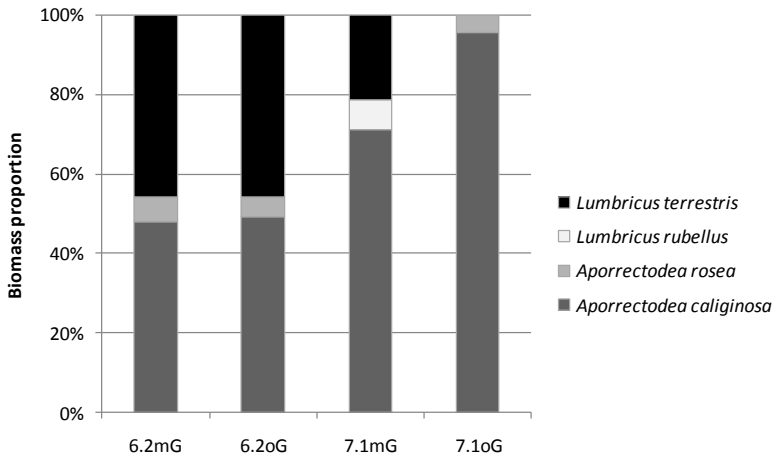


Fig. 2: Species-specific distribution of biomass within adult specimen

Conclusions

The analysis provides some evidence for a positive impact of biogas slurry on earthworms and thus on soil health and biodiversity. However, since the sample size of this analysis was quite small, the results have to be verified. It is planned to repeat the assessment in spring 2011 with an increased sample size.

References

- Dennis P., Herzog F., Jeanneret, P., Arndorfer, M., Bogers, M., et al. (2010): BIOBIO - Deliverable 2.2. Selection and field validation of candidate biodiversity indicators, including field manual. <http://www.biobio-indicator.org> (accessed 2010-12-20)
- Eriksen-Hamel N. S., Speratti A. B., Whalen J. K., Legere A., Madromotoo C. A. (2009): Earthworm populations and growth rates related to long-term crop residue and tillage management. *Soil & Tillage Research*. 104: 311-316.
- Pelosi C., Bertrand M., Capowiez Y., Boizard H., Roger-Estrade J. (2009): Earthworm collection from agricultural fields: Comparisons of selected expellants in presence/absence of hand-sorting. *European Journal of Soil Biology*. 45: 176–183.
- Petz W. (2000): Auswirkungen von Biogasgülle - Düngung auf Bodenfauna und einige Bodeneigenschaften - Eine Freilandstudie an vier Standorten in Oberösterreich.

Effect of nutrient resource and crop diversity on insect diversity

Azizi, G.¹, Jahani Kondori, M.², Koocheki, A.³ & Nassiri-Mahallati, M.⁴

Key words: species diversity, intercropping, Shannon index, variety diversity

Abstract

In order to investigate the effects of plant diversity and nutrient resource on insect density and diversity, an experiment was conducted as split plot based on complete randomized block design with 3 replications at the Agricultural Research Station, Ferdowsi University of Mashhad, Iran, during 2006 and 2007. Treatments included manure and chemical fertilizers as main plots and intercropping of 3 soybean varieties (Williams, Sahar and Gorgan3), intercropping of 3 Millet species (common millet, foxtail millet and pearl millet), intercropping of millet, soybean, sesame (Sesamum indicum) and intercropping of millet, sesame, fenugreek (Trigonella foenum-graecum), ajowan (Trachyspermum ammi) as sub plots. Result indicated that pests was more than natural enemies, significantly, in 2 years. In first year the maximum of natural enemy population was observed in intercropping of 3 Millet species (4.16%) and monoculture of soybean and Ajowan (5.03 and 3.57%, respectively). In two years, insect density and diversity was lower in manure treatment. There was a significant correlation between crop and insect Shannon indices. With increasing crop diversity, insect diversity deceased. With altering in planting pattern, the mean of insect Shannon index changed. In first and second year, the maximum of insect Shannon index was observed in variety and functional diversity, respectively. Monocultures had the lower insect Shannon index than other planting patterns.

Introduction

A method for control insects and diseases, is application of chemical toxins and resistance varieties. But these methods is impermanent and expensive. In other hand chemical toxins extent resistance in insects and disease factors (Cardwell and Lomer 2002). The vast application of insecticides, has been caused for secondary invasion and resistance to insecticides (Hooks and Johnson 2003). A new view to intercropping systems is for the reason that these systems make different interactions between herbivores and predators (Nassiri-Mahallati *et al.* 2001). Also, it makes barriers for plant insect and disease development (Vandermeer, 1990) and decreases insect damaging (Vandermeer 1990; Liebman and Dyck 1993; Baumann *et al.* 2001) whereas in the monoculture fields, there are great amount of nutrient resources permanently for disease factors and pest that it cause proper conditions for insect and disease increasing (Vandermeer 1990). Yang and Tang (1988) showed that 267 plant species have insecticide characteristics that can be used in polyculture patterns.

Materials and methods

¹ Payam Noor University of Sabzevar, Iran, E-Mail azizi40760@gmail.com

² Ferdowsi University of Mashhad, Iran, E-Mail mrkondori@yahoo.com

³ Ferdowsi University of Mashhad, Iran

⁴ Ferdowsi University of Mashhad, Iran

This experiment was conducted as split plot based on complete randomized block design with 3 replications at the agricultural research station, Ferdowsi University of Mashhad, Iran, during 2006 and 2007. Treatments included manure and chemical fertilizers (equivalent to nutrient in manure) in main plots and intercropping of 3 soybean varieties (Williams, Sahar and Gorgan3), intercropping of 3 Millet species (Common millet, Foxtail millet and Pearl millet), intercropping of Millet, Soybean, Sesame (*Sesamum indicum*, intercropping of Millet, Sesame, Fenugreek (*Trigonella foenum-graecum*), Ajowan (*Trachyspermum ammi*) and monoculture of these plants in sub plots. Plots were not treated with insecticides.

Table 1: manure and soil characteristics in 2006 and 2007

| year | nutrient resource | nitrogen (%) | phosphorus (PPM) | potassium (PPM) | pH | EC (ds.m ⁻¹) | texture |
|------|-------------------|--------------|------------------|-----------------|-----|--------------------------|---------|
| 2006 | soil | 0.05 | 14.00 | 110.11 | 7.1 | 2.99 | loam |
| | manure | 1.23 | 168.12 | 171.06 | - | - | - |
| 2007 | soil | 0.07 | 20.92 | 8.60 | 7.7 | 2.08 | loam |
| | manure | 1.28 | 276.07 | 2992.50 | - | - | - |

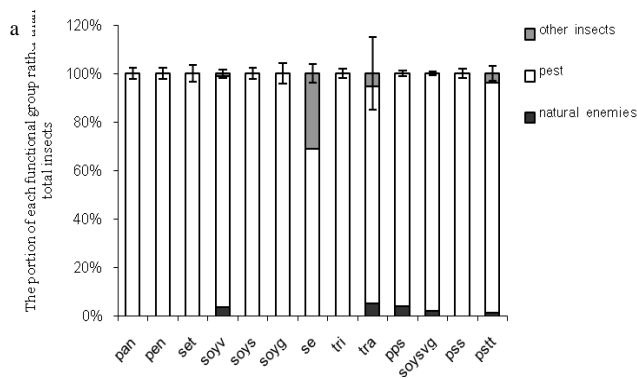
Main plot was 71 meter length and 3 meter wide and every sub plot was 5*3 meter. In order to determine insect density and diversity in different treatments, the measurements was conducted when 80% radiation was absorbed by plant canopy. Shanon index (H) was used for defining insect diversity:

$$(1) \ H = - \sum P_i \times \text{Log} P_i$$

$$P_i = \frac{n_i}{N}$$

N: number of total individuals n: number of individuals in a species P_i: Relative frequency for a species

a)



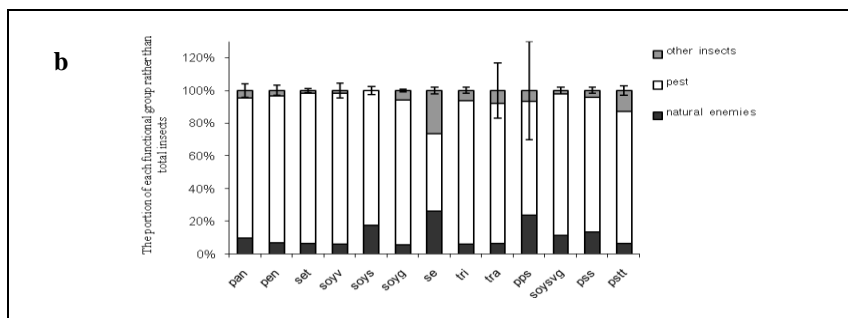


Figure 1: The portion of each functional groups rather than total insects in different planting patterns (2006, a. and 2007, b.)

pan (common millet) pen (Pearl millet) set (Foxtail millet), soya (soybean, Williams variety) soya (soybean, Sahar variety), soya (soybean, Gorgan3 variety), se (sesame), tri (Fenugreek) tra (Ajowan), pps (intercropping of 3 Millet species), sss (intercropping of 3 soybean varieties), pss (intercropping of Millet, Sesame, Fenugreek) pss (intercropping of Millet, Sesame, Fenugreek, Ajowan)

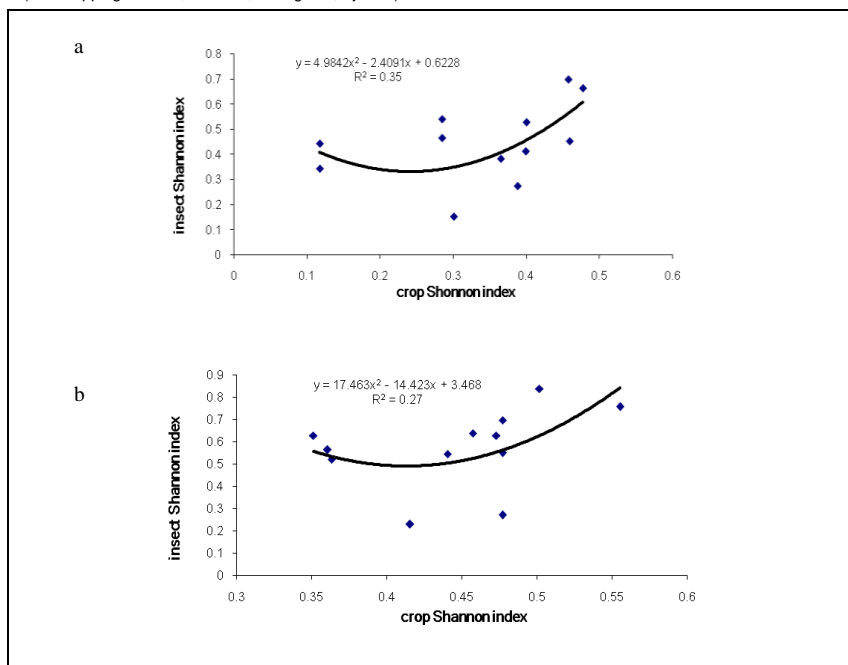


Figure 2: Relationship between crop and insect Shannon index in 2006 (a) and 2007(b)

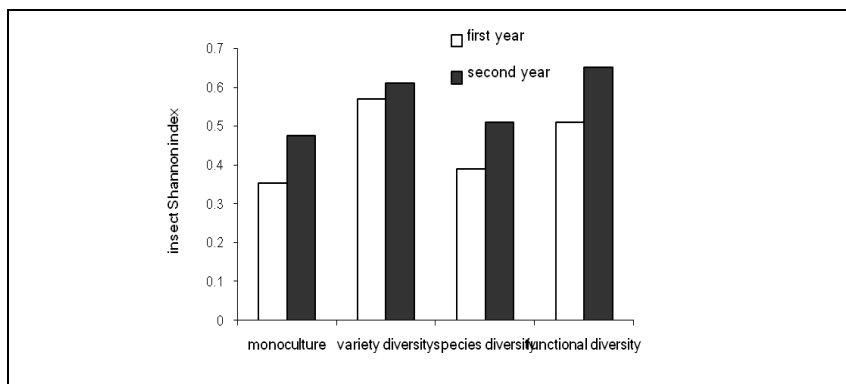


Figure 3: The means of insect Shannon index in monoculture and intercropping systems

Results

As it was observed in figure 1, in two years, portion of pests was more compare to natural enemies. One of reasons of this result is persistent variations in fields due to agricultural activities. This factor maintain agroecosystems in first serial stage of succession and increase insect and pest population.

In first year the maximum of natural enemy population was observed in intercropping of 3 Millet species (4.16%) and monoculture of soybean and Ajowan (5.03 and 3.57%, respectively).

In the second year, the population of natural enemies was increased compare to first year. One of reasons of this result could be plant establishment and climate change.

There was significant regression between crop Shannon index and insect Shannon index. With increasing the crop Shannon index and increasing physiological and morphological differences in planting pattern, insect diversity was increased (figure 2). With altering in planting pattern, the mean of insect Shannon index changed. In first and second year, the maximum of insect Shannon index was observed in variety and functional diversity, respectively. Monocultures had the lower insect Shannon index than other planting patterns (figure3) .

Discussion

Monocultures had the lower insect Shannon index than other planting patterns Because in the monoculture fields, there are great amount of nutrient resources permanently for disease factors and pest that it cause proper conditions for insect and disease increasing (Vandermeer 1990).

Conclusions

In general, pests was more than natural enemies in studied agricultural systems. Nutrient resource affected on insect diversity. Insect density and diversity was lower in manure treatment. With increasing crop diversity, insect diversity deceased. Also, monocultures had the lower insect Shannon index than other planting patterns.

References

- Baumann D. T., Bastiaans L., Kropff M. J. (2001): Composition and crop performance in a leek- celery intercropping system. *Crop Science*, 41: 764-774.
- Cardwell, K. F., and Lomer, C. J. (2002). Principles of Pest Management with Emphasis on Plant Pathogens. www.Informaworld.com.
- Hooks C R. R., Johnson, M W (2003): Impact of agricultural diversification on the insect community of cruciferous crops. *Crop Protection*, 22: 223–238.
- Liebman, M., Dyck, E. (1993). Crop rotation and intercropping strategies for weed management. *Ecological Applications*, 3: 92–122.
- Nassiri-Mahllati M., Koocheki A., Rezvani-Moghadam P., Beheshti A. (2001): *Agroecology*. Ferdowsi University Publication
- Vandermeer, J. H. (1990): Intercropping. In: Carrol, C. R., Vandermeer, J. H. Rosset, P. (Eds). *Agroecology*. McGraw-Hill, New York.
- Yang, R. Z. and Tang, C. S. (1988): Plants used for pest control in China: a literature review. *Ecological Botany*, 42: 376–406.

Research methodology and knowledge dissemination

A cross-disciplinary approach to multicriteria assessment and communication of the effects of organic food systems

Alrøe, H.F.¹ & Noe, E.2

Key words: multicriteria, assessment, credibility, perspectives, MultiTrust

Abstract

This paper describes a cross- and transdisciplinary approach to develop a multicriteria assessment framework that aims to help organic actors and stakeholders conduct, document and communicate balanced overall assessments of the effects of organic food systems on society and nature. The framework will be based on extensive analyses of existing methods for multicriteria assessment and communication, and the adaptation and development of selected methods to suit organic food systems and the principles organic agriculture. The validity and utility of the framework is secured through involvement of actors and participatory testing of prototypes in practice. The goal is to help sustain an integrated development of the organic production, contribute to open and credible communication, and thereby support long term growth.

Introduction

The organic form of production aims to fulfil many different private and societal objectives at the same time. And according to a recent Danish knowledge synthesis, the potential for continued growth of the organic market depends not only on further technological and organisational development, but also on securing the integrity and credibility of the organic alternative through continued improvement in line with the organic principles and increased synergy with societal goals and consumer concerns about health, animal welfare and the environment (Alrøe & Halberg 2008). There is therefore a need for tools that can mediate and communicate overall assessments of a range of different effects of organic production and food chains on society, environment and nature.

Some of the effects of organic agriculture can be measured and assessed in quantitative terms. For others only qualitative assessments are available. An important question is therefore how to establish a balance between using quantitative and precise assessments where available and avoiding that aspects which are relatively easy to measure, gain disproportionate weight in the overall assessment. Attempting to evaluate all aspects of organic farming in monetary terms would be empirically demanding and in some cases theoretically problematic. Multicriteria analysis offers an alternative approach in terms of techniques for structuring and solving decision problems characterised by multiple, incomparable and possibly conflicting criteria (Bogetoft & Pruzan 1997). There is a body of general multicriteria techniques available, but they have to be adapted to the distinct and varied problems posed by overall assessments of organic food systems.

¹ Research Group for Integrated Geographical and Social Studies, Department of Agroecology and Environment, Aarhus University, Blichers Allé 20, P.O. Box 50, 8830 Tjele, Denmark, E-Mail hugo.alroe@djf.au.dk, Internet hugo.alroe.dk

² As above.

Appropriate assessment techniques are important for making a balanced and comprehensive evaluation of the effects of organic agriculture. Yet, they are of little relevance if they are not easy to communicate and understand for the many different organic actors and stakeholders. From a communication perspective the main challenges for multicriteria assessment of organic agriculture are normative transparency and complexity handling. In any assessment there is both an empirical and a normative aspect. The assessment of complex systems must be based on a reduction of complexity, such as the choice of indicators. Indicators are quantitative or qualitative measurements of certain states or dynamics in the system, which are selected because they are important to us. For the ways in which they are important, Hartmut Bossel (e.g. 1999, 2001) has suggested the term *orientors* to represent fundamental interests, values, criteria or objectives. "It does not make much sense to develop indicator systems without explicit reference to the orientors about which they are to provide information. But that means starting by first analyzing the fundamental interests or orientors of the system for which we want to define indicators." (Bossel 1999: 26)

There is therefore a need to work explicitly with how normative criteria are built into the multicriteria assessment framework, e.g. in the selections and condensations made, and how orientors in the framework relate to values and principles of organic agriculture and societal interests and objectives. The importance of this normative work is underlined by the fact that different actors and stakeholders may attach different weights and values to different effects.

Furthermore, the ability to handle complex information differs, communication strategies are multiple, and there is a fragmentation of information. Modern societies are media-saturated, and the media have to be taken into consideration when credibility and trust are constructed and negotiated. Important research questions are how credibility and trust is constructed in the organic value chains, and what the potentials are for more nuanced assessments – particularly in light of the increasing complexities caused by 1) globalisation and differentiation of food chains, 2) expansion of media and communication channels, and 3) efforts to include additional considerations for nature and society in the certifications of organic agriculture.

The cross-disciplinary approach described here will be carried out in the research, development and demonstration project "Multicriteria assessment and communication of the effects of organic food systems (MultiTrust)." The project is supported by the Danish Organic RDD programme and runs in 2011-2013. It includes partners from agricultural science, food economy, environmental education, media science, business communication, animation and visualisation, advisory services, a dairy company, and municipalities and regions, as well as nine international partners. The main goal of project is to provide analyses, methods and prototypes of multicriteria assessment, which can help organic actors and stakeholders develop, document and communicate balanced overall assessments of the effects of organic food systems on society and nature.

Methods

If the MultiTrust project is to successfully achieve its goals, the two main perspectives outlined in the introduction (the technical and economic assessment perspective and the contextual communication perspective) will have to be combined throughout the work. There are multiple other and more specific perspectives involved in the project, perspectives that cannot be unified, but must be utilized in unison. The project is

therefore construed as a multiperspectival (or polyocular) approach, which works explicitly with the different scientific and actor perspectives involved (in line with Giere 2006a, 2006b), and how they expose different aspects of organic agriculture (see further in Alrøe & Noe 2008, Noe *et al.* 2008). The multiperspectival approach is required both to facilitate the cross-disciplinary work and to enable the participation of a diverse range of organic actors and stakeholders in this work (Alrøe & Noe 2010).

The research studies in the MultiTrust project are divided into three parts with different methods. They run in sequel, but with a large overlap to ensure interaction. The first part is to carry out reviews of general approaches and methods for multicriteria assessment, and of how such overall assessments can be communicated with regard to complexity, values, trust, and credibility. This will provide a theoretical background for the project. The second part is to establish a framework for how to carry out overall assessments specifically of organic food systems in relation to the organic principles, and moreover to develop concrete assessment, communication and visualisation tools. In relation to this, it will also carry out empirical analyses of relations and communication in selected organic food networks. The last part will test prototypes of methods for multicriteria assessment and communication in selected cases with groups of stakeholders, including organic farmers, food processing and marketing companies, consumers and public officials at the municipal, regional and state level. In relation to this, it will investigate consumer conceptions of different assessment criteria for organic food and farming.

Results

The project has barely started yet, but the results are expected to contribute to open and credible communication about the benefits of organics, serve as a policy tool in relation to regulation and differentiated support schemes, and support the integrated development of organic production in relation to the organic principles. And a key hypothesis is that this will improve the potential of the organic alternative to help solve current societal challenges and support long term growth of the organic market.

A separate result of the project is the further development of cross-disciplinary, transdisciplinary and multiperspectival research methodology. Much importance is placed on project meetings that include all university and actor partners, which will facilitate the cross-disciplinary working process by working explicitly with how different perspectives influence goals and problems, observations, communications and results. As an element in this, and to make the participants better able to understand each other, each partner will write a short 'self-labelling' text that describes their perspective. This will include the theoretical or practical background, the meaning of key concepts, what is taken as the main problem, and how the perspective can contribute to the goals of the project.

At the time of the conference we expect to be able to communicate the first experiences with the cross-disciplinary methodology and some first results on the reviews of existing multicriteria assessment and communication methods.

Discussion

Organic agriculture has been studied intensively in research studies (e.g. biodiversity, nutrient flows and consumer reactions), and much information is accessible. Nevertheless, it is complicated to judge how different and often conflicting results should be evaluated. One of the challenges is that in order to pave the way for a

growing importance of organic food production, the organic actors have to document and communicate complex and sometimes intangible benefits, such as ecosystem services, environmental and landscape protection, sustainable food supply, health and food safety, rural development and employment. A broad understanding and acceptance of this challenge is an important means to qualify the dialogue with citizens and policymakers – and this can support the further development of the organic food production methods, and the further implementation of organic agriculture as a part of the measures to meet overall societal goals.

Conventional systems are often optimized with regard to a few criteria that can be measured in quantitative terms, and which have a high societal focus. The framework developed here can be useful to make more comprehensive assessments of agriculture in general – not only of organic agriculture – and this will be important for future agricultural policy and for the food market. Having one common way to assess the effects of different agricultural production methods will also make it easier to compare the effects of organic food systems with other production systems.

Conclusions

There are significant difficulties in developing balanced, overall assessments of organic food systems that can handle the issues of knowledge limitations, value differences and fair comparisons. And there are equally significant difficulties in communicating such assessments with regard to complexity, trust and credibility. Yet the future of the organic alternative in many ways depends on how it compares in such assessments. To address this challenging problem, cross- and transdisciplinary cooperation is needed between natural, social, and cultural sciences and with a range of organic actors and stakeholders – a cooperation that acknowledges and works openly and clearly with the different perspectives involved.

References

- Alrøe H.F., Halberg N. (eds.) (2008): Development, growth and integrity in the Danish organic sector. A knowledge synthesis on the opportunities and barriers for a continued development and market based growth in production, processing and sale of organic products. ICROFS-rapport nr. 1/2008, International Centre for Research in Organic Food Systems, Denmark.
- Alrøe H.F., Noe E. (2008): What makes organic agriculture move - protest, meaning or market? A polyocular approach to the dynamics and governance of organic agriculture. *Int. J. Agricultural Resources, Governance and Ecology* 7(1/2): 5–22.
- Alrøe H.F., Noe E. (2010): Multiperspectival science and stakeholder involvement: Beyond transdisciplinary integration and consensus. In: I. Darnhofer and M. Grötzer (eds.) *Building sustainable rural futures. Proc. 9th Eur. IFSA Symposium, 4–7 July 2010 in Vienna, Austria.* University of Natural Resources and Applied Life Sciences, Vienna.
- Bogetoft P., Pruzan P. (1997): *Planning with Multiple Criteria*, CBS Press, Copenhagen.
- Bossel, H. (1999): Indicators for sustainable development: theory, method, applications. A Report for the Balaton Group, International Institute for Sustainable Development, 124 pp.
- Bossel, H. (2001): Assessing viability and sustainability - a systems based approach for deriving comprehensive indicator sets, *Conservation Ecology* 5(2), 12.
- Giere, R.N. (2006a): *Scientific perspectivism*. University of Chicago Press, Chicago.
- Giere, R.N. (2006b): *Perspectival pluralism*. In S.H. Kellert, H.E. Longino and C.K. Waters (eds.) *Scientific Pluralism*. University of Minnesota Press, Minneapolis, MN.
- Noe E., Alrøe H.F., Langvad A.M.S. (2008): A polyocular framework for research on multifunctional farming and rural development. *Sociologia Ruralis* 48(1): 1–15.

The fairtrade movement: Six lessons for the organics sector

Paull, J.¹

Key words: organic agriculture, certification, logos, social engagement, Max Havelaar.

Abstract

Fairtrade retail sales increased by 12.1% in the UK while organics sales decreased by 12.9% in 2009. This paper examines the lessons that the organics sector might usefully draw from the successful experiences of the Fairtrade movement. Three lessons of exposition and three lessons of engagement are identified. Fairtrade has a common logo across markets, typically there is a narrative, and the provenance of the ingredients is stated. Fairtrade has successfully extended its branding to engage with places and educational and faith communities, and to publicly acknowledge such engagements. There are 500 Fairtrade Towns in the UK, along with 118 Fairtrade universities, a diversity of faith communities including over 6000 Fairtrade churches, and over 4000 UK schools are registered in the Fairtrade Schools Scheme.

Introduction

Organics and Fairtrade share much in common. They both differentiate their products in the marketplace, both offer third party certification of food and farming, both have appeal to the 'ethical consumer', and they both typically sell at a premium price.

Retail sales of Fairtrade products in the UK increased by 12.1% in 2009 (Fairtrade Foundation, 2010). Over the same period, retail sales of organic products in the UK decreased by 12.9% (Soil Association, 2010). It is tempting to attribute the decline in organics sales to the recession, however the increase in Fairtrade sales contradicts any such simple 'explanation'.

The stated goal of the organics movement is the worldwide adoption of organic agriculture (www.ifoam.org). If that is to be achieved then annual gains need to be consolidated year on year. Historically, the experience of the organics sector has been steady incremental growth. At the historical rates of increase, organics would require 39 years to triumph assuming a geometric rate of increase, like compound interest, or 544 years if the increase is arithmetic, like simple interest (Paull, 2010). A step backwards, as has just been witnessed for the UK organics market, and that in concert with a step forward for Fairtrade, invites consideration of the question: are there lessons for the organics sector to be learned from the Fairtrade movement?

Materials and methods

The practices, documentation and statistics of organics and Fairtrade, two third-party certification systems for food and agriculture that have developed independently, are compared and contrasted using longitudinal data and contemporary information with a view to drawing lessons that may be useful in advancing the organics cause.

¹ Institute of Social and Cultural Anthropology, University of Oxford, Oxford, UK
E-Mail: john.paull@anthro.ox.ac.uk, john.paull@anu.edu.au
Internet www.scientificcommons.org/john_paull

Results

Global Fairtrade retail sales are valued at €2.3B and there are 1.5 million producers in 58 countries (Fick, 2009). The Fairtrade certification mark is a trademark of Fairtrade Labelling Organisations International (FLO) which has 24 member organisations (Fick, 2009) and was founded in 1997. This compares to the global organics market valued at €37.2B, with 1.8 million producers in 160 countries (Willer & Kilcher, 2011). The International Federation of Organic Agriculture Movements (IFOAM) has 804 member organisations and was founded in 1972.

In the past twelve years organics sales in the UK have increased 372% (Soil Association, 2010). Fairtrade sales in the same period, coming off a much lower base, have increased 4600% (Fairtrade Foundation, 2010). UK organics sales decreased in 2009 while Fairtrade sales increased. In a study of consumers, 31% of British shoppers stated that they expect to purchase more Fairtrade products in the future, while, in contrast, only 9% expect to purchase more organic products (IGD, 2010).

There is some overlap of organic and Fairtrade certification schemes. For example, the global supermarket Lidl's 'Fairglobe' coffee, "Highland Coffee from Ethiopia, Peru and Papua New Guinea", bears certifications from both Fairtrade and the UK's Soil Association. The coffee prominently declares its provenance and such a declaration is a core element of the Fairtrade narrative. The 'Fairglobe' product also informs shoppers: "The Fairtrade Certification Mark is your independent guarantee that this product has been certified with the international Fairtrade standards. The purchase of this product enables the improvement of working and living conditions of producers in developing countries and encourages environmental protection. www.info.fairtrade.net" (Lidl, 2010, rear label). The product bears no corresponding organics narrative; the inscription "Økologikontrolmyndighed" is not a substitute for an explanatory narrative and will surely have low or zero informational value for British shoppers. Organic-certified products sold in the UK frequently omit their provenance. This omission makes sense from a producer point of view since the product may 'brag' of a positive attribute, such as its 'organic-ness', while suppressing what may be perceived as a negatively valued provenance, such as 'China' (Paull, 2009a).

Both Fairtrade and organic certified products rely on logos for product differentiation - their products are otherwise indistinguishable in the market. The approach to logos differs substantially. For Fairtrade food there is a common logo used in almost all markets. The same logo is used in markets as culturally and linguistically diverse as: Austria; Belgium; Czech Republic; Denmark; Estonia; France; Finland; Ireland; Italy; Japan; Latvia; Luxembourg; the Netherlands; Norway; Spain; and Sweden. Despite the diversity of languages across these markets, the linguistic element incorporated in the logo in each case is the English 'Fairtrade'.

The Fairtrade mark is recognized by 82% of UK consumers and, of these, 94% report that they trust the mark (Fick, 2009). The logo is distinctive and readily recognizable with colourful graphical elements and accompanying the graphic is the single word 'Fairtrade'. Without compromising the integrity of the logo, the Danish and Belgian Fairtrade labels add 'Max Havelaar' in a smaller font (www.maxhavelaar.dk; www.maxhavelaar.be) and the Spanish logo adds 'Comercio Justo' (www.sellocomerciojusto.org). In contrast, there is no universal organics logo. Organics certifiers, of which there are over 500, each impose their own logo (www.ifoam.org) which lack any commonality of shape, graphic elements, or text. China has its own national organics logo which bears bilingual text in Chinese and English (Paull, 2009a). The European Union from 1 July 2010 has mandated an EU-

wide organics logo which may be accompanied by a certifier logo. However, the EU organics logo has no text, and this renders it intrinsically indecipherable - a dozen white stars on a green ground can be 'read' as 'organic' only by the initiated.

Fairtrade has been very successful in engaging places and communities in its vision. Garstang in Lancashire was the first Fairtrade Town in 2001. The Oxfordshire town of Bicester has recently become the 500th 'Fairtrade Town' in the UK (Mall, 2010). Oxford Brookes University became the world's first Fairtrade university in 2003, and there are now 118 Fairtrade universities and colleges in the UK. Faith communities are well engaged with Fairtrade; and include: over 6000 Fairtrade churches; 39 Fairtrade synagogues; a Fairtrade mosque; and a Fairtrade Hindu temple. There are more than 4000 UK schools registered in the Fairtrade Schools Scheme (Mall, 2010).

In contrast, proposed extensions of organic certification have frequently met with resistance. The Soil Association, in partnership with Garden Organic, is heavily involved in the 'Food for Life' programme and 2850 schools are enrolled. The website asks: "So what is the Food for Life Partnership award scheme all about? The Food for Life Partnership Mark is an action framework and award scheme to help schools and their communities transform their food culture. Food for Life Partnership schools are committed to serving freshly prepared, well sourced food and linking pupils with the farms where it was produced, while inspiring them to cook and grow food for themselves" (www.foodforlife.org.uk). This may all be commendable but any mention of 'organic' in the name of the programme, or this stated rationale, is entirely absent.

Discussion

Sales of Fairtrade and organics have both exhibited substantial growth over the past decade, however, with Fairtrade sales advancing and UK organics sales in retreat most recently, it is timely to consider what lessons might be drawn. There are "barriers" to "shopping ethically" and any lessons that can be drawn may most usefully be viewed in the light of these. Consumers identify four such barriers: "too expensive" is cited by 52% of shoppers; "lack of availability" by 31%; "lack of trust" by 14%; and "lack of knowledge" by 17% (IGD, 2008).

There are at least six lessons that can be drawn and they fall into two categories - exposition and engagement. Three exposition lessons pertain to logo, narrative and provenance. Three engagement lessons pertain to places, faith and schools.

The first exposition lesson relates to product differentiation. In the case of Fairtrade, with only a few exceptions such as USA and Mexico, there is a common Fairtrade logo shared across geographic and linguistic boundaries. The logo text is in English, implicitly acknowledging English as the universal language of our times. In contrast, the new text-free European organics mark has near to zero intrinsic meaningfulness, and even the experienced semiotician has no key to unlock its cryptic 'message'. A single universal organics logo would make organic certified produce more readily visible in the marketplace, it would ease the label-reading burden on shoppers, and it would be a demonstration of sector unity. A common organics logo would add visibility and credibility to the organics project, and this can address three of the barrier issues: availability, trust and knowledge.

Two further exposition lessons are to add a narrative message and the provenance to organics products. Aldi Australia, for example, add the message "grown as nature intended with no chemicals or additives, altogether a better way to eat" to their organic products, and the organic honey label clearly states the provenance as "Kangaroo

Island, South Australia". Such narrative and provenance elements address two consumer barriers by adding knowledge and potentially enhancing trust

Fairtrade has been very effective in engaging geographic, social and age cohorts in their vision. The organic sector has been slow and reluctant to extend its 'organic' designation beyond food and farm. The Fairtrade movement, in contrast, identifies and engages key social constituencies and enables the public declaration of that engagement. These initiatives include recruiting towns and universities, a diversity of faith communities, plus primary and secondary schools are being actively and very successfully recruited into the Fairtrade vision. Today's school children are potentially tomorrow's ethical and eco-aware consumers. The vision of engaging children into an organic vision dates back at least to the organics pioneer Henry Shoobridge and the Living Soil Association of Tasmania in 1946 (Paull, 2009b), and yet the recruitment of children into the organics vision of the world remains elusive, and meanwhile at their AGMs, for example, we witness the aging cohort of certain organics advocacy groups.

Conclusions

There are lessons to be drawn from comparing the recent experiences of Fairtrade and organics. Such lessons, drawn from the experiences in one domain and applied to another, are, of necessity, at best indicative rather than definitive. Nevertheless there is substantial commonality of principles, practice, and propositions shared across these two movements and this argues for the potential value and transferability of lessons. With Fairtrade surging ahead and the most recent experience of the UK organics sector contracting, the adoption of any such lessons may be timely, although, admittedly, their novelty may require some mind-set changes. In this study the lessons identified are of two types - exposition and engagement - and their implementation may serve to enhance the consumer offering, to address three of the consumer-barriers to ethical consumption, and to recruit and cohere constituencies.

References

- Fairtrade Foundation. (2010). *Facts and figures on Fairtrade*. London: Fairtrade Foundation.
- Fick, R. (2009). *Fairtrade flows against the tide* (press release, 17 April). London: Fairtrade Foundation.
- IGD. (2008). *Ethical Shopping - Are UK Shoppers Turning Green?* Watford, UK: Institute of Grocery Distribution (IGD)
- IGD. (2010). *Ethical & Sustainable Shopping*. Watford, UK: Institute of Grocery Distribution (IGD)
- Lidl. (2010). *Fairglobe Highland Coffee from Ethiopia, Peru & Papua New Guinea, 100g*. London: Lidl UK GmbH.
- Mall, F. (2010). *Fairtrade movement celebrates as Bicester becomes the 500th Fairtrade Town* (press release, 1 November). London: Fairtrade Foundation.
- Paull, J. (2009a). *The value of eco-labelling*. Saarbrücken, Germany: VDM Verlag.
- Paull, J. (2009b). The Living Soil Association: Pioneering Organic Farming and Innovating Social inclusion. *Journal of Organic Systems*, 4(1), 15-33.
- Paull, J. (2010). The Future of Organic Agriculture: Otopia or Oblivion? *Innovative Science Editions*, 1, 11-14.
- Soil Association. (2010). *Organic market report 2010*. Bristol: Soil Association.
- Willer, H., & Kilcher, L. (Eds.). (2011). *The World of Organic Agriculture: Statistics and Emerging Trends 2011*. Bonn, Germany: International Federation of Organic Agriculture Movements (IFOAM); Frick, Switzerland: Research Institute of Organic Agriculture (FiBL).

Dynamic of thematic and citation patterns in Organic Food & Farming research

Ollivier, G.1, Bellon, S.1 & Penvern, S.1

Key words: OF&F, scientometrics; document co-citation analysis; speciality detection

Abstract

This paper analyses the Organic Food & Farming (OF&F) scientific domain dynamic through a "progressive document co-citation analysis" based on peer-reviewed papers from Web of Science. The dataset of OF&F domain displayed an exponential growth and a thematic diversification pattern. Both dominant and marginal clusters in association with their main cited articles were identified. This study enables to pinpoint major themes addressed or emerging. It can feed further research work and projects, namely with the definition of information system and research policy.

Introduction: need for research and research needs in OF&F

The organic sector is increasingly considered by stakeholders as a tangible alternative to address current challenges faced by agriculture. This leads to a continuous expansion of both the knowledge base and the demand of synthesis in OF&F. Several authors suggested topics for research, whether as general themes (Watson *et al.*, 2008; Rahmann *et al.*, 2009) or specific fields (Kristiansen *et al.*, 2006). Others addressed the specificity of organic research approaches (Lockeretz, 2000; Watson *et al.*, 2008; Drinkwater, 2009). However, such reviews do not analyse evolutions in topics within the OF&F literature. This assessment is important as transnational projects and journals dedicated to OF&F develop. We propose, using scientometrics, to identify dynamic of specialties and associated research topics in OF&F domain.

Material and methods

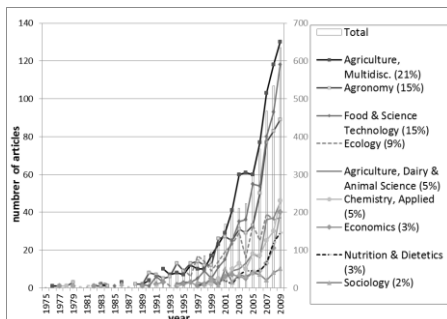
The *progressive document co-citation analysis* (PDCA), developed inside the CiteSpace Software (Chen *et al.*, 2010), allows to find the intellectual basis of specialties developed within the OF&F domain by mapping its internal citation structure. A co-citation link occurs when two documents are cited in the same citing documents. PDCA identifies high-density patterns (clusters) inside the co-citation network. These clusters gather the documents often cited together (intellectual basis) upon which authors build their specialties. The analysis is progressive since the dataset is divided into n-years slices, thus useful to interpret the clusters evolutions. As citation clusters are hierarchically organised, we iteratively tested various threshold parameters to produce different co-citation networks in order to detect a common robust structure emerging from the different resulting clustering. To better synthesise information, we gathered structurally and topically coherent clusters thanks to the CiteSpace *automatic cluster labeling* which detects specific cluster terms from citing documents (Chen *et al.*, 2010).

The *Web of Science* was used because it includes the cited references for each publication. The challenge was to build a query representing all the aspects of OF&F research (production modes, products, social dimensions) without inducing noises.

¹ UR 0767 Ecodéveloppement, INRA E-Mail : gollivier@avignon.inra.fr

Indeed, some terms related to OF&F are also used in other domains. After a first query, we extracted terms using “organic” to test their specificity in the OF&F domain. We finally built a complex query, composed of 120 specific terms representing the domain and resulting in a dataset of 4401 journal articles from 1975 to 2009.

Results



The dataset displayed a clear exponential growth associated with a thematic diversification pattern (Figure 1). The OF&F domain was firstly developed inside Agricultural sciences. Every subject area (SA) increased in the 90's except for Sociology whose growth remained relatively low. Lately, three SA have dominated the domain. Agriculture (Multidisciplinary) and Agronomy prevailed jointly until 2001 and afterwards; they exhibit a rather similar growth.

Figure 1: Evolution of significant subject areas¹

The third SA, Food Science & Technology, remained marginal until 1999 before being the second most important one after 2002. While Ecology was also a major SA, it did not face such a development and increased constantly after the late 90's. In the meantime, secondary SA emerged with significant growth during the past years: Dairy and Animal Sciences, Economics, Applied Chemistry and Nutrition & Dietetics.

The first major co-citation cluster identified concerns performances in the 80's turn, with studies tackling the energetic and environmental crisis of agriculture. This introduced the multiple farming performances assessment in the domain. The domain “diversification” occurred since the turn of the 90's in correlation with its global growth. A specialty related to Soil historically dominated while new specialties emerged. They are related to Biodiversity, Food content, Consumers, and Social aspects of OF&F development.

The main speciality (Soil), composed of many citation sub-clusters (almost 30% of detected clusters and included references) also contained the most cited references of the domain, with various focus of Soil. The most structured approach, first developed, concerned soil biological activity. It essentially referred to the Journal Soil Biology & Biochemistry, which introduced methodologies to measure soil biological features. Related smaller and peripheric clusters focussed on specific biological compartments. A second and more recent approach focussed on nutrient cycling, particularly on the role of nutrient processes in soil fertility. Some clusters combined the previous two approaches with a holistic view of soil. This approach is supported by comparative studies in agronomy or soil ecology, centered on the effects of organic/conventional systems or practices (fertilisation, tillage) on different soil features.

¹Each journal in Web of Science is associated with 1 or more SA. For more details see: http://science.thomsonreuters.com/mjl/scope/scope_sci/

Table 1: main features of specialties detected

| Specialty | year | 1st Author | title | Journal | # cited |
|-------------------------------------|------|------------|--|--|---------|
| Farming performances | 1973 | Pimentel | Food production and the energy crisis | Science | 11 |
| | 1978 | Berardi | Organic and conventional wheat production: examination of energy and economics | Agroecosystems | 13 |
| | 1981 | Lockeretz | Organic farming in the Corn Belt | Science | 36 |
| Soil | 1987 | Vance | An extraction method for measuring soil microbial biomass C | Soil Biology & Biochemistry | 88 |
| | 1993 | Reganold | Soil quality and financial performance of biodynamic and conventional farms in New Zealand | Science | 48 |
| | 1995 | Drinkwater | Fundamental differences between conventional and organic tomato agroecosystems in California | Ecological Applications | 73 |
| | 2002 | Mader | Soil fertility and biodiversity in organic farming | Science | 187 |
| Biodiversity | 1999 | Krebs | The second silent spring? | Nature | 30 |
| | 2005 | Hole | Does organic farming benefit biodiversity? | Biological Conservation | 91 |
| | 2005 | Bengtsson | The effects of organic agriculture on biodiversity and abundance: a meta-analysis | Journal of Applied Ecology | 78 |
| Food qualities | 1997 | Woese | A comparison of organically and conventionally grown foods—results of a review of the relevant literature | Journal of the Science of Food and Agriculture | 118 |
| | 2001 | Brandt | Organic agriculture: does it enhance or reduce the nutritional value of plant foods? | Idem | 51 |
| | 2002 | Bourn | A comparison of the nutritional value, sensory qualities, and food safety of organically and conventionally produced foods | Critical Reviews in Food Science and Nutrition | 98 |
| Consumer & consumption determinants | 1998 | Schiffers | Health-related determinants of organic food consumption in the Netherlands | Food quality and Preference | 39 |
| | 2001 | Magnusson | Choice of organic foods is related to perceived consequences for human health and to environmentally friendly behaviour | Appetite | 32 |
| | 2004 | Lockie | Choosing organics: a path analysis of factors underlying the selection of organic food among Australian consumers | Idem | 16 |

| | | | | | |
|---------------------------------------|------|-----------|--|---------------------------|----|
| Sociology of OF&F dynamics | 1997 | Buck | From farm to table: the organic vegetable commodity chain of Northern California | Sociologia Ruralis | 51 |
| | 2001 | Hall | Organic farmers in Ontario: An examination of the conventionalization argument | Idem | 25 |
| | 2001 | Padel | Conversion to organic farming: a typical example of the diffusion of an innovation? | Idem | 45 |
| | 2001 | Michelsen | Recent development and political acceptance of organic farming in Europe | Idem | 27 |
| | 2004 | Guthman | The trouble with 'organic life' in California: a rejoinder to the 'conventionalisation' debate | Idem | 35 |

The Biodiversity specialty is the most distinctive of the domain due to the weakness of its interconnexion to other clusters. Emerging at the 90's turn, it concerns studies and reviews on farming systems or practices comparisons to assess the effects of intensification on diverse elements of biodiversity (landscape, bird, invertebrates, weed communities). Surprisingly, no citation cluster appears with Biodiversity as a source of services for farming.

Another well-structured specialty concerns organic food content in comparison with conventional food. Two linked clusters, without clear delineation, emerged in the beginning of the 2000's. The specialty focussed on chemical characterisation and to a lesser extent on nutritional and sensory quality concerns. Few studies appear in citing articles on the effects of organic food on human health, but not as a specialty per se, ie without a structured intellectual basis. The specialty is weakly linked to clusters focussing on farming system while some papers refer to the effect of specific production practices on food quality.

The connexion between production and products issues is made through references related to consumer and sociological approaches of OF&F dynamics. The first specialty is based on two main clusters. The first one, occurring as a dense cluster around the 90's turn concerns factors determining consumer purchase decisions. Corresponding studies reveal the importance of Nutrition and Health determinants that are now emerging issues in the "food content" specialty. The second cluster largely extends this approach with a slight evolution in the type of references used. Whereas the first one is mainly anchored in Food Science & Technology, the second one includes more Economics and Sociology corresponding to the integration of commodity chains, linking production and consumption with individual-focused studies. This partly explains the connexions between the last specialty and the one concerning social sciences approaches of OF&F development dynamics. Indeed, the clusters of this specialty, emerging at the turn of the 90's, share a common intellectual basis specific to their discipline whereas they mix different aspects of OF&F from producers to consumers. The main cluster concerns issues about OF&F sector development from the farmer level, with adoption/conversion/abandonment determinants, to the institutional level, with policy issues and certification devices, also addressing collective actions and geographical diffusion. These aspects, emerging in the beginning of 2000's, are gathered under the conventionalisation thesis in OF&F development. A second cluster is focused on OF&F as an element of power/politics transformation in food system/chain/network through the localism issue. In addition, some marginal clusters, ie with less structured intellectual basis, occurred in the DCA

tested. Some expected topics concerning production practices were marginal or absent. Clusters concerning dairy production may arise in some networks but are still in a marginal position. When present, this topic concerned animal health in organic production. We also expected to find specialties about crop protection and weed control but these topics are not based upon a highly cited reference pool.

Discussion and conclusion

The OF&F domain is very dynamic as shown with the continuous emergence of specialties. This outlines the gradual recognition and incorporation of OF&F into the larger agricultural scientific and policy communities where it is progressively viewed both as one credible variant of “alternative” agriculture and as a new research field. The analysis highlights the recurrence of comparative approaches of performances and effects. Researchers rarely design new production systems or techniques and they often tend to value OF&F in confrontation with a conventional model, still considered as the reference. This questions the autonomy of OF&F research. This growth suggests early stages of development. As well as OF&F sector, research development could suffer from conventionalisation. Even if the multidisciplinary and holistic approaches are fundamental in the emergence and the identity of the domain, recent specialisations induce some issues about the maintenance of OF&F as a separate domain. Yet organic research proved to be rarely different from those used in conventional agriculture (Lockeretz, 2000; Watson *et al.*, 2008). We highlighted the institutionalisation but also some lacks in topics we expected. There is a methodological issue about detecting this kind of emerging or lightly structured topics, because statistical tools tend to detect patterns with high frequency. We could deepen our study by using lower thresholds or other parameters in DCA to detect more clusters and crossing with other types of analysis to detect marginal topics (Chen *et al.*, 2010).

References

- Chen, C., Ibekwe-SanJuan, F., Hou, J., 2010. The Structure and Dynamics of Co-Citation Clusters: A Multiple-Perspective Co-Citation Analysis. *Journal of the American Society for Information Science* 61, 1386–1409.
- Drinkwater, L.E., 2009. Ecological Knowledge: Foundation for Sustainable Organic Agriculture. In: Francis, C. (Ed.), *Organic Farming: The Ecological System*. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, pp. 19-47.
- Kristiansen, P., Taji, A., Reganold, J.P., 2006. *Organic Agriculture: A global perspective*. CSIRO publishing.
- Lockeretz, W., 2000. Organic farming research, today and tomorrow. IFOAM 2000: the world grows organic. *Proceedings 13th International IFOAM Scientific Conference*, Basel, Switzerland, 28 to 31 August, 2000. vdf Hochschulverlag AG an der ETH Zurich, pp. 718-720.
- Rahmann, G., Oppermann, R., Paulsen, H.M., Weißmann, F., 2009. Good, but not good enough? Research and development needs in Organic Farming. *Agriculture and Forestry Research* 59, 29-10.
- Watson, C.A., Walker, R.L., Stockdale, E.A., 2008. Research in organic production systems – past, present and future. *Journal of Agricultural Science*, 1-19.

Organic Eprints – making research in Organic Food and Farming more visible

Rasmussen, I.A.¹, Meier, J.² & Willer, H.³

Key words: Open Access, copyright, repositories, citations, downloads

Abstract

Organic Eprints is an Open Access archive for research in organic food and farming. While based in Europe, it is international and open for deposits from all over the world. Since the start in 2002, the archive has steadily grown to over 10,000 deposits in 2010. Open Access enables more users to download and read the deposited papers, and this may lead to increased citations. Development of a platform based on Organic Eprints among other agriculture-related archives should make search even stronger. All researchers who work with organic food and farming are encouraged to register and deposit their work in Organic Eprints.

Introduction

Research results regarding organic food and farming from Europe have become easily accessible – and so can results from the rest of the world. The Open Access archive Organic Eprints (orprints.org) has developed since the start in 2002 so that it now includes more than 10,000 items, has 15,000 registered users and 175,000 visits per month. The archive is open for all to use and registered users can deposit their research publications from refereed journals as well as non-refereed sources. Organisations, research facilities, research programmes and projects are also presented in the archive.

A new platform for agriculture & aquaculture, VOA³R (Virtual Open Access Agriculture & Aquaculture Repository), is being developed on the basis of Organic Eprints and other archives. The platform aims to improve the user interface, implement new search methods, enable online annotating and rating of papers and even include a network for the users.

Background

In 2002, International Centre for Research in Organic Food Systems (ICROFS) founded the Open Access archive Organic Eprints. The aim was to collect all publications from research projects under the Danish Organic funding scheme DARCOF (Alrøe 2003), but it was established in a way so that it was feasible to use it for international purposes as well. Already in 2003, the Research Institute of Organic Agriculture (FiBL) and the Federal Agency for Agriculture and Food (BLE) from

¹ International Centre for Research in Organic Food Systems (ICROFS), Blichers Allé 20, DK-8830 Tjele, Denmark, E-mail IlseA.Rasmussen@icrofs.org, Internet www.icrofs.org

² Research Institute of Organic Agriculture (FiBL), PO Box 90 01 63, 60441 Frankfurt am Main, Germany, E-Mail Julia.Meier@fibl.org, Internet www.fibl.org

³ Research Institute of Organic Agriculture (FiBL), Ackerstrasse, 5070 Frick, Switzerland, E-Mail Helga.willer@fibl.org, Internet www.fibl.org

Germany became partners and today, those three organisations are still responsible for running the archive.

The archive is a repository for all types of deposits concerning research in organic food and farming: journal articles that have been peer-reviewed, books or chapters from books, popular articles from farmers magazines or newspapers, papers, posters or presentations from conferences, reports or chapters from reports, theses, teaching resources such as power-point presentations, web products and working papers. In addition descriptions of organisations, research facilities, research programmes and projects can be deposited. Once deposited, any item is referred to as an eprint.

The aim is that users can find information about research in organic food and farming at many levels – from the organisations and projects involved in the research to the end-product in the form of peer-reviewed articles. To aid the user in the search process, there is both the possibility to browse by subject area (or other browse views) and to search via a powerful search tool with many refinements. Additionally, registered users have the possibility to subscribe to an email alert system to receive emails on new entries in the subject area they are interested in. Another aim is for research funders to have a documentation of the output from the research – not only in peer-reviewed articles, but also in more popular versions of the knowledge derived from the research.

Open Access

Open Access is free-of-charge internet access to research papers, including peer-reviewed journal articles. There are mainly two open access strategies: either to publish articles in an open access journal (golden road) or to publish articles in a paid-access journal and then self-archive in an open access eprints archive (green road). Open Access journals are often only available on the internet, and not in a printed version, but are peer-reviewed. In the Directory of Open Access Journals (<http://www.doaj.org/>) there were in December 2010 more than 200 journals in the subject area Agriculture and Food Sciences. Some printed, well-established journals also allow Open Access if the author of the article pays a fee.

Open Access repositories, like Organic Eprints, receive digital duplicates of published articles by depositing by the authors (self-archiving). The repository makes the articles publicly available. If allowed by the copyright of the journal, the author can deposit a pdf of the published article or the authors own copy of the finished article, after review. In other cases, the copyright only allows the author to deposit a pre-review version of the paper. In order to address the copyright issues, Organic Eprints allows the author to restrict access to the paper either to the registered users or to only the author and archive administrators. In this way, users interested in the paper can still see the abstract and bibliographic data and send an email to the authors to receive a reprint. If the journal has an embargo such as 6 or 12 months after publication, the embargo can be set to be lifted at that time already at the time of deposit in Organic Eprints, making the article openly available as soon as possible with no further actions required from the author. Bernius (2010) states that subject-based repositories provide the best conditions for retrieval of scientific knowledge compared to institutional repositories.

It is widely debated whether Open Access gives an article more citations, ranging from an increase of 140-150% (Lawrence 2001, Eysenbach 2006) to a non-significant negative effect (Davis *et al.* 2008), but most authors agree that downloads are increased by Open Access, and that this widens the circle of those who can benefit to

participants, that may not be able to afford paying subscriptions to printed journals (Evans & Reimer 2009). According to Gargouri *et al.* (2010) the citation advantage is independent of whether the Open Access is self-selected or mandatory.

Use of Organic Eprints

The partnership that is running Organic Eprints is mirrored in the distribution of the origin of items in the archive: by the end of 2010, there were almost 3000 eprints from Germany, almost 2500 from Denmark and more than 1500 from Switzerland. In addition, there were 3000 eprints from other countries. The main part of these originated from other European countries, especially the countries from the European CORE Organic partnership¹, but there were also entries from all other continents, with Australia and USA being especially well represented countries. Also the nationality of the over 15,000 registered users is mainly European (fig. 1).

Many more than those that are registered users benefit from the archive, which throughout 2010 had an average of more than 5000 daily visits. In March 2010, over 30% of the visits resulted in Open Access document file downloads, while about 7% were browsing or searches that did not result in any download. A large part of the visits were directed from internet search engines such as Google. In a ranking of the worlds 800 top repositories in July 2010, Organic Eprints was number 16. The ranking was based on a combination of the size of the repository, the visibility, the number of documents and the number of entries in Google Scholar (Aguillo *et al.*, 2010).

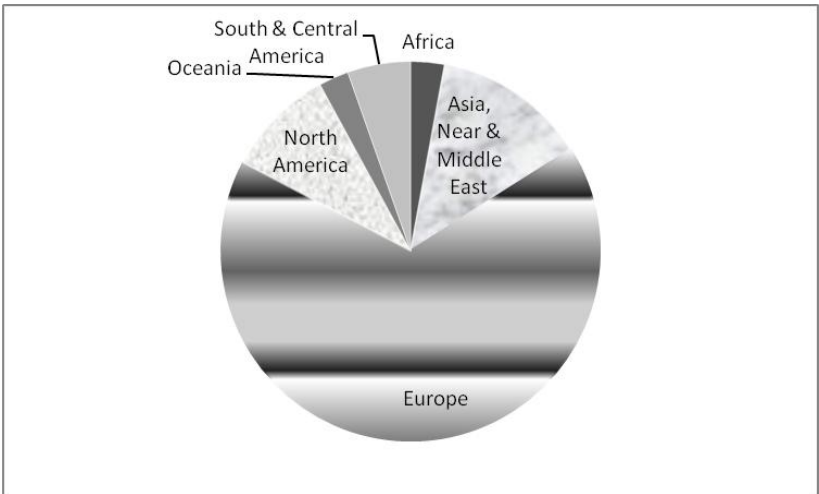


Figure 1: Distribution of registered users of Organic Eprints by continent.

¹ CORE Organic is an acronym for "Coordination of European Transnational Research in Organic Food and Farming". The project is part of the European Commission ERA-NET Scheme. More information is available at www.coreorganic.org.

VOA³R: Virtual Open Access Agriculture & Aquaculture Repository

Generalist search engines as Google Scholar, databases as PubMed, citation systems as CiteULike and indexes as DOAJ require significant effort to retrieve the relevant information. Virtual Open Access Agriculture & Aquaculture Repository: Sharing Scientific and Scholarly Research related to Agriculture, Food, and Environment (<http://voa3r.eu/>) is an EU project that is planned to result in a platform that aims at re-using existing repositories such as Organic Eprints. This will enable users to search for relevant information across the different repositories. The platform will include new search tools and extended evaluation elements such as ratings and public reviews.

Discussion & Conclusions

Making the results of research more easily and freely available will improve the use of the results and in the end hopefully augment the development of Organic Agriculture. Organic Eprints offers a platform for this purpose, and researchers all over the world are invited and encouraged to deposit their papers in the archive. In parts of the world where researchers do not have free access to all the relevant scientific journals, Organic Eprints may be one way to access such papers. All over the world, people outside the scientific community, such as politicians, ngo's, farmers, advisors etc. can benefit from access to the papers, popular as well as peer-reviewed. The platform can and will be continuously improved, i.e. a better user-interface.

Acknowledgments

Organic Eprints is co-funded by the Danish Ministry of Food, Agriculture and Fisheries, the Federal Agency for Agriculture and Food (Germany) and the Research Institute of Organic Agriculture (Switzerland) and supported through the work in CORE Organic and VOA³R EU-funded projects.

References

- Aguillo I.F., Ortega J.L., Fernández M. & Utrilla A.M. (2010): Indicators for a webometric ranking of open access repositories. *Scientometrics* 82:477-486.
- Alrøe, H.F. (2003): Open archive for organic research. DARCOFenews 1, <http://www.darcof.dk/enews/mar03/index.html>, (accessed 2010-12-07).
- Bernius S. (2010): The impact of open access on the management of scientific knowledge. *Online Information Review* 34:583-603.
- Cybermetrics Lab (2010): Ranking Web of World Repositories, http://repositories.webometrics.info/top800_rep.asp, (accessed 2010-12-06).
- Davis P.M., Lewenstein B.V., Simon D.H., Booth J.G. & Connolly M.J.L. (2008): Open access publishing, article downloads, and citations: randomised controlled trial. *British medical Journal* 337:a568.
- Evans J.A. & Reimer J. (2009): Open Access and Global Participation in Science. *Science* 323 (20 February 2009):1025.
- Eysenbach G. (2006): Citation Advantage of Open Access Articles. *PloS Biology* 4(5):e157.
- Gargouri Y., Hajjem C., Larivière V., Gingras Y., Carr L., Brody T. & Harnad S. (2010): Self-Selected or Mandated, Open Access Increases Citation Impact for Higher Quality Research. *PLOS ONE*, 5 (10):e13636 (OCT 18 2010).
- Lawrence W. (2001): Free online availability substantially increases a paper's impact. *Nature* 411(6837):521.

Technology platform organics: knowledge generation and exchange in organic food and farming research

Padel S¹., Pearce B¹., Cuoco E²., Schlüter M²., Niggli U³., Schmid O³., Willer H³., Huber M⁴., Halberg N⁵. & Micheloni C⁶.

Key words: TP Organics, Approaches, Participatory, Knowledge, Research.

Abstract

The paper illustrates the role and activities of Technology Platform Organics (TP Organics) in addressing the requirement that research in organic food and farming systems generates output of relevance to wider end-users. It describes approaches to research and knowledge exchange and suggests that a more participatory approach can improve organic research outcomes. It describes different models of research and knowledge exchange and their pros and cons. The criteria for success of a participatory approach to research also need to be different. These are discussed.

Introduction

TP Organics brings together stakeholders from the European organic sector and the wider public to discuss strategic research priorities that enhance the sectors' ability to produce high quality foods consistently, reliably and in sufficient quantity, while at the same time serving the interests of European societies at large. TP Organics supports agricultural research, by engaging with the food chain through its broad range of stakeholders. Since 2007, TP Organics produced a range of publications addressing organic research and knowledge transfer needs now and in the future (Niggli *et al* 2008, Schmid *et al* 2009, Padel *et al* 2010).

Materials and methods

An objective of TP Organics is to influence the European research agenda so that the topics chosen and the output is of relevance to the organic sector, i.e. it is useful to organic and other farmers, businesses, consumers and stakeholders, as well as civil society and policymakers. As part of this the platform has considered different models to undertake research activities (including priority setting, research approaches,

¹ The Organic Research Centre, Elm Farm, Hamstead Marshall, Newbury, Berkshire, RG20 0HR, UK. E-Mail susanne.p@organicresearchcentre.com, Internet www.organicresearchcentre.com

² IFOAM EU GROUP, Rue du Commerce 124, 1000 Bruxelles, Belgium, E-Mail eduardo.cuoco@ifoam-eu.org, Internet www.ifoam-eu.org

³ Research Institute of Organic Agriculture FiBL, Ackerstrasse, 5070 Frick, Switzerland, E-Mail urs.niggli@fibl.org, Internet www.fibl.org

⁴ Louis Bolk Instituut, Hoofdstraat 24, NL-3972 LA Driebergen, The Netherlands, E-Mail m.huber@louisbolk.nl, Internet www.louisbolk.nl

⁵ The International Centre for Research in Organic Food Systems ICROFS, P.O. box 50, DK 8830 Tjele, Denmark, E-Mail Niels.Halberg@agrsci.dk, Internet www.icrofs.org

⁶ Associazione Italiana per l'Agricoltura Biologica AIAB, via Piave 14, 00189 Rome, Italy, E-Mail c.micheloni@aiab.it, Internet www.aiab.it

disseminating results) and consulted on this with its members. In this paper we have contrasted the contributions of 'top-down' and 'bottom-up' approaches in developing responses to the Europe's grand challenges (Anon 2009).

Results and discussion

Four approaches to research and knowledge transfer activities were considered (RELU 2007). The LINEAR model assumes that users passively receive knowledge. The FEEDBACK model establishes a dialogue between knowledge generators (researchers) and knowledge users who can give feedback on the outcomes of research but not the process. The COLLABORATIVE model is a more integrated approach that puts knowledge generators and users alongside each other and allows them to communicate about problem framing, research methods, context and site-specific conditions and dissemination of outcomes. The JOINT PRODUCTION OF KNOWLEDGE model crosses the boundary between knowledge generators and users, so that all partners involved contribute to undertaking research. Expertise in numerous forms from many actors can make valuable contributions to knowledge production. There is an emphasis on how scientific and non-scientific knowledge can be mutually enriching. The joint production of knowledge model underlines the need to move from ideas about one-way "knowledge transfer" to mechanisms that will facilitate "knowledge exchange" in networks. This model is also known as "participatory research."

Participatory research approaches are often seen as effective means of enhancing end-user learning and instigating change in the relationship between the researcher and the end-user. However, in European agriculture, participatory research has not been widely used, but the value is beginning to be recognised partly in response to a growing number of successes with farmers in developing countries and in countries where agricultural production is not supported by government i.e. Australia (Aagaard-Hansen *et al* 2007, Friend *et al* 2009). Additionally, the second SCAR foresight study acknowledges the importance of such 'niche' experiments in developing profoundly creative, step-wise mitigation and adaptation strategies against climate change (SCAR CEG 2008). In facilitating ecological knowledge systems, the emphasis of research should shift from developing technologies for farmers to working with farmers (Röling & Jiggins 1998) and this has particular relevant for organic farming.

Models differ in the level of input from participants in the research process. In this discussion 'the farm' is usually used as a default example, but participatory research can be undertaken throughout the supply chain with a range of actors and end-users. In participatory on-farm research (also called 'action research' or trans-disciplinary research) the researcher participates in the farm process under investigation. The farmer reveals their tacit knowledge through dialogue with the researcher. The research process is complemented through observations and experiences of the working farm. The assimilation of the knowledge gained from the site-specific research is utilised by the actors (farmer and researcher in this case) to become more expert in the areas addressed, and in their passing on this expertise through farming practice, further research or other knowledge exchange processes.

TP Organics considers that the organic sector must work towards developing closer links between researchers and end-users. Making joint knowledge production more commonly used among a raft of research approaches will require change. Both researchers and funders have to ensure that research is addressing end-users' needs. For this to occur successfully end-users must be part of the whole research process,

as opposed to being passive recipients of its end products. Institutes and researchers who have undertaken participatory or collaborative research have had to go through a considerable amount of institutional learning. A wide range of stakeholders involved in the organic food and farming are potential end-users of research, and their needs should be considered. This includes producers but also processors, market partners, consumers, control bodies, civil society organisations and governments. Stakeholders need to be involved at all stages of the research process: identification of knowledge and innovation needs; scoping of the research activities; engagement with the research and implementation; and adoption of outcomes. In most research the involved stakeholders should represent larger groups and thus may be involved at different times and scales (e.g. identification of main research questions in livestock production may involve representatives of pig farmers prior to an actual research project and, at a later stage, extension workers and regional farmer groups could be involved in selecting promising solutions for experiments). Such close engagement requires stakeholders' time, for which they should be appropriately rewarded. In developing more sustainable systems, there is a need to accept that there is no 'one size fits all' research model. Research needs to consider the specific site and context of the system in which the work is done, for a 'tailor-made' approach in line with farming systems research theory. And participatory research may not be the most appropriate method for all areas of research (i.e. lab work may not benefit), but a joint knowledge generation model should ensure that outcomes of any research are relevant to its end-users.

Criteria for success of participatory research should be different to those of more traditional scientific approaches. TP Organic considers that participatory processes are important in ensuring that more sustainable farming practices become more widespread in the future and proposes three elements to defining their success: (1) Stakeholders are satisfied with their participation and make full use of the results; (2) The results allow stakeholders to keep their independence and their sovereignty of knowledge and property rights; (3) There are real improvements in the system in terms of sustainability. Further indicators of success could include the level of stakeholder involvement, the direct effects of the research on immediate beneficiaries, and also any indirect effects on the whole sector or on wider public policy goals in areas such as environmental protection, public health or animal welfare (Schmid & Lampkin 2008).

Conclusions

Experience has shown us that driving innovation from research for the organic sector is not straightforward, but momentum is lent by models for the joint generation and exchange of knowledge that recognises, integrates and builds on the diversity of the natural environment and people. A joint (participatory) production of knowledge model should reduce the boundaries between knowledge generators and users, while respecting and benefitting from transparent division of tasks. Trans-disciplinary research attempts to straddle disciplinary boundaries, and therefore requires all participants to recognise different forms of knowledge and different ways of discovering knowledge. Researchers and end-users need to learn new forms of active engagement in joint innovation and knowledge production. It must be accepted that there is no 'one size fits all' research model. Different research models will be appropriate for different research questions. All research, however, should consider the specific site conditions and context of the system in which its work is done. Only

by adopting 'tailor-made' approaches can we develop systems that are genuinely sustainable.

Members of TP Organics are involved in developing a European initiative to further develop the model of participatory research for the organic sector. In the TP Organics Strategic Research Agenda (Schmid *et al* 2009) an initiative for knowledge management is proposed for the organic sector in Europe. The main aim of a European organic knowledge management strategy is to facilitate the transfer and exchange of scientific and technical knowledge in organic and low external input agriculture, by putting in place that essential link between research activities and the food and farming sector building on an inventory of existing actors, systems and best practise examples of facilitated communication. The new EU project, "Agricultural Knowledge Systems in Transition: Towards a more effective and efficient Support of Learning and Innovation Networks for Sustainable Agriculture, SOLINSA (SOLINSA 2011) will provide valuable input to the process of organising effective knowledge exchange networks, driving innovation, and improving the multi-functional sustainability of organic farming in Europe.

References

- Aagaard-Hansen, J., Larsen, C.E., Schou, Halberg, N., Hjortsø, C.N., Gausset, Q. and Kabirizi, J. (2007). Mainstreaming participatory and cross-disciplinary approaches in animal science research in developing countries. *African Journal of Agricultural Research*, 2 (4), pp. 119-130.
- Anon (2009). The Lund declaration, www.vr.se/download/18.7dac901212646d84fd38000336/Lund_Declaration.pdf.
- Friend, M.A., Dunn, A.M. and Jennings J. (2009). Lessons learnt about effectively applying participatory action research: a case study from the New South Wales dairy industry. *Animal Production Science* 49, 1007-1014.
- Niggli U., Slabe A., Schmid O., Halberg N. and Schlüter M.. (2008). Vision for an Organic Food and Farming Research Agenda to 2025. TP Organics. Brussels: IFOAM EU Group, Bonn: ISOFA.
- Padel S., Niggli U., Pearce B., Schlüter M., Schmid O., Cuoco E., Willer E., Huber M., Halberg N. and Micheloni C. (2010). Implementation Action Plan for organic food and farming research. TP Organics. IFOAM- EU Group. Brussels.
- RELU (2007). Rural Economy and Land Use Programme Briefing Series No 6. Common knowledge? An exploration of knowledge transfer. June 2007
- Röling, N.G. and Jiggins, J. (1998). The ecological knowledge system. In: Röling, N.G. and Wagemakers, M.A.E. (1998). Facilitating sustainable agriculture. Cambridge University Press, Cambridge, UK.
- SCAR-CEG (2008). 2nd Foresight Exercise: New challenges for Agricultural Research: Climate change, food security, rural development, agricultural knowledge systems. Brussels: Standing Committee on Agricultural Research (SCAR), Consultative Expert Group.
- Schmid O., Padel S., Halberg N., Huber H., Darnhofer I., Micheloni C., Koopmans C., Bügel S., Stopes C., Willer H., Schlüter M. and Cuoco E. (2009). Strategic Research Agenda for organic food and farming. TP Organics, Brussels: IFOAM EU Group.
- Schmid, O and Lampkin, N (2008). ORGAPET: The Organic Action Plan Evaluation Toolbox online at www.orgap.org/internal/orgapet/
- SOLINSA (2011). <http://www.ccri.ac.uk/Projects/FoodandFarming/Current/SOLINSA.htm>

Metabolite profiling for the evaluation of organic amendments.

Okazaki, K.¹, Shinano, T.¹, Oka, N.¹, Saito, S.¹, Sugikawa, Y.², Nakatsuji, T.², Tanaka, F.³ & Takabe, M.³

Key words: Metabolome, GC/MS, manure, nitrogen.

Abstract

*To evaluate the effect of agricultural product quality characteristics, we comprehensively analyzed the metabolite compositions of radish (*Raphanus sativus* L.) leaves and roots using gas chromatography mass spectrometry (GC/MS). A field experiment arranged in a split plot design investigated the effect of three levels of manure amendments (0, 2 and 4 kg m⁻²) and inorganic nitrogen (N) fertilization (0, 6 and 12 g N m⁻²) on radish metabolites. Principal component analysis was applied to all 124 metabolite peaks revealed by GC/MS analysis. The first principal component accounted for 46.3% of total variance and indicated a closely related to inorganic-N (N_{inorg}) application rates, whereas the second principal component, accounting for 14.6% of total variance, pointed to a closely related to manure application rates. Organic acids in leaves showed a close relationships to both N_{inorg} and manure levels. The observation that radish metabolites clearly differed under different application rates of both N_{inorg} and manure, will prove useful in improving and distinguishing the quality of agricultural products grown using organic fertilisers.*

Introduction

Whether organic amendments and the farming systems that employ them improve the quality of the agricultural commodities they produce has been studied and discussed for many years (Woese et al. 1997, Williams 2002). In terms of crop production, the primary and best studied component of organic matter amendments is N. Studies at both the laboratory- and field-scale have mainly evaluated the effect of organic-matter-supplied N on N-uptake and crop yield; however, whether the organic matter acts only as an N-supplier has not been addressed.

In this study, we introduce GC/MS-based metabolic profiling as a holistic assessment of radish leaf and root metabolites. A simple factorial design with three levels each of applied N_{inorg} and dairy manure served to investigate whether any compound(s) specifically fluctuated with levels of manure amendments. Given manure's significant N content, one would expect its rate of application to significantly influence the levels of N metabolism-related compounds in radish. Consequently a split-plot design of applied N_{inorg} × manure rates was used to extract 'manure-specific' effects related to the level of radish metabolites, as well as the broader effects of N application rates on primary metabolites.

¹ National Agricultural Research Center for Hokkaido Region, Hitsujigaoka 1, Sapporo, Japan, E-Mail okazaki@affrc.go.jp

² Central Agricultural Experiment Station, Hokkaido Research Organization, East-6, North-15, Naganuma, Yubari-gun, Hokkaido, Japan, E-Mail sugikawa-yoichi@hro.or.jp

³ National Agricultural Research Center, 3-1-1 Kannondai, Tsukuba, Japan, Mail fukuyot@affrc.go.jp

Materials and methods

Radish (*Raphanus sativus* L. cv. Fujikaze) were cultivated in 2006 at three levels each of manure (daily cattle manure; C/N=10.4; 0, 2 and 4 kg m⁻²) and N_{inorg} (as ammonium sulfate; 0, 6 and 12 g m⁻²) fertilization. Treatments were arranged in a split-plot design with three replications (total of 27 plots). P and K were applied uniformly as 12 and 8 g m⁻² of superphosphate of lime and potassium sulfate, respectively. One month after manure application, radish seeds were sown (23 May) and whole plants were harvested on 25 July. For each of the 27 plots sampled, six plants were drawn from each plot and divided into leaves, petioles and roots. A portion of each type of tissue was frozen with liquid nitrogen and lyophilized for further analysis.

Extraction solution (3:1:1 methanol : chloroform : water), including an internal standard (ribitol at 2 µg mL⁻¹ water) was added to mashed tissue and the slurry incubated at 60°C. samples were derivatised with methoxyamine hydrochloride and N-methyl-N-trifluoroacetamide (MSTFA) along with a retention-time standards mixture (n-alkanes) and analyzed with a GCmate-II sector mass spectrometer (JEOL, Tokyo, Japan). The details of the method are given in Okazaki et al. (2010).

Results

Metabolite profiling was carried out using GC/MS to find an appropriate indicator of overall metabolic response to the levels of N_{inorg} and manure input. Peak areas of the 124 metabolites detected in radish leaves and roots were subjected to multivariate analysis. Radish leaves and to a slightly lesser extent roots contained a wide variety of metabolites whose levels were strongly influenced by the rate of manure application.

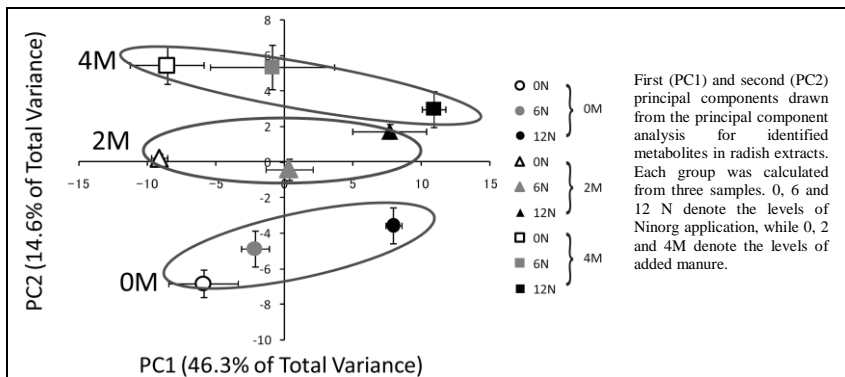


Figure 1: Sample scores plots drawn from the principal component analysis

Plots of the first and second PCA scores revealed differences in the metabolic profiles: with independent components that clearly corresponded to differences in N_{inorg} levels x manure levels (Fig. 1). The first component (PC1) accounted for 46.3% of the total variance, and discriminated between N_{inorg} fertilization rate treatments. The second component (PC2) accounted for 14.6% of the total variance, and discriminated between levels of manure application.

Contributions of each compound were characterized in terms of response indexes representing the absolute values of the PC1 and PC2 compound loading scores (Fig.

2, i.e. response to N_{inorg} vs. response to manure). In leaves and roots amino acids showed higher absolute values of PC1 loadings, indicating that the variation in their concentrations was strongly dependant on N_{inorg} fertilization rates. However, certain sugars in the leaves showed very high PC2 loadings, and many organic acids in leaves had both high PC1 (N_{inorg}) and PC2 (manure) loadings, indicating that these compounds were responsive to changes in the rate of organic matter application. Compared to leaves, compounds in the roots showed relatively lower absolute values of loadings of both PC1 (N_{inorg}) and PC2 (manure).

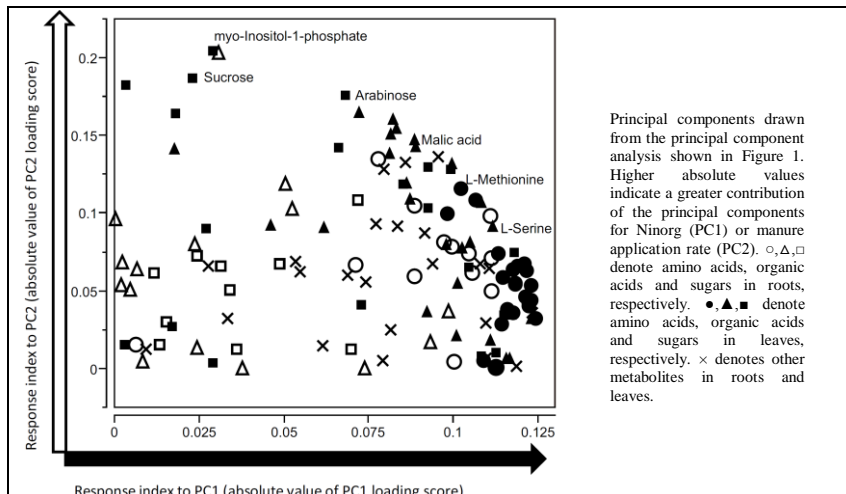


Figure 2: The absolute values of the loadings scores for PC1 and PC2

Discussion

Organic acids are known to be highly influential in generating the flavour of vegetables. In spinach, for example, oxalic acid should be at low levels to avoid an undesirable taste and to decrease the danger of urinary or kidney stones. While some have reported that there were no clear trends in organic acid levels with increasing rates of organic matter application (Woese et al., 1997), our results showed a significant decrease in levels of organic acids (e.g. malic, fumaric and succinic acids) with increasing amounts of added manure (Table 4). Our experiment used controlled applications of both N_{inorg} and manure, allow the effects of manure and N_{inorg} application rates to be separated. These effects of manure application may be attributable to a number of factors. Our previous studies with spinach showed organic acid levels to decreased with a decreasing nitrate-N to ammonium-N ratio absorbed by the crop (Okazaki et al. 2009). The present study's PC loading scores for radish parallel those of N-form components of the previous study, suggesting that manure-specific changes in radish metabolites might be partly due to the change in ratio of N-form supplied by the pool of NO_3^- and NH_4^+ or other form(s) of N in the soil. It is further hypothesized that P, K and organic molecules (such as organic forms of nitrogen) applied by manure also affect the composition of radish metabolites. Further research

with a suitable experimental design will be needed to reveal the mechanism of metabolic change engendered by manure application.

As for future research, we will have plans to integrate the metabolite profiles, crop quality and mutual symbionts which will be expected to make use of metabolite data. Metabolite profiles are closely related to the affinity for microbes in plant and/or the characteristics of tastes and storage as crop qualities. Further investigations will reveal the relationship among those interactions which has not been noted so far.

Conclusions

124 (87 compounds) peak areas in leaves and roots of field-grown radishes showed a clear response to the application rate of either or both N_{inorg} and manure. The PCA showed contributions of 46.3 and 14.6% of the total variance to be attributable to the N_{inorg} and manure application rate, respectively. Responses of compounds to either or both applications were more marked in leaves than in roots. This approach will be useful for characterizing the plants provided by organic cultivations especially as the aspects of metabolic sight of plants. The evidences of metabolic differences as a holistic sight will be able to find out differences of sensory properties or ecological functions of plants. Those findings may contribute to address the characters or the functions of organic cultivations.

Acknowledgments

This study was partly supported by the grant of Ministry of Agriculture, Forestry and Fishes of Japan.

References

- Okazaki K, Oka N, Shinano T, Osaki M, Takebe M (2009): Metabolite profiling of spinach (*Spinacia oleracea* L.) leaves by altering the ratio of NH_4^+/NO_3^- in the culture solution. *Soil Sci. Plant Nutr.* 55, 496-504.
- Okazaki K, Oka N, Shinano T, Takebe M (2010): Metabolite profiling of *Raphanus sativus* L. for the evaluation of the effects of manure amendment. *Soil Sci. Plant Nutr.* 56, 591-600.
- Williams CM (2002): Nutritional quality of organic food: shades of grey or shades of green? *Proc. Nutr. Soc.* 61, 19-24.
- Woese K, Lange D, Boess C, Bogl KW (1997): A comparison of organically and conventionally grown foods - Results of a review of the relevant literature. *J. Sci. Food Agric.* 74, 281-293.

Italian networking of public experimental sites working on Organic Farming: an experience of networking in research

Ortolani, L.¹, Micheloni, C.², Barberi, P.³, Bonazinga, M.⁴

Key words: experimental sites, public research, agro environmental indicators, networking

Abstract

Research in organic farming, especially with an agro-ecological approach, is strictly linked to local conditions and interactions among several variables. The paper will present an example of a process developed in the Italian context to integrate and harmonize research in organic farming from different research stations, with different local conditions. Collecting similar and comparable data from different research stations participating in the network can have an interesting impact in results of organic farming experiments, due to high number and variability of data. ARSIA Toscana, with the aim of creating an Italian National Network of public experimental stations working in organic farming, involved FIRAB as a facilitator of the participatory process. The proposed process follows two parallel paths: individual questionnaire to single experimental sites to know the specific activities in place on organic farming and a series of meetings with direct involvement and exchange among researchers and policy makers from different regions to comment results of the questionnaire and future development of organic research in public experimental stations. The main outcome of the process has been the choice of a specific transversal topic to build the network: the development of synthetic agro-environmental indicators.

Introduction

Research in organic farming, especially with an agro-ecological approach, is strictly linked to local conditions and interactions among several variables. For this reason, the establishment of a national network of experimental activities can be particularly useful to collect a higher number of data from different agro-ecological conditions. However, different research centres and scientists often use different methodological approaches and data collection procedures.

In Italy there are several public experimental sites, belonging to Universities, regional agencies for rural development and other public research centres. The Italian organic sector had 1.106.684 ha in 2009 with a variation of +10.4% in 2008-2009. The total Italian operators involved in organic were 48.509. The domestic purchases of packaged organic products showed an increase in value in 2009 of 6.9%⁵. With this figures Italy has a leading position in Europe and at global level. Considering the

¹ Italian Foundation for Research in Organic and Biodynamic Agriculture FIRAB, via Piave 14, 00187 Roma, Italy, e-mail l.ortolani@aiab.it, Internet www.firab.it

² Italian association for Organic Farming AIAB, via Piave 14, 00187 Roma, Italy, e-mail c.micheloni@aiab.it, Internet www.aiab.it

³ Land Lab, Institute of Life Sciences, Sant'Anna School of Advanced Studies, Piazza Martiri della Libertà 33, 56127 Pisa Italy, e-mail barberi@sss.it. Internet www.land-lab.org

⁴ Regione Toscana

⁵ Survey made by ISMEA, (Institute of Services for the agricultural and food market) in 2009.

growing interest in the country, some of the public research centres started to work on organic farming with different aims (regional priorities, specific interest of the involved researchers, request by local farmers, etc.), using different approaches, often focused on specific crops. To harmonise these public research activities, the Tuscany regional agency for rural development (ARSIA Toscana) involved the Italian Foundation for research in organic and biodynamic farming (FIRAB) to help in developing a National Network of public experimental sites working on Organic Farming.

The Tuscany regional agency for rural development (ARSIA Toscana) is working since several years in organizing periodic meetings among researchers responsible for the management of experimental sites focused on organic farming. This activity has led to interesting experiences and to the creation of consortia for the submission of research projects. The need for systematic networking activity and continuous exchange of experience and information among these research centers was one of the major outcome of these meetings. Such network could benefit the Italian organic farming sector as a whole and could provide relatively cheap services for the national research sector such as reliable and comparable data. FIRAB (Italian Foundation for research in organic and biodynamic farming) has been created in 2008 by AIAB (Italian Association for Organic Farming) and other environmental and social organization, with the economic support of private organic companies and farms. The main aim of FIRAB is to promote applied research in organic farming, giving a central role to farmers; in particular FIRAB staff have a special expertise in facilitating the dialogue between researchers and producers. This paper presents the participatory process put in place for the network creation and the results of the survey on organic farming research in public experimental sites, which was the first step undertaken in this direction.

Material and Methods

The process proposed by FIRAB in 2008 follows two parallel paths:

- a survey on the activity of public experimental sites on organic farming

- a series of meetings to presents survey results and to use it as input for developing the networking process,

The participatory process started with a public meeting organized in 2008 to define national research priorities in Organic Farming.

During 2009 and the beginning of 2010 a survey on experimental sites' activities took place involving most of the participants to the first meeting. The choice was to include just public experimental sites of public institutions and research centres, and do not include all experimental activities in organic farming. The one to one interviews have been done by telephone, taking specific appointment with the person responsible for the experimental station.

After the survey, a second public meeting took place to present the survey results to interested people working in public administration and responsible for public experimental station all over Italy. During this meeting the participants worked also in developing the proposal for the Italian Network of experimental sites working on Organic Farming, defining the main topic to start the collection of comparable data.

After the topic approval by public administration involved, a second survey took place to have a deeper knowledge of the current and past activities related to the defined topic. An e-mail with a specific questionnaire has been sent to all the public

experimental sites involved in the process. A final meeting took place to present the second survey results and to define the main point of an action plan for the network. The defined action plan was the base for a concrete proposal to be submitted to local government for funding opportunities to sustain the partnership activities.

Results

The survey results: activity of Italian public experimental sites on organic farming. Studies of the variation in research approaches and activities of experimental sites that works on organic farming provide evidence of the potential for improvements and reliable data on Italian organic farming systems. It is important to investigate actual systems, covering several representative agro-environmental areas to define possibility for further improvements. In 2009-10 FIRAB, developed a survey to define the number of public experimental sites involved in organic farming and to collect information on their existing experience and current activities on agro environmental indicators. As described above, the surveys have been part of the process to develop the national network of experimental sites working in organic farming. The 2009 survey showed that Italy has presently 36 public experimental sites active in organic farming research. These sites are scattered all over the country but are more concentrated in Emilia Romagna (4 sites) and Trentino Alto Adige (2 sites), focused on all the most important crops grown in these regions. Experimental sites are less common in South Italy, which is against the organic production data (higher in the South). The majority of the experimental sites are working on arable (22) and vegetable (21) crops. A smaller number of experimental sites work on viticulture, olive-growing and fruit trees. Ten sites out of 36 work on three or more types of crops. Fourteen of the experimental sites are more specialized and focus on only one specific crop type, mainly viticulture or arable crops. The survey showed that some of these experimental sites are already collaborating with one another whereas others are more isolated and do not have any knowledge of the activities ongoing outside their region. In particular, two crop specific sub-networks have been identified: one on winter cereals (durum wheat) and another on viticulture. The coordinators of these two networks have been involved in the participatory process to create the national network. This crop-centred approach to research reflects that commonly used in conventional agriculture instead of the systemic approach which is more appropriate for organic farming. The land dedicated to organic farming experiments is generally part of larger experimental sites also working on conventional agriculture. Often, the results of the experiments on organic systems are compared with those of conventional systems carried out at the same sites. Only one site, managed by ARSIA Toscana, is working only on organic farming. In other cases (9) public research centers have specific agreements with private organic farms to use part of their land as experimental sites. The four cross-cutting topics proposed for the 2010 survey were: crop rotation and diversification, soil quality, evaluation of produce quality, and economic evaluation. Crop rotation and diversification are used as baseline for the experiments but are not themselves object of innovation activities. Analyses of soil quality are done only when specific funds are available. For quality and economic evaluation, still few centers are collecting data on these aspects and mainly in a heterogeneous way.

Steps of the participatory process. The first meeting took place in Alberese (Grosseto, Southern Tuscany) in November 2008, with the participation of 90 persons of different backgrounds. The participants, divided in five different groups based on different food production chains, had the opportunity of exchange ideas and indicate

priorities for research in organic farming. In May 2010 a second meeting was organised by FIRAB in Rispeccia (Grosseto). This meeting refined the objective of creating the national network of experimental site:

- To exchange information and data.
- To possibly developing more complex research projects, by comparing the same type of experiments in long-term experiments conducted in different agro-ecological conditions.
- To optimise resource use in organic farming research.
- To standardise data quality as to carry out joint elaboration and publication
- To create synergies for the development of joint methodologies.

One main point of discussion during the meeting was to choose a cross-cutting topic aimed to compare data gathered in all the sites interested in the network, considering the high differentiation level of research activities among sites. The chosen topic was the development of synthetic agri-environmental indicators. The necessity of reorganising and fixing methods and indicators to make them available and comparable came out. This proposal, further refined by FIRAB and by Prof. Paolo Bàrberi (Sant'Anna School of Advanced Studies, Pisa), was presented in a meeting with regional public administrators which took place in Rome in November 2010. This meeting set the ground for a subsequent workshop aimed to develop the set of agri-environmental indicators for common use. In this view, the survey was integrated with information on the kind of agri-environmental indicators – if any – previously assessed at the different experimental sites in recent years. The workshop took place in Florence in December 2010 and was characterized by lively discussion, focused around the comparison of the different indicators already used and proposing possible solutions for future harmonization of assessment protocols. The next steps will be to prepare a detailed proposal on this topic and look for funding opportunities.

Conclusions

The process developed to create this network, based on a participatory process which directly involved the interested stakeholders – in this case people responsible of the management of experimental sites in different parts of Italy – represents a positive experience which could be reiterated in the organic farming sector in general. The participatory process has led to the building of a comprehensive partnership. The choice of sound, simple, and cheap agri-environmental indicators as the first focus topic could help pinpoint the systemic approach in national organic farming research. The availability of data and measurements for such indicators will allow to objectively evaluate the impact of organic farming on climate change, environmental quality, biodiversity conservation and other hot subjects.

Acknowledgments

Roberto Martellucci, Giacomo Nardi, ARSIA Toscana.

References

- Italian Ministry of Agriculture and Food Policies (2010) Italian Organic Farming: Quality for all.
- Morgan K., Murdoch J., (2000) Organic vs. conventional agriculture: knowledge, power and innovation in the food chain. *Geoforum* 31, 159-173.
- Ortolani L, Micheloni C. (2010) Indagine sui centri sperimentali e di trasferimento dell'innovazione in agricoltura biologica, FIRAB 2010.
- Seufert, A., Bach, A. and Von Krogh, G. (1999). Towards Knowledge Networking. *Journal of Knowledge Management*, Vol. 3, No. 3, pp. 183-185.

Identification of research priorities in transnational EU projects in Organic Food & Farming

Bellon S.¹, Alföldi, T.², Anil, S.³, van der Meulen, S.⁴

Key words: Research priorities, Research gaps, Transnational cooperation, Coordination of research in Organic Farming (CORE Organic II)

Abstract

Transnational cooperation is increasingly advocated in organic research and development. The ERA-Net CORE organic aims at coordinating research efforts among 21 European participating countries. It includes a specific work package to identify research topics for transnational calls. In this paper, we account for the process used and results achieved for the first call. Consultations and surveys among national contact persons enabled us to identify national research plans and needs. Research areas were ranked in order to define 3 main themes of common interest. Thematic research areas were then detailed in sub-topics likely to lead to the definition of research projects. The projects were then evaluated in a two-stage process. This process led to 59 pre-proposals, among which 26 were selected to submit a full proposal. Results are discussed in two directions: (i) complementarity between national plans and transnational projects, and (ii) relationships between institutional positions and scientific evaluation. As a whole, the process generated many research ideas likely to feed further research agendas.

Introduction : beyond diversity of national situations, topicality at stake

The political importance of research in organic food and farming (OF&F) is acknowledged, but it varies among European countries (Offermann et al., 2009; Stolze & Lampkin, 2009). The topicality and the thematic preference also vary strongly: some countries are more oriented towards improved production techniques, others to market development or delivering societal benefits. In addition, the state of OF&F research and its scientific excellence are very different: some countries have an established scientific community whereas others have just started to fund OF&F projects. Despite this diversity of situations, can research topics of common interest be identified?

The aim of the ERA-Net project CORE Organic⁵ II is to coordinate research programmes between European partner countries, while agreeing on common research priorities and selecting transnational research projects to be funded by the partners. The CORE Organic Funding Body Network (FBN) was set up in 2007 to continue and broaden the collaboration after the end of the first CORE Organic project (<http://www.coreorganic.org/research/>), and since then, the CORE Organic FBN has expanded to 21 countries.

¹ INRA UR 0767 Ecodéveloppement, 84914 Avignon, France E-Mail : bellon@avignon.inra.fr

² Research Institute of Organic Agriculture FiBL, Ackerstrasse, 5070 Frick, Switzerland

³ Ministry of Agriculture and Rural Affairs GDAR, Turkey

⁴ Ministry of Economic Affairs, Agriculture and Innovation, The Netherlands

⁵ Coordination of European trans-national research in organic food and farming, 2010-2012.

In this paper, we account for a specific CORE Organic II work package dedicated to identify research topics for transnational calls. During this process, a research overview was achieved in the participating countries, as introduced in the first section. We then present the results of a survey among FBN members, concerning research needs. The third section presents preliminary results of a first call, launched in 2010.

Materials and methods : a survey-based approach

An e-mail survey was carried out among the contact-person(s) in the FBN during late 2009. The survey was limited to the key-information in order to understand the different national policies and priorities. The contact-person(s) responsible for organic research in the partner countries were asked to answer the following 5 questions:

Q1/ summarize national research policies for OF&F; Q2/ list ongoing research programme(s); Q3/ indicate the key topic area(s) of each research programme; Q4/ rank research gaps as perceived by each country or organisation, Q5/ list important research topics and questions to be answered within CORE Organic II (opened).

As for questions Q3/ and Q4/, the following nine (9) topics were suggested, based on the main subject areas used in a specific data base (www.orgprints.org):

T1. Farming systems; T2. Animal husbandry and health; T3. Crop production and protection; T4. Soil; T5. Food quality, health, processing; T6. Values, standards & certification; T7. Environment; T8. Knowledge management; T9. Socio-economics.

Respondents were asked to rank them. In case no national research programme exists (Q3), they were also asked to describe how organic research is organised.

The results were presented and discussed during a meeting of the FBN (spring 2010). They were used to define the guidelines and thematic content of a first call.

Results : identification of research gaps, selection of topics for a call

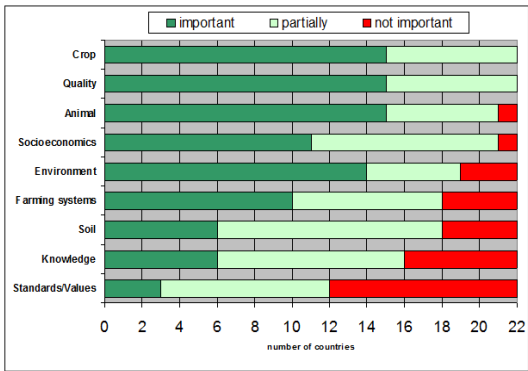
Most of the partner countries have a national action plan, with quantitative objectives for OF&F development. Orientations can vary according to the main arguments used. Three of them were prevalent: (i) to support the growth of the organic sector considered as a whole, (ii) to meet the market demand for organic products, with a commodity chain orientation, (iii) to fulfill the dual OF&F societal role, both for environment and market, as suggested in the new EU council regulation (834/2007).

In half of the countries, research for OF&F is seen as a strategic priority for national research whereas in other countries it is included in overall programs, for example in sustainability-oriented or farming systems research. Budgets allocated also differ among countries, ranging from 0.8 to 8 million €/ year.

The level of formalisation of the process used to identify research priorities also varies considerably between the countries. Based on their own statements, three countries (DK, FR, and DE) appear to have well defined structures and processes to identify research gaps. Like most of the other countries, stakeholder conferences or similar events to identify research gaps are organised, but an additional process of reflecting the past and future is included. Regular stakeholders exchange meetings take place in 11 countries (AT, CZ, BE, IT, NL, SI, ES, SE, CH, TR and UK). However these meetings seem to be less embedded into a continuous process. A less sophisticated priority setting process is described by other countries (EE, FI, IE, LV, and NO). Three

countries mention a working group facilitating the information exchange between research providers and research users (ES, CH, UK). Several countries have a research agenda as a basis for identifying research gaps: for example an ambition and innovation agenda (NL), a strategic agenda (BE), a Technology Platform (CZ), a knowledge synthesis (DK).

Partner countries were asked to rank research areas according to their importance for future research.



As shown in figure 1, the research areas crop or animal production and quality of organic food are important or partially important to all countries. Socio-economics also are supported by most countries, whereas the number of countries considering other areas to be less important increases. As a result, the 3 areas with higher ranking were selected for the first call, launched in 2010.

Figure 1: Importance of research areas for OF&F as perceived by 22 CORE Organic II partner countries.

The partner countries were also asked to formulate concrete research questions regarding the research areas above. Over 100 research questions have been collected, and then been clustered and allocated to the main research areas by the authors. In a second round, CORE Organic II partners have been asked to indicate those topics they would like to be included into the planned CORE Organic II calls. The prioritised topics for the different research areas serve as a basis for the present and future CORE Organic II call texts. They were used in the first call to specify the content of each thematic research area¹. For example, within crop production area, the sub-topics plant protection, nutrients supply and innovative use of local resources were considered to be most important and the theme “Designing robust and productive cropping systems at field, farm and landscape level” was developed.

This topic was also prioritised in terms of budget allocation, with 47% of the total indicative funding (7,9 Million €). As a result, 59 pre-proposals were elaborated in a two-stage application process. Following a consensus meeting of the FBN during late 2010, 26 consortium were invited to submit a full proposal. As for the first theme (cropping systems), a linear combination of classical evaluation criteria was used to assist in the selection of pre-proposals. This enabled to give various weight to criteria considered as more important by the FBN, also in keeping with available budgets. A scientific evaluation of full proposals was conducted in April 2011 by three expert panels. This led to the preliminary selection of 17 projects, submitted to the FBN for funding in May 2011.

¹ [//www.coreorganic2.org/Upload/CoreOrganic2/Document/COII_Call_Guideline_1stCall_final.pdf](http://www.coreorganic2.org/Upload/CoreOrganic2/Document/COII_Call_Guideline_1stCall_final.pdf)

Discussion and conclusions

This process enhanced the experience and outputs from CORE Organic I, namely in identifying research areas and consortium likely to propose projects. The extension to other countries enriches topicality and collaborations. Many ideas emerged, that will be considered for further calls. Working with several call topics, where it is not compulsory to contribute to each topic, has helped the process. New partners can contribute to topics that are best suited to their priorities and a general consensus is not necessary while only some partners are really interested.

Indeed positions differ among countries, ranging from problem-solving approaches as identified in national priorities to innovative topics supported by transnational approaches (Blanc *et al.*, 2008). A balance must be established between prioritisation (based on expert knowledge, existing national programs), scientific consistency (with transnational added value) and financial commitments of participating countries.

Some research areas should be expressed differently to ensure that there is a shared understanding of the issues at stake, especially for areas considered as marginal in the first call (e.g. "standards and values"). Systematic approaches based on state-of-the-art of research could help in this respect (Ollivier *et al.*, 2011).

Participation is also at stake for the definition of future priorities, considering resources available as compared with total demands. This issue is addressed in a specific work package of CORE Organic II ("stakeholder involvement in prioritizing research topics"). For instance, topics can differ according to the existence of an action plan and to the process used (stakeholders and groups meetings, research agenda). Beyond research gaps, a continuous and official process certainly helps in the identification of research questions.

We can conclude that in spite of the diversity of situations, analyses converged in topicality and a consensus was achieved on priorities. As the whole, the initiative is significant in terms of orientations for further research and avenues for funding.

Acknowledgments

The authors gratefully acknowledge financial support from the Commission of the European Communities, under the ERA-NET scheme of the Seventh Framework Programme in the project CORE Organic II (Coordination of European Transnational Research in Organic Food and Farming, Project no 249667 CSA).

References

- Blanc, J., Alföldi, T., Bellon, S., Niggli, U. (2008). How to promote innovation and interdisciplinarity in organic food and farming research evaluation. 2nd Conference of ISOFAR, Modena, Italy, June 18-20, 2008. <http://orgprints.org/11757/>
- Offermann, F., H. Nieberg, et al. (2009). Dependency of organic farms on direct payments in selected EU member states: Today and tomorrow. *Food Policy* 34(2009): 273-279.
- Ollivier, G., Bellon, S., Penvern, S. (2011). Thematic and citation structure of Organic Food & Farming research. Submitted to 3rd Conference of ISOFAR, Korea.
- Stolze, M. and N. H. Lampkin (2009). Policy for organic farming: Rationale and concepts. *Food Policy* 34(2009): 237-244.
- Willer, Helga and Kilcher, Lukas, (Eds.) (2010). *The World of Organic Agriculture - Statistics and Emerging Trends 2010*. IFOAM, Bonn, and FiBL, Frick.

Lifelong learning in organic agriculture: a degree program for working professionals

Specht, J.¹, Haering, A. M.²

Key words: lifelong learning, knowledge transfer, degree program for working professionals, European Qualifications Framework.

Abstract

Demographic change and brain drain are major challenges for rural areas around the world. Organic farms in the former East German states presently face a shortage of skilled staff, while the importance of organic farming is growing. The state of Brandenburg has the highest percentage (10.5%) of organically farmed land in Germany (MIL 2010). Farms in this region tend to be large and need farm managers with both a strong theoretical and practical background. This combination is rare – among university graduates and people with vocational training in farming. This article outlines the first steps in the development of an innovative model for lifelong learning in organic agriculture: a degree program for working professionals (Organic Farming and Marketing, B.Sc.) designed for people with a vocational degree and work experience in farming. This will allow qualified graduates to receive both theoretical education and practical training. By improving flexibility in the qualifications required to study at university level, the degree program for working professionals represents the first attempt in agricultural education in Germany to implement the European Qualifications Framework, a newly designed translation device to make national qualifications easier to compare across Europe.

Introduction

The idea of lifelong learning – i.e. the idea that learning doesn't stop when one is young but continues throughout one's entire life – is gaining in importance as demographic change brings about changes in the social and economical structure of societies. Lifelong learning enables people to adapt to changes in their surroundings and can be a way to improve, e.g. living conditions in rural areas, through education that is better and more multifaceted. Can, as the presented study is asking, innovative educational approaches improve not only the competencies of people working in agriculture but improve the image of the occupational field of agriculture in general as well?

The European institutions asserted the importance of developing a new perspective on education in 2008 when they agreed on the European Qualifications Framework (EQF) as a "translation device to make national qualifications more readable across Europe, promoting workers' and learners' mobility between countries and facilitate their lifelong learning" (European Commission 2010). This framework stipulates that each of the Member States has to develop its National Qualifications Framework not only to incorporate another EU regulation but to shift the focus of what education

¹ Eberswalde University for Sustainable Development, University of Applied Sciences, Friedrich-Ebert-Str. 28, 16225 Eberswalde, Germany, E-Mail judith.specht@hnee.de, Internet www.hnee.de

² As above

means and how it can be measured. The core of the EQF concerns eight reference levels that describe an individual's skills: what a learner knows, understands and is able to do. Learning inputs, i.e. the length of a learning experience or a degree become less important while the learning outcomes – resulting from either formal education, non-formal or informal learning – are the central variable.

For Germany, a country that has traditionally had a highly segmented education system, this new approach to measuring qualifications will require a radical shift in deeply entrenched ways of thinking. Still, some German states have given students with vocational or professional training and two years of work experience access to university-level education in their Universities and Colleges Acts (MWFK 2008). It used to be the case that students needed a high school diploma (Abitur) or a degree from an advanced technical college to attend university. Thus, the first steps are being taken to dismantle the clearly delineated system of vocational and university-level education. For education in agriculture, this option represents an enormous opportunity because it addresses the disparity between experienced farm professional who often lack the ability to manage the farm as a whole and academics who understand the theoretical basis and the economics but may struggle when expected to plough a field by themselves.

Eberswalde University for Sustainable Development, University of Applied Sciences, has identified these shortcomings and tackles the question, if a degree program for working professionals can enhance the interest in lifelong professional development. A growing professionalism of people working in agriculture would also improve the image of working in organic agriculture. The University is in the process of designing a new degree program that is an extension of the existing university-level course "Organic Farming and Marketing, B.Sc.". This new degree program targets people with vocational degrees in agriculture or livestock who have at least two years of work experience. These new students can earn a bachelor's degree while continuing to work on the farm. Thus, the shift of focus in European educational policies, the possibilities presented by the legislation of the state of Brandenburg and the necessity for lifelong learning pave the way for an innovative and sustainable approach to education and training in the field of organic farming.

Materials and methods

Qualitative semi-structured interviews were conducted with 10 experts from the fields of vocational training in agriculture and marketing of agricultural products and organic farming consultants. Main topics were the current situation on the job market, based on which professional development might be successful, and which factors might be an obstacle for lifelong learning in the agricultural sector.

In addition an analysis of existing documents that describe the learning outcomes of vocational training in agriculture in comparison to documents containing the learning outcomes of the full-time "Organic Farming and Marketing" program. The goal of the analysis was to understand to what extent the learning outcomes are equivalent. The result of this comparison serves as the basis for deciding whether the content of the program modules had already been learned in-depth through vocational training and practice. As a result, some of this prior knowledge can be formally "recognized" thus reducing the workload necessary for the B.Sc. degree (equivalence check). Documents from the vocational training courses (vocational training curricula, contents of final exams, textbooks, etc.) were compared to documents that described the learning outcomes of the program modules (module description, textbooks).

Results

The results of the survey and the document analysis underscore the feasibility of implementing a degree program for working professionals and identify the needs of the target group.

The experts interviewed clearly identified the need for more options for continuing education in the agricultural sector, specifically professional development in organic farming. The disparity between supply and demand for highly qualified staff is already evident and will increase in the years to come. There is high demand in particular for people with the ability to successfully manage farms and make decisions and have the skills to assume responsibility for technical, practical, economical and social aspects. The concept of the planned degree program for working professionals responds on this need, as it combines (as the already existing full time program) “Organic Farming” and “Marketing”, dealing with the whole value chain from production to marketing. Still, the interviews showed that learning methods and concept for the degree program would have to be specifically adapted to the unique situation in agriculture: it would only be possible for students to attend classes in winter and it would most likely be difficult to hold classes regularly in the summer even if they were only restricted to evenings and weekends. e-Teaching methods will be crucial the successful transfer of knowledge. To get potential students interested in new possibilities for professional development, it will be important to show them how they can benefit from an additional degree (e.g. in terms of their function or position).

The document analysis showed different levels of equivalence between the vocational degrees in agriculture, gardening and livestock on the one hand and the B.Sc. modules on the other. The primary challenge was to tackle not only which subjects were taught but also the extent to which the content was learned. 10 of the 27 compulsory B.Sc. modules, for example, showed for vocational studies in agriculture a relatively high level of equivalence in the document analysis. Still, it would appear that an additional step which measures the depth of this equivalence would be necessary to arrive at a decision on which prior learning can be recognized. The “Module Level Indicator” (MLI) tool developed at the University of Oldenburg, Germany (Müskens & Gierke 2009) will also be used to check the in-depth knowledge, skills and competencies gained in both the vocational training and at university level. This approach is designed to ensure the process of recognizing prior knowledge can be so well documented that neither the accreditation of the program is at risk nor does the quality of education suffer when a new target group is included.

Discussion

The development of adult learning opportunities that transform the idea of lifelong learning into praxis occupies multifaceted institutions and organisations throughout Europe (EACEA/Eurydice 2011). Considering that educational systems and values differ traditionally high within the European Union, development and trends to transform the national qualification systems show a remarkable similarity (Cedefop 2010). In common are the recognition of prior or informally acquired competences, the development of adult learning programs, and increased flexibility in the vocational and university systems. Accordingly, the various steps undertaken at Eberswalde University of Sustainable Development show that the knowledge gained in certain vocational degrees like agriculture or livestock can serve as a solid basis for the additional university-level study program “Organic Farming and Marketing, B.Sc.”. Using the EQF or the German Qualifications Framework (GQF) as a basis for deciding

to open up the program to a new target group is partly justified. The theoretical background is valuable and helps expand our perspective on European educational policy. Nevertheless, step-by-step implementation needs a more well-defined framework including the opportunities the Eberswalde University for Sustainable Development has at its disposal and the unique situation of the agricultural sector. Recognizing prior learning – a key component of the EQF – appears less and less feasible when one takes a closer look at the equivalence level of the modules. Still it is crucial to analyze the depth of equivalence objectively to ensure that the program will retain its quality and appeal for both the current and new target groups over the long term.

Conclusions

The creation of a degree program in "Organic Farming and Marketing" for working professionals is an innovative approach designed to educate professionals working in the organic agriculture sector. This new form of knowledge transfer has the potential to strengthen organic farming over the long run and simultaneously provide professionals with the opportunity for lifelong learning. To achieve this goal, it will be necessary to find solutions for how this special target group - i.e. people actually working in the agricultural sector - can be encouraged to pursue their education further while continuing to work. e-Teaching methods and a concept that takes into account both seasonality and the day-to-day workload must be developed. If the right solution is found, the program has the potential to be a pioneer in innovative knowledge transfer within organic farming and in the university system.

Acknowledgements

This paper is based on the work of the project "BeStuLa – Mehr Nachhaltigkeit durch berufsbegleitendes Studium im ökologischen Landbau Brandenburgs", financed by the European Social Fund (ESF) and the German state of Brandenburg as part of the INNOPUNKT program: Mehr Durchlässigkeit in der Berufsbildung – Brandenburg in Europa (Increased flexibility in the vocational and university systems – The state of Brandenburg in Europe)

References

- Cedefop (2010): Changing Qualifications. A review of qualifications policies and practices. Publications Office of the European Union, Luxembourg, 263 p.
- EACEA; Eurydice (2011): Adults in Formal Education: Policies and Practice in Europe. Eurydice, Brussels, 88p.
- European Commission – Education & Training (2010): The European Qualifications Framework (EQF), http://ec.europa.eu/education/lifelong-learning-policy/doc44_en.htm, (accessed 2010-11-12).
- MIL (2010): Ministerium für Infrastruktur und Landwirtschaft: Ökolandbau in Brandenburg. Entwicklung des ökologischen Landbaus, <http://www.mil.brandenburg.de/sixcms/detail.php/bb1.c.220603.de>, (accessed 2010-11-17).
- Müskens W., Gierke W. B. (2009): Gleichwertigkeit von beruflicher und hochschulischer Bildung? Report – Zeitschrift für Weiterbildungsforschung. 32(3): 46-54.
- MWFK (2008): Gesetz über die Hochschulen des Landes Brandenburg (Brandenburgisches Hochschulgesetz BbgHG) vom 18. Dezember 2008, <http://www.mwfk.brandenburg.de/media/lbm1.a.1494.de/Hochschulgesetz2008.pdf> (accessed 2010 11-17)

Comparing farmland biodiversity in organic and conventional farming systems: making sense and including context

Langer, V., Rasmussen, J. & Henriksen, C.I.¹

Key words: Farming systems, biodiversity, methodology, crops, landscape

Abstract

The effect of organic farming on farmland biodiversity is measured with conventional agriculture as the reference. Large steps ahead have been taken during recent years, with a lot of attention on distinguishing between field, farm and landscape scale effects, but there are still challenges. Systems comparisons calls for explicit discussions of methodological issues, and the aim of this paper is to facilitate this. The two main issues are handling scale and the question of "which systems to compare". Since both "organic farming" and "conventional farming" change rapidly, also the differences between organic and conventional are highly dynamic over time. Furthermore, what is assumed inherent to the systems has large implications for the conclusions and must be explicitly discussed in relation to the various contexts. ,

Introduction

The effect of organic farming on farmland biodiversity is measured with conventional agriculture as the reference. The most common methodologies for comparing biodiversity of organic and conventional farming systems include simulated agro-ecosystems on research stations (replicated systems plot experiments ((Mäder *et al.*, 2002), unreplicated whole systems experiments (e.g. Fleessa *et al.* 2002), and on-farm studies, either based on groups of similar farms (e.g. Haas *et al.* 2001), matched pairs (e.g. Rundlöf *et al.* 2008) or longitudinal case studies of single farms over time (Drinkwater 2002). Most recently, landscape level studies focusing on fields in "organic" and "conventional landscapes" have also been used (e.g. Holzschuh *et al.* 2008). Systems comparisons calls for explicit discussions of methodological issues, and the aim of this paper is to facilitate this.

Scale of investigation

For all comparisons of organic and conventional systems, handling scale plays an important role. Farmland organisms respond to the living conditions determined by quantity, diversity and quality of habitats on different scales, depending on their living requirements and mobility. Examples of a mismatch of scales, e.g. assessing effects of organic management on mobile organisms in small experimental plots, are rarely seen now, and during recent years more attention has been given to distinguishing between field, farm and landscape scale effects (Gabriel *et al.* 2010). Also, it has become clear that the different scales interact, e.g. that field and farm scale effects of management methods may show in homogenous landscapes but not in heterogenous (Rundlöf *et al.* 2008).

¹ Department of Agriculture and Ecology, University of Copenhagen, Højbakkegaards alle 9, 2630 Taastrup, Denmark, E-Mail vl@life.ku.dk, Internet www.life.ku.dk

Meaningful systems comparisons

For farm level comparisons, the question of “which systems to compare” is crucial (see relevant discussions of this in Hole *et al.* 2005, Bengtsson *et al.* 2005, and Smith *et al.* 2011) and at least two challenges must be handled.

Firstly, the issue of dynamics over time. Especially when using matched pairs of farms, comparisons are like “hitting a moving target”. Since both “organic farming” and “conventional farming” change rapidly everywhere, also the differences between organic and conventional are highly dynamic over time. Maxwell (1986) described research in farming systems as similar to “hitting a moving target”, and this seems to be a quite accurate description also of comparisons of organic and conventional farming, each comprised of different farm types, which develop in divergent directions. This problem calls for critical reflections on how the ongoing development within both sectors potentially may influence biodiversity. E.g. whether farm enlargement leads to lower density of uncropped land and thus influence organisms linked to these habitats, or whether management improvements e.g. in mechanical weed control in organic farming, narrow the gap between organic and conventional systems.

Secondly, the problem of defining what is inherent to the compared systems. One of the latest reviews of organic agriculture and biodiversity lists a range of what is called “generally accepted reasons” for the well documented large number of positive effects and very few negative effects of organic farming (Smith *et al.* 2011). The review concludes that the documented biodiversity benefits may partly be attributed to the fact, that most organic farms are mixed farms or mixed livestock enterprises, that introduction of permanent pasture, hedgerows, beetle banks are linked to organic farms and that management regimes on organic farms tend towards diversity and away from intensification. These characteristics of organic farms may be well documented in the context of the review, i.e. under UK conditions, but are not true generally. In Denmark, for instance, mixed farms are not overrepresented among organic farms, and the links between hedgerows and farming systems are not well established either. This is a good example of the need to explicitly define the inherent characteristics of the system and reflect upon the context dependent nature of some of the characteristics (Table 1).

Tab. 1: Some farm level characteristics of importance for biodiversity effects which may differ between organic and conventional farming systems

| A. Required in standards (always differ) | B. System derived (most often differ) | C. System independent (may or may not differ) |
|--|--|--|
| <ul style="list-style-type: none"> ➤ No pesticides ➤ Use of organic manure instead of mineral ➤ Grazing for cattle ➤ Free range pigs and poultry | <ul style="list-style-type: none"> ➤ Crops and rotations ➤ Tillage <ul style="list-style-type: none"> - more due to weed control - less due to ley ➤ Lower livestock intensity = lower N-level | <ul style="list-style-type: none"> ➤ Field size ➤ Landscape elements <ul style="list-style-type: none"> - quantity (field size, region, topography) - quality (affected by pesticide and fertilizer use on adjacent field, age) ➤ Management of pastures |

Table 1 shows some examples of farm level characteristics of importance for biodiversity. In all contexts the traits required by the standards will be found (A). Group B includes farm characteristics on which organic farms will most often be different from conventional farms of the same type: crops on organic farms will most often include leys or other forms of green manure and continuous grain cropping as on conventional farms will not be seen. Rotations are often said to be more diverse on organic farms, but on organic dairy farms crop rotations may be less diverse than on conventional dairy farms due to a larger demand for self produced fodder. Group C includes farm characteristics which may or may not differ from conventional farms, depending on the context. Field size is often linked closely to farm size, so in contexts where organic farms are larger than conventional, field sizes may also be larger. Also the linkage between landscape elements and farming system seems to be inconsistent across different contexts and may be highly influenced by local and regional topography, soil conditions and agricultural structure.

Table 2 gives some examples of the different assumptions about the factors inherent to organic systems and the implications for the conclusions.

Table 2: Factors assumed to be inherent to organic systems in different kinds of pairwise comparisons on farm level

| Factors kept constant in pairwise comparisons | Assumed inherent to organic agriculture | Examples |
|---|--|--|
| Region, Landscape, farm types, land use | Only management (e.g. pesticides, fertilizer, tillage) | Rundlöf <i>et al.</i> 2008 (bumble bees) Weibull <i>et al.</i> 2000 (butterflies) |
| Region, Landscape, farm types | Crops and management | Wikramasinghe <i>et al.</i> 2003 (bats) |
| Region, Landscape ("neighbour farms") | Farm types, crops and management | Gibson <i>et al.</i> 2007 (plants) |

As seen in table 2 the choice of what is kept constant depends on what is assumed to be inherent to organic systems. Assuming that only management is inherent to organic farming provides widely applicable data, because management in the two systems will differ in the same way in most contexts. However, it will not capture if crops beneficial for biodiversity, e.g. clover grass ley, are more prevalent in organic systems and offer "extra benefits". Neither will it capture the opposite, e.g. that organic farms in some contexts are larger and have larger fields, e.g. soybean producing farms in China. Therefore, comparisons of this type must include a discussion of its context.

Furthermore, when comparing within the same farm type, the asymmetry is a challenge. For some conventional farm types, e.g. industrialized pig production, a reasonable match cannot be found among organic farms and vice versa.

Discussion and Conclusions

When comparing biodiversity in organic and conventional fields and farms and in "organic" and "conventional landscapes" it should be explicit what is assumed inherent

to the systems and what the implications for the conclusions are. This will be closely connected to the context in terms of prevailing farm types and their characteristics.

Furthermore, on a national or regional scale, the overall benefits of organic agriculture to farmland biodiversity depends not only on the differences between organic and conventional farms within the same farm type, but also on the difference in the distribution of farm types between the conventional and organic sector.

Research in farmland biodiversity should be targeted towards documenting and developing the positive effects of organic farming, but also towards grasping the biodiversity impacts of future development towards larger and more intensive organic farms, similar to the development in conventional agriculture.

References

- Bengtsson, J., Ahnström, J. & Weibull, A.-C. (2005): The effects of organic agriculture on biodiversity and abundance: a meta-analysis. *Journal of Applied Ecology* 42: 261–269
- Drinkwater, L.E. (2002): Cropping Systems Research: Reconsidering Agricultural Experimental Approaches. *HorTechnology* 12: 355-361
- Gibson, R.H., Pearce, S., Morris, R.J., Symondson, O.C., Memmott, J. (2007): Plant diversity and land use under organic and conventional agriculture: a whole-farm approach. *Journal of Applied Ecology* 44: 792-803.
- Haas, G., Wetterich, F., Köpke, U. (2001): Comparing intensive, extensified and organic grass-land farming in southern Germany by process life cycle assessment. *Agriculture, Ecosystems and Environment* 83: 43–53.
- Hole, D.G., Perkins, A.J., Wilson, J.D., Alexander, I.H., Grice, P.V., Evans, A.D. (2005): Does organic farming benefit biodiversity? *Biological Conservation* 122: 113–130
- Holtschuh, A., Steffan-Dewenter, I., Tschamntke, T. (2008): Agricultural landscapes with organic crops support higher pollinator diversity. *Oikos* 117: 354-361.
- Mäder P., Fließbach A., Dubois D., Gunst L., Fried P., Niggli U. (2002): Soil Fertility and Biodiversity in Organic Farming. *Science* 296: 1694-1697.
- Maxwell, S. (1986): Farming Systems Research: Hitting a Moving Target.. *World Development* 14: 65-77
- Rundlöf, M., Nilsson, H., Smith, H.G. (2008): Interacting effects of farming practice and landscape context on bumble bees. *Biological Conservation* 141: 417-426
- Smith, J., Wolfe, M., Woodward, L., Pearce, B., Lampkin, N. (2011): Organic Farming and Biodiversity: A review of the literature. Organic Centre Wales, 33pp.
- Weibull, A.-C., Bengtsson, J., Nohlgren, E. (2000): Diversity of butterflies in the agricultural landscape: the role of farming system and landscape heterogeneity. *Ecography* 23: 743–750
- Wikramasinghe, L.P., Harris, S., Jones, G., Jennings, N.V. (2003): Abundance and species richness of nocturnal insects on organic and conventional farms: effects of agricultural intensification on bat foraging. *Conservation Biology* 18: 1283-1292

ORCA-Research.org: The new website of the Organic Research Centres Alliance (ORCA)

Willer, H.¹, Frieden, C.² and Nadia Scialabba³

Key words: Organic research collaboration, developing countries, internet

Abstract

The Organic Research Centres Alliance (ORCA) intends to internationally network and strengthen existing institutions with scientific credentials and empower them to become centres of excellence in transdisciplinary organic agriculture research (Food and Agriculture Organisation of the United Nations 2009). With the launch of the ORCA-Research.org website in December 2010, these efforts to promote synergies and networks in organic agricultural research are now visible. The website is maintained by the Research Institute of Organic Agriculture (FiBL).

Introduction

Organic agriculture has been steadily growing for more than a decade and the demand for organic products continues to be larger than supply. However, a rapid expansion of organic management requires investments in the knowledge base at all levels. Fundamental science and applied research are crucial requirements for the development of organic agriculture, especially in developing countries.

An important objective of the proposed Organic Research Centres Alliance (ORCA) is therefore to ensure that environmental, economic, and social benefits accruing from organic research are shared worldwide. The ORCA concept is designed following a research paradigm that heavily draws on traditional knowledge, improves it with scientific investigation and shares it widely.

The ORCA concept

The ORCA concept has been developed jointly by the Food and Agriculture Organization of the United Nations (FAO, Italy), Tufts University (USA) and the Research Institute of Organic Agriculture (FiBL, Switzerland).

The proposed ORCA research centres

The proposed ORCA research centres may be physical laboratories or “institutions without walls”, formed through alliances between producers and scientists, as well as twinning between developing and developed countries’ institutions. The informal ORCA Research Centre for Climate Change (www.organicandclimate.org) is already pooling the expertise of a dozen institutions worldwide. Once fully developed, ORCA will consist of some eleven research networks, or centres, that pool their intellectual and financial resources to work on common research objectives.

¹ Research Institute of Organic Agriculture FiBL, Ackerstrasse, 5070 Frick, Switzerland, E-Mail helga.willer@fibl.org, Internet www.fibl.org

² As Above

³ Food and Agriculture Organisation FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy, www.fao.org/organicag

All eleven Centres are linked together, forming a global network of networks for organic knowledge generation and sharing. Each ORCA Centre will be coordinated by a consortium of key organic institutions entrusted to ensure the active participation of farmers and the cooperation of relevant institutions. Coordination between Centres will be carried by an ORCA Secretariat hosted by FAO.

Five of the ORCA Centres will focus on specific agro-ecosystems: Coastal and small islands; hilly and mountains; Arid and semi-arid; humid and sub-humid; temperate and irrigated. Further six ORCA Centres will focus on cross-sectoral topics that merit special attention: Climate change; urban and periurban agro-ecosystems; nutrition, quality and health; economics, markets and trade; post-harvest handling and food safety; seeds and breeds. Each of the centres will both undertake inter-disciplinary and participatory research and develop a virtual library where all information on two key topics will be maintained and regularly updated. ORCA Centres will grow from existing institutions, which synergies will create excellence centres on specific themes. The ultimate outcome of ORCA is that multifaceted benefits accruing from the organic sector are shared worldwide.

Partners

The Organic Research Centres Alliance has a number of partners. These are: The Research Institute of Organic Agriculture (FiBL, Switzerland), the International Federation of Organic Agriculture Movements (IFOAM, Germany), the International Society of Organic Agriculture Research (ISO FAR, Germany); the Division of Organic Farming of the University of Natural Resources and Applied Life Sciences BOKU (Austria), the International Centre for Research in Organic Food Systems (ICROFS, Denmark), the Institute for Organic Agriculture (IOL, Germany), AgroEco - Louis Bolk Instituut (LBI, The Netherlands), the Institute of Organic Farming of the Heinrich von Thünen Institute (vTI, Germany).

FAO serves as the ORCA Secretariat.

Results

The ORCA website was set up in 2010 and is currently being developed further. With www.orca-research.org, a dedicated ORCA platform has been created that offers information specific to organic research areas. This website holds information about the ORCA Centres and general information about organic farming research and is maintained by the Research Institute of Organic Agriculture (FiBL), Switzerland.

Current features of www.organic-research.org include:

- Background on the ORCA themes and the proposed ORCA centres including links to relevant information, particularly in the Organic Eprints archive (www.orgprints.org), an online archive for papers related to organic food and farming research, maintained by the International Centre of Organic Farming Systems (www.icrofs.org) – one of the ORCA partners.
- Organic research country profiles (currently ten);
- News about ORCA;
- News about organic farming research in general;
- Information on related events;
- A general resource section.

General information about ORCA and the ORCA secretariat is maintained by FAO at www.fao.org/organicag/oa-portal/en. This page provides information on ORCA developments, including progress in fundraising, future tenders for implementation and calls for biennial conferences.

Discussion

Because organic research is scarce and often difficult to access, pooling resources and building synergies is the most efficient way ahead in creating a critical mass of knowledge. Research plays an indisputable role in the development of organic food and farming systems.

This is especially true for developing countries as this form of agriculture was developed in the temperate zones of Europe, the United States, and Japan. It has never been completely adapted to the diversity of soils, climates, and socio-cultural contexts of the tropics, subtropics, and arid zones.

There are many institutes conducting research of relevance to organic agriculture, however, there is currently no comprehensive research programme addressing organic farming systems. Considering that organic farming research requires a systems approach, including cross-disciplinary knowledge, there is a need to establish an international research programme, based on sharing the complementary efforts of different institutions. ORCA seeks to correct an important deficit by linking relevant research worldwide.

The platform is aimed at farmers, processors, extension agents and scientists seeking to deepen their knowledge and also increasing it by contributing to action research or post-graduate studies.

Conclusions

Launching the ORCA website is a tangible step in creating a dynamic international knowledge system that takes ongoing efforts in organic research and gives these efforts a platform to thrive.

References

Food and Agriculture Organisation FAO (2009): Introducing Organic Research Centre Alliance. A global research consortium, dedicated to organic agriculture. Food and Agriculture Organisation FAO, Rome.

Available at http://www.fao.org/fileadmin/templates/organicag/files/ORCA_en.pdf

Websites

- FAO.org/organicag: Organic agriculture pages at the website of the Food and Agriculture Organisation of the United Nations (FAO)
- ISOFA.org: Website of the International Society of Organic Agriculture Research (ISOFA)
- ORCA-Research.org: Website of the Organic Research Centres Alliance (ORCA)
- OrgPrints.org: The Organic Eprints Archive for scientific publications related to organic agriculture, maintained by the International Centre for Research in Organic Food Systems (ICROFS)
- Springer.com/life+sciences/agriculture/journal/13165: Webpage of the Journal of Organic Agriculture, the journal of the International Society of Organic Agriculture Research (ISOFA) at the Springer website

Toward organic shrimp aquaculture development: Experiences from Bangladesh

Paul, B.¹ & Vogl, C.²

Key words: aquaculture, shrimp, organic, development, Bangladesh

Abstract

Shrimp farming is considered as an important sector of the national economy of Bangladesh. This export oriented sector generates foreign exchange and rural employments. Likewise, organic shrimp aquaculture has come to be as an alternative farming enterprise for farmers in south-western districts. The present study is attempted to understand the socioeconomic conditions of the farmers which will lead to identify the reasons behind the expansion of organic shrimp farming. The empirical data was collected from 144 organic farmers of Kaligonj and Shyamnagar sub-districts using semi-structured questionnaire. The results were derived using descriptive statistics and one way ANOVA. Household income, education, experiences and suitable land holdings have been found to have a strong influence on the expansion of organic shrimp aquaculture development. The potential of organic shrimp aquaculture are higher yield, lower production cost, available shrimp seed and high market prices. It can be concluded that large-scale farmers are likely to earn less income benefits from organic shrimp aquaculture than their small-scale counterparts.

Introduction

Worldwide, aquaculture is dominating all other animal food producing sectors in terms of growth. The sector has been growing at an average annual rate of 8.9% since 1970, compared with 1.4% for capture fisheries and 2.8% for terrestrial meat production systems (FAO, 2002). Aquaculture has lagged behind the agriculture sectors in terms of both quantity and diversity of certified organic produce (FAO, 2002). Organic agriculture is rapidly developing worldwide with an amount of 35 million hectares of agricultural land presently farmed, whereas in aquaculture only 0.43 million hectares of land are managed organically (Willer & Kilcher, 2010). Current growth in global demand for organic foods is estimated at 20% per annum (Pelletier, 2003). The production of organic aquaculture is predicted to increase 240-fold by 2030, i.e. to an equivalent of 0.6% of the total estimated aquaculture production (FAO, 2002). Organic aquaculture has attracted attention due to consumers' awareness about overfishing, environmental degradation, health risks, sustainability and animal welfare (Biao, 2008).

In Bangladesh, black tiger shrimp (*Penaeus monodon*) aquaculture has been attracting considerable attention over the last three decades due to its export potential for international markets. In the financial year 2007-2008, Bangladesh exported 49,907 tons of shrimp and prawn, valued at US\$ 409 million, while the sector contributes with about 4.04% to the total export earnings and with 3.74% to the GDP (DoF, 2009). The shrimp industry employs approximately 1.2 million people in Bangladesh for production, processing and marketing activities. Despite its export

¹ Division of Organic Farming, University of Natural Resources and Life Sciences (BOKU), Gregor Mendel Strasse 33, A-1180, Vienna, Austria, Email-brojo.paul@boku.ac.at, Internet: www.boku.ac.at

² As above

potential and the employment generated, shrimp aquaculture has had considerable environmental costs. Shrimp aquaculture has therefore been criticized by environmental and social scientists around the world especially in terms of unplanned expansion (Paul & Vogl, 2010). As a consequence, organic shrimp aquaculture has been introduced to south-western Bangladesh as an alternative culture. Recently, an organic shrimp project (OSP) has been implemented by the Germany based importing organization WAB-Trading international. The organic farms of the OSP get certified by Naturland and inspected by the Institute of Market Ecology. Therefore, the aim of the study is to understand socio-economic conditions of organic farmers and to identify the potential causes for expansion of organic shrimp aquaculture in Bangladesh.

Methodology

The study was conducted in the Satkhira district, a salinity-affected coastal area of the Bay of Bengal, situated in the southwestern part of Bangladesh. Satkhira district is divided into seven sub-districts. Among them, only Kaliganj and Shyamnagar sub-districts have been considered in this study, because here a large number of shrimp farms are operating due to the available saline water and the closeness to the river channels. Both sub-districts are located close to the world's largest continuous mangrove forest.

Data was collected between October and December in 2009 during the late harvesting season. This study applied both quantitative and qualitative data collection methods. A total of 144 shrimp farmers, 24 in each stratum from each sub-district, were sampled. Primary data was collected during a face to face field survey using a pre-tested questionnaire. The questionnaire contained both pre-coded and open-ended questions. As a means of triangulating the data derived from questionnaires, several topics relevant to the study were presented and discussed in focus groups. A total of 4 focus group discussions were conducted in both sub-districts. Each focus group session comprised 8-12 individuals and the duration of each discussion was approximately an hour. Transect walks were performed systematically with shrimp farmers by walking across the *gher*¹ sites at the beginning of the study to build rapport.

Questionnaire interview data were coded and entered into a database system using MS-Access (Microsoft 2003). The statistical package for social science (SPSS 15.0 for Windows) was used to produce descriptive statistics. Comparisons among farmer's categories were made by ANOVA F-test. The ANOVA was followed by a Tukey Post-hoc comparison of means. Differences are reported as significant at a level of $p \leq 0.05$. In some cases, data was normalized using the log transformation.

Results

Farmers are on average 41.9 years old, ranging from 19 to 82 years (Table 1). The mean household size is 5.6 persons, ranging from 2 to 16. Among the respondents, 15% are illiterate, while 85% have a formal education. Larger farmers stayed significantly longer at school than smaller farmers. On average, farmers have an experience of 14.4 years working with shrimp. Smaller farmers have significantly less experience (in years) than medium and large size farmers. The monthly income of organic farmers is US\$ 477.9 on average (Table 1), and is significantly higher for larger farmers than for small and medium size farmers.

¹ *Gher*: Bangladeshi local term for modified rice fields or ponds located beside canals or rivers, used to cultivate shrimp and fin fish

Table 1: Socio-economic variables (Arithmetic mean, Range) of surveyed respondents (n = 144)

| Variables | Small farmers | Medium Farmers | Large farmers | All farmers | Significance level |
|---|--------------------|-----------------------|----------------------|--------------------|--------------------|
| Years of school attendance | 6.1a (0-15) | 6.8ab (0-15) | 8.4c (0-14) | 7.1 (0-15) | * |
| Experience with shrimp farming in years | 9.6a (2-20) | 15.7bc (4-24) | 17.9c (6-29) | 14.4 (2-29) | *** |
| Monthly income in US\$ [#] | 161.4a (53-415) | 287.3ab (102-1354) | 984.9c (261-5108) | 477.9 (53-5108) | *** |

Significance level: * = $p \leq 0.05$; ** = $p \leq 0.01$; *** = $p \leq 0.001$; ns= not significant.
a, b, c: Different letters indicate significant differences at $p \leq 0.05$.

The land used as *gher* consists of owned, leased-in, and leased-out land. The total *gher* areas under organic shrimp farming are keeping more than 4000 ha of land. Large farmers take up 77% of the total land area for *gher* operation, while only 6% of the area belongs to small farmers. The average size of *gher* under organic shrimp production is 2.32 ha. The mean *gher* size for shrimp production of larger farms is 5.37 ha, followed by small (0.43 ha) and medium (1.17 ha) farms. Of the total farmers, 21.5% that do not own any land for shrimp farming but they are operating *gher* for shrimp production as lease-in or participate in jointly managed *gher*. Nevertheless, 71.5% of organic farmers take lease-in land from their neighbours to pursue shrimp farming. Leasing periods vary from one to five years. Leasing values depend on location and vary from US \$ 57 to 100.

Shrimp farming activities generated more than 75% of the total annual income, and shrimp alone generated about 63.3%. Income from shrimp as compared with the share of fish and others is significantly higher for large farmers than for small and medium ones. Farmers earn 10.2% of their income from fish and others, the major share belonging to large farmers. Income from agriculture is 3.8% of the total income. Of the total incomes, 12.1% of earnings come from other sources and 7.7% come from business sectors (Table 2).

Table 2: Percentage distribution of total annual income from different sources distinguish by farmers category (n = 144)

| Source of income | Small farmers | Medium farmers | Large farmers | All farmers | Significance level |
|------------------|---------------|----------------|---------------|-------------|--------------------|
| Shrimp | 51.3 | 48.8 | 69.5 | 63.3 | *** |
| Prawn | 0.8 | 1.7 | 1.0 | 1.1 | ns |
| Fish and others | 2.7 | 5.9 | 12.7 | 10.2 | *** |
| Agriculture | 2.6 | 9.7 | 2.3 | 3.8 | * |
| Livestock | 1.2 | 0.8 | 0.3 | 0.5 | ns |
| Business | 7.9 | 10.4 | 6.9 | 7.7 | *** |
| Job | 1.8 | 5.4 | 0.0 | 1.3 | * |
| Other | 31.5 | 17.3 | 7.3 | 12.1 | ns |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | |

Significance level: * = $p \leq 0.05$; ** = $p \leq 0.01$; *** = $p \leq 0.001$; ns= not significant.

Organic shrimp aquaculture depends on the availability of post larvae. Two types of post larvae are available in Bangladesh, i.e., natural post larvae and hatchery post larvae. Seventy-nine percent of farmers reported that natural post larvae are hardly available (often not found due to scarcity), and 14% claimed moderate availability (often found, but not high enough quantities). On the other hand, 94% of the farmers stated that hatchery post larvae are sufficiently available for shrimp cultivation.

The mean yield of organic shrimp is 319.61 kg ha⁻¹year⁻¹. The shrimp yield of small farmers is higher than that of medium and large farmers. Eighty percent of the organic farmers revealed that they have got higher yield than their earlier production pattern. Ninety-one percent of the organic farmers stated that production cost has decreased tremendously. All farmers get high price, selling organic shrimp to collection centres of Gemini Sea Foods Ltd.

Discussion and Conclusion

Farmers of organic shrimp in Bangladesh tend to be older, hold an academic degree, have a longer aquaculture experience and higher monthly income. The motivations for organic shrimp aquaculture production in Bangladesh are linked with suitable landholdings, available post larvae, higher yields and higher market prices. The average farm sizes of organic and conventional shrimp farms are quite similar in Bangladesh. This might have happened because the same types of farmers have converted from conventional to organic. The distribution of landholdings is skewed towards large *gher* owners for organic shrimp aquaculture. The yield of organic shrimp is comparatively higher for small than for large farmers. Organic shrimp farming offers a cash crop to farmers, has reduced the production cost and generated employment for small and medium farmers. Organic shrimp farming in Bangladesh has recorded higher yields than conventional but still it is low-yielding compared to other shrimp producing countries. So, more research efforts are required to improve the yield of organic shrimp.

Acknowledgments

We would like to thank the farmers of organic shrimp who participated in the study as interviewees. A special thanks goes to WAB staffs for their tireless support.

References

- Biao X. (2008): The development of and prospects for organic aquaculture worldwide. Outlook on Agril. 37:255-260.
- Department of Fisheries (2009): Fishery Statistical Yearbook of Bangladesh 2007-08 (Twenty fifth edition), Ministry of Fisheries and Livestock, Matshya Bhaban, Dhaka. 42.
- Food and Agriculture Organization (2002): Organic agriculture, environment and food security. In Scialabba, N. E., Hattam, C. (eds.): Environment and Natural Resources Series No. 4, FAO, Rome, 258pp, <http://www.fao.org/DOCREP/005/Y4137E/y4137e4106.htm>, (Accessed 2010-11-10).
- Paul B. G., Vogl C. R. (2010): Impacts of shrimp farming in Bangladesh: challenges and alternatives. Ocean & Coastal Management, in press.
- Pelletier N. (2003): Market trends in aquaculture. <http://www.certifiedorganic.bc.ca/rcbtoa/services/aquaculture-standards.html>, (accessed 2010-08-10).
- Willer H., Kilcher L. E. (2010): The world of organic agriculture- statistics and emerging trends 2010. IFOAM, Bonn, Germany.

Index of Authors

Index of authors

| | | | |
|-----------------|---------------|------------------------|----------|
| Abay, C., | 108 | Cho, J. | 189 |
| Abreu, L. S. | 235 | Cho, Y. | 189 |
| Agbigay, L. | 161 | Choi, J. | 186 |
| Alföldi, T. | 342 | Choi, K. | 186 |
| Alimoradi, L. | 299 | Choi, Youngdae | 290 |
| Alrøe, H.F. | 313 | Cohen, M. | 42 |
| Anil, S. | 342 | Corrales, E. | 120 |
| Arya, S. L. | 243 | Cuoco E. | 330 |
| Athmann, M. | 166 | Cwach, D. | 100 |
| Azizi, G. | 299, 307 | Dabbert, S. | 116 |
| Baars, T. | 170 | Danviriyakul, S., | 230 |
| Baker, B., | 100 | De Melo, E. | 120 |
| Barberi, P. | 338 | De Padua M. | 161 |
| Basweti, E. | 206 | Delate, K. | 100 |
| Bellon S. | 235, 321, 342 | Ding-wu Zhang | 295 |
| Blumenstein, B. | 64 | Eddy, J. | 206 |
| Bonazinga, M. | 338 | Fatrcová-Šramková, K., | 193 |
| Bos, M. M. | 273 | Fleischmann, P. | 197 |
| Boyacı M. | 108 | Fleury, Ph. | 51 |
| Bryan, W. | 206 | Fowler, S. | 59 |
| Burmeister, A. | 197 | Freyer, B. | 22, 26 |
| Cacatian, M. | 161 | Frieden, C. | 354 |
| Casanoves, F. | 120 | Fu Sh. | 133 |
| Castro, C.E. | 264 | Gambelli, D. | 112, 116 |
| Chen, S.S. | 178 | Gekara, J. | 206 |
| Chen; J. | 84 | Geniaux, G., | 76 |
| Cho, Y. | 186 | Gerrard, C. | 59 |
| Cho, B., | 277 | Ghezán, G. | 129 |
| Cho, H. | 189 | Gonzalez, C. | 120 |
| | | Gössinger, K. | 22, 26 |
| | | Grasa, O. | 129 |
| | | Guo, Y. | 260 |

| | | | |
|--------------------|--------------------|--------------------|------|
| Haering, A. M. | 346 | Jeong, Y. D. | 222 |
| Hagggar, J. | 120 | Jerez, R. | 120 |
| Halberg N. | 151, 239, 256, 330 | Jiroušková, Z. | 281 |
| Hametter, M. | 26 | Jørgensen, U | 202 |
| Hamm, U. | 2, 14, 22, 38, 72 | Jung, J.K. | 285 |
| Hansen, M. W. | 30 | Jung, Kiyoul | 290 |
| Hartmann, M. | 124 | Jung, Y. | 277 |
| Hassan, M. R. | 222 | Kainz, M. | 303, |
| Heid, A. | 14 | Kang, A., | 277 |
| Henriksen, C.I. | 350 | Kantanamalakul, J. | 215 |
| Henryks, J. | 10 | Karahan Uysal Ö. | 108 |
| Hermansen, J. | 68, 151 | Karandana, P. | 141 |
| Herrmann, M.E. | 197 | Kesarwani, A. | 178 |
| Hillebrand, S. | 197 | Khatounian, C. A | 226 |
| Hodge I. D | 252 | Kilchsperger, R | 104 |
| Hoque, M. | 157 | Kim J. D. | 218 |
| Horsted, K. | 202 | Kim, G.C. | 182 |
| Huang-Tzeng, C. | 46 | Kim, J. S. | 182 |
| Huber M. | 330 | Kim, K. M. | 182 |
| Huber, B. | 108, 124 | Kim, S.T., | 285 |
| Hülsbergen, K. J. | 303 | Kim, Y. S. | 182 |
| Hüsing. B. | 197 | Kim, Y. | 182 |
| Hwang, Jaebok | 290 | Kittipongpysan, S. | 230 |
| Hwang, S. | 186 | Kleemann, L. | 137 |
| Itohara, Y. | 157 | Kongsted, AG, | 202 |
| J.H. Park | 186 | Konvalina, P. | 281 |
| Jahani Kondori, M. | 299, 307 | Koocheki, A | 307 |
| Janssen, M. | 2, 38 | Koopmans, C.J. | 273 |
| Jee, H. J. | 222 | Köpke, U. | 166 |
| Jeon, K. H. | 218 | Kotcon, J. | 206 |
| Jeong, B. | 277 | Kristensen, I.S. | 68 |
| | | Kristensen, N. H., | 30 |

| | | | |
|---------------------|--------|-----------------------|----------|
| Kristensen, T. | 68 | Mata, D. | 206 |
| Kusche, D. | 170 | Measures, M. | 59 |
| Lacko-Bartošová, M. | 193 | Meier, J. | 326 |
| Lamine, C. | 235 | Meng F. | 133 |
| Lampkin, N. | 59 | Meng, F. | 260 |
| Langer, V. | 350 | Micheloni C. | 330, 338 |
| Lasner, T. | 72 | Micheloni, C. | 338 |
| Latruffe, L., | 76 | Min Dong, Xiang-ge Du | 295 |
| Le Coq, J.F. | 120 | Minch, M. | 206 |
| Lee, H. J. | 218 | Miran, B., | 108 |
| Lee, H. W. | 218 | Mogensen, L. | 68 |
| Lee, J.F. | 178 | Möller, D. | 64 |
| Lee, J-H. | 285 | Moreira, S.R. | 264 |
| Lee, M. H., | 218 | Moschitz, H. | 124 |
| Lee, S.Y | 285 | Moudrý, J. | 281 |
| Legaspi, N. | 161 | Murali Arthanari, P | 151 |
| Leite, R. M. | 226 | Nadia Scialabba | 354 |
| Lepoutre ,J. | 76 | Nakatsuji, T. | 334 |
| Li, H., | 260 | Nam, Minhee | 290 |
| Lin, Yu-Ting | 46 | Nam, S | 186 |
| Lippert, C. | 116 | Nansek, T. | 157 |
| Liu Y. | 146 | Napoléone C., | 76 |
| Løes, A.-K. | 34 | Naspetti, S. | 6, 22 |
| Lohr, L. | 55, 80 | Nassiri-Mahallati, M | 307 |
| Lohr, L. | 80 | Nauges, C. | 76 |
| Luo Y. | 256 | Nielsen, T. | 30 |
| Luske, B. | 273 | Niggli U. | 330 |
| Macdonald, D. | 252 | Noe, E. | 313 |
| Mahesh Chander | 210 | Nölting, B. | 34 |
| Mann, N. | 42 | Nongyao, C. | 230 |
| Marchiori, A. | 264 | Oates, L. | 42 |
| Máriássyová, M. | 193 | Oh, E. Y., | 218 |

| | | | |
|--------------------|--------------------|---------------------|--------------|
| Oka, N. | 334 | Salas, M. | 161 |
| Okazaki, K. | 334 | Sarker, M.A. | 157 |
| Oliveira, D. G, | 226 | Sautereau, N. | 76 |
| Oliveira, M.D.M. | 264 | Schliephake, U. | 197 |
| Ollivier, G. | 235, 321 | Schlüter M., | 330 |
| Ortolani, L., | 338 | Schmid O. | 92, 104, 330 |
| Otani, M.N. | 264 | Seilsuth, S. | 230 |
| Padel S., | 22, 59, 330 | Seo, Y. | 277 |
| Palihawadana, A. | 247 | Seong , J | 186 |
| Panneerselvam, P , | 151 | Sharma, P. | 243 |
| Papaja, S. | 303 | Shim, K. S. | 218 |
| Park, Changyoung | 290 | Shinano, T. | 334 |
| Park, J. | 189 | Siah-marguee, A. | 299 |
| Pastor, C.D. | 161 | Singh, P. | 243 |
| Pastor, F., | 161 | Smith, L., | 59 |
| Paul, B | 357 | Sohn, S. | 174 |
| Paull, J. | 96, 317 | Solfanelli, F | 112, 116 |
| Pearce B | 59, 330 | Sørensen, J. | 202 |
| Pearson, D. | 18 | Soto, A. | 120 |
| Penvern, S. | 321 | Soto, G. | 120 |
| Prasad, R., | 243 | Souza, M.C.M. | 264 |
| Putsakum, M., | 215 | Specht, J. | 346 |
| Qiao Y. | 133, 239, 256, 260 | Stolz, H. | 22, |
| Quilo, A. | 120 | Stolze, M | 22, 108, 124 |
| Rakkumsuk, T. | 230 | Subrahmanyaswari, B | 210 |
| Rasmussen, I.A. | 326, 350 | Sugikawa, Y. | 334 |
| Reents, H. J. | 303 | Takabe, M. | 334 |
| Riordan, P. | 252 | Takada,N., | 88 |
| Ryu, K. S 2 | 222 | Tanaka, F | 334 |
| Sainte Beuve, J | 76 | Taniguchi,Y. | 88 |
| Saito, S. | 334 | Thoma-Rademacher,M. | 303 |
| | | Trautz, D. | 197 |

| | |
|--------------------|-------------------------|
| Tuomisto, H. L. | 252 |
| Turco, P.H.N. | 264 |
| Turnbull, B, | 100 |
| Vaheesan, | 239 |
| van der Meulen, S. | 342 |
| Vincent A.. | 51 |
| Vogl, C | 357 |
| Wang D. | 133 |
| Willer H. | 326, 330, 354 |
| Wolfrum, S., | 303 |
| Wongpichet, S | 215 |
| Woodward, L. | 59 |
| Wright, J . | 268 |
| Wu W. | 256, 260 |
| Yang, J. | 260 |
| Youn,Y. Y. | 218 |
| Yun, Eulsoo | 290 |
| Zander, K., | 22 |
| Zanoli, R | 6, 22, 26, 112, 116, |
| Zeng G. | 256 |
| Zorn, A. | 116 |
| Zoysa, K. | 239 |