International Scientific Conference on Research and Innovation in Organic Agriculture

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Islamic Azad University, Isfahan (Khorasgan) Branch

Isfahan, Iran

November 1st 2016

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Aims and Scopes

- Necessity of research studies and a scientific approach for organic agriculture development.
- Explanation of the social and moral aspects in the organic agriculture system.
- Introduction of *International society of organic agriculture research* and functions of this society in development of the global organic movement.
- Economic analysis focusing on development of organic food markets.
- Scientific and applied research features of organic plant products (soil fertility, pest management, production of organic seeds).
- Scientific and applied research features required for producing organic animal products.
- Scientific methods for evaluation of social aspects of the production and consumption of organic yields.
- Necessities and research potentials for countries development.

Dr. Amiri' Conference Message
The President of University

It is my great pleasure to welcome you to Islamic Azad University. All universities in the world have particular goals; Islamic Azad University's main mission is a commitment to prepare students for future professions. To achieve this goal this huge organization has established different branches all over the country. The main purpose of this branch is encouraging innovation in researchers, students and professors.

Islamic Azad University _Isfahan Branch is one of the largest universities in the central region of Iran. This university has about twenty thousand students in different levels of education including PhD, MA, MS and BA. This university provides different fields of study in about 10 faculties, one of which is agricultural and natural resources faculty. This faculty was established in1987 and includes various departments, namely agronomy, environment, soil sciences, breeding, food sciences, water engineering and irrigations,

In addition, in this branch there are some active research centers and scientific communities such as waste and waste water research center, seed research center, waste community of university and so on. In the line with these scientific activities, apart from publishing useful text books, this university with cooperation of foreign publishers like Springer publishes some international journals including International journal of recycling of organic waste in agriculture, the subject of which is in accordance with those of this conference.

We hope this conference will be an excellent platform to present the latest researches on organic agriculture and participants provide us with valuable ideas.

I wish you all the best for your time in this Branch

Dr. Najafi's Conference Message
The conference executive chairman

As executive chairman I would like first thank the executive committee of the conference who made dedicated efforts and time to hold and manage this conference. And also, we truly appreciate the participation of professors and students and experts here.

It is necessary to acknowledge the international society of organic agriculture research, Isfahan municipal, research institute of IAU, Isfahan healthcare city ,Hyper health, Ahvaz and Shahrekord branches Of Islamic Azad University and other organizations which have sponsored our conference. Undoubtedly the organic agriculture is the most reliable way to achieve public human health. This method is not only economically beneficial but also can reduce environmental pollution, and this matter will result in less financial investment for diseases treatment and human healthcare. Organic farming is also proved to be an effective way to increase agriculture products for vast growing population of world

And we are honored to share our knowledge and experiences in this conference and it will be a good opportunity for all guest to enjoy being in Isfahan city.

Dr. M. Reza Ardakani
Scientific Executive Manager

Welcome to the International Scientific Conference on Research and Innovation in Organic Agriculture which has been organized by Islamic Azad University, Isfahan and supported by the International Society of Organic Agriculture Research (ISOFAR). This conference will review progress in tackling organic scientific based issues in OA. Organic agriculture is a developing sector in Iran and organic movement has been already started by the activities run through Iranian Organic Association and we realized that the awareness of different disciplines related to organic products in Iran has been increased rapidly. This issue does not only illustrates the substantial alteration in management of plant production and development in technical methods but also reveals the fact that many cultural activities has been executed in society which both producer and consumer had gained the inevitable knowledge in concern of organic products.

Organic Science consists of industry-led research and development and its outcomes are centered on competitiveness, market growth, adaptability and sustainability. This will be accomplished by using innovation to drive 'ecological intensification' through the following topics:

- A. Field crops: Optimizing productivity and competitiveness through adaptable systems for field crops
- B. Horticultural crops: Advancing the science of vegetable, fruit and novel horticultural crops
- C. Crop pests: Innovation in sustainable pest management strategies
- D. Livestock: Optimizing animal health and welfare for productivity and quality
- E. Value Adding: Adding value to capture markets through innovative processing solutions

The objectivity of any development and progression in any conceivable field requires a profound and precise understanding and likewise the presence innovation and research based in an organized system in a manner that all the affiliated bodies do their deed significantly while deepening their understanding. In that order, enhancement of public understanding and codification of a coordinated system for the desire of possessing a better interaction between components of organic production seems to be inescapable.

On this very distinguished day, November 1th 2016 I would like to express my utmost gratitude to the God almighty for giving me this opportunity to do a part of my duty for my country in this monumental event which is a milestone in organic science history in Iran. I hope you appreciate the efforts of lecturers and organizers in setting up enlightening discussions, based on a set of proceedings already available to you. Let's not forget that life is organic

Invited Speakers

Mr. Andre Leu (IFOAM President)

Andre Leu is the author of The Myths of Safe Pesticides and the President of IFOAM – Organics International. Andre has over 40 years of experience in all areas of Organic Agriculture, from growing, pest-control, weed management, marketing and post-harvest transport to grower organizations, developing new crops and education - not only in his home country Australia, but across Asia, Europe, the Americas and Africa.

He has written and published extensively in magazines, newspapers, journals, conference proceedings and newsletters in print and online on many areas of Organic Agriculture including climate change, the environment and the health benefits of organic agronomy. He was recently invited by the FAO to present research findings from the organic movement at a high-level "Science Fair for a Safer Tomorrow."

Prof. Dr. Gerold Rahmann

Prof Dr Gerold Rahmann is funding director (established in the year 2000) of the Institute of Organic Farming at the Johann Heinrich von Thuenen-Institute (vTI: www.vti.bund.de). The vTI is part of the research infrastructure of the German ministry of consumer protection, agriculture and nutrition (BMELV) and has the main subject to design sustainable resource use strategies in rural areas, forestry and fisheries to advise the ministry at an excellent scientific level. Prof. Rahmann is a socio-economist and specialized on New Farming Systems Research and Development (NFSR+D) and has worked many years in interdisciplinary teams in tropic and sub-tropic countries as well as in German and EC projects related to low input farming systems. His recent research group with 30 scientists focuses on the development of (a) organic animal husbandry, (b) organic crop production and (c) organic grassland management. He has 38 peer-reviewed scientific, >250 other papers, and 15 books published. The design of policy decision frameworks is an important part of his work.

Organic Agriculture can and must contribute to solve future challenges in the global food chain: Organic 3.0

Prof. Dr. Gerold Rahmann

President, International Society for Organic Agriculture Research (ISOFAR)

Abstract

Organic farming is considered and proofed as sustainable, productive and profitable food and farming system in a low-external-input / medium-output approach. Therefore: Organic is a success story. Nevertheless, from a global perspective, certified Organic is still a niche. But, more than 50% of the farms on the earth – mainly small scaled with low input / low output level – are managed with the measures and strategies of Organic farming, just without certification. This is the chance that Organic farming becomes a reputated and scaled-up solution to defeat the future global challenges in food and farming. Organic can help to prevent hunger, reduce farm land degradation and losses in biodiversity, mitigate climate change, income and jobs, and supply healthy and enough food with a low-external-input / medium output farming strategy. The Organic 3.0 approach is the basis for this contribution.

Introduction

Organic farming is considered and proofed as sustainable, productive and profitable food and farming system in a low-external-input / medium-output approach of the farmers' own concept. The globally harmonised principles of Organic farming – Health, Fairness, Care, Ecology and Quality –are targets and mission for millions of organic farmers all over the world (IFOAM 2005). In 2013, more than 45 million hectare in about 170 countries are managed under the standards of Organic farming and the global organic market has reached a value of 80 billion US-Dollar (Willer & Lernoud, 2015). Beyond agricultural practices and their technical and economic bases, organic farming was and is a life model and thus includes important aspects for social reform. Therefore: Organic is a success story (Paulsen et al. 2009, Rahmann 2010, Rahmann 2011, Zalecka 2014) because:

- Low/un-polluted products
- Environmentally sound
- Improving soil fertility
- High premium price – high farm income
- Organic is climate smart agriculture and multifunctional
- Suitable for low-external-input / medium-output production
- Export chances for development

Nevertheless, from a global perspective, certified Organic farming is still a niche. Less than 1 % of global farm land is managed organically and only a litte share of the global population is consuming organic qualities in a significant amount (Rahmann et al. 2009). But, more than half of the world farming systems are managed with the measures and strategies of organic farming, but mainly in low-input / low-output systems (Rahmann & Aksoy 2014).

Africa lacks behind other continents in taking the chance of going Organic. There are slightly more than 1.2 million hectares of certified organic agricultural land in Africa, which constitutes about three percent of the world's organic agricultural land and only 0.1% of Africa´s farm land (FAOSTAT 2016). With about 574'000 producers and an average farm size of 2 hectare, Organic farming in Africa it mainly done on small scale farms. The majority of certified organic produce in Africa is destined for export markets (Willer & Lernoud, 2015). Key crops are coffee, olives, nuts, cocoa, oilseeds, and cotton. There is a growing recognition among policy makers that organic agriculture has a significant role to play in addressing food insecurity, land degradation, poverty, and climate change in Africa (see www.eoa-africa.org).

The future challenges of food and farming are severe:

- Feed 9 to 11 billion people in the next 30 to 80 years with enough, affordable and healthy food.
- Protect environment like soils, water, air, biodiversity and landscapes in increasing intensification strategies.
- Mitigate greenhouse gas emissions and adapt on climate change in all farming systems and value chains.
- Incorporate novel ethics, food habits, demographic and lifestyles in the food chains.

- Produce food on limited farm land and fosil (non-renewable) resources efficient and profitable.

These challenges must be addressed by all farming systems concepts on local, regional, national and global level. Organic can help to prevent hunger, reduce farm land degradation and losses in biodiversity, mitigate climate change, income and jobs, and supply healthy and enough food with a low-external-input / medium output farming strategy. After decades of farmers driven development of resilient organic farming systems, the role of science becomes more important (Niggli et al. 2014).

The future challenges must be addressed by all farming systems concepts on local, regional, national and global level. Organic methodologies and tricks can play an important role as leading sustainable food system to eleviate small holder farmers from low-external-input / low-output towards sustainable low-external-input / medium-output farming systems. That will help to make sustainable, resilient and profitable food production. The "Organic 3.0" approach is the basis for this contribution (Braun et al. 2010, Strotdrees et al. 2011, Arbenz et al. 2015, DAFA 2015).

What has to be done that Organic is fit to contribute to tackle the future challenges?

There are two time dimensions: the next 35 years till 2050 and the time from 2050 up to 2100. In 2050 we will have approximately 9-10 billion people and 1 ha agricultural farm land per capita. In 2100 we will have 11 billion people and only 0.7 ha per capita. This discussion and challenge is the same like for conventional agriculture: limited resources needs to intensify (factor-factor relation) and be more productive (output-factor relation) and be more efficient (factor-output relation).

My five visions about the need of Organic farming development till 2050:

1. **Conventional can learn from Organic:** The production must be more and more sustainable. That means: ecological sound, high ethical standards (e.g., animal welfare, fair trade), profitable and social acceptable. There is a need to change the industrial production strain of conventional and be back to local acceptable farming systems, where farmers can have a good income and the price is affortable for everyone. The external costs of production needs to be included into the price of products.

2. **Organic can learn from Conventional:** Efficiency and productivity with limited resources, e.g., agricultural land. Organic needs to be more productive to be accepted in societies with limited land and food quantities. Not all farm inputs are bad. Clear criteria are needed to incorporate good conventional strategies into Organic: e.g., synthetic amino acid if all feeds are produced on the farm. Mineral fertilizers, if produced with renewable energy and in a quantity, which does not pollute the environment and products.

3. **Scale-up Good Organic Farming Practice:** Good Farming Practice is necessary to fulfil the consumer and public demands as well as be more efficient with limited resources. Both,

organic and conventional have to train and trigger their farming systems on the track of better practice. In future we can not effort spoiling and inefficient farming practices. Capacity building and training needs to the support of research, mainly via socio-economics: How can we transfer Good Organic Farming Practice to all farms as a permanent process?

4. **The food production needs more close links to the consumer:** Consumer must accept, that in the coming future not everything will be always and everywhere for a cheap price available. It will be not possible and producable in the coming future that everyone on the earth will consume like the western world today. We need to avoid wasted food, reduce livestock and utilize novel food sources. Additionally, the consumers need to bring back valuable nutrients back to farming: clean and efficient.

5. **Farming has to change from „commodity related" towards „needs related" production:** Ecological Food First means also that non-food production is second and needs alternative - not farm related - production bases. Community Supported Agriculture needs to be improved and scaled-up.

What needs to be initiated today to tackle with the challenges after 2050?

There is no real discussion about food security and safety after 2050 and up to 2100. All the five vision from above will not be able to fulfil the demand of 11-13 billion people. As an organic farmer and scientists I must state that I am sceptical that we can improve „*Good Organic Farming Practice*" to a level that the IFOAM principles are fulfilled (care, health, ecology, fair; plus quality). If we just continue with intensification and encroachment of farmland we can not feed 11 billion people and preserve biodiversity, keep water clean and make good food available and affortable for everyone. I see following options, where the innovations (socially and technologically) have to be invented in the coming decades:

6. **Less livestock and changed animal husbandry systems:** Numbers of livestock needs to be reduced by a significant number, from ethical point of view probably even towards zero (in specific cultures and regions). That needs improved food consumption skills (e.g., avoiding malnutrion with vegan diets). Invention of novel proteine food resources based on insects and sea food are necessary.

7. **Local versus global food chains:** The transport of food from one place to an other place on the earth will be not as easy as today. Fosil energy and probably limited space will need new farming and food distribution systems. Probably people have to go to food areas and not food to people areas as today. Migration and better distribution of humans and food have to be innitiated.

8. **Land-less food production:** Organic farming likes soil and prohibites soil-less food production. But: soil is scarce, probably degraded, polluted or sealed and therefore not avail for healthy food production. Food can be produced on sealed surface (urban agriculture, in-door/household, on roofs etc.). Aquaponics is a chance to link water and land related food production. Last but not least inventions should be done to substitute some food ingredients from agriculture towards reactor production. It can be thought about sugar or other carbohydrates produced by bacteria in large scale reactors in highly polluted and populated areas (e.g., in Asia).

Human feaces can be a resource to feed the bacteria and close the chain of production and consumption. Processed food can have a share of natural and artifical food. There is a need that such artificial food ingredient production is common and not private property to avoid shareholder influence on feeding people. Can you imagine: 25-50 % (or even more) of the food ingredients (mass components like carbohydrates) are produced in artifical reactors in urban or peri-urban areas, a lot of land space would be released for our Organic visions: biodiversity, recreation and landscape.

The suggestions for the second half of this century are brave and will probably create a deep debate in the Organic movement as well as in Conventional agriculture. But is brings a lot of chances as well. I guess, that private food companies have started already to going a landless food chain. That must be avoided that food becomes an even more private and shareholder issue (like seads and other farm inputs today). The socio-economic and technological innovations have to be started soon to be applicable and acceptable in the far future.

Conculsion

Organic 3.0 discussion has released a discussion about the future development of the Organic sector. There are many think tanks started ideas. Most of the ideas are very rough and not with practical visions for research. But there should be no time lost, that Organic takes the leadership for innovations, that helps to tackle with the future challenges, to design clear pathways to be more sustainable: food supply and to have ownership for the definition of ecology, health, care, fair and quality.

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Prof. Dr. Peter von Fragstein und Niemsdorff,

Prof. Dr. habil. Peter von Fragstein und Niemsdorff was the leader of the Department of Organic Vegetable Production till his retirement in September 2016. His experience in acadamic teaching and research within topics of organic agriculture/horticulture is dating back over 35 years. As crop scientist his areas are applied plant physiology, biochemistry, plant nutrition & protection. Within the organic fields he is mainly focussed on 'the longevity of crop rotations in an arable organic farming system, silicate rock dusts as multipurpose means in organic farming, plant-based fertilizers as substitute for animal-based fertilizers in organic horticulture'. He was coordinator and partner of several EU-sponsored projects focussing on organic farming issues, 'On-farm development and evaluation of organic farming systems: the role of livestock and agroforestry', 'Intercropping of cereals and grain legumes for increased production, weed control, improved quality and prevention of N losses in European organic farming systems', 'Viable organic stockless systems', 'Enhancing multifunctional benefits of cover crops-vegetable intercroppings'.He published more than 40 scientific papers in the field of organic agriculture. Before leaving the university he was the Dean of the Faculty of Organic Agricultural Sciences at the University of Kassel.

Organic Agriculture, Science and Ethics

Peter von Fragstein und Niemsdorff[1]

Abstract

Although the development of Organic agriculture was mainly initiated by highly critical and conscious practictioners with regard to health and quality issues science has become a valuable partner of farming practice since decades. In the beginning there was a leading role of German-speaking countries meanwhile complemented by a dense network of scientific protagonists within the European countries as well as countries, worldwide. Activities of IFOAM and ISOFAR are a vital proof for that.

Ethical issues became gradually part of the organic scene. Compared to former guidelines for organic farming the revised principles by DARCOF (2000) and IFOAM demonstrate this

1 Retired professor, Organic Vegetable Production, University of Kassel

widening of perspectives and the specific level of responsibility of farming & food producing practice.

Vocational and higher education in organic agriculture relies very much on convincing examples in practice, on the cooperativeness of practitioners for sharing time, space, practical experience as important tool for the development of practical skills and intellectual knowledge of young persons. Participative approaches enable a partnership of different stakeholders and assure the essential reference in practice for theoretical models and considerations.

Meanwhile a vital university network was build up by various educational and/or research programmes. Examples will be presented.

Dr Mahesh Chander

Dr Mahesh Chander, PhD is Principal Scientist & Head, Division of Extension Education at ICAR-Indian Veterinary Research Institute, Izatnagar. He holds a certificate course (Organic Leadership Course-OLC) in Organic Agriculture from IFOAM Academy, Germany. In his scientific career spanning over 25 years, he has guided over 25 Master's & PhD students in Extension Education. He is a Board Member of International Society of Organic Agriculture Research (ISOFAR). He has contributed in several national and International committees to develop the standards for sustainable agriculture including organic farming. He has trained teachers as also hundreds of trainers, farmers and scientists on organic farming through several capacity building programmes including development of Roadmap for Organic Animal Husbandry in Sikkim as resource person, declared as first fully organic state in India.

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Organic Livestock Production: Welfare, standards & requirements

Mahesh Chander

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‘Organic’ is a buzz word now globally, which symbolizes purity! There is substantial increase in organic agricultural production around the world in last few years. A system of production which is said to be environment- friendly, safe for human and animal health. Going by the global trends indicating preference for good quality, health foods, animal welfare and environmental concerns, it looks quite likely that growing number of consumers would increasingly demand organic products of animal origin worldover. Already, the demand for good quality milk, meat and products thereof is getting stronger and the consumers are already paying high premiums for organic food products of animal origin. This emerging trend makes it imperative that serious attention is paid to production, processing and marketing of livestock products as per quality ensuring standards and guidelines alongside research in organic livestock production by the livestock research institutions among others. Many countries around the world are developing standards and legislations to regulate the organic agriculture including animal husbandry. In India, for instance, the organic agriculture standards developed under National Programme on Organic Production (NPOP) are there for over 10 years now. The Animal husbandry standards have also been notified since 1st June 2015, for implementation to guide the organic livestock producers and certifiers.

Organic livestock: a new opportunity

While organic farming is rapidly gaining ground in developing countries including India; the research and development (R&D) activities in organic animal husbandry is confined only to Europe and a few other developed countries like USA, Canada, and Australia. There are opportunities as well as challenges in organic livestock production in developing countries which need to be addressed. The organic livestock development opportunities in developing countries in Asia, Africa and Latin America can be enhanced with more scientific research in organic livestock production under local conditions and strengthening institutional support (Chander et al, 2011; Nalubwama et al, 2011; Rahmann and Godinho 2012; Chander et al, 2012; Mahesh et al 2014; Schimid et al, 2014).

It is projected that by 2050, the global demand for animal food products can be met only by raising twice as many poultry, 78% more small ruminants, 58% more cattle and 37% more pigs, without further damaging natural resources (Rivera and Lopez, 2012). Hence, sustainable development based on balance of ecology, economics, norms and values are to be considered at various levels of the scale: between food and farming systems, regions, nations and continents

(Zipp, 2003). This is where the real challenge lies: producing more food of good quality without further damaging or stressing the environment. For instance, FAO report “Livestock’s Long Shadow” concluded that directly and indirectly, 18 % of the global Greenhouse Gas (GHG) emissions could be linked to animal-based production (FAO, 2006). Not only GHG but also there are several factors which are making intensive livestock production questionable from sustainability standpoints. To deal with this complex issue of livestock in relation to sustainability vis- a- vis climate change and food security issues, some of the options are being studied and tried at different levels to reorient the existing farming systems as per the principles & practices of Conservation Agriculture, Climate-smart Agriculture, Sustainable Agriculture, Precision Livestock Farming & Organic Livestock Farming.

Organic agriculture provides management practices that can help farmers adapt to climate change through strengthening agro-ecosystems, diversifying crop and livestock production, and building farmers’ knowledge base to best prevent and confront changes in climate. Carbon sequestration, lower-input of fossil fuel-dependant resources, and use of renewable energy present opportunities for organic agriculture to lead the way in reducing energy consumption and mitigating the negative effects of energy emissions. Intensive animal production systems contribute to N_2O pollution, since protein-rich animal feeds are used. According to Berg (1997), reducing N in animal feed is the most efficient and cheapest mitigation option. It reduces losses of all N species, including N_2O, NH_3 and nitrate leaching. For dairy farms, it could be demonstrated that lower protein feed concentrations (as typically used in Organic Agriculture) resulted in increased N efficiency. At the same time, N-losses in animal husbandry were reduced by 10-15 % and in plant/soil amendment by more than 40% (Jäckle, 2003). This reduces nitrate leaching, ammonia and nitrous oxide emissions. Thus, the principles and standards of Organic Agriculture help ensure effectively minimizing not only nitrous oxide emissions, but also, has potential to significantly reduce carbon dioxide emissions while practicing organic dairy farming.

Organic livestock and poultry standards emphasize on-farm reliance, substantially reducing the scope for market purchased feeds & other inputs requiring transportation. The external animal feeds - often with long transportation miles - are limited to a low level in organic production systems. Similarly, the animal stocking rates are limited. These are linked to the available land area and thus excessive production and application of animal manure is avoided. Also, animal diets under organic systems are lower in protein and higher in fibre which leads in lower emission values. No synthetic nitrogen fertilizer is used on fodder crops grown for organic animal rearing and this clearly limits the total nitrogen amount and reduces emissions caused during the energy demanding process of fertilizer synthesis. Organic livestock production can be linked with reduction in fossil fuel consumption too. The use of fossil fuel, which is increasingly used in intensive agriculture, is one of the major sources of carbon emissions. This form of agriculture dependent on fossil fuel relies heavily on external inputs like synthetic fertilizers, chemical pesticides, agricultural machinery, and factory-produced inputs like cattle feeds. These activities consume fossil fuel which, otherwise are reduced to minimum in organic livestock rearing. By practicing organic animal rearing, the farmers can claim to be environment-friendly by minimizing the scope of global warming.

The Way Forward

1. To develop organic animal husbandry, it is important to understand the principles, methods, practices, and standards applicable to organic farming & guidelines developed for organic livestock production.
2. Organic livestock production demands controlled disease environment, at least free from infectious diseases like foot & mouth disease (FMD), which restricts trade. The reduced opportunity for export discourages livestock producers to go organic. Disease-free zones need to be developed with a goal to control and finally eradicate the disease from the countries where such diseases exist.
3. Small farmers find it difficult to comply with traceability requirements which are strictly adhered under organic production management systems. The farmer -friendly cheaper traceability systems need to be developed so that small scale farmers too can participate in organic livestock farming.
4. Sanitary conditions at livestock production sites, slaughter houses and processing units need improvement.
5. The demand for organic milk, meat and eggs is growing and consumers are ready to pay premium prices for good quality livestock products. The duly certified organic livestock farmers can give assurance to consumers that their milk, meat and eggs and products thereof are of highest quality standards. With the rising quality consciousness among the consumers alongside their willingness to pay for good quality foods of animal origin, the domestic market for such high quality organic products need to be developed.
6. Grazing land is shrinking due to reducing community land and also change in land-use pattern. Organic animal rearing needs assured grazing opportunity to ruminants at least for 4hrs per day.
7. Natural sources of essential amino acids (Methionin, for instance) are not available good enough to meet the requirements of livestock. The documentation on natural sources of amino acids is required to replace synthetic source of amino acid supply.
8. Green fodder supply in sufficient quantities is essential to meet the requirement of the livestock. Animals survive in some countries on poor quality roughages. Whereas, in organic livestock production, livestock need to be fed high quality organically grown fodder as per the requirement of the species of animal.
9. Animal housing conditions need improvement for optimal productivity, disease prevention and to minimize risk of zoonotic diseases.
10. Research and development (R&D) investment in the area of organic livestock production is almost negligible in developing countries, which needs to be augmented to make organic animal husbandry a sustainable option.

11. The per animal health cost is usually very low in organic livestock farming as preventive methods are emphasized over expensive treatment including antibiotics and other routine prophylactic measures are reduced to minimum.
12. Manure handling in animal rearing is an important issue, especially processing of the biogas slurry. The biogas produces energy and at the same time reduces methane emissions, which result from inadequate handling of animal manure. The Biogas units need to popularized in conjunction with efficient manure handling practices.
13. Good quality animal products including organic milk and meat needs to be incentivized by offering premium price to the clean milk & meat producers.

Many developing countries like India have natural advantages in switching over to organic animal husbandry for domestic as well as export markets. The traditional animal husbandry practices followed by majority of livestock farmers, Indigenous Technical Knowledge possessed by them, indigenous cattle breeds being hardy and tolerant to many diseases, limited or no antibiotic use, limited chemical fertilizers application, less dependence on market for inputs, etc. make such countries ideally suited for organic livestock farming. However, to move further on organic animal husbandry, these countries have to work towards overcoming the limitations too. The high stocking density, feed and fodder scarcity, poor sanitation, prevalence of infectious disease like FMD and near absence of traceability systems affordable to small-scale farmers are some of the limitations to be overcome.

The Research & Development agencies with possible collaboration with international organizations should augment funding for research and technology development efforts to develop organic livestock farming to improve the availability of high quality, safe, organic milk and meat products for the consumers. May be the increasing interest in this underdeveloped organic sector by *inter alia* FAO (http:// www.fao.org/docrep/017/aq381e/aq381e.pdf) and IFOAM would help develop organic animal husbandry in developing countries. Also, the recent initiative i.e International Animal Husbandry Alliance (IAHA) by IFOAM (http://www.ifoam.org/en/sector-groups/iaha-animal-husbandry-alliance) may galvanize organic livestock agriculture around the world.

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- contribution of cover crops, green manure and intercropping to soil fertility, plant nutrition and weeds management, in particular in vegetable production systems;
- evaluation of soil quality in organically managed cropping systems respect to those conventionally managed (intensive and/or integrated cropping systems);
- role of waste biomasses (i.e. composts and anaerobic digestates) in organically managed cropping systems and evaluation of their environmental impact;
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Agro-ecological Service Crops and No-Till Strategies in Organic Mediterranean Vegetable Productions

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Abstract

In sustainable/organic farming systems, Agro-ecological Service Crops (ASC) may provide many beneficial ecosystem services, when they are introduced as buffer zones, living mulches or break crops. However, despite the wide acknowledgement of the contribution of the Agro-ecological Service Crops to sustain agricultural production and to promote environmental protection by a wide range of mechanisms, their diffusion within organic and sustainable low input cropping systems is still limited.

Living mulches and break crops management strategies are here discussed, particularly considering different alternatives for their termination: ploughing under (green manure) with termination by roller crimper. Future perspectives and research needs have been delineated ad identified and clear evidences demonstrate that studies to empower the use of ASC in a wide range of agro-climatic conditions should be further encouraged. Additional studies on the roller crimper should be performed, mainly to understand the dynamic of N mineralization in the soil-mulch interface and synchronization of N release with cash crop N requirements. Moreover, more effective machinery to perform an extremely reduced tillage system relying on the concept of "in-line tillage" to implement the vegetable transplanting and use of the roller crimper should be further developed. Finally, Decision Supporting Systems (DSS) for ASC introduction into vegetable cropping systems should be developed.

Keywords: buffer zones, cover crops, living mulch, roller crimper, termination strategies.

1. Introduction

In organic farming systems, *Agro-ecological Service Crops* (ASC) represent a powerful tool for farmers to positively influence the agro-ecosystem by promoting the whole soil-plant system equilibrium in space and time (Kremen & Miles, 2012; Canali, 2013; Wezel et al., 2014). ASC may have impact on soil fertility (Thorup Kristensen et al., 2012), occurrence of weeds (Bàrberi, 2002), diseases and pests (Patkowska et al., 2013). They increase soil carbon (C) sink potential (Mazzoncini et al., 2011), influence greenhouse gas emission (Sanz-Cobena et al., 2014) and improve system energy use efficiency (Gomiero et al., 2008; Canali et al., 2013). ASC can also greatly reduce leaching of nutrients like soil nitrate (NO3-) (Kristensen & Thorup-Kristensen, 2004).

The traditional, and most widespread, technique used to terminate the cropping cycle of the ASC is incorporation as green manure into the soil by tillage (i.e. plough and/or rotary hoe). However, since tillage is an energy and labour consuming and soil disturbing operation, in recent years, systems that use no/reduced tillage have received increasing interest, as the rolling crimping technology that terminates by flattening the ASC (Mäder and Berner, 2012). In fact, the potential capability of the roller crimping technology to control weeds, reduce soil erosion, maintain or increase soil organic matter content, as well as reduce labour use and fossil fuel energy consumption, has been acknowledged (see Renewable Agriculture and Food Systems, 2012 - Special Issue: Conservation Tillage Strategies in Organic Management Systems). In addition, evidences of the potential of the roller crimping technology to enhance vegetable cropping systems resistance to pathogen and pest attacks are emerging (Bryant et al., 2013).

2. Including ASC in Agro-Ecosystems

2.1 Living Mulches

The ASC can be introduced in the vegetable cropping system as *living mulches* (LM): ASC is intercropped with a cash crop and maintained as a living ground cover throughout the growth cycle. Living mulched systems are managed in order to make most of the system resources (i.e. water, nutrients, light) available to the harvestable crop. Simultaneously, management of the ASC is optimized to provide its environmental services at field/farm level (i.e. increase nutrient availability, contribute to weed, pest and diseases management, biodiversity conservation, NO_3^- leaching reduction, etc.) and to reduce competition with the cash crop (Canali et al., 2014). However, many attempts to use LM in annual cropping systems have resulted in reduced yields of the cash crops (Chase & Mbuya, 2008). According to Masiunas (1998) the success of such systems depends on the capacity to rapidly establish a ground cover and smother weeds, without competing for resources with the associated crop.

Vegetables with a high nitrogen (N) demand, such as cauliflower, can cause intensive leaching of NO_3^- to the environment in conventional as well as in organic production. In organic cropping system, the use of an in-season LM may decrease the risk of NO_3^- leaching after harvest, when left to grow in the field to the end of the leaching season in spring. It has been recently demonstrated that the continued presence of LM in the field over winter may reduce the soil mineral N content compared to bare soil after the sole crop during the leaching season and, as a consequence, contribute to lower the NO_3^- leaching risk from the horticultural systems (Kristensen et al., 2014).

2.2 Break crops

Another option for designing sustainable cropping systems in accordance with agro-environmentally sound criteria, is the use of ASC as *break crops*. These crops are cultivated as sole crop in the rotation, between two consecutive cash vegetable crops. Low input/sustainable and organically managed agro-ecosystems for vegetable production that are widespread in the

European environments are often include break ASC in the rotation. In Central and Northern Europe break ASC crops are mainly cultivated in the winter season to avoid direct competition for land with the cash crops, which, conversely, are mainly cultivated during the warm season (Masiunas, 1998). In milder Mediterranean climatic areas (i.e. Southern Europe), vegetable cropping systems are based on rotations in which cash crops are grown either in the warm or in the cold winter seasons. From an economic point of view, these vegetable cropping systems are rather important, since they provide quality products to be consumed locally or exported to the Northern European areas year round. In the Southern European areas, farmers grow ASC in the rainy season, to exploit rain water, which is not a limiting factor in this season. Nonetheless, those farmers would also be interested in the possibility to design suitable cropping systems that include warm season break ASC, in order to optimise the rotations and to achieve the best economic and environmental performances (Butler et al., 2012). However, ASC and especially grass species can take up all the available water in the soil, so there could be a shortage of water for the following cash-crop, particularly during the summer, unless irrigation is used. In vegetable cropping systems, the break ASC may reduce the risk of NO_3^- losses principally because they take up mineral N from the soil especially if it is left bare. This circumstance happens when the vegetable cash crops are not grown because of adverse climatic conditions (i.e. winter in Central and Northern Europe) and/or due to unfavourable market opportunities.

The effectiveness of break ASC at lowering the risk of N losses is remarkable when they are introduced in the period of the year with high rain intensity. During those periods, soil mineral N not used by the previous crop and/or mineralised during the bare period, is highly potentially leachable. Mineral N taken up by the break ASC and converted into organic matter, is then returned to the cropping system after termination at the end of the ASC cropping cycle. Depending on to the ASC termination techniques (see section 4), the mineralisation rate of plant material may be modulated to synchronise the availability of soil mineral N with the N needs of the subsequent cash crop (Canali et al., 2013).

2.3 ASC genotypes

A wide range of plant species belonging to different botanical families can be utilised as ASC. However, most of them belong to three families: *Graminaceae* (grasses), *Brassicaceae* (brassicas) and *Leguminosae* (legumes), and only a minor number of species belong to other families (i.e. *Polygonaceae* or *Boraginaceae*).

Since plants of the different families show differences in terms of physiology and agronomic characteristics, they have different abilities to provide agro-environmental services. In relation to N, grasses and brassicas have great nutrient requirement, and can take up large quantities of N during their cropping cycle. If this N is not available in the soil, their growth is limited. Conversely, the growth of legumes is not limited by N shortage in the soil since they get the element by biological nitrogen fixation (BNF). Mineral N derived from ASC plant materials is available to subsequent cash crops and the prediction of the mineralisation rate is a key aspect to synchronise it with the following crop needs. Indeed, if mineral N release is not well synchronised with crop needs, its nutritive efficiency is reduced.

Farmers can decide to seed pure (100%) legume ASC if high amounts of N are needed in a short term (i.e. nutrition of high demand vegetable crops) or, conversely, they may seed pure grasses in case of low N requirement of the next crop and/or, in climatic conditions with high potential risk of NO_3^- leaching. Moreover, sowing a *combination (a mixture)* of different proportions (i.e 50/50 or 30/70) of legume and non-legume ASC can determine a range of intermediate scenarios, useful for “fine-tuning” N dynamic in the soil-plant system (Tosti et al., 2012).

3. ASC Management Strategies

3.1 Living Mulches Management

As far as the management of LM is concerned, recent scientific literature reports emerging evidences of the influence of several factors on the effectiveness of this technique in providing agro-ecosystem services, in particular modulating NO_3^- leaching risks. One of these factors is the time of sowing of LM in respect to the transplanting of the associated cash crop (Adamczewska-Sowińska & Kołota, 2010). In addition, differences in term of soil mineral N content and potentially leachable soil NO_3^- have been observed between LM substitutive (reduction of cash crop plant density to leave room to LM) and additional design (same crop plant density), and these differences have been attributed to the different N uptake ability of the LM and the cash crop (Kristensen et al., 2014).

3.2 Break Crops: Green Manure vs Roller Crimper Technology

ASC need to be terminated prior to the subsequent cash crop planting in order to provide their services to the system and avoid competition. The phenological stage of the crop, the time and method of termination represent crucial management factors, especially in vegetable cropping systems where complex rotations and peculiar soil/plant interactions are in place.

The traditional, and most widespread, technique used to terminate the cropping cycle of the ASC is the incorporation as *green* manure into the soil by tillage (i.e. plough and/or rotary tiller). However, since tillage is an energy and labour consuming and soil disturbing operation, in recent years, systems that use no/reduced tillage have received increasing interest. In this perspective, the *rolling crimper technology*, which terminates ASC by flattening, represents a promising choice (Mäder & Berner, 2012). The technique consists of one or two passages of the roller crimper, thus leaving a thick mulch layer into which the next crop is sown or transplanted (Teasdale et al., 2012). The roller crimper is comprised of a steel cylinder (about 41-51 cm diameter) with steel blades welded perpendicular to the cylinder in a chevron pattern. Prior to ASC termination, the cylinder is filled with water to provide an additional weight to aid in mechanical termination. Accordingly, due to the formation of this natural mulch on the soil surface, derived from the ASC plant materials, the potential capability of the roller crimping technology to control weeds, reduce soil erosion, maintain or increase soil organic matter content, as well as reduce labour use and fossil fuel energy consumption, has been acknowledged (cfr. Special Issue in Renewable Agriculture and Food Systems, 2012). In addition, evidences of the potential of the roller crimper technology to provide vegetable cropping systems resistance to pathogen and pest attacks are emerging (Bryant et al., 2013). Furthermore, the roller crimper technology has been recently investigated as a potential technique to mitigate NO_3^- leaching risk in vegetables production (Montemurro et al., 2013).

When an ASC is terminated by green manuring, its entire belowground and aboveground soil biomass is incorporated into the soil. According to the biomass amount and the N content of the plant tissue, it is likely that 50 to 200 kg ha^{-1} of organic N, ready to be mineralized, are incorporated into the soil. Depending on the characteristic of the plant biomass (i.e. C/N ratio), and soil moisture and temperature, mineralization rates vary greatly, up to very high values in favorable conditions. Indeed, in the case of break ASC green manure in spring or in early autumn, large quantities of mineral N may be rapidly released in the soil. If the subsequent cash crop is not ready to take up the mineral N (i.e. not yet in the fast growing phenological phase), this mineral N is potentially leachable and/or can be subjected to re-immobilization processes in the soil, contributing in a limited extent to the cash crop N nutrition. On the other hand, when the break ASC is terminated by the roller crimper, the soil is no or minimally tilled and the ASC aboveground biomass is not incorporated into the soil. In these conditions, the mineralization of the organic matter, of the ASC plant material, occurs in the soil-mulch interface, and the mineral N release may proceed slower than in the green manure, due to the root biomass which may comprise as much as 12% of crop biomass amounts (Montemurro et al., 2013).

4. Conclusion and Research Needs

Despite the wide acknowledgement of the contribution of the Agro-ecological Service Crops to sustain agricultural production and to promote environmental protection by a wide range of mechanisms, their diffusion within organic and sustainable low input cropping systems is still limited. This is due to low awareness on the selection of the most appropriate genotypes and termination strategies (i.e. technology, time of termination, etc.). Accordingly, to further empower the use of ASC in a wide range of agro-climatic conditions, research activities specific to various areas should be encouraged.

For alternative termination strategies, the roller crimper technology to terminate by flattening ASC has been successfully tested in few cropping systems and eco-zone across Europe. However, the experiences acquired so far and the current scientific literature have identified some constrains in the use of this technology. These include: (i) the production of proper amount of cover crop biomass before rolling, (ii) the cover crops re-growth during the subsequent main crop cycle, (iii) nitrogen (N) immobilization and the difficulty in applying fertilizers in the ASC residues forming the mulch, and (iv) low quality of the transplanting or sowing bed preparation. These constrains could further limit success of the roller crimper technology in the Continental and Northern Oceanic eco-climatic area of Europe, where the cash cropping season (spring – summer) is short and soil temperatures remain low for a longer period. Moreover, the application of the roller crimper technology could be limited in vegetable cropping systems because of the low competitive ability of vegetables relative to other species (i.e. cover crops and weeds) and their high nutrients demand (Mortensen et al., 2000). Therefore, further studies are needed to test the effectiveness of the technology in other parts or Europe. In detail, additional studies should be aimed to understand the dynamic of N mineralization in the soil-mulch interface and the synchronization of release of mineral N with the subsequent cash crop N requirements.

Moreover, more effective machinery to perform an extremely reduced tillage system relying on the concept of "in-line tillage" to implement the vegetable transplanting and use of the roller crimper should be further developed. Such a machine is being developed by slightly modifying a roller crimper (Canali et al., 2013). In particular, a sharp vertical disk and a coulter (or chisel) were installed in-line at both the front and rear of the roller. This prototype machine allows to flatten the cover crops and to obtain a 0.2 to 0.3-m deep and few centimeters wide transplanting furrow in a single pass.

Lastly, in order to give guidance to farmers and technicians among the different available options regarding the introduction of (mixtures of) ASC into vegetable cropping systems, the choice of the suitable ASC genotypes and the proper terminations strategies to be adopted, ready to use Decision Supporting Systems (DSS) should be developed, tested and disseminated to farmers.

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SOCIETAL ATTITUDES TOWARDS ORGANIC AGRICULTURE AND PRODUCTS

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1. Introduction

The growth and development of organic agriculture as a novel production system world wide is primarily driven by the conscious awareness of the need by consumers of the products to eat healthy and nutritious food. No wonder, the global market has risen from 63.8 billion US dollars in 2012 to 80 billion US dollars in 2015 (Willer and Lernoud, 2015). Despite the high value of money being spent on organic products, certified organic agriculture is still very insignificant in terms of its global farm land (< 1%) relative to the global total farm land.

Organic farm land of over 38 million ha is distributed as follows: Africa (3%), USA and Canada (7%), Latin America (11%), Asia (10%), Europe (29%) and Oceania (33%). At global level, most of the research activities in organic agriculture are being done in Europe (publication share in web of science stood at 84% and 64% during the 4th ISOFAR Scientific Conference in Istanbul, Turkey, 2014). The overall funding for organic research is less than 1% of the total fund allocated to agricultural research even though the organic farm land in the continent of Europe is above 4% of the total farm land (Rahmann and Aksoy, 2014). This unacceptable ratio of fund distribution should be brought to the attention of the policy makers who are surely aware of the health benefits of organic agriculture.

In the world today, over 200 million children under the age of 5 years are stunted or malnourished, 2 billion people are suffering from ailments caused by lack of essential vitamins and minerals in diets and 1.4 billion people are obese (Global Panel, 2014) and on average 850 million people are hungry with 239 million (28.1%) residing in Sub Saharan Africa (SSA). Organic agriculture can be used as a tool to alleviate most and if not all of these global challenges. This paper discusses the implications of organic agriculture for public health, how to increase willingness to pay for organic food, how organic agriculture can tackle world hunger and organic food for everyone: the examples of European and African countries.

Organic agriculture and public health

According to Sir Albert Howard in 1947 - The birthright of living things is **health**. This law is true for soil, plant, animal and man: the health of these four is one connected chain. Any weakness or defect in the health of any earlier link is passed on to the next and succeeding links, until it reaches the last, namely, man". Furthermore, there is a popular slogan that "***health is wealth***". In the 21st Century, disease associated with the use of chemicals include asthma, autism, birth defects, reproductive dysfunction, diabetes, several types of cancer to mention a few. The Pesticide Induced Diseases Database was launched to bring to the notice of policy makers colossal damage to human health inherent in the use of agro-chemicals. The three categories of people that are exposed to pesticide contamination are farm workers, consumers and children. The farm workers and their families are the most vulnerable since they work and live in places where or near which toxic pesticides are applied, drift and water is contaminated. Their family members are exposed to them through contact and their clothing. For example, pregnant women working under such conditions directly expose their unborn babies to such toxic pesticides. Farm workers that are exposed for a long time stand the increased risks of certain types of cancer. However, the global increasing public awareness of the health benefits of organic food over conventional food has resulted in the increase in demand for organic foods. Benefits of organic foods include prevention of premature ageing, boosts immune system, ensures safe and healthy world for future generation, tastes better than non-organic food, reduces risk of heart diseases, promote animal welfare, reduces presence of pesticides and thereby prevents cancer. Organic milk contains more antioxidants, omega-3, fatty acids, conjugated linoleic acid (CLA) and vitamins, helps to boost metabolism, strengthens immune system and aids in reducing abdominal fat, cholesterol and allergic reactions more than conventional milk because organic cows are pasture grazed (Anon, 2016a). Similarly, organic tomatoes contain more antioxidants that are good for health and reduce the chances of developing cancer (Mitchell et al., 2007). According to a study carried out in the United States of America, average American children are exposed to five pesticides daily in their food and drinking water. A switch however, to organic diets eliminated the traces of organo-phosphate insecticides from these school age children. Thus, confirming the safety of organic food (Organic Centre, 2006). No wonder, the US Environmental Protection Agency now considers 60% all herbicides, 90% all fungicides and 30% all insecticides carcinogenic (CCMOF, 2016). Recent literature review by Lairon, 2010; Brandt, 2011; Smith-Sprangler, 2012) have shown that organic foods are higher in dry matter, magnesium, iron, zinc (less markedly, vitamin C, anti-oxidants, phenolic acids/ flavonoïds, poly unsaturated fatty acids, omega-3 (milk, + 68%: meat +47%) and lower in proteins (cereals), nitrates (vegetables) and cadmium (heavy metal) than the conventional foods. Chicken showed enhanced immune reactivity, a stronger reaction to the immune challenge as well as a slightly stronger „catch-up-growth" after an immunological challenge when fed with organic feed (Huber et al. 2010). It is therefore, suggested that the four principles of organic agriculture (health, ecology, fairness and care) should be strictly adhered to by the practitioners in order to produce safe food under a safe environment.

2. How to increase willingness to pay for organic foods

Basically, organic food is defined as food items prepared according to the norms set by a certifying body such as none usage of chemical fertilizers, chemical pesticides or chemical preservatives. Consequently, organic foods cost more than conventional foods by 20 to 100% depending on the type of food. This could be attributed to the fact that organic food production is normally more labor intensive and involves the use of organic fertilizers and pesticides. According to Golan and Kuchler (1999), willingness to pay for a product is a measure of the resources an individual is willing and able to pay in order to reduce the probability of encouraging a hazard that compromises his health. According to studies carried out in Nigeria to assess the level of awareness and willingness to pay for organic vegetables, about 49 to 72% of consumers were aware of organic vegetables and most of them were willing to pay premium price (extra cost) for the vegetables as against buying vegetables from conventional systems (Dipeolu and Akinbode, 2005; Obayelu et al., 2014). Similarly, the willingness to pay for premium cost for organic produce ranged from 23% for cucumber to 73% for organic fluted pumpkin (Philip and Dipeolu, 2010). In a more recent study, variables that influenced willingness to pay for organic produce included education level of the respondents, household size and awareness of organic produce. The educated government workers were willing to pay more, while the willingness to pay more declined with increased household size because of cost implications (Oyawole et al., 2016.). A major strategy that can be used to increase willingness to pay for organic produce is to embark on massive awareness campaign and also provide enabling environment for new markets to open up. A shift in food consumption towards more nutritious and high-valued foods like organic produce are features of urbanization and the civil servants constitute the major workforce inmany developing countries (Shephard, 2013.)

3. How organic agriculture can tackle world hunger

A very frequently asked question today in the world is if ***Organic Agriculture can feed the world?*** **In** fact, a Cambridge Chemist John Emsley once said that "The greatest catastrophe that the human race could face this century is not global warming but a global conversion to organic farming – an estimated 2 billion people would perish". However, a candid answer to that question is neither YES or NO. In recent times, some schools of thought have argued that conversion to organic farming could better satisfy the hungry 790 million people in the world. There are many arguments that the yield gaps between organic and conventional systems is very wide and this depends on the sources of such data. It was recently concluded that organic yields were about 80% of conventional yields. However, in poorer nations where the poor people live, such yield gaps simply disappear. At present about 80% of the food supply is produced by small holder farmers in Asia and SSA and these are the people who can readily adapt to organic farming (FAO, 2016). A summary of 15 case studies in Africa revealed that the practice of organic farming resulted in the following benefits to the communities: more nutritious diets and health, reduced occupational hazards through decreased exposure to pesticides and more job creation. Furthermore, organic farming is capable of yielding other benefits that cannot be easily quantified such as controlled erosion, elimination of drinking water contamination, death of birds and other wild life, complete ban of growth hormones, antibiotics and many additives allowed in conventional farming, shift towards small holder farmers and redistribution of labor workforce which can contribute to rural stability. It can be concluded that if properly done, organic agriculture can go a long way in reducing hunger in the food insecure regions of the world.

4. Organic food for everyone: the examples of European and African countries

According to the World Watch magazine in 2006, organic food simply refers to the way agricultural products are grown and processed i.e such crops and animals are grown or raised without the use of synthetic pesticides, bioengineered genes (GMOs), chemical fertilizers or sewage slug based fertilizers and the animals must not have received growth hormones and antibiotics or foods prepared according to norms set by an organic certifying body without using chemicals or chemical preservatives. Consequently, organic foods contain much fewer pesticides, they are fresher, more environment friendly, free from GMOs, meat and dairy products richer in desireable nutrients such as omega-3 fatty acids. One of the recent diets being popularized now in Europe is called Nordic diet and it was created in 2004 by a group of nutritionists, scientists and chefs because on the increasing rate of obesity in the Nordic countries (Norway, Denmark, Sweden, Finland and Iceland). The proponents believe a person can improve his or her health by eating Nordic foods (i.e. traditional foods such as plant foods and sea foods. They suggest you eat often fruits, berries, vegetables, legumes, potatoes, whole grains, nuts, seeds, fish, seafood, low fat dairy, herbs, spices and rapeseed oil; eat in moderation meat, free range eggs, cheese and yogurt; rarely eat red meat and animal fats and don't eat sugar sweetened beverages, added sugar, processed meat and food additives. Several studies have shown that Nordic diet can cause only short term weight loss, some reduction in blood pressure and cholesterol level but the results are not very consistent. Can organic food be for everyone since it is more expensive than conventional food? Based on the classification of the United States Department of Agriculture (USDA) guidelines for organic products, the type of organic product could be 100 percent organic (organic ingredients used 100 percent), organic (95%), made of organic ingredients (70 percent) or contains some organic ingredients (less than 70 percent guidelines for organic products, the type of organic product could be 100 percent organic (organic ingredients used 100 percent), organic (95%), made of organic ingredients (70 percent) or contains some organic ingredients (less than 70 percent) ((USDA, 2016). According to an on-going study on organic food consumption patterns in France (Larion, 2016 personal communication), regular consumption of organic food is associated with higher educational level, higher level of physical activity, no smoking, less report of restrictive diet and comparable income that is a little higher than the average. In order words regular consumption is related to healthier life-style profile. Strassner and Roehi (2016) reported the requirements expected of caterers in the city of Munich in Germany for food in terms of quality and origin as follows: minimum 10% of all foods in organic quantity, minimum 30% of all food from local production, minimum 30% of all food or a single animal species with animal welfare standard, marine fish exclusively in fair trade quality.

There is no typical African diet because diets vary across regions and religions in the continent. However, the main meal of the day is lunch which normally consists of vegetables, legumes and sometimes meat and fish. When the various food sources are combined, it is called soup, stew or sauce depending on the region. Depending on the region, foods can be starch based (cassava or yam) or cereal based (rice, millet, sorghum). Many Africans rarely eat meat because of economic consideration or religion (Anon, 2016b).

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An investigation of organic sheep and goat production by nomad pastoralists in southern IRAN

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Abstract

The nomadic pastoralist system in Baft district in Kerman province is well-known in Iran for producing cashmere from Raeini goats. However, there is little information regarding the organic sheep and goat production systems. Interviews and filed observations were carried out with 30 Siahjel nomad families of Raen origin in proximity of the Baft city to characterize the organic production system in terms of feeding, animal health and veterinary treatments, husbandry management practices, transport, slaughtering, housing and stocking rate. Unimproved rangeland was considered the main source of sheep and goat nutrition of nomads in southern Iran. As a nomadic traditional feeding management practice there were no minerals, vitamins, pro-vitamins and GMOs for animal feed. Nomad sheep and goat breeds were considered to be robust, adapted to the environment and disease tolerant livestock. The annual migrations that nomads undertake helped to lower the incidence of internal parasites. In nomadic system no animal cruelty practices such as tail ducking, dehorning and tethering were allowed. To keep ruminants in groups to meet their social needs, nomad families stayed and kept animals together to support each other in different livestock activities including shepherding, feeding, milking and health care. Due to natural breeding in nomadic herds, the male breeding stock was kept and grazed separate from does during the breeding season. Traditionally nomads consume more milk than meat and often express a dislike for killing and trading animals. Nomad livestock were not fed in stables or in restricted areas but moved and grazed freely in extensive open grazing areas.

Key words: Nomad; Rangeland; Goats; Sheep; organic products;

Introduction

The increasing incidences of residues of pesticides, chemical fertilizers, antibiotics and hormones in the livestock products in the recent years are of great concern. Mindset of people towards organic farming is rapidly gaining positive perception from the people in developing countries including Middle Eastern countries (IFOAM, 2005; Jaffee and Howard, 2010; Schleenbecker and Hamm, 2013, FiBL, 2014) for ensuring food safely and protecting human health.

Livestock organic production entails production of high nutritive quality foods free from all kinds of impurities for sound human health, in which ethological characteristics of animals are respected. Organic farmers commit to respect a list of specification governing animal care, welfare and feeding obliging them to herbivores access to pasture (Leroux et el., 2009) which is favorable from a nutritional point of view, as products from pasture-fed livestock has been shown to a nutritionally more desirable composition than products from livestock fed concentrate diets (Fisher et al., 2000, Aurousseau et al., 2004; Santelhoutellier et al., 2008).

Organic sheep and goat production based on grazing (Rahmann 2002, 2014) could be a valid alternative for animals kept in intensive or industrial systems fed with standard ration of concentrates. Existing similarities between organic agricultural products and extensive farming systems in many developing countries (Ben Kheder, 2001, Znaidi, 2001) enables many traditional farmers including nomads to convert to organic system.

The geographical and ecological conditions of Iran are well suited to small ruminant production. The relatively low cost of the sheep and goat farming (local breeds-well adapted to their environment plus extensive free communal grazing areas) and the increasing demand for expensive organic products in domestic and regional export markets (Herman and Steidle, 2014; Steidle and Herman, 2014; Ak and Koyuncu, 2002) encourages nomads to shift to organic production.

There is evidence that, besides being usually free from the detrimental residues, the products from pastoralists are also appreciated for their high nutritional value and better taste. In Iran, the milk and meat produced by nomads regarded as a local specialty is much preferred to that of animals raised by large industrial complexes. In addition to these material benefits of nomadic pastoralist products, there are significant immaterial values. Pastoralist breeds are part of the local heritage and contribute to local and regional identity, besides often being essential for traditional rituals. Despite this array of advantages, nomadic pastoralists currently continue to market their products generically and there is no awareness about the taste and health benefits of their animals among consumers, policy makers and even themselves.

Nomads play an important role in sheep and goats production mainly because they keep 58.5% of the sheep and 39.7% of the goat population of Iran. Sheep and goat populations of Iran are 53.8 and 25 million heads which ranks 6th and 5th in the world (FAO, 2014). Nomadic systems in Iran are based on livestock and are characterised by low population densities, displacement of livestock between grazing areas (cities and provinces) in different seasons, weak linkages to markets and public services and several multiple co-resident family units (clusters of 2-5 households staying together). The majority of the nomadic pastoralists do not have permanent settlements and consequently use mobile homes such as tents (Ansari-Renani, 2015; Ansari-Renani et al. 2013).

Growing demand for organic sheep and goat products will continue to be the main driver of nomadic livestock systems for domestic and export markets. At present information regarding Iranian nomadic organic sheep and goat production systems are very limited. The objective of the present study was to describe the characteristics of and to evaluate potentials and conditions under which nomad pastoralists of southern Iran are able to produce different organic livestock products. Attempts were made to address constraints and shortcomings of a sustainable nomadic system in livestock organic production.

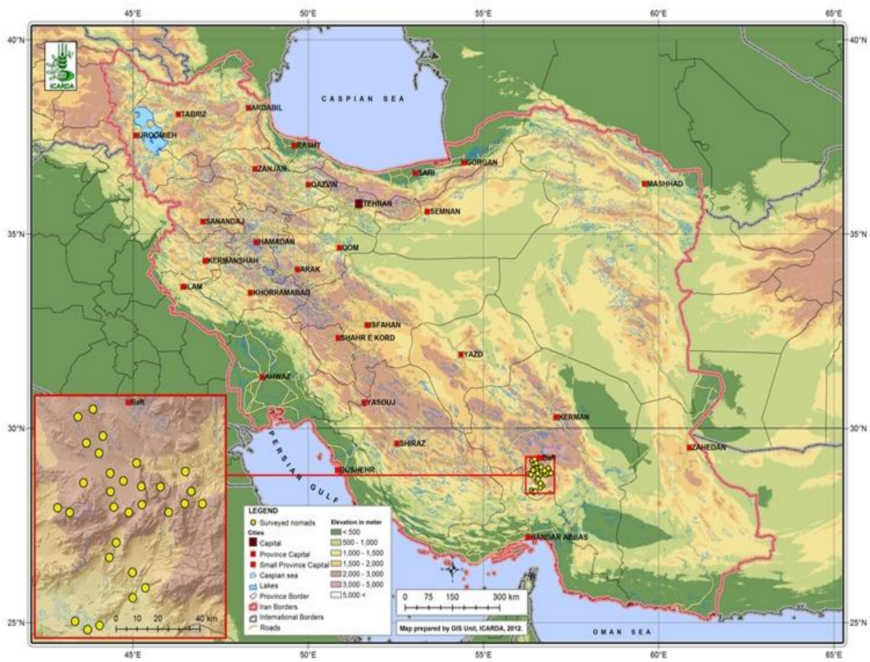
Material and methods

Study area

This study was undertaken in Kerman province, Baft region in the south part of Iran (Map 1). Kerman province is a highland region with < 250 mm annual rain. Summer is hot (up to 35 °C) and dry, and winter is moderate. Baft is a region in the south of Kerman province, which is 2,270 meters above sea level with a latitude of 29°17'N and longitude of 56°36'E. In this area most nomad households belong to the Siahjel sub-tribe of the Raen tribe. This region has two main livestock breeds: the Raeini cashmere producing goat and the carpet wool producing Kermani sheep. Male Raeini goats have an average live weight of 35 kg and females 30 kg. They produce on average 507 g of cashmere of different colours with averages of 56.5 percent down yield, 19.5 micron fibre diameter and a staple length of 54.2 mm (Ansari-Renani et al. 2012). Kermani sheep produce on average 2.0 kg of wool with 70.0 percent efficiency, a staple length of 150 mm and a fibre diameter of 27 micron.

The nomads are completely dependent on livestock as a source of income. Nomad livestock production system is based on mixed herds with 89% of heads being goats, 8% sheep and 3% horses, mules, donkeys and sometimes camels used for transportation (Ansari-Renani et al. 2013). A typical nomad family would run some 250 goats, of which adult female goats (does) constitute 44%; bucks, castrated adult males, male and female yearlings, and male and female kids represent 8, 5, 7, 12, 10 and 14% of the herd population, respectively.

Map 1. Map of Iran showing the study area and distribution of 30 nomad households chosen within Baft region in Kerman province.



Selection of nomad settlements and information gathering

A total of 30 nomad settlements were chosen at random within ± 20 km of Baft city in Kerman province (Map 1, Table 1). Information was gathered primarily through in-depth interviews with nomad men and women and field observations. Four periods of 6-7 day of fieldwork were conducted within the Baft region. Each interview lasted approximately 3 hours and consisted of about 50 predetermined questions. A structured questionnaire was completed for each individual family of settlement heads including family composition and labour allocation structure; herd structure and management, housing, stocking rate, nutrition, feeding, watering, health, veterinary treatment, breeding, transportation, management practices, slaughtering, processing and reproduction. The responses to those questions were tallied and the percentages of the various responses were calculated. Minimum, maximum, standard deviation (SD) and standard error values were measured using SAS package.

Table 1. Details of the 30 nomad cashmere producing herds

Nomad family	Place of origin	Size of family (Persons)	Number of animals (Heads)*		
			G	S	C
1	Arzooeih	7	225	40	30
2	Galoogiran	5	142	40	41
3	Janat Abad	6	251	33	35
4	Janat Abad	8	306	-	50
5	Geloo Mahmoudabad	9	323	4	70
6	Khobr	7	280	21	50
7	Khobr	4	200	10	30
8	Soltani-Baft	6	373	150	20
9	Gelook – Baft	9	315	33	15
10	Geloo Anjeer	6	225	25	25
11	Se Chah Dehsard	4	185	-	18
12	Dashtab – Baft	5	179	47	45
13	Sanouheh Dashtab	5	176	40	1
14	Dokoohe – Baft	6	155	17	30
15	Dokoohe - Baft	4	200	-	25
16	Zarab	5	130	-	30
17	Sechah Dahsard	5	356	3	25
18	Gelook – Baft	4	303	53	15
19	Esmailabad – Baft	5	208	58	20
20	Esmail Abad – Baft	3	109	21	13
21	Esmailabad – Baft	3	102	17	1
22	Geloo Mahmoudabad	4	130	24	15
23	Geloodar Kooshki	5	150	-	12
24	Godar Zarab	3	83	-	15
25	Zarab	6	219	20	20
26	Zarab	3	140	50	13
27	Dahaneh Zardan	4	155	-	20
28	Geloo Mahmoudabad	5	120	15	25
29	Dehsalar	5	286	106	30
30	Dehsalar	5	153	15	15

- **G: goats, S: sheep and C: chicken**

Results and discussion

Compared with conventional system (Table 2), nomadic sheep and goat production is highlighted by natural breeding of locally adapted native breeds, extensive use of rangeland as a source of livestock feed, no use of prophylaxis, minimal allopathical treatments, the protection of the environment, improved animal welfare and sustainable animal husbandry practices. In nomadic system of sheep and goat production, one objective is to achieve animals' well being through animal welfare oriented husbandry and appropriate use. Curtailing freedom of movement, sensory deprivation, and unsocial ways of husbandry, not allowing any contact with animals of the same species, or forcing too close a contact are not permitted in nomadic farming.

Nomad sheep and goat breeds

The livestock breeds kept by nomads had unique characteristics, as they were subjected to selection criteria that were almost entirely different from those used in "scientific animal breeding". They were part and parcel of their respective eco-systems and provided a host of environmental services. To take droughts and hunger in their stride and act as insurance, these breeds walked for miles in harsh terrain and to seek put scattered, spiky, fibrous plants that survive in areas where crops could never be grown.

In organic farming the breeding of small ruminants should be done by natural mating. Artificial insemination is allowed, but not embryo transfer, oestrus synchronization, etc. In nomadic system animal breeding was only by natural mating and artificial insemination, embryo transfer, oestrus synchronization were not popular among nomads. As a result of natural breeding, bucks and male yearlings had disproportionate ratio (15%) compared to adult and yearling females (56%).

As industrial modes of livestock production are spreading, domestic animal diversity is in rapid decline. According to the FAO, one third of all livestock breeds have either perished or are threatened with extinction, due to intensive selection for high production by means of artificial insemination and embryo transfer and the spreading of a small number of genetically narrow high performance breeds around the whole globe. In this scenario, the main stewards of livestock genetic diversity are nomad pastoralists and other "small scale livestock keepers" that raise animals under lo-input conditions.

Table 2. Characteristic of conventional, organic and nomadic animal husbandry

	Conventional*	Organic (834/2007)*	Nomadic
Breeds, origin	Highly performing, special breeds and cross-breeds according to product aimed for	Only animals reared on organic farms, diversity of breeds, sometimes rare breeds, natural breeding	Native breed, locally adapted, natural breeding
Keeping (buildings and free runs)	Animal protection laws (requirements for keeping of animal according to species)	Special requirements for keeping animals oriented toward animal welfare (stock density, space, grazing, tiding, etc.)	Animal are kept in rangeland oriented toward animal welfare
Feeding	According to current food stuffs legislation (permitted food additives such as enzymes, synthetic amino acids, etc.)	Food stuffs produced as much as possible on site, feeding rations according to animal welfare (e. g., minimum use/parts of roughage) only specifically permitted additives, no synthetic amino acids, no genetically modified organisms	Rangeland is considered the main source of livestock nutrition, no synthetics, no GMOs, no pesticides and chemical fertilizers, livestock are not fed in stables or in restricted areas but they move and graze freely in extensive open grazing areas.
Management and treatment	Managed breeding, if necessary stable-wide prophylaxis, legally required waiting periods according to drug prescription law	No prophylaxis (exception: legally required vaccination), only three allopathical treatments per year for long live animals (>1 year) respectively 1 treatment for livestock, which is not used more than one year; double the waiting period after use of drugs, minimum 48 hours. Restricted interfering with the animal's integrity (no polling, beak trimming, tail clipping, etc.)	No prophylaxis (exception: legally required vaccination), minimal allopathical treatments per year, no tethering, polling and tail clipping.
Transport	Animal transport regulation	Animal transport regulation with short transport ways	Animals are displaced by migration mainly, some transportation by trucks

*Adapted from Rahmann, G. 2014.

Termed "guardian of biolocial diversity" (FAO, 2009), these people conserve biodiversity at the level of livestock breeds, vegetation, eco-systems and landscape.

Feeding

In organic farming sheep and goats have to be fed with 100% organic feedstuff (EEC Regulation, 2007). The statement that livestock has to be fed 'predominantly' with self-produced feedstuff is not specific enough. 50% of organic feeds for ruminants can be purchased from other organic farms. Comparatively rangeland was considered the main source (85%) of sheep and goat nutrition of nomad farms without any use of chemicals such as fertilizers and pesticides (Pictures 1) while other sources of feed such as stubbles composed only a small portion (15%) (Table 3). The ratio between the high price of feed inputs and lower price of livestock products provides insufficient incentives for the nomads to purchase synthetic chemical inputs for developing intensive production systems.

In organic farming it is not permitted to use anything produced using GMOs (genetically modified organisms) or derivatives. This includes feed for livestock. There are permissible minerals, vitamins and pro-vitamins for animal feed and artificially produced vitamins may not be used for ruminants. As a nomadic traditional feeding management practice all farms did not use minerals, vitamins, pro-vitamins and GMOs for animal feed while the cost of such feed are too high (Table 3).

In organic farming a feeding system which leads to anemic conditions in sheep and goats is prohibited and considered as animal cruelty.To avoid such condition, as feeding management practice, 23% of nomad farms preferred tree-covered grazing areas (Picture 2) which include wild oak trees, as the nutritive value of leaves that are rich in iron, sulphur and cupper consumed by animals complements the grass very well. 38 and 39% of farms used open grass land and bush/shrub and stone covered rangeland respectively (Table 3). In focus group discussions, nomad herders frequently emphasized that the diversity of plant species consumed was responsible for the superior taste and healthiness of sheep and goat milk and meat. Most of these plants have medicinal value. Local knowledge of nomad pastoralist communities sees a connection between the dietary composition of livestock feed and the nutritional value of livestock products.

Table 3. Percentage of nomad farms using chemicals (fertilizers, pesticides and …), source of feed and type of grazing land

Farms using chemicals	**Percentage**
Fertilizers	0
Pesticides	0
Others	0
Source of feed	
Rangeland	85
Stubbles, agriculture residues, etc	15
Use of genetically modified organisms (GMO)	0
GMO derivatives	0
Minerals, vitamins and pro-vitamins	0
Source of lamb and kid feed	
Colostrums and maternal milk	100
Powdered milk	0
Type of grazing land	
Open grass land	38
Tree covered	23
Bush/shrub and stone covered	39

Nomadic sheep and goat breeds were social animals in the true sense, living in a herd, responding to the voice of their keepers. By means of such breeds of livestock that are co-evolved with their eco-system, nomads were in a position to process the dispersed and extremely bio-diverse natural vegetation of drylands and mountainous areas into a range of high value delicious organic food including meat, milk as well as a range of other organic products such as fibre, fertilizer and hides. They did this without leaving any carbon footprint, as their animals forage for themselves and no energy is expended to grow or transport feed to them.

On many organic farms, kids and lambs receive only colostrum milk and subsequently powdered milk. The young stock does not suckle and receive natural milk because the organic milk is very valuable and expensive as young stock feeds (Rahmann, 2002). Even skimmed powdered cow milk can be used as long as it has an organic label. In nomadic system contrary to intensive and organic sheep and goat systems of production in which early weaning of lambs and kids is practiced and all the milk and milk products are consumed by humans, there was no early weaning system in the nomadic system. In all nomad farms kids and lambs suckled their mothers for 45 days and received only "maternal milk" (Table 3). When young animals were still nursing, the herd returned to the tent at least once each day to allow them to nurse.

Animal health and veterinary treatments

In organic farming the principle of animal health is preventing and not curing/treating. As a preventive practice, newborn and young animals were often kept together at the tent with the nomad women and children until they were old enough to go out to pasture with the herd. Animals that were diseased were likewise kept at the family tent, effectively isolated from the herd so chances that infection will spread throughout the herd are thus reduced.

Picture 1. Rangeland is considered the main source of nomad sheep and goat nutrition of southern Iran

Picture 2. Tree covered grazing land in southern Iran suitable for grazing livestock.

Robust, adapted and disease tolerant livestock ensure fit and healthy animals. Nomad breeds were considered to fulfill these targets. These were indigenous breeds typical of a specific region and adapted to the local environmental conditions and keeping patterns for hundreds of years.

Many of the nomads’ animal management practices had a direct positive impact on the incidence of livestock diseases. Some of the most significant practices include reproduction management, the isolation of diseased animals, grazing and migration patterns. Nomad herders believed that herding more than one species, risk of livestock losses were buffered, whether losses were due to diseases or extreme environmental conditions. They emphasised that annual migrations that most Raen nomads undertake and the generally extensive grazing patterns of the herd, helps to lower the incidence of diseases including internal parasites.

Nomads highlighted that the indigenous technical knowledge and medicinal plants for health care were effective substitute for allopathic medicines, giving them an advantage in the matters of organic livestock production. Indigenous knowledge of nomads may provide effective option for veterinary care through proper validation, as also the negligible use of agro-chemicals especially in drylands and hilly nomadic regions, makes favorable environment for organic livestock production.

Nomads knew that infections of the udder can be spread from one animal to another during milking and washed their hands with water between milking animals. Both men and women helped at animal births. Women often explained that they were better than men at this since they have smaller hands, which is good for repositioning the foetus within the birth canal.

Husbandry management practices, transport and slaughtering

The systematic shortening of tails, dehorning and other such husbandry practices are not allowed in organic system. Management of livestock among nomads was a social issue and they did their utmost for the well being of their animal and to avoid animal cruelty of any kind. In nomadic system there were no tail ducking, dehorning and tethering.

In organic system castration of male stock is allowed to keep traditional animal husbandry practice. In nomadic areas breeding management was difficult in mixed flocks of male and female animals without castration. The castration of male kids and lambs was done at a very young age. The surgical technique of cutting the scrotum open with a knife and pulling the testicles was the common method of castration among nomads. They castrated their animals during the cool months of the spring and autumn, to reduce the chances of infection being spread by flies and other insects.

In organic farming ruminants have to be kept in groups to meet their social needs; however it is not defined how social needs can be fulfilled via farm conditions. Contrarily nomads had well defined social needs for keeping livestock under farm conditions. To keep ruminants in groups majority of nomad families stayed and move together with other families, mostly closely related. Furthermore families staying and keeping their livestock together allowed nomads to herd adult and young animals separately as the social needs and feed requirements of different age groups differ and requires unique management practices.

The kidding period at the beginning of winter was associated with low temperatures and low feed availability. Hence animals were supplemented with limited amount of barley and to avoid losses, at the end of autumn most nomads migrated to warmer areas in the southern provinces adjacent to the Persian Gulf.

As a result of natural breeding and high proportion of males to females in the nomad herd, male breeding stock was kept and grazed separate during the breeding season. Bucks come into rut during the breeding season. Rut is characterized by a decrease in appetite, obsessive interest in the does, and a strong heat. Nomads knew that when strong smelling bucks are not separated from the does during breeding season his scent will affect the milk. In organic farming male breeding stock has to be kept on the farm. It is permissible to use conventionally kept male breeding stock.

In organic farming the animals have to be slaughtered in abattoirs which fulfill the regulations of organic farming and are certified (Leu, 2014). Traditionally nomads consumed more milk in their diets than meat. In fact they often express a dislike for killing and trading animals. Animals were sold to certified abattoirs or butchers directly either for cash needed for income or for culling unwanted livestock. Meat production was almost exclusively for sale.

Home slaughtering for own consumption and sale to neighbours or relatives occurred only occasionally. The proportion of nomads buying animals was very low; the reason was that they often depend on their existing animals to reproduce and increase their herd size.

The transport of livestock is not clearly defined in organic farming, but a stress-reduced loading, transporting and unloading of livestock without the use of allopathic tranquillizer, electrical shockers or similar tools is aimed. Nomad livestock movements between communal grazing areas in different provinces are gradual and animals are displaced by migration and may take up to 3-5 days were depending on the distance. Some times trucks were used to transport livestock between grazing area in different provinces.

Housing and stocking rate

Tethering of livestock is prohibited in organic farming. Basically there was no tethering of any kind of livestock among nomads. When nomad livestock were back from grazing adult and young animals were penned separately near the tent in circular-shaped pens made up of wood and fenced overnight, and milked in the morning before being taken out for grazing.

In organic farming it is obligatory that ruminants should graze on pastures (“free-range”) and not fed in stables as long as the animal, weather and pasture conditions are suitable. If grazing is not possible, a permanently accessible open-air run is obligatory. Free moving stables with permanent access to open-air runs are the principle of ruminant keeping. Only with permanent summer pasture grazing an outdoor run is not necessary, as long as the animals are not tethered.

Nomad livestock were not fed in stables or in restricted areas but they moved and grazed freely in extensive open grazing areas. Nomad families used the rangelands in spring and summer for grazing, and migrate to the warmer southern Persian Gulf provinces in autumn and winter (Picture 3, Map 2). The nomadic pastoralists had no fixed homesteads and covered great distances with their livestock following pasture availability throughout the seasons. The transhumant pastoralists showed a regular seasonal movement between set areas. These pastoralists usually stayed as a single family and did not integrate with other families. Their movement could be described as vertical where pastures at high altitudes are used in summer and pastures in the lowlands are used in winter, or horizontal in the surroundings. Consequently, the livestock density in Baft varied throughout the year, with the highest number of livestock and people in summer.

Picture 3. Nomads migrate to warmer areas of southern provinces adjacent to the Persian Gulf in the beginning of autumn.

Map 2. Map of south Iran showing the spring and winter grazing areas in Kerman (Baft region) and Hormozgan (Roodan region) provinces near Persian Gulf in blue and green colors respectively.

Conclusion

The ideology behind principles and standards of organic animal husbandry is not new to the nomadic farming system of Iran, whose community insist upon the animal welfare and animal natural rearing systems since ancient times. A country rich in indigenous animal genetic resources like Iran is very much suitable for adopting this innovative farming system. Moreover, nomadic farming system with well diversified livestock population in terms of species and breeds is ideal for organic livestock production. Nomad breeds being less susceptible to diseases and stress, need less allopathic medicines/antibiotics. Besides, limited external input use including for animal production and maximum on farm reliance brings it further closer to organic systems. The nomadic sheep and goat production being largely extensive, animal welfare is not much compromised compared to intensive or conventional type of animal production.

Although nomadic type of livestock keeping provides an excellent and "green" alternative to industrial production, nomad pastoralists need to overcome the weaknesses and harness the strengths and opportunities, while developing their capacity in terms of knowledge, skills, infrastructure, animal feeding, hygiene, sanitation, disease control and assured certified supply chain required for organic livestock production.

Nomad farmers need to be oriented and educated about the standards and how to overcome the risks they might face in adoption of organic livestock standards. The livestock advisors should be trained and skilled enough in providing the services in livestock management and permitted therapies in organic rearing systems. The research on the locally adaptable management and disease preventive measures need to be emphasized by the government, organic promoting agencies as well as NGOs, keeping in view the potential of Iranian nomad farmers who can meet the requirements of organic livestock product demand not only locally but also globally in the near future. Organic livestock production may be encouraged through research and development efforts including establishment of model organic livestock farms, processing units, traceability tools and capacity building measures.

Converting extensive, range-based nomadic system to organic production could become economically attractive, if price premiums could be captured for organic meat and livestock products. Development of business module targeting will definitely attract corporate societies and insure vulnerable nomadic communities for receiving attractive returns for their untapped treasure of organic principles. Systematic studies needs to initiate to validate animal husbandry practices of nomads with respect to organic certification and revision/improvement can be made where ever necessary. In this way, organic products will find their way in different communities and have considerable potential for high value niche-markets.

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GOKARN Food Industries and Organic Agriculture Company, due to the shortage in the field of organic and standard agricultural products, has earnestly been working in the field of biotechnology and sustainable agriculture with the related major since 2008 (1387, Solar Hijri).

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Gokarn produces its products through the management and supervision of experts with proper utilization of natural resources and protecting the environment (water, soil, etc.) based on no or minimal use of inputs and nutritional control, in accordance with the relevant statutory standards (organic, GAP, etc.) all done to have a share in ensuring healthy nutrition and food safety.

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R & D Unit:
Technology Incubator Centre, Islamic Azad University Isfahan Branch

Gavah Sabz Ferdous Company
(Inspection of organic products in Iran)

Gavah Sabz Ferdos Co. also known as GSF was founded in 2011(1390, Solar Hijri), by using experts and advanced equipment based on national organic regulations in order to sustaining the ecosystem and its resources and protecting the civil rights. In this way started to training experienced inspectors of healthy and organic production.

Gavah Sabz Co., the inspection company, service provider and certifier of organic food production offers the following services:

- Inspect the production process to supply organic agricultural products according to Iranian National Standard no. 11000 (requirement of production, processing, inspection and certification, labeling and marketing of organic food)
- Inspect the production process to supply organic agricultural products according to international standards (EU, NOP, JAS, etc.)
- Inspect the production process to supply organic agricultural products according to Standard of Good Agricultural Practices (IRAN GAP & Global G.A.P)

We also have a well-equipped accredited laboratory for quality control tests of food products, water, soil and air that improve production monitoring.
All of substances residuals would be measured in our laboratory (The Institute of Islamic Azad University Isfahan Branch).

Furthermore we analyze these residuals based on organic standards based on organic requirements, such as physical, chemical and microbial analyzes.

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