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Building Organic Bridges

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Gerold Rahmann and Uygun Aksoy (Editors)

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Prof. Dr. Gerold Rahmann (Editor)
Thünen-Institut für Ökologischen Landbau
Trenthorst 32
23847 Westerau
E-Mail: gerold.rahmann@ti.bund.de

Prof. Dr. Uygun Aksoy (Editor)
Ege University
Faculty of Agriculture
Department of Horticulture
35100 Bornova - Izmir
E-Mail: uygun.aksoy@gmail.com

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'Building Organic Bridges' with Science

FOREWORD

Plants and animals or in a broader sense, mother-nature, has been serving mankind from time immemorial. If you consider agriculture, as cultivation or domestication of plants and animals then you may start evaluating the impact of mankind since the last 12,000 years. Today, still, agriculture provides food for all living organisms, and fibre and in some cases fuel for human beings. The World today nurture more than 7.2 billion as of April 2014 even if the ecological footprint has exceeded one.

According to UN databases[1], in 1980, out of 4.4 billion, rural population was 1.53 times more than the urban population. Those who were the producers were more than the consumers. In 2015, the rural/urban population ratio is estimated as 0.85 revealing that more will consume and less produce. If this ratio is dissected according to the regions of development: rural/urban population ratio is 0.27 in more developed regions, 1.05 in less developed and 2.30 in least developed regions of the World. Urban growth rate peaked (2.24 %) between 2000 and 2005. Rural growth rate that was 1.13 % between 1985 and 1990 is estimated to be 0.05 % between 2015 and 2020 and then at negative rates. By 2035, 61.7 % of the population will live in urban areas where as 38.3% in rural. So, less people in more and less developed regions of the world will try to supply food for more and more consumers or urban and peri-urban areas in developed regions will become more intensified for adequate agro-food production. Additionally, there are other major issues as changing life styles and consumption habits as higher calories and high consumption of animal products. Relationship between health especially of non-transmissible diseases and nutrition is a bottom-line for many, and new evidences strengthening these relationships appear through research as technology advances. Consumers in more developed regions of the world are becoming concerned about long-distance transfers of agricultural products, energy consuming distribution channels, loss of diversity, erosion of traditional foods or processing techniques. Agricultural land is threatened by intensification, urbanization, non-agricultural activities e.g. mass tourism, mining and climate change. How can agricultural production counteract these diverse issues and still be sustainable?

Organic agriculture rooting on health, ecology, fairness and care principles as defined by IFOAM is practiced in 164 countries according to 2012 data[2]. 88 countries possess a legislative framework for organic agriculture. How many have mutual recognition? Are there any derogations and why? The market size has reached to 63.8 billion US dollars. In all 164 countries data at least on production are collected. The product flows are still towards enlarging organic markets in more developed regions of the world e.g. US or Germany. Domestic markets are enlarging. Who consumes more organic and how much they spend? Why do the consumers prefer organic food/do they also prefer organic non-food products? Are they healthier? What are the health aspects? What are the quality attributes or is it the vital quality that makes it different than conventional systems? In which as-

[1] Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects, 2014: The 2010 Revision and World Urbanization Prospects: The 2011 Revision Monday, April 14, 2014; 7:13:02 AM

[2] Willer, H. an d J. Lernoud (Eds.), 2014: The World of Organic Agriculture. Statistics and Emerging Trends 2014. FIBL-IFOAM Report. Frick and Bonn

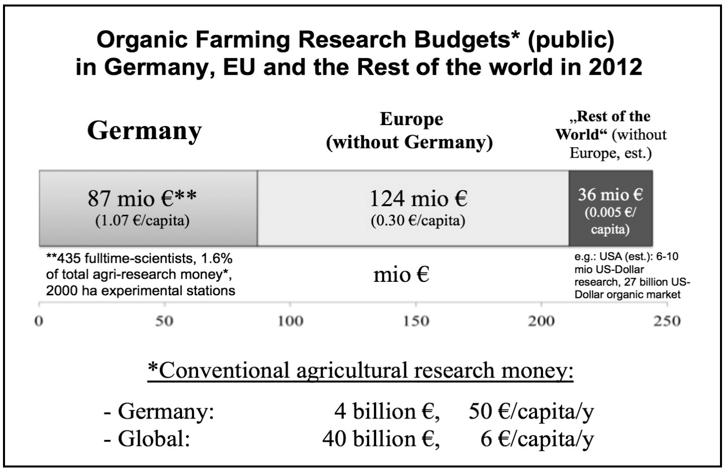
pects are organic more sustainable? Does sustainability of agricultural land differ from non-agricultural organic certified areas? How does organic system contribute to climate change?

Organic management systems aim for finding solutions to these and many other questions through research. The research objectives should derive from real-time or envisaged problems, and outcomes should find paths for quick implementation. Science is needed not only to prove its merits to the general public and lobby but also to put forward solutions to site specific problems. These can be exemplified as: Finding solutions for soil fertility management under arid conditions? How to increase yields; by developing high yielding varieties better adapted to organic conditions, by decreasing losses or by managing the value chains? What are the tools that organic farmers have in preserving animal health, which breed are resistant?

Research and innovation contributes to diversity, to competitiveness and to sustainability. In this respect, scientific meetings are major tools to establish fora to exchange results and experiences. Compared to conventional agriculture, the number of researchers and research projects and available funding is more limited in research on organic food and farming and the concept is much younger. These peculiarities enhance the importance of communication and interchanging among stakeholders. The IFOAM Organic World Congress is the unique opportunity for researchers, policy makers, extension specialists, practitioners and other stakeholders for exchanging knowledge and experiences; to share results and reversely to bring problems to the attention of world-wide research community.

The 18th IFOAM Organic World Congress held on 13-15 October, 2014 in Istanbul-Turkey targets to **'build organic bridges'**. The Scientific track will contribute to bridging not only scientists but also institutions and disciplines, and to linking more developed and less developed, rural and urban, research to extension, plant to animal, farm practices to world-wide problems and producer and consumers. Organic is a management system that requires a diversity of inputs from different disciplines, therefore, an international Congress is the best medium to blend them.

The Scientific Track is organized with special efforts of the co-organizers, International Society for Organic farming Research (ISOFAR; www.isofar.org) and EGE University (Turkey; www.ege.edu.tr). Organic e-prints (www.orgprints.org) acted as the hub for collection, revision and maintaining of all the papers. There were 568 manuscripts and abstracts received for the Scientific Track. Abstracts were not evaluated since the authors were obliged to submit full papers. About 96 reviewers - 37 from Turkey and 59 from all over the world (ISOFAR network) - contributed to the review process (double-blind: 1 reviewer international, 1 reviewer Turkish, final assessment and decision by the scientific board).



Source: compiled by Rahmann

At least, 300 papers have been accepted. They are from 51 countries and represent the countries, were 87 % of the global organic farm land and 75 % of the global organic farms are located (see table below the foreword). It is obvious, that organic farming is practiced world wide (but less the 1 % of the total farm land is managed organically), the organic markets are mainly in the western world (Europe, North America, Japan: 94 %) and the research is mainly done in Europe (publication share in web of science: 84 %, at the 4th ISOFAR congress: 69 %).

The global balance between organic production, consumption and research is not "fair" and "healthy" and has to overcome; a huge challenge for the organic world. The science can help, but the resources for organic farming research is in all regions of the world not sufficient to overcome the challenges and much less compared to the production, market or farmers numbers. Even in Europe, where organic farming research has left niches and became respected and reputable, the overall public funding for research is less than 1% of total public funded agricultural research, despite organic farm land has a share above 4% of the total farm land. This is not fair and politicians and decision makers in all countries on the world need to re-allocate the public research fund in direction to organic farming (see Figure).

All accepted papers are presented oral or as poster in 24 sessions and will try to help to

- bridge the gap between poor and rich areas of the world
- bridge the gap between scientific knowledge and practice
- bridge the gap between new and old technology

This 4th ISOFAR scientific congress will also bridge the knowledge presented in the 3rd ISOFAR Congress in 2011 in South Korea with the one to be organized in 2017. This Book of Proceedings will further help to disseminate and archive the accumulated vast information on organic agriculture.

We wish to express our sincere thanks to all who have contributed in organization of the 18th Organic World Congress (www.owc2014.org), namely IFOAM (www.ifoam.org) and BUĞDAY (www.bugday.org), and to those who delivered presentations or participated in the Congress, prepared manuscripts, reviewed, supported, and many others. Special thanks go to MILENA MATTERN and SYLVIA FENNERT from the Thuenen-Institute (www.ti.bund.de) who spent a lot of time to make the lay-out of this Proceeding and to the president of the Thuenen-Institute and therefore the German government, who gave the generous and valuable donation for printing and the facilities to do the work.

The papers are ordered by countries (country of the first author), not by sessions or disciplines. These decisions are made to make the proceedings affordable (all volumes can be purchased individually) and to merge and bridge the world and not split by disciplines and sessions. You find search facilities (indexes) to find all papers by discipline, eprint-number, keywords or sessions in each volume. A download of the full proceeding is possible under the webpage of ISOFAR (www.isofar.org) and as individual papers under organic eprints (www.orgprints.org). Due to the fact that all papers together comprise 1,300 pages, the printed Proceedings are split into four volumes. These proceedings comply all submitted, accepted for oral or poster presentation and revised manuscripts, but does not imply that they are all presented. The content of the papers are in responsibility of the authors and do not need to comply with the editors opinion.

Prof. Dr. GEROLD RAHMANN (Thuenen-Institute, Germany)
Prof. Dr. UYGUN AKSOY (EGE University, Turkey)

October 2014

Table: Comparison of the World of Organic Farming: Production, consumption, research and the representation of the countries on the 4th ISOFAR scientific congress 2014

Region / country	Organic farm land 2012 (ha) [1]	share on total (%)	Producers [1] (certified farms)	Share (%)	Sales [1] (million Euro)	share	4th ISOFAR papers [2]	share	Scientific publications [3]	share
Africa	1,073,657	3%	540,988	30%	1,000	1%	24	8.0%	221	4%
USA and Canada	2,790,162	7%	16,659	1%	23,000	48%	10	3.3%	459	8%
Latin America	6,857,611	11%	315,889	18%	1,000	1%	6	2.0%	245	4%
Asia	3,706,280	10%	619,439	35%	2,000	4%	49	16.3%	509	9%
Europe	10,637,128	29%	291,480	16%	21,000	44%	206	68.0%	4,676	84%
- only EU27	*9,518,234*	*26%*	*236,803*	*13%*	*19,000*	*40%*	*183*	*61.0%*	*4,330*	*78%*
Oceania	12,185,843	33%	14,138	1%	1,000	2%	5	1.7%	274	5%
World (Total)	37,245,686	100%	1,789,359	100%	48,000	100%	300	100%	5,569	100%
Data from participating countries (4th ISOFAR scientific congress 2014)										
Argentina	3,796,136	2.7%	1,699	0.1%	n.d.		1	0.3%	21	0.4%
Australia	12,001,724	2.9%	2,129	0.1%	942	2.0%	4	1.3%	169	3.0%
Austria	542,553	19.7%	11,575	0.6%	1.065	2.2%	7	2.3%	58	1.0%
Bangladesh	6,810	0.1%	9,335	0.5%	n.d.		2	0.7%	12	0.2%
Belgium	59,220	4.3%	1,274	0.1%	435	0.9%	4	1.3%	17	0.3%
Bolivia	32,710	0.1%	9,837	0.5%	n.d.		1	0.3%	4	0.1%
Brazil	687,040	0.3%	14,437	0.8%	n.d.		3	1.0%	113	2.0%
Bulgaria	25,022	0.8%	978	0.1%	7	0.0%	3	1.0%	3	0.1%
Canada	841,216	1.2%	3,718	0.2%	1.904	3.9%	6	2.0%	107	1.9%
China	1,900,000	0.4%	n.d.		791	1.6%	8	2.7%	209	3.8%
Colombia	34,060	0.1%	4,775	0.3%	n.d.		1	0.3%	7	0.1%
Denmark	162,173	6.1%	2,677	0.1%	901	1.9%	15	5.0%	109	2.0%
Estonia	133,779	14.8%	1,431	0.1%	12	0.0%	2	0.7%	5	0.1%
Ethiopia	140,475	0.4%	122,359	6.8%	n.d.		1	0.3%	13	0.2%
Finland	188,189	8.2%	4,114	0.2%	120	0.2%	8	2.7%	53	1.0%
France	975,141	3.6%	23,135	1.3%	3.756	7.8%	15	5.0%	109	2.0%
Germany	1,015,626	6.1%	22,506	1.3%	7.590	15.7%	58	19.3%	187	3.4%
Ghana	19,893	0.1%	3,464	0.2%	n.d.		1	0.3%	15	0.3%
Greece	309,823	3.7%	21,274	1.2%	58	0.1%	6	2.0%	45	0.8%
Hungary	124,402	2.9%	1,433	0.1%	n.d.		6	2.0%	4	0.1%
Iceland	8,246	0.4%	39	0.0%	n.d.		1	0.3%	4	0.1%
India	1,084,266	0.6%	547,591	30.6%	46	0.1%	16	5.3%	94	1.7%
Indonesia	74,034	0.1%	8,612	0.5%	n.d.		1	0.3%	9	0.2%
Iran	43,332	0.1%	6,120	0.3%	n.d.		4	1.3%	29	0.5%
Iraq	n.d.		n.d.		n.d.		1	0.3%	n.d.	
Italy	1,096,889	8.6%	42,041	2.3%	1.720	3.6%	19	6.3%	101	1.8%
Japan	9,401	0.2%	2,137	0.1%	1.000	2.1%	1	0.3%	52	0.9%
Kenya	4,969	0.0%	12,647	0.7%	0	0.0%	1	0.3%	36	0.6%
Luxembourg	3,720	2.8%	96	0.0%	68	0.1%	1	0.3%	n.d.	
Morocco	17,030	0.1%	120	0.0%	n.d.		1	0.3%	4	0.1%
Netherlands	47,205	2.5%	1,672	0.1%	761	1.6%	8	2.7%	120	2.2%
New Zealand	133,321	1.2%	1,365	0.1%	205	0.4%	1	0.3%	105	1.9%
Nigeria	9,473	0.0%	597	0.0%	n.d.		14	4.7%	64	1.1%
Norway	55,500	5.4%	2,725	0.2%	160	0.3%	7	2.3%	43	0.8%
Philippines	96,317	0.8%	3,010	0.2%	n.d.		1	0.3%	37	0.7%
Poland	609,412	3.9%	23,430	1.3%	120	0.2%	2	0.7%	26	0.5%
Portugal	201,054	5.8%	2,434	0.1%	21	0.0%	6	2.0%	20	0.4%
Slovenia	32,149	6.6%	2,363	0.1%	38	0.1%	1	0.3%	10	0.2%
South Korea	19,312	1.0%	13,376	0.7%	343	0.7%	2	0.7%	18	0.3%
Spain	1,621,898	6.5%	32,195	1.8%	965	2.0%	8	2.7%	150	2.7%
Sri Lanka	19,496	0.8%	403	0.0%	n.d.		3	1.0%	8	0.1%
Sweden	480,185	15.4%	5,508	0.3%	885	1.8%	4	1.3%	98	1.8%
Switzerland	123,000	11.7%	6,060	0.3%	1.411	2.9%	15	5.0%	71	1.3%
Syria	19,987	0.1%	2,458	0.1%	n.d.		1	0.3%	11	0.2%
Tanzania	115,022	0.3%	145,430	8.1%	n.d.		1	0.3%	14	0.3%
Tunisia	178,521	1.8%	2,396	0.1%	n.d.		1	0.3%	7	0.1%
Turkey	442,582	1.8%	2,396	0.1%	n.d.		7	2.3%	73	1.3%
Uganda	228,419	1.6%	188,625	10.5%	n.d.		4	1.3%	11	0.2%
UK, Great Britain	638,528	4.0%	4,650	0.3%	1.882	3.9%	10	3.3%	88	1.6%
USA	1,948,946	0.6%	12,941	0.7%	21.038	43.6%	4	1.3%	77	1.4%
Vietnam	23,400	0.2%	4,385	0.2%	n.d.		2	0.7%	20	0.4%
Sum	32,381,606	100%	1,339,972	100%	48.244	100%	300	100%	2.660	100%
Share of World	87%		75%		99%		100%		48%	

1) Data from IFOAM/FibL survey "Statistics of the Organic World". 2013; 2) Number of papers accepted for the 4th ISOFAR organic congress 2014.
3) Papers found in scientific journals with impact factor, search done in June 2014 in the Web of Science with the keywords „organic farming" and „organic agriculture" with Endnote® software; n.d.: no data

Scientific board (coordinators)

Prof. Dr. GEROLD RAHMANN, Thuenen-Institute, Germany
Prof. Dr. UYGUN AKSOY, EGE-University, Turkey

Lists of reviewers (international: ISOFAR)

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Lists of reviewers (international: ISOFAR) (continued)

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Lists of reviewers (host country; Turkey)

Titel	First name	Last name	Organization	Country
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Prof. Dr.	Ahmet	Altındişli	Ege University, Dept. of Horticulture,	İzmir
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Prof. Dr.	Sevgi	Çalışkan	Agricultural Sciences and Technologies Faculty,	Niğde
Assoc. Prof.	Kürşat	Demiryürek	19 Mayıs University, Dept. of Agricultural Economics,	Samsun
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Prof. Dr.	Yüksel	Tüzel	Ege University, Dept. of Horticulture,	İzmir
Dr.	Sabiha	Ünal	Ministry of Food Agriculture and Livestock,	Ankara

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Developing an organic research agenda with stakeholder involvement promotes increased relevance in research

MARIA WIVSTAD[1], PELLE FREDRIKSSON[1], EVA SALOMON[1], CECILIA SUNDBERG[1], KARIN ULLVÉN[1]

Key words: research strategy, research priorities, participatory approach

Abstract

A Swedish organic research agenda was developed by the knowledge centre EPOK, Centre for Organic Food and Farming, at the Swedish University of Agricultural Sciences in an open and transparent process involving a broad range of stakeholders in the food chain. The methods for developing the agenda include workshops with different actors and within different themes. Through a web-based questionnaire further knowledge needs and research priorities were gathered and complied into five focal areas: 1) High productivity with maintained sustainability, 2) Innovative production systems with many functions, 3) Closed-loop cycles and renewable resources, 4) Sustainable enterprises and market development, 5) Healthy food with added value, and three cross-cutting themes: 1) Robust systems, 2) Added value for the environment and society, 3) Competitiveness and thriving rural communities. It was concluded that the participatory approach used when forming the agenda has prepared for increased stakeholder involvement in coming research projects. A successful approach has also been the early involvement of research funding bodies, which has resulted in research calls giving priority to the knowledge gaps addressed in the agenda.

Introduction – a new Swedish research agenda

EPOK has developed a research agenda in an open process together with interested parties in the food chain (EPOK 2013). The main aim of the research agenda was to provide a well-supported document which would enable decision makers and research funding bodies prioritise future research calls. According to an evaluation of organic research in Sweden (Formas 2006) a continued public support to research in this area is recommended, which could be justified by the public goods that organic farming provides; e.g. increased biodiversity, decreased use of chemical plant protection products and benefits for animal welfare (e.g. Jordbruksverket 2012). According to an extensive scientific literature there are supporting evidence for organic agriculture being beneficial for society and the environment in a number of ways (e.g. Gomiero *et al.* 2011), although there are drawbacks and a need for improved performance concerning for example yield levels (de Ponti *et al.* 2012, Seufert *et al.* 2012).

Organic farming is known to be a knowledge intensive production system and there is a strong need for research to develop new knowledge and innovations to achieve increased productivity and sustainability. Furthermore, many of the research goals defined in national and international research strategies for organic agriculture also address questions of relevance for sustainable development of agriculture in general. Investing in research on organic systems can thus be seen as investing in an innovation system to achieve an overall increased sustainability of our food systems (TP Organics 2009, ICROFS 2012).

Methods for developing the agenda

Workshops discussing stakeholders' knowledge requirements and defining prioritised research topics, both short- and long-term, were arranged with participants from public authorities, industry, and producer and advisory organisations. EPOK also attended farmers' and advisors' meetings and seminars where the participants got the opportunity to contribute with their most important problem areas concerning organic crop and livestock production.

A dialogue with researchers and agricultural research funding bodies was an important part of the process forming the agenda. The dialogue with funding bodies; the research council Formas, the Swedish Farmers' Foundation for Agricultural Research, SLU Ekoforsk at the Swedish University of Agricultural Sciences and the Swedish Board of Agriculture, was central as the agenda was developed by EPOK, which works with communication activities and research cooperation, but is not involved in the funding of research. The Swedish organic research agenda was highly demanded by the funders. as a broad view of actual knowledge gaps and research priorities concerning organic food and farming was missing.

[1] Centre of Organic Food and Farming (EPOK), Swedish University of Agricultural Sciences, Sweden, www.slu.se/epok, eMail: maria.wivstad@slu.se

EPOK also sent out a questionnaire about research priorities to complement the other activities, which resulted in responses from 15 research departments at the Swedish University of Agricultural Sciences, 11 sector organisations, seven advisory organisations and two public authorities. A draft of the agenda was referred back to stakeholders for consideration and their standpoints were taken into account in the final agenda.

Results – an agenda with three cross-cutting themes and five focal areas

The agenda identified the most important future challenges and knowledge needs of the organic food chain on the road towards increased sustainability (EPOK 2013); efficiency and environmental and social benefits. Three cross-cutting themes were identified to describe the overall challenges that face organic agriculture and the organic food chain if production and consumption are to be developed and achieve an increased long-term sustainability:

'Robust systems' in biological, economic and social terms. Diversity and adaptability in time and space are keywords for robust systems. To achieve resilience in the widest terms, it is very important to create possibilities for interdisciplinary research.

'Added value for the environment and society' is the basis of the fundamental vision of organic agriculture and organic food systems. Credibility for positive contributions to different added values, e.g. environmental, animal welfare and food quality values, is essential and research is needed to both evaluate and improve the performance of the organic food system.

'Competitiveness and thriving rural communities' is a continuous challenge for organic food systems. This theme stresses the need to further develop policy instruments such as agri-environmental payments. Both knowledge and communication of added values need to be improved throughout the food chain to get acceptance for premium prices.

Based on the three overarching themes five prioritised focal areas were pointed out in the research agenda including examples of specific research questions:

'High productivity with maintained sustainability' Improving productivity without losing other values embraces a wide range of research questions. More stable crop production levels requires development of new crop protection methods, both direct methods against weeds, pests and diseases, and preventive measures. Feeding strategies based on regional produced feed in combination with grazing is another example of a research priority in the agenda.

'Innovative production systems with many functions' There is a need for developing new multifunctional system designs that support ecosystem functions such as carbon sequestration and biodiversity, while producing sufficient yields. Examples of research questions are new designs of intercropping with the purpose of increased resource use efficiency and livestock systems based on local feed that reduce climatic impact.

'Closed-loop cycles and renewable resources' Within this area there are many conflicting goals and it is urgent to investigate new possibilities and obstacles for achieving an expanded nutrient cycling, especially between urban and rural areas. Resource-efficient solutions for how local/regional energy production can be integrated with organic agriculture also need investigations, in particular solutions for production of biogas and the return of digestate to arable land.

'Sustainable enterprises and market development' A higher focus on economics research was demanded at several stakeholder workshops. Farmers need basis for planning concerning both production and market risks. Analysis of how the premium price could benefit businesses along the entire food chain is another prioritised issue. Furthermore knowledge is needed about consumer priorities of different added values.

'Healthy food with added value' There is a great knowledge gap on health effects of organic food. The underlying mechanisms affecting the characteristics of different food and the relation to production methods need more understanding. New ways of market communication need to be developed in our complex food market to help consumers make informed choices.

Many stakeholders put strong emphasis on higher priority of participatory approaches in research projects. This approach promotes innovation and adaptation of research results to a diversity of farming systems. The approach also increases possibilities for successful implementation and boosts cross-disciplinary understanding and cooperation.

In some of the focal areas in the research agenda that aim at solving applied questions in the organic production systems running today, stakeholder interactions were especially proposed, for influence of e.g. experimental designs and for strengthening innovations for new management solutions adjusted to local contexts.

Discussion

An open and transparent process promotes the credibility of the agenda for policy makers, research funders as well as for agricultural stakeholders. The need for more cooperation between research and stakeholders in the food chain in order to increase societal benefits of research is increasingly being discussed (e.g. TP Organics 2010). The including approach, engaging stakeholders in the food chain as well as the research parties, gives potential to bridging gaps between science and practice. It enables a broad view of the need for new knowledge in the organic food chain, from primary production and marketing questions to the performance of organic agriculture in respect of beneficial contribution to environment and society. The approach also increases the awareness of knowledge gaps and needs of different stakeholders, leading to a better understanding of the challenges in the broad area of knowledge building, knowledge transfer and the development of sustainable food systems.

The work with developing the agenda could be seen as part of a large research process. Starting participatory actions when formulating research priorities in the agenda, establishes opportunities for increased stakeholder involvement in research projects that follows.

A number of workshops with researchers were arranged in the beginning of 2013 in different parts of Sweden to present the finalised agenda. The discussions had the aim of increasing researchers' awareness of knowledge needs in the Swedish organic food chain and also about the main problems that need to be solved for more well-functioning organic food and farming systems. The workshops attracted researchers from a wide range of disciplines, offering ideas of new research topics. The events did also function as a meeting place for cooperation with new partners, both within and between disciplines.

The development of the agenda was initiated in cooperation with the main agricultural research funders in Sweden, both public and private, which was important for a successful implementation concerning funding of organic research. In accordance with the overall aim of the agenda, it has been used as a basis for research calls during 2013 and early 2014, which refer to the whole agenda or select some topics from the agenda depending of the scope of the call.

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Use of digestate from Swedish biogas production in organic agriculture – possibilities for efficient plant nutrient recycling

EVA SALOMON[1], MARIA WIVSTAD[1]

Key words: feedstock, fertiliser, losses, nitrogen, phosphorus, utilisation

Abstract

For farmers to be interested in the digestate as a fertiliser, it must be certified for organic production, have a high plant nutrient content and be suitable for handling with best available knowledge and techniques. Co-digestion of solid and liquid organic residues can be a way to convert a relatively large proportion of the organic N into directly plant-available N in the digestate. During handling of the digestate there is a high risk of N losses. A covered storage and mixing the digestate thoroughly into the soil immediately after spreading efficiently minimise ammonia N losses. Of all animal manures in Sweden, a fraction containing 28 and 38 percent of total N and phosphorus (P), has the economic and technical potential to be digested. Source-separated food and toilet waste are organic residues containing a small proportion of N and P from an agricultural perspective. However, introducing source-separating systems can be the first step in achieving high-quality digestate.

Introduction

In recent years, about 50 small-scale biogas plants have been constructed due to an investment subsidy of 30% for farm enterprises on which animal manure corresponds to at least 50% of the feedstock to the biogas reactor. The political objective was to decrease the climate impact by producing bioenergy that can replace fossil energy. Swedish agriculture contributes 14% of the national climate impact, but the emissions mainly comprise methane from animals and manure, nitrous oxide from soils and carbon dioxide from soils with high organic matter content (SCB, 2012). This means that focusing solely on producing biogas from organic materials will not significantly decrease the climate impact from agriculture or reduce other negative environmental effects. An example of this is leaching of nitrogen (N) and phosphorus (P) to waters, causing eutrophication, where agriculture contributes almost half the total losses from Sweden.

The principle of organic agriculture, i.e. adapting production systems to local conditions and basing production on a high degree of re-use of resources such as plant nutrients, can also be applicable to biogas plants, creating conditions that promote high resource utilisation. Organic agriculture can be a driving force in the development of biogas production systems, both as a producer of feedstock to the biogas plant and as a user of digestate in crop production. Through a Swedish certification system, it is possible to label digestate for use on organic farmland (ISSN1103-4092, November 2012). So far digestate from a few biogas plants has been approved in Sweden. However, the trust in a certification system depends on meeting a variety of quality requirements.

Another challenge is to design biogas production systems that support more efficient plant nutrient recycling in agriculture, promoting secure yield levels and decreasing N and P losses. One important requirement is to develop resource-efficient technology in these kind of systems.

We have conducted an extensive review of current knowledge and experiences regarding the possibilities for use of digestate from biogas production on organic farms in Sweden to improve plant nutrient recycling (Salomon and Wivstad, 2013). The main findings of this review are presented below.

Material and methods

Potential amounts of N and P that can be circulated within the near future were quantified for different organic materials that can be biodigested. Some organic materials cannot be used today in biogas production if the digestate is to be certified for use in organic crop production.

Calculations were based on animal manure volumes produced in 2009 on Swedish pig and cattle farms with at least 100 animal units, which is estimated to be the volume required to reach the technical and economic optimum of a biogas plant (Luostarinen, 2013). Of course several farms can cooperate and pool their animal manure, but transporting manure between farms will require a hygienisation step. Horse manure from enterprises with less than 2 hectares of crop production was included, as these enterprises currently have to pay to get rid of the horse manure and are thus positive to other uses. All solid manure from poultry was

[1]EPOK –Centre for Organic Food and Farming, Swedish University of Agricultural Sciences, Sweden, www.slu.se/epok, eMail: eva.salomon@jti.se

included in the calculations, irrespective of transport distance, because the methane potential per ton solid manure is 5- to 10-fold higher than that of liquid manures.
The potential amounts of N and P from digested plant materials originating from agriculture, parks and gardens are more difficult to estimate. Possible plant materials are plant residues and catch crops, or materials discarded in subsequent handling and processing steps (Linné et al., 2008; Wivstad et al., 2009). Straw litter was excluded, as harvested straw is included in the amounts of animal manures.
The potential amounts of N and P from food consumption are mainly found in human urine and faeces. However, source-separated urine or blackwater (mix of urine, faeces, water and toilet paper) may not be used as fertiliser in organic agriculture. The amounts available in the near future were estimated based on upgrading of sewage systems to legal standard by installing source-separating blackwater systems in those households not fulfilling the law today, which corresponds to 1.8 million Swedish households (Jönsson et al., 2012).
The potential amounts of N and P from food residues will increase in future, because 84% of municipalities in Sweden have introduced, or plan to introduce, source separation systems. It is expected that within the near future, about 40% of food residues and the N and P contained therein can potentially be collected and used for biogas production (Jönsson et al., 2012).

Results

The potential amounts of N and P from animal manures that were available for biogas production corresponded to 28% and 38%, respectively, of the total amounts in animal manures in Sweden. The potential amounts of N and P from digested animal manures corresponded to more than 66% of the total potential amounts (Figure 1). On a per species basis, 34% of all manure from cattle, 81% from pigs, 100% from poultry and 29% from horses could be digested.
The potential amounts of N and P in plant materials represented the second largest source, while the N and P in source separating sanitation systems and food residues represented smaller proportions (Figure 1).

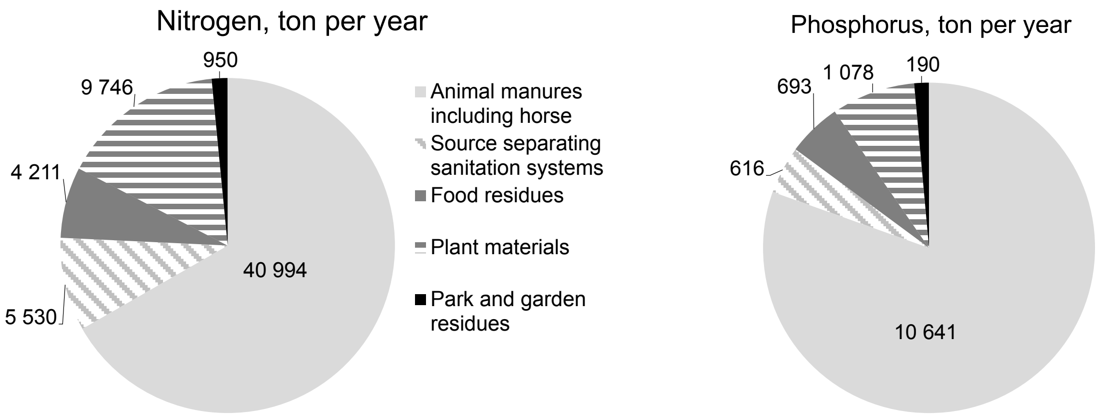

Figure 1. Potential amounts of N and P in different feedstocks for digestion.

Discussion

Our analysis shows that animal manures are the largest potential N and P source for recycling from biogas production. Manures produced on farm enterprises are currently circulated back to arable land and included in the plant nutrient cycle, which means that basic knowledge and experience exist. The question is whether production of biogas with manures as feedstock can allow more efficient plant nutrient recycling. Solid manure contains a high content of carbon, corresponding to almost 25% of total methane potential in animal manures. It would therefore be interesting to develop technology for digestion of solid manures. Mixing solid and liquid feed in the biogas plant would also produce a liquid digestate with physical properties that permit the use of precision techniques for dosing plant nutrients according to crop demands. Using solid manure or other fibre-rich materials with current handling and spreading techniques makes it more difficult to achieve good synchronicity between nutrient release and crop uptake. The objective of good animal welfare and high N use efficiency can interact positively when solid manures are digested, because it requires litter bedding to be used in animal houses. The main technical difficulties concerning digestion of fibre-rich feedstock is that it requires pre-treatment to produce a more decomposed material that is easy to mix with other feedstock and the development of energy-efficient, reliable equipment (Sindhöj and Rodhe, 2013).

Another challenge is to minimise plant nutrient losses during handling of digestate, since otherwise the potential for improvement compared with using animal manure directly is lost. Measures should focus on minimising N losses in the form of ammonia (NH_3-N), which contribute to acidification and eutrophication of aquatic systems. Part of the ammonia also becomes nitrous oxide after conversion in the N cycle. The pH of the digestate is about 8, which increases the risk of ammonia losses during storage and spreading. In order to reduce ammonia losses from storage, the digestate must be covered. Ammonia losses during spreading of digestate can be minimised by quick, thorough incorporation into soil. To achieve high use efficiency of N and other plant nutrients, the plant nutrient content of the digestate must be analysed before planning fertilisation. In addition, the digestate must be applied at a time when the crop can utilise the plant nutrients it contains.

Can biogas production improve the distribution of plant nutrients geographically? The biogas industry and large livestock farms have a growing interest in reducing transport costs by using processing techniques to reduce volume and increase plant nutrient concentration in feedstock to the biogas plant and in the digestate. Little information is available about how these techniques are actually used, their energy efficiency and whether losses of N and P to ecosystems are significantly decreased.

One possibility for recycling N and P from humans to crop production is to develop source separation systems, including a hygienisation step. This will require the development of quality control systems, logistics, cooperation and trust-building between different operators. The main long-term advantage is in the societal perspective, since a source-separating system for toilets can reduce the N and P loads reaching waters with today's wastewater treatment systems.

One strategy for producing plant material to feed the biogas plant is to choose crops that add value to the agroecosystem. A promising option would be cooperation between organic farms to invest in a biogas plant. Farms with a crop rotation that includes rotational clover/grass ley could use forage of lower quality to feed the biogas plant and receive digestate in return. Dairy farms might be interested in buying local feed and forage of high quality and supplying animal manures to feed the biogas plant. The environmental benefit of this system depends on whether the bioenergy produced can fully replace fossil fuels.

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Using clover/grass silage as a protein feed for dairy bull calves

BIRGITTA JOHANSSON[1], ANNA HESSLE[1], KARL-IVAR KUMM[1]

Key words: clover silage, protein, dairy bull calf, feed intake, live weight gain, profitability

Abstract

Calves need high concentrations of protein with high protein quality in their feed ration for proper growth. Soya bean meal is widely used in the world as a protein feed of good nutritional quality but the environmental impact of the cultivation of the beans are often questioned. Home grown or locally produced feeds, such as nitrogen fixating forage and grain legumes as well as rapeseed products, are shown to give less contribution to environmental problems than imported feeds. The objective of the study was to compare dry matter intake, live weight gain, feed efficiency and profitability in calves fed two levels of forages with high inclusion of red clover together with two different amounts of rapeseed cake vs. soya bean meal. Soya bean meal gave the highest live weight gain and the best profitability. However, a greater amount of rapeseed together with clover/grass silage also gave a good live weight gain and profitability, close to the results for soya bean meal.

Introduction

Feeding high levels of forages to ruminants is consistent with organic production. However, calves need high concentrations of protein with high protein quality in their feed ration for proper growth. Nitrogen fixating forage and grain legumes as well as rapeseed products can be used. Forage legumes have many advantages, not at least environmentally, but feeding forage legumes only may result in low weight gain as the protein in forages have a high proportion of rumen degradable protein. However, feeding forage legume silage has been shown to increase dry matter intake (DMI) and an accompanying higher live weight gain (LWG) in growing cattle compared to grass silage (Dewhurst et al. 2009). Locally produced feeds other than forage legumes, such as rapeseed, are shown to give less contribution to environmental problems than imported feeds (Flysjö et al. 2008). Soya bean meal is widely used in the world as a protein feed of good nutritional quality but the environmental impact of the cultivation of the beans are often questioned and, furthermore, hexane extracted soya beans are not allowed in organic production. The objective of the study was to compare DMI, LWG, feed efficiency (FE) and profitability in calves fed two levels of forages with high inclusion of red clover together with rapeseed cake (CRC) vs. soya bean meal (SBM).

Material and methods

The experiment was carried out at Götala Beef and Sheep Research Station, Swedish University of Agricultural Sciences, Skara. Dairy bull calves (79 Swedish Red and Swedish Holstein) were used in a randomized design. The protein feeds studied were red clover (Trifolium pratense)/grass silage (50% each) combined with either smaller amounts of CRC (treatment CGRS; 0.20 kg per animal and day) or greater amounts of CRC (treatment CGRG; 0.46 kg per animal and day), which were compared to imported SBM. The DMI and FE were recorded at a pen level (four pens, each with seven calves, per treatment) while LWG was recorded on the individual calves. The calves were weighed regularly and averaged 94 kg in live weight at the start of experiment, and ended simultaneously at 202, 267 and 290 kg for CGRS; CGRG and SBM, respectively. A total mixed ration (TMR) consisting of grass silage (90% grass, 10% clover), rolled barley and vitaminised minerals, together with either CGRS, CGRG or SBM, was fed to the calves. Feed was offered ad libitum once a day. Diets were rebalanced four times according to changed nutrient requirements during time and subsequent increased live weight. Nutrient composition in DM of the grass silage, the clover/grass silage and concentrates were analysed by conventional methods (Table 1). Analyses of DMI and FE were done with PROC GLM and the model included treatment, whereas PROC MIXED was used for analyses of LWG and the model included treatment and calf nested within pen (SAS 2003). Results with a *P*-value lower than 0.05 were considered as significant and results with *P*-values between 0.05 and 0.10 were considered as tendencies to significance.

[1] Swedish University of Agricultural Sciences, Department of Animal Environment and Health, Sweden, www.slu.se/husdjurmiljohalsa, eMail: birgitta.johansson@slu.se

Table 1. Nutrient composition (means) of grass silage, clover/grass silage and cold-pressed rapeseed cake and soya bean meal used in the experiment, shown as g kg^{-1} dry matter (DM) if nothing else is stated

	Grass silage	Clover/grass silage	Rapeseed cake	Soya bean meal
DM (%)	40	33	89	86
ME (MJ kg^{-1} DM)	11.2	10.8	16.2	14.0
Crude Protein	124	144	330	523
Crude Fat	na	na	199	25
Ash	63	83	64	65
NDF	522	410	235	138

ME - metabolizable energy
na – not analysed

The profitability was calculated as value of calf growth less cost of feeds consumed at 2013 price level in Southern Sweden. In sensitivity analyses different prices were used. It was supposed that differences in calf weights at the end of the experiments would remain until slaughter as young bulls at 18 months of age. Thus, the value of kg calf growth was calculated as carcass price multiplied by dressing percentage.

Results

Feeding clover/grass silage with a small amount of CRC (CGRS) resulted in lower DMI, LWG and FE than feeding a greater amount of CRC (CGRG) or the SBM diet (Table 2). Feeding the calves CGRG gave the same DMI as the SBM diet, but lower LWG and FE. The intakes of metabolisable energy (ME), crude protein (CP) and neutral detergent fibre (NDF) were the same for CGRG and SBM calves but the intake of NDF in percentage of live weight was higher for the CGRG calves, which might have reduced their total intake in comparison to the SBM calves. The diets in the trial were not balanced to be isonitrogenic as we wanted to test the possible weight gain with feeding high levels of forage, and the forage percentage was 54, 66 and 84 for the SBM, CGRG and CGRS calves, respectively. The forage level in CGRG is consistent with organic standards and the daily LWG was just 0.13 kg lower with rapeseed cake and clover/grass silage as the only protein source, than the LWG in SBM calves.

Table 2. Average daily intake, average daily live weight gain and feed efficiency of bull calves fed diets containing either clover/grass silage with smaller amount of cold-pressed rapeseed cake (CGRS), clover/grass silage with greater amount of cold-pressed rapeseed cake (CGRG), or soya bean meal (SBM), means and standard error of the means (SEM)

	CGRS	CGRG	SBM	SEM	*P*[1]
Intake of dry matter (kg day^{-1})	3.95a	4.94b	4.99b	0.141	***
Intake of dry matter (% of live weight)	3.12a	3.02a	2.83b	0.048	**
Intake of NDF (kg day^{-1})	1.45a	1.74b	1.77b	0.048	**
Intake of NDF (% of live weight)	1.11a	1.03b	0.97c	0.016	***
Intake of metabolizable energy (MJ day^{-1})	45.6a	60.8b	63.1b	1.76	***
Intake of crude protein (g day^{-1})	581a	722b	778b	22.5	***
Live weight gain (kg day^{-1})	0.717a	1.147b	1.279c	0.044	***
Feed efficiency (g gain MJ^{-1} ME)	15.7a	18.9b	20.2c	0.29	***

[1]** $P < 0.01$, *** $P < 0.001$, values on the same row that are significantly different ($P < 0.05$) have different superscripts (a, b, c).

Highest profitability per calf in the basic price situation had SBM. However, in organic production with SBM price above 0.90 EUR kg^{-1}, or with a combination of barley price above 0.28 EUR kg^{-1} and silage price below 0.11 EUR kg^{-1} DM, CGRG will become most profitable.

Discussion

The fact that calves fed CGRG had the same intakes of ME and CP as SBM calves, but lower LWG, is probably due to the high CP degradability in the rumen of the clover/grass silage. Feeding greater amounts of CRC gave a higher LWG than when calves were fed small amounts of CRC and it is possible that the rumen microbes of the CGRG calves produced more microbial protein that could be enzymatically degraded and absorbed in the small intestine. Feeding energy and protein at the same time is a way to optimize the protein utilisation (Børsting et al. 2003). In the present study total mixed ration feeding was used and thus energy and protein were offered simultaneously. Also, if the CP concentration in the clover/grass silage had been higher the LWG probably had been higher.

Rearing of organic dairy bull calves can be contradictory, using calves with a high need for quality protein at the same time as a high intake of forage (>60% up to 6 months of age) is required. Forage legumes contain more crude protein than grass, but with high rumen degradability of the protein. When legume forage is fed together with energy-rich cold-pressed rapeseed cake (CRC) the protein in the feeds can be utilized to a higher extent and a satisfactory calf weight gain can be achieved as shown. Using locally produced protein feeds instead of the often used soya bean meal (SBM) is of great interest not only in organic but also in conventional feeding because of environmentally advantages.

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Management of biomass resources within the crop rotation for eco-functional intensification on stockless organic farms

TORA RÅBERG[1], GEORG CARLSSON[1], ERIK STEEN JENSEN[1]

Key words: nitrogen, anaerobic digestion, cropping system, biomass, stockless system, multifunctionality

Abstract

The present study investigates if a cropping system can be designed to produce both high-quality food crops and biogas substrates in synergy with strategic recycling of the nutrient-rich digestate within the system, while considering environmental quality and climate change.

The comparison of three different management systems indicated an increase in food crop productivity when the digestate was used to fertilize the nitrogen demanding crops, in comparison to directly supplying the crop with ensiled biomass or incorporation of biomass in situ. The preliminary results show that it is possible to produce high yields of food crops and use the residual biomass to produce biogas as well as strategically recycle the digestate, without excluding the production of any of the three.

Introduction

There is a need to optimize the use of agricultural land, considering the increased competition for food or energy production (Harvey and Pilgrim, 2011). Farmers may use green manure based on N_2 fixing legumes for supplying nitrogen (N) to stockless organic systems. The practise is often problematic, since significant amounts of N can be emitted as the crop is cut and left as mulch (Larsson et al. 1988) or incorporated into the soil (Baggs et al. 2000).

The aim of this study was to determine the effects of strategic application of a biogas digestate from biomass resources (ley, harvest residues and catch crop) derived from the same system. The application of digestate was compared to *in situ* or redistributed placement of the equivalent biomass resources. Our hypothesis was that anaerobic digestion of biomass and recycling of the digestate will lead to improved resource use efficiency in terms of crop yield per land area, compared to incorporating the biomass directly into the soil.

Material and methods

The experiment was established in 2012 on arable land with sandy loam, included in an organic certified cropping system at the Swedish University of Agricultural Sciences in Alnarp, Sweden (55° 39′ 21″N, 13° 3″E). The anaerobic digestion of ley, catch crops and crop residue in the system, was made in collaboration with Lund University using a leach bed reactor. The pre-crop was ley and the field was fertilized with digestate at the start of the establishment. The choice of crops and design of the crop rotation was made with the ambition to yield food products and allow for an additional production of biomass for efficient nutrient recycling (Table 1).

[1] Department of Biosystems and Technology, Faculty of Landscape Architecture, Horticulture and Crop Production Science, Swedish University of Agricultural Sciences, Sweden, www.slu.se/bt,
e-mail: tora.raberg@slu.se

Table 1. Composition of the crop rotation.

No in sequence	Main crop	Catch crop/winter crop
1	6 species ley (*Dactylus glomerata*, *Festuca pratensis, Phleum pratense, Melilotus officinalis, Medicago sativa, Trifolium pratense)*	6 species ley
2	White cabbage (*Brassica oleracea)*	Buckwheat (*Fagopyrum esculentum)* and oil radish (*Raphanus sativus*)
3	Lentil (*Lens culinaris*) (90%) and oat (*Avena sativa*) (10%) undersown with 3 species ley (*Lolium perenne, Trifolium repens* and *T. pratense.*)	3 species ley
4	Beetroot (*Beta vulgaris* var. *conditiva*)	Winter rye
5	Winter rye (*Secale cereale*)	Buckwheat and lacy phacelia (*Phacelia tanacetifolia*)
6	Pea (*Pisum sativum*) (80%) and malt barley (*Hordeum vulgare*) (20%) undersown with 6 species ley	6 species ley

All of the six main crops were represented each year in separate experimental plots, each plot measuring 3 x 6 m. Each main crop was followed by an autumn or winter-growing crop, to reduce nitrogen leaching, reduce weeds and produce biomass during the autumn-winter season. Eighteen individual plots (six main crops x three treatments) within each of four replicate blocks were randomly assigned to one of the following biomass management treatments:

1) IS - Leaving the biomass resources *in situ* in the field.
2) BR - Moving the biomass resources to nitrogen demanding crops.
3) AD - Collecting the biomass resources for anaerobic digestion and using the resulting digestate for the nitrogen demanding crops.

The 6 species ley was harvested at four consecutive occasions: in June, July, August and September. The grain legumes and cereals were harvested at maturity while the harvest of cabbage and beetroot were based on optimal timing for high quantity and quality but also leaving sufficient time for establishment and growth of catch crops before winter. The biomass resources comprised straw from the grain legumes and cereals, leaves from cabbage and beetroots, and total aboveground biomasses of the ley and catch crops. The biomass was ensiled before application to the field in treatment BR and before the anaerobic digestion in treatment AD. The ensiled and digested biomass was applied to cabbage, beetroot and winter rye in equal proportions in the BR and AD treatments. The composition of the digestate from 2012, applied in the AD field plots in 2013, is presented in table 2.

Table 2. Composition of digestate from the anaerobic digestion reactor in 2012.

Liquid, total amount (kg)	2108,5
Solid residue, total amount (kg)	449
NH_4-N concentration (mg/L)	574
Total N concentration (mg/L)	4635
Phosphate concentration (mg/kg)	330
Potassium concentration (mg/kg)	2300
pH	7,4
Dry matter, total amount (kg)	79.4
Volatile substances, total amount (kg)	50.95

The effect of the different biomass management systems was measured in terms of total yield (food fraction + straw/residual leaves) of each crop, using the sum of mixed species in the intercrops (lentil/oat, pea/barley, ley).

Results

Nitrogen demanding main crops (rye, cabbage, beetroot)

The comparison of the three different management systems indicated an increase in yield when the digestate (AD) was used, but the difference was not significant, Fig. 1.

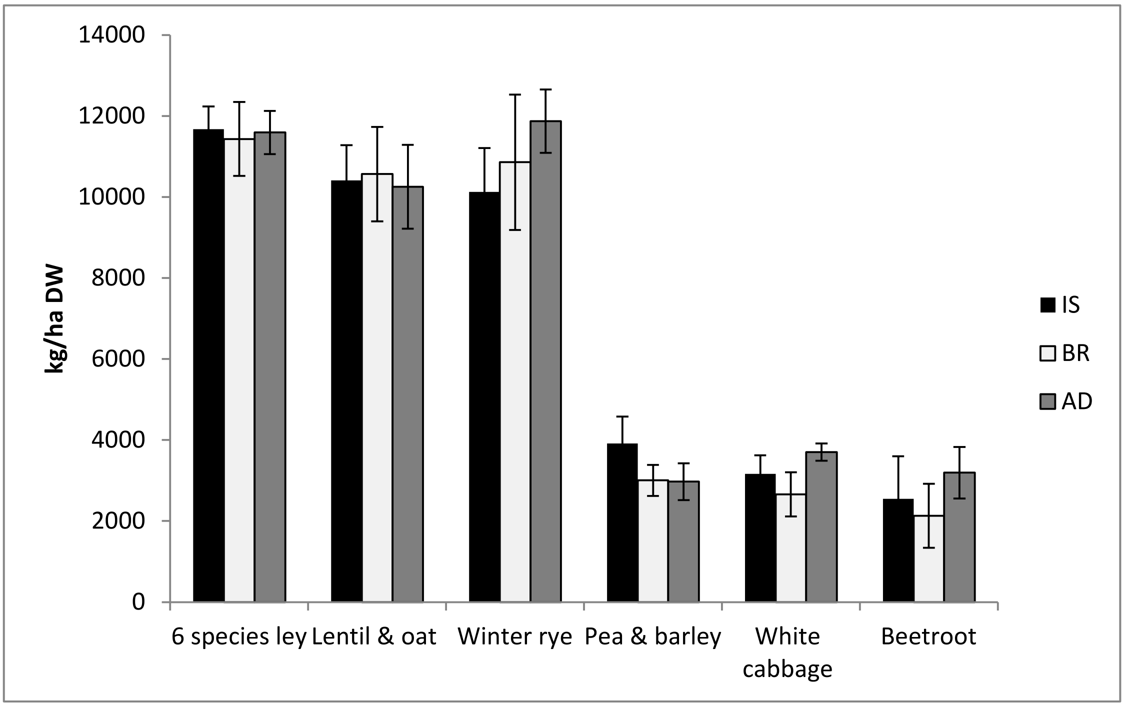

Fig. 1. The total biomass yield (dry weight) of the six main crops indicates an advantage of anaerobically digested biomass resources (AD) as compared to redistribution of the undigested biomasses (BR) to the nitrogen demanding crops (winter rye, white cabbage, beetroot), even though the differences were not statistically significant. The bars represent mean values +\- SEM of 4 replicates.

The cabbage and beetroot crops, which both followed pre-crops containing legumes, showed tendencies of higher yields in the IS treatment than in the BR treatment. Rye, on the other hand, which followed nitrogen demanding beetroot in the crop rotation, had the lowest yield levels in the IS treatment.

Intercrops with legumes (6 species ley, lentil/oat and pea/barley)

The main crops containing legumes did not receive any biomass resources or digestate except from in the IS treatment. The results indicate similar yield levels for these crops in the three treatments, *i.e.* no evidence for negative effects of removing nutrients with biomass resources as compared to the IS treatment, Fig. 1.

Catch crops (3 species ley, buckwheat/oil radish and buckwheat/lacy phacelia)

The yield of the under sown 3 species ley was highest in the AD treatment, both for the legume and the non-legume components (data not shown). The yields of the buckwheat/oil radish catch crop (following cabbage) showed very small differences between the three treatments, while the yields of buckwheat/lacy phacelia (following rye) tended to be considerably higher in the BR and AD treatments than in IS (not shown).

Discussion

The increase in yield of all nitrogen demanding main crops in the AD treatment, although not statistically significant, indicate high nutrient use efficiency after anaerobic digestion of biomass resources. The small yield difference between the three treatments in buckwheat/oil radish, following cabbage, may be explained by the addition of the nitrogen rich harvest residue from the cabbage crop in treatment IS. In contrast, the large yield difference between treatments in buckwheat/ phacelia, following winter rye, may be explained by a low N contribution from winter rye harvest residues in IS. It is possible that the observed tendencies will be enhanced after continuing the treatments during the next year in the crop rotation. Ongoing analyses will show how the studied biomass management scenarios influence the nitrogen use efficiency, food quality and environmental impact of stockless organic production.

In conclusion, the results presented here show that it is possible to produce food crops and use the residual biomass to produce biogas without lowering the food crop yields when using the digested biomasses for strategic nutrient recycling.

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The organic market in Europe – results of a survey of the OrganicDataNetwork project

HELGA WILLER[1], DIANA SCHAACK[2]

Introduction

This paper presents some of the results of the first European survey on detailed organic market data, which was carried out as part of the project "Data network for better European organic market information" (OrganicDataNetwork).3 The project runs from 2012 to 2014 and is funded under the European Union's Seventh Framework Programme for Research, Technological Development and Demonstration. The project aims to increase transparency in the European organic food market through better availability of market intelligence about the sector in order to meet the needs of policy makers and actors involved in organic markets.

Methods and materials

The survey on detailed organic market data was carried out between July 2012 and March 2013 (Willer & Schaack 2013), focussing on the data for 2011.4 It was led by the Switzerland-based Research Institute of Organic Agriculture (FiBL) and the Germany-based Agricultural Market Information Company (AMI). Most project partners contributed to the survey by sourcing organic market data from their own countries as well as from other countries for which they had agreed to take responsibility. The most important survey tools were an Excel questionnaire, a database designed by FiBL and AMI, and Excel PivotTables for data analysis, plausibility and quality checks, and data publication. Data were collected for all countries of the European Union (EU), the EU Candidate countries and the countries of the European Free Trade Agreement (EFTA).

The OrganicDataNetwork partners compiled the data from national data sources. Market data like production, retail sales, export and import data are collected with different methods in the countries of Europe, including surveys among companies, household and retail panel data, trade statistics, or experts' estimates (Feldmann and Hamm 2013). Data collection methods differ from country to country, and a wide range of classifications and nomenclatures is used; making data storage and processing a challenging task.

Results

The data show that the organic market in Europe was at 21.5 billion euros in 2011 (2012: 22.8 billion euros). Germany showed retail sales of 6.64 billion euros (2012: 7 billion euros). France held second place with 3.76 billion euros (2012: 4 billion). This market has shown a very dynamic growth in the past couple of years. In contrast, retail sales continued to fall in Ireland and decreased for the third consecutive year in the United Kingdom (1.88 billion euros; 2012: 1.95 billion euros). Italy's organic market was estimated at 1.72 billion euros (1.89 billion euros in 2012). The highest market shares with 6 percent and over were reached in Denmark, Austria, and Switzerland. The highest per capita consumption of organic food in 2012 was in Switzerland (189 euros), Denmark (159 euros), and Luxembourg (148 euros). The European Union, with 9 percent growth (6 percent in 2012) and a market size of 19.7 billion euros (2012: 20.9 billion euros) is the second largest single market in the world after the United States, which showed a market growth of 9.4 percent in 2011 (10 percent in 2012) to a market size of 21 billion euros (22.6 in 2012) (Schaack et al. 2014).

Whereas area data were available for all countries that were surveyed, domestic market values (in million Euros) were available for 34 countries, which provided the total organic sales for their countries (Figure 1). Of these, only 23 had an updated figure for 2011. Of the 34 countries that provided an overall value for their domestic sales, only 18 had a breakdown by product group. Thirteen countries have a figure for their total

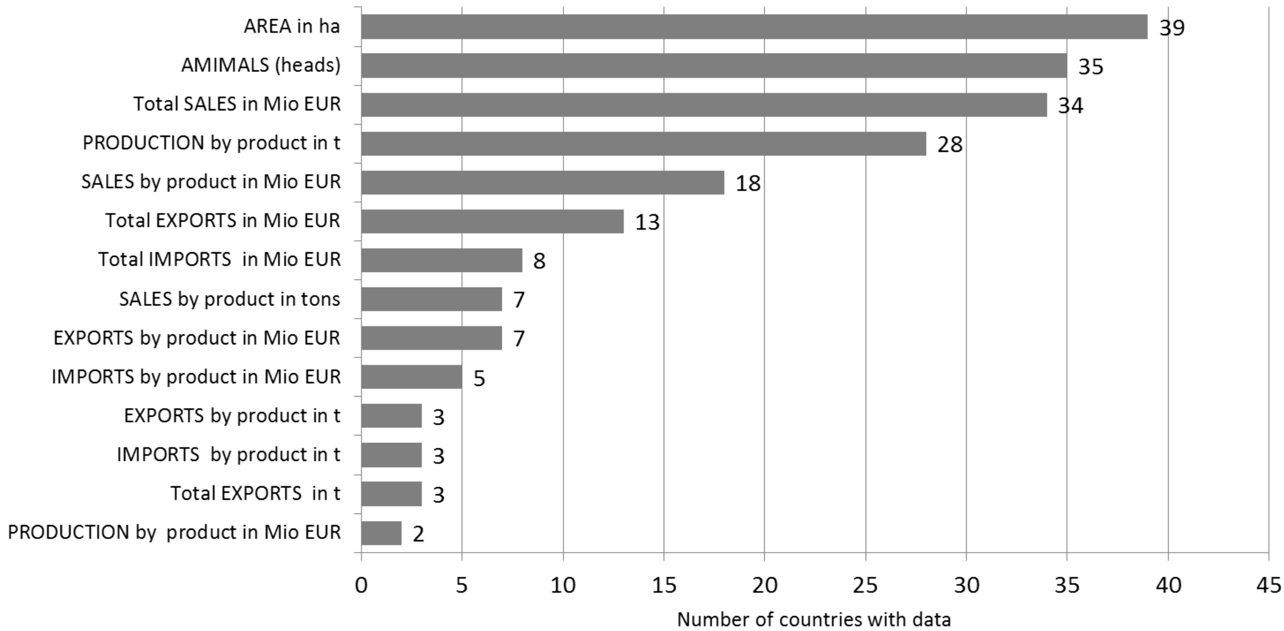
[1] Dr. Helga Willer, Research Institute of Organic Agriculture (FiBL), Ackerstrasse, 5070 Frick, Switzerland, helga.willer@fibl.org, www.fibl.org

[2] Diana Schaack, Agrarmarkt Informations-Gesellschaft mbH, Dreizehnmorgenweg 10, 53175 Bonn, Germany, www.ami-informiert.de

[3] The work for this publication was undertaken as part of the research project titled "Data network for better European organic market information" (OrganicDataNetwork). This project has received funding from the European Union's Seventh Framework Programme for Research, Technological Development and Demonstration under grant agreement no 289376. The opinions expressed in this contribution are those of the authors and do not necessarily represent the views of the European Commission.

[4] For this paper some data on key indicators for 2012, which became available during the revision phase of this paper (February 2014) were included.

exports (in value), and only 8 countries have a figure for their total import value. A breakdown by product is available only from 7 and 5 countries respectively. Export and import volumes in tonnes are only available from 3 countries.



Source: OrganicDataNetwork survey 2013 based on national data sources

Figure 1: Data availability by indicator in a European comparison (n=39)

Looking at the proportion certain organic products have **within** the organic segment, the OrganicDataNetwork survey has shown the following:

- Fruit and vegetables are the pioneer organic products in Europe. They now have shares between one third and one fifth of many national organic markets. They are especially strong in Italy, Ireland, Norway, Sweden, and Germany. All over Europe the organic market is dominated by fresh products compared to the conventional markets.
- In many countries and, in particular, in Northern Europe, animal products, especially milk and dairy products, constitute a high share of all organic products sold. Meat and meat products are very successful, with market shares of around 10 percent in Belgium, the Netherlands, Finland, and France. On the other hand, in many countries, meat and the meat product market is not yet well developed due to the lack of manufacturing capability and high price of surpluses compared to conventional products.
- Beverages, mainly wine, constitute an important part of the organic market and cover nearly 15 percent in France and Croatia.
- Hot beverages (coffee, tea, and cocoa) cover 3 to 5 percent of the organic market in many countries.
- Grain mill products, which are easily sold and stored in the supermarkets, have high shares in the Czech Republic, as well as in Finland and Norway.
- Bread and bakery products have high importance in the organic product range, making up around 10 percent of those in Switzerland, the Netherlands, France, Sweden, Finland, and Germany.

In terms of **market shares compared to the overall food market***,* eggs are one of the organic product success stories in many European countries. According to the OrganicDataNetwork survey, their market shares reach up to 20 percent in Switzerland and around 10 percent in most of the analysed countries. The sales of eggs reflect the high degree of consumer concern with regards to animal welfare and also show the readiness to pay relatively high price premiums. In Germany, for example, organic eggs have at minimum double the price compared to conventional eggs – one of the highest price surpluses among the organic product groups.

- After eggs, vegetables show the highest market shares of 8 to 12 percent in Switzerland, Austria and Germany.
- In many countries, dairy products reach market shares of about 5 percent. In Switzerland, they reach ten percent of all dairy products sold, in Denmark, 30 percent.
- Apart from that, single products can reach a much higher market share in the countries. Baby food or meat substitutes are good examples, because supermarkets do not offer conventional alternatives. Fresh carrots have a 30 percent market share in Germany.
- On the other hand, products like beverages and meat generally reach only low market shares. Often these products are highly processed and or very cheap in the conventional market.

In 2012, many European countries experienced further dynamic growth, and growth rates were similar to those in 2011 (final figures will be presented at the IFOAM Organic World Congress). Consumer interest in organic products remains high in most major markets, even though organic products have to compete more and more with other sustainability and regional labels. In spite of the difficult economic climate in some European countries, in which market shares are still low, consumer concern about the way food is produced is increasing.

Conclusions

The OrganicDataNetwork survey on organic market data has shown that a number of challenges need to be tackled in the future. These challenges include lack and incompleteness of data as well as classification issues as – other than with the area and production data – almost every country uses a different classification/ nomenclature for retail sales, export and import data, which makes harmonized data storage and country-to-country comparisons very difficult. Another issue is the use of different methods for data collection.

In spite of all issues, a number of results have been achieved that were not available before, in particular in relation to the retail sales data. These data show – in a European comparison - what products do best within the organic segment and how certain products and product groups perform in comparison with all products sold. The data show, for instance, that eggs are by far the most popular organic product across most countries that have such data, followed by vegetables, fruit, and dairy products. As regards international trade data, the survey has revealed that there is a major lack of such data and that conclusions regarding the European situation cannot be drawn.

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How to improve research communication in transnational projects

THOMAS ALFÖLDI[1], ADRIAN KREBS[1], HELGA WILLER[1] AND ULLA SONNE BERTELSEN[2]

Key words: dissemination tools, research impact, social media, CORE Organic

Abstract

A continuous dissemination process during the lifetime of a research project is important. However, it remains a challenge for many research consortia as dissemination of intermediate results might have negative consequences for publishing in peer-reviewed journals. Based on an analysis of the dissemination output of eight European research projects, we provide recommendations to researchers on dissemination tools and channels to ensure a continuous knowledge exchange and information flow. We also propose additional criteria to be considered by funding bodies when selecting and evaluating research proposals.

Introduction

Good research dissemination must define exploitable results, produce suitable dissemination tools and select the best dissemination channels in order to bring the key messages to the target groups.

Publications in peer-reviewed journals and other forms of written documents such as articles in popular journals or technical leaflets are traditionally the most frequently selected tools and channels for research dissemination (Poulsen 2010). Because consolidated research results are usually only available at the end of a research project, continuous dissemination activities during the lifetime of a project are not always ensured. We argue that new media, including blogs, YouTube videos, Facebook and Twitter, can help to create an arena for a potential target audience, raising awareness of the research project and assuring a continuous information flow.

The aim of this paper is to provide recommendations to researchers on how to improve the dissemination of their research. Furthermore we propose additional criteria for funding bodies to consider in call announcements and when selecting and evaluating research proposals.

Methods and materials

The recommendations made in this paper are based on a desk study that analysed the dissemination output of eight European research projects carried out under ERA-Net CORE Organic I (Coordination of European Transnational Research in Organic Food and Farming) between 2008 and 2011 (Alföldi and Weidmann 2013). Furthermore, this paper builds on the authors' expertise in research dissemination.

Results

The main results of the dissemination activities of the eight research projects carried out under CORE Organic I can be summarized as follows:

The dissemination plans in the analysed project proposals are all quite similar and standardized. Some consortia try to remain rather vague in order not to "promise" too many dissemination activities, and others present a well-formulated dissemination plan in order to improve their success rate.

The target groups were similar in all projects: farmers, advisors, researchers, and general public/consumers. Based on the number of scientific papers and participation in scientific conferences, all projects have reached the target group of researchers. Farmers, advisors and marketers respectively were partly reached if a project followed a participatory research approach, presented its results at relevant events such as BioFach or produced targeted dissemination material.

The dissemination output consisted mainly of written information, especially scientific articles, workshops and participation in scientific conferences. Compared to the number of scientific publications the number of articles in farmers' magazines was rather low. Not all projects produced popular articles in the national language of the partner countries. Five projects summarized their results in a technical leaflet or handbook.

[1] Research Institute of Organic Agriculture (FiBL), Switzerland, www.fibl.org thomas.alfoeldi@fibl.org

[2] International Centre for Research in Organic Food Systems (ICROFS), Denmark, www.icrofs.org

Additional tools such as press releases or newsletters were used only by some projects. None of the projects included social media or audio-visual tools. Most projects showed a clear potential for improvement.

Recommendations for research consortia

Just as research activities, dissemination activities have to been planned during the development of the research proposal. Ideally, this process will include stakeholders and start as soon as an outline of the planned research is available. This will help to improve the relevance of a research project. The European Commission (2012) provides useful information on how to develop a communication strategy for transnational projects.

Dissemination activities are usually concentrated at the beginning and at the end of a project. For most consortia, continuous dissemination remains a challenge. Researchers in general do not like to disseminate intermediate results because this might have negative consequences for publishing in peer-reviewed scientific journals. However, communication experts underline the importance of a continuous dissemination process during the entire lifetime of a project. The following dissemination tools and channels are discussed in relation to the improvement of continuous knowledge exchange and information flow.

Newsletters are recommended if a consortium already has well-established relations to a target group. The information is directly addressed to the target group and the information collected within the consortium can be used for further planning of dissemination activities. However, newsletters require time for editing and for collecting e-mail addresses, and they might reach only a very limited number of recipients.

Social media platforms like Facebook or YouTube as dissemination channels for a research project are still seen with scepticism by many researchers. Arguments against setting up a Facebook profile are: too time-consuming, too distractive or privacy problems. Here are some arguments for the use of Facebook (FB) as a dissemination tool: (i) unlike other social media platforms, FB is the most widespread and target groups like farmers, marketers or politicians are more likely to find you on FB; (ii) enterprises and universities are using FB, so why not research groups; (iii) FB allows you to build up a community of potential target groups; (iv) by posting photographs of activities in the field, your FB visitors are able to look “behind the scenes” of your project; (v) on FB, you maintain awareness of your project by providing insight into the on-going research and development activities and (vi) you can get feedback from your FB visitors.

Although there are few concrete examples, we are convinced that FB will be a suitable channel for projects with a practical and participatory approach.

Twitter is a suitable tool to specifically communicate with peer institutions. Many research institutions worldwide are present on this social media channel. Compared to FB, Twitter has a more professional image in the online communities. Twitter allows you to follow the most important institutions and persons without their agreement. On your timeline you can assemble a steady flow of information with an academic focus.

In contrast to FB, Twitter has a limited space of 140 characters per tweet. That means that there is hardly any space for unnecessary chatting, and there is almost always the need to have the full information in another place on the internet. You have to come to the point quickly and formulate your message in short words, often combined with a link to the project website with the extended version, or the respective paper or media release. Like FB, Twitter allows the upload of photos. Twitter is a perfect tool for high-speed on-the-spot dissemination of news from the scientific world.

Online videos are a powerful tool to provide insight into on-going research activities and to underline the relevance of research by providing practitioners a platform containing testimonials. Online videos may also be useful in areas of science where records of complex laboratory demonstrations, science documentaries or academic lectures might more effectively communicate scientific experiences than would prose (Kousha *et al.* 2012). Consortia can either hire professional video producers or produce a video on their own. According to Raven (2012), two qualities must be found in any good video: a steady camera shot by using a tripod and a clear, crisp audio by using a wireless external microphone. With today’s consumer equipment and editing programs for online videos, non-professional filmmakers are able to produce high quality videos. However they should have some basic training and consider the following recommendations: (i) keep your video short (2 to 5 minutes); (ii) prepare a story board including key messages; (iii) carefully select the people for interviewing, let them speak freely, but concisely; (iv) use a voice-over speaker if relevant messages need to be added and (v) add additional visual elements such as photographs and graphs.

It can be concluded that a coordinated mix of dissemination tools and channels (website, print, social media, media releases, direct communication and demonstration) will create the strongest impact. Furthermore, the impact of research results can be improved if dissemination material is co-produced and supported by organizations of the target groups such as organic farmers' associations or advisory services. Research output should flow into well-established media such as knowledge platforms, wikis or well-known series of technical guides or handbooks in order to achieve a sustained impact.

Recommendations for funding bodies

In the evaluation of proposals, a strong focus is set on scientific innovation, research methodology, and the consortiums' expertise. Dissemination needs specific skills and expertise. Just as for scientific expertise, dissemination expertise should be evaluated accordingly.

To improve the success rate of their proposals, consortia often maximize the amount of research conducted at the expense of the dissemination activities. As a consequence, resources for strong dissemination are often missing at the end of such projects. Therefore it is recommended that expertise in dissemination should be clearly demonstrated, and enough funds should be allocated for this purpose.

Funding bodies can improve the frame conditions for dissemination in the call description and the evaluation of proposals. The requirements for improved dissemination should be included in the guideline for applicants. Proposals should include a dissemination plan describing: (i) the target groups including their knowledge and dissemination needs; (ii) the relations of the project consortia with the target groups; (iii) how the exchange of opinions and data as well as of knowledge with the stakeholders will be organized during the research process and after completion of a project; (iv) the channels and tools to bring key messages to the target groups; (v) how a continuous dissemination flow during the project is ensured; (vi) how dissemination will be organized within the consortium; (vii) that enough funds and resources are allocated to the planned dissemination activities and (viii) the indicators by which the success of the dissemination activities will be measured (e.g. website visitors, numbers of press releases sent out, number of technical guides printed and distributed).

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Strategic options for sensory quality communication for organic products to different target groups and research needs

OTTO SCHMID[1]

Key words: organic products, sensory properties, consumer expectations, strategies

Abstract

In the EU-funded research project ECROPOLIS (www.ecropolis.eu) sensory properties and sensory profiles from organic products as well as consumer expectations were analysed in six European countries (CH, DE, FR, IT; NL, PL). Recommendations were made for processors, organic label associations, retailers and educational organisations, in particular through the interactive on-line data base OSIS (http://osis.ecropolis.eu). The product groups were: yoghurt, cookies, plant oils, salami, tomato sauce, and apples. There are mainly two areas, where strategic options can be developed: a) for the product development and b) for the sensory quality communication. Communication measures can emphasise the most preferred sensory attributes in order to better attract specific consumer segments. In those countries, where organic labelling has not a positive influence or even a negative image for certain products, attributes other than organic should be communicated. In a differentiation strategy more emphasis should be given on the communication of sensory differences and specific characteristics (e.g. specific traditional recipes).

Introduction

The taste of organic products is getting in the future a more important buying motive for consumers. This was the main rationale for the research done in the EU funded ECROPOLIS project, where several SME's and SME associations were involved. The project focussed on sensory properties of organic food by collecting and analysing data about sensory profiles from organic products and consumer expectations in six European countries (CH, DE, FR, IT; NL, PL). The main purpose of this project was to provide and exchange sensory information on organic food, in particular for organic label associations, producers, processors, retailers and educational organisations, in particular through the interactive on-line data base OSIS (http://osis.ecropolis.eu). The product groups were: yoghurt, cookies, plant oils, salami, tomato sauce, and apples.

This paper outlines strategic options for sensory quality communication and product development policies for different target groups as well as recommendations focussed on research for sensory quality product development and marketing (Schmid, 2011).

Material and methods

Different methods have been used such as literature review, analysis of regulatory framework, laboratory sensory profiling, consumer focus groups, consumer sensory testing. Details can be found in the different research reports of ECROPOLIS project (www.ecropolis.eu).

Results

Research work done in ECROPOLIS project has generated many findings and recommendations for different actors and for different product groups. The main focus is on strategic options for different actors. There are mainly two areas, where strategic options can be developed: a) for the product development; b) for the sensory quality communication. On a product development level a company or organisation can follow two main strategies: a. a standardisation or imitation strategy (product properties of market leader); and b. a differentiation strategy (e.g. with traditionally produced products). The strategic decision to determine what product type for which target group is developed and promoted in the organic market, needs a good knowledge of the attitudes, expectations and preferences of different consumers segments in a specific market. The consumer segmentation model developed in the ECROPOLIS project provides first insights into these issues (Obermove et al. 2011).

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

a. Recommendations for processors and SME's

The consumer testing showed several country-specific sensory preferences for all main product groups, which needs to be considered in the product development.

A standardisation strategy might be a first step in entering the market to ensure a constant demand, however could be risky for some product groups on the long run due to competition by other companies. In this strategy, it is important to ensure appropriate standardised sweetness, spiciness & dryness comparable with conventional benchmark products. Communication measures can emphasise most preferred sensory attributes in order to better attract specific consumer segments. In countries, where organic labelling has not a positive influence or even a negative image for certain products, attributes other than organic should be communicated.

In a differentiation strategy more emphasis should be given on the communication of sensory differences. Furthermore the use of specific ingredients or traditional recipes could be successfully supported by communication measures. How strong the organic origin will be communicated depends on the image of organic of the product group in the respective country as well as the presence of strong conventional brands and well known products. In the differentiation strategy it is also recommended to make consumer tastings in shops and offer training for sales staff. For some product groups like apples or plant oils it might be interesting to introduce special labelling systems, e.g. indicating the taste for different flavour groups.

b. Recommendations for SME-associations and label organisations

Generally the product development is not a core issue of SME associations and label organisations; however guidance can be given to related companies about consumer attitudes and preferences (e.g. from consumer and sensory research).

In a differentiation strategy particular additional requirements in standards or Codes of Practise could be developed to support the differentiation (dialogue with industry necessary). Other measures envisaged could be: taste awards, establishment of a sensory information system for market actors, information campaigns or tasting for product groups, in cases where the impact of organic standards are significant.

c. Recommendations for retailers

There are different strategies, which retailers and retail chain follow with regard to sensory quality. In a standardisation strategy it is important to communicate the added value of organic farming in different areas (not only sensory quality) in particular for product groups, where organic has a good image in the country. It is important that the retailers or retail chains give regularly a feedback to processing companies on consumer preferences to be used for product improvement.

In a differentiation strategy the retailer(s) or retail chain can develop further retailer-specific requirements for different product groups to support the differentiation (in cooperation with the processing industry, wholesalers and farmers organisations). Important other measures are: tastings at the point of sale; special communication system or labelling to highlight special tasty products at the point of sale.

d. Product group specific recommendations – the case of yoghurt

The kind of recommendations is illustrated with the case of yoghurt (Schmid, 2011).

Table 1: Strategic options for organic yoghurts in different countries with regard to product development and communication

YOG-HURT	Imitation / standardisation strategy	Differentiation strategy (freshness, authenticity)	Country specific issues
Product develop-ment	Standardised fat content (ensure creamy character).	Ensure freshness character through minimal processing (no double milk pasteurisation). Fruit yoghurts without flavours and colouring additives or extracts: reduce colour and flavour deficits by requiring special tasty fruit varieties or by mixing different fruits.	Different expectations regarding liquid on surface (e.g. IT yes, CH no). Creaminess: particular important in CH an PL.
Commun ication measu-res	Communicate: "organic is as good as standard products, but they are also organic", particular in countries with a positive image for yoghurts (DE, PL, and FR).	Communicate the paler colour of fruit yoghurts, e.g. strawberry yoghurt as sign of naturalness and authenticity. Make consumer tasting in shops (to explain and experience differences). Offer training for sales staff. Communicate freshness character (in DE and PL).	Preference for organic yoghurts in DE, PL, IT. Preference for conventional yoghurts in FR. Low influence of organic labelling in CH and IT: use other attributes then organic.

Sources: Schmid 2011, Buchecker et al. 2011, Cezanne et al. 2011, Obermove et al. 2011, Espig et al. 2011, Stoll et al. 2010

Countries: CH Switzerland, DE Germany, FR France, IT Italy, PL Poland.

e. Recommendations for training and educational institutions

In a country there might be different institutions capable and willing to support the development of the organic market and of sensory marketing. In most cases these might be a task of SME-associations and umbrella organisations to support their members in training and education. In general information about professional sensory analysis methods and product improvement methods should be provided.

Discussion of challenges and research needs for sensory quality development and communication

From a commercial point of view, integration of the range of sensory quality attributes in the product development and marketing shows a high potential in the market place. It will improve the added value of the organic products. Targeted research and development ideas could provide the basis for achieving this in a much better way.

One challenge in delivering commercially relevant results is to develop a commitment and interest in a mutually beneficial agenda with food businesses. Regular network meetings, exchanging knowledge derived from research and the implementation of research that responds directly to business needs would help.

Research that improves understanding of what motivates consumers based on their diverse expectations, the development of new business models and the identification of new added values could bring together the currently rather separated business and R&D communities. It would be desirable that research started in Ecropolis could be the starting point for innovative technological improvements of sensory deficits, even by linking the quality research with the agronomic field research looking at the impact of choice of varieties and cultivation techniques on the sensory properties.

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Fairness and satisfaction in business relationships: Results of a survey among Swiss organic farmers and buyers

MÜHLRATH D.[1], MÖLLER D.[1] AND SCHUMACHER J.[2]

Key words: fairness, satisfaction, buyer-supplier relationships, organic farming, Switzerland, organizational justice

Abstract

This paper presents results of a standardized online survey among Swiss organic farmers and their buyers on fairness and satisfaction in business relations. The majority of participating Swiss organic farmers and buyers is satisfied with its business relationships. Farmers not only expect their buyers to pay fair prices but also to act consistently, be transparent and invest in good personal relations. Buyers expect their agricultural suppliers to provide high quality products, be reliable and transparent while fair prices are mentioned less frequently. Similarly, the perception of fair payments by business partners slightly differs between farmers and buyers. Presented measurement items of an adapted organizational justice scale in agricultural buyer supplier relationships can be used for further analysis.

Introduction and objectives

With larger enterprises entering organic food markets increasing competition, price pressure and anonymous trade relations are beginning to influence respective food supply chain relationships. In this context various organic food enterprises and sector representatives currently examine how to introduce the concept of Fair Trade, as often established in international context, to domestic food supply chains in the global north (Howard & Allen, 2008). Aiming at assuring fair business relationships the association of Swiss organic farmers Bio Suisse introduced a code of conduct on fairness principles in Swiss organic food supply chains – from farmers to retailers (Bio Suisse, 2012). However, an extensive empirical study on the quality of business relations in Swiss organic buyer supplier relationships was missing so far.

This paper presents results of an online survey among Bio Suisse organic farmers and their buyers. It aims at shedding light on the satisfaction of business partners with their business relations as well as related expectations regarding fairness. Fairness dimensions in agricultural buyer supplier relationships will be presented at the end.

Material and methods

Results presented are based on a standardized online survey among Swiss organic farms (N=5663) and buying enterprises (N=798) conducted in 2012. Dimensions of perceived fairness in business relationships were developed based on organizational justice theory (e.g. Colquitt, 2001; Duffy et al., 2003; Greenberg, 1987; Hornibrook et al., 2009). From its general rather organizational based context, measurement scales were adapted to agricultural buyer supplier relationships and to German and French language. A random sample of 2000 organic farms was selected. Due to the relatively small number of organic buyers in Switzerland, the total population of buyers was contacted via email.

This paper focuses on participating farmers that do not exclusively market their products directly to the end consumer (n=441). The group of buyers analysed (n=123) was limited to processors and traders having direct trade relations to Swiss organic farmers.

Results and discussion – contrasting farmers' and buyers' perceptions

The distribution of participating farms largely corresponds to the population of all farms e.g. regarding farm size, region and livestock. This also applies to the regional distribution of participating buyers. Other structural data on the population of all buyers is not available. In the following, results will be presented comparing farmers' and buyers' perceptions.

[1] University of Kassel, Department of Farm Management, Germany; muehlrath@uni-kassel.de
[2] Bio Suisse, Basel, Switzerland

Are business partners satisfied with their trade relationships?

A majority of both farmers (64%, n=436) and buyers (65%; n=121) is satisfied with its trade relationships in general. In spite of increasing market competition this might indicate that Swiss organic farmers and buyers still have relatively comfortable marketing possibilities. However, the analysis did not reveal specific groups of unsatisfied farmers (19%) and buyers (27%) nor systematic causes of dissatisfaction. Dissatisfied respondents are widely distributed e.g. among different company sizes, product and marketing channels as well as company locations.

What is most important regarding fair business relationships?

Figure 1: Coded aspects of fair behaviour in business relationships mentioned by farmers and buyers (percentage of respondents; only aspects mentioned by >10% of respondents)

Figure 1 summarizes coded answers to an open question on what farmers and buyers expect from their business partners regarding fairness in trade relationships. Aspects mentioned by less than 10% of the respondents are not shown (e.g. understanding, refutability, trust, flexibility and willingness to compromise, competence, equal rules).

Participating farmers most frequently mention aspects of fair payment. Still, other aspects such as transparency, reliability, appreciation and respect as well as honesty appear to be also important for a farmer's perception of a fair business relationship. Buyers mention fair prices less frequently and related aspects represent only one of several almost equally important expectations (product quality, reliability, transparency and open communication). Only the group of buyers mentions product quality issues as well as service and market orientation of supplying farmers.

3.3 Do business partners feel that they are treated fairly?

Based on organizational justice theory three fairness dimensions are distinguished.

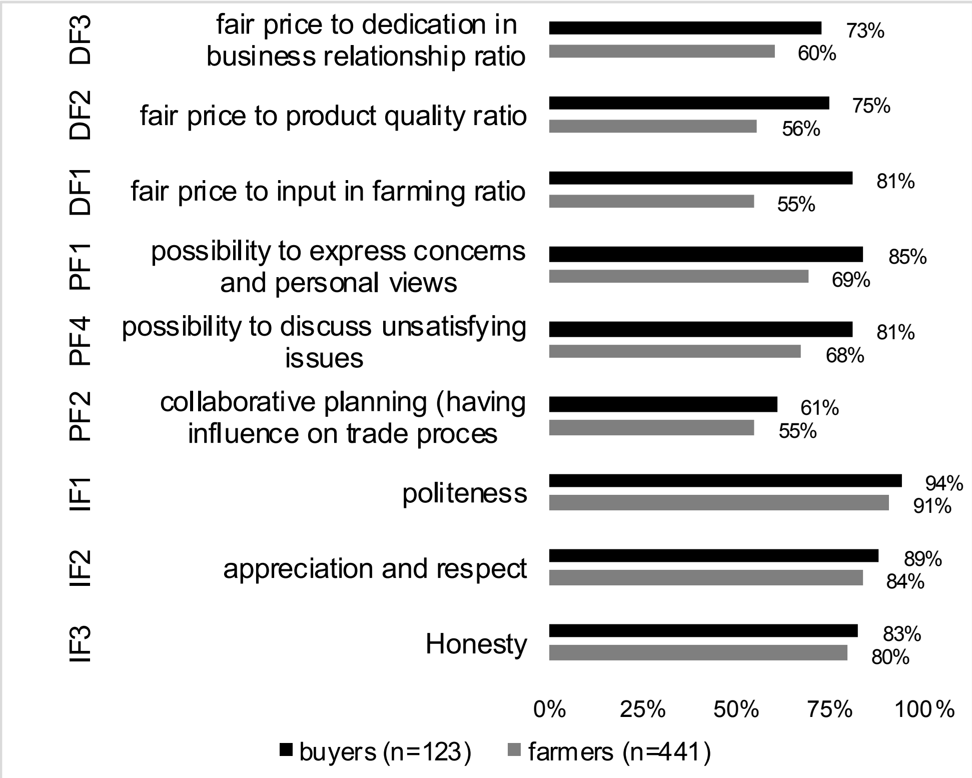

Figure 2: Business partners rating each other's fairness in trade relationships (percentage of respondents ticking "I agree (4)" or "I fully agree (5)" on a 5-point Likert scale; IF=interactional fairness, PF=process fairness, DF=distributive fairness)

The following measurement items could be validated through explorative factor analysis (Fig. 2). Calculated Cronbach's alpha coefficients indicate a good to excellent reliability of these three fairness dimensions (e.g. Kline, 2000): interactional fairness (IF; α=.877), process fairness (PF, α=.790) and distributive fairness (DF, α=.937).

Perceived fair treatment by business partners was analysed regarding both farmers' and buyers' perspectives, farmers rating their buyers and buyers their agricultural suppliers.

Regarding interactional fairness aspects, farmers and buyers seem to have a similar perception of each other's behaviour, with "politeness" having the highest mean values (farmers: 4.48; buyers 4.50). A slightly differing perception of the business partner's behaviour can be observed especially regarding distributive fairness aspects. Results indicate that e.g. a smaller percentage of farmers perceives their buyer's payment fair in relation to their efforts and input in farming. However, even with regard to this aspect the majority of farmers and also buyers indicates that their business partners behaviour corresponds to presented fairness dimensions.

Conclusions

Results show that the majority of Swiss organic farmers and their buyers is satisfied with their business relationships and feel treated in a fair way by their trading partners. However, differing perspectives on fair business relations could also be observed between the group of farmers and buyers. Regarding their buyers' expectations farmers should consider that product quality, reliability and transparency are equally important as fair prices. Buyers of Swiss organic products should know about the signal effect of perceived fair prices. Besides transparency and reliability, their agricultural suppliers also expect respect and appreciation for their products and farming techniques.

Based on organizational justice theory three fairness dimension in agricultural buyer supplier relationships were differentiated and related measurement scales presented proved to be reliable. Bio Suisse can use these scales to continue studying fairness aspects in Swiss organic food supply chains. Further analysis will focus e.g. on the impact of perceived fairness in business relationships on relationship quality (e.g. trust, commitment) and on the trading partners' satisfaction.

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Below ground nitrogen dynamics in the sequence clover-grass maize in the DOK long term experiment

JOCHEN MAYER[1]*, ASTRID OBERSON[2], ANDREAS LÜSCHER[1], EMMANUEL FROSSARD[2], STEFANO M. BERNASCONI[2], PAUL MÄDER[3], ANDREAS HAMMELEHLE[1,2]

Key words: clover-grass, below ground N, rhizodeposition, N transfer, N stabilisation

Abstract

We investigated the effect of organic versus conventional cropping systems on the below ground nitrogen inputs of *Trifolium pratense* L., its transfer to corresponding grass and the fate in the soil organic matter in the clover-grass ley of the DOK long term experiment, Switzerland. BGN tended to be largest in conventional and organic treatments with standard fertilisation and decreased with lower fertilisation intensity. The largest amount of clover N transferred to grass was observed in the minerally fertilised conventional treatment. Clover N derived from rhizodeposition was rapidly stabilised in all treatments to clay rich fractions and thus clover N will have a relatively low direct N contribution to subsequent nonlegumes.

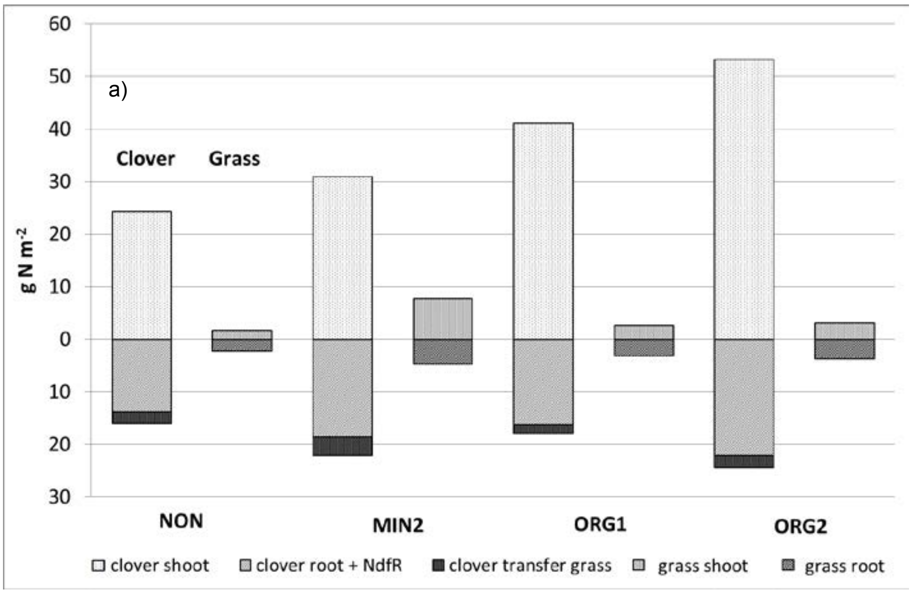
Introduction

Clover-grass mixtures are important animal feed and the main nitrogen (N) source in organic cropping systems. However, biomass production and related below ground N (BGN) inputs vary in a wide range dependent on site conditions, environmental factors, and management practices and are not well understood (Oberson et al. 2013). The direct contribution of legume N to subsequent nonlegumes is small and often not in synchrony to the demand. Improving organic cropping systems require a deepened knowledge in BGN processes in the sequence legume – nonlegume under field conditions.
Our objectives were therefore to examine the effect of different cropping systems, that is conventional and organic, on i) the amount of N rhizodeposition and total below ground N for red clover, ii) the N transfer from clover to grass within the mixture, and iii) the fate of clover root derived N in functional soil pools and its contribution to subsequent maize.

Material and methods

Investigations were carried out in the DOK experiment, near Basle, Switzerland which compares two organic and two conventional cropping systems at two fertilization levels (1=50% and 2=100% of the systems standard fertilization) since 1978 (Mäder et al., 2002). We included the following cropping systems and fertilization levels: bio-organic (ORG1, ORG2), conventional receiving exclusively mineral fertilizers (MIN2), and an unfertilized control (NON). During the model clover-grass mixture (*Trifolium pratense* L. + *Lolium perenne* L.) 11 red clover plants per micro plot (tubes of Ø 40 cm, 25 cm depth) were ^{15}N multi pulse leaf labelled with 99 atom % ^{15}N urea after each cut in 2011 and 2012. BGN and N derived from rhizodeposition (NdfR) were determined from the soil ^{15}N signal after removal of all visible roots and sequential extraction of the soil. From this procedure the fate of NdfR in functional soil pools as dissolved N (DN) and microbial biomass N (N_{mic}) were determined. Stabilisation of NdfR in soil density fractions and subsequent reuse over a 3-years period (clover-grass; clover-grass, maize) was determined by soil density fractionation and the recovery of clover derived N was determined in the subsequent maize (*Zea maize* L.*)* in 2013.

[1] Agroscope, Institute for Sustainability Sciences INH, Zürich, Switzerland; jochen.mayer@agroscope.admin.ch, www.agroscope.ch
[2] Research Institute of Organic Farming FiBL, Frick, Switzerland
[3] Swiss Federal Institute of Technology ETH, Zürich, Switzerland



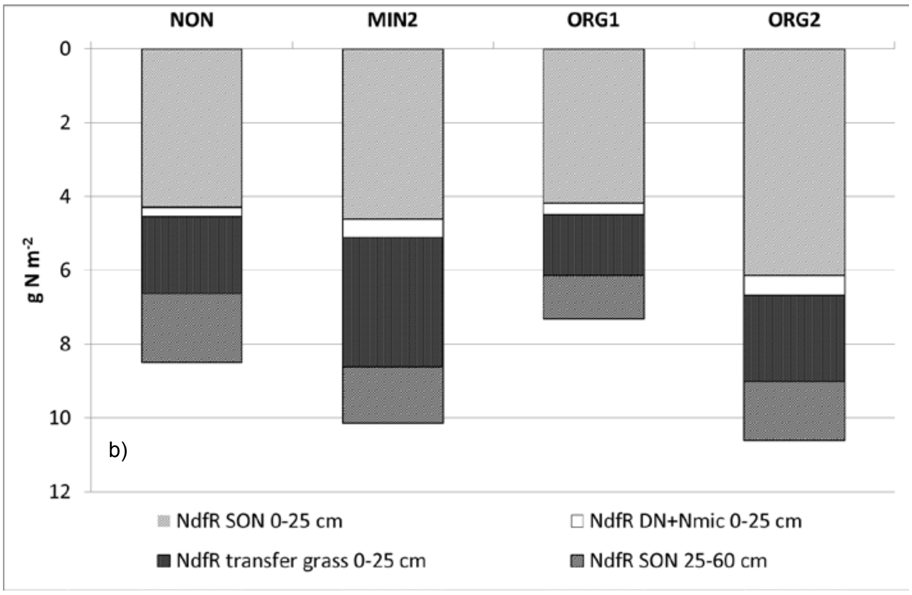


Figure 1: Above and below ground N uptake in treatments of the DOK clover-grass mixture (a), distribution of red clover NdfR in functional soil pools (b)

Results and discussion

We present the first results from 2011. Cropping systems differed significantly between the above ground N (AGN) uptake by clover and grass N with 24 (NON), 31 (MIN2), 40 (ORG1) and 53 (ORG2) g N m^{-2}. Grass AGN ranged between 2 and 8 g N m^{-2} whereas MIN2 had the highest percentage of grass in the mixture and grass N uptake (Fig. 1a). However, clover BGN did not follow the above ground pattern. The lowest input showed NON and ORG1 with 14 and 16 g N m^{-2}, respectively followed by MIN2 with 19 and ORG2 with 22 g N m^{-2}. In all treatments the largest amount of NdfR (54 – 68%) was found in soil organic nitrogen (SON), with the lowest proportion in MIN2 (54%) (Fig. 1b). Considering the N transfer from clover to grass, the highest amount was transferred in MIN2 (4 g m^{-2}), although this treatment had a comparatively low clover N uptake and the lowest clover percentage in the mixture. This could be explained by a denser root network growing around the clover roots compared to ORG 1 and ORG2. ORG2 with the largest clover N uptake and a low grass N uptake could transfer less N to the grass partner. However, in NON grass benefited strongest from clover (56%). Including transfer, the treatments at 100% standard fertilisation showed in tendency higher NdfR inputs.

The ^{15}N enrichment of SON showed the highest value in the fraction <1.65 (particulate organic matter). The following fractions showed decreasing enrichments which are characterized by increasing mineral associations and, thus, increasing stabilization. However, the highest amount of NdfR was found in the clay dominated fraction 2.25 – 2.55 g cm^{-3} indicating a very fast stabilization of the major part of NdfR within 8 months during the first year (Table 1). This fast and strong N stabilization might be one reason of the relatively low direct N contribution from clover-grass to subsequent nonlegumes. We can conclude that it will be difficult to remobilize that stabilized N by management measures to face the N demand for e.g. winter cereals in temperate climate. We will get more evidence by the results from the second year of the clover-grass mixture and the transfer into subsequent maize which are evaluated at present. These data will be available at the conference and presented there.

Table 1: a) Percentage of red clover NdfR in soil density fractions after six months of clover-grass establishment in 2011 in different DOK cropping systems and b) proportion of amounts of NdfR in the respective soil fraction

Soil	a) Percentage of N derived from rhizodeposition[2]					b) Proportion of NdfR[1] in the respective soil fraction (total = 100% of NdfR)[2]			
fraction [g cm^{-3}]	< 1.65	1.65 - 2.25	2.25 - 2.55	> 2.55	bulk soil	< 1.65	1.65 - 2.25	2.25 - 2.55	> 2.55
Treatment									
NON	6%	1.4%	0.7%	0.5%	0.9%	25%	18%	48%	8%
MIN2	4%	1.8%	1.2%	0.8%	1.4%	16%	24%	51%	10%
ORG1	5%	1.8%	1.0%	0.6%	1.2%	20%	23%	48%	10%
ORG2	4%	2.0%	1.2%	0.9%	1.5%	16%	27%	46%	11%

[1] NdfR: N derived from rhizodeposition
[2] Means between DOK treatments differed not significantly

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Olfactometer screening of repellent essential oils against the pollen beetle (*Meligethes spp.)*

CLAUDIA DANIEL[1]

Key words: *Meligethes aeneus*, *Meligethes viridescens*, essential oil, lavender, cornmint, lemongrass

Abstract

*Essential oils can have an impact on pollen beetle (*Meligethes spp.) *host plant location behaviour. We compared the effects of essential oils of* Mentha arvensis, Eucalyptus globulus, Melaleuca alternifolia, Citrus sinensis, Citrus paradisi, Citrus limon, Juniperus mexicana, Abies sibirica, Illicium verum, Gaultheria procumbens, Cymbopogon flexuosus, Syzygium aromaticum, *and* Litsea cubeba *using a Y-tube-olfactometer. Essential oils were diluted 1:10 in acetone and 40 µl of the dilution were applied on a 3.1cm^2 filter paper. Filter papers were placed in the odour containers of the olfactometer together with a flower cluster of spring oilseed rape with 5 open flowers and 10-15 buds. The control treatment involved filter papers treated only with acetone. Hungry pollen beetles were released individually into the olfactometer. Six replicates with six beetles each were conducted. Highest repellency values were obtained for* Mentha arvensis*,* Cymbopogon flexuosus*, and* Litsea cubeba*.*

Introduction

Organic agricultural methods to control pollen beetle (*Meligethes spp*.) are limited. Although effective insecticides are available for organic producers (Spinosad), their use is often restricted by guidelines of producers associations. In Swiss organic production (Bio Suisse) the use of insecticides in oilseed rape is interdicted. Therefore, alternative non-insecticidal methods to control pollen beetles are needed. Experiments in UK showed that essential oils can have an impact on pollen beetle host plant location behaviour (Mauchline et al., 2005; Mauchline et al., 2008; Mauchline et al., 2013). In a laboratory study that compared five different essential oils, lavender oil (*Lavendula angustifolia*) showed the highest repellency value (Mauchline et al. 2005). Lavender oil is relatively expensive, and cost is an impediment for farms to adopt it as a repellent. We compared 15 different essential oils using a Y-tube-olfactometer to see if any of lower cost would have similar efficacy.

Material and methods

The pollen beetles used in all experiments were collected in an untreated winter oilseed rape field in north-western Switzerland. Beetles were denied food for 40 hours before starting the experiment.

Spring oilseed rape **flowers** (variety Hero) used as odour source were produced in a nearby greenhouse. Flower clusters with 5 open flowers and approximately 10-15 closed buds were cut immediately before starting the experiments and were permanently supplied with water.

The experiments were conducted using a **Y-tube-olfactometer** (Belz et al., 2013). Odour sources were placed in the odour containers of the olfactometer. Pollen beetles were released individually into the olfactometer using flexible forceps. The measurement started as soon as the beetle crossed the first line (1.5 cm from the release point; 10 cm distance to the Y-junction) and stopped as soon as the beetle crossed the finish line (4 cm behind the Y-junction). The choice of the beetle was recorded. The beetle was removed from the olfactometer for determination of species (*M. aeneus, M. viridescens*) and sex. Beetles that failed to cross the finish line within 90s after crossing the first line, were removed from the olfactometer and were not included in the analysis. Each replicate consisted of six responding pollen beetles. Odour sources (=flowers and repellent odours) were replaced after each replicate. Six replicates (= total 36 beetles) were conducted per treatment. The sequence of the tested substances was randomized between each replicate to avoid influence of the time of day. Experiments were conducted between 7:30 and 16:30 h. The experimental room was kept at 22±3°C, 50±10% rh relative humidity.

The following **essential oils**, supplied by qualiessentials gmbh (Germany), were used in the experiments: cornmint oil (*Mentha arvensis*), orange oil sweet (*Citrus sinensis*), wintergreen oil (*Gaultheria procumbens*), lemongrass oil (*Cymbopogon flexuosus*), eucalyptus oil (*Eucalyptus globulus*), fir needle oil (*Abies sibirica*), lemon oil (*Citrus limon*), tea-tree oil (*Melaleuca alternifolia*), clove oil (*Syzygium aromaticum*), star anise oil

[1]Research Institute of Organic Agriculture (FiBL), Switzerland, www.fibl.org, eMail: claudia.daniel@fibl.org

(*Illicium verrum*), grapefruit oil white (*Citrus paradisi*), Texas cedarwood oil (*Juniperus mexicana*), Litsea cubeba oil (*Litsea cubeba*), lavender oil (*Lavendula angustifolia*). In addition to the essential oils, the product Heliosol (Omya Agro, Switzerland) was tested. Heliosol is a pine oil based product used as wettening and sticking agent for plant protection purpose. Essential oils and Heliosol were diluted 1:10 in acetone and 40 µl of the dilution were applied on a 3.1 cm^2 filter paper (MN713, Macherey-Nagel, Germany). After 30 minutes, when the acetone had evaporated, the filter papers were placed together with a flower cluster in the odour containers of the olfactometer. The control used filter papers treated only with acetone with a flower cluster.

Statistical analysis: Repellency values (RV) were calculated per replicate according to Mauchline et al. (2005): [RV = number of beetles on the untreated flower / (number of beetles on the untreated flower + number of beetles on the treated flower)]. In order to test if the essential oils had a significant effect compared to the “untreated” control, a Wilcoxon signed rank test was performed to test whether mean RV was significantly different from 0.5. In order to compare the efficacy of different essential oils, the RV were [arcsin√(x)] transformed. Normality of data and homogeneity of variance were tested. RV were compared by an ANOVA followed by a Tukey HSD post hoc tests (α=0.05).

Results and discussion

Behaviour of beetles in the olfactometer: When released into the olfactometer, the pollen beetles needed a few seconds to get on their feet and to orient themselves towards the airflow. Once they started to walk, they moved forward until they reached the junction of the two arms. Irritated either by the light, which was placed directly above the junction or by the disturbance in the airflow, most beetles stopped or walked a vertical looping in the junction. After a few seconds, they started walking into one arm of the olfactometer, usually at a rapid pace. On average, it took the beetles 39.8±0.6 s to cover the distance (14 cm) from the first line to finish line. Beetles rarely moved back into the other olfactometer arm. A total of 772 beetles were released into the olfactometer. Out of these beetles, 232 individuals (=30%) failed to cross the finish line within 90s after crossing the first line. They were removed and not included in the analysis. A total of 540 beetles were responsive. Beetles showed best reaction early in the morning. This might be due to the daily activity pattern of pollen beetles: food foraging behaviour is probably stronger in the morning. Field collected beetles were used for the experiments. Determination of sex and species was done after the beetles had passed the olfactometer. Out of the 540 responding beetles, 474 individuals were *Meligethes aeneus*, 66 individuals (=12.2%) were *Meligethes viridescens*. The sex ratio (M:F) of 0.47 was identical for both species.

Pollen beetle choice in the olfactometer: Ten out of the 15 tested essential oils in a 1:10 dilution significantly repelled the pollen beetles and showed a repellency value (RV) significantly greater than 0.5 (Table 1; Wilcoxon signed rank test, p<0.05). The essential oils from cedarwood, orange, wintergreen, eucalyptus and lemon did not have a significant effect on pollen beetle choice. The RV was not significantly different from 0.5 (Wilcoxon signed rank test, p>0.05). However, all tested essential oils had a mean RV > 0.5. Thus, none of the tested essential oils was attractive for the pollen beetles. Cornmint had the highest RV (1.00): none of the beetles chose the olfactometer arm with cornmint essential oil. Lemongrass and *Litsea* essential oils, as well as the pinolene based plant protection product Heliosol also showed high repellency values of 0.92. Lavender oil was less repellent: RV was 0.81. These results are in accordance with the literature: Maucheline et al (2005) compared different essential oils at 10% dilution and observed the following mean RV: 0.97 for peppermint (*Mentha piperita*), 0.97 for lavender, 0.95 for Tea tree, and 0.9 for eucalyptus.

Prices of different essential oils: In addition to a high repellency value, the price of an essential oil is a major factor to choose candidates for field application strategies. Prices of essential oils fluctuate during the year, depending on origin and harvesting time of plants. Prices given in Table 1 are rough estimations by qualiessentials gmbh. The cheapest essential oil in our experiments was grapefruit oil. Lemongrass and Litsea oil are also reasonably priced. Cornmint oil is considerably more expensive and lavender oil was by far the most expensive oil in our experiments.

Conclusions

Based on the results of the experiments and on the prices of the essential oils, the development of a field application strategy will focus on cornmint oil, lemongrass oil and *Litsea cubeba* oil.

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Table 1: Repellency values (± se) of different essential oils tested in the Y-tube-olfactometer containing "flower clusters + filter paper + acetone" and "flower clusters + filter paper +essential oil diluted 1:10 in acetone" and estimation of price per kg of the essential oils.

Essential oil	RV±se	Wilcoxon Test	Tukey HSD-Test	Prices of essential oils
Cornmint	1.00±0.00	*	D	31.50 € / kg
Lemongrass	0.92±0.06	*	CD	17.50 € / kg
Litsea	0.92±0.06	*	CD	18.00 € / kg
Heliosol	0.92±0.04	*	CD	18.00 € / kg
Tea tree	0.89±0.06	*	BCD	32.00 € / kg
Grapefruit	0.86±0.03	*	ABC	14.00 € / kg
Fir needle	0.83±0.06	*	ABCD	28.50 € / kg
Star anise	0.83±0.06	*	ABCD	22.50 € / kg
Lavender	0.81±0.05	*	ABCD	104.00 € / kg
Clove	0.81±0.08	*	ABC	30.00 € / kg
Lemon	0.75±0.08	n.s.	ABC	
Eucalyptus	0.69±0.07	n.s.	ABC	
Wintergreen	0.69±0.11	n.s.	ABC	
Orange	0.67±0.06	n.s.	AB	
Cedarwood	0.64±0.05	n.s.	A	

Statistical analysis: Wilcoxon signed rank test testing if RV is different from 0.5 with $p<0.05$; Tukey: Data transformed [$\arcsin\sqrt{(x)}$], Four-way-ANOVA: essential oil: $F_{14,72}=5.03$, $p<0.0001$; temperature: $F_{1,72}=21.57$, $p<0.0001$; humidity: $F_{1,72}=0.12$, $p<0.13$; position of olfactometer arms: $F_{1,72}=7.73$, $p=0.007$; Tukey HSD post hoc tests $\alpha=0.05$, different letters show significant differences.

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Growing under the Common Agricultural Policy – The institutional development of organic farming in Central and Eastern European countries from 2004-2013

HEIDRUN MOSCHITZ[1], INGRID JAHRL[1]

Key words: institutional development, policy, Central and Eastern European countries, EU accession, organic sector

Abstract

The goal of this paper is to analyse the mid- to long-term impacts of the EU accession as external trigger for organic farming development. We focus on the institutional development in the Czech Republic, Hungary and Estonia that accessed the EU in 2004; comparing the situation in these countries at the time of their accession with the current situation (2013). Data was collected by desk-top analysis of relevant literature, policy document analysis, and expert interviews with key informants. We conclude that European level policy remains an important external driver for national organic sector development in the countries studied. The financial support, available since the start of the accession process, led to organic farming growth and increased visibility; there is a rising domestic demand for organic produce. After having achieved a certain level of political and societal recognition, the organic farming organisations now are searching new ways to maintain integration and unity of the organic farming community.

Introduction

The EU accession process has triggered the development of organic food and farming in countries accessing the EU. EU organic farming legislation needed to be transposed in these countries, and with that the regulations on organic farming support. Yet, such support has to find its way from the state to the single farmer, and farmers need markets and customers to sell their produce. Institutions need to be put in place that can act as channels for flows of knowledge and resources.

The goal of this paper is to analyse the mid- to long-term impacts of the EU accession as external trigger for organic farming development. We will focus on the institutional development in selected countries that accessed the EU in 2004: Czech Republic, Hungary and Estonia, comparing the situation in these countries at the time of their accession with the current situation (2013).

The relevance of institutions for organic farming development was comprehensively investigated by Michelsen et al. (2001) who identified a path of six steps facilitating organic farming growth: i) the establishment of an organic farming sector with a formal framework for organic farming, ii) the political recognition of organic farming through organic standards, iii) the introduction of financial support to organic farmers, iv) the development of non-competitive interrelationships between organic farming and the general farming community, v) the development of functioning organic food markets governed by market mechanisms, and vi) the establishment of a cross-cutting institutional setting committed to promoting organic farming.

In 2004, Moschitz et al. investigated the institutional development of the organic sector in eleven European countries: Austria, Switzerland, Czech Republic, Germany, Denmark, Estonia, Hungary, Italy, Poland, Slovenia, and United Kingdom (Moschitz et al., 2004; Moschitz and Stolze 2007). For the countries that are of interest in this paper, they concluded that the first three steps of organic farming growth had been completed in 2004: an organic farming community was established, there was a certain level of political recognition (as an organic regulation had been implemented), and financial support was granted for organic farming (with varying levels of payment). Political recognition was reported highest in the Czech Republic, where an institutional setting started to develop (in the framework of the development of an Organic Action Plan). In all three countries, the organic farming community showed a high level of integration and unity, while contacts between the organic and the mainstream farming sector were rare or missing at all. A proper domestic organic food market had not been established by then, and the general society did not recognise organic farming as a realistic option for the future of agriculture.

[1] Research Institute of Organic Agriculture FiBL, Switzerland, www.fibl.org, contact eMail: heidrun.moschitz@fibl.org

Since 2004, the European organic sector and its institutions have developed lively. In June 2004 the European Commission published the European Action Plan for Organic Food and Farming setting out a range of policy measure to support the development of the organic sector (EC-COM 2004). In the following, more and more countries introduced national organic action plans. Furthermore, Council Regulation (EC) 834/2007 has come into force on January 1 2009, replacing the old EU organic regulation. The European market for organic products has been constantly rising from about 14 billion US dollars in 2004 to 28 billion US dollars in 2010 (Sahota 2006; 2012). The institutional environment for organic agriculture in the EU has thus changed since the last thorough study has been carried out (Moschitz et al. 2004).

This contribution analyses the effects that these changes at EU level had on the institutional development of the organic sector in the Czech Republic, Estonia and Hungary.

Material and methods

Data collection on the institutional development of the organic sectors in Estonia, Czech Republic and Hungary was done by applying a triangulation approach: desk-top analysis of relevant literature to update previous own work done on institutional development (Moschitz et al. 2004); policy document analysis for selected countries, based on the evaluation study done for the EU (Sanders et al., 2011), and expert interviews with key informants on organic farming development to complement the written documentation.

We analysed the data collected by applying Michelsen's approach (2001) and structured the analysis according to the three societal domains (i) the farming community, (ii) the agricultural policy, and (iii) the food market plus the cross-cutting institutional setting (iv). This structure helps the comparison with earlier studies on the topic.

Results

The research is on-going at the time of submission of this paper, but will be finalised until summer 2014 so that final results will be presented at the ISOFAR conference. The results presented below are therefore preliminary.

Institutional development within the farming community

In all three countries, an organic farming community had been established already by the time of the previous study in 2004. The new data suggest that this community currently faces the challenge of integration: the position of organic farming organisations as unifying "face" of organic farmers and consumers has become more difficult as the basic structure (institutions) for market and control and certification is already established. It is reported that farmers do not seem to feel the need to become a member of an organisation for reaching their goals, which is largely about selling products and receiving advice. It seems to be difficult to find unifying new or additional objectives that would assemble organic farmers in an organisation (e.g. for political activities). The details of and reactions to this situation differ. In Hungary, internal conflicts within the organic farming community hamper a strong representation in politics, while in the Czech Republic and Estonia, platforms have been developed to assemble a number of organisations and thus join forces of the organic farming community.

Institutional development within the agricultural policy

In all three countries studied, there is an overall recognition of organic farming as one possible alternative to mainstream agriculture, but concrete policy support measures are rare in Estonia and Hungary. The implementation of the new Rural Development Program (RDP) 2014-2020 triggers discussions about the level of support for organic farming in Estonia. In the Czech Republic and Estonia, an Action Plan for Organic Food and Farming has been put in place and is important for the sector's recognition and further development. However, also here, there are no concrete implementation measures (including a budget). In Hungary, an Action Plan is currently in the discussion process. Overall, it was reported that motivated individuals in state departments helped political recognition of the sector, even though concrete measures are lacking.

Institutional development within the food market

In many Central and Eastern European countries, the development of the organic sector has been driven by export, but domestic markets are developing. In particular in the Czech Republic, supermarkets have started to include organic produce in their offers, and this domestic market increase contributes to organic farming development. Also in Estonia single supermarket chains have become interested in organic products more recently. By contrast, in Hungary the domestic market for organic food develops only slowly, with some direct marketing initiatives that lack coordination. Still, most of the organic produce is exported from this country.

Development of the institutional setting

The 'institutional setting' describes the domain were interrelationships between the three domains of farming community, policy, and market take place and thus, organic farming can be discussed in the broader picture. Action Plans can constitute such an institutional setting. As mentioned before, in all studied countries an Organic Action Plan is considered important for organic sector development. In Estonia and the Czech Republic it has been the arena for exchanges between organic farming and mainstream organisations and the state. In Hungary, the non-state organisations are still waiting for their involvement. While in Hungary the institutional setting is not as developed as in Estonia and the Czech Republic, there is a growing interest in organic farming from mainstream organisations and state authorities, such as the agricultural ministry. In Estonia and the Czech Republic the awareness about organic farming and cooperation between the ministry and the organic farming community is reported to have increased in the past ten years.

Conclusion

European level policy remains an important external driver for national organic sector development in the Czech Republic, Estonia and Hungary. The financial support, available since the accession process, led to organic farming growth and increased visibility in the countries. This visibility concerns the policy domain, with a growing political recognition of organic farming, but also society as a whole. There is a rising domestic demand for organic produce, which are increasingly sold in supermarkets and thus made accessible (and visible) to a large number of consumers.

After having achieved a certain level of political and societal recognition, the organic farming organisations now are searching new ways to maintain integration and unity of the organic farming community. The (common) objectives have become less clear-cut compared to early times of organic farming development, in which achieving recognition was the overarching goal. Yet, a unified organic community is needed to enter constructive exchange and debate with mainstream agriculture.

The presented cases can act as examples for other countries that have recently accessed or are in the process of accessing the EU. They can learn about the relevant steps and challenges to consider in the development of the organic sector in their country.

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Black Soldier Fly (*Hermetia illucens*) larvae-meal as an example for a new feed ingredients' class in aquaculture diets

ANDREAS STAMER[1], STEFAN WESSELSS[2], RALPH NEIDIGK[2], G. HOERSTGEN-SCHWARK[2]

Key words: Aquaculture Nutrition, Fishmeal Replacement, Black Soldier Fly

Abstract

Insect meals as ingredients for animal feeds had been rediscovered recently. The potential of using insect meals to replace fishmeal seems to show promising perspectives, especially for organic aquaculture feeds. In the present study, different levels of fishmeal replacement (0, 50, 75 %) by using Black Soldiers Fly larvae meal had been tested on rainbow trout. Also growth responses and carcass compositions were significantly influenced by the content of BSF meal in the diet with a negative trend from the control to the highest substitution level; body weight gain, feed conversion ratio and protein efficiency ratio were comparable among the BSF 50 and the control group. As neither signs of nutrient deficiencies nor of higher mortalities have been observed, it could be concluded that BSF-meal can substitute fish meal up to an extent of 50 % in trout feeds.

Introduction

Regarding the growing demand for fish- and soybean meal in livestock- and aquaculture feeding, alternative protein carriers are of increasing concern to the animal feed industry. Beside the possibility to use animal by-products of non-ruminant origin in aquafeeds (EU-regulation (EC) 56/2013), the use of insect-based feeds is progressively discussed among fish-feed producers, scientists and policy makers. The black soldier fly, BSF (*Hermetia illucens*) occurring circumpolar in warm and temperate climates proved to be an ideal candidate (Bondary and Sheppard, 1981). Its larvae can be reared on a wide range of organic (waste)-material, reduce the volume of this waste by up to 50%, producing biomass with a protein content of about 42% and a fat content of up to 35 % (Sheppard et al., 1994). The suitability of the BSF larvae meal as a protein source in feedstuff had been proven in some warm water fish species (Bondari, Sheppard, 1981) but regarding carnivorous cold water species only limited data is available; e. g. on turbot and trout (Kroeckel et al. 2012; St-Hilaire et al. 2007). This study shows results of a feeding-trial on rainbow trout fed with two BSF-larvae meal containing organic diets.

Material and methods

Experimental design

The trial was conducted at the experimental station of the University of Goettingen, Germany. Rainbow trout of 120g (± 13g) were fattened for a total duration of 8 weeks in triplicates of 200 fish. Three diets with different fish meal substitution levels (0, 50, 75 % BSF meal) were tested. Initial stocking density in the concrete tanks was 6 kg/m^3

Prior to the experiment, the fish were fed a conventional pelleted trout feed (42 % crude protein, 22 % crude fat and 17.4 MJkg-1 digestible energy). At stocking, two fish per replicate were sacrificed and stored at -20 °C for whole body analysis. A random sample of 20 fish was taken to assess the carcass traits body weight, body length, body height, body width, filet-, gut- and liver weight. During the experiment, dead fish were replaced by tagged ones to assure equal stocking densities. The fish were hand fed twice a day according to body weight and water temperatures. At the end of the feeding trial the fish were starved 24 hours. All fish were weighed and a sample of 20 fish per replicate was slaughtered and gutted in order to assess the carcass traits. Ten fish, showing a representative weight within the range of one standard deviation of the replicate's mean, were stored at -20 °C until they were used for whole body and sensory analysis.

Diet Formulation

Pre-pupae of the BSF were obtained from a German producer rearing the larvae on tomato plant compost as a substrate. The pre-pupae were freeze-dried and ground prior to blending to the experimental diets. The main ingredients of the diet were soy bean-, fish- and BSF-meal (except control), wheat, cholinchlorid and a mineral/vitamin premix. All feeds were pelleted (size 4 mm). Three rations with 0% (control), 50 % (BSF 50)

[1] Research Institute of Organic Agriculture, Switzerland, www.fibl.org; andreas.stamer@fibl.org
[2] University of Goettingen, Dept. of Animal Sciences, Div. of Aquaculture & Water Ecology

or 75 % (BSF 75) fish meal substitution were designed by a German feedmill, using the Winfumi-software (Hybrimin®, Germany). The diets were iso-nitrogenous and met the energy and nutrient requirements of rainbow trout. The plant material used was certified organic according to Bioland and/or EU-standards.

Table 1: Proximate feed composition of the experimental diets

	Control	BSF 50	BSF 75
Moisture (%)	9.07	9.04	9.06
Crude protein (%)	47.54	47.53	47.51
Crude fat (%)	13.4	15.6	20.1
Crude fibre (%)	0.76	3.46	4.69
Ash (%)	16.3	12.9	11.2
Phosphorus (%)	2.02	1.14	0.7
Gross Energy (MJ/kg)	19.5	20.4	21.6

Sensory evaluation

Two fish from each replicate were filleted; fillets were washed, vacuum-packed and frozen at -20 °C till the sensory evaluation. Twelve hours prior to the test, the fillets were thawed at 4 °C. The evacuated fillets were poached in a water bath at 90 °C for 5 minutes. Each fillet was then divided into three equal parts. The sensory test was conducted in two replicates with 18 untrained panellists. Each panellist was served an equal piece of the fillet for all diets tested in order to carry out a ranking test (DIN 10963, ISO 8587).

Analytical methods

Proximate compositions of the ingredients were either given by suppliers or by Winfumi software and were considered for the diet formulation. Proximate analysis of fish carcasses was carried out according to German standard methods (Naumann & Bassler, 1976-1997). Based on the measurements taken before (body weight, length, thickness, height, fillet- and gut weight), during and at the end of the experiment the following parameters were calculated for each replicate:

- weight gain (g) = mean initial body weight (g) – mean final body weight (g)
- specific growth rate (SGR) = 100 x (ln final body weight (g) – ln initial body weight (g))/days of trial
- condition factor = final body weight (g) / body length (cm)^3 x 100
- hepatosomatic index = liver weight (g) / final body weight (g) x 100
- net carcass weight (g) = final body weight (g) – head weight (g) – fin weight (g) – gut weight (g)
- gutted weight (g) = final body weight (g) – offals (g)
- dressing percentage = gutted weight (g) / final body weight (g) x 100
- feed conversion ratio (FCR) = dry feed intake (g) /wet weight gain (g)
- protein efficiency ratio (PER) = weight gain (g) / protein intake (g)

Statistical analysis

The data were analysed using the SAS software package (SAS 9.1). The initial and final body weights were log-transformed. All variables were considered to be normally distributed. To compare differences between groups the Duncan's multiple range test was applied to compare the means given by Proc GLM. The following model was used y = μ + Di + Tj + Di * Tj + e, where D is a fixed effect of the ith diet, T is a fixed effect of the jth tank, D*T a fixed effect of the interaction between the ith diet and the jth tank and e the random error term. Differences between means were considered to be significant at a level of *P ≤ 0.05*, indicated by different indices in the results' table.

Results

The initial body weight was similar for all replicates. Growth responses and carcass compositions observed from the experiment were significantly influenced by the content of black soldier fly meal in the diet. The final body weights from those fish fed the BSF 50 diet were found to be 13,4% lower than those from the control fish and the fish fed the BSF 75 diet showed a 15% lower final body weight. Also for specific growth rate, and net carcass weight, marked differences were found between the experimental groups with a negative trend from the control to the BSF 75 group.

Table 2: **Effects of different levels of BSF meal in the diet of rainbow trout**

Trait	Control	BSF 50	BSF 75
Specific growth rate (%)	1.12 ± 0.27 [a]	0.89± 0.19 [ab]	081± 0.25 [b]
Body weight gain (g)	92.8 [a]	80.5 [ab]	62.2 [b]
Feed conversion ratio	1.22 ± 0.11 [a]	1.31 ± 0.35 [a]	1.68 ± 021 [b]
Protein efficiency ratio	1.74 ± 0.17 [a]	1.70 ± 0.50 [a]	1.27 ± 0.17 [b]
Final body weight (g)	227.3 ± 31.88 [a]	196.8 ± 31.11 [b]	193.3 ± 33.30 [b]
Net carcass weight (g)	160.5 ± 24.5 [a]	137.6 ± 26.8 [b]	133.3 ± 25.5 [b]
Dress out percentage (%)	70.5 ± 2.15 [a]	69.4 ± 6.28 [ab]	68.9 ± 2.10 [b]
Corpulence factor (g/cm^3)	1.09 ± 0.07 [a]	1.03 ± 0.12 [b]	1.04 ± 0.08 [b]
Hepatosomatic index (%)	2.7 ± 03 [a]	3.3 ± 0.6 [b]	3.3 ± 0.4 [b]

Nevertheless, body weight gain, feed conversion ratio and protein efficiency ratio were comparable among the BSF 50 and the control. Carcass quality was not significantly different among the different treatments. Fish from the experimental groups (BSF 50, BSF 75) were leaner, the higher the level of fish meal substitution had been. Concurrently the crude protein and ash content increased with an increasing share of black soldier fly meal in the diet, whereas total phosphorus was equal among all groups. Also through the sensory evaluation of the rainbow trout fillets no significant preference for one of the diets was detected. However, the three diets were by trend ranked according to the fish meal substitution level, where BSF 50 and BSF 75 showed a 2.8 % and 21.6% lower mean grade compared to control, respectively.

Discussion

From the present results it could be concluded that BSF-meal might substitute fish meal without severe losses in body weight gain, FCR and protein retention ratio, up to an extent of 50 %. Although the growth performance of rainbow trout fed the highest level of BSF-meal (BSF 75) was poorest, neither signs of nutrient deficiencies nor of higher mortalities were observed. According to Rust (2002) a reason for declining performance could be the chitin content of the pre-pupae as this component of the invertebrate exoskeleton might have adverse effects on the digestibility of nutrients. In order to obtain iso-nitrogenous rations in the present study, soybean meal was added when fish meal was replaced by black soldier fly meal. Glencross et al. (2008) postulated that increasing amounts of soy beans lead to reduced growth in salmonid species. The high content of saturated fatty acids could also have negative effects on the performance of the feed. A reduced fat and energy digestibility of the BSF-component could be the reason for the observed decreasing carcass-fat content of the fish which were fed the BSF-diet. Fasakin, et al. (2003) attributed lower growth in Clarias gariepinus fingerlings fed a full-fat maggot meal to a reduced protein digestibility. Overall performance and digestibility of diets containing BSF-meals should increase if the feed is extruded and the level of lipids is reduced by mechanically defatting of the BSF raw-material.

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Fattening of entire male pigs under organic conditions – Influences of group composition on injuries and behaviour

MIRJAM HOLINGER[1], BARBARA FRUEH[1], EDNA HILLMANN[2]

Key words: entire male pigs, behaviour, housing system, skin lesions

Abstract

Fattening of entire male pigs prevails as an alternative to castration of male piglets. Entire males show more agonistic and mounting behaviour than castrated males, which can be a cause for skin lesions and lameness. Here the question was investigated, how under organic housing conditions single-sex groups with entire males (EE) differ from mixed-sex groups with entire males and females (EF) and from mixed-sex groups with castrated males and females (CF) with regard to lesions, lameness, agonistic behaviour and mounting. Group size was 20 animals. On day 4, 51, and 110 after start of the fattening period, animals were assessed for injuries and 10 male focal animals per pen were observed via video. On day 51 and 110 there were slightly more skin lesions in the EE-groups compared to the CF-groups with no difference between EF and CF. Entire males showed clearly more agonistic and mounting behaviour than castrates. EE and EF did not differ, neither in terms of lesions nor in behaviour. This study indicates that under the investigated housing conditions single-sex groups with entire males and mixed groups are equivalent with regard to animal welfare. So far there are neither in organic nor in conventional animal husbandry specific regulations for fattening of entire male pigs. Our findings, however, give some indications that more generous housing conditions would allow entire males to show their natural behaviour without serious injuries.

Introduction

Fattening of entire male pigs prevails in many European countries as an alternative to castration of piglets. However, the problem of recognizing and processing tainted carcasses as well as a lack of knowledge in terms of housing, transport and slaughter of entire males remain obstacles for a broad implementation. Entire males show more agonistic and mounting behaviour than castrated males or females (Fredriksen et al. 2008) which can lead to more injuries and lame animals (Rydhmer et al. 2006). The aim is therefore to adapt housing and management in order to reduce stress and improve welfare of entire male pigs. So far little is known about the effects of organic housing conditions (litter, space allowances, outdoor run) on the behaviour of entire male pigs, most recent studies have been carried out under conventional housing conditions. In this study we investigated under organic housing conditions (according to the regulations of Bio Suisse in Switzerland) whether there occur more injuries and there is more agonistic and mounting behaviour in single-sex groups with entire males compared to mixed-sex groups with entire males and females and groups with castrated males and females.

Material and methods

At an average age of 80 days pigs were grouped into the experimental group compositions (EE, EF and CF). This was repeated in six rounds. Group size was 20 animals. Space allowance was 1.3 m^2 until a weight of 60 kg, and 1.65 m^2 afterwards. On day 4, 51 and 110 skin injuries of all animals were assessed with a score from 0 to 3, described in Fredriksen et al. (2008). Scores of six body regions were summed up. Lame animals were recorded. On the following day video observations were conducted during one hour before the morning and afternoon feeding respectively as well as during 30 min in the evening. Focal animals were the 10 male animals in the mixed groups and 10 randomly selected males in the EE groups. The following behaviours were recorded: Head-knocking/biting, fighting and mounting. Statistical analyses were made by applying generalized linear mixed effect models with group composition and day of observation as fixed effects, and animal in group in round as nested random effect.

Results and discussion

Because skin lesions on day 4 are probably mainly caused by fighting at regrouping this observation number was analysed separately. Significant differences among the group compositions were only found at later stages of the fattening period (on day 51 and 110; Table 1): animals in the EE groups had more skin lesions

[1]Research Institute of Organic Agriculture (FiBL), Switzerland, www.fibl.org, eMail: mirjam.holinger@fibl.org and barbara.frueh@fibl.org
[2] ETH Zuerich, Switzerland, www.aw.ias.ethz.ch, eMail: edna-hillmann@ethz.ch

than those in the CF groups (χ^2(2)=8.1, p=0.02). Females in groups with entire males did not have more lesions than those in groups with castrated males (χ^2(1)=1.1, p=0.28). Consequentially, penning them together with entire males doesn't seem to impair their welfare. Totally 13 animals were assessed as lame, evenly distributed across groups mainly at the end of the fattening period. The findings which show only small differences in skin lesions among the groups and a low prevalence of lameness contradict previous studies (Fredriksen et al. 2008; Rydhmer et al. 2006). The higher space allowances and the outdoor run might serve as explanation, as suggested by Prunier et al. (2010). The lower percentage of slatted floors may have been favourable for leg health.

Table 1: Prevalence of skin lesions and lameness

	Group composition			
	Only entire males (EE)	Entire males and females (EF)	Castrated males and females (CF)	p-values
Skin lesions (day 4)	6.2 ± 3.3[1)]	5.6 ± 3	5.7 ± 3	n.s.
Skin lesions (day 51 and 110)	3.9[a] ± 2.3	3.4 ± 2.1	3.1[b] ± 2.2	0.02
Skin lesions of females (day 51 and 110)	-	3.5 ± 2.2	3 ± 2.2	n.s
Lame animals (all observations)	1.2%[2)]	1.6%	1.2%	-

[1)] Mean ± standard deviation
[2)] Percentage of animals which were observed at least once to be lame
Means with different superscript letters differ significantly (p<0.05)

The behavioural observations revealed very clear results: The percentage of focal animals which showed head knocking/biting (χ^2((2)=20.2, p<0.001), fighting (χ^2(2)=39.2, p=0.001; Figure 1), and mounting (χ^2(2)=17.2, p<0.001) was higher for entire than for castrated males. No difference was found between EE and EF groups. All behaviours decreased towards the end of the fattening period. Space allowances and feed provision seem to play an important role in the behaviour of entire male pigs: Thomsen et al. (2012) did not find differences in agonistic behaviour between entire males and females under organic housing conditions with min. 2 m^2 and ad libitum feed provision. In or study on the other hand with a space allowance of max. 1.65 m^2 and restricted feeding entire males were much more often involved in agonistic interactions than castrated males. Higher space allowance might offer escape opportunities for lower ranking animals. Ad libitum feed provision eliminates fights for this limited resource.

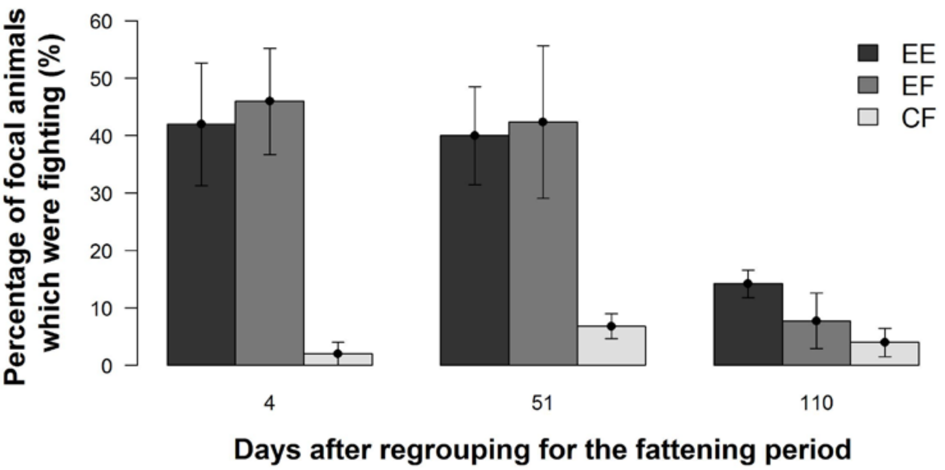

Figure 1. Percentage of focal animals (entire and castrated males) which were observed fighting at least once depending on group composition and day of observation. (± standard error)

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Soil Quality Changes in Field Trials Comparing Organic Reduced Tillage to Plough Systems across Europe

ANDREAS FLIEßBACH[1]*, V. HAMMERL, D. ANTICHI, P. BÀRBERI, A. BERNER, C. BUFE, P. DELFOSSE, A. GATTINGER, M. GROSSE, T. HAASE, J. HEß, C. HISSLER, P. KOAL, A. KRANZLER, M. KRAUSS, P. MÄDER, J. PEIGNÉ, K. PRITSCH, E. REINTAM, A. SURBÖCK, J.-F. VIAN, M. SCHLOTER

Key words: reduced tillage, soil quality, plough

Introduction

Conserving and improving the fertility and quality of the limited soil resource to produce food, feed and fibre has always been the key to organic farmers' management practices. This issue is also addressed in conservation agriculture systems that give up on soil tillage (no-tillage) or reduce tillage intensity, but often build on the extensive use of herbicides and mineral fertilizers. Both systems show advantages for soil quality (Holland, 2004; Mäder et al., 2002) and therefore their combination is promising and may provide better soil quality. Challenges of introducing no- or reduced tillage systems into organic farming are increased weed pressure, retarded mineralization of nutrients that both may lead to reduced crop yield (Peigné et al., 2007). Pioneer farmers have developed solutions and new machinery to be applicable in organic farming systems. Comparisons of reduced tillage to the traditional plough system have started on farms and systematic research started a decade ago. It was the aim of our research activities, accomplished within the frame of the European network TILMAN-ORG (www.tilman-org.net), to evaluate changes in soil carbon stocks and biological soil fertility parameters in soils from European field trials that compared reduced primary soil tillage options with standard procedures (mainly plough). The selected sites represent a geo-climatic gradient from the North-East to the South-West. The hypothesis was that reduced tillage is enhancing the stratification of soil organic matter, soil microbial biomass and activity, and is changing microbial community structure and microbial functions.

Material and methods

Soil samples for carbon stock changes were taken in spring 2012 from replicated field plots of short- (< 2 yrs.), medium- (2-7 yrs.) and long-term (> 7 yrs.) field trials comparing reduced tillage, minimum, or no tillage and plough in Scheyern and Frankenhausen (DE), Thil (FR), Windpassing (AT), Fischbach (LU), Gallecs (ES), and Frick (CH), as well as the use of green manures in Tartu (EE) and San Piero a Grado (IT). Soil strata were sampled according to tillage depths and from the deepest tillage depth down to 50 cm. Ten to 15 soil cores from each replicate field plot were combined to one bulk sample per plot and soil layer. Bulk density was measured in the middle of each sampled soil layer. Soil organic carbon was measured by wet oxidation (Nelson and Sommers, 1996). Soil samples from Scheyern (Start: 1992; chisel plough 15 cm, cultivator and rotary harrow 5 cm; sandy loam) (Reents et al., 2008; Sprenger, 2004), Thil (start 2004; plough 30 cm, shallow plough 18 cm, chisel 15 cm, superficial (5 cm) or no tillage with crimper roller; sandy loam) (Vian et al., 2009) and Frick (start 2002; plough 15 cm, stubble cleaner 5 cm with occasional loosening at 15 cm; clayey loam) (Gadermaier et al., 2012) were studied in more detail: Dissolved organic carbon was analysed by infrared spectrometry. Soil microbial biomass was analysed by chloroform fumigation extraction according to Vance et al. (1987). The soil bacterial and fungal diversity has been determined by amplicon tagging of 16S and ITS rRNA genes to determine microbial genotypes as well as phospholipid fatty acid (PLFA) fingerprints to analyse the microbial phenotype (analyses on-going). Dried samples were used for soil chemical analyses, field moist samples were stored at 4°C for soil microbial biomass and samples for DNA and PLFA analyses were kept frozen at -80°C.

[1]Research Institute of Organic Agriculture (FiBL), Switzerland, andreas.fliessbach@fibl.org, www.fibl.org
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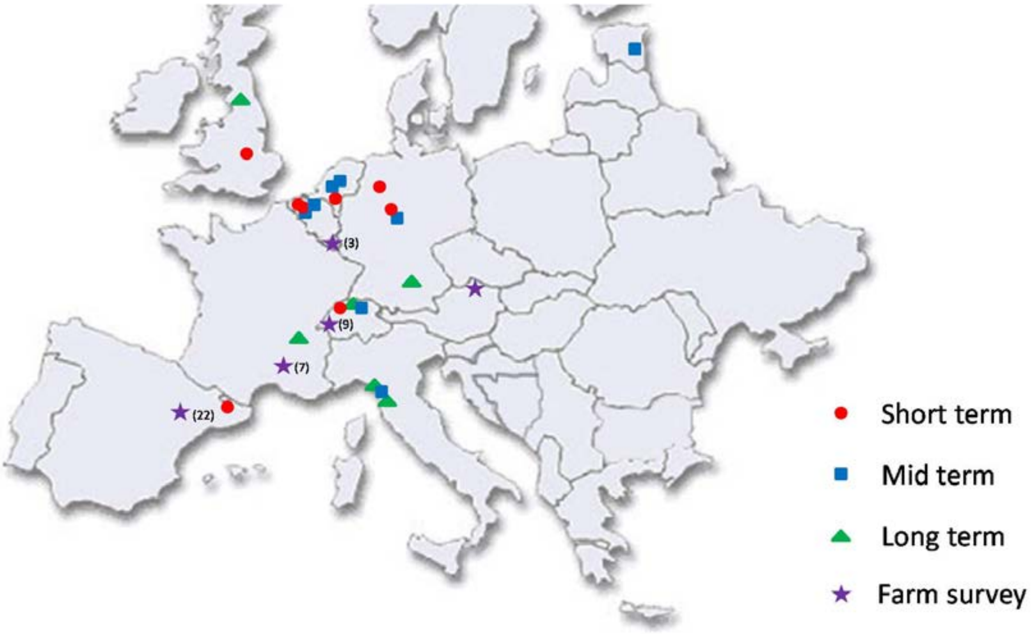

Figure 1. Field trials and farm surveys under investigation in the European network TILMAN-ORG.

Preliminary results from 9 field trials across Europe as shown here will be presented in more detail including hitherto not accomplished soil biological assessments.

Results

Soil organic carbon (SOC) content decreased significantly with soil depth in all soils. Ploughed soils showed a relatively homogenous distribution of SOC within the plough layer but decreased sharply thereunder. The reduction in primary soil tillage intensity and depth caused a relative accumulation in the uppermost soil layer being most important in no tillage soils. In Windpassing (AU) SOC in the uppermost layer was higher in reduced (stubble cleaner) as compared to plough (p=0.05), whereas below this horizon the ploughed soil showed higher SOC values than the reduced tilled one (p=0.05). In the soil beneath the plough layer that has not been tilled at all, SOC ranged between 0.7 and 1.4% across all sites. Compared to this soil layer, where differences between ploughed and unploughed soils at each site were small, SOC in the plough layer was higher by the factor 1.5 to 1.9. In reduced tillage soils this factor ranged between 1.7 and 3.2 for the uppermost layer (0-10 cm) and 1.3 to 2.1 for the layer beneath (10-20 cm). In minimal tillage soils in Scheyern this factor was 2.5 as compared to 1.9 in reduced tillage. Reduced tillage soils over all study sites showed a topsoil (0-10 cm) accumulation of SOC by 15 to 35% as compared to the plough system.

SOC stocks that consider bulk densities in each soil layer showed a decrease with soil depth. Over the 50 cm sampling depth, SOC stocks in reduced tillage soils were not significantly different from those under plough use. In the top ten cm SOC stocks were higher for reduced tillage in Frick and Windpassing and for no tillage in Thil as compared to plough (p=0.05).

Dissolved organic carbon (DOC) decreased with soil depth, except for the site Windpassing, where DOC increased strongly by the factor 5 in the ploughed soil and by the factor 8 in reduced tillage soils. The decrease in DOC was generally stronger in reduced tillage soils than in ploughed soils. In the uppermost soil layer of reduced tillage soils DOC was between 28 and 70% higher than in ploughed soils.

Soil microbial biomass carbon (C_{mic}), as an active soil organic matter pool, also showed a stronger stratification in reduced tillage soils as compared to ploughed soils. Compared to the untilled soil layer below the deepest tillage depth C_{mic} in the topsoil layer of ploughed soils was higher by the factor 2 to 2.9. This factor in reduced tillage soils was 3.4 in Frick and 4.2 to 5.5 (no tillage) in Thil. A repeated analysis with Thil soils in 2013 confirmed these results also for microbial biomass nitrogen. In Scheyern this comparison showed a factor of 2.3 in reduced tillage soils and 3.1 with minimum tillage.

Table 1: Significant soil tillage effects in field trial soils on SOC content (C_{org}) and stocks, dissolved organic carbon (DOC) and microbial biomass carbon (C_{mic})

Site	Tillage	Depth [cm]	C_{org} [%]	C-stock [g m^{-2}]	DOC [µg g^{-1}]	C_{mic} [µg g^{-1}]
Scheyern DE	Chisel 18cm (C) *vs.* Rotary harrow + Cultivator 8cm (R)	0-10	R > C	n.s.	n.s.	n.s.
		10-25	n.s.	n.s.	n.s.	n.s.
		25-50	n.s.	n.s.	n.s.	n.s.
Frick CH	Stubble cleaner 5-7 cm (R) *vs.* plough 15cm (P)	0-10	R > P	R > P	R > P	R > P
		10-20	n.s.	n.s.	n.s.	R > P
		20-50	n.s.	n.s.	n.s.	n.s.
Thil FR	Plough 30cm (P) Plough 18cm (sP) Chisel 15cm (C) No till 5cm (N)	0-10	N > all	N > P	N > P	N > P
		10-20	n.s.	N > P	n.s.	n.s.
		20-30	n.s.	n.s.	n.s.	n.s.
		30-50	n.s.	n.s.	n.s.	n.s.

Soil microbial diversity as assessed by t-RFLP analyses of 16S rRNA genes showed a significant differentiation between soil depths for the field trials in Scheyern, to a lesser extent in Frick and yet not detectable in Thil (analyses are to be confirmed). The different tillage treatments tended to influence microbial diversity patterns in Scheyern, less pronounced in Frick and yet not detectable in Thil. The intensity of change in soil microbial diversity appears to be related to the time of exposure to different tillage systems.

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Conclusions

Reduced soil tillage often leads to accumulation of soil organic matter at the soil surface resp. in the uppermost soil layers, where crop residues are mixed in. This is one of the common features of all the field trials comparing reduced tillage options with the soil inversion by ploughing. The accumulation, however, was only significant when looking at the topsoil layers. When the whole soil profile down to 50 cm depth was examined no difference between reduced tillage and plough tillage was statistically significant. The stratification of soil organic matter and organic matter fractions was more pronounced in reduced or no-tillage soils, however sometimes at the cost of contents in deeper soil layers. Long-term experiments show stronger effects than young experiments, particularly with respect to the microbial community structure.

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Resigning protein concentrates in dairy cattle nutrition: a problem or a chance?

FLORIAN LEIBER[1]

Key words: dairy cattle, feeding concepts, protein, concentrates, rumen fermentation

Abstract

Based on the assumption that the reduction of the use of imported protein concentrates, such as soybean from overseas, is a goal of ecologically sustainable livestock production, this paper is discussing significant aspects of dairy cows' demand for dietary protein. These aspects are put in a general context of rumen fermentation efficiency. The main question is, whether new perspectives on optimal rumen functioning could be found, which allow to develop low-input feed evaluation systems for dairy cattle, especially in organic farming. Besides the reduction in concentrated feedstuff these systems should enable to avoid nutrition based metabolic disorders of the cattle and to indicate advantageous side-effects coming along with low-concentrate feeding. An approximate outline of research and development topics to achieve such systems is presented with this paper.

Introduction

Global needs for soybean as livestock feed are constantly increasing and are considered as a serious environmental and social problem (von Witzke et al., 2011). Generally, but in particular related to soybean, the global land requirements for animal products increase and are prospected to go far beyond the ecological capacity of the earth within the few next decades (Pelletier & Tyedmers, 2010). Especially animal production in European countries relies to a very large degree on soybean imports as the main vegetable protein source for almost all livestock species. Whereas for monogastric species the possibility to resign dietary concentrates is limited, the nutritional physiology of ruminants might allow for considerable reductions in this field. Due to their digestion physiology, which combines fermentation, chewing and particle sorting in a unique way, ruminants, in particular cattle, are able to degrade plant fibres very efficiently (Clauss et al., 2010) and to gain metabolizable energy from roughages which are poor in soluble carbohydrates like sugars or starch. This is the big advantage of ruminants compared to monogastric animals. Correspondingly, ruminants developed a metabolic pathway to reuse blood urea as a nitrogen source by secreting it into the rumen instead of renal excretion and are thus also able to use dietary nitrogen very efficiently (Van Soest, 1994), especially when the supply is low. Based on these considerations, Organic Agriculture should have aim at reducing the use of protein concentrates (soybean) in livestock ruminants' feed rations. Given that goal, it appears necessary to reassess the need of dairy cows for dietary protein in high-roughage feeding systems and to indicate the potential and constraints for resigning or at least reducing dietary protein concentrates.

Protein demands in dairy cow nutrition

The demand of dairy cattle for dietary protein is mostly defined in the national feeding recommendations for livestock. It is usually separated into requirements for maintenance and for milk production and for example based on usability (German system; GfE, 2001) or absorbability (Swiss system; Agroscope, 2013) at the abomasum and duodenum. By this, the ruminal conversion of feed into microbial protein is taken into account, usually based on models which thoroughly consider the contribution of the different feed components to microbial fermentation and degradability of the diet. Thus, the "ruminal" protein demand is defined in quite dynamic and complex models. The endogenous part of the protein demand is not described in such a dynamic way but more or less fixed per kg of body weight and kg of milk yield. These systems allow calculating accurately the dietary demands for given milk yields or – vice versa – the milk production potential of a given diet.

In practice, the farm extension programmes tend to recommend rather too high than too low protein balances in order to be safe in maintaining high milk yields. One indicator for appropriate protein supply of a dairy cow is the urea concentration in the milk, where minimal thresholds are defined, beyond which a cow is expected to develop metabolic disorders.

[1] Research Institute of Organic Agriculture FiBL,Switzerland, Departement of Livestock Sciences, www.fibl.org; florian.leiber@fibl.org.

However, recent experiences in concentrate-free dairy herds in Switzerland show that cows being fed below their theoretical demands in dietary protein may have clearly higher milk yields than calculated, but at the same time less veterinary cases than comparable cows which receive protein concentrates according to the system demands (Furger et al., 2013). These cows show very low milk urea concentrations, which should indicate deficiency in protein supply. It can be assumed that under the specific conditions of the cited research work, the cows reused a large share of their blood urea via the rumino-hepatic circle (Van Soest, 1994). This implies an efficient use of nitrogen, meaning lower dietary demands and lower excretion via urine into the environment, and at the same time higher partitioning of feed protein into milk (Kälber et al., 2012). Further, the rumino-hepatic cycle leads to a lower metabolic pressure for detoxification of rumen-derived ammonia, which would improve the health status of the cows.

It appears that under optimal conditions in concentrate-free feeding systems a low dietary protein supply is not a problem but rather an advantage for the cow's metabolism and the environment. These optimal conditions, however, have to be determined. Forage quality on the one hand and rumen physiology on the other hand are of course the main factors, as in the conventional feeding systems. One key to gain a new position in dairy cows' feeding could be the question whether a maximal rumen fermentation rate is really the right goal in nutrition or not.

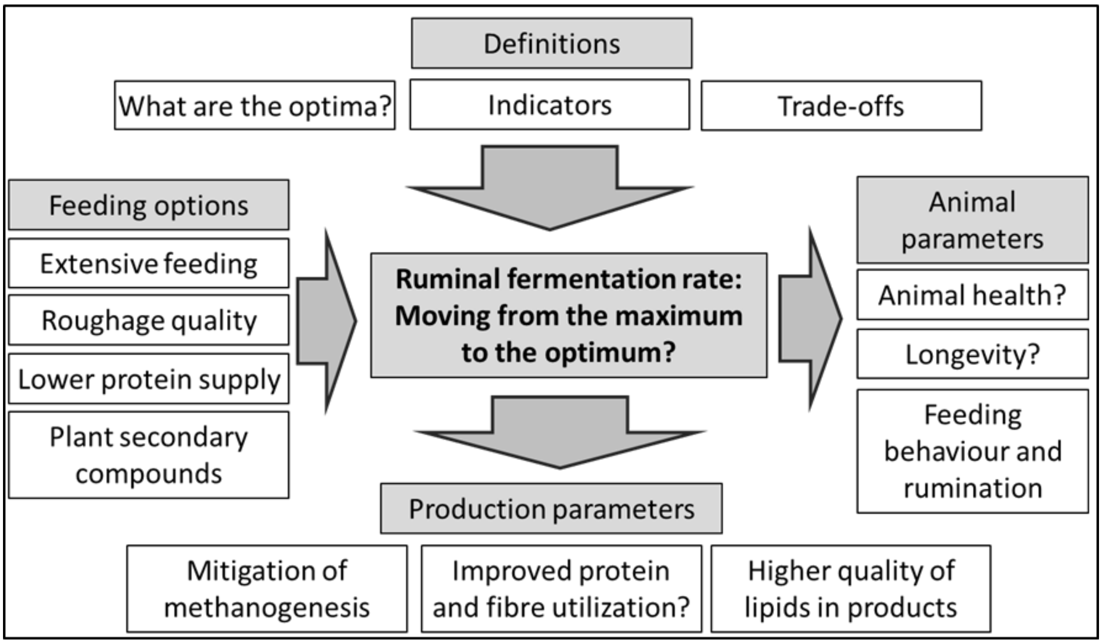

Figure 1. Possible framework of a research & development agenda for optimized low-concentrate feeding systems for dairy cows

The rumen fermentation: is the maximum the optimum?

Contemporary feeding systems for dairy cows are usually aimed to achieve the maximum efficiency of rumen fermentation and at the same time the maximum of proteins (amino acids) reaching the duodenum for absorption. However, there are a number of issues which might serve to question whether the maximal rumen function is really the optimum for the ruminant itself, for the product quality, for the environment, and thus finally for the production system:

(i) If the rumen fermentation and microbial modification of nutrients would be 100% efficient, all polyunsaturated fatty acids, which are essential for any mammal, would be lost in this process and the ruminant could not survive. Therefore, mechanisms exist to interrupt the fermentation process: rumination has not only the function of physical fibre degradation, but it also brings the material from the rumen in contact with oxygen in the cow's mouth during chewing. This inhibits the attached rumen bacteria which are strictly anaerobe and thus stops the fermentation process. The chewing process further activates plant enzymes like the polyphenol oxidase (PPO) because of the contact with oxygen. The PPO is described to inhibit bacterial activity in the rumen thus protecting essential polyunsaturated fatty acids from being degraded by rumen bacteria (Buccioni et al., 2012). The same is supported by the ingestion of phenol rich plants, which therefore play an important role in ruminant diets (Jayanegara et al., 2011). Briefly summarized: partial inhibition of ruminal fermentation is part of the ruminants eating and digestion behaviour and saves essential plant substances for the endogenous metabolism.

(ii) The protection of polyunsaturated fatty acids in the rumen is essential for the ruminant itself, but it also enhances the quality of milk and meat, which may contain higher concentrations of omega-3 fatty acids if the animals are fed with forages rich in PPO or phenolic compounds.

(iii) Also the mitigation of ruminal methane production can be achieved by the same phenolic substances in the diet, which however also implies a partial inhibition of rumen efficiency (Jayanegara et al., 2013).

These examples should introduce a perspective, in which not a maximal but a reduced rumen fermentation would be the goal to achieve an optimum in animal health, product quality, and environmental impact. Also a “low” dietary protein supply, which might reduce maximal microbial growth in the rumen, could be justified and reasonable in this context. However, it is necessary to note, that this is only one perspective, and many other aspects like the degree of fibre utilization and the metabolic animal health have to be kept in mind to achieve a sustainable system. Defining optimal rather than maximal rumen function as a goal in organic livestock systems would require many research activities under controlled as well as under practice conditions in order to find the real optima and the management options to achieve them. The target could be to develop own – organic and science based – feeding recommendations for dairy cows. Figure 1 displays important aspects for the development of such an organic or low-input feeding recommendation system.

Conclusion

On the background of the global challenge concerning the reduction of protein concentrates for livestock and of the indicated ability of dairy cattle to cope with lower protein supplies than recommended, it appears to be necessary to reassess the dietary protein needs of dairy cows fed on high-roughage diets. Further, it seems promising to investigate the specific conditions under which dairy cows can cope with low dietary protein supplies. This should be done in the context of a general investigation about the optimal rates of rumen function, which might be below the maximum, if animal health, environmental impacts and product quality are considered. In this sense, the resigning of protein concentrates from dairy cows' diets in organic farming could be a chance to reconsider the feeding paradigms for ruminant production in a broad perspective.

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Encouraging organic cultivation practices in Swiss allotment gardens

INGRID JAHRL[1], ROBERT HOME[1]

Key words: organic gardening, allotment gardening, motivations, knowledge transfer

Abstract

Allotment gardens are usually managed by associations, with small allotment plots rented to individual tenant gardeners. Many garden associations have rules for organic production but the rules are neither followed nor policed. To find ways to motivate gardeners to manage their plots organically, we investigate the attitudes of Swiss gardeners towards organic gardening, and which motivations can be used to encourage and promote organic garden management. Interviews with 32 gardeners and other key informants from three Swiss target cities were analysed using content analysis. We found that organic practices are more likely when knowledge is held and that the social environment has a strong influence on behaviour, so potential exists for encouraging a culture where organic cultivation is the norm. Education strategies should therefore be developed in consultation with integration and education specialists to enhance their effectiveness by reaching their target groups in a way that encourages the cultural change.

Introduction

In this paper, we investigate the attitudes held by Swiss allotment gardeners towards organic gardening and which motivations can be used to encourage organic garden management. In particular, we investigate whether the availability of information, the understanding of the concept of organic production, and the social environment can combine to form a behavioural intention (Ajzen 1991). However, even in areas with regulations that demand organic management of plots, rules are not always followed, and the associations are reluctant to police them. Motivation strategies for gardeners to garden organically may be more effective than regulation to encourage organic management of allotment gardens. Once such motivations are identified, strategies can be developed to reach this group of producers and consumers. Allotment gardens are under existential threat, which may contribute to a motivation by gardeners to demonstrate sustainability in their practices.

Material and methods

Respondent gardeners were sourced from three Swiss target cities: Basel, Lucerne, and St. Gallen. Data was collected by means of semi-structured interviews with key informants from city administrations, gardening associations, and gardeners in the three cities. The 32 interviews were conducted during the summer of 2013 and analysed using a qualitative content analysis approach (Mayring 2002). The interpretation of the interviews was conducted in conjunction with a review of relevant literature on the topic of allotment gardens in other contexts.

Results

Scope of the problem

In Switzerland, there are 640 hectares of allotments with 25,000 active gardeners. During the last 20 years, there can be seen both, a revival of interest in allotment gardens by urban residents; especially in large cities, and simultaneous competition from other kinds of land use as populations grow. Allotment gardens are usually found on areas of land owned by cities, or in some cases individuals, with smaller individual allotment plots rented to tenant gardeners. The areas are typically governed by an association or club, and the rules and regulations for managing the individual plots vary greatly from area to area. In some cases the city requires the associations to enforce strict regulations, while in others, the cities simply rent the area to the association to manage under the association's own rules. In some cases there are strict rules that plots should be managed using organic gardening practices, while in others, the gardeners have few restrictions in the management of their plots. In any case, policing is almost always left to the associations themselves.

Allotment gardeners produce food and thus have knowledge about food production, and also represent a large and informed group of consumers. An average garden produces 23 kg fruit and 53 kg of vegetables

[1] Research Institute of Organic Agriculture, Switzerland, www.fibl.org, eMail: ingrid.jahrl@fibl.org.

per year, and the gardeners purchase the same amount of fruit and 1.5 times that amount of vegetables each year (IFUA 2001). In addition, allotment gardeners play an important role in terms of nature conservation and environmental protection in cities (BMVBS and BBR 2008). In the same study, 50 % of respondents reported that they produce their fruit and vegetables 'organically': although it was not defined what was meant with the term 'organic', while 48 % of respondents use synthetic fertilizers and 22 % use chemical pesticides (BMVBS and BBR 2008). In cases where gardeners follow the rules and garden 'organically', studies in Swiss allotment gardens have shown that the concept of organic gardening is often simply understood as being only the absence of synthetic fertilizers and pesticides (Kern 2005, Christl et al. 2004). In summary, allotment gardens have a significant role to play in the production of organic food, and in the sensitisation to the concept of organic production, but this potential is not being fully realised.

Characteristics of gardening in allotment gardens

To be involved in allotment gardening is to be involved in an association with rights and obligations. Examples of obligations are to observe building codes, to work in common tasks (e.g. separating hedges), to keep an orderly garden that appears managed, and to regularly take action to prevent excessive spreading of weeds. The rules are established by the municipality and/or the association. Despite the obligations, the demand for allotments exceeds the offer and is increasing in all of the case study cities. The new demand is often from young women or families and the association representatives welcome the interest expressed by younger newcomers as they are seen as bringing new dynamism to allotment garden areas. On the other hand, they are also regarded with some suspicion and doubts are expressed by the older established gardeners about the long term commitment of the newcomers: believing that the younger newcomers often underestimate the workload. The majority of allotment gardeners tend to be older with many in retirement age. Allotment garden areas are often under existential threat as there is development pressure in cities with increasing urbanization. Many garden areas have had to give way to construction projects, such as residential housing or public recreation areas in the cities. A demonstrated interest in allotment gardens has been put forward as an argument for maintenance of the allotment garden areas in their present form.

Motivation for gardening in allotment gardens

A variety of reasons for maintaining an allotment garden were offered. The opportunity to engage in purposeful physical activity, and finding a counterbalance to work, were often cited as reasons among the younger gardeners. For older gardeners, the garden provides a meaningful occupation that gives structure to their days along with a strong social component. Allotment gardens initially served a role in contributing to food security, or at least an affordable supply of fresh food. This role has gradually evolved and the recreational use, such as meeting friends and barbecuing, in the gardens has increased in recent years. The cultivation of vegetables and flowers is however universally required in allotment gardens in the target cities. In addition, a motivation that was frequently expressed is to experience actually producing, rather than purchasing, food: especially young gardeners and families with children stated an interest in experiencing the cultivation of fruit and vegetables. The conscious handling of food and appreciation of food are other reasons which are especially important for younger allotment gardeners.

Approaches to organic gardening

Many gardeners consider the avoidance of synthetic pesticides or artificial fertilizers to be equivalent to organic gardening. The term 'organic' is perceived by some gardeners: especially older gardeners, to have a negative connotation, and is seen as synonymous with 'neglectful', although the term is perceived positively by others. There are the gardeners who consider themselves to be organic gardeners, but use synthetic pesticides and fertilizers when they feel it is necessary. Other gardeners concede that they use synthetic inputs and so often call themselves "natural gardeners" rather than organic gardeners. Most association representatives, and also the gardeners, claim that much less synthetic pesticides and fertilizers are used today than in the past: due to a general awareness through the media and in some cases due to regulations and policies by the associations: sometimes on behalf of the cities, that encourage or demand natural or organic garden practices. Reasons given for the use of pesticides were also varied. While some gardeners have a very pragmatic approach to gardening, with the use of synthetic means against snails or on flowers considered to be acceptable, but the use of pesticides on vegetables to be avoided. Mulching, or the use of organic seeds, is often not considered to be an issue related to organic gardening. However many gardeners are knowledgeable about composting and implement it in practice: often passing on their knowledge to their neighbours.

Knowledge transfer in allotment gardens

Many of the gardeners learned their gardening skills from their parents and grandparents, and update their knowledge with books and brochures, such as the monthly magazine of the Swiss allotment gardeners confederation. This information, however, is distributed in German and French, so is not readily accessible for immigrants, who make up a significant proportion of the gardeners. The Internet serves as an important source of information for young gardeners. Courses and consultancy appear to be of minor importance, and in many cases are not even offered by either the cities or the associations. Other gardeners: usually direct neighbours, are a very important source of horticultural information, although tips and tricks are best accepted when asked for, rather than when offered.

Social controls

The gardens are generally closely situated, and there is a high degree of observation about what the neighbours do. This also creates a certain pressure to keep the garden "in order" and to abide by the rules. It is also interpreted as being restrictive, and some gardeners: particularly new gardeners, are reluctant to engage in organic gardening practices for fear of being perceived to be neglectful. Some older established gardeners claim that organic gardening is not possible on the small allotment plots. The primary social restriction however is disapproval of the expansion of use of the plots from food production to an increased recreation component. Established neighbours tend to resist change.

Discussion

The decision of whether to garden organically is a result of the attitude held by the gardener, which is more important than regulations, which are anyway not policed. Results show that the ecological awareness of gardeners has increased over time and especially young gardeners often aim to garden organically. The knowledge of organic gardening practice has an influence, with synthetic agents more likely to be used when knowledge of alternatives is lacking. Many established gardeners do not access the available information and tools for organic garden management. Furthermore, immigrant gardeners may not have the communication skills to access this information. The understanding of the term 'organic' is varied and the social environment has an influence on the form of gardening. There is potential for creating a culture where organic cultivation is the norm. The existential pressure on the gardens is an opportunity to start the necessary cultural change that would otherwise be resisted.

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Variability of Soil Fertility and Crop Yield on a Sandy Field Site in Western Poland under Bio-dynamic Management

ANDREAS FLIEßBACH[1], TON BAARS[2], SEBASTIAAN HUISMAN[2], THORSTEN JORGAS[2], MAJA LEWANDOWSKA[2], CORNELIUS STRÄßER[2], PAUL MÄDER[1]

Key words: reduced tillage, on-farm trial, sandy soil, soil fertility

Introduction

In the highly variable landscape of western Poland that has developed after the last glaciation about 10000 yrs. ago heavy clay soils, peat, and light sandy soils are abundant and often occur close to each other. Sandy sites are often the most troublesome to manage as they have a low water holding capacity and low pH. The role of organic matter in these soils is highly important to enhance soil fertility. In the study area soils were managed according to bio-dynamic principles since 1995. However, soil fertility is still not satisfying because of the limited amount of manure available. Without irrigation crop yields are low, due to low rainfall between March and June and low water holding capacity of soils (mean annual precipitation 750 mm, mean annual temperature 8.5°C). The aim of our research project on the Juchowo farm was to enhance soil fertility and stability by implementing reduced soil tillage in combination with mineral supplements as additional fertilizers to the regular manure application. The selected field for our research project has been tested for homogeneity of soil analyses and crop yield, the results of which are presented here.

Material and methods

A field site on the Juchowo farm has been selected for analysing the spatial variability of soil fertility and crop yield. On a selected area of approx. 3 ha, 40 plots of 12 × 50 m size were defined and soil samples were taken in May 2010 as a bulk sample from 20 soil cores down to 70 cm depth. In each of the soil layers sampled (0-10, 10-30, 30-50, 50-70 cm) pH (0.1M KCl), soil texture, soil carbon and total nitrogen (Nelson and Sommers, 1996) and plant available nutrients (Egnér et al., 1960) were determined. Soil microbial biomass carbon (C_{mic}) and nitrogen (N_{mic}) (Brookes et al., 1985; Vance et al., 1987) and soil basal respiration (Isermeyer, 1952) was determined in the two top layers only (0-10 and 20-30 cm). Winter rye was cultivated in 2010 and was harvested plot-wise with a farm-owned harvester. All data were subject to statistical testing using a combined model (JMP 8.0, 2008).

Results

The soils of the field averaged at 91.4% sand, 6.3% silt and 2.3% clay and had a bulk density that was slightly increasing with depth from 1.48 to 1.57 g cm^{-3}. In the selected field, two zones were identified with clearly different winter rye grain yield (14% moisture). Overall the yield was very low. Along a slight slope grain yields were 0.78 (± 0.09) t ha^{-1}, whereas they were 1.2 (± 0.12) t ha^{-1} on a plain area. Soil organic C in the top soil was 6.3 (± 1.4) mg g^{-1} and decreased to 3 (± 1.4) mg g^{-1} in the lowest soil layer. The trend for total N was similar. In the zone with high crop yield, soil carbon stocks over 0-70 cm depth averaged at 31 (± 5.7) t ha^{-1}, whereas in the zone with low crop yield they were 23 (± 3.5) t ha^{-1}. Nevertheless, the regression of crop yield with carbon stocks was low with r^2=0.2. C_{mic} in the top 30 cm of the high yield area were 441 (± 65) kg ha^{-1} and in the low yield area they were 341 (± 57) kg ha^{-1} and correlated with an r^2=0.48 to rye yield. The same r^2 was found for N_{mic} showing 67 (± 10) kg ha^{-1} in the high yield area and 52 (± 5) kg ha^{-1} in the low yield area.

Soil pH averaged at 6.2 in the top layer (0-10 cm) and increased to 6.6 at 50-70 cm depth. pH was negatively correlated to soil organic carbon indicating either a pH effect on carbon stabilization or carbon inputs decreased soil pH. Phosphorus and potassium-levels also showed some spatial effects but were poorly related to crop yield.

This assessment of spatial variability served to design a balanced layout of a field trial. The effect of four reduced tillage options (cultivator and skim plough with or without loosening at 30 cm) as compared to ploughing at 30 cm depth is currently tested with regard to the development of soil fertility parameters and crop yield. Farm owned machinery is used for all field operations.

[1]Research Institute of Organic Agriculture (FiBL), Switzerland, www.fibl.org, andreas.fliessbach@fibl.org
[2]Fundacja im. Stanisława Karlowskiego, Juchowo, Poland, www.juchowo.org

Discussion

Soil organic matter is an important factor to explain crop productivity at this site due its multiple functions in physical, chemical and biological characteristics of soil fertility. The role of soil microbial biomass as a biological indicator of soil fertility and as a source and mediator of plant nutrients has been approved (Jannoura et al., 2013). The multifactorial role of soil organic matter in supporting soil fertility and crop growth appears to be of particular importance in sandy soils.

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Functional biodiversity to improve pest control in annual and perennial cropping systems

LUKAS PFIFFNER[1], HANS-JAKOB SCHÄRER[1], HENRYK LUKA[1/2]

Key words: functional agrobiodiversity, habitat management, natural enemies, pest control, flowering strips, companion plant

Abstract

A sustainable use of functional agrobiodiversity (FAB) providing habitats with suitable floral resources is needed to conserve and improve pest control by natural enemies in organic cropping and other low-input systems. We present an overview on our activities identifying appropriate flowering plants in relation to the antagonists-pest complex and quantifying benefits and limits in lab- and field tests. We have focussed on the control of apple-aphids and cabbage lepidopteran pests in two organic cropping systems. We can show that tailoring the flowering strips to the needs of specific natural enemies within a cropping system is a key issue for successful application of FAB. We found plants as Fagopyrum esculentum, Centaurea cyanus and Vicia sativa enhancing target parasitoids in cabbage, and we found Daucus carota, Carvum carvi, Pastinca sativa, Vicia sepium as promising plants in apple orchards. A successful on-farm application of FAB using flowering strips and companion plants is challenging and needs further analyses of its impact on pest control, considering different scales as plot, farm and landscape.

Introduction

There is a growing concern that declining biodiversity caused by intensive agriculture affects ecosystem services. Due to landscape fragmentation and loss of suitable habitats natural enemies have been reduced in species diversity and abundance. In consequence this leads to a substantial loss of biocontrol function. Therefore a sustainable use of FAB, providing habitats with suitable floral resources to conserve these functions, is needed (Bianchi et al. 2013). Herbivore populations are regulated by bottom-up control through food availability and quality and by top-down control by natural enemies. Land-use dominated by monocultures provides abundant food to specialized herbivores and simultaneously has a negative impact on natural enemies because lacking in adequate food sources (Balmer et al. 2013). We have found insufficient effects of 'unspecific' flowering strips, which were based on officially recommended plant mixtures, targeting to increase the overall biodiversity (Pfiffner et al. 2009). Therefore we have tailored the strips in relation to the requirements of the specific complex of natural enemies within a cropping system.

Here we focus on flowering plants as one promising approach to boost pest control within a four-step pest-control strategy (Zehnder et al. 2007). We present an overview on the activities in which we analysed this targeted approach in two cropping systems. The overall objective was (i) to identify appropriate plants in relation to the antagonist-pest complex, (ii) to quantify the benefits and assess the limits under field conditions.

Material and methods

We have focused our activities on two model crops as apple with multi-annual flowering strips and cabbage cropping system using annual strips and companion plant. Apple and cabbage were selected since perennial and annual crops differ greatly in biology and management and are highly productive and economically relevant.

The use of flowering strips was tested in organic apple and cabbage cropping systems on different farms in low-land of Switzerland. First, based on literature data, we conducted lab-trials to identify selective plant species that would improve the longevity and fecundity of natural enemies (parasitoids, predators) without benefiting the pests and are attractive to natural enemies (olfactory tests). Effects of floral and extra-floral nectar of the plants were analysed in the cabbage crop. Afterwards we investigated the impact of the flowering strips under field conditions, focussing on the control of aphids in apple and lepidopteran pests (*Mamestra brassicae: Noctuidae)* in cabbage. Weekly visual observations, monthly beating-tray samples and branch samples in winter on randomly chosen trees were performed to analyse the impact in a low-tree

[1] Research Institute of organic agriculture (FiBL), Ackerstrasse 21, Postfach 219, 5070 Frick, Switzerland, lukas.pfiffner@fibl.org; www.fibl.org
[2] University of Basel, Department of Environmental Sciences, NLU-Biogeography

orchard with and without flowering plants. To better understand the plant-parasitoid interaction, we have studied the olfactory attractiveness of five wildflowers (*Ammi majus*, *C. cyanus*, *F. esculentum*, *Iberis amara* and *Origanum vulgare*) to *Microplitis mediator* (Braconidae), a larval parasitoid of the cabbage moth *M. brassicae*. We conducted choice experiments in a Y-tube olfactometer to test the attractiveness of flowers against air and the relative attractiveness in paired choice tests.

Results and discussion

One of the most relevant pest species of cabbage in central Europe is *M. brassicae.* Its primary larval parasitoid is *M. mediator* and the main egg-parasitoids are *Trichogramma brassicae, T. evanescens (Trichogrammatidae*) and *Telenomus sp.* (*Scelionidae*).

Beneficial effects of *F. esculentum* (floral nectar), *C. cyanus* (floral and extrafloral nectar) and non-flowering *V. sativa* (Extrafloral nectar (EFN)) on parasitoids *M. mediator* have been found in lab-tests (Geneau et al. 2012). Longevity and fecundity of the pest (*M. brassicae*) were not increased by the plant species tested. Longevity of *M. mediator* as well as parasitism rates of *M. mediator* were significantly increased by the presence of *F. esculentum, C. cyanus* and non-flowering *V. sativa* (EFN only). The key parasitoid *M. mediator* parasitized 202.3±29.7 *M. brassicae* larvae during its lifetime when presented *F.esculentum*, compared to 14.4±3.4 larvae in the absence of floral resources (Geneau et al. 2012).

The olfactory test of plant attractiveness showed that *C. cyanus* and *I. amara* were greatly attractive to the target parasitoid *M. mediator*. This has shown innate preferences that can be effectively exploited in biological control (Belz et al. 2013).

Our field trials showed that the application cornflowers as companion non-crop flowering plant within the crop can significantly increase parasitism by larval parasitoids. Additionally, higher parasitism and predation of herbivore eggs finally reducing crop damage and may increase yield (Balmer et al. 2013). Companion plant presence lead to a significant increase in parasitation of *M. brassicae* by *M. mediator* and had a significant positive effect on cabbage head weight and the number of damaged leaves was also significantly lower in plots with companion plants (Balmer et al. submitted).

Furthermore, we found higher abundance and species richness of spiders and carabids in flowering strips compared to adjacent cabbage fields (Dittner et al. 2013). Intersown cornflowers had a positive effect on spider and carabid abundance. Other predators such as syrphids, chrysopids and coccinellids were also detected on these flowering plants. The species richness of spiders and carabids was only weakly affected by this companion plant.

Table 1: Impact of FAB using flowering strips on a key-pest and their natural enemies and pest-control function in a cabbage and apple cropping system (data sources in references 1, 2, 4, 5, 8 and 9)

	lab-trial		**field test**				
	Increased (parasitoids)		*Reduced*	*Increased*		*enhanced density of*	
	fecundity	*longevity*	*pest density*	*parasitism*	*predation*	*predator*	*parasitoids*
M. brassicae	+	+	+	++ (larvae)	+	+	o
in cabbage[1)]				+ (egg)			
D. plantaginea	o	o	+	-	++	++	-
A. pomi	o	o	+	-	+	++	-
in apple [2)]							

Legend: + +: high impact, +: moderate impact, o: not investigated, -: not found
Useful plants in [1)] *F. esculentum, C. cyanus, V. sativa* [2)] *D. carota, C. carvi, C. sepium, L. corniculatus, M. sativa*

Apple orchards are in general characterised by simplified plant and animal communities. The soil below the trees is often kept bare and has a uniform flora dominated by grass which is mulched regularly. Using flowering strips in organic apple orchards we found a positive impact in controlling apple key pests (Wyss et al. 2005). The higher numbers of all relevant predator groups (Coccinellids, Chrysopids, Syrphids, Cecidomyiids, Bugs, Spiders, Staphylinids) leads to a better pest control in the plots with flowering plants compared to the control plots without (Wyss 1995a). These predators were able to keep the aphids (*Dysaphis plantaginea, Aphis pomi*) under the commercially threshold In autumn, spiders (i.a. *Araniella sp.)*

were the dominant predators of aphids and they were significantly more reduced in the area with flowering strips compared to areas without flower strips. This was mainly due to higher abundance of spiders and more spider webs (Wyss et al. 1995b).

Conclusions

An accurate plant screening is essential to achieve plant selectivity and to maximize biological control. In cabbage crop, *Fagopyrum esculentum, Centaurea cyanus and Vicia sativa* can be recommended as selective plant species to enhance target parasitoids. In orchards it is challenging to establish a perennial flower strip. Plants of the family of Apiaceae (*Daucus carota, Carvum carvi, Pastinca sativa*) and others (*Vicia sepium, Lotus corniculatus, Medicago sativa*) are promising plants.

For a successful practice, the composition of the agro-biodiversity elements needs to be adapted to the crop, pest complex, pedo-climatic conditions, as well as to the farm structure and the farmer. Suitable tailored flowering plants can also improve the efficacy of commercially available biocontrol agents. The pest-damage reduction has to be substantial within the pest-control strategy and the management needs to be practically and economically feasible.

The implementation of FAB to effectively control pests in the practice of farming systems is a challenge and we are still at the beginning of the development of eco-intensification. We want to find the optimal use of specific biodiversity elements and further research is therefore needed to appropriately combine indirect-preventive measures and direct intervention strategies which are effective in controlling pests and finally pay off for farmers and the environment.

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Greenhouse gas fluxes in agricultural soils under organic and non-organic management

ANDREAS GATTINGER[1]*, C. SKINNER, A. MULLER, H.-M. KRAUSE, A. FLIESSBACH, P. MÄDER

Key words: nitrous oxide, methane, farming systems, climate change

Introduction

Farming practices are known to exert strong control over the soils' function to act as sources or sinks for greenhouse gases (GHG). A recent meta-analysis based on the evaluation of 74 published long-term system comparisons provides a comprehensive data base regarding soil organic matter development (SOM) and C sequestration potential of organic systems (Gattinger et al., 2012). Furthermore, the impact of sustainable land management practices including organic farming on soil carbon was also analysed for agricultural systems under Mediterranean climate (Aguilera et al., 2013. A comprehensive literature review on GHG (= non-CO_2) fluxes in agricultural soils under organic and non-organic management is missing. The generally lower N input level in organic agriculture compared to non-organic supports the expectation of lower nitrous oxide emissions and enhanced methane uptake in organically managed soils. There are some indications that organic agriculture leads to less soil-born greenhouse gas emissions than conventional agriculture (Niggli et al., 2009), but this phenomenon has, however, never been investigated systematically. Thus a comprehensive literature review followed by a meta-analysis was conducted to compare non-CO_2 GHG emissions from soils under organic and non-organic management. In addition we provide first GHG flux data from the well-known DOK farming system trial in Therwil/CH.

Material and methods

A literature search on measured soil-derived greenhouse gas (GHG) (nitrous oxide and methane) fluxes under organic and non-organic management from farming system comparisons was conducted and followed by a meta-analysis. Eligible data originates from paired comparisons on organic and non-organic farming systems from peer-reviewed research papers that report field measurements of nitrous oxide and methane fluxes from agricultural soils. Most of the collected research papers were published in scientific journals but also studies from conference proceedings, book chapters and dissertations were included to enlarge the data set, since those contributions also undergo a peer-review process. All studies are based on farming system comparisons where the organic practice was explicitly defined as such by the respective authors. In the current paper the term non-organic is applied to a range of modern management systems which are defined as conventional or integrated and, as such, its exact meaning varies across studies. We thus take non-organic to mean any farming system, which could rely on the use of synthetic nitrogen fertiliser and chemical plant protection means. We employed random effects meta-analysis to investigate our data as described by Gattinger et al. (2012). Meta-analysis is a statistical technique to combine and compare results from a range of independent studies, by weighing these results according to their different precisions, reflected in their standard deviations and underlying replications. We employed the inverse-variance method conventionally used in meta-analysis as well as in meta-analysis on GHG flux data as a weighing function of the various studies. All the analyses were done with the "Comprehensive Meta-Analysis 2.0" software (Biostat, Englewood, NJ/USA). Further informations can be obtained from Skinner et al. (2014).

In addition to the meta-analytical evaluation of the already published GHG flux data, GHG flux measurements in organic and conventional treatments of the DOK farming systems trial (Mäder et al., 2002) are conducted since 2012 by weekly gas samplings with the closed chamber technique according to Hutchinson and Mosier (1981). These activities are paralleled by molecular analyses of the underlying soil microbial communities by quantifying functional genes involved in nitrification and denitrification (Harter et al., 2013), the main processes for nitrous oxide formation in soil.

Results

Meta-analysis

Up to date 19 GHG studies from pair-wise farming system comparisons could be retrieved (Skinner et al., 2014). All 19 retrieved studies were conducted in the Northern hemisphere under temperate climate. Based

[1]Research Institute of Organic Agriculture (FiBL), Switzerland, andreas.gattinger@fibl.org, www.fibl.org

on 12 studies that cover annual measurements, it appeared with a high significance that area-scaled nitrous oxide emissions from organically managed soils are 492±160 kg CO_2 eq. ha^{-1} a^{-1} lower than from non-organically managed soils (Table 1). For arable soils the difference amounts to 497±162 kg CO_2 eq. ha^{-1} a^{-1}. However, yield-scaled nitrous oxide emissions are higher by 41±34 kg CO_2 eq. t^{-1} DM under organic management (arable and use). To equalize this mean difference in yield-scaled nitrous oxide emissions between both farming systems, the yield gap has to be less than 17% (data not shown). For a comprehensive GHG assessment of a given farming system not only the soil-derived emissions but also all other emissions caused by the production of different (synthetic) fertilisers, energy use from farm machinery and irrigation, as well as emissions caused by livestock and manure, need to be accounted for as well (Gattinger et al., 2012). This, however, is beyond the scope of the current study.

The higher nitrous oxide emissions determined for non-organic farming systems can be linked with the higher N inputs applied. In average non-organic farming systems received 156 and 191 kg N ha^{-1} a^{-1} as external (only fertiliser) and total N (fertiliser + plant residues) inputs, respectively, as opposed to 89 and 123 kg N ha^{-1} a^{-1} applied in the organic systems. However, according to the results from the meta-regression N inputs appear to be an important determinant for nitrous oxide emissions in soils under non-organic but not for those under organic management. This can be explained by the higher bioavailability of the synthetic N fertiliser in non-organic farming systems, whereas the N inputs in the organic systems consist mainly of farmyard manures and plant residues including those from grass-clover leys where N availability is much lower. These findings on influential factors have been derived with meta-regression on rather small data sets and have thus descriptive indicative character only and should not be used for statistical inference.

Table 1: Mean differences as revealed by meta-analysis of area- and yield-scaled nitrous oxide (N_2O) emissions under organic compared to non-organic management for the different land use types

	Area-scaled N_2O emissions (kg N_2O-N ha^{-1} a^{-1})					Area-scaled GWP [d] N_2O emissions (kg CO_2-eq. ha^{-1} a^{-1})					Yield-scaled GWP [d] N_2O emissions (kg CO_2-eq. t^{-1} DM)				
land-use	MD [a]	CI [b]	p	studies	comp. [c]	MD [a]	CI [b]	p	studies	comp. [c]	MD [a]	CI [b]	p	studies	comp. [c]
all (annual)[f]	-1.05	0.34	0.00	12	70	-492	160	0.00	12	70	42.4	33.1	0.01	7	25
arable	-1.06	0.35	0.00	11	67	-497	162	0.00	11	67	41.1	34.2	0.02	6	23
grassland	-2.33	5.40	0.40	2	3	-1091	2531	0.40	2	3	45.6	190.3	0.64	2	2
rice-paddies	-1.38	2.22	0.22	1	3	-646	1040	0.22	1	3	-25.4	49.2	0.31	1	3
overall[g]	-0.93	0.25	0.00	18	98	-434	118	0.00	18	98	30.7	28.9	0.08	8	30

[a] MD, Mean Difference under organic treatments; negative values mean less emissions compared to non-organic treatment, [b] ± 95%confidence interval (CI), [c] comparisons, [d] Greenhouse Warming Potential (GWP) [f] all annual measurements excl. rice (arable & grassland), [g] all landuse types excl. rice; annual and short time measurements, [h] no data available for respective land-use type

Table 2: Mean differences as revealed by meta-analysis of area- and yield-scaled nitrous oxide (CH_4) emissions under organic compared to non-organic management for the different land use types

	Area-scaled CH_4 fluxes (kg CH_4-C ha^{-1} a^{-1})					Area-scaled CH_4 fluxes (kg CO_2-eq. ha^{-1} a^{-1}) [f]					Yield-scaled CH_4 fluxes (kg CO_2-eq. t^{-1} DM)				
land-use	MD [a]	CI [b]	p	studies	comp. [c]	MD [a]	CI [b]	p	studies	comp. [c]	MD [a]	CI [b]	p	studies	comp. [c]
Arable	-0.10	0.15	0.01	3	8	-3.2	2.5	0.01	3	8	-2.10	2.33	0.08	2	5
Rice paddies	9.37	8.19	0.00	1	3	950	415	0.00	1	3	128.3	26.1	0.00	1	3

a MD Mean Difference under organic treatments; negative values mean (higher) uptake, positive (higher) emissions compared to non-organic treatment;
b ± 95%confidence interval (CI); c comparisons

Our literature evaluation further revealed a net methane uptake in arable soils (3 comparative studies) independent from the farming system. In organically managed soils, methane uptake is more pronounced compared to non-organic with a mean difference of 3.2±2.5 kg CO_2 eq. ha^{-1} a^{-1} (Table 2). This might be related to higher mineral N contents in the soil solution under non-organic management suppressing the activity of the relevant enzymes for microbial methane oxidation.

GHG fluxes in organic and conventional treatments of the DOK farming systems trial

To further broaden the knowledge base on the climate impact of organic and conventional farming systems, since August 2012 GHG fluxes are measured weekly in the well-known DOK farming systems trial (Mäder et al., 2002) for a time span of 48 months. First evaluation of the 12 months data of a grass-clover/maize sequence revealed highest nitrous oxide and highest methane emissions in those treatments which are managed conventionally and receive farm yard manure (data not shown). Most of the emissions of both gases occurred in the spring period and early summer after ploughing of the grass-clover ley and application of fertilizers when soil temperature and moisture content were most favourable. Unexpectedly high nitrous oxide emissions were also determined in the unfertilised treatments, which serves as control. This might be an indication, that in systems which receive neither mineral nor organic N fertiliser, nitrous oxide losses can be substantial, when a vigorous plant cover for N uptake is missing. On-going molecular analyses will reveal if the observed differences in nitrous oxide emissions between organically and conventionally managed soils is due to different functionalities of the underlying soil microbial communities.

Conclusions

There is scientific evidence for lower nitrous oxide emissions from organically managed soils when scaled to the area. However, further data from farming system comparisons are required, particularly from long-term GHG measurements covering several cropping seasons or ideally entire crop rotations. This enables closing knowledge gaps concerning N fluxes and pools under organic management as well as the formation of the new soil ecosystem (soil quality) equilibrium after implementing organic practices. Substantial reductions of nitrous oxide emissions as well as enhancement of methane uptake can be reached by consequent application of "good agricultural practice" and simple adoptions of soil management, forming together a balanced set of GHG mitigation mechanisms.

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Conversion to Organic Farming as an Opportunity for Syrian Farmers of Fresh Fruit and Vegetables: An Application of the Theory of Planned Behaviour

IRWA ISSA[1] , ULRICH HAMM[2]

Key words: farm conversion, theory of planned behaviour, attitudes, structural equation modelling

Abstract

The export of organic fruit and vegetables to the European Union might offer a great opportunity for Syrian farmers and exporters. Yet, the organic sector in Syria is comparatively young and only a very small area of fresh fruit and vegetables (FFV) is organically managed. To date, little is known about Syrian farmers' attitudes towards organic fruit and vegetable production. Therefore, the aim of this study was to explore the intentions and attitudes of Syrian farmers of FFV towards organic farming and the likelihood of converting their farms to organic production within the next five years. The study was based on a survey among 266 Syrian farmers. The theory of planned behaviour (TPB) was used as theoretical framework and partial least squares structural equation modelling (PLS-SEM) as the main tool for data analysis. The results show that the majority of farmers currently use at least one of the practices, which are also part of certified organic production, and hold strong positive attitudes and intentions to adopt organic production within the next five years.

Introduction

Syria is a major producer and exporter of various agricultural products in the Arabic region. Different varieties of fruit and vegetables are produced, and a considerable amount is exported. Before the political rumours, Syrian fresh fruit and vegetables were mainly exported to the neighbouring countries and the Gulf States as well as to Eastern European countries. Although the EU is potentially one of the most profitable markets of high quality fruit and vegetables in the world, Syrian exports of FFV to Western European countries like Germany have been small. It could be a lucrative opportunity for Syrian growers and exporters of FFV to export high value organic products to markets such as Germany, where national production is limited to a few months due to climatic conditions. Yet, the organic sector in Syria is comparatively young and only a very small area of FFV is certified according to EU organic regulations. However, many farmers are producing FFV traditionally with low chemical inputs. These are good pre-conditions for further expansion of organic agriculture among Syrian farmers. So far no research has been conducted on Syrian farmers' attitudes towards organic fruit and vegetable production. Therefore, the aim of this study is to explore the intentions and attitudes of Syrian farmers of fresh fruit and vegetables towards organic farming.

Material and methods

In order to explore the intentions and attitudes of Syrian farmers towards organic farming and the likelihood to convert their farms to organic, the theory of planned behaviour (TPB) was used as theoretical framework (Ajzen, 2012). The theory of planned behaviour stipulates that the intention to perform a specific behaviour (BI) is the immediate antecedent of that behaviour (B), and the intention itself is considered as a function of attitude towards the behaviour (ATT), subjective norm (SN) and perceived behavioural control (PBC). Moreover, the theory of planned behaviour assumes that these three conceptual components of a person's intention to perform a specific behaviour are also functions of behavioural beliefs (bsoe), normative beliefs (nbmc) and control beliefs (cbpc), respectively (Ajzen 2012, see figure 1). Thus, behavioural intentions are basically derived from person's salient beliefs (i.e. bsoe, nbmc & cbpc). The effects of these beliefs on behavioural intention, however, are indirect (i.e. mediated) through ATT, SN and PBC, respectively. Therefore measuring those beliefs is important to better understand a person's intention to perform behaviour. Following the theory of planned behaviour, it is important to formulate questionnaire statements that represent best the TPB components. In order to do that, the *'principle of compatibility'* should be followed:'' *a single behaviour can be viewed as involving an action directed at a target, performed in a given context, at a certain point in time''* (Ajzen and Fishbein 2005: 182). In this study the four elements are

[1] Department of Agricultural and Food Marketing, University of Kassel, Steinstrasse 19, 37213 Witzenhausen, Germany, Internet: www.agrar.un-kassel.de/alm. E-Mail: issa.irwa@gmail.com.
[2] Department of Agricultural and Food Marketing, University of Kassel, Steinstrasse 19, 37213 Witzenhausen, Germany, Internet: www.agrar.un-kassel.de/alm. E-Mail: hamm@uni-kassel.de.

explicitly identified as follows: the *action* is defined as '*producing fruit and vegetables organically*', the *target* is '*organic fruit and vegetables'*, the *context* is '*the specific farm*' and the *time* frame is set as '*five years*'.

The survey region for this study and the main production area for FFV in Syria is the coastal region, where 1.1 and 1.2 million tons of citrus fruit and tomatoes, respectively, were produced in 2010 by about 100,000 farmers and workers (MAAR 2012). Using a cluster sampling procedure, about 266 conventional farmers in 75 villages located in different districts of the coastal region were selected for this survey. The data was collected through face-to-face interviews by a project partner in Syria (Citrus Fruit Board in Tartous). A pre-test of five interviews was conducted in November 2012. Data was collected between December 2012 and mid of May 2013. The data for this paper was mainly analysed with partial least squares structural equation modelling (PLS-SEM). PLS-SEM is a prediction-oriented technique that tries to maximize explained variance in the model using ordinary least squares (Hair *et al.* 2013). Results of PLS-SEM are shown in (Figure 1, Table 1).

Results

60% of the interviewed farmers had heard about the term 'organic farming' through different sources. Their understanding of organic farming, however, varies from avoiding chemical inputs to a correct description of what certified organic farming includes. The majority of farmers indicated that they use 'low chemical inputs' on their farms, and that their current practices for maintaining soil fertility (94% of farmers) and for pest control (86% of farmers) includes at least one of the practices that are part of certified organic production. For instance, 89% of farmers used livestock manures for their fields and 60% and 68% of farmers indicated using biological enemies and physical-pheromone traps, respectively, for controlling pests and diseases.

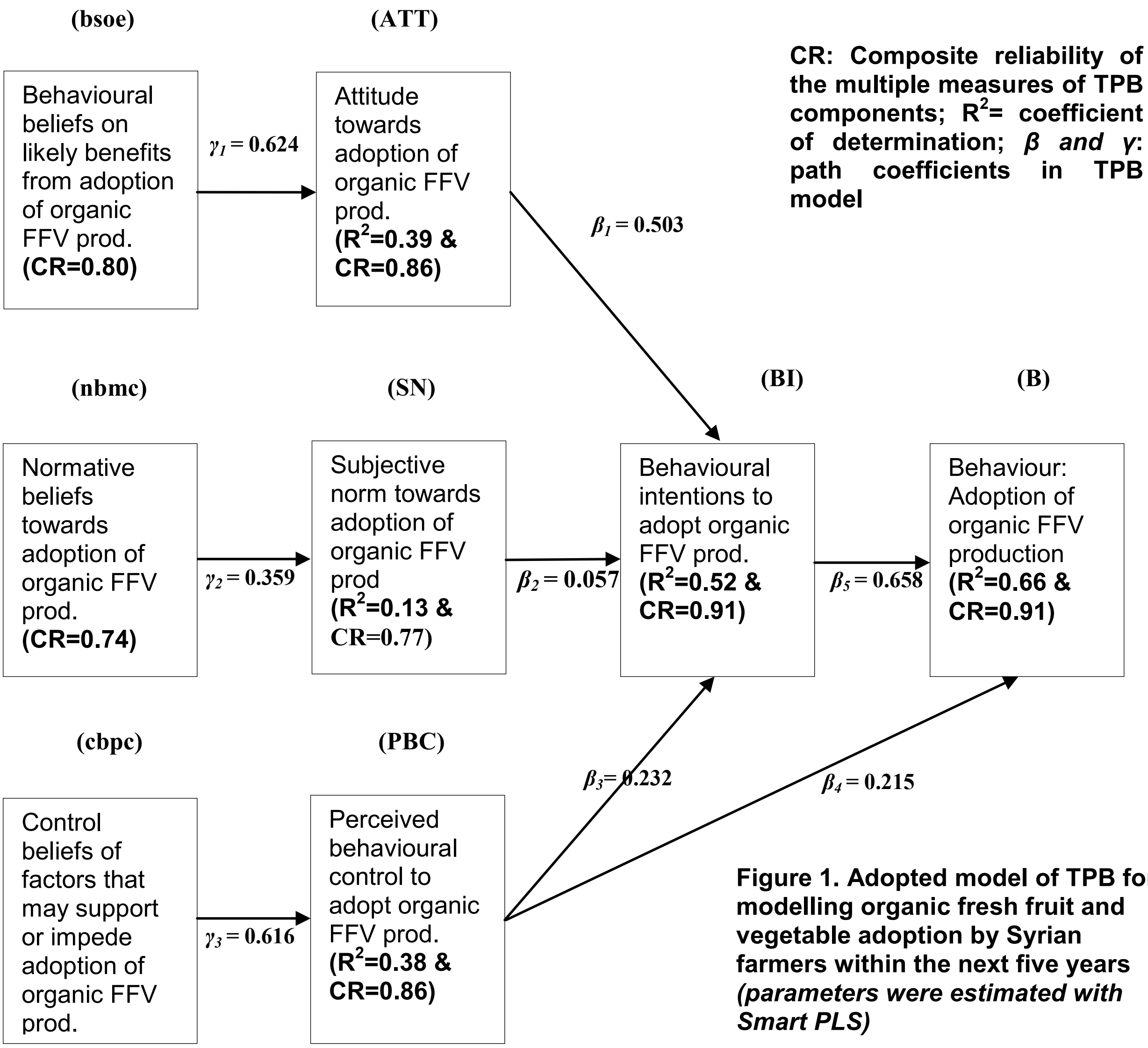

Figure 1. Adopted model of TPB for modelling organic fresh fruit and vegetable adoption by Syrian farmers within the next five years *(parameters were estimated with Smart PLS)*

Table 1: Total effect coefficients of TPB components on behavioural intention to adopt organic FFV Production (BI) and adoption decision (B): *(coefficients were estimated using Smart PLS)*

Total Effects = direct effects (i.e. path coefficient when there is a direct path linking between two given components of TPB model) + indirect effects (i.e. mediated effects) between two components, not necessarily, having direct path linking between them)

-> : effect direction (e.g. Attitudes -> Behaviour: represents effects of attitudes on behaviour)	coefficients (Original Sample) (N=266)	coefficients (Sample Mean(M))	Std. Error (N=266)	P-value
Attitudes (ATT) -> Behaviour (B)	0.331**	0.330	0.067	0.000
Attitudes (ATT) -> Behavioural intention (BI)	0.503**	0.500	0.085	0.000
Behavioural intention (BI)-> Behaviour (B)	0.658**	0.657	0.055	0.000
Perceived behavioural control (PBC) -> Behaviour(B)	0.368**	0.369	0.068	0.000
Perceived behavioural control(PBC) -> Behavioural intention (BI)	0.232**	0.233	0.078	0.003
Subjective norm (SN) -> Behaviour(B)	0.037	0.039	0.036	0.305
Subjective norm(SN) -> Behavioural intention(BI)	0.057	0.059	0.055	0.301
Behavioural beliefs (bsoe)-> Attitudes(ATT)	0.624**	0.635	0.037	0.000
Behavioural beliefs(bsoe) -> Behaviour(B)	0.206**	0.210	0.049	0.000
Behavioural beliefs(bsoe)-> Behavioural intention(BI)	0.314**	0.318	0.062	0.000
Control beliefs(cbpc) -> Behaviour(B)	0.227**	0.229	0.047	0.000
Control beliefs(cbpc) -> Behavioural intention(BI)	0.143**	0.145	0.050	0.005
Control beliefs(cbpc) -> Perceived behavioural control(PBC)	0.616**	0.621	0.042	0.000
Normative beliefs(nbmc) -> Behaviour	0.013	0.015	0.014	0.343
Normative beliefs(nbmc) -> Behavioural intention(BI)	0.020	0.022	0.021	0.341
Normative beliefs(nbmc) -> Subjective norm(SN)	0.359**	0.382	0.056	0.000

*: Total effect coefficients of original sample (N=266) is significant at $P<0.05$ and **: coefficient is significant at $P<0.01$

(M): Sample mean represents the total effect mean obtained from PLS bootstrapping procedure (5000 samples of 266 cases for each)

Generally speaking, the majority of farmers had positive attitudes towards organic farming aspects, measured on a five-point Likert scale from strongly disagree(1) to strongly agree(5). Thus, famers rate many statements regarding the environmental, health and economic aspects of organic agriculture positively. Attitudinal statements about protecting the environment and providing healthy food for family members were rated with a mean score of 4.18 (standard deviation 0.91). Attitudes towards economic and profitability aspects of organic farming were also positively rated, however, with a mean score of 3.55 (standard deviation 1.16). Interestingly, the interviewed farmers stated that an adoption of organic FFV production within the next five years is a feasible option for them (mean score of 4.13, standard deviation 0.76).

The results of PLS-SEM (Figure 1) show that farmers' positive attitudes and perceived behavioural control towards conversion to organic FFV production have positive influence on behavioural intention to convert. These findings are in line with the TPB assumptions as explained in section 2. Subjective norm towards a conversion to organic FFV production, however, plays a small role in forming behavioural intention in this study. Furthermore, the direct components of behavioural intention (ATT, PBC and SN) are also well predicted by their respective salient belief (bsoe, cbpc, nbmc). PLS path modelling results confirm these findings: (1) the significant path coefficients linking the TPB components, and (2) the total effect coefficients that demonstrate the chain of causal effects from the set of salient beliefs (bsoe, cbpc, nbmc) to behaviour (B) in the TPB model (see Table 1). Table 1 shows that most of total effect coefficients are highly significant ($\alpha = 0.01$). Though normative beliefs (nbmc) have significant effect on subjective norm (SN), their total effects on intention (BI) and behaviour (B) are not significant.

Conclusions

The results of this study suggest that the majority of Syrian famers of FFV have positive attitudes towards organic farming and are willing to convert their farm to organic within the next five years. The strong intention to convert to organic agriculture can be seen particularly with farmers who are already using many organic practices and low chemical inputs. Though farmers have positive intentions and attitudes towards conversion to organic farming, governmental and NGOs initiatives about organic farming are important to spread out further information about conversion, certification and markets for their organic produce.

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Why transaction costs impede smallholder farmers' participation into export organic markets

DONASIAN SEVERINE[1], EVELYNE LAZARO[1], PAUL KLEDAL[2], KOSTAT KARANTININIS[3]
KALUNDE SIBUGA[4], SHADRACK MBAPILA[1]

Key words: transaction costs, smallholder farmers, markets

Abstract

There have been growing trends of exports from countries dominated by smallholder agriculture to many of developed world (Kledal and Kwai, 2010). This shows that smallholders farmers development perspectives have gained interests in global markets and Value chain Approaches. However, these smalholders are constrained to participate by transaction costs apart from standard constraints in economics. To understand transaction costs effects on smallholder farmers' participation in global value chains a study on governance of global value chains for organic ginger exports was conducted in Tanzania. The study employed a case study method, using transaction cost theory in a value chain approach. General characteristics that describe the smallholder farmers and the institutions they operate in were found to be the main reasons for high transaction costs, hence the main reason for failure of smallholders to participate in global markets.

Introduction

Integrating smallholder farmers into global economic systems especially in high value products chains has been a growing focus (World Bank, 2008). There are very few literatures that have elaborated why transaction costs impede smallholder farmers in high value chains if off-course they must be there! Many of developments in transaction costs have been on answering why firms choose the way they choose; for example, why they contract, why they employ an agent, why they vertically integrate, why does the firm exist (Coose, 1992) this article is focused on elements that smallholder farmers have which makes them more prone to impediments by transaction costs hence fail to participate in global value chains.

People confuse the meaning of smallholder farmers and subsistence farmers. A purely subsistence farmer is a smallholder farmer cultivating for the aim of consumption, while a smallholder farmer is not always a subsistent farmer. In this aticle smallholder farmers are those who make their lives from a relatively small size of agriculture investments. In India FAO (1990) defined Small-holder farmers as those marginal and sub-marginal farm households that own or/and cultivate less than 2.0 hectare of land – they constitute about 78 per cent of the total India farmers. Tanzania smallholders have average farm sizes of between 0.9 hecters and 3.0 hectares and There are so many facts about them there are some 500 million smallholder farms worldwide; more than 2 billion people depend on them for their livelihoods. They produce about 80 per cent of the food consumed in Asia and sub-Saharan Africa. In Tanzania they dominate the entire agriculture sector producing 95% of the food consumed in the country.

Such farmers need a distinct governance structures and economic organisations to enable them participate in high value chain. Their businesses need clear linkages along the value chain, from production through processing, and marketing, to consumption. This is to guarantee effectiveness and efficiency along the chain (Nwanze, 2010).

Apart from standard constraints in economics that impede the smallholder farmers, they are also constrained to participate in value chains by transaction costs; but why? In economics, a zero transaction cost assumption in any stage of value chain is not ideal (Coase, 1992; Williamson; 1991; and Gereffi *et al.*, 2005). Mimicking a zero transaction cost, perfectly competitive, markets along value chains for most of smallholders produce is and should be a principle target. Transaction costs occur whenever a product is transferred from a producer to a consumer. Ginger farmers in Mnazi and Mamba are amongst the farmers who have been struggling in export of organic ginger but are constrained by transaction costs; knowing what subject them to high transaction cost is important, as it spur robust value chain development initiatives.

Material and methods

This article is extracted form a case study, using the value chain approach and transaction costs theory, which was conducted to study the governance of the value chain exporting organic ginger from Tanzania.

Data used for this article were on land ownership and tenure systems, institutions, marketing systems and household's dependence on agriculture farming and topography. The data were collected using a questionnaire, checklist, observations and review of documents. We looked at each finding and how they contribute to high transaction cost proxies. Proxies used were, asset specificity, bounded rationality, frequency, uncertainty, and opportunism.

Results

- The farmers had a small acreage size (0.25-6 acres)
- Fragmented Land tenure, i.e. farmers own scattered plots of 0.25-1 acre
- Ginger plots are situated in high altitudes with rough topography and varying proximities to the important marketing structures.
- Inefficient institutions characterised by
  - Inefficient game players in the value chain (both farmers and their cooperative) with simple contract and trust as a means of its enforcement.
  - Lack of institutional barriers to entry. That is, there were no specific regulations for traders to follow in case they wanted to purchase directly from the farmers.
  - Unclear Marketing systems where Ginger is bought in different forms by different buyer. Presence of numerous smallholder farmers, local and regional buyers and high price fluctuations with long periods of very low prices

Discussion

Owning a small plot of land which is also fragmented causes large transaction costs to smallholder farmers and to other participants in the value chain. Frequency of transaction is high as it implies that a smallholder farmer is constrained to a certain economically rational maximum level of production of his land, often not enough to be supplied as a separate consignment. This probably calls for specific investments such as establishment of groups. If it is not possible to do the specific investments, then, dealing in a high standards-demanding value chain by numerous smallholder farmers is nearly impossible. High assert specificity occurs in certification. High frequency in inspection of small plots of land also is costly as it demands more time, more fuel, and even more considerations. For buyers dealing with numerous individual farmers will probably lead to high coordination monitoring costs, more inks and papers and high costs of frequent bank drawings. This would be amongst the reasons as to why on different studies most researchers have found positive correlation between access to land and household livelihood variables though not often mentioned (Jayne *et al.,* 2003).

Location and proximity are variables that have been studies especially in determining household livelihood variation as they change. Location of the ginger cultivation plots in places of high altitudes with a rough topography, makes abiding to organic standards costly especially on standards concerned with environmental conservation. Asset specificity is high as farmers prepare structures such as terraces to meet standards; topography makes mechanisation difficult. On the other hand collection of the produce for purchase by buyers is limited to transportation using labour which is in most cases is relatively expensive. When the issue of land location is associated with high proximities to roads and other value chin infrastructures we expect the transaction costs to be even higher.

Inefficiency in institutions makes performance of the value chain poor: When there are no institutional barriers to entry, it is very uncertain as to whether the farmers are guaranteed to sell to specific buyers. When this happens some buyers fail to enter into the value chain as they anticipate a high opportunism from the sellers, organic buyers probably holds back and hence farmers fail to deal in the global organic value chain.

When farmers' organisations are assuming very little roles in bringing about the trade then some transaction costs proxies of frequency, and limited rationality that would be minimised by the advantages of having the cooperative are unnecessarily high as the economic organisations are not doing what Mastern, (2000) said should, i.e. evolve or be formed to minimize transaction costs. High drawing costs by buyer; high follow-up costs by farmers for their payments, high delivery costs are all transaction costs that would probably be minimised.

High opportunism is spurred by; firstly presence of a simple long term contract between farmers and buyer with trust as the means of its enforcement. Secondly, the fact that ginger was bought in different forms by

different buyers; indicating a low-or-no need to standardise the products to a certain common level of standard by all the farmers at the same group. Therefore some farmers may join the chain and easily free ride. Lastly, presence of numerous local buyers, who buy from numerous farmers' without caring standards, thereby opening room for opportunistic buyers to sell whenever and to whoever they like; this therefore makes it difficult to deal with this farmers at the same level and similar governance structures.
Low price of produce and high price fluctuations is also a trigger to high transaction costs to farming to smallholder farmers with limited non-farm income. Farmers normally sell their produce with response to their family needs which cannot wait for the good price. Lack of buyers who can guarantee consistent buying of produce make the scenario even worse, a large market power would help to boost the farmers' prices high, but how while every one is tempted to achieve a family objective very soon.

Conclusion and Recommendations

Characteristics that describe smallholder farmers are principle components for high transaction costs that deter participation into export value chains.

When developing global value chain these characteristics of Smallholders should be taken care of apart from the other measures that describe the trading between countries and those which determines production and productivity.

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Performance of durum wheat varieties (*Triticum durum* desf.) under conventional and organic agriculture

KHALED SASSI [1], GHASSEN, ABID [2], BOUTHAINA DRIDI AL MOHANDES [3], ABDERRAZAK DAALOUL [4]

Key words: organic agriculture, durum wheat, selection, yield, quality

Abstract

Field experiments were conducted for four years to determine the effects of organic and conventional systems and fourteen varieties on growth, yield and quality of durum wheat crop. The experiments were laid out in a split-plot design with four replicates. Studied parameters included (i) grain yield, (ii) technological and nutritional quality of the whole grain.

Results of the agronomic traits indicated that grain yield is on the average lower under organic cultivation compared to conventional methods (2.32 and 2.98 t/ha respectively). Data analysis indicated high production potential of some varieties such as Khiar, Ben Bechir and INRAT69 (2.47, 2.46 and 2.44 t/ha respectively) under organic farming method.

Results of the nutritional quality were influenced by the cultivation method. The organic method affected positively proline contents (1.154 vs 1.146 g/100g of FM) and cystein (0.216 vs 0.186 g/100g of FM) and gluten index (64.73 vs 61.46 %). Contrary to the organic method, grain protein content is better in the conventional method (13.9 vs 13.5 %/FM).

Based on these results, only INRAT69 variety could be potentially used in organic agriculture, it could also be adapted for manufacturing organic pasta and couscous.

Introduction

In Tunisia, organic cereals represent a sector that can easily be adapted to conversion into organic agriculture. The area which is reserved does not exceed the 1200 ha (DGPA, 2012). Currently, Tunisian and foreign consumer expectations related to organic cereals quality and in particular durum wheat, are numerous and their request is increasing continuously. Tunisia has so many advantages to produce and export organic products mainly to Europe. These advantages include the persistent demand of European countries in organic cereals, geographical proximity of Tunisia to the place of the request, the quality (high protein), especially from some old varieties of durum wheat (Ben Salem et al., 1995).

In order to contribute to identifying some varieties adapted to organic agriculture, we undertook a research project that focuses on 14 varieties old and recent. The objectives were the effect of organic mode on: i) wheat grain yield, and ii) wheat grain quality.

Material and methods

The comparison trial of durum wheat varieties was carried out during four years at two sites. The first site is part of the experimental farm of ESAK located in the semiarid region and the second site is at the experimental station "El Kodia" in National Institute of Field Crops of Boussalem located in the higher semi-arid region.
Fourteen durum wheat varieties were tested in this work (9 old varieties: Chili, Biskri, Hamira, Swabaa Algia, Jnah Khortifa, INRAT69, Badri, Bechir Ben and Maghrebi and five improved varieties: Karim Razzak, Khiar, Om Rabia and Nasr).
The experimental design used during the four years of trial, was "split plot" with four repetitions. The method of cultivation (organic vs conventional) is the main factor. The variety randomized in each treatment is the secondary factor.
The seeding was done during the second half of November each year. The seed rate calculated was 600 seeds per plot (120 kg / ha).

[1] National Agronomic Institute of Tunis, Tunisia, http://www.iresa.agrinet.tn, eMail: sassi_khaled5@yahoo.fr

[2] Centre of Biotechnology of Borj Cedria, Tunisia, http://www.cbbc.rnrt.tn, eMail: gha_abid@yahoo.fr

[3] Institut Supérieur Agronomique de Chott-Mariem, Tunisia, http://www.isa-cm.agrinet.tn, eMail: bouthaina2@yahoo.com

[4] National Agronomic Institute of Tunis, Tunisia, http://www.iresa.agrinet.tn, eMail: adaaloul@yahoo.com

The development of weeds was controlled by hand for organic plots and chemical control for conventional plots.
Fertilization consisted:
- For the conventional plot: application of ammonium nitrate ammonium 33.5% in two fractions at 100 kg / ha: the first contribution was made after emergence, the second in early tillering stage.
- For the organic plot: an application of a nitrogen organic fertilizer (liquid) that is composed of 5.9% organic nitrogen, organic carbon 22.2% and 36.9% amino acid in a proportion of 2 l / ha.
The parameters studied are grain yield, protein, total amino acids and gluten contents.

Results

Grain yield of durum wheat varieties in organic agriculture

The comparison of the grain yields of forteen durum wheat varieties grown for four seasons in organic and conventional methods shows that the grain yield over all varieties was in favor of the conventional, with 28% increase. However, the difference was not stable and it varied from the first growing season to the fourth, making organic cultivation competing well when it is relatively a dry season.

Based on results of this particular experiment, three varieties were distinguished in organic cultivation for four growing seasons in grain yield, ie Khiar (improved variety), Ben Bechir and INRAT69 (old varieties) with average grain yield of 2.47, 2.46 and 2.44 t/ha respectively. In fact, the distinction of old varieties in organic mode is expected. These varieties are known by their local adaptation, rusticity and productivity.

Some varieties are well adapted to many environments, while others are particularly adapted to specific environments. These conclusions could be applied especially for the varieties Khiar, Ben Bechir and INRAT69 which have behaved well with very satisfactory performance in organic method for four years of trials combined.

Technological quality of grains

Crude proteins

The protein content is affected by the method of cultivation. In effect, there is a significant difference between the two methods of cultivation ($P < 0.001$), 13.91 and 13.51% / FM for conventional and organic methods respectively. This result can be attributed to nitrogen that is different both in quantity as the method of its application. Woëse *et al.* (1997) reported similar results indicating that the low crude protein should be obtained in varieties conducted organically.

Contrary to what these authors have suggested, we recorded values of crude protein high in organic method compared to conventional in six varieties. This is the case of Chili and Razzak varieties with a difference of 20.54 and 5.51% respectively for the organic conducting. This could be explained by better use of these varieties of regular inputs of organic fertilizer nitrogen (5 fractions) from the lifted stage which allows them to escape to nutritional stress. In other words, these varieties are characterized by better absorption and remobilization of nitrogen. However, plants conducted in conventional method only benefited from nitrogen fertilizer ammonium-nitrate into two fractions only. In addition, Gate (1995) indicated that the fractionation of fertilization during the cycle of durum wheat affects the protein.

Total amino acids content

Most amino acids analyzed (76.47%) are more frequent in conventional than organic method with the exception of histidine (0.300 *vs* 0.297 g/100 g FM), phenylalanine (0.549 *vs* 0.546 g/100g FM), proline (1.154 *vs* 1.146 g/100 g FM) and cysteine (0.216 *vs* 0.186 g/100 g FM). This last amino acid is higher in most varieties conducted organically.

Among the fourteen varieties studied, eight showed a total amino acids composition higher in organic than conventional method. These varieties in decreasing order are: Jnah Khortifa, Hamira, Chili, INRAT69, Swabaa Ilgia, Nasr Razzak and Karim with 14.803, 14.787, 13.116, 12.858, 12.115, 10.956, 10.874 and 10.404 g/100g FM respectively. Remember that the first five varieties are old and are characterized by a remarkable protein quality in organic method and their constitution of amino acids. In general, cereal products contain varying amounts of free amino acids, depending largely on the species, varieties and growing conditions (Abdel-Aal & Hucl, 2002).

Gluten content

In the case of conventional and organic methods, gluten index average of all varieties showed a slight difference in favor of organic method compared to the conventional mode with 64.73 and 61.46% respectively. In general and according to Perten (1990), this is a balanced gluten. Garrido-Lestache *et al.* (2005) report that gluten index of durum wheat responds positively to temperatures during grain filling.

Still referring to the work of Perten (1990), we can say that in organic method, and in decreasing order, the varieties Jnah Khortifa, Hamira, Biskri, Badri, INRAT69, Chili, Swabaa Algia, Nasr, Om Rabia and Maghrebi have a balanced gluten reflecting good technological value. In effect, the gluten proteins (prolamins), with their spiral and elastic structures, giving the soft bakery products and excellent cooking. It is well known that a deficient gluten in semolina has negative consequences on the rheological properties and hydration of the pastes obtained. For varieties Ben Bechir, Khiar, Karim, and Razzak, gluten is soft, extensible and inelastic implies little technological value. In fact, and as was previously planned and announced, varieties with high protein content (Jnah Khortifa, Badri Chamira, Chile and INRAT69) are suitable for good behavior to make pasta or couscous. This is confirmed by their balanced gluten. Moreover, He & Hoseney (1992) report that the elasticity and extensibility of gluten wheat semolina are determined by the quantity and quality of protein.

Discussion

The combined analysis of the four growing seasons showed that Khiar (improved variety), Ben Bechir and INRAT69 (old varieties) had the best grain yield potentials in organic agriculture with 2.47, 2.46 and 2.44 t / ha respectively. These varieties may be promising to be conducted in organic method because they showed a great aptitude to accommodate in terroirs and climatic conditions vary widely. Finally, the grain quality of the fourteen varieties from organic and conventional production was also determined. The analysis revealed that the variety INRAT69 has better quality than Ben Bechir especially protein content (14.19 and 10.67% / FM respectively), amino acids (12.86 and 10.14 g/100 g FM respectively) and gluten index (77.32 and 38.86% respectively). These characteristics are considered support for organic farmers to choose and conduct the variety INRAT69 guaranteed since both a satisfactory yield with good quality. This variety could be recommended to making organic pasta and couscous and even bread, since it showed good baking quality.

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The effect of some organic acid and plant-derived material treatments on the germination and emergence of lettuce

LEVENT ARIN[1], HAYDAR BALCI[2]

Key words: Lactuca sativa, seed, organic treatments

Abstract

The research was carried out to investigate the effect of plant materials which are used as an alternative to the synthetic chemicals in organic farming (thyme, mint, basil and garlic oil, hot pepper and neem tree seed extract) and some organic acids (salicylic and jasmonic acid) on the germination, emergence and seedling characteristics in lettuce (Lactuca sativa L.) cv Arapsaçı. The seeds of lettuce treated with these materials were subjected to germination and emergence tests at temperature 20±1 °C and 60±5 % RH in autumn period. After that, all seeds (including untreated) were kept at 5±1 °C and again checked for germination, emergence and seedling characteristics in spring period.

Thyme oil affected negatively the germination and emergence and also the infected seed ratio increased. Although the infection ratio was 1% in untreated seeds, it was 7.8% in the seeds treated with thyme oil. After the storing period, infection ratio of thyme oil was 8.5% which was higher than other treatments. There was no significant effect of treatments on seedling characteristics.

Introduction

Lettuce is widely grown both in the field and greenhouse as salad vegetable in all over the world also in Turkey. On the other hand, the size of organically cultivated area in Turkey has reached 614 000 ha and Turkey is one of countries which have highest increases to the area of organic farming all over the world (Willer and Lernoud, 2013).

Because of synthetic-chemical use is forbidden in organic agriculture, some physical and biological methods aimed at the control of seed-borne pathogens are being investigated. There are some physical seed treatment methods like hot water, hot (humid) air, electron beam, but they are required special equipment and have the potential to damage the seed if they are not applied at appropriate dose (Nega et al. 2003, Wolf et al. 2008). The potential alternative seed treatments (microorganism, plant extract and inducer of resistance) have been developing against the different seed-borne pathogens and for mitigating the impact of stress conditions (Groot et al. 2004, Hammer et al. 1999, Klessig and Malamy 1994). However, limited information is currently available dealing with their effect on germination and seedling quality.

The aim of the research was to evaluate the effect of these materials on germination, emergence and seedling quality of lettuce.

Material and methods

The essential oils and plant extracts which were used in this research were selected on basis of their reported antimicrobial properties against a number of pathogens due to be natural agents allowed in organic agriculture. The lettuce seeds had not been treated with any chemicals.

The essential oils were provided from local seller of herbs. The aqueous extracts of hot pepper and neem seed were prepared. The organic acids were obtained from Sigma Aldrich (Interlab Inc. İstanbul). A suspension of essential oils was prepared by dispersing 10 ml amount of essential oil in 1 L of sterile deionized water. The seeds were soaked in water including 10 ml/L oil, extract or acid for 0.5 h at room temperature except jasmonic acid (1 ml/L). After treatment, seeds were dried for one day on a clean cloth under laboratory conditions.

To emergence test, seeds were sown into multi-cell plastic pot (each cell having 30 ml growing media). The properties of peat used as growing medium were as follows: 100-300 ppm N, 100-300 ppm P_2O_5, 150-400 ppm K_2O, pH: 5.4-5.9, electrical conductivity 350 µS/cm. To germination test, each combination of 4 replicates of 100 seed was placed on 2 pieces of Whatman 1 filter paper moistened with distilled water into a 9 cm glass petri dish. Petri dishes were placed in incubator at 20±1 °C, 60±5 % RH with a photoperiod of

[1] Namık Kemal University, Faculty of Agriculture, Turkey, www.nku.edu.tr, eMail: larin@nku.edu.tr

[2] Yüzüncü Yıl University, Gevaş Vocational School, Turkey, www.yyu.edu.tr, eMail: balcihaydar@hotmail.com

16:8 h (light:dark). Radicle protrusion to 1 mm was scored as germination. Seed germination was recorded at 24 h intervals and germinated seeds were removed from the petri dishes.

The seeds were stored at 5±1 °C for 6 months. Afterwards the experiment was repeated to determine the efficacy of different treatments after storage in spring growing season.

The diagnosis of diseases was made by Prof. Dr. Nuray Özer (Department of Plant Protection, Namık Kemal University) during trials.

The experiment was arranged to completely randomized design with 4 replicates. Arcsin transformation of germination or emergence percentage values was used to stabilize variance. The values were analyzed using analysis of variance followed by an LSD mean separation tests.

Results

There was no statistically significant difference among treatment regarding germination percentage in autumn period, but seed treated thyme oil had the lowest germination percentage in spring and the seeds treated with other materials responded similarly (Table 1). The thyme oil led to the lowest germination percentage with 85.75 %, while other treatments taken part in same important group (ranged from 97.00% to 93.50 %).

In autumn, the mean time germination/emergence was significantly increased after treatment with jasmonic acid compared to other materials (Table 1, 2). It was not observed significant differences among treatments in term of mean time emergence in spring.

The seedling quality properties like seedling length, seedling weight, vigor index etc. was not adversely affected by any of the treatments (data not shown).

The seed treated with thyme oil have highest percentage of infected seed. When it taken into account germination, emergence, seedling properties and infection ratio, best results was obtain from seeds treated with neem tree extract (Table 1, 2).

Table 1: Effect of different seed treatments on germination percentage (GP, %), mean time germination (MTG, days) in autumn and spring periods

	GP		MTG	
Treatments	Autumn	Spring	Autumn	Spring
Thyme oil	92.00	85.75	4.55	3.71
Mint oil	92.00	93.50	4.20	3.67
Basil oil	93.25	94.50	4.13	3.48
Garlic oil	91.75	95.50	4.05	3.49
Hot pepper extract	97.50	93.50	4.10	3.37
Neem seed extract	94.75	94.50	4.08	3.31
Salicylic acid	92.25	94.25	4.01	3.38
Jasmonic acid	94.75	97.00	4.86	3.71
Non-treated	94.50	96.25	4.11	3.47
		*	**	**

* significant at P<0.05 and ** significant at P<0.01

Table 2: Effect of different seed treatments on emergence percentage (EP, %), mean time emergence (MTE, days) and infected seedling ratio (ISR, %) in autumn and spring periods

	EP		MTE		ISR	
Treatments	Autumn	Spring	Autumn	Spring	Autumn	Spring
Thyme oil	84.00	85.75	7.69	9.94	7.75	8.50
Mint oil	71.00	80.50	7.43	8.99	2.00	3.50
Basil oil	79.00	90.25	7.40	8.60	1.00	3.25
Garlic oil	81.00	87.50	7.37	8.32	1.33	2.25
Hot pepper extract	90.00	84.50	7.07	9.11	1.50	4.25
Neem seed extract	95.00	88.75	7.09	7.87	1.00	2.75
Salicylic acid	82.50	90.00	7.57	8.40	2.00	2.75
Jasmonic acid	75.50	87.50	8.17	9.04	1.66	4.00
Non-treated	76.50	90.25	7.69	8.32	1.00	2.00
			*		**	*

* significant at P<0.05 and ** significant at P<0.01

Discussion

As similar to results concerning mean germination time, Blum et al. (2006) stated that there was no indication of a positive effect of seed treatment with plant strengtheners on parsley or dill concerning a better germination rate of emergence

Although thyme oil, among essential oils tested, exhibited the highest in vitro inhibitory activity against seed-borne pathogens (Wolf et al. 2008), in this research, the seed treated with thyme oil have highest percentage of infected seed, while infection ratio changed between 1% and 4% in others. This may be due to high concentration and/or the lack of sufficient purity. Wolf et al. (2008) reported that cinnamon oil at a concentration of 3.3% was damaged the cabbage seeds.

Although neem is generally known to be effective against insects, it was reported that neem can be used for Fusarium wilt by Foerster et al. (2001).

Suggestions

Based on these results, it can be stated that the neem seed extract can be used to promote germination or emergence and to decrease disease infection without loss of quality characteristics of seedlings.

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Ofia - Innovation applicable in organic farming Rethinking on household/population anthropometric and real food consumer demand evaluations of eu27/candidates by using per capita (PC) versus per adult human unit (PAHU) method/1999-2010-2020

SÜMER HAŞIMOĞLU[1]

Key words: Per Capita (PC), Per Adult Human Unit (PAHU), Organic, Consumer

Abstract

Accurate population and household demographic and anthropometric projections are necessary for proper economic and social planning including organic/conventional food consumption evaluations of EU27-(Candidates-Turkey/Croatia). We must be open to rethinking on how accurately the current methods (*i.e.* PC, Adult Equivalent–AE) are and other estimates that represent the true nature of family/household's gender and the age (Young and old) differences of the consumer potential of EU. We are dealing with a contemporary, developed PAHU methodology that aims to reduce the errors (19.4 percentage units) inherent in PC projections for organic/conventional food and other commodities production and consumptions. The first aim of the developed PAHU (Copyright ©1989) is to standardize EU nations or target populations that will make them comparable. Second aim is to create a platform that would promote a dialogue on statistical policy relevant interactive domains of consumer and consumption potential on one hand and family/household dynamics and socio-economic processes of economic development on the other hand. Application of PAHU method improves the data validation process by providing an alternative to the current "One size fits-all"– PC, accept or reject approach that I call (**Gender and Age Corrected PC^{gac})** that may play an important role in orienting innovation systems, so **PC^{gac}** may better address global challenges in reevaluating real consumer and organic/conventional food consumption potential.

Introduction

Defining, evaluation and interpreting EU27 plus candidates-Turkey/Croatia's demographic structures, family/household and their organic and conventional food security on PC basis is a stubborn and difficult task for the researchers, decision and policy makers. It is extremely important to measure the food consumption of the families/households of developed (EU) and developing (Turkey) countries on a standardized ``**unit**´´ base that will make them comparable. When data are presented on PC basis, (Defined as equal to each individual, per unit of population) for production and consumption of commodities, the assumption is that 0 to19-year-old, (*i.e.* 6.0 month-old baby), and 66 to 80+ year old will produce and consume as much as a mature person-20 to 65-year-old man/woman. Aiming to reduce the magnitude of errors inherent in PC food consumption projections, the PAHU method (Copyright©1989) was developed to eliminate the error bound "one-size–fits–all-accept or reject" approach of PC evaluations.

Material, Methodology, Concept and Key Innovations

State of the art of this paper is implementing PAHU, (Copyright © 1989) to evaluate the real consumer potential of any population or target group and to compare them with other evaluation procedures and approaches (*i.e*. PC and AE). PAHU aims to reduce the errors (19.4 percentage units) inherent in PC projections for food and other commodities production and consumptions, (Hasimoglu, 2001; 2012, 2013). Calculation of PAHU **(20-24-year- old)** based on Basal Metabolic Body Rates (BMR) to obtain the conversion factors for each age group into PAHU (Table 1.) that standardizes any population or a target group. Since PAHU development and its practical use were presented previously (Hasimoglu, 1989; 1999; 2000; 2001; 2012; 2013), the criteria used in the method development are summarized: **1. Nutrition and Energy Expenditure for Human Productivity:** Method deals with primarily the requirement for a standard reference individual (20-24-year-old=Unit) MBR energy which are calculated for each (5-year- interval) age-groups. **2. Age and Gender Structure of a Population/Target Group:** Selected method design correlates to deviant anthropometry that includes defined age and sex structure and other factors (Body weight, height, body frame, environmental temperature etc.) affecting BMR, which are also considered and included in calculations. **3. Selected Anthropometric Criteria:** Cut-off points for indicators were selected carefully, all were based on literature and were documented on research results in order to characterize changes and

[1] Schwerin/Germany/shasimoglu@gmx.de

trends on BME within the age/gender groups of the population. **4. Calculation Procedure of PAHU:** BMR and affecting factors are the criteria used to calculate the PAHU conversion factors for the different age groups to standardize a population or a target group under one unit (Table 1.) because BMR is an essential part of human vitality. The formula and calculations were based on the long-term research findings of Brody (1945) and Kleiber (1947). Kleiber (1961) suggested a three-fourths power of the body weight is the best correlation between body size and resting metabolism thus the calculated value applies not only persons of quite different body builds, but to almost all homeotherms (*i.e.* Mice and elephant). **BMR Calculation: BMR (kcal) = 70 (W kg)$^{0.75}$; c = bW^{n} or log c = log b + log w^{n} where c = kcal : w^{n} = metabolic size and c / W^{n} = Statistical constant b; Conversion Factor Calculation = Male or Female BME kcal/d : 20-24-year old (PAHU) Male or Female BME kcal/d.**

Findings, Results and Discussions

The EU, currently, has to cope with demographic decline, low natural growth and the aging of its population. EU27 policy-makers have to consider looking into the erroneous use of PC and its effects on the results of the decision–making and policy-implications not only in food consumption issues, but also in other economic issues that affect the continuing global and EU economic crisis. To start with, each mini market of EU27, candidate countries, whole Europe's PC and PAHU-real consumer potentials are calculated for 1999, 2010 and 2020 and are tabulated. With the expansion of the EU (1999 – 2010), addition of 187 million PC and/or 156 million PAHU, (Including Turkey/Croatia), the EU-29 population added up to 561 million PC; 469 million PAHU. In 2020, EU27 plus candidate countries-(577 million PC; 486 million PAHU), plus dependency of EU-member states, EFTA, micro states and former Soviet Republics; thus Europe's consumption potential will go up to 701 million PC; 591 million PAHU. Europe will be the world's third largest organized trading, production power and organic/conventional food consumer after China and India.

Further graphic analysis made by using the findings of (Table 1.) by plotting BMR kcal requirement values against age groups, (Figure1.), illustrates deleterious assessments are not less than 7.6 percentage units for the age group less than 20 and 11.8 percentage unit for the age group over 25-year respectively, totalling up to 19.4 percentage units for each PC as compared to PAHU which are confirmed by findings of Hasimoglu, (2001; 2012; 2013).

In addition, there is a significant difference between under 20-year age population of the developed and developing nations (21 percentage unit) when calculations are based on PC; aside from assuming that 0-19/+65-year old individuals consume the same amount of grain as compared.

Table 1. Calculated Conversion Factors of the Age Groups[2]

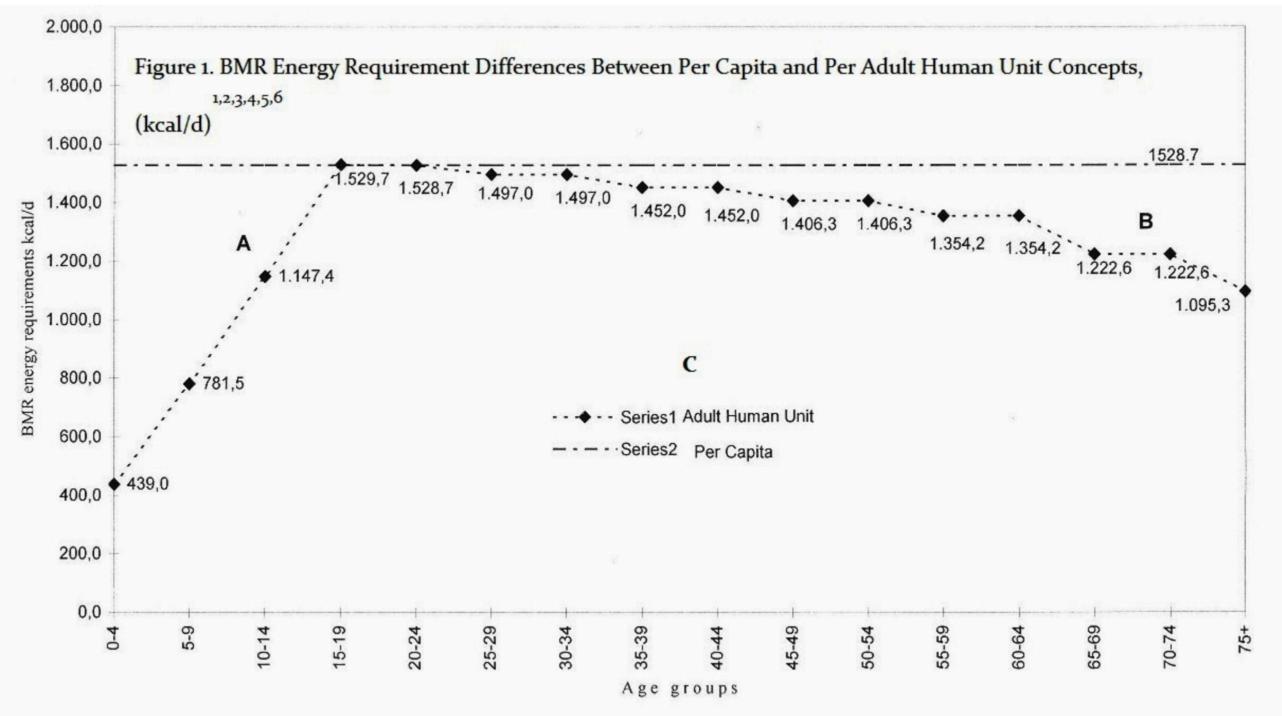
Age Groups	Calculated BME [3] Requirements kcal/day			PAHU Conversion Factors		
	Male	Female	Average	Male	Female	$\bar{X}$
0-4	445,1	432,7	438,9	0,262	0.,317	0,287
5-9	782,1	780,5	781,4	0,462	0,572	0,511
10-14	1138,6	1156,1	1147,4	0,672	0,848	0,751
15-19	1571,5	1487,9	1492,5	0,974	1,091	0,976
20-24[1]	**1694,0**	**1363,3**	**1528,7**	**1,000**	**1,000**	**1,000**
25-34	1659,0	1336,0	1494,5	0,979	0,979	0,980
35-44	1609,0	1295,0	1452,0	0,950	0,950	0,950
45-54	1558,5	1254,0	1406,3	0,920	0,920	0,920
55-59	1473,8	1234,5	1354,2	0,870	0,906	0,886
60-64	1473,8	1234,5	1354,2	0,870	0,905	0,886
65-74	1354,6	1090,6	1222,6	0,800	0,800	0,800
75+	1218,0	972,6	1095,3	0,719	0,713	0,716

[1] Standard Adult Human Unit (Age 20-24) for male and female BME requirements are 1694.0 and 1363.36 kcal/d respectively, averaging 1528.7 kcal/d. [2] PAHU calculation = Population of the age group x Age group's conversion factor. ***Conversion Factor Calculation = Male or Female BME kcal/d : 20-24-year old (PAHU)***

Male or Female BME kcal/d. [3] *Basal Metabolic Energy (BME) is the minimum energy cost of body process, representing the excess of endothermic over exothermic reactions in the body.*

to 20-24-year old. To emphasize the difference between developed and developing countries, two almost equally populated countries are considered: Belgium 10,423,493 and Chad with 10,543,464 populations for the year 2010. Although the population numbers (PC) are quite similar (0.98 % difference), the PAHU numbers showed huge differences (8,784,050 and 7,840,591 respectively), that are due to differences, especially in the age groups, under-20 (22.0% and 57.4% for Belgium and Chad respectively). On the basis of 200 kg world PC grain consumption (Hasimoglu, 2012), both Belgium's and Chad's total grain requirements would be almost the same, 2,084,698 t and 2,108,692 t respectively. However, on the PAHU basis the requirements would be 1,756,810 t and 1,568,118 t respectively. Percentage unit deviations of PAHU grain consumption from PC (Savings) were 16.6% and 26.9% for Belgium and Chad respectively. These findings illustrate the presence of the big gap between PC and PAHU from the standpoint of projecting grain consumption of developed and developing states.

Household income is the main factor that determines the level of nutrition of the inhabitants and poverty. EUROSTAT's approach is the household's consumption and income divided by the household size (number of persons-PC) living in the household (EUROSTAT, 1995, 1999 and 2005). Micro-economic analysis of the household must be situated within a larger structural analysis of gender and age based inequalities within the world economic system. One should not forget that household numbers and the number of occupants in the households have great impact on economy and on food consumption. Last ten years, increasing single and low number person households changing structures are important consumer segments. They tend to consume more PC compared to those living in larger households who share resources, resulting in higher domestic consumption in EU and in the world. This increase is seen in developed, emerging and developing economies (Turkey) that impacts the consumer spending patterns. In EU, average household occupant is 2.6 however this number in Turkey is 4.2. In Eastern Anatolia average household number is 5.2 and in the rural areas, goes up to 7.2 (Euro-monitor-International, 2012). In order to



1. PAHU, BMR energy requirements are the average of males and females of each age group, (Table 1. PAHU calculated conversion factors). **2.** Rectangle is PC area = (A+B+C) = 100%; Triangle A is < 20 - age group = 7.6% of rectangle; **3**. Triangle B is > 20-24 age group = 11.8% of rectangle; **4.** Difference from PC = A+ B = 7.6 + 11.8 = 19.4%; **5.** PAHU = C - (A+B) = 100 - (7.6+ 11.8) = 80.6% of PC.

illustrate the effect of gender and age differences between equally numbered two households were picked from the real world of two developing countries. Equal numbered two households with different age and gender structure (Table 2.) shows that PC and AE calculations can result in unintended deleterious assessments of food (Grain) consumption projections as compared to PAHU.

Table 2. Comparing Household-Aboubakar-Chad and Household-Çelik-East Turkey

Gender (Age)	PC	AE	PAHU	x	Gender (Age)	PC	AE	PAHU
Woman (49)	1	1.0	0.920	x	Woman (65)	1	1.0	0.800
Boy (15)	1	0.5	0.974	x	Man (45)	1	0.5	0.920
Girl (12)	1	0.3	0.848	x	Woman (38)	1	0.5	0.950
Boy (10)	1	0.3	0.672	x	Girl (18)	1	0.5	1.091
Girl (7)	1	0.3	0.572	x	Boy (16)	1	0.5	0.974
Girl (3)	1	0.3	0.317	x	Boy (9)	1	0.3	0.461
Total	**6**	**2.7**	**4.303**	x	**Total**	**6**	**3.3**	**5.196**

Grain Req. T/Y 1.2 0.54 0.86 Grain Req. T/Y 1.2 0.66 1.04

T=Tons; Y=Years; PC= Per Capita; AE= Adult Equivalents; PAHU= Per Adult. Human Unit
AE: First adult in the house=1; other adults, >13 = 0.5 and child (13 or under)=0.3.Gender is not considered nor the >66 age group,(EUROSTAT, 1999; 2005; 2008); PAHU values, Table 1.

Suggestions, Conclusions

The idea to develop a single composite indicator-**PAHU/Gender and age corrected PC = PC^{gac}**-has so far not taken into work list in scientific community. This deficiency should now be covered. As Albert Einstein ones put it "We can not solve problems by using the same kind of thinking we used to create them". Thus it is time to develop a new society-wide single composite indicator (PAHU) that describes welfare in more sophisticated way than old and primitive PC-GDP and/or organic/conventional food consumption-measure. This composite may also guide us in next decades towards sustainable world where economy does not exceed the global limits and endanger global ecosystems as today. **PAHU=(PC^{gac})** evokes innovation playgrounds of the researchers. It can well be applied to every country's/target groups' food consumption evaluations. In addition it may have the potential to have an impact on economic evaluations when Genuine Progress Indicator (GPI) and Sustainable Society Indicator (SSI) are used as basis for the societies-replacement of PC-GDP that is needed for the development in economic re-evaluations. The innovative action of **PC^{gac}** may require shifts in government planning by adding its ecological impacts into the equation.

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An Organic Agriculture Model for Turkey

ATIYE YONCA DEMIR[1], BULUT ASLAN[2]

Key words: Organic agriculture, linear programming, mathematical models, agricultural planning

Abstract

Organic farming presents a solution to socio-economic, environmental and health problems caused by conventional food production methods. In this paper, we propose a linear programming model to plan Turkey's organic food production. Specifically, we want to find how many hectares of each food type should be planted in each municipality of Turkey so that the whole population consumes organic foods only. The model incorporates transportation between regions while identifying any missing or excess foods. We also describe the data requirements of the model and discuss data availability. Results on a small aggregate model are promising.

Introduction

Agriculture is listed as a human activity with an impact on the carbon cycle in several reports on climate change (Meehl et al. 2006, Cubasch et al. 2001). In addition to substantially contributing to the local and global food supply (Badgley, 2007), organic agriculture reduces the harmful environmental effects of conventional agriculture. On a regional scale, organic farming in Turkey presents a solution to the country's environmental, economic and social problems. In this paper, we propose a Linear Programming (LP) model to study the feasibility of organic products as the sole agricultural food source for Turkey's population. Assuming that all land available for agriculture in Turkey is allocated to organic farming, we aim to answer questions including: Can Turkey's population be fed mainly on organic foods? Do we need to convert any hectares of land from other uses to agriculture? Which food types should be transported among different municipalities to make up for missing products?

Material and methods: linear programming

Since 1950s, LP has been successfully used for the modeling and solution of many real world problems. Agricultural problems are no exception (Williams 1999, Moss 2002); in part due to the linearity requirement being naturally satisfied by most problems of agriculture. When it comes to solve problems of organic agriculture, mathematical models conducted use goal programming, dynamic LP or data envelopment analysis, (Acs et al. 2007, Annetts & Audsley 2002, Kerselaers et al. 2007, Lansink et al. 2004, Pacini et al. 2004). These are mainly farm level studies modeling the economic conversion potential to organic farming, comparing conventional and organic farming systems, studying environmental farm planning in detail with crop rotation, land and machine availability. A country level formulation to satisfy Turkey's food needs via organic products can be found in (Demir, 2007), which is a preliminary version of the current work.

Since the goal is to enable the whole population to consume only organic foods, we assume that all arable land of Turkey is allocated to organic agriculture. There are *N* different food types grown in *L* geographic locations. For each *i =1 N, j and k=1 L,* the parameters and variables are defined in Tables 1 and 2, respectively. In the model, we employ the concept of a typical family, an average household, composed of 2 adults, 2 children and 0.5 elderly persons using data on population by age group and gender (TUIK 2011).

[1] İstanbul Bilgi University, Business Administration Department, Turkey; yonca.demir@bilgi.edu.tr.
[2] İstanbul Bilgi University, Industrial Engineering Department, Turkey; bulut.aslan@bilgi.edu.tr.

Table 1: **Definition of model parameters**

H_j	hectares in location *j* available for agriculture
F_j	number of typical families in location *j*
Ri	annual requirement of food i of one typical family (kgs)
Yij	yield of food i in location j under organic farming (kgs/hectare)
djk	distance between locations j and k (km)
SC_{ij}	cost of shortage of food type *i* in location *j*

Table 2: **Definition of model variables**

$\boldsymbol{x_{ij}}$	hectares to be allocated for growing food type *i* in location *j*
$\boldsymbol{t_{ijk}}$	kgs of food *i* shipped from location *j* to location *k*
$\boldsymbol{r_{ij}}$	kgs of food type *i* produced in location *j* for consumption in the same location
$\boldsymbol{e_{ij}}$	excess kgs of food type *i* in location *j*
$\boldsymbol{s_{ij}}$	kgs of food type *i* in shortage in location *j*
$\boldsymbol{i_{ij}}$	kgs of food type *i* inventoried in location *j*

The problem is then defined as:

$$\text{Minimize } z = \sum_{i=1}^{N} \sum_{j=1}^{L} \sum_{k=1}^{L} d_{jk}\, \boldsymbol{t_{ijk}} + \sum_{i=1}^{N} \sum_{j=1}^{L} SC_{ij}\, \boldsymbol{s_{ij}}$$

Subject to

$$Y_{ij}\, \boldsymbol{x_{ij}} = \boldsymbol{r_{ij}} + \sum_{k=1}^{L} \boldsymbol{t_{ijk}} + \boldsymbol{i_{ij}} \qquad \text{for } i=1 \quad N \text{ and } j=1 \quad L \quad \textbf{(1)}$$

$$\boldsymbol{r_{ij}} + \sum_{k=1}^{L} \boldsymbol{t_{ikj}} + \boldsymbol{s_{ij}} - \boldsymbol{e_{ij}} = F_j\, R_i \qquad \text{for } i=1 \quad N \text{ and } j=1 \quad L \quad \textbf{(2)}$$

$$\sum_{i=1}^{N} \boldsymbol{x_{ij}} \le H_j \qquad \text{for } j=1 \quad L \quad \textbf{(3)}$$

$$\boldsymbol{t_{ijk}}, \boldsymbol{r_{ij}}, \boldsymbol{x_{ij}}, \boldsymbol{e_{ij}}, \boldsymbol{s_{ij}} \ge 0 \qquad \text{for } i=1 \quad N \text{ and } j=1 \quad L$$

The objective is to minimize **z**, the total distance travelled by food and total amount of food shortage representing the cost of not satisfying food needs from local produce or not satisfying at all. Constraints (1) impose that the amount of each food type produced in each region is either consumed or inventoried in the same region or shipped to other regions. Constraints (2) ensure that the food needs of the population are met and keep an account of any food shortages whereas (3) represent the land availability constraints.

Data requirements and sources

The LP model proposed above has various data requirements. First of all, the different food types to be included in the model should be selected; eventually we plan to include all foods consumed regularly by the population. There are two options for selecting the different geographic regions to be considered: municipalities or agricultural basins. For both choices as regions, some data is available either from the Ministry of Food, Agriculture and Livestock or from the Turkish Statistical Institute. To account for the whole population we estimated the number of typical families in the country to be 15 million distributed appropriately to different geographic regions. Data needed is summarized in Table 1 as the amount of arable land in each region, the number of people living in each region aggregated to typical families, yearly food requirements of typical families, yields of each food in each region under organic farming conditions, distances between regions and costs of not satisfying a food requirement in a given region. Among those data requirements, yield information is the most difficult one to obtain. Next, we describe the different data sources to be used.

Arable land: Eventually, we plan to run the model with municipalities as locations; data on available arable land in each municipality is available from TUIK (2011). An alternative is to use agricultural basins made up of several municipalities. Agricultural basin model is used by the Ministry on the basis of similarity in terms of climate, production efficiency and soil quality.

Geographic distribution of the population: Population by provinces data is available from TUIK (2011). Some pre-processing of data needs to be done to obtain the population of each municipality.

Annual food requirement of a typical family: We determine an average consumption level for a typical family for each food type using purchasing patterns of organic food consumers. This information is obtained through interviews at the organic marketplaces in Istanbul. This is in contrast to the model proposed in Demir (2007) which uses nutrient requirements. Still, we plan to ensure that these average consumption levels satisfy general nutrient requirements.

Organic yields: Data on yields will be found through certification agencies and discussions with organic farmers serving organic markets in different cities of Turkey.

Distances: Distances between municipalities can easily be found from the website http://www.illerarasimesafe.com that uses a calculation based on information from Google MAPS and the General Directorate of Highways of Turkey.

***Shortage costs**:* Shortage costs are used to understand whether Turkey can produce a sufficient amount of organic foods to feed its population properly. We will update these costs until a balance between the amount of shortages and the amount of food transported is reached.

Discussion

Projections indicate that climate change will impact food security in Turkey, (Şen 2013). In this paper, we propose a mathematical model to come up with an organic agriculture plan for Turkey. We also discuss data requirements of the model and potential sources from which these data can be obtained. It has been acknowledged that data collection is a difficult phase of our study. Results on a small instance of the problem are encouraging. Eventually, we plan to obtain results that incorporate the majority of the foods consumed and all the municipalities in Turkey with more realistic organic yield data.

Suggestions to tackle future challenges

To reduce the negative impact of human activity on climate change and the adverse health, environmental and social problems caused by conventional agriculture, conversion to organic agriculture is necessary globally.

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Dependence on agricultural trade in Turkey

SEVIL ACAR

Key words: agriculture, trade dependence, import coverage of exports, organic agriculture, Turkey

Abstract

This study is an attempt to show the dependence on agricultural trade in Turkey focusing on the "import coverage of exports". Using this simple methodology, we aim at showing whether Turkey relies on exports or imports of food and live animals. The analysis indicates that Turkey has gradually become import dependent in some of agricultural products such as meat and meat preparations, live animals and feeding stuff for animals. Besides, exports of organic products have been on a declining trend since 2003.

Introduction

Although Turkey has been known to be self-sufficient in food production, the share of its agriculture sector in total gross domestic product (GDP) has been declining for several decades. As such, the country is becoming more and more dependent on agricultural products from abroad. This study undertakes an analysis of the dependence on agricultural trade focusing on the import coverage of exports calculated as "exports divided by imports" in percentages. This measure helps to see whether a country relies on exports or imports of a specific product or product group. Besides, export value of organic products is displayed in a separate graph. Since organic imports are very limited, import coverage of organic exports is not calculated.

Material and methods

This study uses data for agricultural value-added, imports and exports of food and live animals, and its subcategories as well as exports of organic products from the data sources such as World Development Indicators (WDI), Turkish Statistical Institute (TUIK) and the Ministry of Food, Agriculture and Livestock. It carries out a descriptive analysis of these indicators graphing their trends in time. In addition, it utilizes a very simple indicator of agricultural trade dependence which is calculated as "exports divided by imports" in percentages.

Results

Although Turkey depicted a self-sufficient economy in terms of agriculture in the past, there has been a sharp decline in agricultural production as a share of GDP in recent years. Agriculture made up 56% of total value added in 1960. As of 2012, the share of agricultural value added in Turkish GDP fell down to 9%. Figure 1 illustrates this rapid decline in the last five decades. What is more, since mid-1980s, Turkey has been a net importer of agricultural raw materials owing to a declining share of agricultural exports as a share of merchandise exports and an increasing share of agricultural imports (WDI, 2013).

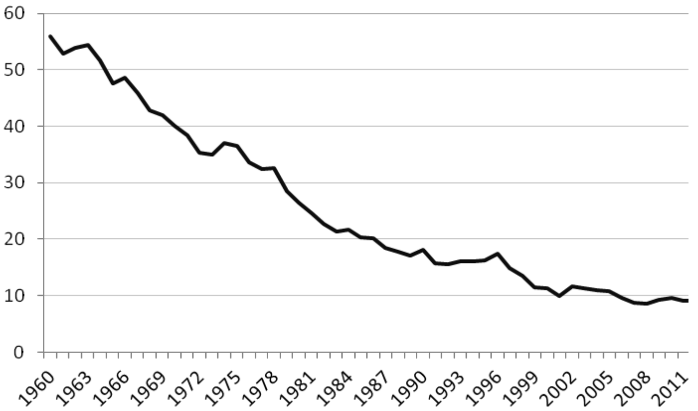

Figure 1. Agriculture, value added (% of GDP)

Source: WDI (2013). *Note: Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs (WDI, 2013).*

According to the Standard International Trade Classification, Rev.4 (SITC Rev.4), imports covered by exports (%) for “Food and live animals” displays a volatile figure in the last ten years. As of 2002, import coverage of exports (%) was around 295 meaning that the exports were almost three times the imports of food and live animals in Turkey. This ratio dropped down to 178 in 2011.

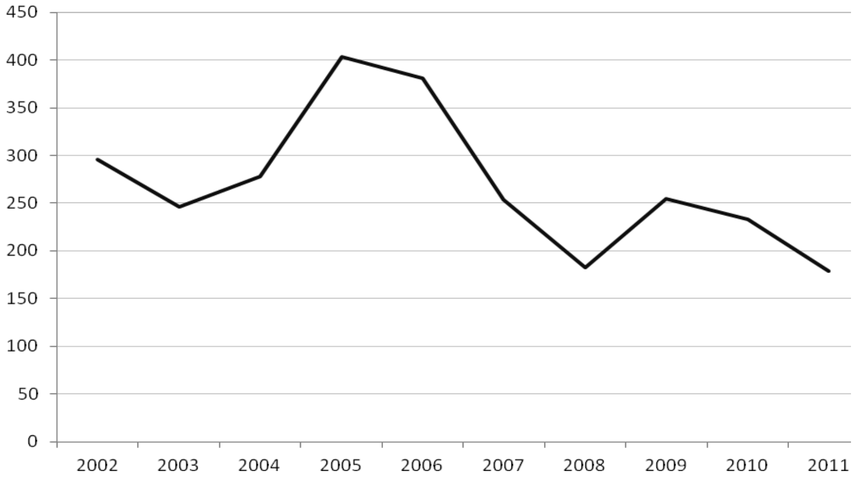

Figure 2. Import coverage of exports (%) for “Food and live animals”
Source: TUIK (2013)
“Food and live animals” section is divided into the following divisions in SITC Rev.4:

- 00 - Live animals other than animals of division 03
- 01 - Meat and meat preparations
- 02 - Dairy products and birds’ eggs
- 03 - Fish (not marine mammals), crustaceans, molluscs and aquatic invertebrates, and preparations thereof
- 04 - Cereals and cereal preparations
- 05 - Vegetables and fruit
- 06 - Sugars, sugar preparations and honey
- 07 - Coffee, tea, cocoa, spices, and manufactures thereof
- 08 - Feeding stuff for animals (not including unmilled cereals)
- 09 - Miscellaneous edible products and preparations

Import coverage of exports (%) of these sub-categories is given in Figures 3.a and 3.b. For visual simplicity, the ten categories above are displayed in two separate graphs. Figure 3.a shows the overwhelming decline in the import coverage of exports of meat and meat preparations. Besides, fish (not marine mammals), crustaceans, molluscs and aquatic invertebrates, and preparations thereof, vegetables and fruit also display declining trends but still lie well above meat and meat preparations in 2011. In Figure 3.b, exports of cereals and cereal preparations as well as coffee, tea, cocoa, spices, and manufactures thereof are almost covering the imports of these products in 2011. However, exports of live animals other than animals of division 03 and feeding stuff for animals (not including unmilled cereals) are far from covering their imports displaying import coverage rates close to zero. Miscellaneous edible products and preparations and dairy products and birds’ eggs are performing better in terms of their import coverage due to increased exports in the recent years.

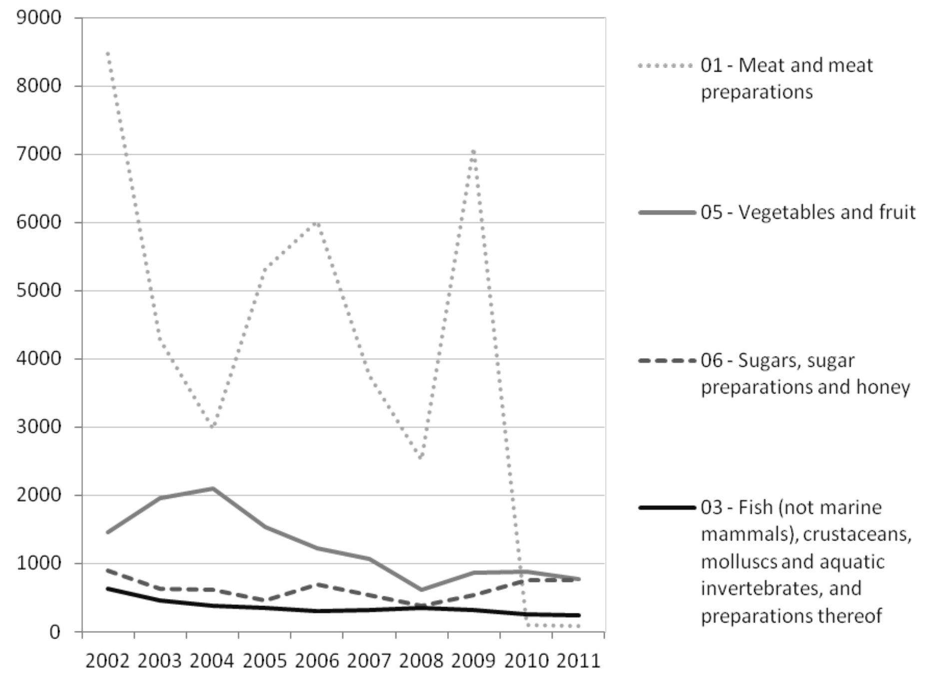

Figure 3.a. Import coverage of exports (%) for the breakdown of "Food and live animals"
Source: TUIK (2013)

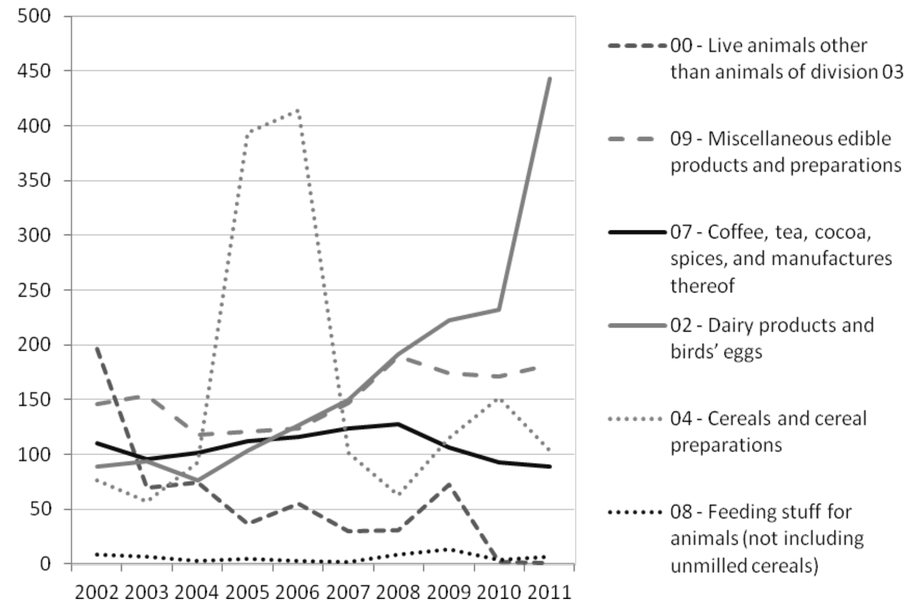

Figure 3.b. Import coverage of exports (%) for the breakdown of "Food and live animals"
Source: TUIK (2013)

Data on organic products which mainly include agricultural products is available from the Turkish Ministry of Food, Agriculture and Livestock. Organic exports mainly include dried fruits, cereals, herbs and spices, industrial crops, fresh or processes fruits and vegetables whereas imports remain fewer and mostly limited to baby food, coffee, chocolate and animal feed. Figure 4 shows the export value of organic products between 1998 and 2011. Imports are reported not in terms of value but in volumes by the Ministry; hence we do not display the import figures here.

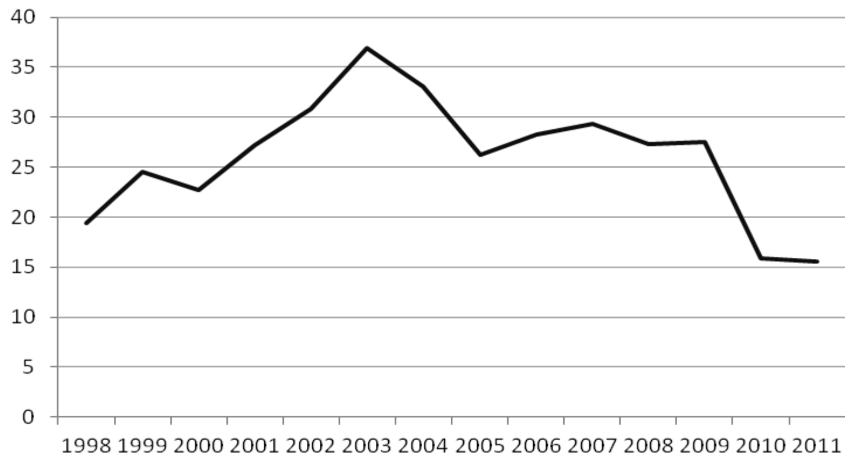

Figure 4. Exports of organic products (million US dollars)
Source: Ministry of Food, Agriculture and Livestock
http://www.tarim.gov.tr/Sayfalar///IceriklerDetay.aspx?rid=320&NodeValue=173&KonuId=133&ListName=Icerikler

Having a diversified environment for organic production, Turkey is listed as one of the top ten countries globally in terms of the number of organic producers (43,000 farmers compared with 400 thousand in India) producing mainly textile crops, protein crops, and cereals (FAO, 2012: 5). Figure 4 reveals that organic exports of Turkey accelerated until 2003 and followed a declining trend thereafter. In 2011, exports declined well below their 1998 levels in US dollars. The reason for this might be the increased domestic demand for organic products rather than declining production. However this needs to be further analyzed and evaluated in another study. Data from the Ministry reveals that around 95% of organic products produced in Turkey are exported. On the other hand, imports are very few consisting of baby food, coffee and chocolate from countries such as Germany, France, Switzerland, Czech Republic, England, and Sweden.

Discussion

The descriptive analysis shows that Turkey has gradually become import dependent in some of agricultural products such as meat and meat preparations, live animals and feeding stuff for animals. On the other hand, it has boosted its exports of miscellaneous edible products and preparations and dairy products and birds' eggs.

According to the recent data from the Ministry of Food, Agriculture and Livestock, total organic production area in Turkey increased around 800% in the last ten years. In 2002, this area was 89,827 hectares whereas it reached 702,909 hectares in 2012. In line with this, organic production escalated from 310,125 tons to 1,750,127 tons. On the other hand, Bugday Association for Supporting Ecological Living reports that a very small portion of total organic production goes to domestic consumption in Turkey. Instead, organic products are largely exported despite the declining value of exports in the recent years.

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Effects of Some Nutrition Experiments on Ellagic Acid end Nitrate Contents in Fruit in Organic Strawberry Production

ADEM ATASAY[1], NURGÜL TÜREMIS[2]

Key words: Organic strawberry, ellagic acid, nitrate

Abstract

In this study carried out in Isparta province of Turkey in 2005 and 2006, it was determined how ellagic acid and nitrate contents of fruit were affected from some application performed in organic and conventional strawberry production. In the study, 18 different application were made at Camarosa strawberry cultivar. The plants were planted as frigo seedlings in the third week of July and irrigated by drip irrigation method. According to the results; ellagic acid contents were ranged from 0.487 to 0.498 mg 100g^{-1} and there were no significant differences among values. Nitrate contens were ranged from 1.43 to 4.57 mg kg^{-1} and there were significant differences among values.

Introduction

Organic agriculture is an alternative method in the settlement of environmental and health problems resulting from the gradually intensifying use of agricultural inputs (Aksoy, 2001). As organic agriculture has gradually become widespread, the production of plant growth regulators and nutrient preparations which might be used in organic growing has begun to multiply. The total strawberry production of Turkey is about 300 thousand tons (Anonymous, 2013a), and of this production, approximately 4 thousand tons are produced under organic conditions (Anoymous, 2013b). The organic strawberry production is rapidly increasing in Turkey as all around the world. This fruit is particularly rich in vitamin C, and 100 g of this fruit contain up to 100 mg of vitamin C (Türemiş et al., 2000). It is reported that the amount of fructose in strawberry ranges from 5.40 to 11.00 g 100ml^{-1} and its amount of organic acid from 1.20 to 1.80 g 100 ml^{-1} according to cultivars (Hakala et al., 2002). Ellagic acid is an anticarcinogenic and antimutagenic phenolic compound which is important to cardiovascular diseases. Ellagic acid is the one which is found at the highest amount in terms of phenolic compounds in strawberry (Koşar et al., 2004; Hakkinen, 2000). Strawberry contains a higher amount of ellagic acid than many fruits Williner et al. (2003), and the amounts of ellagic acid in fruits vary by cultivar and harvest maturity (Maas et al., 1991). An important issue to which attention must be paid in fruit & vegetable growing is that the nitrate and nitric contents of the edible parts should be within the limits which will not be deleterious to human health. This issue becomes far more important especially in organic fruit growing. The researchers reported that nitrates and nitrites were present naturally in vegetables, fruits, forage crops, and freshwater and that the extra nitrates and nitrites in foods directly threatened human and animal health (Maas et al., 1991; Osweiler, 1985).

Material and methods

The study was conducted in Eğirdir (Isparta) in 2005 and 2006. The plants were planted in the form of a square of 30 cm X 30 cm on the beds which were 30 cm in height and 100 cm in width. Planting was performed with frigo seedlings in July, and the experiment was set up biennially according to the randomized block experimental design with 5 replications. The Camarosa cultivar was used as the plant material. Irrigation was performed in the form of drip irrigation, and weed control was carried out by using a hand hoe and mulch (black polyethylene).

The applications whose effect was tested in the study are as follows: 1-Organic growing (15 different nutrient applications and the C-1 application with no nutrient application); 2-Conventional growing (CG); and 3-Control (C-2). Farm manure (FM), green manure (GM), clinoptilolite (Cln), seaweed (S) and their combinations were tested as nutrient applications in organic growing, while nitrogen had been applied before planting, and nitrogen and phosphorus were applied in the first year and nitrogen, phosphorus and potassium in the second year according to the results of the soil analysis in conventional growing. In addition, iron was applied to both all applications in the organic plot and the conventional plot in the second year. However, no nutrient or agricultural control was applied in the control. Statistical analyses were performed using analysis of variance in JMP statistical software. The means were separated by Tukey.

[1] Fruit Research Station,Turkey, www.marim.gov.tr, eMail: atasay15@yahoo.com
[2] Cukurova University, Agriculture Faculty, Turkey, www.cu.edu.tr, eMail: nturemis@gmail.com

To determine the ellagic acid content, the fruits were frozen in liquid nitrogen following the harvest and left in a deep freezer till the analysis. 3 g of fruits were obtained for ellagic acid extraction and mixed with 10 ml of acetone:water (at the ratio of 1:4); 0.1 ml of TFA (Trifluoressiqsaure acetic acid) was added; and they were extracted for an hour in the 100^oC water bath. The specimens were filtered and read at 200-600 nm wavelengths in liquid chromatographic apparatus (Shimadzu WP HPLC), and the obtained results were detected in mg $100g^{-1}$. The detector used was Photodiode Array detector; the column was Nucleosil C 18 (150mm x 4.6mm); and its flow rate was 1 ml/minute. Solvent A was prepared by mixing 2.5% formic acid (HCOOH) in water, while Solvent B was prepared by mixing 2.5% formic acid in acetonitrile (Koşar et al., 2004).

To determine the nitrate content, first of all it was intended to determine the amount of nitrite in 500g of fruits obtained randomly; however, no nitrite could be detected in any of the specimens, and it took the value of zero (“0”) in the formula. For nitrite detection, the sample was extracted with hot water (40-45^oC), and the proteins were precipitated with potassium hexacyanoferrate and zinc acetate and filtered. A red complex was created by adding sulphanilamide chloride and N-(1-Naphthyl) Ethylenediamine Dihydrochloride to the filtrate, and it was read at 538nm wavelength of Biocrom 8500 II spectrophotometer. For nitrate detection, the filtrate in the nitrite detection was reduced to nitrite with metallic cadmium; a red complex was created using the resulting filtrate and the color reagent; and it was read at 538nm wavelength by a Biocrom 8500 II spectrophotometer and computed with the following formula (Anonymous, 2000). NO_3 (ppm) = 1.348 x [(Dilution rate x the value read in the spectrophotometer)-(NO_2 conc.)]

Research and Discussion

Ellagic Acid: The values of ellagic acid are shown in Table 1. When these values were examined, the statistical difference between the applications and years were found insignificant. It was seen that the amount of ellagic acid in Camarosa strawberry cultivar did not vary by application and that the values ranged from 0.487 mg $100g^{-1}$ to 0.498 mg $100g^{-1}$. The researchers detected 0.36 mg $100g^{-1}$ of ellagic acid in the ripe fruits of strawberry (Koşar et al., 2004). In another study, it was stated that no difference in the total amount of phenolic acid (ellagic, p-coumaric, caffeic, and ferulic acids) was seen between the fruits obtained from organic and conventional growing (Hakkinen, 2000). These data overlap our findings.

Nitrate: The amounts of nitrate in the fruit are demonstrated in Table 1. When these values were examined, the statistical difference between the applications and years were found significant. According to the data in the experiment, the highest values were obtained from conventional growing in the first year (4.57 mg kg^{-1}) and in the second year (4.06 mg kg^{-1}), whereas the lowest values were obtained from S (1.68 mg kg^{-1}) in the first year and from C-1 (1.43 mg kg^{-1}) in the second year. According to the amounts of nitrate it contains, the strawberry fruit is included in the moderate-nitrate group (200-600 mg kg^{-1}) (Anonymous, 2000). When the data obtained from the experiment were evaluated, it was seen that these limits were not reached in any of the applications (0-200 mg kg^{-1}).

Table 1. Ellagic acid values and Nitrate values

Applications	Ellagic acid values (mg 100g^{-1})			Nitrate values (mg kg^{-1})		
	2005	**2006**	**Average**	**2005**	**2006**	**Average***
FM	0.492	0.491	0.492	3.60	2.03	2.82 bc
GM	0.492	0.489	0.491	1.98	1.68	1.83 d-f
Cln	0.490	0.488	0.489	2.17	1.62	1.90 c-f
S	0.494	0.494	0.494	1.68	1.73	1.70 ef
FM+GM	0.493	0.493	0.493	2.91	2.47	2.69 b-d
FM+Cln	0.494	0.496	0.495	3.86	1.92	2.89 b
FM+S	0.495	0.493	0.494	3.08	2.03	2.53 b-f
FM+GM+Cln	0.495	0.489	0.492	2.79	2.57	2.68 b-d
FM+GM+S	0.494	0.490	0.492	2.97	1.96	2.46 b-f
FM+GM+Cln+S	0.494	0.491	0.492	3.09	1.87	2.48 b-f
FM+Cln+S	0.489	0.497	0.493	2.57	2.17	2.37 b-f
GM+Cln	0.496	0.497	0.497	2.42	2.21	2.32 b-f
GM+S	0.496	0.487	0.491	2.38	1.87	2.13 b-f
GM+Cln+S	0.493	0.496	0.495	2.55	2.21	2.38 b-f
Cln+S	0.490	0.498	0.494	2.84	2.40	2.62 b-e
C-1	0.494	0.494	0.494	1.90	1.43	1.67 f
CG	0.491	0.491	0.491	4.57	4.06	4.31 a
C-2	0.490	0.492	0.491	1.88	1.81	1.85 d-f
Average *	0.492	0.492		2.70 a	2.14 b	

* significant at $P<0.05$

Conclusion

When the applications in organic strawberry growing and conventional strawberry growing are compared in terms of the values of ellagic acid, it is seen that the difference between them is statistically insignificant. According to the averages of both years, the values of ellagic acid from 0.489 to 0.495 mg 100g^{-1}. It is known that an organically grown strawberry is healthier than those which are conventionally grown. Nevertheless, the fact that nitrate and some metals are higher than the specified limits threatens human health and might cause the formation of diseases up to cancer. According to the values of nitrate obtained, it was detected that the values obtained from conventional growing both in the first year (4.57 mg kg^{-1}) and the second year (4.06 mg kg^{-1}) were higher than the values in organic growing (1.43-3.60 mg kg^{-1}). Although the strawberry fruit was stated in the moderate-nitrate group (Anonymous, 2000), the values obtained from all applications in the experiment were included in the low-nitrate group. According to these findings, it might be stated that all products obtained from both organic and conventional growing are safe in terms of nitrate.

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The role of a civil society organization in the development of the domestic organic market in Turkey

ALI ALPER AKYÜZ[1], ATIYE YONCA DEMIR[2]

Key words: Organic agriculture, civil society organizations, consumers, stakeholders, domestic markets

Abstract

In this paper, we report of a case from Turkey where a civil society organization took an active role in influencing laws, regulations and their implementation regarding organic agriculture and the marketing of organic products. Although the country's climate and biodiversity is suitable for organic agriculture, the domestic market remained underdeveloped; the organic sector was directed mainly towards exports. By establishing the first marketplace solely for certified organic products in 2006, a non-governmental organization became the locomotive of the domestic sector. The process that leads to the 100% organic bazaar exhibits a contingent characteristic where particularly social and symbolic capital were mobilized by the NGO together with a framing of positive 'ecological living' discourse and therefore contributing to the 'organic' movement.

Introduction

Certified organic farming in Turkey started with the production of dried fruits for a German company in 1986, (Rapunzel 2012) and grew steadily since then. When the EU imposed conditions on the countries exporting organic products in 1992, (Aktar and Ananias 2005), Turkey had to develop her own regulations for organic production in 1994 and 1995 (Kenanoğlu and Karahan 2002). The Turkish Parliament passed the organic farming law in December 2004. However, throughout the process, production has been made vastly for export and domestic market could not develop till mid-2000s. This paper presents and analyses efforts of a civil society organization, Buğday Association for Supporting Ecological Living (Buğday), to build up a domestic market with mobilizing and meeting supply and demand within the country and organizing a space for trade, exchange and interaction among relevant stakeholders.

Material and methods

Research reported in this article is compiled from three sources of information. First data source is sales and participation data gathered at the bazaar by Buğday for the period between the launch of the first organic market in June 2006 and December 2009, the timing of the second marketplace. Secondly, unstructured interviews with farmers, middlemen, consumers and Buğday members have been conducted. Finally, participant observation at the bazaar and at the established consumer-producer committee meetings is used to understand the workings of the organic bazaar and the relationship between farmers, middlemen and Buğday.

Results: NGO aids in developing the domestic organic sector in Turkey

Buğday is a not-for-profit and non-governmental organization (NGO) working in all areas related to ecological living. Started as a movement in the 90s with a healthy food restaurant and institutionalized into an association in 2002, Buğday's activities include promoting production, marketing and consumption of organic produce; preserving local heirloom seeds; bringing together urban and rural people via eco-tourism and voluntary exchange and recovering lost tales of nomadic tribes in Turkey. Buğday utilized international networks such as IFOAM to learn about organic agriculture practices as well as about solutions to common problems in other countries and shared information with producers and consumers in Turkey. In the following list we categorize the activities of Buğday that led to the launch of the first organic bazaar:

Expanding the production base: Throughout its existence, Buğday team was contacted and invited by farmers located in different regions of Turkey to give insight for a farming practice that is "in peace with nature". Farmers had various economic, social and political motivations, but Buğday established a

[1] Center for Civil Society Studies, İstanbul Bilgi University, www.bilgi.edu.tr, alper.akyuz@bilgi.edu.tr
[2] Business Administration, İstanbul Bilgi University, www.bilgi.edu.tr, ydemir@bilgi.edu.tr

supporting relationship with them to convert to organic agriculture using knowledge accumulated throughout the years.

Efforts to expand the consumption potential: Two among Buğday's projects, a food box and a community supported agriculture project (GARDEN), targeted Istanbul's citizens in the period between 2002 and 2005. These projects, despite their limited scopes, contributed to the building up of an infrastructure and mobilization of consumers for community supported agriculture.

Raising awareness of organic farming and products using communication channels: Buğday used a diverse array of communication channels and methods to disseminate information and to build knowledge and awareness as well as to bring together interested individuals and parties. These channels included a well-known ecological magazine, a weekly e-bulletin, an internet portal, and a radio program, trainings and educational activities at its rural office and ecological research and education center, media campaigns, supporting production of documentaries and television programs.

Bringing together actors of organic agriculture: In 1999, Buğday organized the Bafa Congress on "A Healthy Market of Organic Products for Turkey", the first official meeting of actors of the organic sector: activists, farmers, consumers and entrepreneurs interested in trading organic products. This congress is the start of expanding organic agriculture beyond a few good men, (Anıl, et al., 2004). A long list of decisions about all the phases that a product goes through from agriculture to its marketing and sales formed the basis of the future lobbying.

Legislative efforts: Buğday lobbied successfully in order to promote organic agriculture as well as providing consultancy to the Ministry of Food, Agriculture and Livestock for drafting of the organic farming law which the Turkish Parliament passed in December 2004. Due to lobbying efforts of Buğday, organic products are exempt from the wholesale food market law, therefore reducing costs and ensuring traceability of the products.

Turkey's first organic marketplace: During the time between December 2004 and June 2006, Buğday intensified its work with municipalities and sponsors. Two organic producer/retailer companies stepped in as sponsors and a local government (Şişli municipality) provided one of the local marketplaces. The rules for participation in the marketplace were collectively written down and Turkey's first organic bazaar has been launched in June 2006. Producers and consumers started meeting every Saturday at the market.

Consumers report that they can now purchase organic products, cook 100% organic meals and observed a mobilization of the organic sector; other organic marketplaces have been established, the number of organic stores and internet groceries has increased, several restaurants started to offer organic menus, well-known chefs started to use and mention organic ingredients on TV programs and the organic bazaar became much more crowded. Consumers also witnessed an expansion in the quantity and variety of products traded in time. Producers expressed pleasure in having the chance of trading directly to the consumers. Buğday employees report increases in the number of companies, the variety of marketing channels and the number of consumers. The increased supply and availability of organic products boosted up demand which naturally caused a further increase in organic production. Finally in 2011, the ministry for the first time published the list of enterprises active in organic agriculture. Besides providing a very much needed sales channel to organic farmers, Istanbul's organic bazaar and particularly the cafe areas within have social impacts; people interact, exchange ideas, meet old friends and form new friendships and collaborations. Consumer influences motivating farmers and examples of social learning, innovation and entrepreneurship are observable (Hunt 2006, Hinrichs et al. 2004). Some consumers reported partnerships with farmers whereas some farmers reported new business ventures to produce much desired products by consumers. Organic bazaar has been another venue and space for raising awareness of Buğday's activities as well.

In countries with developed organic markets, the majority of organic food sales are conducted through mainstream retailers, (Sahota 2007). This has not been the case for Turkey. Still, the development of the domestic market in Turkey bear some similarities to the initial stages of the development of Germany's organic market, in the sense that activists played a significant role, (Rottner 2007). The recent appearance of farmers' markets in Prague resulting in a new direction in the shopping behavior of Prague's citizens (Spilková et al. 2012) is also relevant, however these farmers' markets remain small (30-50 stalls compared to around 250 in İstanbul's organic bazaars) and offerings are not limited to organic products. The role of public institutions and civil society for promoting alternative food networks (Renting and Wiskerke 2010), has three axis: (i) short food chains with new relations between civil society and the food chain, (ii) public sector as buyer and consumer of food, (iii) municipalities and city-regions as food policy makers. Indeed, Turkey's first organic bazaar is an example of a short food chain with a direct and indispensable role of civil society in the actual development of the domestic organic sector.

Discussion

The organic bazaar provided farmers a sales channel and consumers an access to organic products. The meeting of stakeholders at the bazaar facilitates collaborations, strategic alliances, innovations, information exchange and development of relationships. The process leading to the establishment of the bazaar is contingent; it's an action that was not planned already from the beginning, but was made possible as a consequence of former activities and accumulation of human, social and symbolic capital (Bourdieu 1998). An NGO that planned and initiated the bazaar also manages the marketplace, with the consent and trust of both producers and consumers. The organic bazaar has provided a regular physical and intellectual space of interaction between different stakeholders and among those stakeholders themselves. Together with the framing of Buğday's ecological living discourse (Snow and Benford 1988), this space has contributed to the formation and consolidation of an 'organic' movement.

Suggestions to tackle the future challenges With the organic bazaar, a major obstacle of domestic accessibility of organic products has been overcome, however this effort needs to be supplemented by the government and the sector to further expand the domestic market. The diverse forms of power relations between stakeholders who have varying and possibly conflicting goals require further research. Finally, problem of lack of data on organic food sales in Turkey at large has to be solved to truly grasp the extent of expansion of the organic sector.

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Effect of conventional and organic farming systems on yield and quality of vineyards

ÜLFET ERDAL[1], ÖMER SÖKMEN[1], ALI RIZA ONGUN[2], ATILA ERTEM[3]

Key words: Organic, Conventional, Vineyard, Turkey

Abstract

In this study, the aim was to compare changes in yield and various qualities in vineyards where conventional farming systems (CFS) and organic farming systems (OFS) are practiced. The experiment was carried out in 5 replicates with a completely randomized design in Manisa-Salihli, Poyrazdamları Village over a period of 9 year between 2000 and 2008. According to soil analysis results, certified fertilizer, green manure and vineyard pruning waste were applied in organic plots. 21% ammonium sulphate, 26% ammonium nitrate, 43% triple super phosphate as P_2O_5 and 48-52% potassium sulphate as K_2O were applied in conventional plots. When the yields were assessed, table grape and raisin yields were higher in conventional plots at a statistically significant degree.

Introduction

In Turkey, organic agriculture started in the mid of 1980s as a result of the demand of European importers and was concentrated primarily in the Aegean Region. Raisins (sultanas), apricots and figs are the first products produced by organic farming. Turkey has produced and exported organic raisins since 1986 and is the world leader in organic raisin production. Raisin exports from Turkey have largely increased over the years. While in 1986 there were few producers and a limited amount of table grape production, as of 2012 more than 10.000 tons were produced in Turkey. In this study, the aim was to compare differences in yield and various qualities in vineyards where conventional farming systems (CFS) and organic farming systems (OFS) are practiced.

Material and methods

In Turkey, organic agriculture started in the mid of 1980s as a result of the demand of European importers and was concentrated primarily in the Aegean Region. Raisins (sultanas), apricots and figs are the first products produced by organic farming. Turkey has produced and exported organic raisins since 1986 and is the world leader in organic raisin production. Raisin exports from Turkey have largely increased over the years. While in 1986 there were few producers and a limited amount of table grape production, as of 2012 more than 10.000 tons were produced in Turkey.In this study, the aim was to compare differences in yield and various qualities in vineyards where CFS and OFS are practiced.

The experiment was conducted in the Gediz Basin (Manisa-Salihli), in the Aegean Region of Turkey (38°35´35.26˝N; 28°07´42.70˝E). Manisa-Salihli is dominated by a Mediterranean climate, where summers are hot and dry, and winters mild and rainy. The soil has a loam texture with a pH of 7.5 and contains 0.56 % organic C and 0.079 % total N. The experiment was carried out in 5 replicates with a randomized design over a period of 9 years between 2000 and 2008. Soil samples were taken at the depths of 0-20 and 20-40 cm. According to soil analysis results, certified fertilizer and green manure and vineyard pruning waste were applied as plant nutrition material in organic plots (Table 1). On the other hand, 21% ammonium sulphate, 26% ammonium nitrate, 43% triple super phosphate and 48-52% potassium sulphate were applied in conventional plots. Certified products and traps permitted in the related regulations, Bordeaux mixture, copper preparations and sulphur were used in the OFS for disease and pest control. In the CFS, synthetic pesticides were used as plant protection material in the plots.

[1]International Agricultural Research and Training Center Menemen-Izmir/Turkey ulfeterdal@yahoo.com, www.utaem.gov.tr

[2] Ege University, Faculty of Agriculture, Department of Soil Science and Plant Nutrition, Bornova-Izmir/Turkey. www.agr.ege.edu.tr, ali.riza.ongun@ege.edu.tr

[3] Senior Expert on Organic Agriculture, Bornova-Izmir/Turkey

Table 1: Fertilization program

	Conventional	Organic
2000	150 kg N ha^{-1}	GM + VPR + 600 kg AB ha^{-1}
2001	150 kg N ha^{-1}	GM + VPR + 600 kg AB ha^{-1}
2002	150 kg N ha^{-1} + 60 kg P_2O_5 ha^{-1} + 100 kg K_2O ha^{-1}	GM + VPR + 600 kg AB ha^{-1}
2003	150 kg N ha^{-1} + 60 kg P_2O_5 ha^{-1} + 50 kg K_2O ha^{-1}	GM + VPR + 600 kg AB ha^{-1}
2004	150 kg N ha^{-1} + 60 kg P_2O_5 ha^{-1} + 100 kg K_2O ha^{-1}	GM + VPW + 600 kg AB ha^{-1}
2005	150 kg N ha^{-1}	GM + VPW + 600 kg AB ha^{-1}
2006	150 kg N ha^{-1}	GM + VPW + 600 kg AB ha^{-1}
2007	150 kg N ha^{-1}	GM + VPW + 600 kg AB ha^{-1}
2008	150 kg N ha^{-1}	GM + VPW + 600 kg AB ha^{-1}

N: ½ $(NH_4)_2SO_4$ + ½ NH_4NO_3
GM: 80 kg vetch(*Visia villosa* L.) ha + 20 kg barley ha^{-1} VPW: Vineyard pruning waste
AB: Agro-Biosol (N:P:K 7:1.5:3.5)

Results and Discussion

The yield of the organic and conventional systems at the vineyards between 2000 and 2008, as well as the results obtained at some quality parameters, were examined, and interpreted as follows:

Table grape and raisin yield: The experiment was started in 2000, when the vine stocks were 4 years old. Since the vineyards were not ready for full yield, the lowest grape yields in both systems were in 2000. In the experiment areas, after they became ready for yield in 2001 (5th year), the table grape yields demonstrated the lowest yields in both systems in 2002. The difference in table grape yields from OFS and CFS were found to be statistically significant (Table 2).

When the table grape yields from CFS and the yield from OFS in 2002, 2003, 2004 and 2005 are compared, the difference between the practices were at a statistically significant level. The yield upsides in conventional production in the mentioned years were 24%, 33%, 11% and 14% respectively. The highest difference in yield between the two systems was found in 2003. When the yields were assessed statistically, they were found to be significant in favor of conventional agriculture in 2002, 2003, 2004 and 2005. In 2008, which was the last year of the experiment, although there was not a statistically significant difference between the yield values obtained from conventional production and the yield values obtained from organic production, it was observed that the organic production (4009,88 kg/da) provided a yield value close to conventional production (4103,70 kg/da) (Table 2). The average organic and conventional table grape yields obtained in this study are in accordance with the product amounts obtained in the region (İlter, 1980; Erdem et al, 1995; Altındişli and Kısmalı, 1998; Ilgın et al., 2002).

Table 2: Effect of CFS and OFS on table grape and raisin yields

	Fresh Grape (kg da^{-1})				Raisin (kg da^{-1})			
years	CFS		OFS		CFS		OFS	
2000	681.12	f	570.39	e	133.28	f	105.45	e
2001	2514.56	de	2590.12	c	585.43	de	590.86	bc
2002	2309.87	e	1755.55	d	476.91	e	393.33	d
2003	4096.90	a	2756.76	bc	952.44	b	697.48	bc
2004	3846.28	ab	3416.08	ab	767.28	c	699.04	bc
2005	3090.00	cd	2650.60	c	639.60	cd	557.20	c
2006	3218.40	bcd	2871.40	bc	708.20	cd	663.00	bc
2007	3236.60	bc	2889.60	bc	729.20	cd	717.00	b
2008	4103.70	a	4009.88	a	1170.36	a	1229.60	a
		**		**		**		**

** Tukey $p<0.01$

The variance analysis concerning the raisin yield values of the OFS and CFS is summarized in Table 2. The difference between the organic and conventional systems was found to be statistically significant. The values concerning raisin values are shown in Table 2. It was found out that a raisin yield, which was higher compared to organic production at a statistically significant degree, was obtained from conventional production in 2003. In other years, differences with statistical significance were not found between the practices. The average yields of OFS and CFS, obtained from the experiment, are in compliance with the grape yields obtained in the same region (İlter, 1980; Erdem et al., 1995; Altındişli and Kısmalı, 1998; Ilgın et al., 2002).

Concerning table grape yields, there are differences between two systems at a statistically significant degree. However, these gaps between the yield values obtained from both practices are not noteworthy in the practical sense. Especially when the yields of the last year are compared, it can be seen that very close values are obtained. The yields, which were low during the first years, increased in years and demonstrated a more stable trend, and reached the highest level in the last year. In raisin yield, a difference in favor of conventional was observed again at a statistically significant degree. The table grape and raisin yields obtained from the organic plots are similar to the conventional yield averages obtained in the region.

Size in raisin: There is a statistically significant difference between two systems. It is determined that size of table grapes which were cultivated with organic agriculture in 2000 and 2004 are higher than the sizes of those which were cultivated conventionally in the same years (Table 3 and 4). In their study in the field Altındişli et al. (2004) determined that size of organically cultivated raisins were between size 8.25-9.5. Altındişli (1998) stated that in the same area the size of conventionally cultivated raisins were around size 9-9.5. Lowest size was detected in 2002 in both systems. It was due the epidemic of powder mildew, inhibiting grapes from growing enough (Altındişli et al. 2004)

Dried matter (brix %) in table grapes: There is not an overall statistically significant difference between two systems. It was determined that there are differences at a statistical significance level for dried matter amounts between the practices in 2001 and 2008. In 2001 it is stated that there was a 12.5% higher amount of total brix for CFS compared to OFS but in 2008 we see that there was an 8% higher amount of total dried matter for OFS compared to CFS. In the trial area the percentage of sugar in grapes cultivated for drying changes from province to province yet Altındişli et al. (2004) informed that this must be around 18% - 20% (Table 3 and 4). The result obtained in this trial for CFS is 18% - 20% and for OFS is 16% - %21 and they show agreement the results stated by Ilgın et al. (2002) and Altındişli et al. (2004).

Table 3: Effect of CFS and OFS on dried matter (brix %) and size

	Dried matter (brix) (%)				Size			
years	CFS		OFS		CFS		OFS	
2000	18.700	ab	18.600	bc	9.700	a	10.300	a
2001	19.900	ab	17.400	c	9.450	a	9.450	b
2002	17.200	b	17.800	c	7.000	d	7.000	e
2003	18.500	ab	18.400	c	9.500	a	9.800	ab
2004	18.100	ab	17.400	c	7.900	c	8.400	d
2005	18.160	ab	18.120	c	9.200	ab	9.200	bc
2006	17.400	ab	16.120	c	8.600	bc	8.700	cd
2007	20.140	a	21.380	a	9.350	a	9.350	bc
2008	19.552	ab	21.280	ab	8.250	c	8.450	d
		**		**		**		**

**Tukey p<0.01

Table 4: Comparison of the effects of CFS and OFS on yield and some quality characteristics

	CFS (n=45)	OFS (n=45)		
Table grape yield (kg da^{-1})	3010.83 a	2612.26 b	**	
Raisin yield (kg da^{-1})	684.74 a	628.11 b	**	
Dried matter (brix %)	18.63 a	15.50 a	ns	*ns: not significant*
Size	8.77 a	8.96 a	ns	***Tukey p<0.01*

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Homegardens in Uganda: Diversity and Potential

CORY WILLIAM WHITNEY[1,2], JENS GEBAUER[1,3]

Key words: Uganda, homegardens, Organic potential, rare plants, indigenous crops, agrobiodiversity

Abstract

Ugandan homegarden systems are sustainable small-scale solutions for food security and conservation; they contain a great diversity of indigenous plant species and act to preserve the associated, and time-tested, traditional knowledge of both nutrition and conservation. These systems and traditions are under threat. Ugandan Organic may hold some of the keys for the revitalization of these oases of diversity and culture. More in-depth investigations of the influences on homegardens biodiversity are necessary.

Introduction

Ugandan homegardens are complex farming systems (Buyinza 2009) important to rural living in Uganda (FAO 2011). Ugandan homegardens hold many underutilized food plants (Tabuti 2012) and strong potential exists for the expansion of homegarden biodiversity and the promotion of indigenous plants (Tabuti et al. 2011). Potential also exists for the promotion of this underutilized diversity in Ugandan Organic. However, more research is needed, to understand both the influencing factors on agrobiodiversity (Scales & Marsden 2008), and the dynamics of homegarden systems (Buyinza 2009). Knowledge of general effects is substantial, but more information at the local level is needed to accurately predict biodiversity responses (Scales & Marsden 2008).

Material and Methods

This review was conducted to ascertain the biodiversity in homegardens and Organic markets in Uganda. What follows comes from journals and library databases, as well as available information from the National Organic Agriculture Movement of Uganda (NOGAMU) and the Uganda Organic Certification Ltd. (UgoCert).

Results & Discussion

Ugandan Homegardens

Ugandan homegardens are complex and small-scale farming systems (Buyinza 2009) optimized to meet multiple needs and maximize resources with high levels of plant diversity, characteristic of areas where production is particularly difficult i.e. semi-arid, high altitude, and isolated communities. These homegardens persist, and are very important to life in the extremely variable production environments of Uganda with limited access to resources and markets (FAO 2011).

Many indigenous plants are found in these homegardens (Eilu et al. 2007), close to homesteads, in crop gardens and in young fallows (Tabuti et al. 2011). Over many generations, local people have been carefully selecting these plants for optimal food security and risk insurance against environmental stresses (FAO 2011). They are also preferred for their natural regeneration, ease of management, fast maturation, seedling availability (Tabuti 2012), yield, maturity period, taste, quality, storability, drought resistance, marketability, ease of processing, among other cultural and traditional uses (FAO 2011). These plants grow in a wide diversity of farm niches[4] playing additional ecological roles (Tabuti et al. 2011).

Uses of Species by Ugandan People

Studies have shown that Ugandans are frugal and industrious when it comes to using plant resources. They have a diversity of uses for many parts of plants (Kakudidi 2004), primarily for food (FAO 2011), but also with

[1]Faculty of Life Sciences, Rhine-Waal University of Applied Sciences, Kleve, Germany, www.hochschule-rhein-waal.de

[2] eMail: CoryWilliam.Whitney@hochschule-rhein-waal.de

[3] eMail: Jens.Gebauer@hochschule-rhein-waal.de

[4]e. g. *Mangifera indica*, *Milicia excelsa*, *Ficus natalensis*, *Ficus sycomorus*, *Artocarpus heterophyllus* and *Albizia coriaria* in many homegardens in Nawaikoke sub-county

multiple other uses[5] including firewood, medicine, construction, environmental services, pest control (Eilu et al. 2007), as well as cultural[6] and social purposes such as ceremonies (Kakudidi 2004).

Despite this variety there are many underutilized food plants[7] in Uganda (Tabuti 2012). Their richness and abundance generally decrease with increasing prevalence of crop species, more intensive management and shortening of cultivation cycles (Scales & Marsden 2008).

In spite of their known ecological stability, homegardens are on the decline, mainly due to social and economic pressures (Buyinza 2009). Many useful indigenous species are in danger[8] due to over-harvesting[9], destructive harvesting, pests, lack of farmer's knowledge, and droughts (Tabuti 2012). For example a study in Nawaikoke sub-county it was found that indigenous species are depleted[10] and that most face some level of threat through destruction of seedlings and saplings (Tabuti et al. 2011). In Kamuli district, it was found that smaller holdings are generally more intensively cultivated than the large and very large holdings but that the fragmentation of land eventually makes some of the holdings too small and uneconomical and people move away from farming (Buyinza 2009).

Potential

Potential exists for the expansion of homegardens in Uganda and the subsequent promotion of indigenous plants for traditional food and nutrition. This promotion should have a special focus on native species that provide shade, fruits and timber, encouraging farmers to plant and utilize these plants, or at least allow them to grow naturally (Tabuti et al. 2011). Furthermore, in developing local solutions, it is important that users are brought together based on common interests (Eilu et al. 2007), especially related to the use and associated conservation of indigenous plants. These interests may span across socio-economic characteristics such as age, sex, and occupation.

As was described above homegardens have many indigenous plants and the people of Uganda have many uses for these species. Potential exists for the Organic movement to utilize this diversity and to take full advantage of the diversity of crops being produced in homegardens. According to National Organic Agriculture Movement of Uganda (NOGAMU) and the Uganda Organic Certification Ltd. (UgoCert), the Ugandan Organic markets have fresh and dried fruit[11], herbs[12], tea[13] and spices[14] nuts and butters[15], and processed essential oils with around 20 species of bark cloth[16] (Nogamu 2013, UgoCert 2013). Not all of these species are indigenous and the diversity of products has a lot of room for expansion to meet the diverse demands of the Ugandan people.

The Ugandan Organic movement can embrace this diversity and help to increase and encourage diversity for the benefit of small producers and indigenous plant species. By working to open up markets the Organic movement can help farmers and improve the state of agrobiodiversity in the country while at the same time getting a more healthy and diverse diet of indigenous plants to people of Uganda.

[5] e.g. for *Cymbopogon nardus*, *Ficus natalensis, F. ovata, Hibiscus fuscus*, *Phoenix reclinata* (Kakudidi 2004).

[6] e.g. 87 cultural plant species of 36 families and 66 genera in Tororo District (Eilu et al. 2007)

[7] e.g. *Arundinaria alpine*, *Colocasia* spp./*Xanthosoma* spp., *Vondzeia subterranea*, *Cucumis figarei*, *Corchorus tridens*, *Crotararia ochroleuca*, *Hyptis spicigera*, *Phaseolus lunatus* in Eastern, Northern and Western Nile Regions (FAO 2011).

[8] e.g. *Milicia excelsa*, *Albizia coriaria*, *Combretum molle*, *Terminalia glaucescens*., *Coffea* spp., *Combretum collinum*, and Citrus spp. (Tabuti 2012)

[9] esp. *Milicia excelsa* (Eilu et al. 2007)

[10] e.g. *Ziziphus pubescens*, *Casuarina* spp., *Maesopsis eminii*, *Psorospermum febrifugum*, *Psydrax parviflora* subsp. *parviflora*, *Sarcocephalus latifolius*, and *Securidaca longipedunculata* (Tabuti et al. 2011).

[11] *Malus domestica*, *Musa* spp., *Persea americana*, *Mangifera* spp., *Carica papaya*, *Passiflora edulis*, *Ananas comosus*) and roots (*Zingeberacea* spp.)

[12] *Agropyron* spp., *Cymbopogon* spp., *Hibiscus* spp., *Lavandula* spp., *Melissa officinalis*, *Mentha × piperita*, *Mentha* spp., *Mondia whitei*, *Moringa* spp., *Ocimum basilicum*, *Origanum vulgare*, *Ribes* spp., *Rosmarinus officinalis*, *Thymus* spp., *Urtica* spp.

[13] *Hibiscus* spp.

[14] *Capsicum annuum*, *Theobroma cacao*, *Vanilla* spp.

[15] *Sesamum indicum*, *Vitellaria paradox*

[16] *Broussonetia papyrifera*, *Artocarpus altilis*, and *Ficus* spp.

More Studies Are Needed

In order to make this expansion of species diversity in Ugandan Organic a reality more research is needed. Simply opening up markets may not be the full solution for the loss of agrobiodiversity. A better understanding of the dynamics of homegarden systems is essential to create ecologically sound, economically appropriate and socially relevant solutions (Buyinza 2009). Further work is also required to discover the influence of the structure of these systems on biodiversity retention, and in understanding how to minimize loss of biodiversity with changing agricultural practices. Knowledge of the general effects of these systems on biodiversity is substantial, but more information is needed at the local level (Scales & Marsden 2008).

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Ecosystem services in smallholder coffee farming systems: a case study in Uganda using chemical soil indicators

WALTHER POHL[1], AXEL MENTLER[2], EMMANUEL OKALANY[3], LORENZ PROBST[4], SOPHIE ZECHMEISTER-BOLTENSTERN[5]

Key words: organic, coffee, soil, ecosystem, farming system, indicators

Abstract

Organic farming practices support ecosystem services at local, regional and global scales. It is crucial for organic smallholder farmers do understand linkages between the applied practices and their effects on the ecosystem. The soil parameters pH (H_2O), electrical conductivity (EC), total nitrogen of the solid phase (N_t), organic carbon (C_{org}), plant-available potassium (CAL-K), plant-available phosphorus (CAL-PO_4), total dissolved nitrogen (TDN), dissolved organic carbon (DOC), nitrate (NO_3), phosphate (PO_4), sulphate (SO_4), carbonate (CO_3) and cation exchange capacity (CEC) can be linked to soil-related ecosystem services derived through agricultural practices, and they highlight differences between organic and non-organic farming systems. The measured soil parameters in this study of organically managed systems and their quality exceed those of non-organically managed ones.

Introduction

Coffee experts from countries with a coffee-drinking culture are discovering that organic coffee beans have unique qualities unlike conventionally produced ones.

The bean quality needed for the perfect cup of coffee is for most farmers intangible, so economic incentives are the major reason to go organic. Farmers may not be aware of the economic, social and ecological benefits available through organic agriculture. At a local, regional or global scale, smallholder coffee farmers can discover that organic production methods are linked to provisioning, regulating, cultural and supporting ecosystem services (MEA, 2005). Figure 1 shows an overview of ecosystem services and their spatial dimension and agro-ecosystem impacts. Besides the quality of coffee beans, changes in soil chemical properties reveal advantages for coffee farmers.

The filtering, buffering, and transformation function of soils (Figure 2; Blum, 1998) regulates and supports ecosystem services like nitrogen fixation, erosion control, soil conservation, soil formation and nutrient cycling.

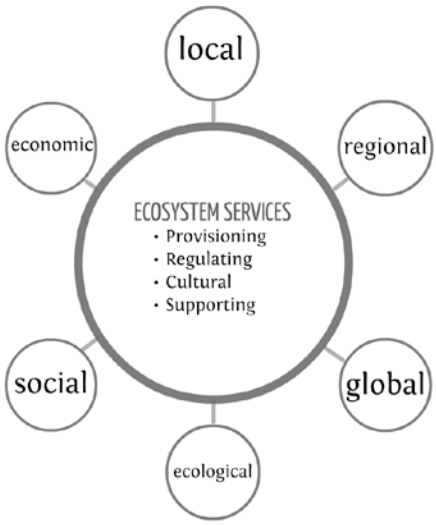

Figure 1: Ecosystem services, including their spatial scales and agro-ecosystem impact indicators (illustration: Pohl)

[1] Institute of Soil Research, University of Natural Resources and Life Sciences, Vienna, Austria, www.boku.ac.at, eMail: walther.pohl@students.boku.ac.at
[2] Institute of Soil Research, University of Natural Resources and Life Sciences, Vienna, Austria, www.boku.ac.at, eMail: axel.mentler@boku.ac.at
[3] College of Agriculture and Environmental Sciences, Makerere University, Kampala, Uganda, www.mak.ac.ug, eMail: emmaokalany7@gmail.com
[4] Centre for Development Research, University of Natural Resources and Life Sciences, Vienna, Austria, www.boku.ac.at, eMail: lorenz.probst@boku.ac.at
[5] Institute of Soil Research, University of Natural Resources and Life Sciences, Vienna, Austria, www.boku.ac.at, eMail: sophie.zechmeister@boku.ac.at

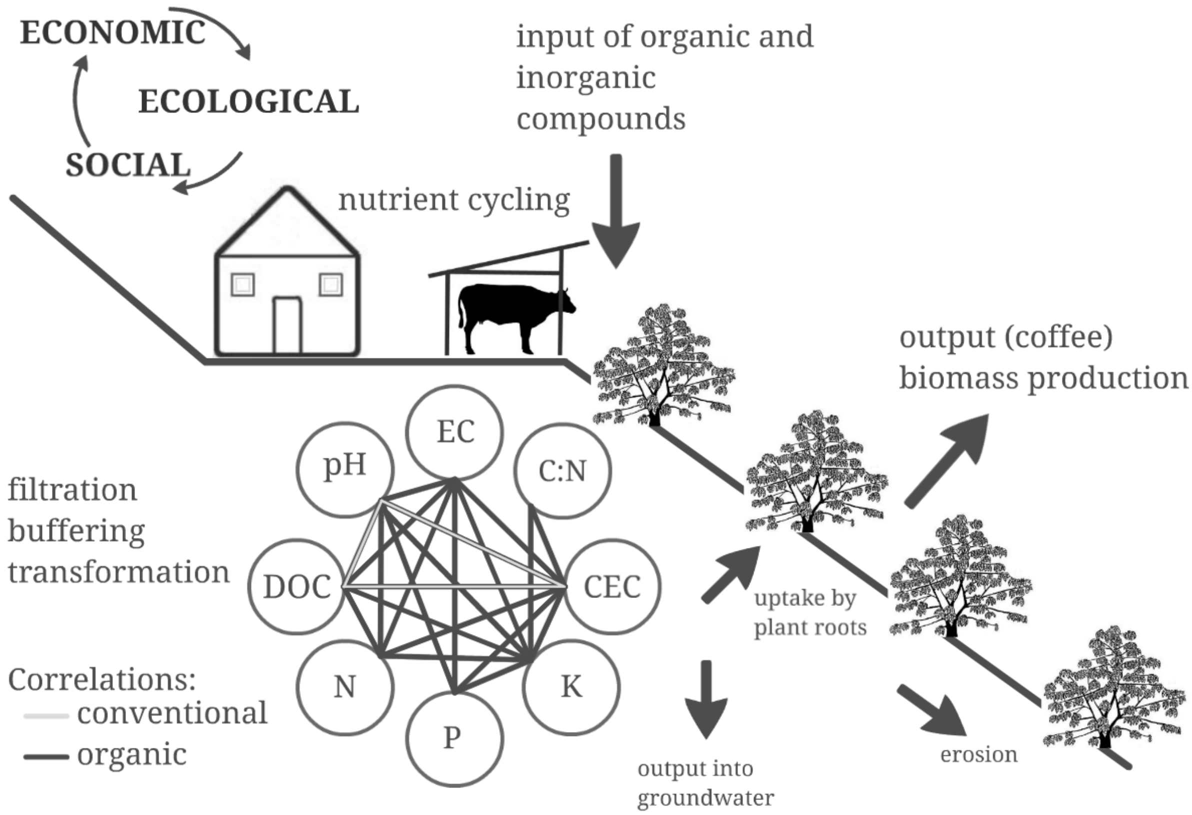

Figure 1: Schematic diagram of a typical coffee farming system with significant correlations between soil parameters and their ecosystem functions according to Blum (1998) (illustration: Pohl)

Material and methods

The study determined soil health indicators of 20 coffee (*Coffea arabica*) smallholder farms in four subcounties in the area of the Mbale, Mount Elgon region (1200 to 1900 m.a.s.l) in the southeast region of Uganda. Four groups, comprising five farmers each in the subcounties Bufumbo, Bukonde, Bubyango and Budwale, were researched. Farmers in the subcounties Bufumbo, Bukonde and Bubyango are working under the Bufumbo Organic Farmers Association (BOFA) and are certified organic. A non-organic control group in the subcounty Budwale was selected for comparison.

Most organic farms are agroforestry systems, whereas the non-organic coffee farms in Budwale have nearly no shade trees. They appear to operate with similar practices and production systems as those used by larger scale commercial coffee plantations, but they have limited access to additional fertilizer inputs into their system.

Soil samples (0-20 cm) were collected in August 2012 on each farm, one at the upper and one in lower areas of the coffee plantation. Soil characterization data from those samples are indicated as “upper” and “lower”, respectively according to the sampling area. Samples were analysed in the laboratory according to OENORM standards from October 2012 to December 2012. Due to learning transfers between organic and non-organic farmers nearby, different subcounties were selected. The samples were air-dried and sieved through a 2mm sieve to determine pH (H_2O), electrical conductivity (EC), total nitrogen of the solid phase (N_t) and organic carbon (C_{org}). These upper soil samples were additionally analysed for plant-available potassium (CAL-K), plant-available phosphorus (CAL-PO_4), total dissolved nitrogen (TDN), dissolved organic carbon (DOC), nitrate (NO_3), phosphate (PO_4), sulphate (SO_4), carbonate (CO_3) and cation exchange capacity (CEC).

The values of the soil parameters were tested for correlations between the parameters. A one-way analysis of variance (ANOVA) was conducted using the statistical analytical software, SPSS Statistics Version 22.

Results

According to the Leven's test, the following soil parameters of the upper soil samples had homogeneous variances: pH, C:N ratio, K, DOC and CEC. The lower soil samples had homogeneous variances in pH, N_t and C:N ratio. The results of the one-way ANOVA showed a significant difference between pH, N_t, C:N ratio and DOC of upper soil samples. For the lower soil samples, significant differences were found for pH, N_t and C:N ratio. The characters (a,b) in Tables 1 and 2 indicate significant differences between the subcounties according to Duncan's multiple comparison test. The control group in the subcounty Budwale had significant differences compared to the organic operating subcounties in the soil parameters pH_{upper}, pH_{lower}, Nt upper, N_t lower, C:N $ratio_{upper}$, TDN and DOC. The higher C:N ratio of the organic systems' soils was probably due to a high input of acidic humus and organic matter from animal manure and litter of shading trees. In general, tropical soils with low organic matter (SOM) have a C:N ratio of <10, and a C:N ratio around 12 indicates "good" soils, and >20 signifies acid humus (Wintgens, 2004). All of the soil samples studied here had "good" soil C:N ratios, indicating the soil fertility of the Mbale region. The organic farms exceeded the commonly used pH range of 5.5 and 6.0 (Wintgens, 2004), but in natural coffee forests, the best quality coffee can be produced in the pH range 5.3 and 7 (Kufa, 2011) .

Table 1: Laboratory results of upper soil sample chemical properties in comparison (illustration: Pohl)

subcounty	n	pH		EC [mS]		Nt [g/kg]		Corg [g/kg]		C:N ratio		P [mg/kg]		K [mg/kg]		TDN [mg/kg]		DOC [mg DOC/l]		CEC [meq/kg]	
		soil chemical properties upper soil samples																			
Bufumbo (org.)	5	6,7 ±0,4	b	47,9 ±38,0	a	1,5 ±0,6	a	19,9 ±5,6	b	13,9 ±3,0	ab	95,8 ±162,6	a	314,5 ±244,5	a	42,8 ±20,4	b	23,8 ±11,3	b	151,0 ±55,6	a
Bukonde (org.)	5	6,3 ±0,4	b	26,0 ±10,3	a	0,8 ±0,2	b	11,7 ±2,2	a	16,2 ±3,4	b	34,7 ±45,5	a	290,6 ±322,3	a	30,1 ±2,9	ab	24,3 ±6,9	b	104,9 ±95,1	a
Bubyango (org.)	5	6,4 ±0,3	b	26,5 ±9,4	a	1,2 ±0,1	ab	15,7 ±2,2	ab	13,0 ±1,5	ab	35,3 ±26,4	a	117,0 ±52,3	a	33,3 ±9,2	ab	18,5 ±7,0	b	141,2 ±41,7	a
Budwale (con.)	5	5,7 ±0,2	a	20,5 ±9,2	a	1,8 ±0,7	a	19,5 ±6,6	b	10,7 ±0,4	a	9,1 ±7,4	a	189,1 ±116,5	a	24,1 ±4,6	a	6,7 ±4,4	a	83,3 ±43,4	a
Levene's test homogenity (sig.)		0,215		0,012		0,001		0,009		0,166		0,017		0,071		0,018		0,063		0,397	
ANOVA		0,002		0,223		0,015		0,041		0,017		0,451		0,447		0,117		0,008		0,320	

Means (± SD)

soil reaction (pH), electric conductivity (EC) ,organic carbon (Corg),total nitrogen (Nt), phosphorus (P), potassium (K), total dissolved nitrogen (TDN), dissolved organic carbon (DOC), cation exchange capacity (CEC)

level of significance $p < 0,05$ *

Table 2: Laboratory results of lower soil sample chemical properties in comparison (illustration: Pohl)

subcounty	n	pH		EC [mS]		Nt [g/kg]		Corg [g/kg]		C:N ratio	
		soil chemical properties of lower soil samples									
Bufumbo (org.)	5	6,3 ±0,3	ab	31,4 ±16,5	a	1,5 ±0,7	ab	21,5 ±7,7	ab	14,5 ±1,3	b
Bukonde (org.)	5	6,3 ±0,4	b	26,9 ±16,1	a	0,8 ±0,4	b	13,4 ±3,8	b	17,7 ±3,2	a
Bubyango (org.)	5	6,0 ±0,2	ab	17,9 ±6,6	a	1,3 ±0,5	ab	17,3 ±6,5	ab	12,9 ±1,9	b
Budwale (con.)	5	5,9 ±0,3	a	26,1 ±4,6	a	2,1 ±0,9	a	24,1 ±9,8	a	11,9 ±2,5	b
Levene's test homogenity (sig.)		0,748		0,047		0,534		0,638		0,659	
ANOVA		0,050		0,392		0,054		0,142		0,007	

Means (± SD)

soil reaction (pH), electric conductivity (EC) ,organic carbon (Corg),total nitrogen (Nt), phosphorus (P), potassium (K), total dissolved nitrogen (TDN), dissolved organic carbon (DOC), cation exchange capacity (CEC)

level of significance $p < 0,05$ *

Indicators of higher biodiversity of soil microorganisms in organic systems are the increased mobilization of bonded soil nutrients through the release of organic compounds by microorganisms and plants. This was shown in the significant differences in dissolved organic carbon (DOC) between the organic farmers and the control group.

The distribution of N_t between upper and lower samples varied less in the organic systems than in the non-organic systems; probably reflecting less soil erosion of the organic soils. Due to high precipitation, especially between March and June, and due to the steep slopes at the foot of Mount Elgon; erosion control is a necessary management practice to prevent nutrient losses and landslides.

The higher amount of nutrients (P, TDN and K) in the soils from the organic farms indicated a better supply of soil nutrients to the coffee plants than in the non-organic soils. Organic matter in the soil is an important reservoir of P, N and S. Consequently, organic farmers are enhancing nutrient cycling and the phosphorus level of the soil by the application of manure, compost and mulch. An increased interaction between organic matter and mineral components of soils characterizes soil fertility and is confirmed through higher cation exchange capacities (CEC) of organic farming systems. An additional aspect of an increased activity between various binding agents is the forming of aggregates and their stabilization.

The use of N_2-fixing trees, as well non N_2-fixing trees can enhance soil physical, chemical and biological properties through releasing and recycling nutrients from decomposing litter and the large annual inputs to soil organic matter (Beer et al., 1997; Jose, 2009).

Discussion

The multifunctional landscape of agroforestry is supporting organic farmers to maintain soil quality and profits through ecosystem services. Beneficial ecosystem services in organic coffee systems are higher inputs of organic matter, higher biodiversity of soil microorganisms, less soil erosion, and the potential for higher aggregate stability and superior nutrient circulation. The non-organic farmers lack inputs of organic and inorganic materials, and they miss the advantages of natural pest control, buffering capacity of water, reduction of temperature extremes, nutrient access through deep rooting trees and further beneficial ecosystem services of agroforestry systems. The health of the coffee plant is decreasing due to a low nutrient supply and natural regulating ecosystem services.

Organic farmers are able to create good growing conditions for coffee and foster the resilience of farming systems against risks such as climate change, while realizing long-term benefits from ecosystem services.

Future challenges to face in organic coffee production systems

Soil as a major resource within an agro-ecosystem, provides a number of functions, which support the health of other important pillars of a soil-plant-microbial system. The regulating and buffering service provided by soil will gain importance in tackling the challenges of climate change and nutrient availability, especially phosphorus. To integrate and develop methods into a simple soil field test kit to determine soil parameters relevant for organic farming will provide mutual understanding of natural processes by researchers and organic farmers.

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Animal husbandary practices of smallholder organic farmers in Uganda: Challenges and future prospects

SYLVIA NALUBWAMA[1],MUHAMMAD KIGGUNDU[2], METTE VAARST[3]

Key words: Animal husbandry, practices, organic, smallholder, Uganda

Abstract

Organic agriculture development in Uganda has been mainly in crop production. Currently certified organic livestock production is non-existent. However, some of the existing animal husbandry practices of smallholder organic farmers are similar to those recommended in organic animal husbandry. A survey to understand these practices and challenges was conducted among ninety certified organic pineapple farmers in two districts using a semi-structured questionnaire. Results indicated that organic farmers kept a diversity of livestock species. Most organic farm (81%) had cattle. Other species owned were goats, pigs and chicken. Farmers mainly kept indigenous livestock breeds and majority (90%) used natural mating as a form of animal breeding. Farmers in Luwero district kept a significantly higher (P< 0.001) number of cattle (mean 2.3) than in Kayunga district (mean 1.6). Sixty four percent of farmers had no housing for their livestock. Natural pastures and crop residues formed bulk of feed for ruminants and pigs. Tethering was the commonest form of management system in ruminants (90%). Pigs (60%) and chicken (95%) were under free range system. There was a significant relationship (P= 0.047) between breed of cattle and grazing system. Major challenges of livestock production were inadequate feeds, pests and diseases. Selection of tolerant breeds and use of herbal concoctions were the adopted coping strategies. Majority of farmers (100%) resorted to use of synthetic chemical drugs in case of failure of these strategies. The future development of organic animal husbandry among smallholder organic farmers lies in developing sustainable research based technologies/ solutions to tackle existing and future challenges, investing in infrastructural development as well as improving farmer's knowledge.

Introduction

Uganda has 188,625 certified organic farmers, the highest in Africa following India with 400,551 certified producers globally ((Willer and Kilcher, 2012). Organic agriculture development has been mainly in organic crop production. Currently organic livestock production is non-existent as a result of fewer efforts towards its development. Uganda's agricultural sector is dominated by smallholder mixed crop-livestock farmers. The smallholder livestock farmers face numerous challenges mainly endemic diseases and inadequate animal feeds ((Nalubwama et al., 2011; Vaarst et al., 2006). These are more amplified in organic systems where use of chemical drugs and feed additives is prohibited. Livestock is an integral part of many organic farms due to its role in nutrient recycling. Promotion of integration of livestock into organic crop production not only creates opportunity for farmers to benefit from synergies of mixed crop-livestock systems, environmental protection but also an opportunity for production of organic animal products for niche organic markets. Currently there is scarcity of documented information on existing animal husbandry practices, challenges and opportunities among smallholder organic farmers to understand future development prospects. This paper aims at discussing the above based on a survey conducted among mixed smallholder certified organic pineapple farmers in Uganda.

Material and methods

A cross sectional study was conducted in Kayunga and Luwero districts of Uganda. Study sites and population were purposively selected to target certified organic pineapple farmers also keeping livestock. Snow-ball sampling was used to select respondents (Marshall, 1996). A pre-tested structured questionnaire (Gill et al., 2008) was used to collect data from 90 respondents. Data was analysed for descriptive statistics using SPSS statistical package (SPSS Inc., Chicago, Illinois, USA). Chi- Square and T- Tests were performed to test for significant differences in distribution of responses. P-values less than 0.05 were considered statistically significant.

[1] Makerere University, School of Veterinary Medicine, Uganda, eMail: drnalubwama@gmail.com
[2] Makerere University, School of Agricultural Sciences, Uganda, eMail: kiggundumuhammad@gmail.com
[3] Aarhus University, Faculty of Agricultural Sciences, Denmark,eMail: mette.vaarst@agrsci.dk

Results

Results indicated organic farms were diversified to include different livestock species, crops and trees. Livestock species and numbers are presented in Table 1. Majority (81%) of organic farms kept cattle. Cattle herd size was significantly higher (P<0.001) in Luwero than in Kayunga districts. None of the farmers reported managing their livestock according to organic standards. Most of farmers (64%) had no housing for the livestock but rather kept the animals under tree shades. Majority of the farmers had indigenous breeds of cattle (62%), goats (97.8%), pigs (87.5%) and chickens (100%). Over 90% of farmers reported using natural mating as the method of animal breeding.

Natural pastures were the most common feed resource for cattle (100%), goats (100%) and pigs (50%) followed by crop residues. Tethering was the commonest form of management system in ruminants (90%). Pigs (60%) and chicken (95%) were under free range system. There was a significant relationship (P= 0.047) between breed of cattle and grazing system, indigenous breeds (74.4%) were tethered while the crossbreeds (83.3%) were zero grazed.

Major challenges of livestock production in both districts were inadequate feeds (quality and quantity) and livestock pests & diseases. The common pests and diseases reported were internal parasites (helminthes) in cattle (55%), goats (86%) and pigs (75%), tick infestation, tick borne diseases, and new castle in chicken (75%). Selection of tolerant breeds and use of herbal concoctions were some of the adopted coping strategies. All organic farmers (100%) resorted to conventional veterinary drugs in case of failure of these strategies.

Table 1: Types of species and means of Livestock numbers

Livestock Species	Kayunga district	Luwero district		
	Mean	Mean	SEM	P-Value
Cattle	1.6	2.3	0.4	<0.001
Goats	3.3	4.6	0.79	0.103
Pigs	4.0	3.0	0.87	0.212
Chicken	12	11.6	2.05	0.916

Discussion

This study showed that organic farms are diversified which might create a basis for a well-balanced system for nutrient recycling, an important concept in organic farming. These results are consistent with other studies (Esilaba et al., 2005; Walaga et al., 2000). Integrating livestock in organic systems not only creates avenues for nutrient recycling but also enables farmers to access niche organic livestock product markets. In addition the diversity in fauna and flora gives opportunity for the use of natural herbs in treatment of some livestock disease conditions as reported by some farmers.

Although the current organic farms have non- organic herds, there are good prospects for future organic animal husbandry considering some of the existing animal husbandry practices which are similar to recommendation by the East African Organic Standards. Organic farmers mainly reared indigenous breeds which are adapted to local tropical conditions. Indigenous breeds are known to have low production, but are more tolerant to tropical climate, endemic diseases and pests unlike exotic breeds. The use of well-adapted breeds is highly recommended in organic production systems as these are usually disease resistant (Magnusson, 2001; Stockdale et al., 2001) hence minimal requirement for use of synthetic veterinary drugs for disease control. Tethering of ruminants on natural pastures and free range management in pigs and chicken observed in the study areas provided animals with free outdoor access which is a requirement in organic farming systems. Such systems also predispose animals to parasites especially ticks and helminthes which might comprise the animals' health status. However, the development of disease might depend on the animal's nutritional status which pays a big role in its immunity.

Although organic animal feeds are not currently a requirement in the study area pending conversion to organic livestock production, inadequate feed is generally still a constraint for livestock production. The dependence on natural pastures with limited avenues of supplementation which characterizes most smallholder organic farms has consequences. The availability of natural pastures is depends on availability of rainfall, therefore during dry seasons there is always drastic scarcity of this resource. Secondly nitrogen (N) is a limiting nutrient in many tropical pastures (Bogale et al., 2008). This may compromise the health and welfare of animals which are aspects of importance in organic farming. This might explain why diseases and feed came out as the major challenges in livestock production. Therefore management strategies on how animals can have access to outdoor environment and good feeding without comprising their health and welfare need to be developed.

Although existing animal husbandry practices of organic farmers might indicate good prospects for conversion to organic animal husbandry, farmers play a big role in decision making. Organic farmers in Uganda invest their time and resources in high value crops like organic pineapples and other horticultural products due to the available local and export markets. There is substantial investment required in research, infrastructural development as well as improving farmer's knowledge in organic animal husbandry which government and private sector will need to consider supporting farmer's efforts.

Suggestions to tackle with the future challenges of organic animal husbandry

Future challenges of organic husbandry in Uganda lie in the increasing human population which is bound to increase pressure on land for production. Inevitably this might lead to changes in existing production systems to more intensified production. Currently ruminant production is based on poor natural pastures while the non- ruminants require cereal based proteins which are competed for with humans. In conventional systems, supplementation with synthetic feed additives is the strategy adopted to address the nutrient shortages; however these are not acceptable in organic systems. Secondly, the animal pests and diseases that are still majorly managed using synthetic veterinary drugs even in the existing organic farms is another challenge. Therefore development of innovative strategies/ technologies in animal nutrition and disease control under organic farming systems as well as development of local and regional consumer markets for organic animal products will assist in tackling future challenges of organic animal husbandry.

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The Multi-stakeholder Centre

CHARLES SSEKYEWA[1], STELLA NAMANJI[2]

Key words: Research, multi-sectoral, multi-stakeholder, incubation, sustainable, innovations

Abstract

In spite of the outgoing Millennium Development Goals (2015), it has not been possible to achieve sustainable development in the past years. The effort has been put on establishment of incubation centres. However, the challenge has been incubation of technologies that at the end are not well demanded by consumers. Based on an open space discussion with various key persons in Uganda, Africa and Europe, the cause of this limitation of incubation centres has been attributed to their lack of a multi-sectoral/multi-stakeholder approach. Participation of stakeholders in research (participatory research) is not a new concept, however the desired impact has not been fully achieved and most researches have not contributed to sustainable development. High technology adaption rates would be expected when stakeholders are broadly involved in the research process. This forms basis for establishing a mechanism which ensures stakeholder participation in research needs identification at community level. A multi-stakeholder centre established to identify community needs using a multi-sectoral approach would serve that purpose. This would bring about a three level research chain, that is,

- *(i) A multi-stakeholder centre to generate appropriate community needs, and make them accessible to research centres of excellence*
- *(ii) A research centre to conduct appropriate/ innovative research to address community needs*
- *(iii) An incubation centre to concretize/ commercialize research results and package them for community use (industry/consumers, policy)*

Introduction

After 2015, the Millennium Development Goals shall be history, achieved or not achieved. The UN is in high gear to yet field another set of guidelines to lead development in the world. These Sustainable Development Goals are build with full awareness of limitations of achieving the MDGs by 2015. One key element is the failure of employing a multi-sector and systems thinking approach to implementation of MDGs. This would have meant engaging all stakeholders and machinery together to address development issues irrespective of their sectors. Research is seen as one of the critical activities that would lead to sustainable development (Ssekyewa, 2008). For this to happen, research must also ensure a multi-sector, multi-stakeholder and systems thinking approach. To some extent participatory methods have been advocated, but have neither been fully applied nor have they engaged fully the multi-sector, multi-stakeholder, systems thinking approach at planning and implementation stages (Ssekyewa and Namanji, 2012). Hence, most research results solve the target problem but do not lead to sustainable development.

In recent years, among many ideas applied has been the establishment of Technology Incubation Centres. These centre deal with polishing up research results for the purpose of commercializing or applying them. However, such research results may not yield expected sustainable outcomes if the process was not multi-stakeholder driven (Namanji and Ssekyewa, 2012). The multi-stakeholder/multi-sector characteristic can be in built through normal planning and implementation research institution activities. However, there has been lack of consistence with this method. It is against this background that establishment of multi-stakeholder centres is seen as necessary in the research stream. This paper gives the importance of using a multi-sectoral/multi-stakeholder approach to identify sustainable development gaps. It also elaborates on the position of the multi-stakeholder centre in the research process. The paper is intended to influence research policy as we move towards implementing the UN endorsed Sustainable Development Agenda after 2015.

[1] Ssekyewa Charles, Uganda Organic Certification Ltd,Uganda,www.ugocert.org,e-mail: cssekyewa@gmail.com
[2] Namanji Stella, Center for Ecosystems Research and Development, Uganda, www.cerdug.org, e-mail: stelladorothy@yahoo.com

Material and methods

Qualitative research methods were applied to investigate the reason why introduction of incubation centre in the research process has not increased the adaption rate of generated research outputs. An open space method was used to find out views of key development persons in Uganda, Africa and Europe. Respondents were purposively selected. The question was asked to selected individuals during meetings, workshops and conferences authors attended during 2012-13. A total of 50 persons were engaged in open discussions. Generated data was analysed for categories and themes that would bring sense into establishment of a multi-stakeholder centre.

Results and Discussion

All persons involved in open discussions pointed out the need for a multi-sectoral approach and wide involvement of stakeholders. The idea of establishing multi-sectoral centres was 100% accepted, though some limitation our observed as discussed in this section below.

Thus, multi-stakeholder centres would serve as think-tanks where ideas are built around solving a problem or addressing a community or market need by bringing all interested partners together (Figure 1). Multi-stakeholders play a big role in coming up with innovative ideas, spot-on with sustainable solutions to community, industry and market needs. Generated ideas would then be shared with research institutions who would then plan for all needed research activities for the desired out put to be achieved, and in as sustainable a form as possible. Since researchers would also be involved in brain-storming meetings of MSCs, some ideas would be rejected at the MSC stage or re-thought for better research outputs.

Such multi-stakeholder centres would ensure pulling together ideas that would feed into the innovative and sustainable research agenda of countries (Selsky, 1991). Thus, through the year the MSC would bring together stakeholders to brainstorm a blend of ideas which would result into sustainable and innovative research products. An example of such ideas is,

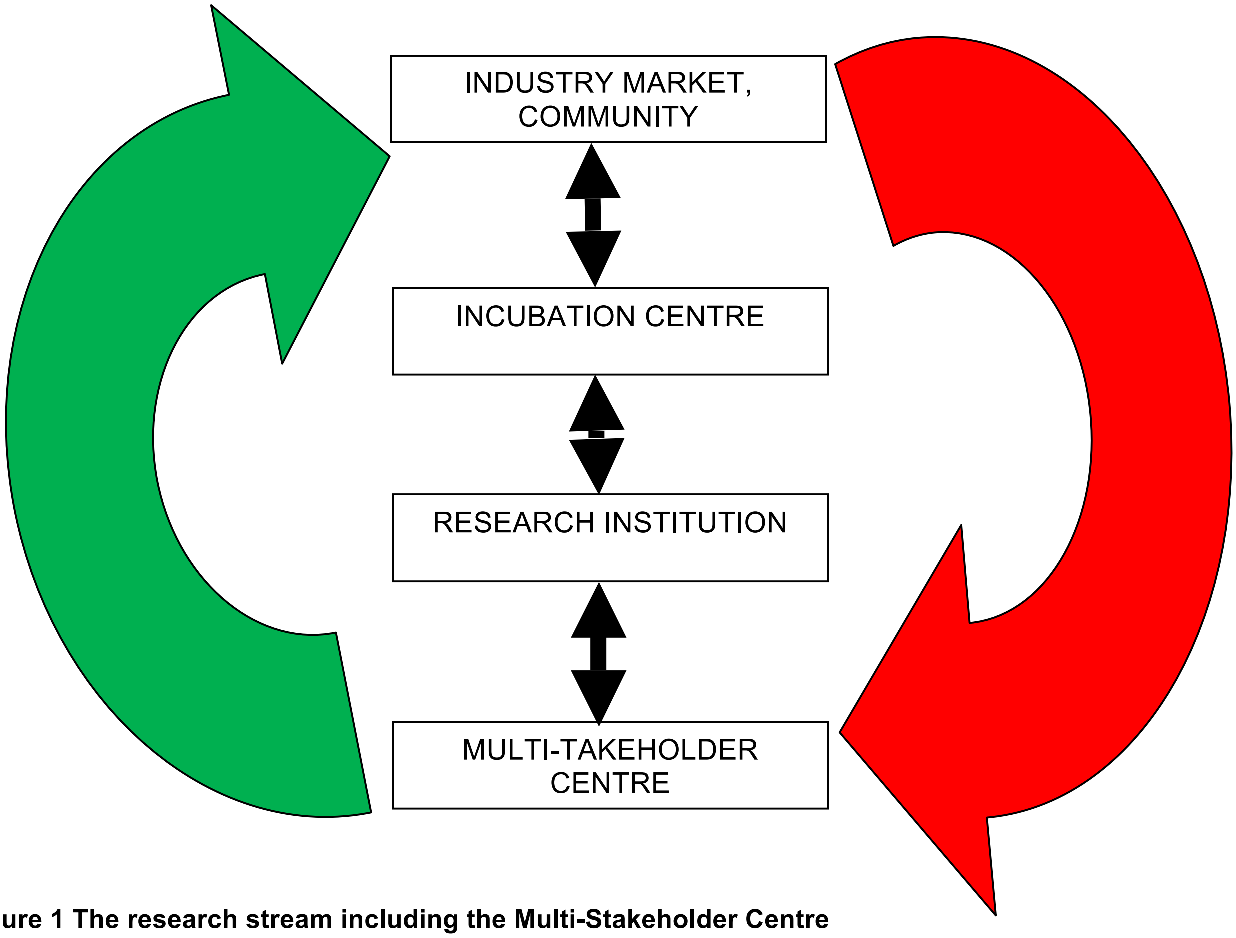

Figure 1 The research stream including the Multi-Stakeholder Centre

TAM Concentrate and herbicide: Two potential products or even more could be produced from the Tamarind tree. These are the concentrate for juice production and the by-product for use as herbicide. These may need to be researched for their sustainable use. However, as for now the tree is wild and targeted for charcoal burning, so the community would have to plant more trees to ensure sustainability. Therefore, the community, the industry and researchers would have to come together and develop such an idea into a research agenda.

With such multi-stakeholder ideas generated and documented, the MSC would disseminate annually to research institutions to form basis for their research programmes. This way, research outputs would lead to rapid achievement of sustainable development.
The MSC would have at least five major operation steps (Figure 2). This way a multi-stakeholder involvement in research for sustainable development would be ensured. Accroding to experiences in South America, as reported by IFPRI (Garrelt and Natalicchio, 2011), achieving multi-sectorality takes long and requires multiple interactions/ conferences, but at the end end there are successes and benefits.

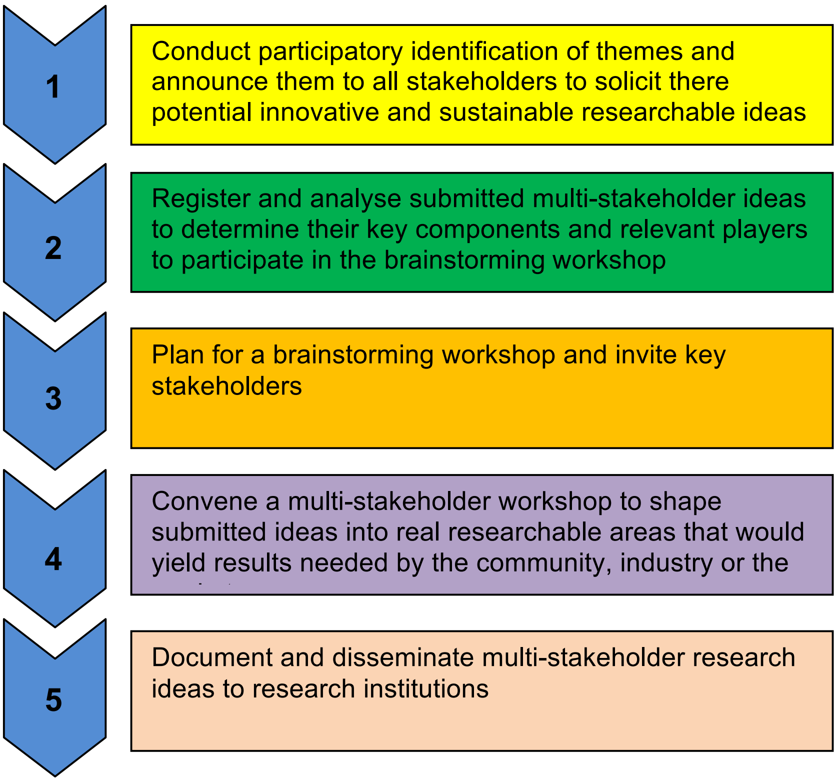

Figure 2: Annual Cycle steps for operation of the Multi-Stakeholder Centre

Rapid generation of innovative research would be achieved and sustainable as well as relevant commercial technologies would be generated in the long run.
However, there are key concerns that must be address in the implementation of Multi-Stakeholder Centres. These would include,

- Resources to establish such centres in UN member states
- Stakeholder pro-active response to request for raw ideas and to invitation to participate in brainstorming workshops without per diems
- Research funding toward rapid investigation of generated multi-stakeholder ideas
- Research results being a public good if not funded by the industry

Note that it would also be possible that the industry identifies some researchable areas for its own funding and benefit.

Conclusion

This is a new idea for the research stream. The UN in its discussion of the Sustainable Development Agenda after 2015, could consider it as one way to ensure that research contributes to achievement of the agenda. The writer is willing to participate in the process of shaping this idea further for the benefit of Sustainable Development in the World, and especially in Africa.

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Farming practice effects on nitrogen footprints

ARIEL N. MAJIDI[1], JESSICA SHADE[2], ALLISON M. LEACH[1], JAMES N. GALLOWAY[1]

Key words: Nitrogen, pollution, organic, agriculture, crops

Abstract

Organic practices in food production attempt to reduce the detrimental impacts of agricultural systems on the environment and human health. This study explores the effects such practices have on nitrogen (N) pollution, in comparison to conventional food production practices. Virtual N factors were used for this comparison. An organic virtual N factor of 4.6 was calculated for vegetables (37% lower than conventional), 0.9 for starchy roots (-64%), 0.7 for grains (-86%) and 0.3 for beans (-53%). The organic food N footprints were 43 – 53% less than the conventionally produced food N footprints. This study found that organic practices reduce N pollution with respect to conventional practices of food production. Tracking the effects organic practices have on N pollution will contribute to raising awareness, popularizing the better management of N in agricultural systems, and reducing the negative environmental and human health consequences associated with N pollution.

Introduction

Over the last century human activities have increased the abundance of reactive nitrogen (N) in the environment, thus contributing to large-scale environmental degradation (Galloway and Cowling 2002). Food production is one of the largest contributors to N pollution (Galloway and Cowling 2002), due in part to the use of synthetic fertilizers by conventional systems. While organic practices to not employ synthetic fertilizers they do use green manure and leguminous cover crops, both of which have the potential to result in increased amount of N lost to the environment.

Because organic methods employ practices that reduce N as well as some that could add reactive N to the systems, the impacts of organic farming on N pollution remain unknown. This study addresses the contribution of conventional versus organic practices to N pollution by comparing virtual N factors for organic crops with established conventional virtual N factors.

Material and methods

To determine the N pollution associated with organic farming practices, the Leach et al. (2012) method for virtual N factor calculations of conventionally produced food was used to calculate organic virtual N factors. Virtual N factors determine the amount of nitrogen released to the environment during the production of a food product per unit of nitrogen endogenous to that food. These calculations sum the reactive nitrogen lost to the environment and recycled at each stage of food production. Using maize as an example (Figure 1A), first, 100 units of new nitrogen enter the system through fertilizer application or fixation of atmospheric nitrogen by biological processes. The calculation then takes into account nitrogen taken up by the crop, nitrogen lost due to processing, nitrogen lost in removing inedible parts of food before consumption, and nitrogen lost during human consumption. Nitrogen from processing waste is sometimes recycled and reused; when it occurs, it is assumed to be recycled as fertilizer for the next crop cycle. Calculations were carried through five crop cycles to account for the nitrogen recycled back into the system.

The calculations for organic virtual nitrogen factors modified the calculations of the conventional virtual nitrogen factors in two areas – 1) the crop's nitrogen uptake factor, or the amount of nitrogen taken up by the crop per unit of nitrogen applied, and 2) the recycling factor for processing waste (Figure 1B). The nitrogen uptake factor was calculated by dividing the nitrogen content of crop yield by the amount of nitrogen applied in organic production practices. Average yield and nitrogen input information were obtained by a literature review. The nitrogen uptake factors for vegetables were 35% for organic and 20% for conventionally produced crops, 89% for organic starchy roots and 87% for conventionally produced starchy roots, 87% for organic grains and 80% for conventionally produced grains, and 90% for both organic and conventionally produced beans. The nitrogen uptake factor for organic beans was not modified from that of conventionally produced beans because nitrogen-fixing legumes do not require additional nitrogen application for growth, unless soil conditions are poor.

[1] Environmental Sciences Department, University of Virginia, Charlottesville, VA 22904
[2] The Organic Center, 444 N Capitol St. NW, Washington DC, 20001

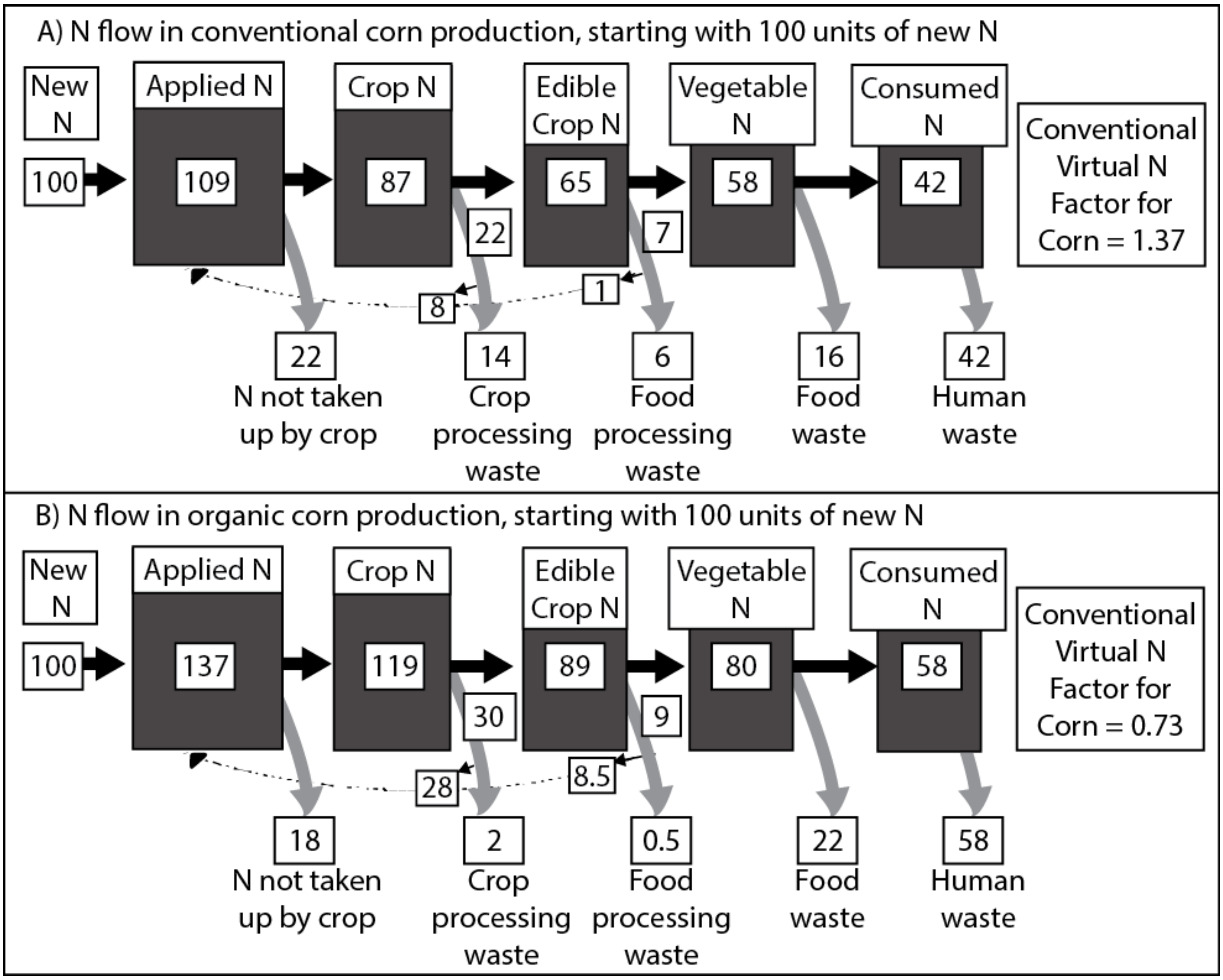

Figure 1: Reactive nitrogen flows in a) conventional and b) organic corn production

Because USDA organic standards prohibit the use of synthetic fertilizer and encourage the recycling of wastes, most organic farms use compost and incorporate residual plant matter into the soil as green manure. To account for this recycling of plant material, a 95% recycling factor for processing waste was incorporated.

Results

When we calculated organic and conventional virtual N factors and their percent differences (Table 1), we found that in all cases, the conventional virtual N factor is larger than the organic virtual N factor (i.e., more N lost to the environment per unit of N in food consumed). Given the differences between the virtual N factors of organic vs. conventionally produced crops, it is not surprising that the N released to the environment in the production of one serving size of vegetables, grains, starchy roots, and beans is considerably lower when foods are produced organically as opposed to conventionally (Table 1).

Table 1: Conventional vs. organic virtual nitrogen factors for vegetables, starchy roots, grains and beans

Food Category	Virtual Nitrogen Factor		% Difference
	Conventional	Organic	
Vegetables	9.6	4.6	-52%
Starchy Roots	1.5	0.9	-43%
Grains	1.4	0.7	-47%
Beans	0.5	0.3	-53%

While all organic virtual N factors were lower than conventional virtual N factors, starchy roots present the smallest difference (43%). Nitrogen uptake factors are similar between agricultural management systems for starchy roots, so the difference in processing waste recycling drives the virtual N factor disparity. Nitrogen uptake factors for starchy roots are high for both conventional (87%) and organic (89%) production, meaning that most N applied to the crop is yielded in the product's protein content, thus indicating good nutrient management. Unlike in conventional production, the majority of this processing waste is recycled in organic production, thus resulting in a low virtual N factor of 0.9 for organic starchy roots.

Grains present a similar situation to starchy roots when comparing organic and conventional production. With N uptake factors of 80% for conventional grains and 87% for organic grains, organic practices contribute to better nutrient management in grain production and therefore less N losses to the environment. In both the organic and conventional cases, more N is lost to the environment due to the processing and consumption of starchy roots than grains. As such, the virtual N factors for both organic and conventionally produced grains are lower than those of starchy roots. Because there is a larger disparity between the organic and conventional N uptake factors, grains show a larger difference (47%) in their virtual N factors.

The difference in organic (35%) and conventional (20%) uptake factors for vegetables also explains the large difference between organic and conventional virtual N factors (52%). The virtual N factors for vegetable production are higher than those of other food types due to the significantly lower N uptake factors. These lower uptake factors indicate that most N applied to the crop does not go to the protein content of the crop but rather stays in the soil, contributing to potential runoff or atmospheric emissions that further pollute the environment. Since vegetables do not yield high amounts protein, most N pollution in vegetable production is released in the first step of crop N uptake, and the residual waste, which leaches into soil, cannot be recycled. Thus, recycling processing waste in vegetable production does not reduce N pollution as much as reducing N application to the plant in the first step of crop growth.

Beans are the most N-efficient crop, as evidenced by their high N uptake factor and present the greatest difference between N released in conventional versus organic production (53%). Similar to starchy roots, beans have high N uptake factors, and as such, most N lost in bean production is due to processing of the crop to its consumable form and its subsequent consumption. Therefore, the increased recycling of processing waste in organic bean production drastically reduces the N losses to the environment. Compared to the other food types, less N is lost in bean production due to the processing and consumption steps, further explaining its low virtual N factor.

These calculations of organic virtual N factors facilitate the determination of specific farming practices that best reduce N pollution. The low virtual N factors of grains and beans demonstrate the effect a high crop N uptake factor has on N pollution due to food production. Increasing N efficiency by enhancing this uptake factor can be accomplished by reducing N application to a crop without leading to decreases in crop yields. Decreasing application of N fertilizer to recommended levels can also result in higher N use efficiency in crops, because many yields plateau as N application rate increases (Fageria and Baligar 2005). Crop systems can become saturated with N, at which point there is limited potential for plants to retain added N through increases in yield and production of organic matter (Vitousek et al. 1997).

Discussion

The movement towards organic farming practices has the potential to reduce N pollution due to food production in the United States. However, while organic farming may result in the reduction of N pollution, such practices also diminish the productivity per unit area of cropland with respect to conventional standards. The determination of virtual N factors specific to organic food production will encourage the tracking of N pollution by agricultural systems and justify the reducing effects organic practices have on N pollution. Future work will assess organic virtual N factors of animal products, which will allow for a more thorough comparison of N pollution of organic farming practices with conventional practices.

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The meaning of 'health' in the organic principle of health

ANJA VIEWEGER[1], THOMAS DÖRING[2]

Key words: concept, health, organic agriculture, principle, resilience

Abstract

In the past, aspects of health in agricultural contexts have mainly been discussed in separate discourses within soil, plant, animal and human medical science, with little interaction or communication among these disciplines. The questions "What is health?" and "How can health be measured?" have not been discussed in a holistic and integrated way. However, a key statement of ecological agriculture and a foundation stone for the principles of the organic agriculture movement is the connectedness of soil, plant, animal, man and planet through health. If health is such an important goal in agriculture, it needs to be clear what it means and how it can be assessed. This project clarified and critically assessed health concepts in organic farming, reviewed and compared current approaches to define and measure health; and, by starting a dialogue between the presently disconnected debates, uncovered resilience as a universal criterion of health.

Introduction

In the early 1940's, Lady Eve Balfour concluded in her book 'The Living Soil' that: "The health of soil, plant, animal and man is one and indivisible" (Balfour 1943). With this key statement she set one of the foundation stones for the principles of the organic agriculture movement, later laid down by IFOAM (IFOAM 2005). It describes the connection of health between soils, plants, animals and humans, and implies that the promotion and maintenance of human health, as one of the highest goals of mankind, critically depends on the health of all other agricultural domains. This study explored the possibilities, limitations and consequences of bringing together perspectives on health from different domains, with the aim to gain a better understanding of health in agriculture. It reviewed current approaches to defining and measuring health in agricultural contexts, comparing commonly used concepts in the different domains, and attempted to bring together the presently disconnected debates.

Material and methods

One essential first step when attempting to link the various domains of health in agriculture is to assess which criteria and indicators these domains use to describe health. This study looked at the five agricultural domains of human, animal, plant, soil and ecosystem and investigated which criteria are used to describe health in these five domains, performing a qualitative content analysis. Using the text analysis software QSR NVivo10, health criteria were analysed in the current scientific literature. The analysis of 75 scientific articles was used to gain a first insight into the concepts and ideas which are most frequently used to describe and define health in the various domains. Sections within the papers were selected for analysis when they defined or described health in the specific domain. A coding system was developed using nearly 50 descriptors of health; examples are 'balance', 'coping', 'immunity', 'regeneration' or 'tolerance'; terms were coded (scored) on a five-point scale to rate how strongly the authors of the selected texts describe the term as a suitable criterion of health.

Additionally, in an interdisciplinary expert workshop, the text of the IFOAM principle of health was evaluated in light of the results of this study, and arguments explored for potential changes or amendments to the text of the principle. The expert group identified and initially discussed the impact pathways of the principle of health in three relevant areas: Practice, Research and Policy/Regulations; and explored how these areas would need to develop to do the principle justice.

[1]The Organic Research Centre, UK, www.organicresearchcentre.com, Email: anja.v@organicresearchcentre.com

[2] Humboldt University Berlin, Germany, www.hu-berlin.de

Results

How is health assessed and measured?

As the literature shows, the disciplines of soil science, plant pathology, veterinary science, human medicine and ecology have answered the questions of the definition of health and of suitable criteria of health in different ways. According to the text analysis of this study, the keywords used most frequently to describe health in the analysed papers are often shared among the different domains; but also considerable differences were found (Table 1). The terms 'function', 'maintenance' and 'resilience' were used in papers from all five domains. Other terms are more common in one domain ('resistance' in plant health; 'sustainability' in soil health), but less so or entirely missing in other domains. Some were found to be used very rarely as criteria of health ('normality', 'coping', 'wholeness') despite the relatively large amount of literature on the respective topics. This indicates that the number of papers analysed in this study is likely to be too small to cover the entire diversity of health definitions. However, this immense diversity of health definitions is also reflected in the analysis, as in total 42 different terms used as criteria of health were found. In each domain, 24 or more different criteria were identified that describe health; except in the papers on animal health, where only 12 different terms were found. The trends shown in the results suggest that some concepts are indeed comparable and that the different domains share criteria to describe health. The analysis revealed that 'resilience' is among the most frequently used criteria over all domains, and this could be one of the most promising shared concepts (Döring et al. 2013).

Linking health research across the domains

One of the most frequently chosen ways of linking health research in the domains of soil, plant, animal, human and ecosystem is by following one specific substance, e.g. nutrients or toxins, along the whole food/production chain, from one domain to another. Such studies investigate the paths of certain substances (e.g. nitrogen, heavy metals) and assess their health effects in the different domains; many toxins have negative health effects in all five domains. Examples of further types of links are microorganisms, as an important element impacting health (negatively or positively) in all domains. Also biodiversity in agricultural contexts provides a link of health across the domains: research in all five domains has shown that greater biological diversity tends to promote health. Linking research activities across the domains therefore offers opportunities to explain general mechanisms of how biodiversity affects various components of health. Bringing the domains of health together in interdisciplinary research projects can provide clarity and solutions to health related problems in agriculture and food systems. However, is it also useful to harmonise the assessment and functionality of health across the different domains? This seems to be difficult for various reasons: (a) identical terms may be used to describe health, but they might have different meanings in the other domains; (b) criteria need to reflect the specifics of different domains, describing their distinctive characteristics. For example, the concept of 'welfare' in animal health cannot be transferred to health assessments for soils or ecosystems. Criteria of health need therefore be chosen to comply with the specific demands of each domain.

Consequences regarding the IFOAM principle of health

In light of the discussions of this study, and after exploring the impact pathways of the organic principle of health, the expert workshop identified the following important next steps towards a better understanding, application and communication of the principle of health.

For Practice: The focus here should be on best practice in relation to health contexts, as it is crucial to assess which farmers are successful and why. The assessment should follow a bottom-up approach where researchers and farmers jointly investigate and define what 'best practise' with regards to health is.

For Policy and Regulations: First necessary steps are (a) a dialogue among disciplines and stakeholders (since health is not everyone's apparent highest priority); and (b) conducting a gap analysis, to evaluate which aspects are not yet covered sufficiently or with enough clarity by the rules. Creating a network of best practice, farmers and processors would demonstrate what is meant by the terms used in the IFOAM principle.

For Research: Initially, the focus should be laid on measuring and analysing components of health, rather than the one 'whole' concept of health. Health concepts need to be functional and need to address the difficulty of different interpretations and languages. A reference system is needed (a set of farms operating to best practice at that time etc.) and working definitions of health need to be formulated. Research outcomes should feed directly into policy and regulation statements, demonstration and the formulation of health principles.

Discussion

A stronger focus is needed on the implementation of the health principle in organic agriculture. This requires three steps: (1) clarification of the principle of health (explanatory text, working definition of health, clarifying organic views); (2) development of assessment tools for measuring health-related performance at farm, local and regional level; (3) integration of health assessments in best practice networks.

One important next step is the clear identification and demonstration of health concepts in organic agricultural practice. A network of best practice examples focussed on testing, monitoring and demonstrating health effects could contribute to a better understanding of health, its attributes, its connectedness in the various domains and its impact on the whole food system.

Many stakeholders, from farmer to policymaker would benefit and rules and regulations could be formulated in a more applied and clear form to enable the direct translation of principles into actions.

Table 1: Criteria of health according to a content analysis of 75 papers (15 in each domain: animal health, ecosystem health, human health, plant health and soil health). The table shows the number of papers in each domain using the term as a criterion of health; terms listed are mentioned at least in 3 papers.

Term	Total	Soil	Plant	Animal	Human	Ecosystem
function	25	8	3	3	4	7
maintenance	19	6	4	3	3	3
productivity	18	9	3	4	2	0
resistance	17	3	7	4	1	2
resilience	16	2	2	2	3	7
capacity	14	6	1	0	2	5
sustainability	12	9	0	0	3	0
diversity	9	4	4	0	1	0
adaptation	8	1	1	0	4	2
dynamic	8	4	0	0	1	3
wellbeing	8	0	0	1	4	3
complexity	7	2	3	0	1	1
tolerance	7	1	2	3	0	1
ability to recover	6	2	0	1	1	2
balance	6	1	3	0	1	1
performance	6	2	1	1	1	1
provision	6	2	2	0	1	1
survival	6	3	3	0	0	0
vitality	6	4	2	0	0	0
equilibrium	5	0	1	0	1	3
immunity	5	0	1	1	2	1
integrity	5	1	1	0	1	2
resources	5	1	1	0	1	2
natural	4	0	0	0	2	2
stability	4	3	0	0	0	1
fitness	3	2	1	0	0	0
homeostasis	3	0	0	1	1	1
restoration	3	0	2	0	1	0
welfare	3	0	1	2	0	0

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Results of surveys of organic market data collectors and end users in Europe

CATHERINE LOUISE GERRARD[1], ROBERT HOME[2], ANJA VIEWEGER[1], MATTHIAS STOLZE[2], SUSANNE PADEL[1]

Key words: market data, data collection, data users

Abstract

Despite the continuous growth of the organic market in Europe, in most countries only very basic statistics exist. Data and market information are needed by private and public actors to make correct decisions. To assist in improving data quality and availability, it is first necessary to be aware of who collects, analyses, and/or disseminates such data and their methods. It is also necessary to identify the needs and demands of end users of organic market data, and to find areas of information asymmetry. The results of two surveys carried out in Europe: one of data collectors and one of end-users are presented. The results have shown that recent claims regarding a lack of organic market data are justified. There was an almost universal expression by end users of feeling at a competitive disadvantage because of lack of available data. This is problematic, as without good quality information it is difficult for stakeholders to make decisions about the risks and benefits of investment.

Introduction

Despite the growth of the organic market in Europe, in most countries only basic statistics exist. Individual country governments collect data which are published by EUROSTAT (the statistical office of the European Union), on the number of certified holdings, land areas and livestock numbers. Market statistics such as the amount of production, consumption, retail sales, international trade and prices are lacking in most countries. Lampkin and Rippin (2005) have given a number of reasons for the need for reliable data. Data and market information are needed by members of the organic supply-chain to make investment decisions, and by policy makers to calibrate measures targeted to the sector. To understand the availability of data, it is necessary to be aware of the organisations that collect, analyse and/or disseminate them and the methods that they use. It is also necessary to identify the needs and demands of end users of organic market data, and to find areas of information asymmetry.

Material and methods

Two separate surveys were carried out (Gerrard et al. 2012; Home et al. 2013). To assess the current status of organic market data collection in the EU and its neighbours, an online survey was developed and nearly 600 organisations within the EU27, EFTA, the rest of Europe and the Mediterranean were invited to participate. The useable response rate was 28%: based on 112 useable responses from organisations within the EU, EFTA (Norway, Switzerland, Iceland and Liechtenstein), the rest of Europe and the Mediterranean (MOAN); 51 e-mails explaining that such data were not collected by the respective organisation; and removal of insufficiently complete responses from the sample.

To assess the needs of end users, a survey was undertaken to evaluate the quality of the existing available data that is used. In an online questionnaire, 390 people from 36 European countries were surveyed. Most of the responses (40%) came from France, Germany, Italy, the Netherlands, Spain and the UK, which are all countries with a more developed organic market corresponding with a higher number of organic operators and thus a higher number of potential end users of organic data.

[1] The Organic Research Centre, Elm Farm, Hamstead Marshall, RG20 0HR, eMail: catherine.g@organicresearchcentre.com

[2] Research Institute for Organic Agriculture, Ackerstrasse, Frick, Switzerland

Results

Respondents

The majority of the organisations who responded to the data collectors' survey are government bodies (29%), followed by control/certification bodies (20%). Of the 23% who selected 'other', some of the organisation types included: private and state research institutes, not for profit organisations, non-governmental organisations and advisory services.
Of the respondents to the end users survey, 39% worked for organic producers, 29% for distributors of organic produce/products, and 22% for processors of organic products. 46% of the respondents were engaged in executive/management, 27% in sales, and 22% in marketing. The regions described by the data that are used are primarily national data (62%), and also to a large extent regional data (41%). Approximately 32% of the respondents use international European data or whole of Europe data, while 20% of the respondents use data from non-European countries or data on world level respectively.
The data collectors reported that the collected data are generally used for statistics (32%) and market information (19%). When comparing different groups of European countries, the results for 'EU15' (e.g. the older EU states such as the UK) show a slightly higher proportion using the data for market information (26%) compared with 'newer EU states' (14%); and a lower proportion using the data for the purposes of subsidies/governmental support programmes (4%) in the 'EU15' group than in the 'newer EU states' (14%).
End users of organic market data reported that the primary uses for organic market data are marketing strategy formulation (41%), decision support (39%), strategy/policy development (34%), research (26%), and forecasting (23%) (note: these total more than 100 percent as each respondent was allowed to indicate more than one use).

Data quality

Data collection methods vary with the type of data collected, but surveys are a commonly used method across data types. Censuses are often used to collect production volume data and other types of data such as international trade data (they are not used to collect data in non-European countries). Expert estimates are occasionally used across most of the country categories. For retail data and consumer price data, consumer/household panels or retail panels (scanner data) are likely to be used, whereas catering sales data are collected by surveys. Import and export data are generally collected using surveys and sometimes censuses but some reliance is also placed on expert estimates. The data analysis carried out in the different countries (across all of the categories) tends to be compilation or basic analysis (such as averages, and ranges). Other methods mentioned include time-evolution, comparison to averages or totals, and sense-checking with other data (particularly for export data).
The data types that are most commonly collected are production data, especially land area, followed by production volume; whereas production value is much less commonly collected. Price data and retail sales data are the next most commonly collected market data. Export data are more commonly collected in non-European countries than in the EU, perhaps reflecting a higher importance to their economies. The product categories most often represented in EU27+EFTA market data collection are meat, milk and dairy products, fruit and vegetables. Across the other groups of countries (e.g. other European, non-European) the pattern of data collection of individual product categories varies with regards to the most popular products. Data on non-food products are rarely collected. From an end users perspective, the quality of the collected data is shown in figure 1.
The end users of organic market data expressed that 'relevance' is always the main quality need for existing data that they used, with other quality indicators ranked about equal: namely that data should be affordable, available as often as needed, accurate, up to date, easily accessible, comparable with other data that respondents use, of high quality, and sufficient for the respondents' needs. The most common criticisms of organic market data were with regard to accessibility, availability as often as needed, and whether it is up to date. Data on organic import volumes were also criticised as being inaccurate and incomparable with other used data, while retail consumer price data for organic food and organic sales data at retail level were both criticised on their affordability. When asked about available data that is not used, the main reason was lack of relevance. Price and comparability were rarely the reason, and infrequency and inaccuracy were almost never the reason. The majority of respondents reported however that they continue to use poor quality data if that is all that is available.

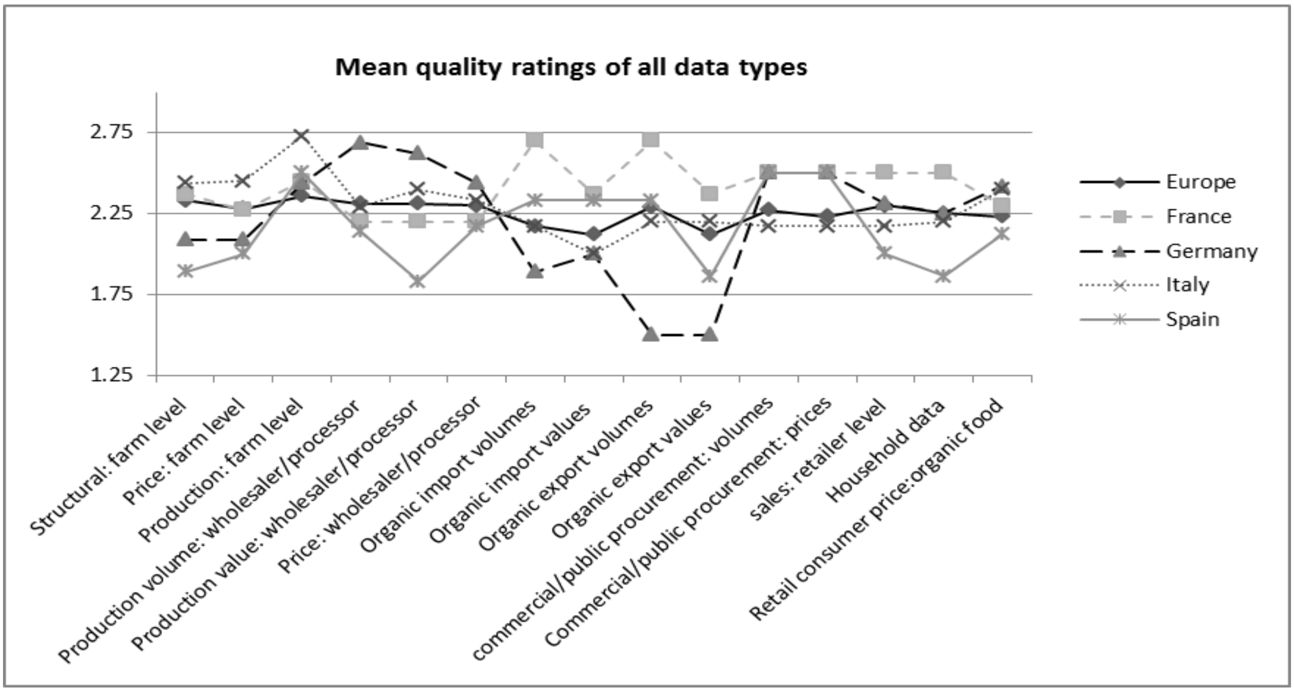

Figure 1: Mean ratings of overall quality for specific data types

(1 = poor quality; 5 = good quality)

Data publication

The responses by data collectors to the question about data publication frequencies suggest generally low publication rates (especially for data other than production data); with less than 50% in each group of countries giving a positive answer. Of all the data types that were asked about, production data are most likely to be freely available, but not all production data that are collected are also published. Data are usually published annually; price, retail or export data are occasionally published more frequently. When end users were asked about data that is unavailable, about 30 respondents (up to 25% of respondents) could not access each data type, although most would use the data if available and would wish for monthly or annual data to be available for all data types.

Discussion

The purpose of these surveys was to produce an overview of collectors of organic market data and the needs of end users. In many cases, the quality evaluation responses and data needs expressed by end users to export volume and value data were very similar (or the same) against all of the quality criteria. Using the same means of comparison, import volume and value data, and commercial /public organic procurement price and volume data were evaluated very similarly. These data types are all considered to be quite different from the data collection perspective, but seem to be bundled from the end user perspective.
The market data collection effort remains varied across Europe. The surveys may not have detected all activities that are carried out, however, there was an almost universal expression by end users of feeling at a competitive disadvantage because of lack of data. This is problematic, as without good quality information it is difficult for stakeholders to make decisions.

Disclaimer:

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Scientific Technology Development a Necessary Tool for Promotion of Organic Agriculture in Africa: A case study of Scientists in organic Agriculture in the South western Nigeria

PETER OLATUNDE OLANREWAJU[1], NKIRU TERESA MELUDU[1], OLUWATOYIN OKANLAWON[1]

Key words: Organic Agriculture, Technology development, Motivational factor, Promotion, Scientists

Abstract

Appropriate technology development (TD) and transfer are fundamental to the promotion of organic agriculture (OA) as mitigation to climate change and food insecurity. This study assessed the technology developed by scientists, motivational factors and the challenges of TD for the promotion of OA in Nigeria. The study area was South Western zone of Nigeria. 30 % of the members of OA movements were randomly selected (62) and surveyed with the use of questionnaire. The result of the study revealed that interest in OA, health and environmental concern ranked high as motivational factors for TD. Funding and inadequate exposure to Oa techniques we-re challenges to TD. There was significant correlation between motivational factors and TD (r = 0.277, p≤ 0.05). In conclusion, a few technologies have been developed, but funding and inadequate exposure to OA techniques are challenges to scientific technology development for promotion of OA in Nigeria.

Introduction

Organic Agriculture (OA) has the potential to both influence and address the factors that contribute to climate change and food insecurity. The constraints in adoption of OA include; the limited amount of truly scientific research on organic technologies, and difficult access to needed plant material, animal breeds and plant-protection inputs (Rezvanfar *et al.*, 2011). Adopting OA does not mean a return to low form of technology or backward agriculture but involves blend of innovations originating from participatory intervention of scientists and farmers.

The current participation of farmers, professionals and consumers in OA in Nigeria, indicate the need for scientific technologies to enhance promotion of organic production. Recent study shows the researchers potential to develop technologies that could be transfer to farmers. Hence, the need to assess the motivational factors, the technology developed, and constraints of technology development to scientists in OA in Nigeria.

Material and methods

This study was carried out in selected States in the South Western zone of Nigeria being the agro-ecological zone that has the highest concentration of research institutes and tertiary institutions that offer are active in organic agriculture. From the available data, 30 % of the scientists that are involved in OA were randomly selected; this gave rise to a sample size of 65 respondents. Data were collected from the respondents with the use of structured questionnaire. Out of the 65 questionnaire administered, 62 were returned giving about 95 % return rate. The dependent variable of the study was assessment of technology developed for promotion of organic agriculture, measured at the level of availability and it's transferred to farmers, from a list of identified areas of technology needs. Meanwhile, motivational factors, challenge to organic agriculture technology development, were measured as the independent variables. The data collected were analysed with the aid of the descriptive and inferential statistical tools such as frequency count and percentage, mean and Person Product Moment Correlation.

Results

The respondents were drawn from research institutes and tertiary institutions across the zone. Majority have higher education as PhD (46.3%), M.sc (50%) and B.sc (3.2%). Table 1 shows the ranking of the respon-

[1]Department of Agricultural Extension & Rural Development, University of Ibadan, Ibadan Nigeria
www.ui.edu.ng,eMail: rocktunde@yahoo.co.uk
*Corresponding author: rocktunde@yahoo.co.uk

dents' motivational factors using the mean score to rank. Interest in organic agriculture was rank 1st as the major motivational factor for involvement in organic agriculture research and technology development, while health and environmental concerns was rank 2nd on the list of motivational factors. This is in line with the reports of IFOAM, (2004) and Adrian Muller, (2009), identifying health and environment as fundamental principles of organic agriculture. Meanwhile, exposure to organic farming techniques and research grants were ranked as the 8th and 9th motivational factors for technology development by the respondents.
Analysis of technologies developed by scientists with focused on the availability and transfer of these technologies to the end users (farmers) are presented in Table 2. Composting techniques (22.6 %), planned crop rotation technique (12.9 %) and soil fertility improvement techniques (11.3 %) were the technologies developed that few of the scientists have transferred to farmers. While majority claimed to have developed same technologies but have not transferred to farmers. Aside from the low transfer of the developed technologies, most of the farmers' production challenges in organic agriculture, such as disease management technique (4.8 %), Pest management (8.1%), and Weed management (8.1 %) have low level of technology developmet and transfer.
Table 3 shows the mean scores and the ranking of the respondents' serious challenges to organic agriculture technology development. Majority of the respondents identified inadequate funding for research (28%) as most serious constraints to technology development. This is line with the findings Sami,(2002) and Olanrewaju,(2011). Inadequate exposure to organic farming techniques (18.8%) was ranked as the 2nd serious constraints, while low demand for organic research by farmers (11.5%) and low market for organic products (10.4%) were ranked 3rd and 4th as serious constraints to technology development respectively. Analysis presented in Table 4 revealed that there was significant correlation between the motivational factors of the respondents and technology development on organic agriculture.

Table 1: Ranking of respondent's motivational factors for organic technology development

Motivational Factor	Mean $\bar{x}$	Rank
Demand driven/Market	2.29	3rd
Interest in organic agriculture	2.56	1st
Friends' involvement	1.84	5th
Promotion	2.11	4th
Institutional mandate	1.81	6th
Health and Environmental issues	2.32	2nd
Research grant	1.61	9th
Private investment	1.74	7th
Exposure on organic farming	1.65	8th

Source: Field Survey, 2013 *Multiple response*

Table 2: Distribution of the respondents' technologies developed on organic agriculture

Technology Developed	Mean score	Not available		Available not transferred		Available transferred	
		Freq	%	Freq	%	Freq	%
Composting techniques	0.94	18	29.0	30	48.4	14	22.6
Planned crop rotation techniques	0.82	19	30.6	35	56.5	8	12.9
Disease management	0.61	27	43.5	32	51.6	3	4.8
Pest management	0.70	26	41.9	31	50.0	5	8.1
Weed management	0.65	27	43.5	30	48.4	5	8.1
Bio pesticide	0.39	39	62.9	22	35.5	1	1.6
Soil fertility improvement technique	0.81	19	30.6	36	58.1	7	11.3
Bio fertilizer	0.60	30	48.4	27	43.5	5	8.1
Storage techniques	0.23	50	80.6	10	16.1	2	3.2
Value addition	0.30	47	75.8	12	19.4	3	4.8

Source: Field Survey, 2013 *Multiple response*

Table 3: **Distribution of serious constraints faced by respondents on organic agriculture technology development**

Challenges to organic agriculture technology developed	**Mean** $\bar{x}$	**Percent**	**Rank**
Organic production is time consuming	0.89	7.3	7th
Inadequate funding for research	1.89	28.0	1st
Labour intensive	1.10	8.9	5th
Inadequate exposure to organic farming techniques	1.50	18.8	2nd
Availability of Raw material	1.00	7.8	6th
Low demand for organic research by farmers	1.42	11.5	3rd
Criticisms of organic agriculture	0.89	7.3	7th
Low market for organic products	1.30	10.4	4th

Source: Field Survey, 2013 **Multiple response*

Table 4: Pearson Product Moment Correlation (PPMC) of the relationship between motivational factors and technology developed for promotionof OA

Variable	r value	p value	Decision
Motivational factors	0.277	0.029	Significant

Source: Field Survey, 2013

Discussion

This investigation revealed high interest of the scientists in having a healthy production of crops with environmental friendly technologies. However, inadequate exposure to the best organic practices and lack of research grant were constraints to the development of organic agriculture technologies and it's promotion among farmers. In-depth interviews were conducted with some of the scientists, majority emphasised that, the few technologies that have been developed and transferred were achievd by funding form international donors. Aside from the low transfer of the developed technologies, most of the farmers' production challenges in organic agriculture, such as disease, pest and weed managements have low level of technology development and transfer. The significant correlation between motivational factor and technology development emphasized the need to effectively motivate the scientists in a multidimensional ways for farmers oriented technology development.

Comment, Suggestions and Recommendations

Scientific technology development is tool for promotion of OA in Africa. This study suggest; multidimensional approaches should be employed by scientists for funding of technology development and transfer across the organic production chain. Survey of farmers' challenges in organic production, and the appropriateness and adaptability of scientific TD should be conducted in Africa, to prioritize research focus for the continent

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100 % Organic feed for poultry – results of feed trials in the UK

CATHERINE LOUISE GERRARD[1], JO SMITH[1], REBECCA NELDER[1], ASHLEIGH BRIGHT[2], RUTH CLEMENTS[2], BRUCE PEARCE[1]

Key words: poultry, broilers, feed trials, protein, algae

Abstract

Current regulations for organic monogastric production systems permit feed ingredients of non-organic origin, primarily due to concerns about meeting the demand for the essential amino acids methionine and lysine. However, 100 % organic diets will become compulsory in the EU from 1st January 2015, so there is a need to develop feeds which will supply the required level of nutrients and support high animal health and welfare. This paper reports on feeding trials carried out with broilers in the UK to investigate the impact of three 100 % organic diets: a control diet with globally sourced ingredients, a diet based on locally sourced (i.e. within Europe) organic ingredients, and a diet based on locally sourced organic ingredients and algae. The results of the summer and winter trials showed that there was no significant difference in bird weights between the three diets, indicating that using locally sourced and locally sourced with algae feeds do not impact on broiler productivity.

Introduction

Current regulations for organic pig and poultry production systems permit feed ingredients of non-organic origin, primarily due to concerns that a 100% organic diet would be unable to meet the demand for the essential amino acids methionine and lysine. This is compounded by the fact that the most obvious and commonly used protein feed source (soya) is not widely grown in Europe due to climatic conditions, and there are environmental and social concerns about using imported soya. However, 100 % organic diets for poultry and pigs are due to become compulsory in the EU from 1st January 2015. This paper reports on feeding trials carried out with broilers in the UK to investigate the impact of locally sourced 100 % organic feed on broiler performance. Our hypothesis is that productivity will be maintained when globally-sourced protein feed resources are replaced by locally sourced organic ingredients.

Material and methods

Two feed trials were carried out at FAI Farm, Oxford, UK, one over the summer (July-Aug 2012) and one over the winter (Jan-Feb 2013). The three 100 % organic diets tested were: a control diet with globally sourced ingredients, a diet based on locally sourced (i.e. within Europe) organic ingredients, and a diet based on locally sourced organic ingredients and algae. Algae are an excellent source of methionine. The algae (*Spirulina*) were grown in North Wales using a production system that creates zero waste, and the slurry produced was freeze-dried and sent to the feed mill for inclusion in a standard pellet. The three diets were developed to provide similar nutritional profiles and are detailed in Table 1 below.

In the summer trial, the broilers (Hubbard JA 757) were housed in two houses positioned side by side. Each house was divided into twelve pens and four pens in each house were fed each of three diets. Each pen contained 10 or 11 birds. Due to the colder weather conditions in the winter it was necessary to double the amount of birds in the house to ensure that the birds were able to keep warm. Thus only one house was used in the winter trial. Twenty birds were placed in each pen and four pens were fed each of the three diets. In both the winter and summer trails, weights were recorded on a weekly basis taking a sample of 50% of the birds from each pen. The mean weight was calculated for each pen and thus the mean weight for each of the trial diets.

[1]The Organic Research Centre, UK, www.organicresearchcentre.com, eMail: catherine.g@organicresearchcentre.com

[2] FAI farms, UK, www.faifarms.com

Table 1: Diet ingredients and nutritional information.

	Fresh Weight Percentage		
Raw materials	**Control**	**Local feed**	**Local feed with Algae**
Wheat	56.91	30	30.29
Soya Expeller	22.24	0	0
Sunflower Expeller	9.78	12	6.62
Maize	5	21.37	21.59
Rape Expeller	0	15	15
Sweet Lupins	0	14.29	10
Beans	0	0	5
Algae	0	0	3
Linseed Expeller	0	2.09	3.5
Soya Oil	2.01	2.35	2.5
Di Cal Phosphate	1.45	0.45	0.55
Rice Concentrate	1.15	0	0
Vitamins and Minerals	0.75	0.75	0.75
Calcium Carbonate	0.71	1.2	1.2
Px Lucerne Concentrate	0	0.5	0
Nutritional Information			
Crude Protein	20.15	19.5	19.54
Lysine	0.95	0.85	0.88
Methionine Eq	0.38	0.37	0.4
Methionine	0.33	0.32	0.35
Meth + Cys	0.68	0.7	0.71
Tryptophan	0.23	0.21	0.2
Threonine	0.7	0.74	0.77
Av Lysine	0.85	0.66	0.64
Metabolisable energy (MJ/kg)	12.65	12.2	12.3

The statistical analysis was carried out using R version 2.15.2 (R development core team, 2009). The weights across the diets and the weight gains across the diets were compared using ANOVA (analysis of variance). A two-factor ANOVA was used to analyse the summer feed trial data to test that the house did not have an impact on the weights. Post-hoc testing was unnecessary.

Results

The summer trial data was analysed to see whether there was a significant difference between the diets in terms of total weight gain (i.e. the final weight minus the initial weight). The ANOVA gives F=1.064 (on 5 and 18 degrees of freedom) with a p value of 0.4121. There is no significant difference suggesting that neither the house nor the diet have an effect on weight gain. Removing the effect of house and modelling the weight gain with diet as the only factor gives F=0.03978 (on 2 and 21 degrees of freedom) with a p value of 0.961.

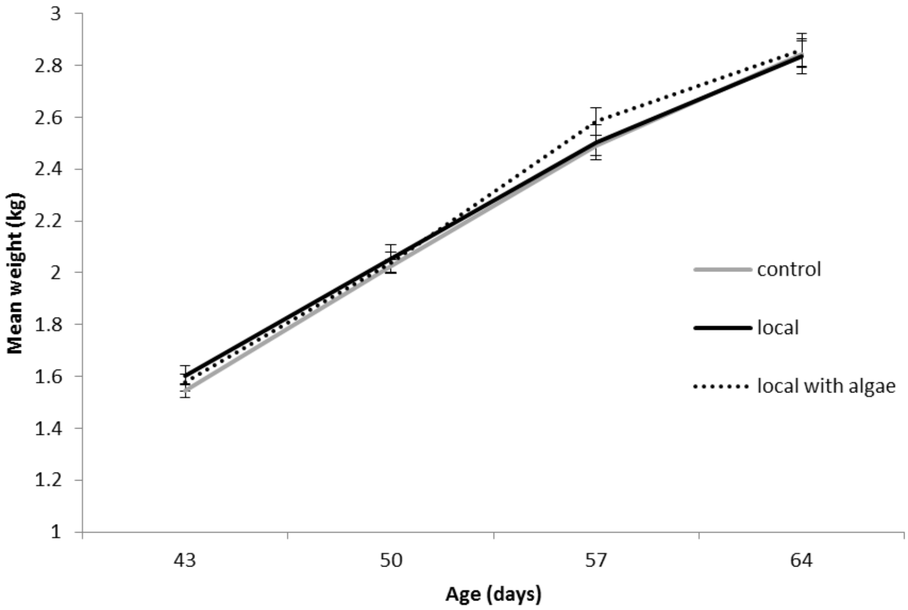

Figure 1: Plot of weight gain for each diet in the summer trial. Error bars shown are standard errors.

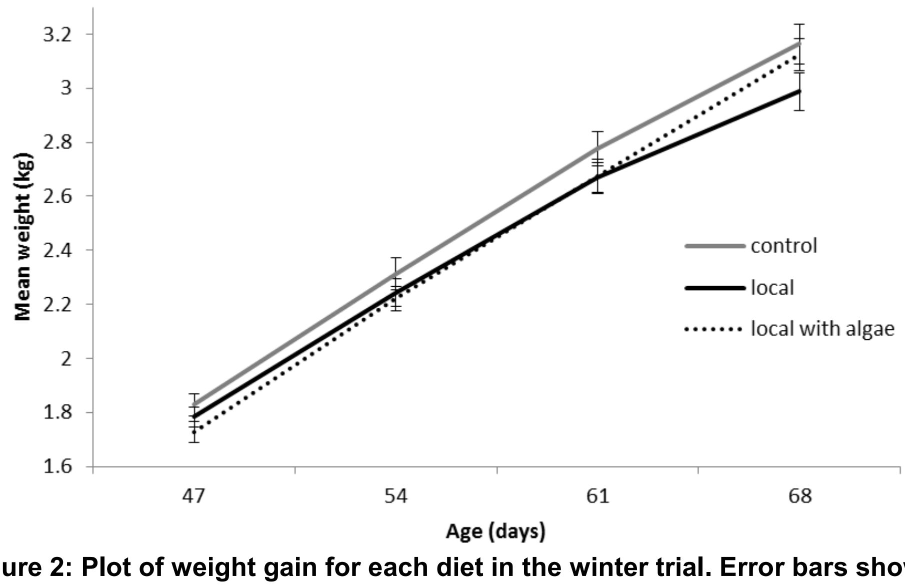

Figure 2: Plot of weight gain for each diet in the winter trial. Error bars shown are standard errors.

From Figure 2 it appears that in the winter trial, while the control and local with algae diets give very similar weights at the end of the weighing period, the local diet may be resulting in slightly lower weights. However, a one-factor ANOVA gave a p value of 0.0875 (F statistic of 3.372 on 2 and 9 degrees of freedom) for the gain between 47 and 68 days, which is not statistically significant at the 0.05% level, although it is worth noting that is closer to being so than the summer trial.

Discussion

The results of both the summer and winter trial showed that there was no significant difference in bird weights between the three diets, indicating that using locally sourced and locally sourced with algae feeds does not impact on broiler productivity. Animal welfare parameters (breast and feet assessments) were recorded and showed no differences between the three feeds (data not shown). Further work is needed to compare the economic and environmental impact of the ingredients that were included in the trial diets, and this will be carried out within the ICOPP project in the forthcoming year.

Acknowledgements:

This research was carried out as part of the CORE Organic II funded project 'Improved contribution of local feed to support 100% organic feed supply to pigs and poultry' (ICOPP: www.icopp.eu). This is a three year project, funded in the UK by Defra as part of the European CORE2 Eranet programme to support organic research, led by Aarhus University in Denmark with 15 partners across 10 EU countries.

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R Development Core Team (2009), R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org.

100 % Organic feed for pigs – results of feed trials in the UK

JO SMITH[1], CATHERINE L. GERRARD[1], REBECCA NELDER[1], RUTH CLEMENTS[2], BRUCE PEARCE[1]

Key words: roughage, silage, beans, peas, monogastrics

Abstract

Current regulations for organic pig and poultry production systems permit feed ingredients of non-organic origin, primarily due to concerns that a 100 % organic diet would be unable to meet the demand for the essential amino acids lysine and methionine. 100 % organic diets for monogastrics will become compulsory in the EU from 1st January 2015, and so there is an urgent need to develop economically profitable feeding strategies based on organic feed across Europe. Feeding trials carried out with Gloucester old spot pigs in the UK found that there was no significant difference in the weight gains across the diets until the last week of the trial when there a significant difference in weight increase for the male pigs on the bean diet. This suggests that a 100 % organic diet using peas or beans can provide an acceptable alternative to a soya-based diet.

Introduction

Current regulations for organic monogastric production systems permit feed ingredients of non-organic origin, primarily due to concerns that a 100 % organic diet would be unable to meet the demand for the essential amino acids lysine and methionine. Soybean meal, the most commonly used protein feed source is not widely grown in Europe due to climatic conditions, and there are environmental, GM and social concerns about using imported soya. 100 % organic diets for monogastrics will become compulsory in the EU from 1st January 2015, and so there is an urgent need to develop economically profitable feeding strategies based on organic feed across Europe. This paper reports on feeding trials carried out with Gloucester old spot pigs in the UK; a control diet (lucerne silage and barley with soya) was compared with two novel diets (lucerne silage with beans; lucerne silage with peas).

Material and methods

Three diets for pigs were compared, each containing 55 % lucerne silage. The control diet contained soya. The remaining two diets contained either peas or beans as alternative protein sources. The details of the diets are shown in Table 1 below.

Six pens were used, each containing seven or eight animals (Gloucester old spot) of the same gender. Each diet was floor fed ad-lib to two pens (one containing males and one containing females).

The pigs were weighed on a weekly basis on the same weighbridge. Ear tag numbers and electronic IDs were checked so that weights were recorded as individuals and the mean weight for each pen calculated. The first weighing was carried out on 21.8.2012 (week 0) and the final weighing 14 weeks later on 20.11.2012 (week 13). The trial diets began on 28th August (week 1) and the lucerne started 10 days prior to that.

The statistical analysis was carried out using R version 2.15.2 (R development core team, 2009). The weights across the diets and the weight gains across the diets were compared using analysis of variance. A two-factor ANOVA was used to analyse the data to test the impact of diet and gender (and the potential interaction between the two). Post-hoc testing, where necessary, was carried out using Tukey's HSD test.

[1]The Organic Research Centre, UK, www.organicresearchcentre.com jo.s@organicresearchcentre.com
[2]FAI farms, UK, www.faifarms.com

Table 1: Comparison of the diets.

Ingredient	DIET 1		DIET 2		DIET 3	
	%	Ration weight (kg/pig)	%	Ration weight (kg/pig)	%	Ration weight (kg/pig)
Lucerne silage	55	1.10	55	1.21	55	1.21
Rolled barley	30	0.60	30	0.66	30	0.66
Field beans	0	0	14	0.31	0	0
Field peas	0	0	0	0	14	0.31
Soya	14	0.28	0	0	0	0
Mineral	1	0.01	1	0.02	1	0.02
Actual feed fed (kg/day/pig)		1.99		2.20		2.20

Results

Figure 1 shows the weight gain over the period for each category (i.e. for each diet and each gender).

The results of the statistical analysis are shown in Table 2. The first column shows the p values for the two-factor ANOVA and the second column shows the results if diet only is considered as a factor. The weights at each weighing period are considered separately and then the weight gain is calculated at each period compared to week1.

The weight gain between week 1 and week 13 shows a significant difference (F-statistic: 2.856 on 5 and 40 DF, p-value: 0.02687 for the two-factor ANOVA and F-statistic: 3.478 on 2 and 43 DF, p-value: 0.03979 for the one-factor ANOVA). Tukey's HSD was used as the post-hoc test to investigate the apparent significant difference.

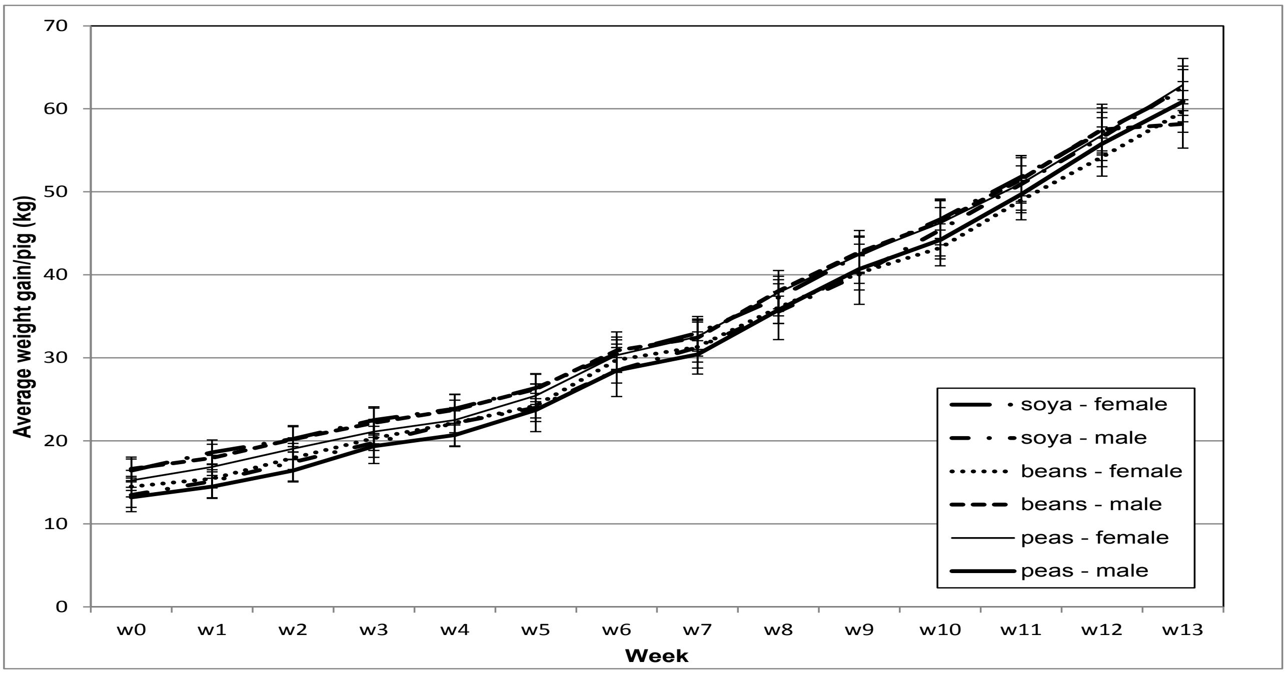

Figure 1: The average weight per pen at each weighing period showing the weight gain for each diet and gender. The error bars shown are the standard errors.

This identified that the significant difference for the weight gain between week 13 and week 1 is due to the male pigs on the bean diet. This can also be seen in Figure 1 which shows that this group had a slower increase in weight during the final week of the trial compared to the other diets. It is not clear from the data what caused this.

Discussion

There was no significant difference in the weight gains across the diets until the last week of the trial. This was caused by a significant difference in the last week (week13) for the male pigs on the bean diet which had a slower increase of weight compared to the other diets. This suggests that 100 % organic feed for pigs that meets the the required level of nutrients in different phases of production and support high animal health and welfare is possible to achieve by combining home grown protein from legumes with lucerne silage. Feeding pigs silage as part of a total mixed ration that includes barley and beans or peas for protein provides additional benefits as there is less aggressive behaviour such as tail-biting and can reduce costs by replacing bought-in feed.

Table 2: The p values for the ANOVAs of the weights and weight gains at each weighing period.

Week	Diet*gender	Diet
w1	0.3412	0.7192
w2	0.4717	0.7051
w3	0.7352	0.8176
w4	0.84	0.6844
w5	0.8365	0.9229
w6	0.9469	0.9015
w7	0.9588	0.9562
w8	0.9487	0.963
w9	0.9355	0.9923
w10	0.8996	0.8642
w11	0.9662	0.8808
w12	0.9486	0.911
w13	0.777	0.3486

Week	Diet*gender	Diet
w2-w1	0.284	0.2649
w3-w1	0.285	0.6078
w4-w1	0.08986	0.7482
w5-w1	0.4195	0.5089
w6-w1	0.2581	0.2592
w7-w1	0.4469	0.6859
w8-w1	0.4345	0.2243
w9-w1	0.7563	0.3632
w10-w1	0.6321	0.4623
w11-w1	0.6861	0.6768
w12-w1	0.5966	0.5901
w13-w1	0.02687	0.03979

Acknowledgements

This research was carried out as part of the CORE Organic II funded project 'Improved contribution of local feed to support 100% organic feed supply to pigs and poultry' (ICOPP: www.icopp.eu). This is a three year project, funded in the UK by Defra as part of the European CORE2 Eranet programme to support organic research, led by Aarhus University in Denmark with 15 partners across 10 EU countries.

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Diverse Swards and Mob Grazing for Dairy Farm Productivity: A UK Case Study

KATHARINE LEACH[1], GONZALO PALOMO[1], WILLIAM WATERFIELD[2], KONSTANTINOS ZARALIS[1], SUSANNE PADEL[1]

Key words: sward monitoring, stocking rates, grazing systems

Abstract

The paper presents first year results of one participatory case study carried out as part of EU FP7 funded SOLID project (Sustainable Organic and Low Input Dairying) on an organic dairy farm managed with diverse swards and mob grazing in Britain. Mob grazing is a livestock management strategy consisting of high stocking density for a short time to remove forage rapidly due to high grazing pressure and then removing livestock to allow grass recovery. On the farm this is combined with a diverse sward, paying particular consideration to soil fertility. First results indicate that there was more available herbage in front of the cows, especially in the summer months, than could be expected from rotational grazing with shorter rest periods. Differences between the diverse and standard mixture measure in one field were not as marked as expected. Further measurements during the coming grazing season will be carried out.

Introduction

Mob grazing is a livestock management strategy consisting of stocking density pressure for a short time to remove forage rapidly due to high grazing pressure and then removing livestock to allow grass recovery, paying particular consideration to soil quality. The basis for this approach is the grazing patterns of some species of wild herbivores roaming unrestricted over large rangelands. The animals spend a short time in a small area before moving on, leaving behind manure concentrated on a small area, and considerable plant residues, above and below ground, both of which contribute to Soil Organic Matter (SOM) and to soil nutrients (Savory and Butterfield, 1999). Published work on such grazing systems to date has mainly been carried out in arid areas (e.g. Weber and Gokhale, 2011). Interest in the approach has been developing in the UK, but there is some uncertainty about the levels of production that may be achieved. Diverse swards (with a range of grasses, legumes and herbs) may be well suited to this type of grazing management.

This paper presents first year results of one participatory case study carried out as part of EU FP7 funded SOLID project (Sustainable Organic and Low Input Dairying) on an organic dairy farm managed with diverse swards and mob grazing in Britain. The main aims of the case study where to explore the suitability of the system on this farm by determining the pasture herbage productivity, herbage dry matter (DM) utilisation by the animals. Measuring and estimating forage productivity on farms is time consuming. A second aim was therefor to explore the suitability of the plate meter method for estimating herbage yield of such diverse swards in the field.

Material and methods

The case study farm

Manor Farm is a 220 ha mixed dairy /arable farm in the Cotswolds (Gloucestershire, UK) at approx. 260 m above sea level. The thin limestone based soils are prone to drought. It has a long history of arable use in many fields and was converted to organic production in 2005. A mob grazing approach with diverse swards was introduced with the aim of increasing Soil Organic Matter (SOM). The farmer believes that this holds the key to improving and maintaining soil fertility and forage productivity in his organic system. Leys are reseeded as part of the rotation every five years with a diverse sward mixture that should be more suitable to the approach. The diverse sward mixture includes 10 different grass species (i.e. *Lolium multiflorum, Lolium perenne, Dactylis glomerata, Phleum pratense, Festuca pratensis, Festuca arundinacea, Poa pratensis, Cynosurus cristatus, Trisetum flavescens, Festuca rubra)* six legumes (*Trifolium pratense, Trifolium repens, Trifolium hybridum L., Lotus corniculatus, Melilotus, Onobrychis viciifoli*a) and five herbs (*Cichorium intybus, Plantago lanceolata, Sanguisorba minor, Achillea millefolium, Petroselimun sativum*). The best method for establishing the long-term diverse ley is was found to be undersowning under a spring cereal crop.

[1] The Organic Research Centre, Elm Farm, Hamstead Marshall, Newbury, RG20 0H, UK, www.organicresearchcentre.com. eMail: susanne.p@organicresearchcentre.com.
[2] The Farm Consultancy Group, Waterfield & White Ltd Upper Clatford, Andover, SP11 7RQ, UK

The herd of Friesian-Shorthorn cross dairy cows is spring calving, with a lactation period of 300 – 310 days. Full-time housing of the cows is limited to two months (Dec & Jan). Kale and fodder beet are grown for additional winter grazing. The mob grazing scheme uses high stocking densities of animals. During 2013, 48 heifers and a bull (equivalent to a body weight of 135 ton of livestock per hectare) and 186 milking cows (equivalent to 127 t/ha) were moved on twice a day after each milking. Typically 186 cows grazed 0.8 ha plots, delimited by electric fences. Following grazing pasture was allowed to recover for about 40 to 50 days. The case study used fields as established by the farmer with the above mixture.

Monitoring and sampling

Starting in March 2013, herbage yield and composition of the grazed swards were assessed on several fields representing the range of age of sward across the farm on a monthly basis. A one-square-metre quadrat was randomly placed in the un-grazed area just before the grazing cows and immediately after them on the grazed area. All the vegetation within the quadrat area was harvested to approximately 5 cm height and the herbage fresh weight was recorded. Samples were then separated into clover and legumes, broadleaves, grass and senescent material. This was used to determine percentage of grass, clover, broadleaved species and bare ground on the grazing plots and to estimate forage DM intake of the grazing cows. The dry matter (DM) content and forage proportion of each plant species within the sampled area were determined and forage yield (t DM/ha) was calculated for each sampled field before and after grazing. Additional herbage samples were analysed by wet chemistry for metabolisable energy (ME) content. Data on farm milk production were provided by the milk buyer.
Comparison of the productivity of two seed mixtures (i.e. perennial ryegrass/white clover mix *versus* the diverse sward (see mixture above) was determined in only one field ('Laines Estate') grazed by the heifers. On several sampling dates in August and September 2013, an Ashgrove Rising Plate Pasture Meter ® (PM) was also use for estimating herbage yields. The quantity of herbage was estimated by PM based on 50 measures per plot of compressed sward height and by using the following equation: t of DM/ha = (mean compressed sward height x 125) + 650. Calculated values were compared with those derived from cutting. In line with commercial use of the PM, it was assumed that the material from the plots that could not be grazed by cows amounted to 1.4t DM/ha.
Student's t test for comparison of means for paired samples was used to compare a) DM yields of the two sward types, and b) DM yield estimated by cutting and plate meter.

Results

Figure 1 shows the productivity (t DM/ha) of the swards grazed by the cows and Table 1 shows the calculated estimates for dry matter intake and milk production per month for 2013.

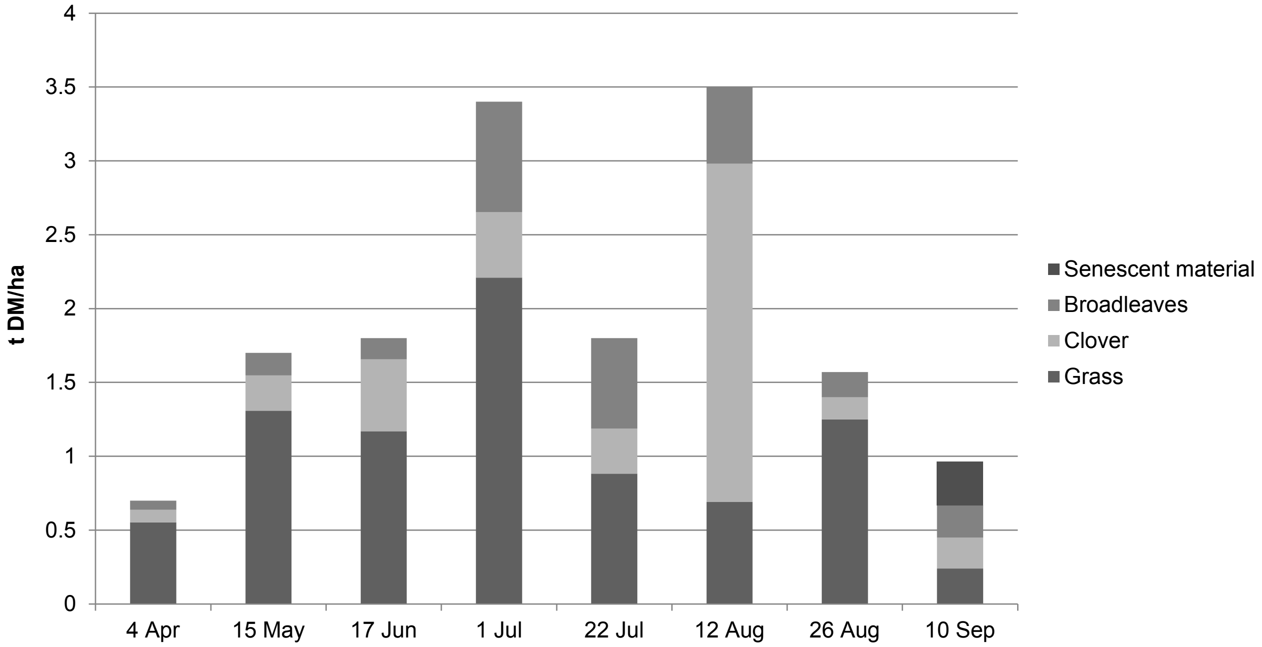


Figure 1: Productivity & herbal composition (DM) of diverse sward grazed by milking cows (2013)

In a search for useful predictors to allow more rapid assessment of herbage production, correlations between percentage cover and percentage of DM yield for the sward components were calculated. Among the relationships between percentage cover of each botanical group and the relative contribution to DM yield assessed on sample plots, only percentage clover cover and clover DM yield showed a statistically significant correlation ($r2 = 0.724$, $p < 0.05$). The correlations for grass and broadleaves were not significant.

Table 1: Milking cows' feed consumption, feed composition and milk production

Month 2013	**Estimated grazed intake cow/day**		**Supplementary feed**	**Milk production**
	kg dry matter	Metabolisable Energy (MJ)	per cow and day	litres per cow/day
March	4.25	No ME analysis	Silage+6 kg cake	16
April	7.45	87	Silage+6 kg cake	18.5
May	18	206	2 kg cake	24
June	14	141	1 kg cereal meal	20
July	18	184	1 kg cereal meal	15
August	10	99	1 kg cereal meal	14

No significant difference between the two sward mixtures was found (Figure 2). No significant relationship was found between herbage mass estimated by PM from compressed sward height and by cutting using the existing equation (Figure 3).

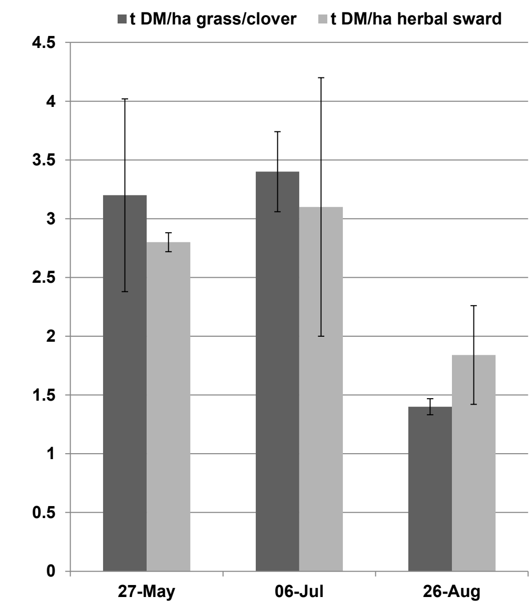
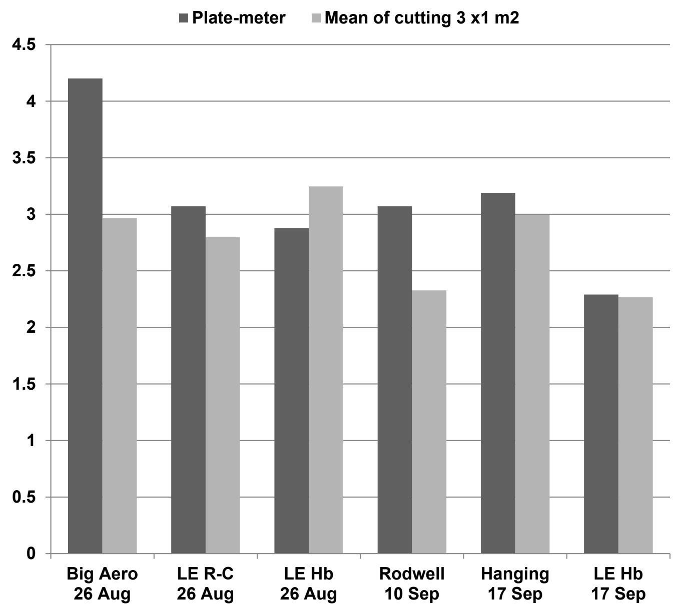


Figure 2. Comparison of the yields of grass/clover and herbal mixture sward (tDM/ha)



*1.4 t DM/ha has been added to the yield measured by cutting to allow for unharvested material

Figure 3. Comparison of herbage mass (tDM/ha) predicted from compressed sward height (PM) and measured by cutting*

Discussion and conclusions

Mob grazing allowed for higher forage availability for the grazing cows, especially in the summer months, compared with rotational grazing with shorter resting periods and with ryegrass (fertilised) or ryegrass/white clover (Leach et al. 2000).

The data illustrate that there was a large variation in herbage composition between dates and fields (Figure 1 and additional data not shown), but no significant difference in DM yield was found between the two mixtures compared (Figure 2).

Mob grazing with long pasture recovery periods can lead to better utilisation of mature swards by the grazing cows. It is well established that growth stage of sward influences digestibility, due to lignification. The effect of the increased proportion of senescent vegetation on milk yield should therefore be monitored carefully. It was noted that the proportion of senescent material was lower in the sward available to the cows than in the residual herbage, while the proportion of legumes and broadleaves was higher (data not shown). This suggests that the cows selected for the legumes and herbs and against the senescent herbage. Senescent material in the residual herbage is expected to make an important contribution to increasing SOM.

Monthly average milk yields (Table 1) were lower than those reported for British organic farms by Kingshay Dairy Costings (http://www.dairyco.org.uk/market-information/farming-data/kingshay-dairy-costings/kingshay-dairy-costings-organic) with the exception of the May lactation peak.

Regarding the use of the PM method to monitor diverse swards, the lack of good relationships between different sward parameters is likely to be due to the very heterogeneous nature of the diverse swards at different times.

Further measurements during an imminent grazing season are needed to evaluate the productivity of these swards and to fully validate the suitability of the plate meter for assessing varied swards and explore other predictive measures.

Acknowledgements

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Energy use in organic farming

LAURENCE SMITH[1], ADRIAN WILLIAMS[2], BRUCE PEARCE[1]

Key words: energy, organic, biodynamic, fossil-fuel

Abstract

Within this review, the extent to which organic farming can offer a more energy efficient mode of production was investigated through a comparison of 50 studies. The results illustrate that for nearly all crop and livestock types, organic systems use less fossil-fuel energy on a unit of land area basis, although results are more variable per unit of product. In many cases the difference can be attributed to the high energy requirements for the manufacture of nitrogen fertiliser used in conventional systems. Lower yields and higher energy requirements for weed control can make some organic cropping systems perform worse. Higher feed conversion ratios and mortality rates also make some organic livestock systems less efficient per kilogram of meat produced. Overall the review has found that organic farming systems have the potential to contribute towards a more energy efficient agriculture, although this will be at the expense of a lower yield.

Introduction

Limited fossil fuel reserves, growing populations and rising input prices highlight the importance of increasing the efficiency of food production systems and reducing greenhouse gas emissions. The organic sector places an emphasis on reducing inputs to the farm and recent reviews have found that organic farms use less fossil energy use and emit less greenhouse gases when results are expressed per hectare (Lynch et al. (2011), Gomiero (2008) and Lampkin (2007). When comparisons are made per unit of product, results are less consistent, with some organic production systems requiring more energy, due to a lower yield. The above reviews also found that the variety in energy assessment methods makes comparisons between studies difficult and that results varied greatly depending on whether the conventional systems used intensive or extensive production methods. The aim of this review was to build on previous work, providing a more complete and up-to-date assessment of the comparative energy efficiency of a range of organic systems.

Material and methods

A literature review of organic/conventional energy use studies was carried out in 2012 using web based search engines. The following or similar search terms were used:

- energy, emergy, fossil fuel
- organic, biodynamic, agro-ecological
- life cycle assessment, LCA, emergy, thermodynamic
- comparison, compare

The review only included studies based on pairwise comparisons and publications had to contain energy use data on both organic and conventional agriculture. Comparisons were made for each product group in relation to the amount of energy required per unit of product (e.g. kilograms or litres) in addition to the amount used per unit of land.

[1]The Organic Research Centre, United Kingdom, www.organicresearchcentre.com, laurence.s@organicresearchcentre.com

[2] School of Applied Sciences, Cranfield University, United Kingdom, www.cranfield.ac.uk

Results

Organic systems consistently use less fossil-fuel energy on a unit of land area basis for nearly all crop and livestock types, as shown in Figure 1.

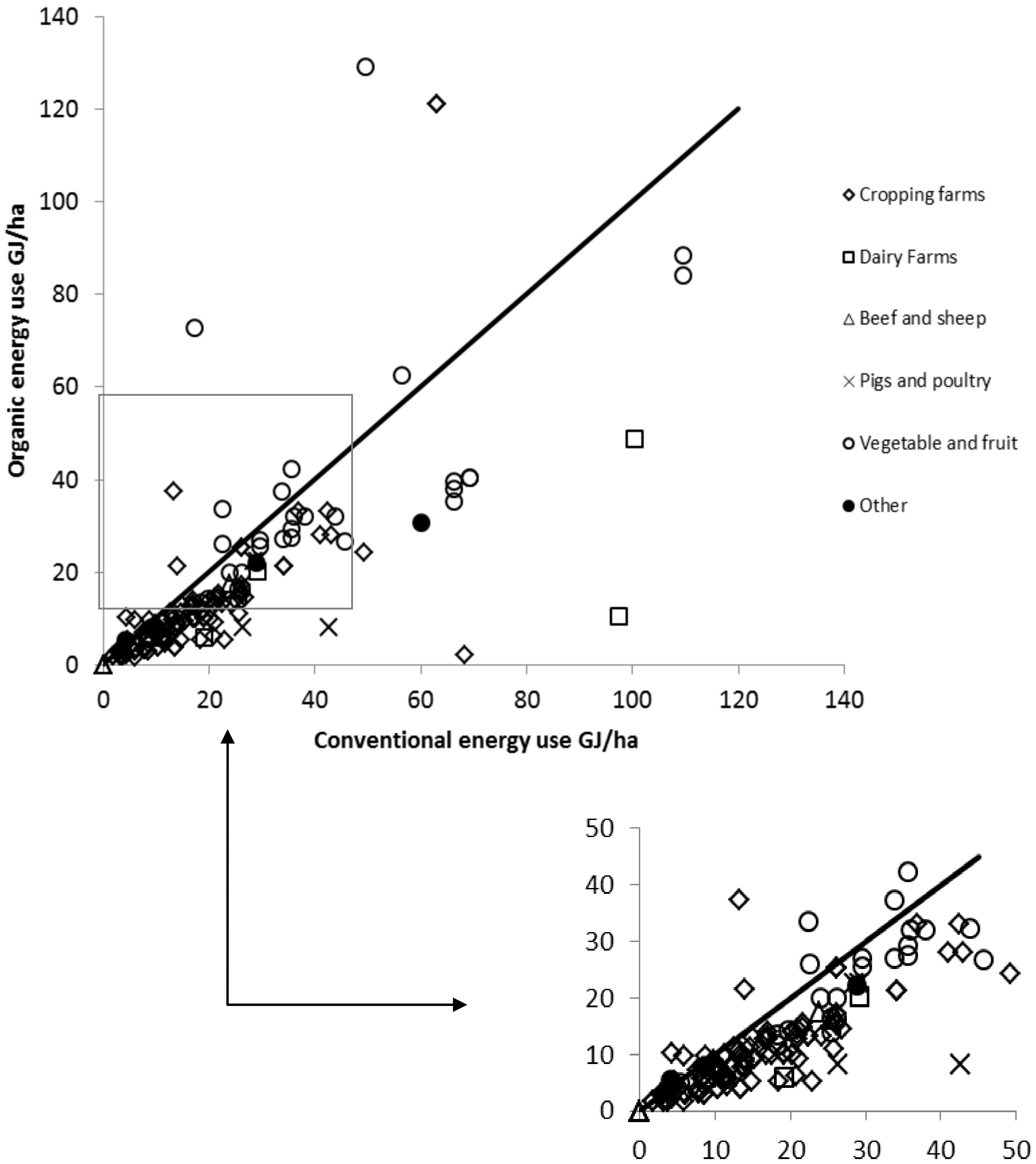

Figure 1: Organic vs conventional energy use per hectare with expanded selection. Organic performs better below the line, worse above the line. Please note the 'trend-line' is x=y for the purposes of illustrating the relative performance for each product type and is *not* a line of best fit.

In many cases the difference can be attributed to the high energy requirements for the manufacture of nitrogen fertiliser. Results are more variable per unit of product, where lower yields and higher energy requirements for weed control can make some organic cropping systems perform worse (see Figure 2). For example, for organically produced potatoes, energy use tends to be greater due to yield losses from pests and disease, causing lower yields overall (Williams et al., 2006). Higher feed conversion ratios and mortality rates also make some organic poultry systems less efficient per unit output (Leinonen et al., 2012).

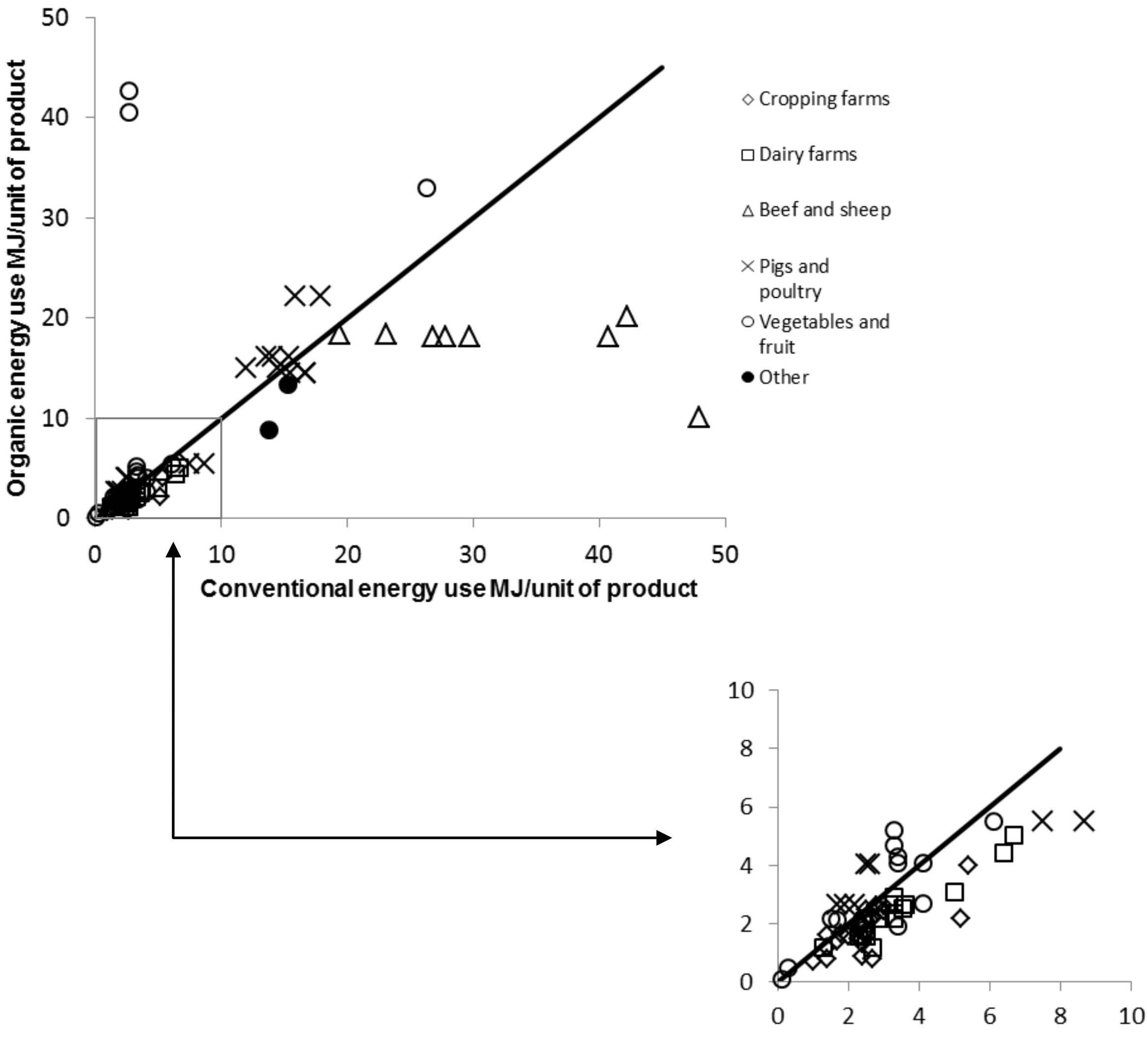

Figure 2: Organic vs conventional energy use per unit of product with expanded selection. Organic performs better below the line, worse above the line. Please note the 'trend-line' is x=y for the purposes of illustrating the relative performance for each product type and is not a line of best fit. Units of production were not consistent across the studies compared.

For most grazing systems, organic farming will result in a lower energy use, on a unit area or weight of product basis. This is a direct result of the use of clover and other forage legumes within leys, which results in more efficient forage production compared to the conventional practice (e.g. Küstermann et al., 2008). Similarly, for dairy systems, organic production tends to result in lower energy use per litre of milk produced, due to greater energy efficiency in the production of forage and reduced reliance on imported concentrates (Cederberg and Mattsson, 2000; Haas et al., 2001; Thomassen et al., 2008). With regard to on farm energy use, in common with Lynch et al. (2011) this review has found that in many cases organic farmers' diesel requirements are comparable to conventional; although for some crops this energy source may be greater through increased reliance on mechanical tillage, e.g. for broccoli (Venkat, 2012), wheat and potatoes (Williams et al., 2006). Higher human energy (labour) requirements were also found on organic farms because of increased mechanical weeding and greater diversity (Nguyen and Haynes, 1995).

Discussion

Overall, the review found that organic farming systems have potential to contribute towards more efficient agriculture, but with lower yields. The review also highlighted that organic systems do not offer a radical alternative, as they are still reliant on fossil fuel sources and the differences in energy use per unit of product were often marginal. Organic methods could still be applied to increase the efficiency of the agriculture sector as a whole, although energy use is only one aspect of sustainability.

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Effects of reduced tillage in organic farming on yield, weeds and soil carbon: Meta-analysis results from the TILMAN-ORG project

JULIA MARY COOPER[1], MARCIN BARANSKI, MAJIMCHA NOBEL DE LANGE, PAOLO BARBERI, ANDREAS FLIESSBACH, JOSEPHINE PEIGNE, ALRED BERNER, CHRISTOPHER BROCK, MARION CASAGRANDE, OLIVER CROWLEY, CHRISTOPHE DAVIDE, ALEX DE VLIEGHER, THOMAS DORING, MARTIN ENTZ, MEIKE GROSSE, THORSTEN HAASE, CAROLINE HALDE, VERENA HAMMERL, HILFRED HUITING, GÜNTER LEITHOLD, MONIKA MESSMER, MICHAEL SCHLOTER, WIJNAND SUKKEL, MARCEL VAN DER HEIJDEN, KOEN WILLEKENS, RAPHAËL WITTWER, PAUL MÄDER

Key words: minimum tillage, non-inversion tillage, conservation agriculture, ecological agriculture

Abstract

Within the CORE ORGANIC II project, TILMAN-ORG, we have compiled data from ongoing trials and the published literature to conduct a meta-analysis on the effects of reduced tillage on yields, weed pressure and soil C in organic farming. The results indicate that replacing deep inversion tillage with some form of reduced tillage intensity results in yield declines of 5-10%; however, relative to shallow inversion tillage, there is no yield penalty from further reducing tillage intensity. Weed pressure does not appear to be the sole cause of yield declines. Reducing tillage intensity also offers an opportunity to further increase the soil C sequestration ecosystem service provisioning of organic farming. Humid oceanic climates are least suited to implementation of reduced tillage systems in organic farming, while the production in the Mediterranean appears to benefit from reduced tillage. The study has highlighted the need for flexible, region- and system-specific design of reduced tillage systems in organic farming.

Introduction

The TILMAN-ORG project brought together 15 partner organizations in 11 European countries to address the challenge of compiling and translating knowledge on conservation agriculture in organic farming systems. While conservation agriculture (CA; the use of reduced tillage practices in combination with increased vegetative soil cover) is increasingly adopted in conventional farming systems, uptake by the organic sector has lagged behind. This is due to the real or perceived challenges of implementing CA in organic systems where interventions such as herbicides and N fertilizer are not permitted.

A major activity within TILMAN-ORG was the compilation of unpublished data from existing field trials where CA was tested under organic conditions. In addition, the peer and non-peer reviewed literature was also compiled. The objective of this activity was to create a database of trial results and use this data to conduct a statistical meta-analysis that would address the questions:

1. What is the magnitude of the effect of reduced tillage intensity on crop yields in organic systems?
2. Is this effect consistent across all environments (soil types and climatic zones)?
3. Are there certain management practices that can be used to enhance production under reduced tillage in organic systems i.e. crop rotation, crop choice (current and previous year), use of mechanical weeding?
4. Does the potential negative yield effect using CA in organic systems reduce over time?
5. Is it really weed pressure that is causing yield reductions? Or could there be other factors?
6. Does using reduced tillage in organic systems increase soil organic C above the levels already achieved by organic practice?

Material and methods

Data from a total of 14 field trials were compiled. This included trials located in 8 European countries and Canada. A literature survey of non-peer and peer-reviewed published literature was conducted to identify articles that reported results from experiments using reduced tillage in organic farming systems using the ISI-Web of Science and CAB Abstracts (Ovid) from 1910 to 2013. This provided around 180 articles published from 1986 to 2013 in scientific journals from the Journal Citation Report. More relevant papers were found by searching through the reference lists of papers already selected for the meta-analysis and recommendations of experts in tillage research. Papers were scrutinized and included if they met the following selection criteria: i) experiment under organic management for at least three years prior to the date of response measurement;

[1]Nafferton Ecological Farming Group, Newcastle University, UK; www.nefg-organic.org; eMail: Julia.Cooper@ncl.ac.uk

ii) at least two levels of tillage intensity included as a treatment; iii) no “mixing” of treatments i.e. only tillage varied between experimental treatments; iv) included climatic zones found in Europe.

For both data sources (published and field trials) values for response variables were provided as means for each treatment and information on the number of replications (N) and variability of the mean (standard error or standard deviation) were recorded. In each experiment the tillage treatment factor was assigned to a class based on the level of tillage intensity. The six classes in order of decreasing intensity were: deep inversion tillage (>25 cm depth), double-layer ploughing, shallow inversion tillage (<25 cm depth), non-inversion tillage (10-25 cm depth), non-inversion tillage (<10 cm depth), and no-tillage. Environmental variables included as factors were soil type and climate as described in Quemada et al. (2013) while management factors were crop rotation class, mechanical weeding class and main crop and previous crop. All data was summarized in a database to allow easy manipulation and extraction of key subsets.

For crop yields and weed data the effect size was calculated as the ratio between the experimental and control treatments. This resulted in an effect size that was standardized and unitless; therefore it was not necessary to have the same units of measurement when combining data from different experiments. For the soil C data, since all measurements were in the same units (g m-2) the effect size was calculated as the mean difference. This allowed presentation of the effect in actual units of mass per area.

Data were analysed using meta-analysis techniques to study the effects of reduced tillage on crop yield, soil C and weed pressure. All data were analyzed using the R statistical software package (www.r-project.org) (R Development Core Team 2011). An observation pair consisted of a datapoint for a designated control treatment and a datapoint for an experimental treatment. The effect size for each yield and weed pressure observation pair was calculated as the response ratio (r = Xe/Xc), where Xe is the experimental treatment mean and Xc is the control mean of each variable. For the soil C data, since all measurements were in the same units (g m-2) the effect size was calculated as the mean difference (MD=Xe-Xc). Mean effect sizes were calculated for each variable of interest and data-set category, and bias-corrected 95% confidence intervals (CI) were generated by a bootstrapping procedure (5000 iterations). Means were considered significantly different from zero if the 95% CI did not overlap zero, and different from one another if their 95% CIs interval were non-overlapping (Hedges et al. 1999). The results of each mean ratio (r) were expressed as % effect size (e), where e = (r-1)×100. The data was divided into two subsets: subset one consisted of observation pairs where deep inversion tillage was included as the “control” treatment, and subset two consisted of observation pairs where shallow inversion tillage was the “control” treatment.

Results

A total of 901 observation pairs were identified for the comparison “reduced tillage” versus “deep inversion tillage” under organic management in subset one. Reducing tillage resulted in an average yield decline of 5-10% relative to the deep inversion control. For the subset of data where the control was shallow inversion tillage (178 observation pairs) there was no significant reduction in crop yield by reducing tillage under organic management, and there was actually a significant increase in yield for the 26 observation pairs where no-tillage was used compared with shallow inversion tillage.

Yield reductions due to reducing tillage intensity in organic systems were significant for all climate classes except for the Mediterranean group within the subset with shallow inversion as a control. For this set, yields were increased relative to the control by nearly 10%. There were no clear trends for the impact of soil type on these effects.

Yields of legume leys and cover crops were the least affected by reductions in tillage intensity, while other crop types appeared to be equally affected by reduced tillage. The crop rotation system also did not result in a differentiation of the yield effect when tillage intensity was reduced.

For both subsets of data weed pressure was significantly higher when tillage intensity was reduced. However, weed pressure only correlated with reduced yield when double-layer ploughing or shallow inversion tillage were implemented instead of deep inversion tillage was the control; when compared to shallow inversion tillage, the reduction in crop yields correlated with increased weed pressure when deep non-inversion tillage was used.

As expected, reducing tillage intensity increased soil C stocks compared with deep inversion tillage (183 observation pairs); however, soil C stocks were only higher when no-tillage was used when compared to shallow inversion tillage (74 observation pairs).

Discussion

This analysis confirmed that using reduced tillage in organic farming systems can result in yield reductions; however, it also demonstrated that this was only the case when tillage intensity was reduced relative to deep inversion tillage. Yield reductions were not always correlated with increased weed pressure, which suggests that other factors may also be inhibiting yields when reduced tillage is used in organic systems. These may include reduced rates of N mineralization from soil organic N sources in the early spring due to colder surface soil temperatures, as suggested by Mäder et al. (2012). A more in depth analysis of this database will further elucidate the mechanisms of yield reduction when reduced tillage is used in organic farming systems. This analysis will also help to identify optimum management practices (crop rotations, crop choice, tillage intensity) needed to realize the ecosystem services of conservation agriculture, while also maintaining crop yields.

Suggestions to tackle the future challenges of reducing tillage in organic farming systems

A key recommendation is that "hybrid" systems will need to be adopted in organic farming, so that farmers can use deep inversion tillage at key stages of the rotation when weed control and/or incorporation of a green manure is required, or for removal of grass-clover leys. Special attention however has to be paid to the fact that one single deep inversion ploughing may lead to an immediate loss of accumulated soil organic carbon and that large pores built by earthworms and roots may be disrupted. Carbon models may further be adopted using datasets from reduced tillage systems under organic management to predict soil organic carbon with more accuracy in the long-term, and CA techniques may be improved in on-farm experiments in a participatory way with farmers. It is also useful to note that special equipment, e.g. the double-layer plough for primary tillage, does not appear to offer a benefit over simple shallow inversion tillage with a mouldboard plough. The potential to use conventional equipment when reducing tillage intensity should make this option more attractive to the organic farming community. However special equipment like chisels with large goose feet sweeps or a stubble cleaner to undercut the soil and thereby control weeds, and special ploughs to superficially till the soils may still be useful.

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Innovations in low input and organic dairy supply chains – what is acceptable in Europe?

PHILLIPA NICHOLAS[1], SERENA MANDOLESI[2], SIMONA NASPETTI[3] AND RAFFAELE ZANOLI[3]

Key words: dairy, low input, organic, innovation, acceptability, Q-Method

Abstract

There is a need to develop innovations within low input and organic dairying in order to overcome some of their identified constraints. This study applies the Q methodology to determine the attitudes of low input and organic dairy supply chain members in four European countries (Belgium (BE), Finland (FI), Italy (IT) and the United Kingdom (UK)) to the acceptability of various innovations in dairy farm and dairy supply chain practices. The results of the study indicate that the preference of low input and organic dairy supply chain members in Belgium, Finland, Italy and the United Kingdom regarding innovations to improve the sustainability of their supply chains, lies in developing innovations to improve animal welfare and to improve forage quality in order to be able to reduce the need for purchased concentrate feeds. Our investigation confirms that there is no interest within these sectors for innovations based on biotechnology.

Introduction

There is a need to develop innovations within low input and organic dairying in order to overcome some of their identified constraints (e.g. Smit et al., 2009; Darnhofer et al., 2005; Smith and Marsden, 2004) and improve their multi-functional performance.The applicability of innovations across a wide geographical area and in a wide range of low input and organic dairy systems is important for maximizing the return on investment in research and development. In order for an innovation to be taken up and effect desirable change, that innovation must be acceptable to the whole supply chain, including producers, processors, retailers and consumers. Different actors in the supply chain and consumers may have different views on an innovation depending on how it is perceived to affect their business or themselves. In addition, the acceptance of an innovation in farming or supply chain practices is also likely to vary significantly geographically due to differences in climate, farming practices, farm ownership and structure, lengths of supply chains and supply chain relationships. It is necessary, therefore to evaluate the acceptability of a range of potential innovations for improving dairy supply chain competitiveness across a range of European countries

Material and methods

The Q methodology (McKeown and Thomas, 1988) was applied to understand the different attitudes of supply chain participants to innovations within organic and low input dairy supply chains. The five key steps in the methodology were:

1) Definition of the research topic ("The acceptability of innovations in dairy farming and dairy supply chain practices to achieve more sustainable low input and organic dairy farming and supply chain systems") and the discourse surrounding it. The relevant discourse included materials on innovations across the broad range of dairy farming systems applicable or existing in the participating countries.

2) Derivation of a representative set of innovations statements from the discourse to be presented to participants for sorting. Four categories were used to select the statements in this study: Breeds, Feeds, Management and Practice on Farm and in the Supply Chain. From the 200 statements identified in the concourse, 34 statements (the Q-sample) were selected (Table 1).

3) Participants (8-12) were selected from each of the following: Consumers, Producers and Retailers & Processors involved in organic, low input and conventional dairy supply chains in the UK, IT, FI and BE.

[1] Institute of Biological, Environmental and Rural Sciences, Aberystwyth University, Wales, United Kingdom, www.aber.ac.uk/en/ibers, email: pkn@aber.ac.uk.

[2] Dipartimento di Scienze Agrarie, Alimentari e Ambientali (D3A), Università Politecnica delle Marche, Italy, email: s.mandolesi@agrecon.univpm.it

[3] Dipartimento di Scienze e Ingegneria della Materia, dell'Ambiente ed Urbanistica (SIMAU), Università Politecnica delle Marche, Italy, email: simona@agrecon.univpm.it, email: zanoli@agrecon.univpm.it

4) The participants, in a series of workshops and interviews, ranked the 34 innovation statements on a template in a quasi-normal distribution. The 34 statements had to be sorted from 'strongly like' (+9) to 'strongly dislike' (+1). These workshops and interview were followed by short informal interview for participants to explain their choices.

5) The statistical analysis of the results was carried out using the software package PQMethod (Schmolck, 2002). The first step in the analysis involved correlating every sort with every other sort. The sorts were then factor analysed applying the centroid factor extraction (Watts and Stenner, 2012) to reduce the data to a smaller number of defining sorts. The factor analysis was applied for all supply chain participant categories (Consumers, Producers and Retailers & Processors) and for each country involved (UK, IT, FI and BE)..

Results

There was considerable agreement across countries and supply chain members as to the acceptability of innovations in low input and organic dairy farm management and supply chain practices (Table 2). In all countries surveyed there was an overwhelming dislike of those innovations related to practices that are perceived to be “unnatural”. They include activities improving the forage quality and yields in low-input and organic dairy systems by GM plant breeding techniques, developing designer dairy food from transgenic animals, accelerating genetic selection using processes that includes recombination in vitro and innovations to speed up calf development from birth to maturity. It is perhaps unsurprising that these technologies are rejected by certified organic supply chain members as they do not comply with current organic principles or regulations but they were firmly rejected by all participants in the study. In all countries there were two main themes that dominated the innovations that were liked, these were innovations to improve animal welfare and innovations to improve feed and forage quality and reduce the use of purchased concentrate feed. The latter highlights the importance of good quality forage in low input and organic dairy systems and also reflects consumers desire for more “naturally” fed animals. The strong desire by all supply chain participants for innovations to improve animal welfare builds on the findings of previous studies looking specifically at consumer attitudes to animal welfare (European Commission, 2005; 2007). There were some innovations that were only strongly liked in certain countries due to the countries specificities (e.g. Italy- innovative solutions to improve the efficiency and customer convenience of short supply chains in the dairy sector).

Discussion

Albeit qualitative in nature, the results of the study indicate that the preference of low input and organic dairy supply chain members in Belgium, Finland, Italy and the United Kingdom regarding innovations to improve the sustainability of their supply chains, lies in developing innovations to improve animal welfare and to improve forage quality in order to be able to reduce the need for purchased concentrate feeds. Our investigation confirms that there is no interest within these sectors for innovations based on biotechnology. Further research is needed to confirm our findings in other countries and to fully investigate the antecedents of these attitudes in larger samples.

Table 1. 34 innovation statements that made up the Q-Sample

No.	Statement
1	Improve breed performance in different natural environments.
2	Identify adapted breeds for organic and low input production systems
3	Reduce the risk of Genetically Modified Organism (GMO) contamination in dairy feeds by optimal use of proteins alternative to soy.
4	Develop techniques to improve soil biodiversity to increase the feed value of forage.
5	Develop new forage varieties specific for low input and organic farming.
6	Develop the use of herbs in pastures for their phytotherapeutic properties to reduce animal health problems.
7	Improve milk quality by better use of forage.
8	Improve the Carbon Footprint of dairy supply-chains through improved logistics.
9	Develop an efficient network for the selling of biogas from livestock manure and slurry.
10	Improve storage and processing methods for organic food products to maximize their nutritional quality.
11	Innovation in automation and robotics in dairy management.
12	Increase animal welfare by prolonging maternal feeding in an efficient way.
13	Develop organic dairy production systems free of antibiotics.
14	Innovation in milk analysis to enable traceability (e.g. access to pasture, place of rearing, quality of feed).
15	Innovation in on farm processing of raw milk.
16	Innovation in housing aimed at improving animal welfare.
17	Selection of breeds for higher levels of desirable fatty acids in milk to produce healthier milk products.
18	Improve forage quality and yields in low-input dairy systems by GM plant breeding techniques.
19	Minimize the use of purchased feed through efficient use of home-grown feed.
20	Develop management systems that reduce the use of wormers to control parasites.
21	Improve forage conservation techniques to improve feed quality.
22	Develop systems for reducing water and fossil fuel consumption on organic and low input farms.
23	Advances in crop and soil management to improve on farm recycling of nitrogen from slurry and manure.
24	Reduce the nitrogen in slurry and manure through better management of the animal diet.
25	Develop approaches to manage health problems during the transition between gestation and lactation.
26	Develop designer dairy food from transgenic animals.
27	Improve the efficiency of reproductive techniques acceptable for organic dairying.
28	Acceleration of genetic selection including recombination in vitro (e.g. semen sexing).
29	Innovation in dietary supplements to increase milk yield and quality.
30	Develop feed additives to reduce greenhouse gas emissions without reducing milk yield or quality.
31	Innovative solutions to improve the efficiency and customer convenience of short supply chains in the dairy sector.
32	Improving the digestibility of feeds via physical, chemical or other processing.
33	Innovations to speed-up calf development so that they can breed earlier.
34	Innovation in indoor (100% housed) dairy systems to improve animal welfare.

Table 2. Summary of Consensus and Distinguishing statements*

	Belgium		Finland		Italy		UK	
	F1	F2	F1	F2	F1	F2	F1	F2
Consensus Statements								
Positive	8, 13		16		7, 16, 19, 22		none	
Negative	18, 26, 28, 32, 33		18, 26, 28, 33		18, 26, 28, 33		18, 26, 28, 34	
Distinguishing statements								
Positive	5, 6, 19	34, 9, 12	4, 5, 19, 23	2, 6, 12, 13	4, 6, 12	31	4, 19, 22, 23	2, 3, 6, 13
Negative	34	none	none	none	34	none	none	none

* A full list of innovations related to the statement numbers is available in Table 1.

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People, place and participation. Bringing together organic and place – insights from Austria and the US

JIM BINGEN[1], BERNHARD FREYER

Key words: geographical indications, terroir, Genussregionen, typicity, governmentality, collectivity

Abstract

Deliberate policies and programs designed to identify and promote specific places (or terroir) could favor expanded organic production and market development. More specific relationship built on organic and geographically indicated products and practices might offer opportunities to set priorities and identify smart strategies for enhancing the promotion of organic. One strategy to do so might be derived from the organic principles underlying organic participatory guarantee systems (PGS). This paper draws upon several years of field research and experience in Michigan (US) and in Austria to explore how the concepts of collective participation, typicity and governmentaliy can unite organic and terroir efforts to promote rural development.

Introduction

Those who currently promote *terroir* production and products (geographical indications) frequently share and celebrate a similar commitment as organic farmers to specific ecosystems, to traditions and to the quality of life for all involved. Given current challenges to both organic and *terroir* production from capital-intensive farms and food industry political lobbies, public investment in market protection and promotion could prove to be difficult, especially in the US. In Austria, the term *terroir* is used mainly by the wine industry, while the concept of "taste/food regions" (*Genussregionen*) represents a closely related approach. Consequently, a more effective strategy might be derived from the organic principles underlying organic participatory guarantee systems (PGS). Such an approach might be based on a "process of participative and deliberative democracy".

Material and methods

This paper draws upon several years of parallel field research, five years of jointly authored academic papers and presentations and a recently completed book manuscript on "re-thinking organic" to be published by Springer. More specifically, this paper reflects upon several years of close association and conversations with organic growers and especially those engaged in the direct marketing of their products. In the US, these ideas underlie a new non-profit initiative to promote "American origin products" from specific and different ago-ecological regions in the US.

Results

Of specific interest, these processes could draw upon at least three shared features of PGS and "origin" or *terroir* products: active collective participation by producers, processors, and consumers; focus on typicity of the social-historical-ecological qualities of specific food products and practices; and, public, governmentality (Bingen 2012)(Padel 2010).

Farmers, consumers, and often, processors, collaborate in creating, managing and enforcing participatory guarantee systems. The organic standards are sometimes even more strict than those used by third party certifiers (Källander 2008). Based on the PGS principle of sharing knowledge and experiences among all stakeholders, an organic *terroir* perspective could be developed.

Typicity. This concept emphasizes the social-historical-ecological qualities of specific food products and practices. It draws attention to the constructed nature of *terroir* and the human activities that are expressed in a specific place through particular skills, social patterns, practices and perceptions. Typicity emerges from the "human activities [in a particular locality] expressed through particular skills, social patterns, practices and perceptions" (Bérard and Marchenay 2008:17). In addition "shared knowledge" is a "distinctive characteristic of local production. It may relate to a particular breeding or growing practice, special curdling or refin-

[1]Jim Bingen, Michigan State University, East Lansing, Michigan USA, bingen@msu.edu; Bernhard Freyer, Division of Organic Farming, University of Natural Resources and Life Sciences (BOKU), Vienna, Austria, Bernhard.freyer@boku.ac.at

ing techniques, or indeed any production method or mode of consumption that helps to define a product and root it in local culture” (27).

Collectivity. Collective organization is the masterpiece of origin products/geographical indications. A collective, commonly involving producers, processors/companies and government, is responsible for identifying, maintaining, promoting quality and defending interests of all the members of the collective. A geographical indication or origin product is the result of a coming to agreement and an on-going conversation within the collective on the “place”, and a “code of practices” governing production, processing and sometimes marketing. With an agreement in place, a geographical indication becomes public property that is held and protected by the state, not by an individuals or private firms. The Missouri Regional Cuisines Project illustrates a somewhat similar effort to create associations among businesses, public agencies, non-profit groups and residents, and draw attention to the food ways characteristic of the region.

However, the challenge for these groups, and others like them in different US regions, involves developing their capacity to work collectively. Unlike some organic groups (e.g., those organized around participatory guarantee principles) these groups confront challenges that GI producers find challenging: how to “define and maintain GIs characteristics and values” (Allaire, Casabianca et al. 2011).

Governmentality. Public, governmental involvement in this process and its on-going commitment to, and support for protecting the code of practices is a third essential feature that ties organic to geographical indications. This involves much more than a regulatory or policing function, but active advocacy for, and defense of producer and processor interests. This support is commonly connected with broader commitments that supports policies focused on, but not restricted to, keeping smaller farmers on the land but is also threatened by budget cuts.

Discussion

Typicity. Groups of “speciality crop” growers in Michigan, hops growers, viticulture) are beginning to promote the “terroir” of their crops by defining the territory of production, the crop history and traditions, specific characteristics of varieties and of their growing practices. With financial support from local governments, the Austrian *Genussregionen* were established in 2005 (Groier 2007; Greiner 2009). The use of the concept has been challenged and the criteria for typicity in these regions could be more clearly defined.

Collectivity. The Northwest Michigan Food & Farming Network illustrates one approach to associate and advance the shared interests and activities in a region. In Austria, the GenussRegionen Marketing GmbH is a collaboration of producers, processors and the government that seeks to define new regionally specific products and to associate all the partners (Kastner and Mendoza 2012).

Governmentality. In the US, there is more often an adversarial, not a collaborative, relationship between (especially smaller farmers) and most governmental agencies. In Austria *Genussregionen* are a central marketing strategy (Kastner and Mendoza 2012) to strengthen rural development, and not specifically organic farming(Straub 2012). Nevertheless, consumers associate these products with organic agriculture (Fürtbauer, Spreitzer et al. 2011).

Suggestions to tackle with the future challenges of organic

Production and marketing strategies could be designed to foster transparency among organic farmers and consumers and the geographic area of organic production could be celebrated (c.f. Schermer 2005; Risku-Norja and Mikkola 2009). Deliberate efforts to encourage local socio-economic and ecological conditions by promoting small-scale production and processing could be designed. In this way, bringing “organic” and *terroir* closer could contribute to the development of a “revised embeddedeness concept” (Kjeldsen and Alrøe 2006). GI-Organic collaboration also offers new opportunities for incorporating the principles of organic agriculture into the definition of GIs.

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US National Organic Standards Board: Does it preserve the public voice amidst USDA and corporate interests?

CAROLYN DIMITRI[1], CHRISTINA BRONSING[2]

Key words: organic integrity, National Organic Program, organic certification

Abstract

The institutionalization of organic within USDA has been a tumultuous process. During the twelve years between the time USDA was authorized to create a standard and the time the standards were operational in the market, philosophical differences among the parties involved - USDA, organic farmers, organic processors, consumer and environmental advocates, corporate agriculture, and the public interest – have been apparent. The Organic Foods Production Act created an advisory board, the National Organic Standards Board (NOSB) that was meant to protect the integrity of the organic standard over time. This paper analyses the composition of the NOSB over time, with an effort to determine if the board is meeting its stated goal of protecting the public by ensuring the purity of the organic standard.

Introduction

From the start, the institutionalization of organic within USDA has been a tumultuous process. Twelve years elapsed between the time the Organic Foods Production Act authorized USDA to create a standard and the time the standards were operational in the marketplace. During this time, and continuing today, philosophical differences among the parties involved - USDA, organic farmers, organic processors, consumer and environmental advocates, corporate agriculture, and the public interest – have been apparent. In fact, the very first draft set of organic standards proposed by USDA did not reflect the public's perception of organic, and failed to prohibit the use of biotechnology and sewage sludge in organic (Federal Register, 1997). Since then, the media and some consumer groups have accused organic of having been "co-opted" by corporations, with some linking the so-called corporatization of organic to USDA's promulgation of the organic standard (Jaffee, 2010; Delind, 2000; Fromartz, 2000).

Further complicating the situation is the fact that the historical relationship between USDA and organic agriculture has been, at best, uneasy. The position of USDA scientists regarding chemical use, made clear in their response to *Silent Spring*, was that chemicals are needed to produce enough food to feed a growing population. Damage to human health and wildlife, USDA scientists stated, could be avoided by proper use and handling of chemicals (Lear, 1992). Little known is that, for nearly 75 years prior to 1950, USDA entomologists had success with biological methods for many (but not all) pests (Sawyer, 1990). Perhaps the most obvious anti-organic action of USDA was that towards the employee Garth Youngberg. The Reagan administration attempted to squash his 1980 report outlining recommendations for organic agriculture, and in 1981, his Organic Resources Coordinator position was eliminated (Heckman, 2006).
Given the history, the fact that the USDA would be developing, administering and enforcing the organic regulation set up an interesting tension: in order to protect organic consumers and farmers, the industry would have to rely on USDA. But how would the essence of organic be maintained, given USDA interests, plus growing corporate attention to profits associated with the organic sector? The crafters of the legislation were cognizant of these factors, and recognized that without a voice for the public interest, the standards could be shifted in a direction that was decidedly 'not organic.' The mechanism designed to ensure that the public would have a voice in the organic industry from inception and over time was an advisory board, "The National Organic Standards Board (NOSB)" that would make recommendations to USDA.

The board is unique in that it has members from all parts of the organic industry plus guardians of the environment and consumer interest. The board, whose members are selected by the Secretary of Agriculture, does not have complete power. As an advisory panel, the board can ban but cannot add substances to the National List. This list is the cornerstone of the organic sector: it specifics which ingredients and substances can be used in organic production and handling. The exclusion or inclusion of a particular product has significant financial implications: the manufacturer of the substance on the list stands

[1]New York University, USA, carolyn.dimitri@nyu.edu
[2] MPA graduate, New York University, USA, christina.bronsing@gmail.com

to earn money if the product is included on the list. Thus, both politics and self-interest play an important role regarding the substances included on the list.

This paper explores the relationships among the members of the National Organic Standards Board, the National Organic Program, industry growth, the organic standard, and the rulings on controversial findings. The theoretical basis underlying this paper is that the organic standard can be viewed as a form of common property, where rules (promulgated by the National Organic Program) control access to the label "organic," and the same rules restrict access to the use of the word organic.

Organic standards and collective action

The primary purpose of the Organic Foods Production Act (OFPA) was to develop standards for marketing organic agricultural products, along with a mechanism for enforcing the standards. The Act provided general guidelines for organic food products: they would be (1) produced and handled without synthetic products, except as specified in the legislation; (2) crops (specifically excluding livestock) would be produced on land that did not have prohibited substances applied for three years; and (3) would be produced and handled according to an organic plan. Other than these general thoughts about organic, the Act did not provide additional guidance about specific farming and handling practices. In doing so, the Act left room for interpretation in writing the details of the National Organic Standards.

Groups composed of heterogeneous agents frequently have difficulty reaching agreements over a common good, such as a quality standard (see, for example, Hoffman and Libecap's discussion of orange marketing orders). Factors that facilitate agreement are homogeneous groups, relatively small number of agents, or a low economic value of under consideration. The US organic industry is a prime example of a situation where reaching agreement is difficult: the core interest groups are diverse, with competing interests (farmers, businesses, and consumers.) These groups, as well as individual members of each group, possess differing preferences over the attributes of organic agriculture and food, such as environmental health, food quality, food safety, human health, animal welfare, and profits. In addition, the profit potential for businesses involved in organic has been increasing, compared to stagnation in the food industry in general, which provides incentives for conventional food businesses to expand their operations into organic.

In order to address the challenges of collective action head on, OFPA created an advisory board that represented all of the different stakeholders in the organic industry: farmers, consumers, the environment, and the industry. The board consists of 15 members, with roles clearly specified in the legislation: farmers, environmentalists or resource conservationists, consumer or public interest advocates, 2 handlers, etc. In some cases there are overlaps – certifying agents might align more closely with farmers and with handlers than with other stakeholders.

The NOP, the NOSB and the National List are inseparable. In its twice yearly meetings, the advisory board makes recommendations about which products to allow (or disallow) on the National List. The web is more tangled than it appears, since the board selection process is complex, and is ultimately influenced by several people, including the Secretary of Agriculture, who has the final authority to select the board members. The selection process is not transparent. The obvious agents with influence on who is appointed to the board are: the head of the National Organic Program and the Secretary of Agriculture. While the NOP head is an employee of USDA, the Secretary of Agriculture is a political appointee. This means that the head of the NOP can remain in office when administrations change, but the Secretary always changes with the president (and sometimes changes if a sitting president is elected to a second term). The Secretary is inextricably tied to the President's political affiliation, and sets a tenor that ripples through all of USDA, including to the head of the NOP. Appointment decisions, ultimately, are tied not only to food industry politics a la Nestle, but also to executive level politics.

Now, the complexity increases even more: obviously, big organic firms have a stake in the outcome of which products are included on the list. But once competition from conventional agriculture, which can be viewed as anti-organic, is considered, even more is at stake. Now USDA is in a position of having to support organic without irritating conventional agriculture. This is not always an easy place or position. As an example, the description of organic agriculture as a marketing strategy is clearly a conciliatory act towards conventional agriculture: the original USDA "Organic Fact Sheets" specifically stated that organic food was not better than conventional food.

Many leaders of the NOP had difficulty filling the role. Barbara Robinson's views about organic were called into question by the Cornocopia Institute, and she was smeared in a *Washington Post* exposé. Mark Bradley was accused of being too cozy with the organic industry, so he was demoted. These two failures, along with others, might have been rational behavior, dictated by the president, or a lack of skill on the part of the individuals. The lack of leadership in the NOP meant that recommendations of the NOSB were not implemented, which caused a backlog in the administration of the organic regulation plus bred mistrust on the part of organic industry watchdogs.

The National Organic Standards Board is a critical part of ensuring that organic maintains the essence of organic, even as the industry grows. Thus, in order to meet the spirit of OFPA, the board members need to be filled in positions that match their skill and expertise. Merrigan's choice of roles and positions was a clear effort to keep one part of the organic industry from dominating others. Her assignment of different numbers of members in each role is telling about her view of the relative importance of the different segments. The choice of four farmers on the board, which exceeds other stakeholder groups, grants farmers the most power. The environment and consumers have equal weight, and their influence is equal to that of the "industry" segment of organic (the handlers plus retailer).

Politics and composition of the National Organic Standards Board

Analysis of the composition of the NOSB, politics, and decisions on substances allowed or disallowed on the National List provides insight into the politicizing of the National Organic Standards. Questions addressed include whether the composition of the board shifted towards "big food" companies as the industry has grown in terms of retail sales? Is the representation of "big food" interests on the NOSB related to politics? Is the "goodness of fit" between the board member's role on the board and the person's expertise related to politics?

Between 1992 and 2012, the NOSB had 74 different members. A dataset was compiled that recorded (1) dates served on board, (2) professional affiliation at the time of the appointment, and (3) knowledge and expertise. Each board member was classified as having roots in the organic sector, conventional sector, or sustainable agriculture. This assessment was made on the basis of research and conversations with several researchers who have long studied the organic standards in the US, and included cross checking on the part of the research team to ensure each member was appropriately classified. Statistical analysis of the roles assigned to the NOSB members and their professional expertise indicated that those appointed under the Clinton administration were most likely to be well suited to their assigned roles. Those appointed under Bush (41) were least likely to be well suited.

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Producers continuing versus exiting from organic production in California USA: Regulatory, technical, and economic challenges

SONJA BRODT[1], KAREN KLONSKY[2], RON STROCHLIC[3], LUIS SIERRA[4]

Key words: organic reversion, organic regulation, certification, farming challenges

Abstract

Organic farms face challenges unique to organic production that can lead to cessation of the farm business or conversion to conventional production. This study compared farmers in California, USA who had recently discontinued their mandatory government organic registration with farmers still registered, to determine the main challenges that drive farmers to leave the organic sector. Significantly fewer deregistered farmers own their own land than still registered producers, and a significantly higher percentage had farm revenues lower than US$100,000, showing a need for more strategies to assist small organic farms. Deregistered producers indicated that they would have benefited from more financial assistance with certification costs and more streamlining of regulatory processes, especially paperwork, while registered producers were more concerned with production issues and organic research and extension.

Introduction

Organic farms face unique challenges that can lead to cessation of farming or reversion to conventional production. A review of European studies showed that reasons for reversion varied widely by country, but financial reasons (low prices, high production costs), and regulatory issues (high certification costs and changes in regulations) predominated (Sahm et al. 2012). In California, all producers of commodities marketed as organic are legally required to register with the California Department of Food and Agriculture's (CDFA) Organic Program. Registration data indicate approximately 20% annual turnover among registered producers. The purpose of this survey study is to compare deregistered and still registered farmers to determine the fate of deregistered farmers and to shed light on the main challenges faced by organic farmers. Ultimately, the goal is to understand what types of technical, financial, or policy assistance would enable more producers to continue farming organically.

Material and methods

1) A mail survey was sent in February, 2007 (with two subsequent reminder mailings) to 501 producers who had discontinued organic registration during the period January 2003-December 2005 (based on CDFA Organic Program records). This represents all of the known deregistered farmers minus 21 individuals who were contacted for preliminary open-ended telephone interviews that helped to formulate the survey questions. The survey included questions regarding current registration status, reasons for discontinuing registration and/or organic production, challenges faced as an organic farmer, and farm and farmer characteristics. We received 107 completed surveys (24% response rate), but three surveys were later removed due to insufficient or inconsistent responses, leaving the sample size at 104.
2) Simultaneously, a similar mail survey (with two reminder mailings) was sent to a random sample of 1,000 of the 2,178 organic producers registered in 2007. Completed questionnaires were returned by 390 individuals (39% response rate), comprising 17.9% of all registered organic producers in California.
3) Data were entered into SPSS, coded, and analyzed for differences between the two groups using Mantel-Haenszel Chi Square and Kruskal-Wallis tests.

[1] University of California Sustainable Agriculture Research and Education Program, Davis, CA. USA. E-mail: sbbrodt@ucdavis.edu; http://www.sarep.ucdavis.edu
[2] Dept. of Agricultural and Resource Economics, University of California, Davis, CA. USA
[3] Center for Weight and Health, University of California, Berkeley, CA, USA
[4] California Center for Cooperative Development, Davis, CA, USA

Results

1. Farming outcomes of deregistered growers

Twenty-seven (26%) of the respondents identified by CDFA as having discontinued organic registration were mistakenly identified as such for a variety of reasons, including late submissions, being listed under another grower's name, or changing farm name. This result lowers the expected exit rate to 15% from the observed rate of 20%. Among the remaining 77 "actual" deregistrants, 27 (35%) had stopped farming altogether and 29 (38%) had converted to conventional practices, while 19 (25%) were either still using organic methods (n=12) or farming using methods they described as "beyond organic" (n=7). Therefore, 44% of those identified as deregistered by the CDFA Organic Program were either mistakenly identified as such or still using organic methods but no longer marketing as organic. We restrict our analysis to the 77 "actual" deregistrants and the 390 continuing organic registrants.

2. Comparisons of demographic and farm characteristics

Registered and deregistered farmers did not differ significantly in terms of years of experience farming (averaging 12 and 10 years, respectively), numbers of organic (averaging 8 and 10, respectively) or conventional crops (averaging 3 and 1, respectively) they produced, the proportion who produce both conventional and organic crops (32% and 30% respectively), the proportion who produce perennial crops (67% and 69% respectively), or the proportion who market their crops exclusively through wholesalers as opposed to direct marketing outlets (51% and 48%, respectively). The two groups also did not differ significantly in percent of area in organic production (77% and 75%, respectively) nor percent of farm revenue derived from organic sales (67% and 73%, respectively). However, deregistered growers were less likely to own land than continuing growers. Only 47 percent of deregistered growers owned at least 80 percent of their land, compared to 72 percent of registered growers ($p<0.0001$). The two groups also differed in total farm revenue ($p<0.0001$), with continuing registrants grossing higher revenues (Figure 1). Registered producers also have significantly larger farms ($p=0.0032$), also highly correlated with farm revenue; $p<0.0001$). The importance of annual farm revenue is demonstrated by the US$100,000-250,000 threshold category, which is the point at which the sample shifts from being dominated by deregistered farmers (with revenues <US$100,000) to being dominated by still registered farmers (at revenues ≥US$100,000). These results indicate that an operation earning less than US$100,000 is more difficult to maintain as an organic farm, perhaps due to lack of economies of scale in the time and costs required to maintain organic certification.

3. Differences in types of issues considered most problematic

Registered and deregistered organic producers differed when ranking a set of five broad categories of challenges. Continuing producers tended to consider production issues as the most important problem area, while deregistered producers viewed regulatory issues as the most important. Both groups placed price as their number two challenge. Regulatory issues and production issues were ranked third by registered growers and deregistered growers, respectively. Both groups ranked market access and farm management issues as fourth and fifth most important.

When asked to rank specific challenges within each of the above categories, deregistered producers did not differ significantly from registered producers, except that they considered "too much paperwork" to be a more severe problem than did registered producers. Continuing producers rated "learning about organic production methods," "insufficient access to production information," and "finding organic inputs" as significantly more problematic ($p<0.05$) than deregistered producers (Table 1).

4. Differences in technical and financial assistance needs

More registered producers (29%) than deregistered producers (6%) requested production assistance in the form of organic-focused research and extension. A larger percentage of deregistered producers wanted reductions or subsidies for certification costs (12% versus 3% of registered producers) and more streamlining and clarification of the certification process and organic rules (21% versus 12%). These differences may be related to the smaller average farm size of deregistered producers, making certification and registration costs a larger relative burden. Overall, it appears that those producers who dropped out of organic production had crucial problems with up-front costs and regulations, which act as the gateway to the organic industry. Continuing producers have likely gotten past these issues and become more focused on production and marketing concerns.

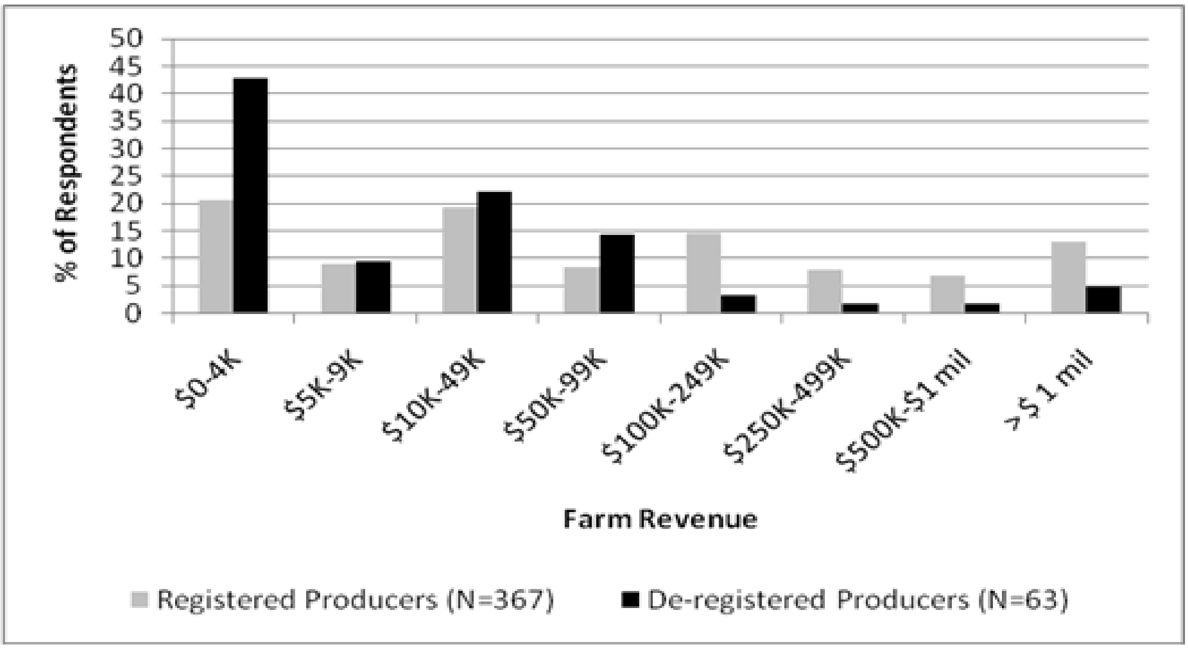

Figure 1. Farm Revenue (US$) of Registered and Deregistered Producers

Table 1: Specific Issues Considered Most Problematic by Organic Producers

Issue	Category	% of Respondents Assigning a 4 or 5 Rating (most severe)	
		Deregistered	Continuing
Too much paperwork/recordkeeping	Regulatory	50	40
Certification costs	Regulatory	44	32
Cost of inputs	Production	38	41
Overall time requirements	Management	36	26
Marketing	Management	32	21
Premiums too low	Price	27	25
Low yields	Production	26	20
Lack of price information	Price	25	27
Competition w/ farmers or imports	Market Access	25	24
Lack of transition price premium	Price	22	25
Pest/disease-related yield losses	Production	21	24
Weed-related yield losses	Production	15	23
Learning organic prod practices	Production	8	11
Finding organic inputs	Production	6	19
Access to production information	Production	5	15

Discussion

The viability of the organic farm sector can be enhanced by assistance to small farms via continuation of the federal certification cost share program and paperwork streamlining and electronic data entry for certification/registration. Organic farmers need more government reporting of organic prices and centralization of updated information on allowable organic inputs. Trained organic advisors could disseminate information about organic production methods and act as facilitators between farmers and certifying and regulatory agencies. Also foremost is a need for more research to improve organic production methods. With public sector research and extension resources dwindling, alternative funding entities could include private foundations, organic marketing and consumer-oriented associations, and organic retailers and wholesalers. Organic cooperatives for small farmers might help them pool production information, share skilled farm labor, and enhance their wholesale marketing ability.

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Value Added Grains for Local and Regional Food Systems

LISA KISSING KUCEK[1], BRIAN BAKER[2], JULIE DAWSON[3], DAVID BENSCHER[4], MIKE DAVIS[5], ROBERT PERRY[6], GREG ROTH[7], JUNE RUSSELL[8], STEVE ZWINGER[9], MARK SORRELLS[10]

Key words: ancient grains, plant breeding, heritage wheat, spelt, emmer, einkorn.

Abstract

Interest in locally produced ancient and heritage grains has grown in recent years. Organic farmers stand to benefit from producing and marketing these grains. Our on-farm research and farm, processing, and marketing case studies will add value a) through production techniques that achieve and maintain high grain quality and b) through processing and identification of high-value varieties/landraces that are well adapted to organic management. Results of agronomic trials conducted in the Northeastern and Upper Midwestern regions of the US are presented. Varieties suitable for growing value added grain products using organic methods are presented.

Introduction

Farmers, consumers, processors, handlers and retailers have all expressed interest in locally adapted crop varieties suitable for cultivation under organic farming conditions. Wheat (Triticum aestivum ssp. aestivum), with a consumption rate in the United States of 132.5 lbs/person/year, is a commodity of particular importance (ERS, 2013). Additionally, production and consumption of hulled wheat relatives, such as spelt (Triticum aestivum, ssp. spelta), emmer (Triticum turgidum subsp. dicoccum) and einkorn (Triticum monococcum) is rising (NASS, 2007). Most wheat in North America is currently grown in the great plains of the United States and the prairies of Canada.

Small grains provide multiple benefits to organic farms. The fibrous root systems and high carbon plant residues of small grains can improve soil health, bolster microbial communities, increase water holding capacity, buffer soil temperature extremes, and provide nutrient binding sites. Winter grains can be planted and harvested in windows that do not compete with labour needed for other operations. Such crops can be relatively competitive against weeds and help break pest and disease cycles for other high value crops. Despite these benefits, many organic farmers frequently do not plant small grains because of their relatively low economic value compared to other organic crops, such as fresh market vegetables. Organic farms in the Northeast United States, 85% of which are defined as "small farms" (NASS, 2007), also struggle to find production and processing equipment appropriate to their scale of production.

Organizations in the Northeast—where consumer demand for locally grown grain is rapidly expanding—and in North Dakota, which has developed expertise in hulled grain production, have joined forces to add value in multiple ways to wheat and specialty grain crops to enhance the diversity and sustainability of organic farms. The project "Value-added grains for local and regional production systems" promotes the incorporation of small grains in organic systems by establishing foundational knowledge on growing, selling, and processing high-value small grains.

[1] Cornell University, USA, lkk26@cornell.edu.

[2] Consultant, bpb33@cornell.edu.

[3] University of Wisconsin, USA, dawson@hort.wisc.edu.

[4] Cornell University, USA, db57@cornell.edu.

[5] Cornell University, USA, mhd11@cornell.edu

[6] Northeast Organic Farmers Association of New York, USA, rlp@twcny.rr.com.

[7] Penn State University, USA, gwr@psu.edu

[8] Greenmarket, GrowNYC, USA, jrussell@greenmarket.grownyc.org.

[9] North Dakota State University, steve.zwinger@ndsu.edu.

[10] Cornell University, USA, mes12@cornell.edu.

Objectives

The project's objectives are to:

1) Evaluate heritage wheat and spelt varieties and landraces of emmer and einkorn for adaptability to organic management and desirable grain and baking characteristics;

2) Develop best management practices for heritage wheat, emmer, spelt, and einkorn;

3) Optimize grain quality through improved management;

4) Investigate a variety of approaches to grain de-hulling and milling that will work for small and larger-scale growers or entrepreneurs; and

5) Explore multiple strategies for accessing local and regional markets.

Materials and methods

Preliminary research results indicate promising small grain varieties for organic production systems. Researchers collected and evaluated diverse germplasm from around the world, including 125 winter and 24 spring wheat varieties, 28 winter and 6 spring spelt varieties, 18 winter and 68 spring emmer varieties, and 27 winter and 4 spring einkorn varieties. These varieties and species were assessed for grain yield, kernel quality, pest resistance, height, lodging, and heading date at locations in Pennsylvania, New York, Vermont, and North Dakota.

Results

Agronomic Trials

Farmers have limited experience with growing varieties of heritage wheat, emmer, einkorn, and spelt in the Northeast United States. Results from two years of agronomic field trials can help farmers select the most effective seeding rates, seeding times, and nitrogen rates for optimal use on organic farms. Preliminary analysis shows that spring wheat exhibited a lower relative yield loss due to late planting (51%) than did spring emmer (68%).

High protein content is particularly important for farmers seeking to add value to their production through artisanal bread markets. A replicated on-farm trial on top-dressing hard red winter wheat with N-fertilizers permissible under NOP standards showed that wheat top-dressed with either Chilean nitrate or blood meal at late boot stage had protein contents over 1% higher than untreated wheat.

Variety Trials

Data from the first year and second year of field trials show significant differences among varieties for yield, test weight, lodging, height, and heading date (Table 1).

Value-added Production

In order to add value to production, the project will assess the quality of heritage and modern wheat, spelt, emmer, and einkorn varieties. Milling, baking, and sensory evaluations will take place in the winter of 2013-2014. Wheat varieties were analysed for test weight, protein, falling number, and DON. After receiving laboratory results, six wheat varieties were chosen to represent a wide range of quality characteristics for baking evaluation. The baking evaluation will gather eight artisanal bakers from the Northeast United States to evaluate the selected wheat varieties for baking characteristics. Bakers will prepare and rate variety-specific breads according to the representative baking method of the region: traditional fermented sourdough. Following the baking evaluation, a trained panel including both bakers and consumers will characterize the sensory quality of breads baked from distinct varieties.

Table 1. Top ten yielding winter wheat, spring wheat and emmer† cultivars 2012-2013

Name	Yield (kg/ha)‡					Test Wt.	Ht.	Lod-ging	Head-ing
Variety	FV	PA	WB	ND	Mean	(kg/hl)	(cm)	(1-9)	(d+5/1)
Winter Wheat									
Arrow	3181	2880	4643	NA	3568	70.8	103	0	30
Warthog	2901	2932	3999	NA	3277	74.5	89	0	30
Susquehanna	2672	2802	4358	NA	3277	70	89	0	33
ARS09-173	2317	3243	4182	NA	3247	75.6	76	0	26
Genesee	2756	2816	4165	NA	3246	71	109	2	32
Yorkstar	2608	2784	4264	NA	3219	69.8	107	1	31
ARS07-1214	2925	2625	3990	NA	3180	74.4	79	0	28
Appalachian White	2346	3030	4097	NA	3158	74.6	79	0	27
NuEast	2065	3069	4190	NA	3108	76	78	0	27
AC Morley	2585	2648	3948	NA	3060	74.6	96	0	30
*Spring Wheat**									
Tom	2997	1804	4201	2965	3001	72.3	91	0	43
Sabin	3332	2022	3599	3090	2984	70	84	0	44
MN00261-4	3292	1797	3807	ND	2965	71	85	0	45
Steele	3343	2050	3357	ND	2917	70.9	89	0	45
ND735	3137	1668	3944	ND	2917	70.6	92	0	46
RB07	3138	1742	3853	1924	2911	68.8	83	0	43
Ulen	3098	1835	3684	1120	2872	70.1	89	0	43
Glenn	2873	1840	3634	2334	2783	73.9	89	0	42
MN06078W	2875	1484	3734	ND	2698	69	90	1	43
Grandin	3078	1292	3609	ND	2660	68.5	90	0	43
Spring Emmer									
Lucille	2820	802	3216	4220	2765	44	109	3	56
Red Vernal	2550	839	3206	3885	2620	44.5	109	3	57
ND Common	2658	891	2984	3860	2598	44.7	107	4	57
Vernal	2699	917	3050	3555	2555	45.2	106	2	56
Common-MC	2393	687	2193	3170	2111	44.1	105	3	57
PI254148	1693	669	3217	2595	2043	36.2	74	3	49
Common-M	2293	601	2263	3014	2043	43.2	106	3	57
Common-R	2222	508	2133	2959	1955	41.7	102	3	58
Common-H	2019	598	2058	3130	1951	42.3	101	4	57
Bowman	2022	578	1907	3201	1927	41.2	102	4	57

NA: no data from site-year; MD: data missing from at least one site-year; † emmer yields are presented in hull; ‡ FV: Freeville, NY, PA: College Station, PA, WB: Willsboro, NY, ND: Carrington, ND; * spring wheat means are calculated without ND data

Conclusion

Small grains can help create more sustainable cropping systems on organic farms. To foster adoption of small grains in organic systems, this research establishes foundational knowledge on growing and processing high-value ancient, heritage, and modern wheat. Results from two years of field trials can help farmers select the most effective seeding rates and seeding times for optimal use on organic farms.

Additionally, research has identified superior genotypes for organic production and is assessing quality for artisanal baking in the Northeast.

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Farm Management Schemes within Organic PGS; Survey and Analysis in Sóc Sơn, Hanoi, Vietnam

CORY WILLIAM WHITNEY[1], KOEN DEN BRABER[2], NHUNG TU TUYET[3], SØREN THORNDAL JØRGENSEN[4]

Key words: farm analysis, collective farm management, collective land-use planning

Abstract

A comparative analysis of collective and individual management schemes within Organic Participatory Guarantee Systems (PGS) in the Hanoi province in northern Vietnam indicates that collective farm management enhances social and ecological practices. The study has juxtaposed the schemes in terms of social and ecological systems as well as impressions of farmers and retailers.

Introduction and Background

Demand is rising for organic vegetables in Vietnam. This poses many challenges for small-scale rural farmers who supply the Hanoi markets. Strict third party certification is well beyond their reach, both in terms of cost and technical ability. Organic participatory guarantee systems (PGS) offer an alternative through peer-review and social control, supporting appropriate farming practices, local market development, and social cohesion (Zanasi and Venturi 2008). PGS is based on civil society (Fonseca et. al, 2008), and ensures agro-biodiversity conservation and livelihood security by recognizing the merits of traditional practices and customs (Darlong 2008). PGSs are context specific and the systems vary greatly, but all propose collective efforts for marketing and certification of organic products. The purpose of this study was to determine how PGS farmers manage collective work and decision-making in land-use planning when they share collective organic land.

Material and methods

Following are the results of a comparative analysis of two PGSs management systems, which took place from January to April 2012. The farms covered by the survey are in the Hanoi province in northern Vietnam. All the farms are operating within a PGS framework outlined by the Agriculture Development Denmark Asia (ADDA) and Vietnam Farmers Union (VNFU) Organic Project (ADDA-VNFU 2009). These farmers groups are operating under 'National Basic Standards for Organic Products in Vietnam' prepared by the Vietnamese Ministry of Agriculture and Rural Development (MARD 2006) and further clarified in the PGS Organic Standards published by the ADDA and VNFU Organic Project (ADDA-VNFU 2011).

In the study area organic producers are organized into groups, which manage the production of organic vegetables and the supply of these vegetables to the local markets through the PGS. Most are operating under what can be called an 'individual' farm management system, wherein farmers are responsible for a small plot of land within an organic managed land area but work together on the sale of their products through the PGS. However, the ADDA-VNFU Organic Project is promoting a transition to what can be called 'collective' land management, wherein groups cooperate on the management of a single piece of farmland (Fresh Studio 2010). At the time of this study, there were already as many as six producer groups under 'cooperative' management and more making the transition.

Past studies have found large potential for organic markets in Hanoi as well as room for improvement in the management systems and standards for production (Fresh Studio 2010). This research sought a detailed comparison of the different management systems, to determine the strengths and weaknesses of the transition to 'collective', to clarify the exact implications of the shift, and to determine areas for improvement. It was hypothesized that the transition from individual plot management to cooperative land management would assure better crop rotations, more reliable fallow periods, higher use of green manures, better and more reliable yields and higher quality and productivity overall; that cooperative systems would be perceived

[1] Rhine-Waal University of Applied Sciences, Germany, www.hochschule-rhein-waal.de, eMail: cory.whitney@hsrw.eu

[2] Agriculture Development Denmark Asia – VietNam Farmer's Union (ADDA-VNFU) Organic Project, http://www.adda.dk/eng/organic_eng.html, eMail: koenhuyen@gmail.com

[3] Hữu Cơ Organic PGS Vietnam, http://vietnamorganic.vn, eMail: nhungadda@gmail.com

[4] Agricultural Development Denmark Asia (ADDA), www.adda.dk, eMail: s.thorndal@mail.tele.dk

by the farmers as a net positive with an easier and more fair work environment (Whitney et al. 2014) and better income generation; that retailers dealing with these producer groups would prefer the 'collective' management system.

Farmer surveys were conducted in the field as semi-structured questionnaires with 6 managers and 24 member farmers from six organic vegetable PGS producer groups[5]. These six groups were randomly chosen from 13 local PGS groups; half were 'collectively' managed[6], and half 'individually' managed[7]. Representatives from four randomly chosen retailers[8] who deal with farm groups under both systems of management, were also interviewed. This study will focus on the economic and nutrient efficiency of these systems based on interviews, observations, and PGS bookkeeping. Data was processed with OpenOffice 3 Calc, 2010, and tested with the Student's *t*-test. .

Description of the Farming Area

Soc Son is a district of Hanoi located about 40km northwest of the city center, near Noi Bái International Airport and easily reachable via the Thang Long Highway. This rich delta region is largely rice fields at the moment but is undergoing a rapid transformation from countryside to suburb as the urban center of Hanoi expands and the population radiates outward to the surrounding villages. The area has 13 PGS groups with 141 farmers (16 male and 125 female), all growing market vegetables along with subsistence farm animals and rice fields. The weather and soil conditions in the area lead to rapid mineralization and heavy nutrient losses in soil with low pH and imbalances of soil Ca, K, and Mg. The area around Soc Son is within the Red River Delta, which tends to have higher soil quality but these soils have been heavily worked and are nutrient poor with very low CEC.

Each farmer group works within a single portion of land (avg. 6,000 m^2) managed under organic standards, surrounded by a buffer zone, with an average of 9 members. They grow 24 different species of vegetable crops throughout the cropping cycle with an average farm yield of around 1.8 tons per month. Each farmer household had an average of 4.5 people with 1 cow or buffalo, 2 pigs and 20 chickens or ducks. PGS groups have app. 9 members with labor from family members and the occasional hired hand i.e. for heavy tilling with a buffalo.

Results

Group leaders reported average yields of 319 kg/ha/month. Major soil amendments included 25 kg/ha/month compost, 40 kg/ha/month mulch, and 1 kg ea/ha/month kitchen ash and lime. Horizontal nutrient balances from a three-month cropping plan (63 rows and 9 vegetable types) from the Than Cong group (collective) showed a positive balance of 8.3 kgN, 10.2 kgP, 6.1 kgK/ha/month. An extrapolation of this against other rotational and yield data leads to the conclusion that both management systems are likely in the positive (2.5kgN 4.3kgP 5.1kgK /ha/month). However, compost made by 'collective' farmers is of better quality (C:N 30:1) then that made by 'individual' farmers' which is more nitrogen rich (24:1), and only the collective groups regularly use green manures and fallow; future 'collective' cropping plans call for increases of both.

Farmers in both systems reported an average turnover of 2.8 million Vietnam dong (VND)/month (150USD). However, collective groups were cheaper to run for the farmers by area (1.5 million VND/ha/month for collective, vs.2.3 million VND/ha/month for individual, $p=0.02$); the total costs of production per farmer within a PGS group ranged from 2-5 million VND/month for collective and 6-9 million VND/month for individual.

Likewise, labor differed greatly (collective 222hr/month,vs. individual 274hr/month, $p=0.002$). Farmers in collective management systems reported spending less time working on the field by area, deriving from less time on weed control and tillage. They also generally reported less time on management activities though they were ultimately responsible for a lot more (e.g. when and where to weed and who should do it). Individual groups had a daily meeting and all tended to have a monthly meeting, whereas, in collective groups, meetings took up little time as impromptu part of work on the field.

Retailers were asked a series of questions about the working relationship with PGS groups. A Student's *t*-test of all responses revealed that retailers preferred the quality of the collective groups products ($p=5e-04$),

[5] located in the villages of Trung, Thanh Nhàn and Bái Thuong, in the Thanh Xuân commune, Sóc Son district, Hanoi and part of the Thanh Xuân PGS Inter-group

[6] Bái Thuong (n=6), Thanh Cong (n=5), Thanh Nhan (n=5)

[7] An Duong (n=5), Doan Ket (n=4), Trung (n=5)

[8] Organic Roots, EcoMart, Tam Dat and Vinagap in Hanoi

communication with collective groups (*p=8e-05*), product management of collective groups (*p=5e-04*), and business relations with collective groups (*p=4e-05*).

Discussion and Conclusions

Results from this study suggest that the transition from individual plot management to cooperative land management assures better crop rotations, more reliable fallow periods, higher use of green manures, better and more reliable yields and higher quality and productivity overall among these small-scale producers. The management of collective groups is more comprehensive but, at the same time, easier. Retailers prefer the collective management scheme, find that the products are better, and the groups easier to do business with. Collective labor is a more effective and efficient way to go about doing the more labor-intensive work i.e. weeding and tilling, where the majority of the labor happens. However, there are some important issues to tackle regarding yields, labor and income generation, to make the transition a smooth and high functioning one. There are also several areas where significant improvement could be made in both types of cropping systems, better management of inputs being paramount, especially in the making and storing of compost.

Suggestions

More in-depth review and data collection within these farmers groups are needed to determine what is really going on in the fields. The data presented here is very rough, to say the least. However, it should give a general picture of the possible areas to be addressed and may help to guide future research. It may also serve as a catalyst for good data collection on the field, throughout the farming practices, so that future analysis (especially nutrient analysis) can be more effective. Data collected in the field, throughout the farming practices, will also help in strengthening the organic standard within the PGS.

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Measurable Impacts of the "Principles of Organic Agriculture"; Survey of a Vietnamese Organic PGS

CORY WILLIAM WHITNEY[1], KOEN DEN BRABER[2], NHUNG TU TUYET[3], SØREN THORNDAL JØRGENSEN[4]

Key words: health, ecology, fairness, care, farming ethics, farm happiness

Abstract

A farmers' survey within the Organic Participatory Guarantee System (PGS) in Soc Son, Hanoi, Vietnam, indicates that farmers are largely satisfied with the management schemes and farming systems but that they feel there is room for improvement. Farmers gave a high score for questions related to the organic principles of health (74%), ecology (79%), fairness (68%), and care (71%). These results are outlined and the case is made that the organic principles are measurable and comparable. It is further argued that with a quantifiable measurement of the functioning of organic systems from the farmer we may find more ways to promote and help shape the future of the movement according to the principles.

Introduction

The Principles of Organic Agriculture are considered to be the basis from which organic agriculture grows and develops. They were developed by the International Federation of Organic Agriculture Movements (IFOAM) through a global participatory stakeholder process to help to address globalization challenges and to unite the values across the organic movement (Luttikholt 2007). They also help to define the uniqueness of organic agriculture, to serve as a guide for practice and development and to mitigate the need for an organic movement based on too many rules (Alrøe & Kristensen 2004).

Material and methods

A full description of the four principles, *Health*, *Ecology*, *Fairness*, and *Care*, can be found in extended form in 19 languages (IFOAM 2013). The principle of Health states that Organic: *should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible*. The principle of Ecology states that Organic: *should be based on living ecological systems and cycles, work with them, emulate them and help sustain them*. The Principle of Fairness states that Organic: *should build on relationships that ensure fairness with regard to the common environment and life opportunities*. The Principle of Care states that Organic: *should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment* (IFOAM 2013).

As of yet there have been no concrete attempts to measure these principles in action. The survey results described in this paper are an early attempt to find a holistic, but also comparable data set based on the principles.

Similar attempts to measure qualitative and holistic aspects of people's lives can be found in the literature regarding happiness. They have successfully been able to estimate happiness regressions using large random samples of individuals (Clark & Oswald 2002) and with single item scales (Abdel-Khalek 2006). Some critiques of happiness measurements point out poor design of questionnaires and results with low comparability, hampered by non-uniform data. There has been a call for more professional, uniform, and reproducible analysis (Ng 1996).

Measurable data on the state of the organic principles came from part of a farmer survey done for the NGO Agriculture Development Denmark Asia (ADDA) and Vietnam Farmers Union (VNFU) collaborative Organic Project on the Organic Participatory Guarantee System (PGS) in Soc Son, Hanoi, Vietnam (Whitney et. al. this issue). Based on information gathered in these interviews this paper argues that the organic principles are measurable and comparable.

[1] Rhine-Waal University of Applied Sciences, Germany, www.hochschule-rhein-waal.de, eMail: cory.whitney@hsrw.eu

[2] Agriculture Development Denmark Asia – VietNam Farmer's Union (ADDA-VNFU) Organic Project, http://www.adda.dk/eng/organic_eng.html, eMail: koenhuyen@gmail.com

[3] Hữu Cơ Organic PGS Vietnam, http://vietnamorganic.vn, eMail: nhungadda@gmail.com

[4] Agricultural Development Denmark Asia (ADDA), www.adda.dk, eMail: s.thorndal@mail.tele.dk

Farmers from six organic vegetable PGS producer groups in the villages of Trung, Thanh Nhàn and Bái Thượng in Thanh Xuân commune, Sóc Son district, Hanoi, Vietnam were interviewed. See Whitney et al. 2013 for a full description of the farmers, etc. (Whitney et al. this issue).

Interviews were conducted from mid March to early April of 2012 with 30 farmers (2 men and 28 women) from 6 PGS groups (Bái Thượng, Thành Công, Thanh Nhàn, Trung, Anh Duong, Doan Ket) from the Thanh Xuân PGS Inter-group. The surveys were conducted in the field a s semi-structured questionnaires by a researcher, a translator and a farmer-trainer from the ADDA-VNFU Organic Project. The principles related aspects of the survey were based on current standard happiness and satisfaction questionnaires (OECD 2013). Final analysis of quantitative data was done using Microsoft Excel for Mac (2007), Open Office Calc 3.2.1 (2010) and the program R (R 2011).

As a part of the survey on different management schemes, farmers were asked to gauge their satisfaction (interval scale) with various aspects of the production system, cropping plan, and for their perception of the qualities, the functioning of their groups and areas where they felt there was room for improvement. The survey related strictly to the operation and management of the individual groups and not to the functioning of the whole PGS.

Results

Weighted averages of farmers' (N=30) answers[5] to principles related survey questions to create the variables 'Health' (3 questions), 'Ecology' (4 questions), 'Fairness' (5 questions) and 'Care' (8 questions). The strength and direction of the linear relationship between these variables was tested using Pearson's product-moment correlation coefficient (*r*) (R 2011). Significant positive correlations were found between 'Ecology', 'Fairness', and 'Care' (Table 1). Percent agreement within these variables also indicated that farmers feel there is room for improvement, but that they are largely satisfied with the principles ('Health' 74% (σ13), 'Ecology' 79% (σ12), 'Fairness' 68% (σ20), and 'Care' 71%(σ12)).

Table 1. Correlation and significance of *r* for all principles *(bold where p<0.05)*[¥]

Health	*0.3326*	*-0.2451*	*0.2420*
0.0724	**Ecology**	**0.4020**	**0.8229**
0.1917	*0.0276*	**Fairness**	**0.6895**
0.1976	*2.39E-08*	*2.50E-05*	**Care**

[¥]Correlations upper right and p-values lower left in italics

Strong collinearity was found for 'Care' as it is a more holistic principle based on health and well-being as a fundamental part of farming. Furthermore, this analysis was based on the functioning of management systems and less about the more soft sciences aspects of personal wellness although there were several questions that fit specifically for 'Care' and one question specifically about happiness and well-being (see Table 3 below).

Table 2 shows the results of r against weighted averages of farmers' overall scores for the functioning of the group management system 'System' (25 questions) and the cropping plan 'Crop Plan' (24 questions) against the principles variables. Furthermore, percent agreement within these variables also indicated that farmers feel there is room for improvement within the 'System' (63% (σ9.6)) and 'Crop Plan' (57% (σ7)).

Table 2. Correlation and significance of *r* for cropping and management satisfaction *(bold where p<0.05)*

	System*	*p-value*	**Crop Plan†**	*p-value*
Health	0.246	*0.191*	0.065	*0.733*
Ecology	**0.812**	*5.08E-08*	**0.513**	*0.004*
Fairness	**0.515**	*0.004*	0.227	*0.228*
Care	**0.816**	*3.88E-08*	0.321	*0.084*

*System = functioning of the farming system in general.

[5] ADDA's farm managers and field assistants, researchers, and translators worked closely with farmers to ensure that there was no missing data for these questions. Follow-up interviews were made where data was missing from first interviews.

†Crop Plan = functioning of the cropping plan in specific.

Table 3. Correlation and significance of *r* for well-being *(bold where p<0.05)*

	Well-Being	*p-value*
Health	**0.465**	*0.009*
Ecology	**0.431**	*0.017*
Fairness	0.227	*0.227*
Care	**0.616**	*2.2E-04*

Finally, measuring happiness with a single item scale has been found to be as effective as other more intensive forms of analysis for life satisfaction (Abdel-Khalek 2006). The survey also asked the farmers to rank the contribution of the system on their own happiness or well-being. Table 3 shows correlation and significance of *r* for scores for this question against the overall scores for the principles

Discussion and Conclusions

The more satisfied the farmers are with the functioning of the farming system in general and with the cropping plan in specific, the higher the satisfaction with the organic principles. Farmers who gave higher scores for ecological aspects of the farming system also had more satisfaction with the cropping plan and overall functioning of their group. Similar studies with more farmers may reveal more of the dynamics of this relationship.

The study indicates that measuring the organic principles is possible. However, the current survey can only serve as a starter. Quantifying concepts that are holistic is problematic but it may act as a benchmark for determining the functioning of a farming system in a less mechanistic way. Uniform measurement is necessary and we propose this as a general outline and springboard for future studies into the measurement of the organic principles.

Suggestions

Organic agriculture has a unique approach to more than just agricultural production. It is a movement and a way of life (as in e.g. Gross National Happiness). With a quantifiable measurement of the functioning of organic systems, from the point of view of the farmer at the center of these systems, we may find more ways to promote and help shape the future of the movement according to the principles of organic agriculture and as a challenge to existing dominant and damaging paradigms.

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thuenen-report@ti.bund.de
www.ti.bund.de

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