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Good, but not good enough? Research and development needs in Organic Farming

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Abstract

With the development of independent production concepts and emergence from its agricultural niche status, organic farming has fulfilled its promise to a large extent. Organic agriculture has also become a recognized part of the agricultural world - not only in Germany - and retains a very positive image. Against this background, predictions of further growth are not just wishful thinking.

In recent years, now that organic agriculture has matured, it has been confronted with more intensive questioning by the public, consumers and conventional farmers on actual yields and their sustainability (Niggli, 2005). Also, new questions (i.e., climate change, food security, globalization) have emerged or play a more important role than they did several years ago.

In this context, it is imperative that organic farming deal with its problems and deficits in a sober, pro-active and self-confident manner. Due to the diversity of structures and problem situations, general evaluations make no sense. Nonetheless, from a research perspective, they permit the basic topics and lines of discussion to be identified.

In the opinion of the authors, the development of organic farming is too closely tied to certification regulations and too far from trying to achieving organic farming goals. The limitations of the guideline-oriented monitoring and certification of organic farming are not adequate for a comprehensive check of the self-set goals. For this reason, a further development of certification beyond the goals and targets met would make sense. Here research can help to find the decisive indicators.

Keywords: Organic farming, principles, R and D

Zusammenfassung

Viel erreicht und doch nicht genug? - Forschungs- und Entwicklungsbedarf für den Ökologischen Landbau -

Der Ökologische Landbau hat konzeptionell viel versprochen und tatsächlich hat er in der Vergangenheit viel geleistet. Er hat ein eigenständiges Produktionskonzept entwickelt and die Nische verlassen. Der Ökologische Landbau ist – nicht nur in Deutschland – zu einem anerkannten Bestandteil der Agrarstruktur geworden and verfügt über ein sehr positives Image. Vor diesem Hintergrund ist es keine Wunschvorstellung, ihm weiteres Wachstum vorauszusagen.

In den letzten Jahren ist der Ökologische Landbau, indem er zur Normalität gereift ist, jedoch auch intensiver Fragen der Öffentlichkeit, der Konsumenten und auch der konventionellen Kollegen ausgesetzt, die sich auf die tatsächlichen Leistung und ihre Belegbarkeit beziehen (Niggli, 2005). Hinzu kommt, dass neue Fragen (unter anderem Klimawandel, Welternährung, Globalisierung) aufgetaucht sind oder sich brennender stellen als noch vor einigen Jahren.

In diesem Kontext ist es für den Ökologischen Landbau unerlässlich, sich mit den Problemen und Defiziten nüchtern, engagiert und mit Selbstbewusstsein auseinander zu setzen. Angesichts der Vielfalt der Strukturen und Problemlagen sind pauschale Bewertungen unsinnig. Dennoch lassen sich mit Blick auf die Forschung einige grundlegende Themenschwerpunkte und Diskussionslinien benennen.

Nach Einschätzung der Autoren wird die Entwicklung des Ökologischen Landbaus zu sehr von der Einhaltung der Richtlinien und zu wenig von dem Erreichen nachhaltiger Ziele dominiert. Die Beschränkung auf richtlinienorientierte Kontrolle und Zertifizierung des Ökologischen Landbaus reicht nicht zur umfassenden Überprüfung der selbst gesetzten Ziele Aus diesem Grund ist eine Weiterentwicklung der Zertifizierung über die erbrachten Leistungen und Ziele sinnvoll. Hier kann die Forschung helfen, die entscheidenden Indikatoren zu finden.

Schlüsselworte: Ökologischer Landbau, Prinzipien, F und E

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1 Introduction

Organic farming has developed enormously in the past, not only in Germany but all over the world (Willer and Yussefi, 2008). In many cases it has emerged from its niche. It also serves as a model for sustainable agriculture for many people. In some spheres, conventional agriculture even has adopted concepts from organic farming. Despite the worldwide success, organic farming has no reason to sit back and stop developing. Without doubt fundamental progress has certainly been achieved in the past years, but on the other hand, some new development problems have emerged and deficits have become clearer. These problems are above all related to the question of how organic farming stands as measured against its own high goals.

Up until today, it has not been systematically studied in how far the 30-year-old goals (IFOAM, 1980) have been achieved (Gerber et al., 1996). The basic goals of organic farming, above all the goals of environmental protection, animal welfare and healthy foods, are truly demanded by consumers and the public. Even if much of this is merely based on general expectations based on general consumer awareness, and not based upon differentiated knowledge of agricultural production processes, these expectations are the basis of the sector's image and thus a basic requirement for marketing. One always has to keep in mind that trust is only generated, and consumers only willing to pay a higher price for organic products, because a large group of consumers welcomes the goals of organic farming and believes that they can be implemented by farmers. Furthermore, the goals of organic farming are also the starting point for manifold societal expectations on organic farming, in particular with regard to natural protection and the preservation of the natural landscape. Whether the great public trust in organic farming is justified, is one reason that evaluation is of great importance. And here some doubts have sprung up in the past. They even have led to uncertainty in development paths among concerned actors (Braun and Plagge, 2008). For example, the BNN, an association which represents organic food processors and traders in Germany, published a Codex (set of guidelines) in 2008 in order to strengthen the traditional catalogue of organic farming objectives (BNN, 2008). The competition with the conventional food chain is obvious.

With the market successes on the one hand, and with old, as well as some new, challenges on the other hand (food quality and quality assurance, climate change, globalization, securing world nutrition, biodiversity, strengthening endogenous rural development, income security for farmers), it must also be considered which potential organic agriculture truly has within the general framework of conditions and challenges that are valid for the whole of agriculture. Agricultural sciences should certainly be the first to raise these questions (Alrøe and Kristensen, 2002; Watson et al., 2008).

The following evaluation and suggestions refer to the situation of Germany. With our contribution an attempt is made to evaluate the development of organic farming on the basis of the original basic principles of organic farming. Here the results available from the research and development projects of the German Federal Program for Organic Farming (www.bundesprogramm-oekolandbau.de), as well as publications in the database http://orgprints.org, were used for database searches. Requirements for research and development of organic farming are derived. The suggestions do not lay claim to completeness, but the selected topics in the following are, in our opinion, absolutely representative of organic farming. Processing and trading of organic products is not considered.

2 Organic Farming – its Vision

Organic farming[1] is based on the idea of practices that are environmentally friendly, animal welfare oriented and geared toward improving the living conditions of farmers. To strive for close-to-nature farming is a central piece of the farmers' own concept.[2] Beyond agricultural practices and their technical and economic bases, organic farming was and is a life model and thus includes important aspects for social reform.[3] But these ideas are in part very complex and far reaching, and in part very concrete and tied to individual forms of working and living. It is therefore difficult to present a complete list of guiding principles which are understood and accepted by all actors in the same way. Even some eclectic traits are undeniable.

In the beginning organic farming started without public support and without any access to public financial resources. The pioneers promulgated organic farming as an alternative model to intensive, specialized and partially industrialized – "anonymous and soulless" – food production (Rusch, 1968; Meadows et al., 1973; Krieg, 1981, Brand, 1985). From the perspective of the participants this was a fully acceptable and comprehensive critical attitude which could be integrated into the overriding field of so called "new social movements" (Heldberg, 2008).

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[1] The term „organic farming" is imprecise since it is used for both the production of food as well as off-farm processes (farm inputs, processing, trade, consumption).

[2] Defined by the International Federation of Organic Agriculture Movements (www.ifoam.org).

[3] Politically, ecologically and socially oriented activities, such as for example the support of anarchist, feminist, pacifist and spiritual groups, demonstrations against large industrial or infrastructural facilities (nuclear power plants, airports, etc.). Activities in NGOs like one world and environmental protection groups was important. Organic food production was one part of the activities.

The German-speaking area (Germany, Switzerland, Austria) was and is one of the most important regions of origin and development for organic farming. Even before the First World War, people started to find alternatives to "chemical food production," particularly in gardening. For example, in 1893, some vegetarians established the Eden settlement (orchards and gardens) close to Berlin as one of the living reform projects (Lebensreform-Bewegung). In 1924, the agricultural course of Rudolf Steiner (*1861; † 1925) motivated a group of farmers to follow new paths of food production. Biological dynamic farming was developed from this with the Demeter Association. Agricultural reform policy, especially in defending small scale farms and rural traditions, was also evident.

Organic farming was further developed after the Second World War by Hans Müller (*1891; † 1988), his wife Maria (*1894; † 1969) and Hans-Peter Rusch (*1906; † 1977), and served as inspiration for the largest German organic farming association Bioland, founded in 1971.[4] Particularly in the 1970s and 1980s, farmers, and a number of non-farmers ("city refugees") - the latter often with no specific agricultural knowledge or resources - began to produce food for self-sufficiency or for small local (regional) markets (Seymour, 1973).

Sometimes even regarded as "social dropouts," many of them lived in communities and practiced an alternative and often altruistic lifestyle. Self determination and self realization were central spiritual goals combined with a disdain for economic interests. The economic exchange relationships normally were personal and direct. Products were sold from farm to farm or hand to hand, or in some cases traded on a restricted level. In the cities, food coops were started, organic stores opened and farmers markets created (Heldberg, 2008). In the beginning, these living and working forms were hardly more than tolerated in village communities. Examples of integration were rare (Baeumer, 1986).

The period in which development goals targeted at integration in the total economy began later. One has to go back to the late 1980s and the early 1990s to identify professionalisation and market oriented strategies at a strong level (Oppermann, 2001). But within a decade, competitive infrastructures were built up (pre and post harvest facilities, marketing, trade, certification, monitoring) (Heldberg, 2008). Economic success was set as a prerequisite for a blossoming development of farms and the improvement of the own living conditions, and in this context, the importance of esoteric or social Utopian images and behavioural standards reduced significantly. Since about the year 2000, production and processing were developed further on the basis of a systematic inclusion of research and professionally bundled development experiences.

3 Evaluation of the IFOAM-objectives from 1980

Organic agriculture is considered an environmentally sound and socially acceptable land use system with "natural" food production (FAO, 2000). Different studies in the 1990s confirmed the high production and processing quality of organic farming in contrast to conventional farming (compiled in Tauscher et al., 2003; Schnug et al., 2006).

In the last decade organic farming has left its niche and is spreading worldwide. Organic farming is a food production label and is becoming more and more popular throughout the world (Organic Monitor, 2008). In 2007, about 32 million hectares were certified according to organic standards and the world market volume was 46 billion US-$ (Willer et al., 2008). The EU and the US are the biggest markets with an annual growth of 10 to 20 %.

Nowadays, organic production and its certification system are seen as the best monitoring food production chain (www.bmelv.de).[5] In the areas of food quality, for example, pesticide residues are found in conventional products more often than in organic products (Baker et al., 2002; www.n-bnn.de). The low contamination risks of organic products are an important reason for consumer choice and market success.

Today, organic food production is clearly defined with legal standards and regulations. The EU Regulation 2092/91 gave mandatory standards and guidelines for the entire EU and for importing third countries. Since the beginning of 2009 regulation schemes were reformed and replaced with Regulation 834/2007 and the implementation regulation 889/2008. These regulations integrate goals for organic agriculture (834/2007 §3 ff.). Non-food products (i.e. textiles, cosmetics, building materials, medical substances) have not been implemented yet. Private standards for these products have, however, been set (see IFOAM Basic Guidelines, www.ifoam.org).

The evaluation shall – strikingly and certainly incompletely – be done on the basis of the IFOAM principles from 1980. This evaluation is justified because the new EU Organic Regulation 834/2007 – which since 2009 the previous "untargeted" EU Organic Regulations 2092/91

[4] There were also other people inspiring organic farming outside of the German speaking countries (including Albert Howard (*1873; † 1947) and Eve Balfour (*1898; † 1990)). The history of organic farming was compiled by Vogt (2000).

[5] Cases where conventional products are renamed and sold occur now and then. Most cases are discovered by the organic farming monitoring system itself.

replaces – sets similar goals. This shall be addressed in the subsequent research and development requirements. The discussion about the research needs for the further development of organic farming therefore should not last start with the acknowledgement of some clearly identified deficits (Watson et al., 2008).

3.1 IFOAM-objective: Work as much as possible in a closed system and rely on local resources

A basic principle of organic farming is to work in cycles and to use local resources in the entire processing chain. For a long time this goal was the core of the concept. One of the greatest achievements of organic farming was the re-integration of crops and animal husbandry through the cycle of fodder crops and the manure fertilization. This has been lost in conventional farming in the non-land related intensive animal husbandry.[6] Stock densities (max. 2 livestock units per ha) limit the number of livestock on the farm to avoid ground water contamination with nutrients.

This cyclical concept has lost significance in current practice. In today's organic farming mixed farms are losing importance (Rahmann et al., 2004). Supra-regional and partially globalized input and output markets form a strong trend in the external economic relationships of the farms. The most striking example is feed import (i.e.. organic soy) and manure export (to other organic farms). Today, organic farmers are delivering their products to wholesalers trading on national or international markets. Also the local consumption of locally produced organic products has lost ground. A strong shifting of weight between the marketing paths towards centralized concepts with dominating top-down approaches has to be acknowledged. The nationally and internationally organized food dealers (including discounters) are already at the peak with a market percentage of nearly 60 %,[7] while direct marketing and the trade marketing via bakeries and butchers are continuing to lose on percentage of sales (ZMP, 2008). The recycling of nutrients from consumers back to farms is not possible.

<u>Evaluation</u>: Closed cycles in production and more regionally oriented structures in sales and consumption of food products are apparently not competitive today. The cyclical concept and the local or regional relationship to farm inputs have lost importance.

<u>Research and Development needs</u>: *As the antipode to global competitiveness (food sovereignty, rural development) due to increasing transportation costs, ecological advantages and risk minimization (disease, contamination, etc.), local or rather regional cycles are of new importance. Above all there is a strong need for research on economically sustainable concepts for farm, local and regional food cycles. For this purpose, locally adapted as well as efficient production technologies and products must be developed. Target group oriented marketing and product innovation are of particular interest in this domain.*

3.2 IFOAM-objective: Maintenance of long term soil fertility

Soil fertility is determined by water, air, temperature, nutrient level and organic carbon levels of the soil. Biological and physical factors must be stabilized in organic farming to a level that makes good and sustainable plant growth possible. The addition and mobilization of adequate nutrient amounts in addition to a stabilized soil structure are required for the yield development. If no organic fertilizer is available with which the nutrient transfer from grassland or from animal husbandry in other farms can be attained, the planting of legumes in the crop sequence is essential for an adequate input of nitrogen.

The decrease of soil fertility is due to cropping practices that do not follow these principles over a long period of time. Increasing cereal cropping in organic crop rotations and the reduction of grain legumes (Gruber and Tietze, 2008; Zöllner, 2008) is critical with regard to humus production, above all in pure crop farms. The nutrient cycles are broken with the export of the products (see above). Thus, after a while, the soil fertility decreases through a loss of nutrients such as potassium, phosphorous and trace elements (Watson et al., 2002; Stolze et al., 2001; Newmann, 1997). The use of sludge and household compost (Adam et al., 2008; Pinnekamp et al., 2008) is, however, not permitted in organic farming, since it could be contaminated with undesirable substances (Kratz and Schnug, 2006). Other purchased fertilizers are usual in organic agriculture today, particularly in vegetable crops. An increasing portion comes from non-renewable sources (i.e., crude phosphates, peat) or from risky conventional sources (i.e., medicinal residues in feathers, blood and horn meal). Their availability is either limited and/or not sustainable (Schnug et al., 2003; Déry and Anderson, 2002). Consistent analyses on the on-farm value of biogas substrates for the maintenance of the soil fertility and the reduction in the nutritional losses in organic farms were until now not decision-making criteria for the building of biogas facilities and are not consistently analysed.

Consistent organic fertilizing and diverse crop sequences promote the stability of soil aggregates (Munkholm et

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6 Also for conventional animal husbandry today a linkage to land area is demanded. According to the German Fertilization Regulations (DüV from February 17, 2007) all farms can only hold so many animals that they maximally distribute 170 kg N manure fertilizer per hectare and year. This is in accordance with the requirements for organic farming and is thus no longer a criterion for differentiation.

7 In other EU countries and the US the share of discounters and large retailers in organic food marketing is even higher.

al., 2002) as well as the infiltration ability of soil (Rogasik et al., 2006). The specialization and expansion of organic farms also leads to higher wheel load through larger machinery. Impacts on the soil fertility can be expected.

Evaluation: Soil fertility remains a central challenge of organic farming. It is dependent on crop rotation management and the return of nutrients to the soil. Here the negative consequences of non-closed nutrient cycles between production and consumption are particularly evident. The trend towards heavy machines has a negative impact on soil texture.

Research and development requirements: *For the long term conservation of soil fertility, local nutrient cycles must be optimized and nutrients must be used efficiently. Possibilities for cooperation concepts beyond individual farms strongly have to be taken into consideration. The drop in legume cropping must be counteracted. An efficient use of the green growth linked nutrients must become a central part of inner farm management. For the return of non contaminated sludge and compost (or the nutrients won from them) in the production cycle, technical and structural solutions should be developed so that possible risks can be excluded. Research on these possibilities must also concentrate on the conditions of social acceptance and cooperation between farmers. Further soil compaction should be avoided and reduced with farming concepts and crop planting measures. Here, soil conserving tillage processes, and mechanical and biological processes to eliminate compaction, must be found (Munkholm, 2005). The attractiveness of clover grass cropping and the improvement of nitrogen and humus supply linked to it could be strengthened with the inclusion of biogas facilities in organic commercial farms (Stinner et al., 2008).*

3.3 IFOAM-objective: Avoiding any type of pollution through agricultural technology

Most of the great environmental problems of conventional agriculture can be traced back to the use of pesticides, easily soluble mineral fertilizer and too dense animal populations. Thus, biodiversity, as well as abiotic resources, are endangered (soil, air, water), and in part food as well (pesticide residues in fruit and vegetables). That is why one of the central concerns of organic farming is to avoid these inputs. The lower production yields are accepted. The fears that the product qualities are lower have been not confirmed (Meier et al., 2000; Ellner, 2000; Döll et al., 2000; Obst et al., 2000; Backes, 1998; Marx et al., 1995; Usleber et al., 2000; Paulsen and Weissmann, 2002; Paulsen et al., 2004; Oldenburg et al., 2008).

Some pesticides are allowed in organic farming, i.e., copper and natural substances. The main problem is the use of copper in fruit, potato, grape and hop crops. According to the organic regulation 889/2008, 6 kg copper are allowed per ha and year, the private organic farming associations have restricted themselves to 3 kg. An accumulation which is toxic for the biodiversity can nonetheless occur with the low levels and thus may not be ignored. Even if through the copper input much less pollution can be assumed as in the pesticide use in conventional farming, one cannot be satisfied with this pollution (Kühne, 2008). Long term convincing solutions have still not been found.

In addition to fungicide alternatives and natural insecticides (i.e., Neem and Pyrethrum preparations) natural herbicides are under research and development (Verschwele, 2005). Particularly weeds such as thistle and dock and grasses like wind bent grass and couch grass present enormous problems in organic farming in Germany. Mechanical, pesticide-free management is very difficult or expensive (Böhm et al., 2004). The development of herbicides in difficult environments (i.e., tropical soils) does not conform to the principle of preserving biodiversity and has until now been prohibited in organic farming regulations ("conventional approach"). On the other hand, discrepancies can be seen in influencing of wildlife by harrowing and hoeing for mechanical weed control in organic farming. Ground breeders (Hötker et al., 2004) and small mammals are endangered and an adapted field management is required. The strategy of the stabilization of agrarian ecology to avoid external plant protection inputs is difficult. The application of pesticides with a field sprayer would nonetheless be tied to a negative image in uninformed consumers ("sprayers are bad").

Due to the refusal to use easily soluble mineral fertilizer, the water pollution of organic farming is, in principle, less than in conventional farming (Köpke, 2002). Erosion of soil without vegetation is also an increasing problem in organic farming. Nitrate pollution is still possible in organic farming through the autumn ploughing of clover grass (biomass with a lot of nitrogen). In frost free winters with much precipitation, nutrients will also be leached from organic farming if no catch crops are planted after ploughing. Here, also, special management options should be used to minimize nitrogen effluxes. A comparison of organic and conventional cultures should take into account that clover grass comprises only part of the agriculturally cultivated land. A correct consideration must take the crop sequence, the farm level, or a budget per product level used as unit for ecological indicators.

Animal medications also pollute the environment (Winckler and Grafe, 2000). The prohibition of preventive animal treatments and the prohibition of hormones and yield-increasing medications lead to lower pollution than in conventional animal husbandry. But conventional husbandry has achieved significant improvements in the past years (mostly through legal prohibitions). Pollution could come from yards and pastures of organically raised animals (noise, odour, water pollution with faeces, local climate gas emissions). On the other hand, pasture husbandry is an important instrument for animal protection, landscape, biodiversity, water protection and for humus protection and carbon sequestration. Here organic goals compete with each other, and optimization concepts must be sought that are not only oriented on a single goal. Complete life cycle analysis's are demanded. Above all this holds true for improvements in yard, pasture and fertilizer management.

Current critique of the environmental compatibility of organic animal husbandry is due to negative climate impact (Foodwatch, 2008). In the field of climate relevant emissions, the discussion centres on a basic interrelationship to ecologically conforming housing systems and a correlation of feeding (or rather, nutrient offering) and animal performance (Hirschfeld, 2008; Sundrum, 2002; Williams et al., 2006).

Evaluation: Pollution through organic farming is less than in conventional farming due to the foregoing of artificial pesticides, and most easily-soluble fertilizers, through smaller herd size (livestock per ha) and the restrictive use of animal medications. The foregoing does however lead to significant drops in production (lower area yields and animal productivity). Several studies show that organic farming has less impact to the green house effect than comparable conventional farms. Nevertheless, organic farming can pollute the environment as well. Problems also exist in the further use of copper as fungicide, nitrate leaching and the climatic impact.

Research and Development Requirements: The production (productivity, efficiency) must also be increased in organic farming without increasing the risk of environmental pollution. Research must develop improved, environmentally-sound practices in crop and animal farming. The use of copper must be reduced (avoided) and better methods for health maintenance, or disease/parasite as well as weed control must be developed without losing sight of organic stability (avoiding "conventional" strategies: external input-related solutions). Indoor and outdoor husbandry must be optimized and analysed in terms of environmental impact and performance.

3.4 IFOAM-objective: Producing enough food of high nutritional quality

Organic agriculture is also suited to cover the increasing need for food for a growing world population. Decisive is the question of whether additional food needs will truly be covered by the further intensification of high input systems, or whether the existing low input systems (about half of all farms and areas on earth, above all in developing countries and subsistence economies, FAO, 2007) can be improved technically and in their management practices. In low input systems with very backward technical ability, or management deficits, a production increase of 20 to 50 % is possible by following the guidelines for organic agricultures. Also in medium input systems or in regions with long summer droughts, the yield differences between conventional and organic systems are "only" 0 to 20 % (Pimentel et al., 2005; Mäder et al., 2002). In high input systems in the better climate areas of central Europe, the yields in conventional farming are, as a rule, 30 to 50 % higher than in organic farming (Badgley et al., 2007). Here organic farming will not be able to achieve the yields of conventional farming as long as they can use high energy inputs to a broad extent.

It has until now not been proven that organic foods are healthier, or rather that they can be differentiated from conventional products (Kahl et al., 2007). But the risk of contamination with undesirable substances (heavy metals, pesticides) is generally less in organic products than in conventional products which, for example, has been shown for years in studies by the public food monitoring agency in Baden Wurttemberg and trade organizations as well as market tests by Greenpeace, Foodwatch and Ökotest (FQH, 2005). Not all organic products are absolutely free of pesticides. (Monitoring data can be found under www.bvl.bund.de).

The rejection of genetic modified organisms in organic farming and the significant monitoring mechanisms tied to this create a meaningful quality factor for customers who reject products with GMOs. This is a steadily increasing differentiation factor with a view to product quality in comparison to conventional products. Furthermore in animal and plant production, organic farming relies to a large extent on conventional breeding practices which do not meet many of the original organic farming ideas (land varieties, local breeds). Conventional strategies like CIS-genetic breeding and gene mapping are discussed in organic farming. Independence from conventional breeding systems is not possible yet but necessary in the future to keep the label of GMO-free and develop adapted varieties and breeds for organic farming. The organic sector is too small for companies to go the way of organic breeding.

Evaluation: The production performance and increases lag behind that of conventional farming. But, measured on the outset conditions, it can also be seen as positive that organic foods today also achieve the same product quality as conventional food products, although the trading classes for the latter are firmly established. Proof that there are fewer negative ingredients in organic products exists, while proof of positive ingredients is not significantly available. GMO-free products have become a core image for organic products. There is still a dependence on conventional strategies and systems (i.e., breeding) that is increasingly going the way of GMOs or related techniques.

Research and Development Requirements: *The production yields per hectare and the animal performance must be increased in organic farming. Productivity and efficiency oriented concepts require more consideration. For this reason new crop and husbandry concepts must be developed without leaning on genetic engineering and conventional breeding structures. In animal and plant breeding, the limits and level of tolerance of organic farming for breeding methods must be defined and clarified (i.e., gene mapping, CIS-genetics, artificial insemination). The product quality must be further improved. The presence of positive ingredients has to be assessed. New expectations of consumers and behavioural patterns of different target groups must be considered. Animal nutrition must be improved in order to achieve better product quality and animal welfare. Organic trade classes must be developed to avoid conventional production strategies for conventional product standards.*

3.5 IFOAM-objective: Reducing the input of fossil fuels in agricultural practice to a minimum

In a study for the Enquete Commission of the German Parliament, "Protection of the global atmosphere," Haas et al. (1994) compared the energy input per hectare for typical and comparable organic and conventional full-time farms. Here a 65 % lower energy use by organic farms was found, particularly through the refusal to use high energy produced synthetic nitrogen fertilizer and plant protection substances (organic: 6.8 GJ ha^{-1} a^{-1}, conventional: 19.4 GJ ha^{-1} a^{-1}). The land relations must be critically viewed in this case since the production levels achieved in organic farming are lower (see above). In a production related evaluation organic farming does not always fare as well. Energy hungry production systems are above all greenhouse cultivation as well as pig and poultry fattening (Rahmann et al., 2007). In organic farming there is also a trend toward stronger mechanization linked to an increase in fuel input per hectare (with sinking use of fuel, for example, in the minimal tillage in conventional farming).

Evaluation: Organic farming needs less fossil energy than conventional farming because mineral fertiliser and chemical pesticides are not used. Nevertheless fossil fuel per ha to run the farm machinery can be above the conventional level. However, there are still exceptions and on the part of conventional farming, new, more energy efficient systems are developed (i.e., minimal tillage systems). Thus the advantage of organic farming is reduced. Systems for the production and use of renewable energies were often introduced very early in organic farms. But conventional farming has here followed suit and above all reached a positive position with large scale biogas facilities. But in this area, they generally show a series of negative ecological and economic consequences (i.e., landscape changes through maize monocultures, production competition "Table or Tank," increasing food prices).

Research and Development Requirements: *The use of energy saving technologies and regenerative energy must be developed and implemented in organic farming. The technical, social and economic impacts of regenerative energy production and energy saving strategies must be considered. Above all the chances for local or regionally optimized energy systems must be developed.*

3.6 IFOAM-objective: Providing farm animals with living conditions based on animal welfare and an ethical basis.

Animal protection is a central objective of organic farming and one of the most important purchase motives for consumers (Ökobarometer, 2007 and 2008). Since the Regulation 2092/91 (implemented with 1804/1999), many conventional animal husbandry practices (beak cutting, tail or horn removal, single animal housing, etc.) are either not permitted in organic animal husbandry or only allowed in exceptional cases. Animal medication shall not be given preventively and "natural healing practices" should be the priority in the treatment of sick animals.

The reality, however, often differs from the goals. The removal of horns from beef cattle is still broadly practiced (Rahmann et al., 2004). Hybrid poultry - bred for cage and intensive keeping - kept on organic farms often show severe difficulties in behaviour and health. Feather picking and cannibalism are still unsolved problems (Hörning et al., 2004; Berg, 2001; Fiks et al., 2003). Male chicks from laying hen populations are still killed instead of fattend. There are no races of poultry or double purpose breeds used because they do not fulfil the performance and production requirements of the farmers. Poultry is still kept in large flocks with several thousand animals in one barn.

An example for a conflict of goals is the castration of piglets in the range of unsolved problems or alternatives (i.e., pain alleviation, immuno-castration, breeding, sperm sexing, boar fattening) with impact on animal welfare (i.e., castration, keeping of boars), environmental aspects (i.e., climatic impact of anaesthesia), economic viability (i.e., production cost advantages, marketing sacrifices), consumer acceptance (i.e., consumer expectations, consumer protection) and meat quality (boar odour – tenderness, juiciness, low intramuscular fat content). The life performance of dairy cows is not higher and the animal medication input not significantly less than in conventional animal husbandry (Krutzinna et al., 1996; Brinkmann and Winckler, 2005; Sundrum and Ebke, 2005). The use of natural medications is the exception (Rahmann et al., 2004). The young animal losses in pigs are in fact much higher than in conventional husbandry (Löser, 2007).

As a rule, stables in organic husbandry offer more space for animals than stables in conventional agriculture. This makes sense from the perspective of animal welfare. There are, however, exceptions. The tethering of cows is still widely practiced in organic farms and can be maintained in small farms (< 35 cows). The target of the EU organic standards 2092/91 to terminate tethering was postponed to 2013 because of German organic farmer intervention. Further problems in organic cattle keeping: grazing is not obligatory and cereals are still the basis for milk production (40 % concentrates are allowed in the ration, 50 % in the high lactation phase).

Feeding of livestock is one of the most difficult problems. As a consequence of the BSE crisis, omnivore animals (meat and plant eaters like pigs and poultry) have been turned into pure vegetarians while maintaining high daily weight gains and accordingly essential amino acid requirements. Synthetically produced essential amino acids, as in conventional animal husbandry, are not allowed in organic agriculture. The protein gap resulting here (Zollitsch et al., 2002) has not been closed with plant based organic feeds in fast growing young animals (piglets, chicks) and high yield animals (sows, laying hens). In addition to the according economic losses (Löser and Bussemas, 2007) this is also problematic from an animal welfare perspective (Zollitsch, 2007). As of 2012, 100 % organic feeding will be required by law. This is just a few years from now, but a solution is nowhere in sight. Above all essential amino acids are missing in feed rations for poultry and pigs (Wlcek and Zollitsch, 2004). That is why conventional feed is allowed in specific portions until 2012 (i.e., potato protein, corn gluten). The target of the private organic associations Bioland and Demeter in 2003 to require 100 % organic feeding already in 2005 was rejected by the member farms. The EU regulation 834/2007 does not define the origin of organic feed. All feed can be purchased on the organic market. Private standards are more restrictive (50 % of the feed shall come from the farm).

Evaluation: Organic animal husbandry is still the most fragile and least developed element in the system of organic farming, particularly the production of chicken and pigs. Animal husbandry on many organic farms (certainly not on all farms) is, from the perspective of animal welfare and with a view to production yields, unsatisfactory. Here is an economic risk, but also an image risk. Many of the problems are related to management deficits. Appropriate organic feeding, breeding and housing techniques are available, but the implementation on a larger scale is still at the outset. Natural therapy and disease prevention strategies are not developed.

Research and Development Requirements: *The development of natural healing practices including natural medicines and livestock keeping with high animal welfare standards must be strengthened. Breeding can be a core element for improvements. Many problems in organic animal husbandry have, from a scientific perspective, either been solved or can be solved. Acceptance and implementation problems in practice play a large role. Sociological and economic studies are necessary in order to understand the problem and develop solutions which seem acceptable for all concerned actors. The impact of improved animal protection of the economic viability of animal husbandry systems must be evaluated.*

3.7 IFOAM-objective: To provide farmers the opportunity to earn an acceptable living and to develop their professional and personal abilities

In 2008, the German organic market volume of 5.8 billion Euros was slightly more than 3 % of the total food market (BÖLW, 2009). Based on turnover, organic food has been the most strongly growing segment for years in food markets, especially since the organic seal was introduced. Already more than 3,108 farms and companies of the overall food-sector have had more than 51,368 products certified (www.biosiegel.de, Status 31.12.2008). All in all more than 26,820 companies (producers, processors, importers and dealers) are state certified by the Federal Agency for Agriculture and Food (BLE).

In Germany, the conversion of farms toward organic farming is not as fast as the market development. In 2008, about 19,824 certified organic farms cultivated 911,385 ha (+5.3 % compared to 2007). Very characteristic for the structures of organic farming in Germany is a relatively large number of farms that are active both in primary production as well as in the domain of further processing (2,655 farms). However, more than 50 % of the raw materials of organic products sold in Germany are imported (Haccius, 2008).

The professionalisation of organic farming has led to the situation that the income in organic farming is now comparable with according conventional colleagues or even higher. In the recent past there has even been a trend favouring the organic farms (Nieberg et al., 2007). Whether this trend is permanent cannot yet be determined (Oppermann et al., 2009). The prices and demand for organic products swing quite strongly (ZMP several years, found under www.zmp.de).

The work stress in many farms, particularly dairy farms, is problematic. Regular vacations and appropriate free time are seldom found here (Rahmann et al., 2004). This too is a reason for the strong trend to establish organic farms without keeping animals. In organic farming, farmers are also forced to thrive and give way. Small and smallest farms are often economically fragile and do not always have an heir. In the future a strong structural change will also take place in organic farming, and as we have seen in conventional agriculture for decades, the question emerges of how the structural change can be better accompanied socially and politically.

Organic farming creates jobs. It is estimated that organic farming has created 50,000 new jobs up until today (BMELV, 2006). Organic farming, in contrast to conventional farming, also offers space for decidedly socially-oriented employment concepts (handicapped persons, persons requiring care for other reasons, etc.). For example, handicapped persons are employed on about 150 organic farms (www.gruenwerkstatt.de). Ultimately organic farms have often played a progressive role in the building of regional economic concepts (www.reginet.de).

Evaluation: The economic viability of organic farming is comparable to that of conventional farming. Meaning: there are known differences in the results with a large group of farms with weak income and hardly any investment ability. In both systems there will be growth and a giving way and production will be further specialized and intensified on this basis. International competition presents great challenges to both systems if they want to keep their place on the market. On the other hand, organic agriculture offers jobs that are no longer available in other businesses, not even on conventional farms. Multiple occupations and social aspects are important development potentials for the future.

Research and Development Requirements: Resource efficient production processes, new types of products and marketing paths as well as new, additional sources of income (tourism, handicapped facilities, school groups, biotope management and nature protection, energy production) must be developed and explored for organic farming. The policy framework conditions have to be defined and assessed (i.e., second pillar of CAP).

4 Further adaptation and development needs of organic farming

The development of organic farming can not only focus on internal conditions and be limited to self-discussion (Nieberg and Kuhnert, 2007; Rahmann and Oppermann, 2008). Organic agriculture must show that it has the right stuff to achieve improvements or can lead to convincing solutions, at least in the long-run (Watson et al., 2006). As the most important challenges can be named:

- Food security for an ever-growing world population with multi-functional land area demands (biomass, natural protection), loss of production areas (desertification, contamination, sealing).
- Develop adaptation strategies so that agriculture can achieve good yields even under changing climate conditions (agrarian climate impact, farming adaptation).
- Contribution to the demand of the public for the improvement and maintenance of human health (reduction of malnourishment, minimization of health-threatening, and maximization of health-promoting, substances in food).
- The conservation and maintenance of both agricultural as well as natural genetic resources.

Parallel to the major global topics, a range of national or "only" regional challenges can be named, demanding new answers from society. These include:

- Preservation of biotic and abiotic resources (reproduction functions) for urban areas (soil and water resources, fresh air).
- The maintenance of attractive, diverse landscapes and conservation of rural, and particularly agrarian, traditions for rural tourism.

This is all tied to the changes in international business exchange structures (globalisation) and forces all production systems to adapt.

Ultimately agriculture in all of its production forms is under "sharper observation" in its achievements by the public. It must deal with changing values and a new position in the society vs. food and its production forms (animal protection, consumption and eating habits, recreation). The point of departure is thus marked by the paradox situation that knowledge of most people on the basics of agricultural production has dropped considerably, while, on the other hand, a trend has emerged to judge agriculture and to censure it if it appears to be worthy of criticism.

Also, there is a popular perception in the world about "good farming" that is extremely emotionalized (the feelings of the topic and the aspects shown) and romanticized. The media and advertisements play a major role here. It should not be underestimated what this means for the judgement ability of people and what it means for the ideal perception of agriculture that, in turn, flows into the political consensus process. Organic farming today is also confronted with this problem. In many ways it was shown to be an alternative to conventional farming and must therefore suffer under expectations that are obviously exaggerated.

In this context, it is imperative that organic farming deal with its problems and deficits in a sober, pro-active and self-confident manner. Due to the diversity of structures and problem situations, general evaluations make no sense. Nonetheless, from a research perspective, they permit the basic topics and lines of discussion to be identified.

Even if a classification of the problem fields seems to make no sense, it soon becomes apparent that a large portion of the deficits as well as a large portion of the solution discussions can be ordered under the main concept of "professionalisation." Here not only gaps in professional knowledge are prevalent, but also problems in the implementation, which are in turn very strongly dependent on the motivation of actors, the business conditions and the infrastructure. Secondly, a large part of the problem emerges due to areas with which conflicts of goals, which previously did not exist or were not apparent, have arisen with organic farming. The third complex is most related to the fact that additional, absolutely new, challenges must be integrated into the organic farm production concept.

Ultimately, in many fields of production, and in some products, overlaps between the structures and qualities of organic and conventional farming emerge. This is a positive point of departure for a strategy for change and the further development of farms and structures. It forces organic farmers to approach problems in cooperation with conventional farmers, and to protect themselves from a self-glorifying and ideological perspective. Organic farming needs intensive, critical and constructive accompaniment by agricultural science to solve its problems.

The EU Organic regulation 834/2007 provide the legal groundwork naming objectives for organic farming (§3-6). According objectives must, however, permit reasonable benchmarking in the area of tension between absolute and relative indicators. Research should develop solutions for organic food production which can produce and prove its own goals in process and product quality without exceptions.

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