



*Organic agriculture – production and consumption*

# **FRAMEWORK PROGRAMME FOR RESEARCH 2007–2009**



Editor: Ulrika Geber

Cover photograph: Björn Dahlfors, [Pixonnet.com](http://Pixonnet.com)

Other photographs: Jessica Alm, Mats Gerentz, Rebecka Milestad, Karin Ullvén

Layout and editing: Helena Georgsson

Translator: Lewis Gruber

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## *Foreword*

This framework programme is a description of the need for knowledge in organic production and consumption. Its aim is to help research funding agencies in prioritising among projects and provide a basis for the investments made by these agencies in this area. It is also to serve as guidance and inspiration for researchers who are interested in organic agriculture and in the sustainable development of agriculture. This framework programme has been developed by the Centre for Sustainable Agriculture (CUL) together with players in the food chain, researchers and research funding agencies. CUL has been responsible for the development of framework programmes for research concerning organic agriculture since 2000.

The framework programme has been developed in a process where all those interested have had an opportunity to exert an influence and to contribute. The function of CUL has been to lead and coordinate the work. Behind the practical work on formulating the framework programme there has been a working group comprising the staff of CUL (Sara Antell, Ulrika Geber, Gunnela Gustafson, Susanne Johansson, Rebecka Milestad, Birgitta Rämert, Maria Wivstad), representatives from Federation of Swedish Farmers, LRF (Kjell Ivarsson), Swedish Ecological Farmers Association (Maria Dirke), Swedish Board of Agriculture (Ann-Marie Dock Gustavsson, Thorsten Rahbeck Pedersen), an independent consultant (Kåre Olsson), and a coopted representative from Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, Formas (Sara Österman). The working group has also been helped by a reference group comprising representatives of the largest research funding agencies, i.e. Formas, Swedish Board of Agriculture, Swedish Farmers' Foundation for Agricultural Research SLE, and SLU-Ekoforsk. Two open workshops were held in 2006, on 1 February at SLU in Alnarp and on 14 March at SLU in Uppsala. These were attended by about 130 people, comprising researchers, representatives of various agricultural organisations and authorities, farmers and others. The opportunities, challenges and problem areas were formulated through group discussions (CUL, 2006a; 2006b). From the problem areas that were identified, CUL compiled an initial proposal for a framework programme which was sent out for consultation to the interested authorities, research institutions and companies in the food industry. The consultation process was advertised and was also available on the CUL webpage. A direct link to this page was communicated to those who had attended the introductory workshops of the framework programme, and to researchers and postgraduate students who were in some other way involved in the research project on organic agriculture. The consultation period extended from 22 May to 26 June. A total of 22 answers with observations were received. The working group also awaited the results of the international evaluation of Swedish research on organic agriculture between 1997 and 2004, which Formas had commissioned (2007). Most of the conclusions and recommendations of the evaluation were taken into account in the framework programme.

Ulrika Geber, Departmental Director, CUL

## *Guide to the document*

The framework programme relates to the problem areas which, during the work on the programme, were considered to be especially important for research and development in organic production and consumption. It is hoped that researchers will be inspired by the descriptions of the problem areas and will apply a number of approaches in solving the problems.

In the introduction, there is a discussion of the importance of organic agriculture for the sustainable development of agriculture and the food industry, for the environmental quality objectives, and for the national objectives which Sweden had set up for the production and consumption of organic foods. A summary is also given of the financing of research on organic production and food consumption.

In the chapter "Situation analysis" we analyse the challenges we are facing at present regarding agriculture and future food supplies, and the organic production and consumption in Sweden today.

The next chapter defines the problem areas which were identified in the preparatory work on the framework programme, i.e. during the workshops, situation analysis and the international evaluation of research (Formas, 2007).





## Introduction

The general vision for the development of agriculture is set out, inter alia, in the United Nations Rio Declaration with Action Plan 21 (Regeringen, 2006a) and in the environmental quality objectives of the Swedish Riksdag (Miljömålsportalen, 2006). These call for sustainable development which satisfies today's needs without jeopardising the opportunities of future generations to satisfy their needs (WCED, 1987). Agriculture and the food industry must therefore both produce for today's population and create freedom of action for the future. The Swedish environmental quality objectives, with relevance to agriculture, are primarily a rich agricultural landscape, a nontoxic environment, no eutrophication, limited impact on climate, a rich plant and animal life, and groundwater of good quality (Regeringen, 2006b).

### *Organic agriculture – a way to work for sustainable development*

The starting point for organic agriculture is that the production and food systems must be based on local and renewable resources, and that the functions of the ecosystems must be preserved and strengthened. Organic production and foods must promote human health. It must also guarantee the welfare of livestock, for instance by ensuring that they are given an opportunity to perform their natural behaviours and receive the fodder they are adapted to. A fair allocation of the earth's resources is seen as essential for sustainable development. IFOAM (International Federation of Organic Agricultural Movements) has summarised this view in the form of four principles: health, ecology, care and equity (IFOAM, 2005). Swedish interpretations of these principles are found in the objectives of KRAV, the Swedish certification body for organic production (2006) and by Swedish Ecological Farmers Association (Ekologiska lantbrukarna, 1996). When, in this framework programme, the terms organic agriculture, organic production and food consumption or similar expressions are used it is agriculture and consumption in accordance with the principles of organic production which are referred to.

In order that the overriding sustainability principles of organic agriculture should be practically and economically feasible, large sections of organic agriculture have opted to use certification as a tool. Owing to labelling of



products in accordance with the organic regulations, they can be traded in an open market. While an EU Directive lays down what may be called organic and constitutes a European standard, the KRAV regulations are a further reinforcement in these areas, especially in livestock husbandry.

### *National objectives concerning organic production*

The national objectives for the development of organic production and food consumption are set up by the Swedish Riksdag and Government. The political will is that production and consumption of organic food must increase in accordance with the advantages that organic production has for the environment and animal welfare, as shown by research (Carlsen, 2003). Another issue of national importance is rural development that is dependent on long term sustainable agriculture (Miljömålsportalen, 2006). Organic agriculture is believed to be important for a viable countryside. However the social and economic effects of organic production, processing and distribution do not, at present, qualify as a basis for financial compensation within the Rural Development Programme (SJV, 2006a).

### *Research on organic agriculture*

Since 2001, State finance for research on organic production has been MSEK 43 annually. When other funding is also included, total funds are about MSEK 60 annually (see below).

*Annually available funds or research in organic agriculture (MSEK), 2001-2005, allocated through grant competitions.*

<b>Funding agency</b>	<b>2001–2006</b>
Formas (formerly Sw Council for Forestry & Agriculture Research, SJFR)	23
Swedish Board of Agriculture (SJV), Tests and Development	13
Swedish University of Agricultural Sciences (SLU), Ekoforsk	7
Ekhaga Foundation	2–5
Swedish Farmers' Foundation for Agricultural Research (SLF)*	ca 13
<b>Total ca</b>	<b>58–61</b>

*\*SLF funds individual projects and has no fixed grant for organic agriculture.*

In 2006, in cooperation with Swedish Board of Agriculture (SJV), Swedish Farmers' Foundation for Agricultural Research (SLF) and SLU-Ekoforsk, Formas commissioned an international evaluation of the scientific quality, relevance and usefulness of Swedish research on organic agriculture between 1997 and 2004. The research was considered to be very relevant to organic agriculture, and also for the development of agriculture as a whole. The evaluation groups recommend continued earmarking of research funds for organic production in preference to more general calls for applications for research funds in sustainable agricultural systems (Formas, 2007). Further information on this can be found in Appendix 1.

## *Situation analysis*

Swedish agriculture and food consumption are influenced by the global development and, in their turn, they also influence natural and societal systems in other parts of the world. Globalisation gives rise to a process of change, where countries and societies all over the world are mutually interdependent. Parallel with globalisation there is a movement that is looking for roots of a more local nature. A description is given below of the trends and structures, both global and national, which influence Swedish agriculture and in this way organic production also. From the soil to the table, locally and globally.

### *Global changes pose a challenge*

Today, mankind utilises ecosystems and their services, the basis for our own existence, more than ever before. This has contributed to economic development and a higher standard of living for many, but at the same time it has also caused accelerated deterioration of the soil and the disappearance of entire biotopes (WRI et al, 2000; MA, 2005). Over the past fifty years the fertility of about two thirds of the agricultural land in the world has decreased through erosion, salinisation, soil compaction, nutrient losses and pollution. Irrigation of agricultural land accounts for seventy per cent of fresh water consumption in the world. At present, 17 per cent of agricultural ecosystems are dependent on irrigation (WRI et al, 2000). Climate changes will cause areas that are already arid to be more arid still, and rainy areas to become more rainy. Precipitation and temperatures will also become more extreme (IFPRI, 2001; Parmesan & Yohe, 2003). All in all, this threatens the long term productivity of ecosystems.

### *Will there be enough food for all?*

Agriculture must feed a further 1.7 billion people in the next twenty years, when the world's population is estimated to rise to 8 billion (WRI et al, 2000). Together with changes in consumption patterns, with a higher percentage of foods of animal origin, this will put greater pressure on cultivation resources such as soil and fresh water (FAO, 2006). At the same time, large proportions of the populations of poor countries are dependent on subsistence farming.

Business concentration in the food industry is on the increase, and for many raw materials on the export market price development is weak. Duties and export subsidies contribute to low world prices. In the long run, this reduces food security for the poorest, since a majority of these live in the countryside and depend on their income from agriculture (FAO, 2004).

### *Lack of oil – a threat or a chance for the green sector?*

Global harvest levels have been dramatically increased owing to higher inputs of fertilisers, irrigation and herbicides, but also through the development of new plant varieties, livestock breeds and farming techniques (Tilman et al, 2002). In turn, this development has been dependent on cheap energy. The availability of fossil fuels has been essential for the development of



food production systems from being mainly local into increasingly global systems and greater trade. The green sector is thus facing great challenges when energy prices rise. On the other hand, opinions vary as to how large and dramatic the necessary changes must be (Helmfrid & Haden, 2006).

### *New conditions in Sweden*

#### *Restructuring of agriculture*

In Sweden, one third of agricultural land has been taken out of production since 1945, and the number of companies has dropped by more than 20,000 over the past decade (SJV, 2003; 2005). The area under cultivation on the remaining farms is increasing. Agricultural companies deal with this development in different ways, some by forming larger companies and utilising new techniques, others by changing to more extensive production and complementing their incomes from other sources. A third group opts for greater diversification, with several fields of activity (OECD, 2001; SJV, 2004; LRF, 2006). With an incisive wording, the larger, specialised farms may be said to account for a high proportion of production, while the smaller companies often have an important role in environmental protection and landscape management (Nordiska Ministerrådet, 2004; Regeringen, 2006d). Horse riding is greatly increasing in Sweden, and today horse feed is the fifth largest source of income in agriculture. (Nordiska Ministerrådet, 2004; SJV, 2004). The higher oil prices increase the interest in changing to alternative energy sources (LRF, 2006), and just now there is massive investment in growing energy crops in Sweden. There are however differences of opinion as to how well food and biofuel production on Swedish agricultural land can be combined in the future (Helmfrid & Haden, 2006; Rydberg, 2006). Under the set-aside reform, the EU will pay for land management instead of production, and some analysts believe that there will be an increasing proportion of fallow land, mainly in the northern parts of Sweden (Ekman, 2005).



Demographic development also has a great influence on the future of Swedish agriculture. General population development in the Swedish countryside is positive near towns and negative a long way from towns (SJV, 2004). Because conditions for farming businesses have deteriorated in several ways, few young people want to be farmers, and the farming community is becoming older (Nordström Källström, 2003). Recently, descriptions of farming by the media have become more favourable. At the same time, descriptions by farmers of their own situation have changed only marginally (Nordström Källström, 2007).

#### *The health and capacity of ecosystems are decreasing*

Owing to the extensive structural rationalisation since the end of the second world war, the landscape has changed, from a traditional agricultural landscape of small scale characterised by variation to a more uniform landscape (Björklund et al, 1999; Wramner, 2003). This change, especially

the decreasing area of managed pastures, has caused a loss of biodiversity (Weibull & Östman, 2003; Bengtsson et al, 2005). There is still large scale use of chemical herbicides and pesticides in Swedish agriculture, as shown by the fact that they are used just as often as twenty years ago. The quantity, however, has decreased owing to the introduction of “low dose” products (Kemikalieinspektionen, 2006; SCB, 2005). Chemical herbicides and pesticides can be found in lakes, rivers, sediments, groundwater and rainwater, and they are present in food as residues. There is great uncertainty regarding the significance of these compounds for the functions and capacity of ecosystems in the long run (Åkerblom, 2004; Wivstad, 2005). The specialisation in agriculture, with a division between cereal production and livestock production, is an important reason for large nutrient surpluses which pose a risk of environmental damage, particularly in areas with intensive livestock production (SCB, 2001; Naturvårdsverket, 2005). There is also a relationship between feed imports and high nutrient surpluses in livestock production (Bleken et al, 2005). Eutrophication of lakes, rivers and the sea is one of the most serious environmental problems, especially in south and central Sweden (Wramner, 2003). Algal blooms, dead sea bottoms, changes in fauna and flora, and decrease in biodiversity, are some of the consequences (Naturvårdsverket, 2003).

#### *Parallel trends in the food system*

The pressure to reduce costs in the whole food chain is on the increase (LRF, 2006) and this reduces the profitability of Swedish agriculture and the food industry. At the same time, a development is emerging in which



smaller enterprises create new networks for processing and distribution. The Farmer's Market, subscription to boxes of vegetables direct to one's home and small specialised processing companies that offer foods with added value are some examples of this trend.

Eating habits in Sweden are also changing and the demands for convenience and for products that meet these demands are increasing. International food influences proliferate, and at the same time there is greater interest in local products, production quality and broader value issues (LRF, 2005). Although the health trend continues to be strong (LRF, 2005) in practice the changed eating habits and reduced physical activity of the Swedish population have resulted in greatly increased incidence of diseases of affluence (SLV, 2005).

Our consumption pattern, what we choose to eat, affects our resource economy and our environment. Different foods give rise to different demands on land, resources and environmental impacts (Reijnders & Soret, 2003) and, in a global perspective, our eating habits impose increasing demands on resources (Edman, 2005). They may have greater influence on future use of resources and the demand for agricultural land than the rise in population and production development (Gerbens-Leens & Nonhebel, 2002; Johansson, 2005).

#### *Increasing organic market*

Organic food makes up 2-3 per cent of consumption, while at the same time 6-7 per cent of agricultural land is certified by KRAV and 19 per cent receives an environmental subsidy for organic production (KRAV, 2006; Regeringen, 2006b). The market for organic products is characterised by the fact that the products are sold in the same shops as conventional foods and that, until recently, there has been one dominant label, the KRAV label. Compared with other European countries, in Sweden the differences between the prices of conventional and organic products are relatively small (Furemar, 2004).

According to the recently adopted objectives for organic production and consumption, twenty per cent of agricultural land must be organically certified by the end of 2010, which is three times that at present. For this increase to be realised continued favourable development of the organic market is essential. To stimulate this, the objective is that twenty-five per cent of the food consumed in the public sector must be organically produced. More specific targets for individual livestock breeds and for crops including fruit and vegetable growing and market gardening can be expected when the new action plan for organic production is presented (Regeringen, 2006b).

Another important issue for the future of organic agriculture is co-existence with genetically modified crops (GMO). Work is at present in progress on formulating legislation for the co-existence of farming with GMO crops with organic and GMO-free conventional farming (Jacobsson & Wahlberg, 2006).

## *Problem areas*

Development of organic production and food consumption towards greater sustainability requires new knowledge in a number of critical areas. Solutions must be found to acute problems, but more complex issues that demand comprehensive changes in the food industry must also be tackled. Challenges are faced along the entire chain, from primary production and processing to the market for organic foods. While the problems faced by primary production concern issues at field, farm and landscape levels, issues to do with logistics and organisation in the food chain belong to a higher systems level. Problem areas thus extend over several different scales in time and space. The need for research at different system levels and with different degrees of interdisciplinary cooperation has also been described by the international evaluation of research in organic agriculture (Formas, 2007). The scientific evaluation describes the needs in three principal areas:

- I. Research on marketing, economy of production and resources and the policy issues and social effects of a growing organic food sector. Research in this area has not reached the extent aimed for in spite of the fact that it had been accorded priority in previous research programmes. The evaluators therefore propose research collaboration with groups outside the traditional agricultural research.
- II. Research for the development of long term sustainable production systems concerning production, economy and environment. The evaluators consider there is a need for somewhat larger, clearly interdisciplinary, thematic projects that comprise both applied research and research of a more strategic nature concerning sustainable production systems.
- III. Research concerning key problems that strengthen effective organic production. Examples of these may be processes for better plant protection or plant nutrient management. The evaluators emphasise that research on more clearly defined areas must also be placed in the context of organic agriculture so that it may contribute to the development of production and food consumption.

The problem areas are structured around these three principal areas. For further information, mainly on the third principal area, the need for research on critical key processes, reference is to be made to the following documents: Formas, 2007; Nilsson, 2007, and Ekologiskt Forum, 2007.



*Problem area I - Research on marketing, economy of production and resources and the policy issues and social effects of a growing organic food sector*

The recently adopted objectives concerning a threefold increase in certified organic production and a 25 per cent organic consumption in the public sector will place stringent demands on the organic food chain. The challenge lies in scaling up today's market, i.e. efficiency in primary production and the processing stages must increase, and different types of distribution channels must be developed. Research is particularly needed on how coordination between the various parts of the food chain – primary production, processing, distribution, commerce and consumption – can be improved in both the small scale and increased scale systems. Another important condition for expansion is that knowledge about organic agriculture should be increased. This demands that the present state of knowledge is analysed and that effective information and marketing are developed. In an increasingly complex food market, consumers need a sound foundation if they are to be able to make informed choices as regards the use of resources (see Problem Area II), origin and content (Regeringen, 2006c). The values, lifestyles and attitudes of consumers concerning organic and social sustainability will also be significant for the way in which small and large scale markets are developed. A growing organic food sector is a potential driving force for the social and economic development of the rural areas. For research in these areas to be relevant, a considerable input of social science competence is required.



*Communication and logistics - essential for strong growth of the organic food chain*

Because of reduced profitability along the food chain, the restructuring in agriculture, the processing industry and retail trade continues. Infrastructures for processing, such as slaughterhouses, grain storage installations and mills are centralised, which means that it is becoming more difficult for agriculture to store, process and finally to sell its primary products. The distribution and purchasing of food, and the design of kitchens in municipalities and county councils, often make it difficult to handle locally purchased vegetables, and in this respect there is much that could be changed.

The traditional retail trade companies are hard pressed by the new lowprice players, which results in greater investments in own trade marks and increased food imports.

Creating greater profitability in the organic food chain is therefore a serious challenge. More knowledge is needed concerning effective economic instruments and institutional support, such as policies, legal provisions, regulations or other more informal agreements to achieve this.

The large uninterrupted production flows which are demanded by cooperative companies, the retail trade and public purchasing are lacking, especially in the case of organic meat, fruit and vegetables. Larger volumes are needed if consumers in a shop are to be offered a choice of organic foods that have been processed in different degrees. There is uncertainty as to how the market for organic products will develop. Because of this and the serious organisational and logistical problems, there is a need for new tools and forms of cooperation between producers, processors, wholesalers and buyers, in order that more players should dare make the decision to turn organic. There is great potential for the growth of e.g. small scale processing and product development of fruit and vegetables. The lack of small scale processing companies and distribution channels for small and medium quantities of products also hampers development of local food production.

Small scale organic market gardeners, whose number has considerably decreased over the past decade, often have both diversified production and different forms of direct sales (Nilsson, 2007). This places great demands on the producer. Small scale distribution often has great economic importance for the individual farmer, but foods in the local channels account for only a small proportion of our total consumption. The new small scale distribution systems, with Farmers' markets and subscriptions for boxes, are appreciated by consumers but encounter problems when the number of consumers rises. Examples of these are logistics, uninterrupted refrigeration along the whole chain, long distance transports and packaging. In addition, there are pronounced differences in conditions for different types of local distribution, depending on e.g. geographic and demographic conditions. In many cases, the individual producer has no access to business economic analyses concerning the advantages and drawbacks of various sales strategies. The handling of fresh produce may make the work load of the farmer unreasonably hard during certain periods, and there are no small scale, flexible technical solutions that can reduce the physical work load.

The regulations of EU and KRAV regarding organic production fill a number of functions. They are to provide consumers with a guarantee on how the foods are produced. At the same time, they are to provide guidance for the farmer and form the basis for the contract that the producer enters into with the certification organisation. The way the regulations are formulated has a decisive role for realising in practice the objectives of organic agriculture. At times conflicts arise between objectives. The regulations can in such a case be a compromise between what is feasible at the time and the long term endeavour. At the same time, farmers, especially those with small and medium holdings, regard the work on certification and EU farm support time consuming. For credible and effective marketing of organic foods,

these aspects of the regulations must be dealt with in communication with the consumers and other players.

*The farmer should prosper and be contented*

For sustainable development of agriculture, it is necessary that there are farmers who remain in farming, and that these prosper and are contented. The psychosocial dimension of the sustainability issues of agriculture is therefore of critical importance. While the countryside near towns is thriving, continued depopulation of rural areas has serious consequences for the farmers who remain on the land (Nordström Källström, 2003). Depopulation also creates difficulties in creating a customer base for a local market, where the farmer could increase her/his social contacts and receive a higher price for his products. For financial reasons, many farmers work on their

own, which often increases the physical and mental load. Few young people are tempted to take up farming, which results in an ageing farming population and difficulties in handing over to a younger generation (SJV, 2006b; Nordström Källström, 2007). Regulations and support systems, sales and prices are constantly changing, sometimes drastically, and competition through global trade increases. Farmers without good networks or cooperation with other farms may have difficulties in developing their business and in making new investments, or in holding their own in contacts with e.g. the authorities and the processing industry.



*Summary, Problem Area I:*

- The market for organic products must be analysed, and well targeted and effective information and marketing must also be developed.
- There is no properly functioning small and medium scale processing for many organic foods.
- Innovative solutions must be produced to solve communication and logistics problems which are often experienced by organic farmers.
- The profitability and social situation of the individual farmer must be improved.

## *Problem area II – Development of long term sustainable production systems by interdisciplinary thematic research*

The future scarcity of fossil fuels, as well as climate changes and the discussion concerning a more equitable global distribution of resources, will have increasing impact on Swedish food production. This applies to both crop farming and livestock husbandry, where there is great dependence at present on oil and other finite resources (Regeringen, 2006e; SOU, 2006).

### *Local ecological adaptation*

The starting point for organic agriculture is that the production and food systems are primarily based on local and renewable resources and that the functions of the ecosystems (ecosystem services) are not only utilised but also preserved and strengthened. Diversity, variation and solutions in production that are suited to local conditions are the pivotal issues in local ecological adaptation. Inferior ecological adaptation, i.e. poor utilisation of ecosystem services, leads to greater need for external inputs. On the other hand, in an operation of very low capital and labour input, or when the operation closes down, the potential of the agricultural ecosystem to produce food and environmental services is not utilised at all. The choice of a production route, with the types and breeds of livestock, crops and varieties selected in view of local conditions, demands both great knowledge and access to a sufficiently varied choice of these. The latter is far from the situation at present.

Today, it is hard for the farmer to make a profit from a multifunctional and locally based production. There is instead a development towards greater specialisation and rationalisation through scaling up, which may cause difficulties in utilising and strengthening ecosystem services. There is therefore a great need for broad based interdisciplinary research to develop new production systems that are based on utilisation of local resources. Apart from purely production issues, it is necessary to elucidate various aspects such as the long term sustainability of systems, inter alia the demand on resources, economy and feasibility (Formas, 2007). One important aspect is that food production in Sweden gives rise to environmental impacts and negative socioeconomic effects in other parts of the world. About one third of the farming area that our consumption demands is situated outside Sweden's frontiers (Johansson, 2005). The environmental impacts of products and their effects on economic and social conditions may be both indirect and occur after a time, and are often insufficiently reflected in the price. There is also a difference of opinion among researchers as to the boundaries that must be drawn and the methods of analysis that are needed, when natural resources are to be valued. In turn, this affects the conclusions that are drawn regarding the effective utilisation of resources in various production systems and food chains.

In organic crop production, the knowledge concerning utilisation and strengthening of the cultivated and surrounding biodiversity and the ecosystem services this contributes is an important resource in solving production issues concerning plant nutrients, plant protection and weed control (Nilsson, 2007). One specific crop production problem is that the



cultivated biodiversity is generally low, with relatively few species and a greatly limited access to different varieties. Today, there are few organic crop production farms in areas with intensive agricultural production, among other places in the flatlands of southern Sweden, where the environmental benefits of changing to organic production are particularly great.

Locally, there are no models for cooperation between dairy and crop producers, or between dairy or beef producers and the producers of pigs, eggs or chickens. Such cooperation could result in better utilisation of agricultural land for fodder production, plant nutrient circulation and the effects of rotation on weeds. Research can therefore comprise both the social scientific aspects of cooperation and economy and the natural scientific and technical aspects concerning management of plant nutrients, fodder supply and animal welfare, and resource utilisation and technical development.

Much remains to be done as regards the feeding of livestock with locally produced fodder of high nutritional and hygienic quality without synthetic additives. The role of non-ruminants in organic agriculture must be further elucidated. The question of 100% organic fodder must be set in relation to the various available resource effective by-products from the whole food chain. It may be difficult to provide effective and environmentally acceptable grassland systems for non-ruminants where the animals are really pasture fed and where species-specific characteristics can be utilised. The development of organic pig production is an exceptionally difficult challenge since it is drastically different from conventional livestock husbandry as regards access to the outdoors, fodder and grazing. All the above aspects, production of organic fodder, rules for access to the outdoors and the provision of grassland systems (KRAV, 2006), as well as recruitment, must be taken into consideration.

In organic livestock production, the special criteria for breed selection must still be taken into consideration.

The one-way flow of plant nutrients in society gives rise to environmental problems and the exploitation of finite resources, and at the same time there are serious difficulties in handling and processing the organic waste and sewage of towns. The return of organic waste and sewage to agriculture, with acceptable management, resource use and quality with regard to heavy metals, environmentally disruptive organic compounds and pathogenic microorganisms, is a continuing difficult challenge.

In the whole of agriculture, as well as in organic production, there is a low degree of self sufficiency at farm level regarding electric power and fuel. Finding innovative, organisational and technical solutions, and the biophysical and economic conditions that are required for the development of self sufficiency in fuel at the farm is a serious challenge. This is particularly the case in greenhouse systems.

#### *Animal health and animal welfare*

The design of the production systems must be based on both the strengthening role of livestock in production and on the wellbeing and health of the individual animal. It can be difficult to define, and to find ways to evaluate



and measure, the wellbeing of animals when the positive effects of greater space and freedom of movement with the opportunity to exercise their natural behaviours must be balanced against health risks. Owing to the less strictly controlled livestock environments in organic agriculture, with greater access to the outdoors, questions of how well the health and welfare of individual animals can be safeguarded merit extra attention (Lund, 2003). Access to the outdoors may increase the exposure of livestock to some types of infection and injury. Animal health statistics show that the disease spectrum of animals in organic production is somewhat different from that of animals in conventional production (Alarik et al, 2006). Many farmers, both conventional and organic, regard parasites in sheep and cattle as troublesome. Since general preventive anthelmintic treatment is not used in organic livestock husbandry, development of other tools must continue.

The outdoor access of livestock places great demands on the ability of the farmer to give consideration, at the same time, to good animal welfare, with a stimulating outdoor environment and good protection against infection and to various environmental aspects. More work is often necessary and this work may be both heavy and dangerous. Since the design of outdoor access and thus the whole livestock husbandry system is dependent on local conditions such as the shape of the farm, its topography and soil type, there are few standard solutions and suitable techniques to resort to. Development of flexible livestock husbandry systems, where the positive effects of outdoor access on the health and welfare of animals, food quality and environment are safeguarded and negative effects are mostly avoided, is thus a great challenge. It may be a matter of pasture rotation, grazing of different species in the same pasture, and other measures to promote animal health.

There are still gaps in our knowledge as regards the welfare and health of non-ruminant animals when these are fed a limited selection of fodder, which may occur when the feed regime is fully based on local or domestically produced organic fodder.

#### *Coupling between production method, food quality and health*

The quality of food has become an increasingly important but also broader term. It comprises both the technical quality of food such as nutrient content, the absence of impurities and additives, hygiene, odour, flavour (Deaton & Hoehn, 2005). and consistence. But it may also comprise ethical value judgements concerning social and resource economic issues in the production systems where the foods are produced. Product quality is also seen as the result of the quality of the entire production chain (Deaton & Hoehn, 2005). At present we have no systematic, clear and simple tools for the characterisation of these two types of quality.

The way we produce, process and store fodder and food affects quality and this, in turn, produces effects on the health of animals and humans. Production factors such as growth site, the humus content of the soil, mineral balance, the choice of fertiliser and other cultivation measures, all influence the quality of the plants grown. We still do not know enough



about how product quality can be managed and improved by developing the organic production methods. The comparative studies made between organically and conventionally produced foods vary in their arrangements, and it is therefore difficult to draw general conclusions regarding the differences. More knowledge is needed concerning data on elevated contents of secondary plant metabolites (substances that can provide colour, flavour or form part of the defensive system of the plant) with antioxidative and other properties (Olsson & Magnusson, 2004).

The husbandry system and the hygienic and nutritional quality of animal fodder, apart from directly affecting the health and welfare of the animal, can also play a part in the quality of foods of animal origin. Access to pasture and a greater proportion of green fodder in the feed regime may further increase the proportion of beneficial fatty acids in meat, milk and eggs (Enfält et al, 2006; Nilzén et al, 1999; Lopez-Bote et al, 1998). The challenge we are facing, if we are to be able to present a credible argument concerning the health effects of organic foods, is to develop knowledge and to cooperate with human medicine in these areas. In this way, favourable effects of food and feed can be utilised and more of the unfavourable effects can be avoided.

In recent years, food safety has increasingly come into focus, owing to the incidence of e.g. zoonotic diseases (diseases that can be transmitted from animals to humans) such as salmonella, EHEC (SVA, 2006) and BSE. Manure is a known infection hazard for food. There is little knowledge of how various infections survive in manure and how manure is to be handled, stored and spread in order to minimise these hazards. Because of the demands for safe foods, there is also restrictiveness concerning recirculation of plant nutrients from human waste.

#### *Summary of Problem Area II:*

- Production systems need to utilise local resources to a greater extent.
- There is a shortage of innovative solutions to improve the profitability of local multifunctional agriculture.
- Organic farms are needed in areas where biodiversity must be strengthened.
- Crop farming and livestock farming must be integrated for synergistic effects.
- There are no models for the return of nutrient-rich organic waste to farmland.
- Agriculture must become more self sufficient in fuel.
- Forms of cooperation concerning locally produced organic fodder and plant nutrients must be developed.
- Flexible livestock husbandry systems must be developed in which the positive health effects of the outdoor access of animals are safeguarded while the negative effects are minimised.
- 100% organic fodder – the opportunities must be developed and the consequences analysed.
- There is uncertainty regarding the feasibility of quality management through production factors.
- There are risks of contagion through manure.

### *Problem Area III – Research on key problems that strengthen effective organic production*

Research in Problem Area I has great significance for the achievement of the national consumption and production objectives for organic foods. Research in Problem Area III is important to improve specific problems of particular importance for organic primary production and in this way it is also closely related to the national objectives. In the background documentation for the national action plan for organic production and consumption (Ekologiskt Forum, 2007) it is emphasised that research and development in primary production should concentrate on branches of production which can be quickly converted from conventional to organic in view of present conditions concerning practice, regulations and markets. They should also produce foods that are easily handled in shops and in catering establishments, and should have positive side effects on other branches of production. In view of these criteria, priority is accorded to a number of branches of production, the first three of which are

- dairy production
- crop farming of strategic interest (forage seed, grain legumes, oil seed plants and potatoes), and
- vegetable growing.

The international evaluation of research on organic agriculture points out that applied, production-related research is often conducted best when there is close cooperation among researchers, advisers and farmers (Formas, 2007).

#### *Organic livestock production*

The present shortage of organic milk must be solved primarily by recruiting new organic dairy producers. The main bottlenecks are fodder production, since most conventional producers do not have sufficient land to produce fodder in the quantities needed (see integration of livestock and crop production, Problem Area II). By 2008, when all fodder for dairy cows must be organically produced, fodder production must be expanded. In order that organic dairy production should be developed, there is also a need for new interactive models for a functioning provision of certified calves to breeders with organic meat production.







### *Organic crop production*

The domestic production of organic fodder must be secured. Dairy production must handle forage silage with a high clover content, and must find a way to improve the hygienic quality of forage silage. And it must also find how the clover proportion of the leys can be kept at an even and lower level. Forage seed production has become more attractive, but it must be more stable still as regards yield and quality. Nor has the production of domestic organic fodder in pig and poultry production been completely solved, mainly as regards fodder of the correct amino acid composition.

The production of grain legumes and oil seed plants must be developed for a higher and more stable yield. There are problems concerning diseases in seed and insect pests (aphids and pollen beetles) in growing crops. Pollinating insects have great importance for the harvest level in these crops, but there is no specific advice as to how the farmer can use and favour these in his production and protect them from insect pests.

The production of potatoes has been hit hard in recent years by the spread of late blight in Sweden. As far as organic potato production is concerned, this mainly affects the security of cultivation. Among farmers there is great demand for a wider choice of resistant varieties, with specifications of yield and quality under different growing conditions such as soil type and the availability of plant nutrients.

### *Organic market gardening*

There is development potential and a belief in the future among producers of organic fruit and vegetables (Nilsson, 2007). In primary production, in the short term, it is chiefly the heavy work load in controlling weeds that is a problem. There is a continued need of method and technology development for weed control. Since there are great differences among market gardening companies, from small scale and mainly manual production to large scale mechanised enterprises, several tailor-made solutions are needed.

More knowledge is needed concerning measures that alleviate the problems caused by insect pests and diseases in market gardening, e.g. biological

control. In most crops there is often also an imbalance in the availability of plant nutrients.

In greenhouse production, the cost of heating is very high. There is a need for further research and development concerning energy saving measures and the use of renewable sources of energy.

There is scope in market gardening for greater diversity, both in greenhouse systems and in outdoor systems with vegetables, fruit and berries. There is also a very great need for a wider choice of disease resistant varieties of fruits and berries.



### *Summary, Problem Area III*

- The three types of business which have been judged to have the greatest potential for organic agriculture are dairy production, crops of strategic interest (forage seed, grain legumes, oil seed plants and potatoes) and the growing of fruit, berries and vegetables.
- The lack of land for fodder production is often a problem for farmers who want to start organic dairy production. The organic fodder production must be developed for all livestock species.
- Production of grain legumes, oil seed plants and potatoes is affected by problems due to insect pests, diseases, etc.
- In market gardening, weed control, as well as certain insect pests and diseases, are expensive for the farmer.
- There is great scope for more diversification in market gardening as regards species and varieties.

*For further specification of needs concerning key problems, the reader is referred to the working papers produced during the work on a new action plan for organic production and consumption 2010 (Ekologiskt Forum, 2007) and to the identification of problems in organic horticultural production that was carried out by Nilsson (2007).*

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## *Appendix – Swedish research in organic agriculture evaluated*

Since 1997, funds earmarked for financing research in organic agriculture have been available in Sweden. A group of internationally well qualified agricultural researchers has now evaluated the scientific quality of research in organic agriculture. At the same time, a group comprising experienced Nordic agricultural advisers and an agricultural journalist reviewed the relevance and usefulness of research for advisory services and agriculture in practice. According to the scientific evaluation, there is a large proportion of projects of high quality, but in many cases there has been far too little international publication. The second group finds a high degree of relevance and satisfactory achievement of the objectives, but at the same time it criticises the poor dissemination of the results of projects.

A total of 74 projects financed by Formas (Research Council for Environment, Agricultural Sciences and Spatial Planning), SLF (Swedish Farmers' Foundation for Agricultural Research), SJV (Swedish Board of Agriculture), and projects within the SLU programme "Ekoforsk", were included in the evaluation. The total cost of the projects had been MSEK 201.

### *More publication and cooperation needed*

The evaluators found great variation among the projects with regard to scientific quality. Almost one half of the projects were considered to be of very high standard. On the other hand, as many as 28% of projects exhibited clear weaknesses. The greatest failing of the projects given low marks was that, in most cases, they had not been published in scientific journals to a sufficient extent. Research concerning social and economic aspects was somewhat weaker than that in other areas.

With a few exceptions, the scientific evaluators considered that the projects had great general significance and very great significance for organic agriculture – especially the projects which had been completed recently. Some of the earlier projects had not given enough attention to the special properties and problems that characterise organic agriculture in comparison with conventional agriculture.

The group of scientific evaluators saw many good examples of national and international research cooperation, but would have preferred to see more. Generally, large projects received better marks than small ones.

The competence of research leaders received high marks. On the other hand, the group was more critical about the way in which the projects had succeeded in influencing capacity building in research, i.e. whether they had resulted in Master, Licentiate or PhD degrees. In many projects, there was complete absence of this. The evaluators also pointed out that there should be greater institutional responsibility to ensure that every project results in a final report and publication.

### *Good achievement of objectives*

The group which reviewed the relevance and usefulness of research found that most projects well satisfy the objectives set by the funding agencies. In most cases there is high relevance to organic agriculture, particularly in cases where practitioners had taken part and influenced the design of projects. However, this group also criticised some of the projects for their lack of focus on the issues in organic agriculture.

### *Poor dissemination of results*

The evaluators consider that, in most cases, dissemination of research results to advisers and farmers, as part of the research projects, has been insufficient. The evaluators are also of the opinion that the projects had made no major contribution to the development of capability within the advisory services.

### *Closer cooperation with practitioners*

The evaluation group for relevance and usefulness emphasises the importance of cooperation among funding agencies in formulating research programmes. Practitioners should take part in the research process at an earlier stage. Those who evaluate the project applications should have a background and competence in organic production.

## *Recommendations*

### *Recommendations by the evaluation group for scientific quality*

- Continued earmarking of research in the field of organic agriculture, which is preferable to the more general term sustainable agricultural systems.
- Future research programmes must focus on the following:
  - I. Research on marketing, economy of production and resources, and the policy issues and social effects of a growing organic food sector. The research in this area has not reached the extent aimed for, in spite of the priorities it had received in earlier research programmes. The evaluators therefore recommend research cooperation with groups outside traditional agricultural research.
  - II. Interdisciplinary research on production systems relating to production, economy and environment. The evaluators consider there is a need for somewhat larger, clearly interdisciplinary, thematic projects that comprise both applied research and research of a more strategic nature concerning sustainable production systems.
  - III. Research on key problems which strengthen effective organic production. Research on more clearly defined areas must also be related to the context of organic agriculture, in order that it may contribute to the development of both production and food consumption.
- Increased internationalisation. Greater visibility of Swedish research in Europe would assist the development of organic agriculture in Europe, and also in Sweden through greater international research cooperation.



- Better management of research projects, which means
  - a greater focus in calls for applications for research grants to ensure that research really occurs in the areas of the highest priority. This mainly concerns social scientific research and major interdisciplinary thematic projects.
  - applications should contain concrete descriptions of what results the project will deliver. Applications should be written in English and should be assessed and prioritised by both Swedish and international experts.
  - projects must be monitored better and it is recommended that annual reports on specific progress should be submitted.
  - stronger institutional responsibility is needed to ensure that all projects are completed and final reports are submitted.

*Recommendations by evaluation group for relevance and usefulness:*

- Closer cooperations among funding agencies.
- Better knowledge of organic agriculture when funding agencies assess and prioritise projects.
- Greater interdisciplinary research cooperation and research methods that focus on problem solving.
- Better communication between funding agencies and researchers during the research process.
- Cooperation and communication between researchers, advisers and farmers should be a qualifying factor when finance for research projects is prioritised.
- An overriding research strategy for research on organic agriculture, and thus continued earmarking of funds.
- The present scope of advisory services in organic production must be maintained to bridge the gap between research and the users of research results.

This framework programme is a description of the need for knowledge in organic production and consumption. It has been drawn up in a dialogue among researchers, advisers, consumer and other players within organic agriculture. The programme has been developed in an open process within the framework of the activity in the Centre for Sustainable Agriculture (CUL).

*Centre for Sustainable Agriculture (CUL) is a collaborative forum for researchers and others who have an interest in organic agriculture and in the sustainability issues of agriculture. CUL is engaged on developing interdisciplinary research methods and on coordinating measures for*

- *research and long term capacity building*
- *development work*
- *education and training*
- *dissemination of information*

*within organic agriculture.*

*It is also the aim of the work to assist in developing the whole of agriculture into a sustainable and viable agriculture.*



Centre for Sustainable Agriculture (CUL)  
SLU  
Box 7047  
S-750 07 Uppsala  
Sweden  
[www.cul.slu.se](http://www.cul.slu.se)

