CORE Organic Country Report

Report on Danish Research in Organic Food and Farming

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Content

1 Introduction

During the 1990s, Organic Food and Farming production became an important sector in Danish agriculture. From something, which hardly could be measured in the early 1990s, both production and consumption of organic products rose significantly during the decade.

In 2003 there were 3510 organic farms in Denmark corresponding to 7.2 % of the 48613 farms in Denmark. The organic farmers were cultivating approximately 168022 hectares making up for approximately 6.3 % of the total cultivated area.

The rapid rise of the production in the 1990s was chiefly a consequence of increased consumer demand for organic products. Today, Denmark has one of the world's highest consumptions of organic products; approximately five percent of all food products sold in Denmark are organic.

The development of the Danish organic production has since the mid 1980s been supported by the various Danish governments. Organic farming has foremost been considered to represent a more environmental-friendly agricultural production, but also in relation to food quality, food safety, as well as animal health and welfare, it has been recognised that organic farming represents possible answers to problems haunting conventional farming systems.

Support to the development of Organic Food and Farming systems has thus included economic support for conversion of farms, regulation and control, advisory services, education and public information together with the initiation and conduction of specific research programmes.

The aim of this country report is to present an overview of the Danish research in Organic Food and Farming. The overview is given within the subjects below.

2 History

2.1 Development of Danish research in organic farming

The early development of organic farming in Denmark was inspired by the formation of alternative growing systems as they appeared early in the 20th century in Germany, England, Switzerland and the US. It was however, problems in the 1970s and 1980s related to the industrialised agricultural production methods that sparked a more weighty interest in alternative production - an interest that could be identified in environmentally conscious farmer groups and at several universities.

Denmark has also contributed to the international development of organic farming research. In 1996, the 11th Scientific conference1 of the International Federation of Organic Agriculture Movements (IFOAM) took place in Copenhagen, which from a scientific point of view has been one of the best IFOAM Conferences. In 2006, DARCOF is organising the Joint Organic Congress at which, for the first time, all current European research projects related to organic farming will present their results.

2.2 The first research initiatives

Even though the Danish Research Council during the 1970s hosted several discussions on research in organic farming it was not until the 1980s that the discussion became productive. In 1983, a study conducted on organic farms mapped the most evident research needs. The study was followed by a series of institutional projects on the influence of various production methods on crop yield, plant pests, nutrient turnover and soil quality, but also projects dealing with product development and marketing issues etc.

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[1] Information on the 11th IFOAM Scientific Conference and abstracts
http://www.organic.dk/english/ifoam/conf96/index.htm

Later, in 1986, the Minister of Agriculture initiated a five-year research programme, which – among others - opened up for research projects on various aspects of organic farming. However, it was not until 1993 that the first research programme dedicated to organic farming was initiated. The programme duration was five years and it involved 13 projects with a total value of 50 million Danish Crowns (DKK; approx. € 6.7 million). The projects were fixed within two main areas: 1) research in basic organic principles and 2) development of organic production methods.

2.3 The first Danish Action Plan

Experiences from the initiation and evaluation of the first research programme in organic farming were utilised in the preparation of the first Danish Action Plan for Organic Farming, which was published in 1995. The action plan was prepared as a result of an overwhelming consumer demand for organic products - which the organic producers could not fulfil. The scope of the Action Plan was thus to look for ways to improve production and to ease the transition for those farmers, who wanted to establish an organic production.

The Action Plan contained several recommendations on research: Generally, it was recommend that research and the education of researcher with expertise should be intensified. Specifically, it was recommended to establish an organic research station as a base for the research. Finally, the Action Plan noted the need for further coordination and transdisciplinary cooperation within organic farming research.

2.4 Establishment of DARCOF

In late 1995, as a response to the recommendations in the Action Plan the Ministry of Food took the initiative to establish the Danish Research Centre for Organic Farming (DARCOF)[2]. The responsibilities of the new "research centre without walls" included initiation, coordinating and utilisation of research in organic farming. The idea was to make use of best available research knowledge at existing institutes, and to make this knowledge relevant for organic farming. The individual researchers should be able to stay in their own research environment, but work with organic farming in collaboration with researchers from other institutes.

2.5 DARCOF I

At the same time as DARCOF was established, the Ministry set aside DKK 100 million (approximately € 13 million) for a research programme (DARCOF I) to be conducted from 1996 to 2000. Furthermore, the Ministry provided funding for the establishment of an organic research station at Rugballegaard, together with organic workshop sites at several localities. Finally, a research professorship in organic plant production was established at the Royal Veterinary and Agricultural University. During 1996 the programme was initiated with 33 research projects, involving 13 institutions and about 100 research workers.

2.6 Second action plan for organic farming

In January 1999, the Ministry of Food, Agriculture and Fisheries had the second Action Plan prepared. The title of the new plan was "Developments in Organic Farming", which was to reflects the Ministry's commitment to significant expansion of organic food production and sales in Denmark. In relation to the first action plan, where the focus was production, the new action plan focused merely on the expectations and needs of the consumer, and safeguarding confidence in organic products was seen as a vital factor in the continued growth of the sector.

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2 Forskningscenter for Økologisk Jordbrug (FØJO) / Danish Research Centre for Organic Farming (DARCOF). www.fojo.dk and www.darcof.dk

2.7 DARCOF II

The Action Plan also examined barriers and possibilities for the development of commercial areas of organic food production. For many of these areas it was recommended to implement research in order to investigate possibilities for further developments. The overall recommendation on research was to initiate a new research programme within DARCOF.

Timeline for Danish research in Organic Food and Farming

- 1983 Mapping of research needs at organic farms
- 1987 World's first legislation on organic production
- 1988 Study shows 27 ongoing research projects at 14 different institutions
- 1993 First central research programme in organic farming
- 1995 First Danish Action Plan for Organic Farming
- 1996 Establishment of Danish Research Centre for Organic Farming (DARCOF)
- 1996 11th IFOAM Scientific Conference takes place in Copenhagen, Denmark
- 1996 First coordinated research programme (DARCOF I)
- 1999 Second Danish Action Plan for Organic Farming
- 2000 Second coordinated research programme (DARCOF II)
- 2005 Third coordinated research programme (DARCOF III)
- 2006 Joint Organic Congress held in Odense, with the presentation of results from current European projects

3 Organisation of Danish research in organic farming

In Denmark research programmes with direct relevance for Organic Food and Farming are provided by the Danish Ministry of Food, Farming and Fisheries. The actual funding is generally distributed by the Danish Directorate for Agribusiness - after advice from the "Advising committee on research".

In the case of research in Organic Food and Farming, tasks concerning initiation and coordination of programmes have been entrusted to the Danish Research Centre for Organic Food and Farming (DARCOF). Plans for new research programmes are to be presented for the Advising Committee, who can comment on the initiatives. Likewise, new programmes and other major initiatives regarding Organic Food and Farming are presented for the Organic Food Council, who is advising the Directorate and the Ministry in questions regarding Organic Food and Farming. The overall organisation is shown in figure 1.

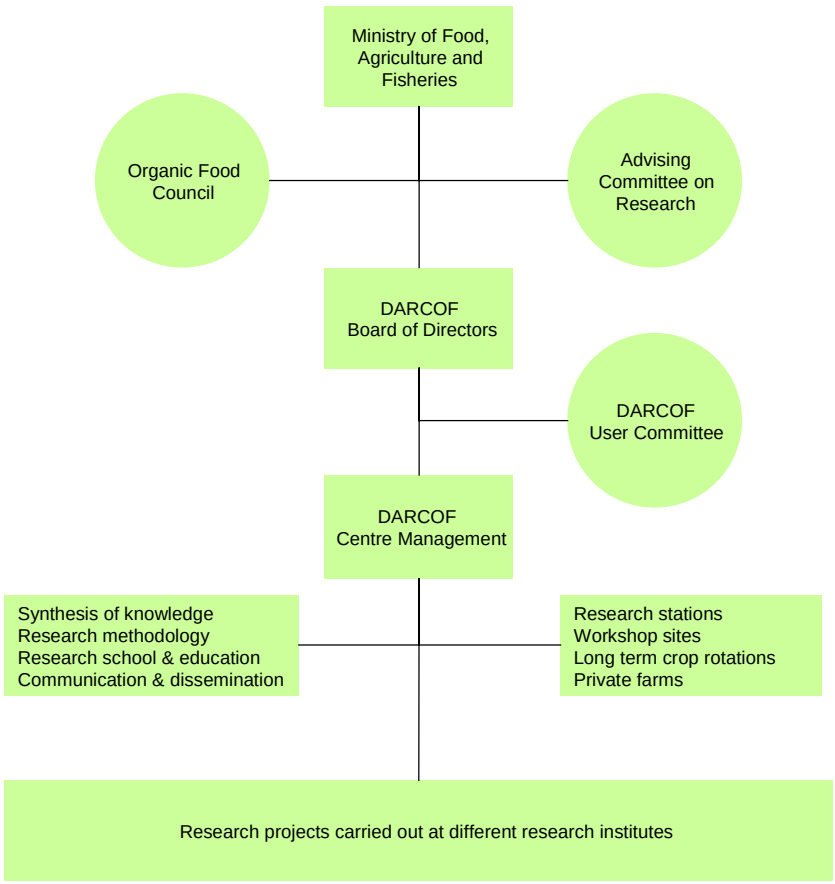

Figure 1: Organisation of Danish research in Organic Food and Farming

The board of directors carries out the overall management of DARCOF. The Minister appoints the regular board members after nomination by the central research institutes (textbox 1), while the chairman of the board is appointed directly by the Minister without any prior nomination. Furthermore, the DARCOF User Committee is represented at the board (see chapter 6 on stakeholder engagement). The obligations of the board include the task of initiating new research programmes and to safeguard the scientific quality of research.

The DARCOF board of directors are represented in the Advising Committee for Research and the Organic Food Council. Links to the homepages of these institutions are available at the DARCOF Homepage[3].

[3] http://www.darcof.dk/links/index.html

Textbox 1. DARCOF Board of Directors

- Chairman appointed directly by the Minister
- 1 member nominated by Centre for Advanced Food Studies
- 2 members nominated by Danish Institute of Agricultural Sciences
- 1 member nominated by Danish Research Institute of Food Economics
- 1 member nominated by National Environmental Research Institute
- 1 member nominated by National Institute for Food and Veterinary Research
- 1 member nominated by Risø National Laboratory
- 2 members nominated by The Royal Veterinary and Agricultural University
- 1 member representing the DARCOF User Committee
- 1 member appointed by the Directorate for Food, Fisheries and Agricultural Business (observer)

Several other research institutes and organisations participate in the DARCOF cooperation, but are not represented at the board of directors. These institutes are listed in textbox 2.

Textbox 2. Other institutes participating in DARCOF research programmes

- Universities and sector research institutes
- Centre for Bioethics and Risk Assessment
- Danish Institute for Fisheries Research
- Danish Institute for International Studies
- Food and Resource Economics Institute
- Technical University of Denmark
- University of Aalborg
- University of Copenhagen
- University of Southern Denmark
- University of Århus
- Organisations and agencies
- Danish Agricultural Advisory Centre
- Danish Aquaculture Organisation
- Danish Bacon and Meat Council
- Danish Food Agency
- Danish Meat Research Institute
- Danish Technological Institute

4 Research programmes 2000 - 2010

In the following, the content and volume of the Danish research programmes in Organic Food and Farming are laid out.The programmes, which were carried out before 2000, are mainly of historical interest, only programmes from 2000 and forward are described.

4.1 Research 2000 – 2005 (DARCOF II)

In the late 1990s, the public interest in organic and sustainable agriculture stimulated the preparation of various national documents (policies) on the subject. For organic farming the most important document was *Action Plan II – Developments in Organic Farming*, which was prepared by the Danish Organic Foods Council to the Minister of Food, Agriculture and Fisheries.

On the basis of the Action Plan it was concluded that research initiatives must take due regard to market demands, while preserving the values associated with organic principles. The remit of DARCOF II, which was initiated in the prolongation of the Action Plan, was thus "*to produce knowledge that can be used to promote increased production and a closer relationship between the inherent and organic qualities of organic foods*".

Key figures for DARCOF II

▪ Title of programme:	Increased production and a closer relationship between inherent and organic qualities of organic foods (DARCOF II)
▪ Duration:	2000 – 2005
▪ Financing:	€ 30 million in total
▪ Research institutes:	20
▪ Number of projects:	34

4.2 Research areas and projects

As it appears from the project portfolio (annex 1), the projects can be listed under six main areas:

I. Crop production, the environment and the quality of vegetables
II. Animal husbandry, health and the quality of livestock products
III. Agriculture and society
IV. Research units and workshop areas
V. Research co-ordination, synergy and education
VI. Seed production and developments

However, the projects listed under each heading are more embracing than the headings might suggest. In the area of crop production, the projects relate to plant production systems, nutrient metabolism, foods quality and safety. The animal husbandry area incorporates projects on livestock production, health and welfare, as well as food quality and safety. For agriculture and society, the projects cover consumer preference, legislation and confidence, society and economics, organic food and human health, nature quality and research within the organic principles. Areas IV and V include projects that are instrumental in the completion of the research projects in the other areas. Finally, area VI contains projects dealing with improvement of seeds and plant varieties, together with research aiming on providing knowledge on how to avoid contamination of organic produce with genetically modified materials. All research results, reports and articles are documented in the Organic Eprints Archive.

4.3 Distribution of funding

DARCOF II is involved in approximately 140 research scientists corresponding to approximately 360 person-years. The total grant amounts to approximately 30 million €. The distribution at the individual projects appears from annex 1. In table 1, the budget is distributed according to the overall subjects areas of Organic Eprints.

Table 1: Budget of DARCOF II distributed according to subject areas

Subject area	Projects	Amount, 1 000 €
1 Farming systems	IV	2 669
2 Animal husbandry	II.1, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10	5 181
3 Crop husbandry	I.1, I.2, I.5, I.6, I.8, I.9, I.10, I.11, I.12, I.14, VI.1, VI.2, VI.3, VI.4, VI.5	10 188
4 Soil	I.7	751
5 Environmental aspects	I.3, I.13, I.15, I.16, III.3, III.5	4 161
6 Food systems	I.4, II.2, II.11, II.12, III.1, III.2, III.4, III.7, III.8	4 343
7 Values, standards and certification	III.9	267
8 Knowledge management	V	2 707
Total		30 267

4.4 Research 2005 – 2010 (DARCOF III)

Key figures for DARCOF III

- Title of programme: International research cooperation and organic integrity [4] (DARCOF III)
- Duration: 2005 - 2010
- Budget: € 27 million in total (2 millions set aside for transnational research)
- Number of institutes: 20
- Number of projects: 15 national projects (transnational projects are expected)

DARCOF III is the new Danish research programme in Organic Food and Farming. Funds for the programme (approximately 27 million € in total) were allocated as part of a parliament decision in 2004 on the so-called "Water Environment Plan III". The programme was initiated in continuation of the DARCOF strategy from 2003, which called for research supporting:

- The integrity and efficiency in the whole organic food chain – from farmer to consumer
- A sustainable development of society as a whole

The programme consists of 15 large projects within the following eight main themes:

- Nutrition, health and food safety
- Processing, quality and consumption of organic products

[4] Integrity can be understood as the ability to act independently, honestly and in agreement with moral principles, but also as the right to exist as a group without being offended by others.

- Development of an efficient primary organic production
- Organic integrity
- Different production systems significance for sustainable development
- Bio-energy as a complement to organic food production
- Regulation and trade
- Organic farming in a global perspective

4.5 Distribution of funding

The total grant amounts to approximately € 27 million. The distribution of the national projects appears in annex 2. In table 2, the budget is distributed accordingly to the overall subject areas of Organic Eprints.

Table 2: Budget of DARCOF III distributed according to subject areas

Subject area	Amount, 1 000 €
1 Farming systems	933
2 Animal husbandry	1 490
3 Crop husbandry	4 400
4 Soil	0
5 Environmental aspects	2 800
6 Food systems	12 064
7 Values, standards and certification	1 533
8 Knowledge management	933
Total	24 800

4.6 Plans for transnational research

In addition to the above numbers approximately € 2 million have been set aside for a common pool for transnational research in Organic Food and Farming. The common pool is part of the DARCOF III programme.

5 Financing

Since 2000, the main part of the Danish research effort in Organic Food and Farming has been carried out through the research programme DARCOF II. As this programme is carried out under the auspice of the Ministry of Food, Agriculture and Fisheries, the Directorate for Food, Fisheries and Agri Business (DFFE) administer the funding for the individual projects in the programme.

Means for funding of research programmes are provided via an account at the Danish Finance Act (§ 24.33.02 - Grants for Research in Food and Agriculture), meaning that major research programmes have to be approved by Parliament. Payments are made annually according to a set of instructions, which among others include annual status reporting and evaluation as a prerequisite for continuing release of funding.

Co-financing by institutes, other authorities or private companies is commonly used in many projects. The expected co-financing will appear from the project application, while the actual

co-financing will appear in the final project report. As average it is estimated that approximately 25 % of the total programme are co-financed. Table 3 provides an overview of the distribution of funding of the research programme.

5.1 Funding of development activities

The Directorate for Food, Fisheries and Agri Business is also coordinating the Danish programme for business innovation, which provides funding for development of products and processes in small and medium size enterprises (SMEs).

Research institutes can apply to the programme in cooperation with a private company. However, as the private company has to carry the main part of the overall expenditure, the programme has primarily resulted in innovations rather than regular research. A comparable programme called "grassroots research" focuses on innovations on organic farms. This programme has mainly been utilised by organic farmers, who seek to develop their production.

Finally, the "Foundation for Organic Farming" was established in 2004, by means of a parliamentary decision. The objective of the foundation is to strengthen business possibilities within Organic Food and Farming. Emphasis has thus been on product developments, marketing etc.

Table 3. Estimated annual research funding for Organic Food and Farming (million € per year)

	2000 – 2004	2005 - 2009
Research programmes (DARCOF)	5.5	5.3
Co-financing of research programmes	1.4	1.1
Other public R&D	2.0	2.0
EU-funding	0.1	1.0
Total	9.0	9.4

6 Research facilities

During the first years of DARCOF's existence several organic research facilities were setup to provide opportunities for conducting different projects simultaneously, using the same research fields, herds, etc. As researchers from different research environments cooperate in DARCOF, the use of common facilities may stimulate interdisciplinary collaboration, synergy and complementary research. The main facilities are described below.

6.1 The organic research station Rugballegaard[5]

At Rugballegaard near Bygholm Research Centre, a research station has been established to investigate organic animal production and the interactions between animal husbandry and crops on a large area of land. Rugballegaard covers an area of 140 hectares, its stock comprising 60 dairy cows, with followers and about 60 sows, for the production of slaughter pigs. The farm has been authorised for organic farming since 1996 and several new research buildings have been built for the housing of animals. Financing of these facilities is provided by the Danish Institute of Agricultural Sciences (DIAS).

5 The Organic Research Station Rugballegård, http://web.agrsci.dk/jbt/Rugballeg_uk/index_uk.shtml

6.2 Research farms at KVL

One of the research farms at the Danish Agricultural University (KVL)[6], Bakkegaarden, is dedicated to organic farming. It has been converted in 1999-2000 and covers about 48 hectares. On another of KVL's research farms there are areas for studying different organic cropping systems and an organic workshop site, running since 1988. Financing of these facilities is provided by KVL.

6.3 Crop rotation trials

Long-term organic crop rotation trials have been performed since 1996 on four locations: Jyndevad, Foulum, Flakkebjerg and Holeby[7]. The crop rotations have different proportions of legumes, cereals and cash crops. They are carried out on different soil types and with different levels of manure. The aim of these trials is to investigate how the type of rotation affects yields, nutrient balances, weed and disease problems, as well as soil fertility. Financing of these facilities is provided by DARCOF II (Project IV).

6.4 Organic workshop sites

Organic workshop sites for research, which cover a total of 55 hectares, have been setup at Flakkebjerg, Aarslev and Foulum research centres and at Jyndevad and Askov research stations. These sites have all been managed according to organic principles since 1996 and some were converted as early as 1987. They are principally dedicated to plant production investigations. At these sites, it is possible to conduct analytical studies that require different soil types and climatic conditions. Furthermore, a part of the long-term fertiliser trials on Askov, which have been running since 1893, has been converted to organic farming in 1998. Financing of these facilities is provided by DARCOF II (Project IV).

6.5 Farm studies

Finally, agreements have been drawn up with private organic farmers who make their farms available for research in relation to different projects. Expenses for farm studies are covered by the individual projects undertaking such activities.

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6 The Royal Veterinary and Agricultural University (KVL), Centre for Ecology and Environment (CENVIR), http://www.agsci.kvl.dk/coem/English/ukintro.html

7 See also Djurhuus, Jørgen und Olesen, Jørgen E. (2000) Characterisation of four sites in Denmark for long-term experiments on crop rotations in organic farming. DIAS report Nr. 33, Danish Institute of Agricultural Sciences. Archived at http://www.orgprints.org/1814/

7 Initiation of research and stakeholder engagement, prioritised research needs in DARCOF III

A major argument for establishing DARCOF, as a coordinating centre for Danish research in Organic Food and Farming, was to secure the coordination between the policy level, the organic associations and other stakeholders as well and relevant research institutes.

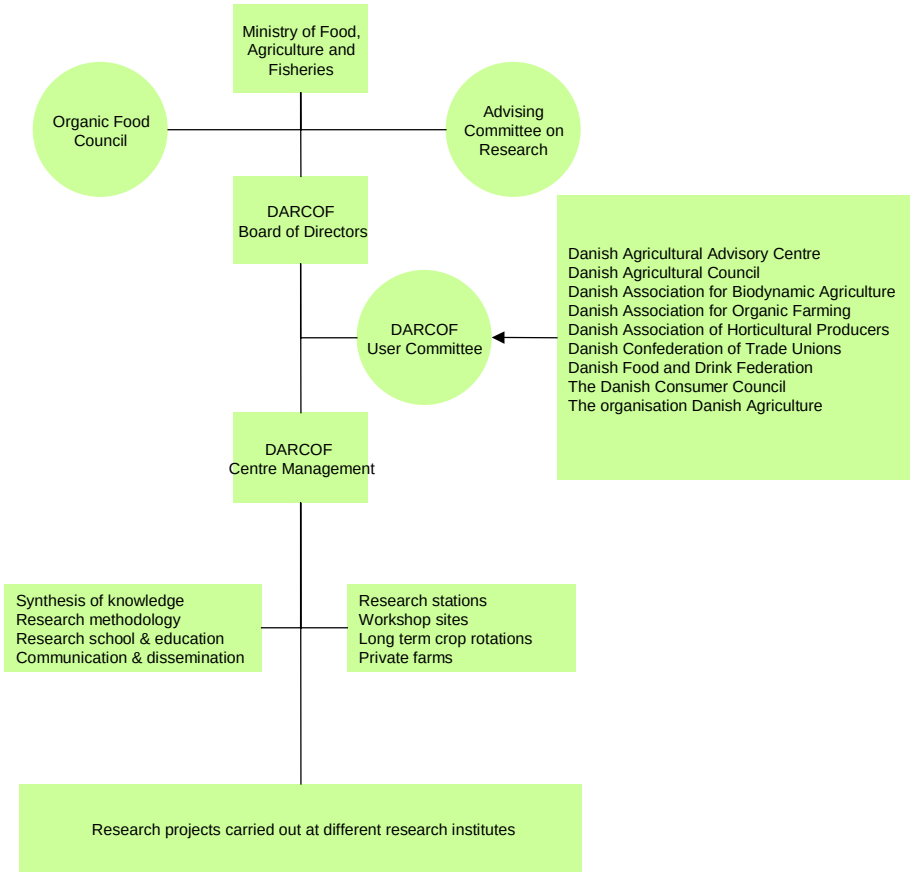

Figure 2: User representation in the Danish organic farming research system

The organisation of DARCOF includes a board of directors, which are appointed by the Ministry of Food Agriculture and Fisheries (see chapter 2). Thereby, the Board is responsible for initiating and implementing the research in accordance with the policy of the Government. To ensure the relevance of the research activities, including contact with the various user groups, a user committee has been appointed with representatives from professional organic associations, NGOs, etc. The User Committee advises the Board in all relevant matters and the main obligation is to ensure that the research initiated in DARCOF is relevant for users (foremost organic farmers and manufactures) and that research results are mediated to the relevant user groups. However as shown in figure 2, also other stakeholders can influence the decision process above the Board of Directors. The Organic Food Council advises the Ministry in all matters concerning Organic Food and Farming. The Advising Committee on Research advises the Ministry in all matters concerning research.

7.1 Initiation of research programmes

Very often, major research programmes have their own unique story of origin, as they are influenced by political and societal discussions, new technological possibilities etc. However, in the case of research in Organic Food and Farming, some typical phases can be identified (Table 4).

In the following chapters, the main phases are described further.

Table 4: Typical phases in initiation of research programmes

	Involvement of stakeholders	Involvement of board of directors
Public discussion on research needs	+++++	++
Governmental action plan or policy paper	+++++	+
Preparation of DARCOF strategy or guiding principles	++++	+++++
Call for expressions of interests	+++	+++
Call for project applications	+	+++++
Evaluation of research quality		+++++
Final selection of projects	++	+++++

+ Low degree of involvement

+++++ High degree of involvement

7.2 Public discussions and preparation of action plans

Prior to both DARCOF II and I the Danish Ministry of Food, Farming and Fisheries asked the Danish Organic Council to prepare action plans with suggestions for the overall development of organic farming in Denmark. In both action plans, research was seen as the pre-requisite for further development of the organic form of production, but also as an important tool for society as a whole to meet targets of environmental and social sustainability, healthy, high-quality foods and better animal welfare.

As the Organic Council and the DARCOF User Committee represents the same stakeholders, the involvement of the User Committee has also been high.

7.3 DARCOF strategy and expressions of interests

Prior to the DARCOF research programmes DARCOF has prepared documents (strategy or guiding principles) highlighting the research needs and challenges in relevant areas of Organic Food and Farming. In order to get ideas from all interested research communities on how to meet the challenges, a call for expressions of interest has been put out. Concerning DARCOF III, which has recently been implemented, the complete strategy can be seen at the FOEJO website[8]. The call for expressions of interest can be seen at the OKOFORK homepage[9], which serves as an internal communication tool for all researchers involved in DARCOF projects.

[8] Forskningscenter for Økologisk Jordbrug: Strategioplæg 2005 – 2010. Internationalt forskningssamarbejde og økologisk integritet. http://www.foejo.dk/debat/strat19sep03.pdf

9 Forskningscenter for Økologisk Jordbrug: Oplæg til ny forskning I økologisk jordbrug og økologiske fødevaresystemer 2005-2010 (FØJO III). Internationalt forskningssamarbejde og økologisk integritet. Available at http://www.okoforsk.dk/funktion/koor/nyforsk/indkald_juli04.pdf

7.4 Call for project applications, prioritised research needs in DARCOF III

Based on the policy need and the most prospective ideas given by researchers in the expressions of interests, a call for project applications is prepared. In contrast to the call for expressions of interest, the call will be quite precise in stating the prioritised research needs and the specifications needed in the applications. In DARCOF III, the call was specified so it could correspond to one single project within the following themes, in total 16 topics (number is shown in brackets):

- Nutrition, health and food safety (1)
- Processing, quality and consumption of organic products (6: Dairy products, meat and eggs, fish, vegetable products, cereal products, consumers study of demand)
- Development of an efficient primary organic production (2: Utilisation of grass clover, intelligent weed management)
- Organic integrity (2: natural sources of vitamins and minerals, organic seeds)
- Different production systems significance for sustainable development (2: Production systems, biodiversity)
- Bio-energy as a complement to organic food production (1)
- Regulation and trade (1)
- Organic farming in a global perspective (1)

In order to enable the formation of joint project applications and project groups involving researchers from different research environments, the individual expressions of interest are put on DARCOF website. The complete call, with the deadline of 15 March 2005 is available at the Okoforsk homepage[10].

7.5 Evaluation of quality and selection of projects

In DARCOF II, an international evaluation of research quality in the individual projects was executed by DARCOF. According to the change of the rules for the Danish Research Council System in 2004, the Danish Research Agency must now perform an independent evaluation of the scientific quality of all major research programmes. A programme committee appointed by the Danish Council for Strategic Research performs this evaluation – very often by help from international experts.

The final selection of projects can only be done among projects that have been quality approved by the Danish Research Agency. The selection is done by the DARCOF board of directors by advice from the User Committee. The relevance of the research project for Organic Food and Farming, the proven research skills of the applicants (especially the project leader) and the possibility for achieving optimum benefit from the allocated resources, are some of the criteria used.

7.6 Areas of dispute

When initiating DARCOF II, the expressions of interest in some central areas were so diverse and incoherent that it was not possible to initiate research projects directly in the above manner. This was especially the case of organic pig production, quality of nature, protection of ground water, food quality and human health, quality of organic plant breeding and seed production, as well as the possibilities for an organic production free of genetically modified organisms (GMOs). For in-

[10] Forskningscenter for Økologisk Jordbrug : Ny forskning i økologisk jordbrug og økologiske fødevaresystemer 2005-2010; http://www.okoforsk.dk/FoejoIII/Foejo%20III%20oplaeg.pdf

stance, there were very different expectations as to which production systems would prevail in future organic farming – something that is quite decisive for the initiation of research.

In these areas, knowledge syntheses were performed during the year 2000. In short, a knowledge synthesis analyses, discusses and synthesises the existing knowledge on a not clarified, and often disputed subject in relation to the main points of view. The work takes place in a group of experts from different fields, representing the different points of view on the subject. An important aim of the knowledge synthesis is to create mutual understanding among the experts with a view to future research and the development of organic farming.

8 Selection criteria and evaluation procedures

In the following, the common criteria for selection of projects are described together with a description of the procedures used for annual and mid-term evaluation of individual projects.

8.1 Selection of projects and research teams

Both DARCOF II and III were established on the basis of expressions of interest from the research community. In textbox 3, the common criteria for selecting research groups and projects are shown.

Textbox 3.
Common evaluation criteria

I. Fulfilment of the general objectives for the overall research effort and adequate coverage of specific research areas
II. The short- and long-term relevance for organic farming - and the potential relevance for conventional farming
III. Contribution to the internationalisation of research, including participation in formalised research cooperation
IV. An assessment whether the project objectives can be fulfilled within the suggested time schedule
V. The relationship between the benefits of the expected results and the estimated expenditure
VI. The scientific background, experience and technical competence of the applicants
VII. The desires for focused and long-term build-up of knowledge, including development of specific competence on participating institutes
VIII. Continuity in research, including synergy and coherence with existing and concluded research
IX. Contribution to education of researchers and mediation of results nationally and internationally
X. General quality, news value and potential for innovation

8.2 International evaluation of applications

As a means to further secure the scientific quality of the research, all project applications for DARCOF II undertook a thorough evaluation by external, international experts, whose criticisms were decisive for determining to which extent a project could be conducted (see textbox 4 for the criteria used for the evaluation).

This evaluation was conducted by DARCOF. The rules for the Danish Research Counselling System have later been changed, meaning that the Danish Research Agency at the present day must perform evaluations of all new major research programmes.

The consequence of this change of rules was that experts appointed by the National Research Agency evaluated all project applications for DARCOF III.

Textbox 4.
Criteria for international evaluation of applications for research in organic farming

Project as whole

- Scientific quality (problem identification and –reduction (as given in the introduction, state-of-the-art objective), project organisation and suggested time schedule etc.)
- Contribution to over all objectives of DARCOF II
- Competence of the applicants (in particular the project leader)
- Suggestions for cutting the project budget with approximately 25%:
- Important aspects not included

Individual work packages

- Scientific quality: materials, methods, conduction etc
- Are the proposed budgets appropriate with the expected achievements?
- Other remarks

8.3 Monitoring progress in ongoing projects

One of the key activities of DARCOF is to coordinate, evaluate and manage the research projects in accordance with the overall objectives of the whole research effort. This is done by means of the following management activities:

- Continuing dialogue with the project leaders in order to ensure that the individual projects are conducted according to plans and, if necessary, ensure that plans are changed
- Conducting a critical evaluation of annual status reports in dialogue with the project leaders
- Motivating maximal publication and communication activity, partly through annual status report meetings (planning, follow-up and adjustment) and partly through external meetings and information
- Avoiding unnecessary overlap between projects
- Striving for the greatest possible synergy in the allocation of resources
- Encouraging the review and evaluation of research findings in both national and international forums
- Recalling / reallocating resources in cases where the returns do not live up to the expectations

The management is conducted on the basis of an annual status report accounting for project results and progress. This includes an overview on the fulfilment of the following: task, deliverables and milestones, a description of deviations and adjustments of plans, changes in budgets, staff etc. and a list of project publications and other products. Finally, the project leader is asked to provide a "critical reflection on the project".

Based on the status report, the DARCOF Centre Management meets with the project leader and senior researchers in order to discuss results and plans for the projects. After the meeting, the

DARCOF Centre Management can approve the status report or changes to the project can be suggested. Continuation of the project (continuing funding) can only be authorised, when the DARCOF Centre Management has approved the status report. Furthermore, the status report provides the foundation for the international mid-term evaluation of the research quality that typically is performed.

9 Utilisation of research

One of the objectives of the DARCOF Centre is to provide an overview of the research and to disseminate the research findings to relevant user groups. On this background a number of tools and activities, which intends to provide opportunities for utilising the research, has been established.

9.1 Mediation of research

Comprehensive information including descriptions of all the individual research projects in DARCOF, their findings and publications can be found at both the Danish[11] and the English[12] internet site of DARCOF. The sites make full use of the Organic Eprints Archive, which holds most Danish papers related to research in organic agriculture.

In relation to the websites, electronic newsletters are issued. The newsletters are available both in Danish and in English[13] and they provide easily accessible information on new research results, new research developments, new publications, theme days, workshops, field walks, etc.

Most research results are published in scientific journals, but DARCOF issues a number of reports, proceedings, reviews, etc. together with bi-annual reports on its research activities. One of the objectives for the reports is to provide a comprehensive view on the research and its results.

DARCOF has agreements on regular columns and articles in periodicals directed at farmers. The articles bring news on research and research findings.

9.2 Dialogue and interaction

It is important to provide opportunities for direct dialogue and interaction between researchers and the various groups interested in organic farming. An important forum for this dialogue is the DARCOF User Committee, who has the opportunity for initiating debates and discussion on specific subjects. Examples are discussions on the fundamental principles and values of the organic movement and analyses the use of different technologies in Organic Food and Farming processing.

On a more regular basis, DARCOF organises theme days and workshops on chosen subjects; for example in connection with knowledge synthesis and initiation of new research activities. On a bi-annual basis the Danish Organic Congress is held by DARCOF and three other organisations. One of the ambitions of the congress is to be a joint forum for all working professionally on Organic Food and Farming. In 2006, the Danish Organic Congress is gaining a European dimension ("Joint Organic Congress") by providing a platform for researchers from Europe an other parts of the world to present their results[14].

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[11] Forskningscenter for Økologisk Jordbrug (FØJO = DARCOF), DK-Tjele, www.foejo.dk
[12] Danish Research Centre for Organic Organic Farming; www.darcof.dk
[13] DARCOF-E-news: http://www.darcof.dk/enews/mar03/about.html
[14] Information on the Joint Organic Congress is available at www.organic-congress.org. The papers submitted to that congress are available at http://orgprints.org/view/projects/int_conf_joint2006.html

Since 1999, "organic field walks" have been organised each summer, where interested farmers, advisers etc. are invited to visit the organic workshop sites, crop rotation trials and the research farms. Furthermore, in collaboration with the national advisory service, the organic workshop sites and the crop rotations are utilised as forums for education of organic advisors etc.

Finally, DARCOF has prepared several exhibitions on the research and it has participated in TV-programmes and other media productions.

10 Scientific education & research schools

One of the main objectives for DARCOF is to "contribute to the education of research scientists involved in the projects". In order to fulfil this objective, several activities have been undertaken.

10.1 Post-graduate research school in organic farming

In the spring of 2001, the Royal Veterinary and Agricultural University (KVL) in cooperation with DARCOF established a post-graduate research school in Organic Food and Farming. The purpose of "The Research School for Organic Agriculture and Food Systems (SOAR)"[15] is to strengthen the quality of research education in organic farming.

The school offer scientific courses as well as a network environment for post-graduate students in organic agriculture. The students are encouraged to interdisciplinary and wholeness-oriented work. Moreover, the school aims to reinforce the cooperation of students and supervisors in and across institutions.

10.2 Training of researchers

A wide variety of Bachelor, Master and Ph.D. studies are included in DARCOF's research projects. To further strengthen the education of researchers with qualifications in organic farming, DARCOF offers supplementary funding of PhD students in relevant areas. In DARCOF III, it is expected that each of the 15 projects will attach at least one PhD student.

10.3 Scientific workshops

Under the auspice of DARCOF, scientific workshops on a variety of technical aspects of organic farming are also convened. These workshops have different objectives, but generally they focus on the presentation and discussion of pressing problems in particular areas and the formulation of research strategies for making progress in these areas.

10.4 Bachelor and Master of Science programmes

The Royal Veterinary and Agricultural University in Copenhagen (KVL) offers a wide range of possibilities for scientific education within agriculture, horticulture and related topics. However, there are neither Bachelor nor Master of Science programmes aimed specifically at Organic Food and Farming. Likewise a professorship established in 1996 as a supplement to DARCOF I was abolished in 2000. Instead, students are offered the possibility of joining courses within specific areas of Organic Food and Farming.

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15 Research School for Organic Agriculture and Food Systems; http://www.kursus.kvl.dk/shares/soar/

11 Annex

11.1 Annex 1: Budget for DARCOF II projects

I	Crop production, environment and food quality	1 000 €	1 000 DKK
I.1	Organic production of cucumber and tomato	627	4 700
I.2	Sustainable production systems for apples	313	2 350
I.3	Nitrogen dynamics, crop production and biodiversity	1189	8 915
I.4	Enhanced bread wheat production	876	6 570
I.5	Production of grain legumes and cereals	876	6 570
I.6	Cultivation in ridges and mixed cropping	627	4 700
I.7	Soil quality in organic farming	751	5 631
I.8	Management of perennial weed species	313	2 350
I.9	Band heating for intra-row weed control	627	4 700
I.10	Organic vegetable cultivation methods	1 503	11 270
I.11	Cultivation of org. clover and grass seeds	501	3 755
I.12	Preventing mycotoxin problems	513	3 851
I.13	Dinitrogen fixation and nitrous oxide losses	488	3 660
I.14	Control of scab in organic apple growing	289	2 170
I.15	Nitrate leaching from dairy farming	133	1 000
I.16	Regional groundwater protection	400	3 000
II	**Animal husbandry, health and food quality**		
II.1	Organic dairy production systems	1 207	9 050
II.2	Prod. of organic milk of high quality	267	2 000
II.3	Production of steers and bioactive forage	876	6 570
II.4	Health and welfare for organic calves	400	3 000
II.5	Use of antimicrobials	213	1 600
II.6	Research in poultry production systems	751	5 630
II.7	Improved pig feed and feeding strategies	667	5 000
II.8	Health management in organic pig prod.	333	2 500
II.9	New systems in organic pig production	467	3 500
II.10	Bacterial infection risk – pig production	267	2 000
II.11	Production of raw milk cheese	367	2 750
II.12	Product quality of organic beef and pork	103	770
III	**Agriculture and society**		
III.1	Consumer demand for organic foods	564	4 230
III.2	Analyses of the future development	751	5 630
III.3	Closing the rural-urban nutrient cycle	751	5 630
III.4	Organic food and health	1 048	7 860
III.5	Nature quality in organic farming	1 200	9 000
III.7	Future supply and marketing strategies	160	1 200
III.8	Distribution channels for organic foods	207	1 550
III.9	Organic agriculture in social entirety	267	1 999
IV	**Experimental units for research**	2 669	20 020
V	**Coordination, synergy and education**	2 707	20 300
VI	**Breeding and production of GMO-free seeds**		
VI.1	Healthy seed – cereals and legumes	1 333	10 000
VI.2	Characteristics for spring barley varieties	1 393	10 450
VI.3	Tools for protection against cont. by GMO	293	2 200
VI.4	Grain legumes for organic farming	713	5 350
VI.5	Vegetable and forage seed	267	2 000
Total		**30 267**	**226 981**

11.2 Annex 2: Budget for DARCOF III projects

No.	Themes and projects	1 000 €	1 000 DKK
I	Nutrition, health and food safety		
I.1	Content and bioavailability of essential trace elements and bioactive compounds in cereals and vegetables cultivated in four diverse organic agricultural systems	1 867	14 000
II	Processing, quality and consumption of organic products		
II.1	Organic milk of high quality - development of production concepts based on grazing of the dairy cows and gentle treatment of the milk during handling and processing	1 867	14 000
II.2	Quality and integrity of organic eggs, chicken meat and pork	1 867	14 000
II.3	Organic aquaculture: the linkage between sustainable production and superior products	933	7 000
II.4	Organic cropping systems for vegetable production, product quality, natural regulation and environmental effects	1 800	13 500
II.5	The viability and stability of demand: the future outlook for the organic market in Denmark	1 333	10 000
III	Development of an efficient primary organic production		
III.1	Grass-clover in organic dairy farming: options to reduce costs and improve nutrient utilisation	1 867	14 000
III.2	Effective control of perennial weeds and intra-row weeds in organic cropping through novel technology and new management strategies	1 600	12 000
IV	Organic integrity		
IV.1	Increased integrity in organic dairy production through natural sources of vitamins and minerals and non-antibiotic health control	1 493	11 200
IV.2	High quality seed: maintaining integrity in organic farming	933	7 000
V	Different production systems significance for sustainable development		
V.1	The effect of cropping systems on production and the environment	1 867	14 000
V.2	The role of organic farms as refuge for biodiversity	933	7 000
VI	Bio-energy as a complement to organic food production		
VI.1	Biomass and bio-energy production in organic agriculture – consequences for soil fertility, environment, spread of animal parasites and socio-economy	1 867	14 000
VII	Regulation and trade		
VII.2	Public policies and demand for organic food: An international comparison of policy effects and policy determinants	933	7 000
VIII	Organic farming in a global perspective		
VIII.1	Sustainability of organic farming in a global food chain perspective	1 507	11 300
Others	Common pool set aside for a transnational research programme	2 000	15 000
	Knowledge management, mediation and communication	1 000	7 500
	Co-financing of EU research projects	1 000	7 500
Total		26 667	200 000