Midterm evaluation of DARCOF II

Increased production and closer relationships between organic and inherent qualities

Final report 15th November 2002

Danish Research Centre for Organic Farming

DARCOF

The Danish Research Centre for Organic Farming (DARCOF) coordinates Danish research in organic farming with a view to achieving optimum use of the resources allocated for research.

DARCOF is a so-called "centre without walls" where the research expertise is constituted by the app. 140 researchers and 20 institutions participating in the research effort.

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Preface

In the autumn of 2002 we have participated in the midterm evaluation of 23 research projects under the auspices of DARCOF II. The basis for the evaluations was comprehensive midterm reports prepared by the leaders of the projects.

On the basis of the individual projects together with a report on the formation, status, remit, stated goals etc. we have also given an evaluation of DARCOF II as a whole.

The present report summarizes the procedure and the basis for the evaluation. It also summarizes the presentations and the discussion at the meeting in Viborg on the 23rd of October. The evaluators, the project leaders, the board of directors, and the user committee of DARCOF participated in the meeting.

Furthermore, the report contains and summarizes the written evaluations on DARCOF II as a whole.

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In October 2002 seven international scientists with expertise on organic farming performed an evaluation on DARCOF II. The evaluation covers 23 projects established in 2000 and DARCOF II as a whole.

There were two main goals for the evaluation:

1. An midterm evaluation of individual projects and, if necessary, suggestions for changing the plans
2. An evaluation of DARCOF II as a whole with respect to its stated goals and, if necessary, suggestions for adjustments

The first goal has been met through written evaluations of the individual projects. The project evaluations can be found at DARCOF's internal website *www.okoforsk.dk* together with the midterm status reports prepared by the project leaders.

On the basis of the evaluation of the individual research projects, information on the status of DARCOF II together with the discussion and presentations on an evaluation meeting in Viborg on the 23rd of October, written evaluations on DARCOF II as a whole has been prepared. The present evaluation report summarizes the information on which the evaluation is based. The actual evaluations from the individual evaluators are annexed.

General assessment
Among others, the evaluators were asked on their assessment of the quality of the research process in DARCOF II as well as their assessment of the quality and quantity of research products.

The general opinion is that the overall formation of DARCOF II has been of a high standard. The programme includes a wide range of subject areas, which appear to have been funded without a bias towards one particular area. The allocation of resources reflects the need for research. The flexibility and adoption on recent developments of organic market was shown in the programme changes and programme development.

The individual projects generally seems to focus on important study areas where there is a lack of knowledge in relation to a number of factors - including the levels of production from organic systems, efficiency of production within systems, animal health and quality of the products produced within the organic systems.

Assessment of objectives
Several evaluators found that the remit is well justified, as it is motivated by present days' acute need to increase productivity in organic farming, to ensure inherent quality of the organic food products, and to justify claims of organic (external) quality of the food products.

All thou the remit of DARCOF II were recognized, suggestions on a shift in focus - from primary production to research in the entire organic food system was put forward. This change in focus was to some extent taken into account when DARCOF presented its second call for expressions of interest in 2002.

Research products and international collaboration
The quantity and quality of research products (especially publications) are assessed as being of a very high standard, meaning an important contribution to European organic science. The evaluators agree that the organic E-prints initiative taken by DARCOF is *excellent* and will help to make the outputs from DARCOF available to a wide audience.

Generally the level of international collaboration in DARCOF was acknowledged. However, a higher emphasis on international networking of the individual projects as well as DARCOF II is suggested.

Introduction

Since the mid nineties the Danish Research Centre for Organic Farming (DARCOF) has had the responsibility for initiating and coordinating research that contributes to the development of organic agriculture and the general promotion of sustainable agriculture in Denmark. DARCOF is a "centre without walls", which is to say that the researchers remain in their own research environment. The research is based on collaboration between researchers, research institutes, and professional associations in organic farming, consumer organisations and authorities.

From 1996 to 2000 thirty-three large research projects were carried out within the framework of DARCOF. The projects involved about 100 researchers from 15 different research institutes. In 2000 a new research effort (DARCOF II) was initiated in continuation of the second Danish action plan for organic farming. After the initiation of complementary research projects in 2001 and 2002 the effort today involves 43 research projects, 20 research institutes and app. 140 researchers.

23 of these projects were initiated in 2000 and they are planned to end in 2004 or 2005. In early 2002 DARCOF's board of Directors and DARCOF's User Committee therefore asked for a midterm evaluation these projects and for DARCOF II as a whole. In the middle of 2002 the outlines for the evaluation procedure were determined, and a team of seven international researchers with experience in organic farming was appointed.

There are two main goals for the evaluation:

1. An evaluation of the individual projects and, if necessary, suggestions for changing the plans
2. An evaluation of DARCOF II as a whole with respect to its stated goals and, if necessary, suggestions for adjustments

The first goal is met through written evaluations of the individual projects. Two evaluators have evaluated each project and each evaluator has evaluated 6 to 7 projects. The evaluation of the 23 projects has been examined in DARCOF's board of directors. Following this examination the board has made decisions about the necessary change of plans for the rest of the period.

Each evaluator has also evaluated DARCOF II as a whole (goal no. 2). These evaluations were orally presented on a common evaluation meeting on the 23rd of October in Viborg. Besides the evaluators, the board of directors, the user committee and all the project leaders from DARCOF participated in the meeting.

This paper presents the formation and present status of DARCOF II, and it summarizes the presentations and the discussion at the meeting in Viborg. The final evaluations of DARCOF II as a whole by the individual evaluators are enclosed as appendixes. On this basis a number of conclusions and reflections are given.

1 Danish Research Centre for Organic Farming

Danish agriculture and food productions are in a state of flux. Society makes ever-increasing demands for a reduction in the use of agricultural inputs such as pesticides, artificial fertilisers and prophylactic medicines. At the same time there is scepticism amongst many consumers with regard to the intensification and specialisation that has characterised agricultural development in recent years.

In this context, organic farming represents an alternative and more holistic view of agriculture and food production, and directly addresses the problems faced in many areas of conventional agricultural practice. Concerns for the environment, biodiversity, animal welfare, product quality, safety, and nutritional value are thus essential ingredients of the philosophy behind organic farming.

Based on a holistic view of agriculture and food production, organic farming has emerged and grown as an alternative to the general development. In Denmark throughout the 1990s a continuing transition from conventional to organic farming occurred. In 1990 organic farming accounted for less than 1 percent of the cultivated land, whereas in 2002 this proportion has approach about 6,5 percent. The conversion has primarily occurred on relatively large farms. For example, organic milk amounts to app. 10 percent of the total milk production in Denmark.

1.1 Formation of DARCOF

Since organic production addresses many of the difficulties faced in current agricultural practices, research in this area can be expected to gain considerable benefits for agriculture and society in general.

In accordance with its policy to promote protection of the environment and to produce a sustainable development in agriculture, the Danish government has provided considerable support for transition, regulation and control, advisory service, education, and research relating to organic farming. This development has been planned through the preparation of national policies (action plans).

As a direct result of the first action plan for organic farming in Denmark the Danish Research Centre for Organic Farming (DARCOF) was founded in 1995 with the objective to provide the overall framework for Danish research on organic farming. The general remit of DARCOF is thus to coordinate Danish research and development (R&D) for organic farming, with a view to achieving optimum benefit from the allocated resources. Its aim is to elucidate the ideas and problems faced in organic farming through the promotion of high quality research of international standard. This research is intended to ease the transition from conventional to organic farming, while encouraging a sustainable development of the economic, ecological and social aspects of agriculture.

During the period 1996 – 2000, DARCOF activities involved 15 research institutes and about 100 research scientists, who, in six main areas of interest completed a total of 33 large research projects. More information on this research can be found on www.darcof.dk.

1.2 Organisation of DARCOF

DARCOF is a "centre without walls", which is to say that the researchers remain in their own research environment but collaborate across institutes. Currently, app. 140 researchers from 20 research institutes participate in DARCOF (see www.darcof.dk).

A board of directors consisting of research leaders from the central research institutes leads DARCOF. To ensure the relevance of its R&D activities, including contact with the various user groups, a user committee has been appointed with representatives from farmers associations and NGOs within organic farming (Figure 1).

1.3 Synergy activities[1]

As the co-ordinating organ for Danish research in organic farming, DARCOF must first and foremost ensure that the research system focuses on the most relevant challenges, that the projects are undertaken in the most appropriate manner, and that the various target groups are regularly informed of the findings. In relation to these objectives, the assignments are:

Co-ordination
The main responsibility of the centre management is to co-ordinate, evaluate and manage ongoing research projects in accordance with the overall objectives of DARCOF.

Synthesis of knowledge
The collaboration in DARCOF offers a unique opportunity to synthesise information in order to analyse different aspects of the transition from conventional to organic farming, to identify areas where new research is most needed, and to clarify complex problems.

Research methodology and value inquiry
The organic movement is based on explicit principles and goals, and certain values are entailed in these principles and goals. Therefore value inquiry and awareness of the interplay of values and facts are significant elements of systems research in organic farming.

Education
An important aim of DARCOF is to contribute to the postgraduate education of researchers in the disciplines and research areas of greatest relevance to organic farming. In collaboration with the Royal Veterinary and Agricultural University a research school for organic farming has been established.

National communication and mediation
Activities of DARCOF are conducted in dialogue with producers, advisors, consumers and various research institutes. National and international communication is thus an integrated part of the activities.

International cooperation
DARCOF seeks to contribute to the international development of research in organic farming. Among others, this is done by supporting the exchange of research results, by improving knowledge on EU-research programmes, and by international evaluation of research projects.

[1] The activities are organized in project V. Coordination, synergy and education.

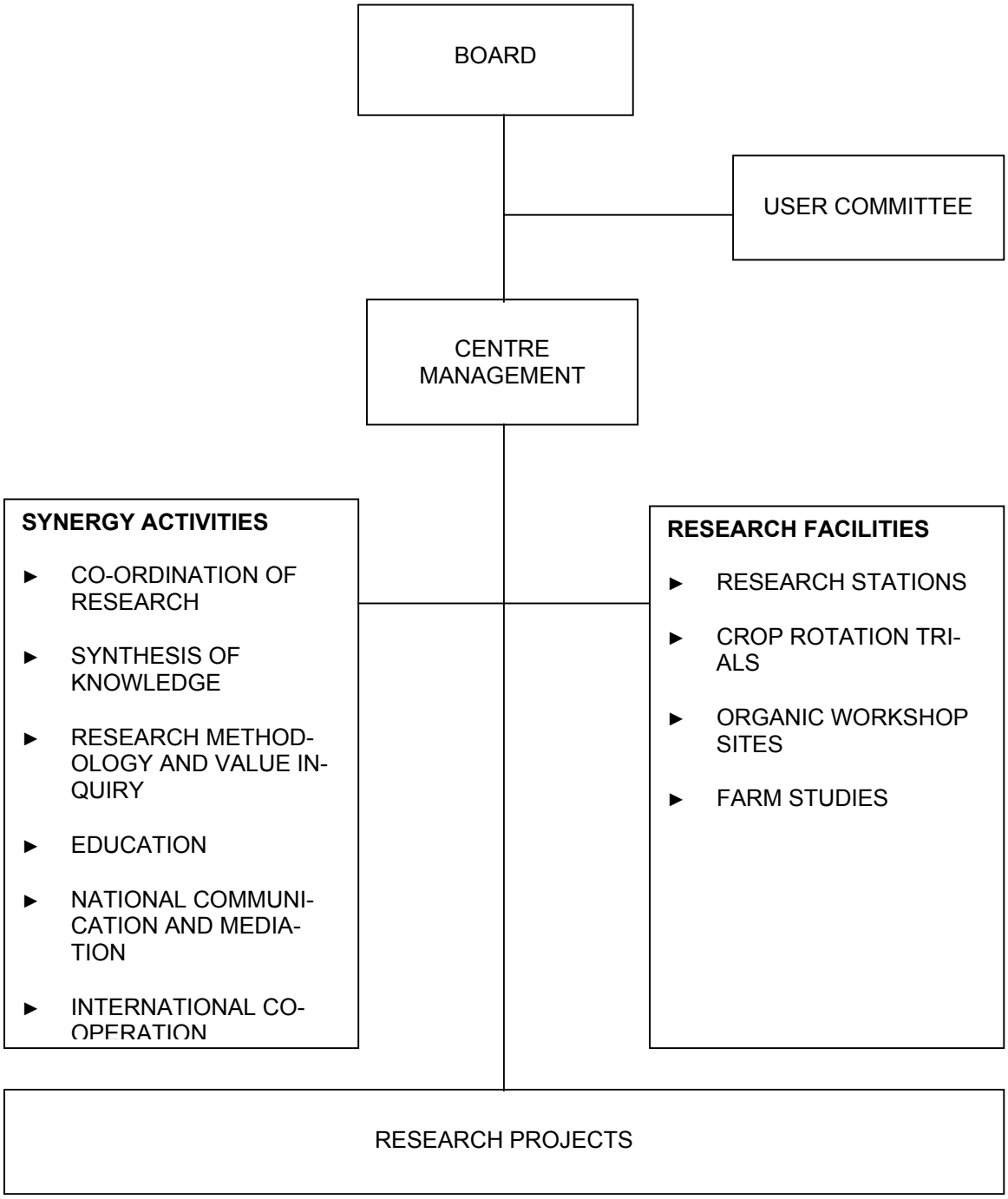

Figure 1. Organisation of DARCOF

1.4 Research facilities[2]

In DARCOF a series of unique research facilities has been set up to provide opportunity for conducting different projects simultaneously, using the same research fields, herds, etc. This allows close co-operation between different research environments, with a high degree of interdisciplinary collaboration, synergy, and complementary research. The main facilities are:

Organic research stations
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. Furthermore, one of the research farms, Bakkegaarden, at the Royal Veterinary and Agricultural University, is dedicated to organic farming.

Crop rotation trials
Long-term organic crop rotation trials are performed on four locations: Jyndevad, Foulum, Flakkebjerg and Holeby. The aim is to investigate how the type of rotation affects yields, nutrient balances, weed and disease problems, and soil fertility on different soil types and with different levels of manure.

Organic workshop sites
Organic workshop sites for research are set up at Aarslev, Flakkebjerg and Foulum research centres and at Jyndevad and Askov research stations. At these sites it is possible to conduct analytical studies that require different soil types and climatic conditions.

Farm studies
In addition to the establishment of research facilities, agreements have been drawn up with private organic farmers who make their farms available for research. The systematic monitoring and the collaboration of the farmers provide in-depth information about the individual farms. In this way a sound basis is acquired for analysing and interpreting farm results in relation to different management strategies, this providing a solid foundation for the further development of organic production.

[2] The establishment and running of the research facilities are organized in project IV. Experimental units for research in organic farming systems.

2 Formation and status of DARCOF II

As early as the beginning of 1998, DARCOF's Board of Management and User Committee began to discuss the research input of DARCOF II.

2.1 Research challenges

In the late nineties the public interest in organic and sustainable agriculture stimulated the preparation of various national documents (policies) on the subject. In addition to describing the main social interests in this area, these documents raised a number of demands and concerns relating to the associated research.

For organic farming the most important documents were *Action Plan II – Developments in organic farming*, which was prepared by the Danish Organic Foods Council to the minister of Food, Agriculture and Fisheries.

One of the problems dealt with in Action Plan II (published in February 1999) was the fact that large quantities of organic cereals, protein crops and vegetables are imported, in contravention of the organic principle of using local resources. This problem may become more acute in future years, since an increased demand for organic food is expected. Another aim of the Action Plan was to describe how organic farming could develop its management and production practices such that its various sustainability principles can more successfully be adhered to. Specific developments were recommended that will help to improve the management of nutrients and energy, taking due regard to natural assets, soil fertility, and better health and welfare in organic animal production.

An important goal of organic farming is to produce foods of optimal nutritional quality. The Action Plan therefore pointed to various initiatives that would help to improve the quality of organic foods, both in their cultivation and the manufacture of products. In this context the opportunities for promoting the nutritional and health promoting characteristics of foods are being investigated.

Development in these areas will mainly occur in response to an increase in research activity, and for this reason the Action Plan also recommended that research in organic agriculture must be increased and intensified.

It should also be mentioned that an important aim of the Action Plan was to increase the sale and export of organic foods. As far as possible market forces must drive this development, and research is seen as an important link to improve effectiveness, ensure adequate supplies, and secure the relationship between the organic and inherent qualities of the product and the consumer's food desires. It is therefore important that research activities help to raise public confidence in organic products, partly by providing information and recommendations for the regulation of organic food production.

This was supported by another national document, namely the report of the so-called Bichel Committee, who – by order of the Danish parliament - investigated the possibilities for reductions in the use of pesticides and the consequent pollution of ground water and the environment. this committee report supported the development of organic farming as a tool for advancing environmental policies.

2.2 Remit and objectives of DARCOF II

On the basis of the national documents described in the previous section it can be concluded that research initiatives must take due regard to market demands, while preserving the values associated with organic principles. The aim is therefore to raise production, and secure the relationship between the inherent and organic qualities of a product. This is achieved by developing production systems that build on a desire to raise the natural component of organic farming, improve animal health and welfare in organic production systems, and raise the quality of organic foods, etc. Clearly, this is something other and more comprehensive than goal-oriented research that tries simply to reduce the problems associated with food quality, animal health, or environmental stress.

Expressed in another way, in future initiatives emphasis must concentrate on the development of sustainable production systems that build on a desire to actively sustain appropriate conditions relating to nature, the environment, animal welfare and health, food quality etc. The objective is that these concerns and the organic principles can be directly associated with organic products such that the latter stand out as a real alternative to conventional produce. Against this background the remit and objectives of DARCOF II can now be described.

Remit
The remit of DARCOF II is 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*".

Objectives
The objectives are to provide information on:

1. Effective and rational organic production methods

2. Inherent qualities, including:
   - the content of nutrients (primary and secondary constituents)
   - food safety (freedom from such undesirable compounds as pesticides, residues of medicines, mycotoxins, zoonoses)
   - the standard of manufacture and other traditional parameters of quality

3. Organic qualities, including:
   - reduced environmental pressures (nitrogen, phosphorus, pesticides, GMOs, residues of medicines, etc.)
   - higher quality of nature (diversity, variety, and harmony in primary production)
   - higher levels of animal welfare (harmony, natural behaviour and needs, and animal care)
   - other organic principles (recycling, precaution and prophylaxis)

Regarding 1: Information on effective and rational organic production methods
There is an increasing demand for many organic foods. Nevertheless, their higher cost relative to that of conventional foods is undoubtedly of great significance in determining their market share. A continuing requirement for information on how to make organic food production more effective and rational can therefore be predicted. On the other hand there is also a need for information on whether there are types of product for which the efficiency of production can hardly be improved, and for which the market is expected to remain niche-oriented.

Regarding 2: Information on inherent qualities
The information on inherent qualities is directly associated with the product and is therefore hardly different from that for conventionally produced foods. The difference is, however, that on the one hand organic foods are known to be free of various undesirable compounds and to supplement with a higher content of secondary metabolites that could be health promoting. Against this, the production method can raise problems with, for example, mycotoxins.

Another feature of inherent quality parameters is that information on these can be used directly in the market place, since they can be measured and documented in the product itself.

Regarding 3: Information on organic qualities
Information about organic qualities relates primarily to the production process. In other words it relates to characteristics that cannot be measured directly in the product. The Ø-mark (the Danish organic label) and associated regulations thus constitute a guarantee for society and the consumer that organic food production lives up to the particular demands of organic quality.

2.3 Selection and establishment of projects in 2000

In September 1999, DARCOF invited expressions of interest from any research scientists and research environments interested in collaborating in organic farming studies. Subsequently it received 216 responses, with a stated funding requirement of about 700 million DKK (almost 100 million Euro).

Individual applications were examined and their merit assessed on the basis of the criteria stipulated in the invitation. DARCOF's Board of Management and Consumer Committee then nominated 23 research teams, and a project leader responsible for each project. In this way, each project satisfies the interests of several different research groups, which, under the project leader, are responsible for organising and co-ordinating the project. This approach satisfies the individual areas of interest, and to the greatest possible extent complies with the overall objectives of DARCOF II.

As a means to further secure the scientific quality of the research, the project applications undertook a thorough evaluation by external, international experts, whose criticisms were decisive for determining to which extent a project could be conducted.

2.4 Selection and establishment of projects in 2001 and 2002

In some central areas of interest (pig production, the quality of nature, the protection of ground water, food quality and human health, quality of organic plant breeding and seed production, and the possibilities for an organic production free of GMOs) the expressions of interest were so diverse and incoherent that it was not possible to initiate research projects directly in the above manner. For instance, 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 an unclarified, 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.

Based on the knowledge syntheses six new research projects were initiated in 2001. Three of these projects were dealing with organic pig production (II.8, II.9 & II.10), one project with nature quality (III.5), one with healthy seeds (VI.1), and one project was dealing with food quality and human health (III.6).

Following the knowledge syntheses on *"Consequences of genetically modified crops for organic farming in Denmark*" and "*Breeding and improvements of seed quality in organic grain and grain legumes"* a new call for expressions of interest was announced in June 2001.

In addition, the call also asked for expressions of interest on a number of issues that the DARCOF board of directors and the DARCOF user committee believed would strengthen the whole programme.

All together the call asked for expressions of interest under the following headings:

- Breeding and protection of GMO-free organic varieties
- Food quality, food safety and health
- Regional protection of groundwater
- Principles of organic farming
- Communication and research within organic practices

After a procedure much similar to the one described in section 2.3 a total of 19 new research projects within the mentioned areas was established.

2.5 Integration of objectives in the individual research projects

In selection the research teams much emphasis was laid on a holistic approach to the individual project. This meant that, as far as possible, the subjects of research would incorporate the whole chain of causal events from resources to production and quality, both organic and inherent. In practice the projects are relatively large, and typically involve many different disciplines. Furthermore, a particular problem is examined under a range of conditions: for example, on clay and sandy soils, in lysimeter studies, field trials, and farm studies.

Effect on the inherent qualities (objective 2) and organic qualities (objective 3) are often related to production level and economics (objective 1). In order to know this relationship it is important to investigate all aspects in one project.

In some situations a positive relationship can be assumed between the objectives of organic quality and the production economics. For example an improvement in nutrient management is likely to benefit both the environment and the production. In these situations the provision and application of more information is sufficient to achieve an improvement.

In other cases a negative relationship between organic quality and production economy objectives will occur. In these situations, scientific knowledge can be used to recommend regulation changes and promote continued confidence in the Ø-mark.

In table 1 it is shown how the different objectives are integrated in the different projects. It appears that plant production is the main aspect in 35 projects. Cattle production is targeted in 25 projects, while 26 projects were oriented towards the production of pigs and poultry. The inherent quality is a main aspect in 30 projects and, likewise, organic qualities are an important aspect in 36 projects.

As it appears from the final project portfolio, the projects are 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
IV Research co-ordination, synergy and education
VI Breeding and production of GMO-free seeds

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, and foods quality and safety. The animal husbandry area incorporates projects on livestock production, health and welfare, and 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 with in 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.

2.6 Progress in the individual projects

Table 2 shows the progress and the use of economic resources in the individual projects. In the progress reports and the midterm evaluation reports (see www.okoforsk.dk) the progress including preliminary results can be studied in details[3].

By studying the progress report the general picture is that minor delays has occurred in many projects, but the subsequent adjustment in plans indicates that the overall objectives will be made. However in a few projects more severe delays and adjustment suggest that the projects overall objective will not be met in time without major adjustments in plans.

2.7 Quantity and quality of products

Table 3 shows the amount of products in four different categories. It appears that in total 85 papers are submitted or published in reviewed scientific journals (category 1), 196 papers in other journals (category 3), 157 distributions has been given to scientific congresses (category 2) and 187 distributions are given on field days etc. (category 4) 20 Ph.D. students and 13 MSc student are connected to the projects.

It should be noted that not all products are entirely from the mentioned projects, and that there might be some overlaps in papers from collaborating projects.

[3] It should be noted that some of the main preliminary results were shown at the meeting of October 23 (see section 3).

Table 1 Contribution to the objectives of DARCOF II

DARCOF II		Budget 1000 DKR	Production systems[1)]			Inherent quality	Organic quality
			Plants	Cattle	Pigs/ poultry		
I Crop production, environment and food quality							
I.1	Organic prod. of cucumber and tomato	4.700	x			xx	x
I.2	Sustainable prod. systems for apples	2.350	x			xx	
I.3	Nitrogen dynamics, crop prod. and biodiv.	8.915	x	x	x		xxx
I.4	Enhanced bread wheat production	6.570	x	(x)	x	xx	xx
I.5	Production of grain legumes and cereals	6.570	x	(x)	x	x	x
I.6	Cultivation in ridges and mixed cropping	4.700	x		x	x	xx
I.7	Soil quality in organic farming	5.631	x	x	x		xx
I.8	Management of perennial weed species	2.350	x	x	x		
I.9	Band heating for intra-row weed control	4.700	x	x	x	x	x
I.10	Organic vegetable cultivation methods	11.270	x		x	x	xx
I.11	Cultivation of org. clover and grass seed	3.755	x	x	x	xx	x
I.12	Preventing mycotoxin problems	3.851	x		x	x	
I.13	Dinitrogen fix. and nitrous oxide losses	3.660	x	x		xx	
I.14	Control of scab in organic apple growing	2.170	x			x	
I.15	Nitrate leaching from dairy farming	1.000	x	x			xx
I.16	Regional groundwater protection	3.000	x	x	x		xx
II Animal husbandry, health and food quality							
II.1	Organic dairy productions systems	9.050	x	x		x	xx
II.2	Prod. of organic milk of high quality	2.000	x				
II.3	Production of steers and bioactive forage	6.570	x	x	x	xx	xx
II.4	Health and welfare for organic calves	3.000		x		x	xx
II.5	Use of antimicrobials	1.600		x		x	xx
II.6	Research in poultry production systems	5.630			x	x	x
II.7	Improved pig feed and feeding strategies	5.000			x	xx	
II.8	Health management in organic pig prod.	2.500			x	xx	xx
II.9	New systems in organic pig production	3.500	x	(x)	x	x	xx
II.10	Bacterial infection risk – pig production	2.000			x	x	x
II.11	Production of raw milk cheese	2.750		x		xx	xx
II.12	Product quality of organic beef and pork	770		x	x	xxx	x
III Agriculture and society							
III.1	Consumer demand for organic foods	4.230	x	x	x	x	x
III.2	Analyses of the future development	5.630	x	x	x	x	x
III.3	Closing the rural-urban nutrient cycle	5.630	x		x		xx
III.4	Organic food and health	7.860	x			xx	x
III.5	Nature quality in organic farming	9.000	x	x	x		xx
III.7	Future supply and marketing strategies	1.200	x	x	x	x	x
III.8	Distribution channels for organic foods	1.550	x	x	x	x	x
III.9	Organic agriculture in social entirety	1.999	x	x	x	x	x
IV.1	**Experimental units for research**	20.020	x	x	x		xx
V	**Coordination, synergy and education**	20.300	x	x	x	x	xx
VI Breeding and production of GMO-free seeds							
VI.1	Healthy seed – cereals and legumes	10.000	x			x	xx
VI.2	Characteristics for spring barley varieties	10.450	x				xx
VI.3	Tools for protection against cont. by GMO	2.200	x				xx
VI.4	Grain legumes for organic farming	5.350	x				xx
VI.5	Vegetable and forage seed	2.000	x				xx
Total		**226.981**					

1) Effective and rational organic production methods in different systems

Table 2 Progress and use of economic resources 2000-2005

No.	Short title	Established year	Consum. < 2002	Consum. 2002	Budget 2003	Budget total
I Crop production, environment and food quality						
I.1	Organic prod. of cucumber and tomato	2000	1.153	1.657	1.573	4.700
I.2	Sustainable prod. systems for apples	2000	517	240	451	2.350
I.3	Nitrogen dynamics, crop prod. and biodiv.	2000	3.879	2.830	2.301	8.915
I.4	Enhanced bread wheat production	2000	1.642	2.228	1.970	6.570
I.5	Production of grain legumes and cereals	2000	2.200	2.440	1.930	6.570
I.6	Cultivation in ridges and mixed cropping	2000	1.512	1.866	1.162	4.700
I.7	Soil quality in organic farming	2000	915	1.557	1.828	5.631
I.8	Management of perennial weed species	2000	789	546	569	2.350
I.9	Band heating for intra-row weed control	2000	1.892	1.186	828	4.700
I.10	Organic vegetable cultivation methods	2000	3.468	3.311	2.705	11.270
I.11	Cultivation of org. clover and grass seed	2000	1.159	911	932	3.755
I.12	Preventing mycotoxin problems	2000	1.074	1.236	870	3.851
I.13	Dinitrogen fix. and nitrous oxide losses	2000	1.035	1.127	1.228	3.660
I.14	Control of scab in organic apple growing	2002	-	383	891	2.170
I.15	Nitrate leaching from dairy farming	2002	-	-	37	1.000
I.16	Regional groundwater protection	2002	-	432	1.480	3.000
II Animal husbandry, health and food quality						
II.1	Organic dairy productions systems	2000	3.153	2.272	2.183	9.050
II.2	Prod. of organic milk of high quality	2002	-	168	546	2.000
II.3	Production of steers and bioactive forage	2000	2.829	2.302	1.103	6.570
II.4	Health and welfare for organic calves	2000	893	1.237	691	3.000
II.5	Use of antimicrobials	2000	246	864	676	1.600
II.6	Research in poultry production systems	2000	1.453	1.847	587	5.630
II.7	Improved pig feed and feeding strategies	2001	356	1.326	1.541	5.000
II.8	Health management in organic pig prod.	2001	-	765	866	2.500
II.9	New systems in organic pig production	2001	81	1.067	1.289	3.500
II.10	Bacterial infection risk – pig production	2002	-	138	1.454	2.000
II.11	Production of raw milk cheese	2002	-	936	1.529	2.750
II.12	Product quality of organic beef and pork	2002	-	137	524	770
III Agriculture and society						
III.1	Consumer demand for organic foods	2000	1.365	1.430	1.308	4.230
III.2	Analyses of the future development	2000	1.843	1.734	2.053	5.630
III.3	Closing the rural-urban nutrient cycle	2000	136	1.182	1.709	5.630
III.4	Organic food and health	2001	852	2.631	3.267	7.860
III.5	Nature quality in organic farming	2001	688	2.250	3.965	9.000
III.7	Future supply and marketing strategies	2002	-	273	590	1.200
III.8	Distribution channels for organic foods	2002	-	180	861	1.550
III.9	Organic agriculture in social entirety	2002	-	593	958	1.999
IV.1	**Experimental units for research**	2000	7.986	3.631	2.756	20.020
V	**Coordination, synergy and education**	2000	3.000	5.000	5.000	20.300
VI Breeding and production of GMO-free seeds						
VI.1	Healthy seed – cereals and legumes	2001	352	2.818	2.883	10.000
VI.2	Characteristics for spring barley varieties	2002	-	2.086	3.340	10.450
VI.3	Tools for protection against cont. by GMO	2002	-	730	1.470	2.200
VI.4	Grain legumes for organic farming	2002	-	1.018	1.368	5.350
VI.5	Vegetable and forage seed	2002	-	90	740	2.000
Total			46.468	60.655	66.012	226.981

Table 3 Products in different categories in individual DARCOF II projects

No.	Short title	Products				Phd/ MSc
		1*	2*	3*	4*	
I Crop production, environment and food quality						
I.1	Organic prod. of cucumber and tomato	-	1	1	3	1/-
I.2	Sustainable prod. systems for apples	1	3	11	15	-/-
I.3	Nitrogen dynamics, crop prod. and biodiv.	7	4	-	1	1/2
I.4	Enhanced bread wheat production	12	6	7	4	-/-
I.5	Production of grain legumes and cereals	4	5	7	22	1/3
I.6	Cultivation in ridges and mixed cropping	1	4	3	13	-/4
I.7	Soil quality in organic farming	7	8	5	21	2/1?
I.8	Management of perennial weed species	-	-	-	6	1/-
I.9	Band heating for intra-row weed control	2	9	2	4	-/-
I.10	Organic vegetable cultivation methods	1	3	1	?	-/1?
I.11	Cultivation of org. clover and grass seed	-	5	12	5	(1)/-
I.12	Preventing mycotoxin problems	2	2	6	4	-/-
I.13	Dinitrogen fix. and nitrous oxide losses	1	3	2	7	1*/1*
I.14	Control of scab in organic apple growing	-	1	1	3	-/-
I.15	Nitrate leaching from dairy farming	-	-	-	-	-/-
I.16	Regional groundwater protection	-	-	-	-	-/-
II Animal husbandry, health and food quality						
II.1	Organic dairy productions systems	1	9	10	4	-/1+2?
II.2	Prod. of organic milk of high quality	-	-	-	-	1/-
II.3	Production of steers and bioactive forage	7	9	9	7	2/2
II.4	Health and welfare for organic calves	4	5	4	7	1/-
II.5	Use of antimicrobials	1	-	2	2	1/1
II.6	Research in poultry production systems	5	4	3	1	(1)/-
II.7	Improved pig feed and feeding strategies	-	-	-	-	(1)/-
II.8	Health management in organic pig prod.	-	2	-	3	1/-
II.9	New systems in organic pig production	1	2	3	4	(1)/-
II.10	Bacterial infection risk – pig production					1/-
II.11	Production of raw milk cheese					-/-
II.12	Product quality of organic beef and pork					planned/-
III Agriculture and society						
III.1	Consumer demand for organic foods	4	7	14	4	1
III.2	Analyses of the future development	-	6	20	24	-/-
III.3	Closing the rural-urban nutrient cycle	1	2	3	3	-/-
III.4	Organic food and health	1	6	2	3	?/-
III.5	Nature quality in organic farming	1	-	1	2	2/-
III.7	Future supply and marketing strategies	-	-	-	1	1/-
III.8	Distribution channels for organic foods	-	-	-	-	-/-
III.9	Organic agriculture in social entirety	-	1	-	2	-/-
IV	**Experimental units for research**	14	23	38	6	+/+
V	**Coordination, synergy and education**	7	16	17	-	(10)/-
VI Breeding and production of GMO-free seeds						
VI.1	Healthy seed – cereals and legumes	-	4	6	5	-/-
VI.2	Characteristics for spring barley varieties	-	6	-	-	1/-
VI.3	Tools for protection against cont. by GMO	-	-	1	-	1/-
VI.4	Grain legumes for organic farming	-	1	-	1	-/-
VI.5	Vegetable and forage seed	-	-	5	-	-/-
Total		85	157	196	187	20/17

1* Articles in international, scientific journals with review procedures
2* Presentations at congresses, symposiums etc.
3* Reports, articles in agricultural journals etc.
4* Other presentations, public meeting, field days etc.

3 Examples on research in DARCOF II

One of the purposes at the meeting in Viborg on the 23rd of October was to present examples on research in the individual projects in DARCOF II. As it was not possible to present all projects, four projects were chosen as representatives. The number was limited in order to give room for a comprehensive evaluation of DARCOF II as a whole, where both the international evaluators and the participants from DARCOF could contribute to the discussion.

The projects were chosen on two criteria: they must represent a substantial part of the research effort and they must work with central aspects with respect the organic ideas and the remit of DARCOF II.

3.1 Sustainable organic crop rotation systems

The first presentation was given by Jørgen E. Olesen under the theme *Organic crop production systems in the long run – possibilities and restrictions on the production of cereals and pulses*. The presentation was based on project IV and I.3 with relations to project I.4, I.7, I.8, I.13, I.15 and I.16.

Project IV involves long-term rotation studies, which in particular investigate how yields, nutrient balances, the occurrence of weeds, rotational diseases, and soil fertility are affected by the proportion of legumes, catch crops and green manure crops in the rotation on different types of soil and with different (but low) applications of animal manure. The background for establishing these investigations in 1996 was that the experience from farm studies showed that it is difficult to isolate and quantify the significance of individual factors at farm level, since whole farms differ from each other in a number of respects. To obtain an insight into how key factors influence plant production at the rotational level, field experiments were set up at Foulum, Jyndevad, Flakkebjeg and Holeby representing different soil types and climate regions.

The long-term field experiments includes three factors in a factorial design with two replicates: A) fraction of grass-clover and pulses in the rotation (crop rotation), B) catch crop (without or with catch crop), and C) fertiliser (without or with animal manure applied as slurry). The long-term field experiments also function as workshop areas for other dedicated experiments. Yields and nutrient leaching are measured in all these experiments.

The project is carried out in close relation to project I.3 *Interactions between nitrogen dynamics, crop production and biodiversity in organic crop rotations analysed by dynamic simulation models* (BIOMOD). The focus in this project is to analyse whole systems by integrating analytical studies of system components in dynamic simulation models, namely DAISY, FASSET and the Food Web Model. They supplement each other on important aspects. The idea is to use simulation models to make predictions on organic farming systems, which can help to understand the system. This will assist in design of crop rotations, and help the evaluation of environmental effects such as nitrate leaching, biodiversity and changes in organic matter contents. It is thus expected, that the models in the future will help to improve organic farming, protect the environment, and support the national administration and regulation system.

Based on the experiences, it is possible to draw the following conclusions.

Conclusions: Long-term changes
As experiments within crop rotations has been conducted for several years, it is possible to conclude on a number of overall changes, namely:

- Soil fertility changes over time depending on fertility building/exploiting crops and use of manure
- The changes in fertility affect crop productivity, soil nutrient status, nutrient leaching and soil microbial activity
- Increasing soil fertility increases risk of N leaching
- The weed community changes over time (more perennial weeds in arable rotations)

Conclusions: Location effects
As the experiments are carried out on various locations representing different soil types and climate regions etc. it is possible to give preliminary conclusions on the effect of location. Summing up the investigations shows that:

- There are high N (and K) leaching on coarse sandy soil
- It is difficult (impossible?) to obtain low N leaching losses after grass-clover in cereal based systems on coarse sandy soil
- Higher yields from ryegrass cover crops on sandy soils than loamy soils. Cover crops with lower C/N ratio are required on loamy soils
- Couch grass dominates on sandy soils (low competitive ability of crops). Thistles dominate on loamy soils (soil structure?)

Conclusions: Management
Following the experiments with different crops, catch crops, species, and cultivation techniques it is also possible to conclude on the effect of management:

- Effective cover crops are needed to reduce N leaching and build fertility (cover crop type must be adapted to required function)
- Rotations with grass-clover on sandy soils should use forage crops (whole-crop silage) after grass-clover, which makes it possible to grow effective cover crops
- Grass-clover crops provide self-regulatory capacity to the crop rotations
- Fertility-building crops are required on previously intensive arable lands

Overall conclusions
It is thus possible to draw the overall following overall conclusions:

- Long-term changes are important in organic farming (soil fertility, nutrients, weeds)
- Soils and climate greatly affect the magnitudes and rates of change
- The cropping systems must be adapted to the conditions of the site (soil, climate, cropping history)

Discussion
On the conclusion that "Increasing soil fertility increases the risk of Nitrogen leaching", Bent Tolstrup Christensen warned, that we need to be careful how we use the concept 'soil fertility'. He suggested being more specific and saying e.g. 'the amount of nitrogen in the soil'. Increasing soil fertility might also reduce the risk of Nitrogen leaching.
Christine Watson asked what the specificity to soil type mean for the transferral of knowledge?

Jørgen E. Olesen answered: "We will first of all communicate the dependency on soil type, and focus specifically on single soil types in our communication. E.g. in form of field days and holding courses for advisors on single soil types, including other experiments on that soil type as well".

Søren Frandsen asked if organic is better that conventional with respect to leaching in relation to yield? Jørgen replied, that they have tried to avoid that question: "The reason is that we believe it is more important to try to improve organic production than to make comparisons with conventional. Just 'shifting to organics' will not solve the problems, even though some politicians like to believe this". "Through modelling you can get the sort of answer you want – depending on how you set up the rotation, management, etc. It is difficult to be confident". -"But we do know that reduced inputs reduce leaching", he added.

Ralph Martin pointed out that tillage seems to play a large role for the results: "Do you address this? I mean, you plough in both the rotations you compare".
Jørgen replied, that reduced tillage is looked upon in other projects, but he agreed that there are possibilities in tillage, and it is an issue that we probably need more research on in DARCOF II.
Bent Tolstrup Christensen added: "In project I.4 (NIMAP) we do have a little work on using tillage in the crop growth period to induce nutrient availability".

Hanne Østergaard found that the project mostly had focused mostly on restrictions?
Jørgen agreed: "You are right. There are indeed many possibilities, especially in cover crops, better use of pulses, e.g. Lupin instead of peas, and in intercropping. But then again this may give weed problems".

3.2 Using plants to solve the problems

Kristian Thorup-Kristensen gave the second presentation under the theme *the interplay of crops – possibilities and restrictions*. The presentation was based on project I.10 with relations to projects I.5, I.6 and I.11.

The initial background for the research is the delay in the development of organic vegetable production in Denmark. The development is delayed because only a few species have been grown successfully in substantial amounts. To be able to fulfil the consumer demand, all the major species must be produced in significant amounts, and it is a major aim of the project to contribute to this.

The foremost problems limiting the production are i) the insufficient nutrient availability, ii) difficulties with pest and disease management, and iii) product quality. There is a lack of knowledge on cultivation methods adapted specifically for handling these problems in organic vegetable production. Several interactions exist between these problems and neither of them can be handled in isolation.

A major management option to handle a number of problems is to use catch crops and autumn green manures strategically in the crop rotation. The studies on catch crops involve a number of topics ranging from improving their effects on N leaching losses and on N supply for main crops, to beneficial effects on other major plant nutrients as K, S and P, and to aspects of soil biology relevant for crop protection.

Furthermore, catch crops may have other beneficial or undesirable effects on pests or diseases and these subjects are also addressed in the research. It is obvious that if other advantages, apart from im-

proved N husbandry can be gained from the catch crops, this would encourage farmers to grow them more often.

Therefore, improving the N effects, and improving the chances to use catch crops for other purposes at the same time can reduce leaching losses to the environment and improve the living conditions for soil organisms, which may serve as predators for pests.

Conclusions: Nutrition of the crops
Most of the vegetables are produced on plant production farms, where the access to farmyard manure and other manures are limited. On such farms catch crops and green manures offer a possibility to utilise internal farm resources to improve the system.
In order to maintain a reasonable production a high biological fixation of N_2 must be secured while nutrients must be recycled and maintained.

The present research is carried out in a crop rotation system that has not received any fertilizer at all since 1996. As the yield of the sales crops after six years are still competitive with conventional production the potentials in the use of catch crops and green manures especially on a sandy loam are clearly demonstrated.

In the experiment very significant effects of catch crops have been observed, with striking differences among the different catch crop/green manure species. This is the case with the effect of catch crops on the population density and species composition of mesofauna and earthworms in the soil, on rooting depth of the catch crops, and on their sulphur uptake from the soil, C/S ratio and S release for the succeeding crop. Further interesting results are seen in the experiments on catch crop effects on P dynamics, on N and K dynamics and losses.

For instance, N_{min} measurements showed a clear relationship between the observed rooting depth, and the ability of the crops to deplete N_{min} from the different soil layers during the growing period.

Conclusions: Handling of pests
In the present project, two examples of plant pests, *Plasmodiophora brassicae* (club root) and entomopathogenic nematodes (EPN), are being studied.

The preliminary results indicate that catch crops may have a limited effect on the occurrence of EPN in the soil, but there seem to be clear effects of the choice of main crops. Interestingly, a full year green manure crop did actually reduce the occurrence of EPN in the soil, whereas rapeseed, carrots, cabbage and peas increased it.

Conclusions: Quality of the produce
In some of the project experiments more general "system effects" have been made. Studies on different varieties of cauliflower, onion and carrot grown organically and conventionally indicate that some diseases and pests are less problematic in the organic production than in conventional production. With one of the crops (carrots) this has actually led to higher saleable yield in organic production, especially due to a lower incidence of the cavity spot disease.

Overall conclusions
The overall conclusions is that it is possible to establish systems for organic crop production where catch crops, green manures and direct plant interactions in intercropping are used to achieve:

- Very substantial effects on plant nutrients
- Positive environmental effects at the same time
- Potential in management of weeds, pest and diseases

It is also concluded that the methods can be a valuable supplement to other methods and that it is necessary to continue the search for plant-based methods. This will include a search for more plant species and studies on their specific effects

Discussion
Hanne Østergaard asked if yield is the full picture – what about quality?
Kristian answered: "Even though quality is included, we have good results. In some cases even better than conventional. There are no great differences concerning vitamins etc."

On a question about how the nutrient balance was affected, he added that the soil K is declining, but not the content in the plants".

Bent Tolstrup Christensen found, that it is a good idea to try this out in high value crops like vegetables, but – he asked - can it also be used in low value crops?
Kristian: Certainly! Seed is the only major cost, and the seed price will fall if the catch crops are used in big scale.

Christine Watson: Are varieties important?
Kristian: There are very large differences between varieties – but at the moment this is restricted by the availability of seed. How ever, it is important to remember, when we are growing catch crops, we do not need to full fill any market demands.

Urs Niggli asked: Have you compared the use of green manure with compost?
Kristian: In greenhouse production we have. But this project is really to show how far you can come with on-farm resources. Green manure release nutrients fast, so it would be good to look at combinations with slower manures like compost.

Hanne Østergaard asked: Can the same sort of experiments be done with cereals?
Kristian: There is much more variation in vegetables, but it is a good idea.

3.3 Organic livestock production: Product quality, health and bioactive crops

The third presentation, which emphasised on health and quality in the organic livestock production, was based on project II.3 with relations to projects II.1, II.2, II.4, II.5, II.11 and II.12. The theme was *Production process and product quality – possibilities and restrictions.* Stig Milan Thamsborg gave the presentation:

Animal welfare, health and high quality of the product are explicit goals for organic production. However, recommendations in these areas have often been given on a somewhat inconsistent background and there is strong needs to combine an effort to secure animal welfare, health and product quality with the fundamental goals of organic agriculture. On this background a number of research projects with various objectives has been established under the auspices of DARCOF II.

Commonly, the projects intend to explore measurable inherent qualities, e.g.:

- Product quality of meat after use of bioactive forages
- Use of medicine and risk of resistant bacteria/residues in livestock

Further more, they intend to explore organic qualities related to the production process like:
- Biodiversity related to grazing
- Harmony in primary production by using bull calves from dairy herds
- Prevention of diseases/infections through appropriate feeding (vitamins/parasites)

The particular conditions for project II.3 are that the present market share of organic beef is only 2%. As a consequence, there is a shortage of high quality organic beef in spite of a steadily growing number of organic dairy farms in Denmark. Economic profitability is seen as a major constraint in using dairy breed calves in beef production. However, the interest in organic meat production is increasing and the need for reliable information on production parameters and strategies is evident.

The objective of this project is thus to contribute to development of economically viable production systems for organic meat of beef and pork. Emphasis is on steer production that attempts to improve animal health and welfare, product quality and improved nature value of marginal areas through grazing. This may provide a scientific basis for decision support to organic beef producers and provide future guidelines for management of marginal areas to increase biodiversity. The investigations also include the use of selected forage species with a possible influence on health and meat quality. The approach to improve meat quality and health of animals, particularly parasite control, is novel and may limit the unwanted use of medication. Therefore, the project attempts to improve the internal and external quality of organic produce.

Conclusions: Viable productions systems
Research supporting the development of environmentally and economically viable production systems for organic animal production is carried out. The activities illuminate both challenges and possibilities connected to integrating animal husbandry in organic productions systems.

Conclusions: Animal health and Welfare
Some plants contain compounds that may affect establishment, fecundity or expulsion of nematodes. In project II.3 a number of compounds and forages were tested. The preliminary conclusions on these experiments are:

1. It is possible to substantially reduce the nematode egg excretion of an established mixed infection
2. A remarkable reduction in *Teladorsagia* worm counts was observed following the move to new pasture whether it was grass or a bioactive crop. This may provide new information on the effect of repeated moves for control
3. In lambs being infected on the bioactive pasture, there was clearly a pronounced reduction in faecal egg counts in sainfoin
4. The establishment of *Teladorsagia* in lambs while grazing chicory was significantly reduced (by 85%).

Conclusions: Product quality
In project II.3 there are clearly promising prospects for use of selected bioactive crops to improve product quality. Overall, groups fed chicory were perceived as more acceptable relative to the other feeding treatments.

Overall conclusions
The multidisciplinary approach yields many interesting findings. The findings are discussed in a larger forum, which strengthens the applicability of results. But cutting-edge science may be difficult to achieve in combination with the very applied approach in the projects.

Discussion
Richard Weller asked: Is there only low vitamin E status after the winter foddering?
Troels Kristensen: Yes, it is related to winter foddering. Except for vitamin D we can handle the vitamin problems. We don't know much of vitamin D, because it has traditionally been given as a supplement to conventional cows.

Ralph Martin asked if it is possible to use 100 % Danish produced fodder?
Troels Kristensen: Yes, it is possible to use only silage and grass or supplement with rape cakes. We look at only Danish fodder (instead of just 100% organic) because this is the most problematic.

Urs Niggli: Are nematode eating fungi registered for use in Denmark?
Stig: No – and it probably won't be.

3.4 Analyses of the future development of organic farming

Finally, Søren Frandsen gave the last presentation under the theme *Organic agriculture in society – possibilities and restrictions*. The presentation was mainly based on project III.2 with relations to projects III.1, III.7, III.8 and III.9:

Previous research in organic farming in Denmark and the research undertaken under the auspices of the so-called Pesticide Committee (Bichel-udvalget) in 1998-1999 demonstrated the need for combining and strengthening agronomic and engineering insights with economic expertise allowing for a systematic approach to establishing a consistent analytical framework.

The objective of research project II.2 is thus to analyse the future development of organic farming in Denmark from the field, farm, sector and macroeconomic perspectives. Emphasis is placed on the economic impacts of a continued expansion of organic farming in Denmark taking into account the adjustment problems of converting conventional farming into organic farming. Part of the research will also be devoted to analysing the regional effects, the impact on various environmental indicators of organic farming as well as the economic effects of policy initiatives in general (i.e. changes in agricultural and environmental policies).

Key words for the research efforts are the analyses of barriers to entry, the effects of uncertainty with respect to future markets and prices for organic products, impacts of different policy initiatives as well as the dynamic processes of converting Danish conventional farming into organic farming.

A core activity is a number of illustrative scenarios describing the economic effects at the farm, sector and macroeconomic levels. The scenarios include both the construction of a baseline scenario describing possible perspectives for the future expansion of organic farming in Denmark as well as a number of policy, regulatory and technology scenarios. The results of the research project will illustrate the impacts of different designs of agricultural and environmental policies on the agricultural sector in general and on organic farming in particular. Furthermore, the results from the field and farm level analyses can

be used to support farmers in converting to organic farming and to develop organic production systems.

The research is characterised by co-ordinated efforts from the field level to the farm, sector and macroeconomic levels. At the field and farm levels the project will focus on the specification of labour and machinery systems in organic farming. Furthermore, the implications for total production costs and cost structures for different farm types are determined. Given these and existing data for cost structures in conventional and organic farming, existing farm, sector and macroeconomic models are adjusted and extended to incorporate the information obtained through the research.

The dynamic general equilibrium model (GE) used in the project is chosen, because of the following reasons:

1. It represents an integrated approach – both theoretically and empirically. That is, the GE approach is well known and it is an internationally extensively used economic analytical tool. It is theoretically better founded that the partial models. It is consistent - with no "free lunches" as all budget constrains are fulfilled. It uses established microeconomic data from this and other projects as well as the constructed database is in accordance with the Danish National Accounts.
2. It takes into account that organic farming is an integrated part of agriculture and the economy in general with explicit links to the input supplying sectors and the food processing industries. Also full account of the use of organic products (intermediate usage, exports and public and government consumption) is taken care of.
3. It takes into account the competition with other land, capital and labour using activities remembering that e.g. the return to land has shown to be an important factor explaining the growth of organic farming.
4. It takes into account the competition in the demand for food products (organic and conventional products are often close substitutes) and thereby the consumers willingness to pay and the income and own- and cross-price elasticity (coordinated with project III.1).
5. It is possible to incorporate important institutional features for the development of the organic production, including changes in the CAP, environmental policies and other regulatory policies.

Preliminary conclusions: farm level

Trends

- Some organic dairy farmers with low productivity will leave farming as their income is declining;
- The number of conventional dairy farms converting to organic farming will be reduced to almost zero due to the high supply milk compared to the demand;
- Farmers converting to organic farming will mainly consist of part time arable farmers and some pig farmers;
- The arable farms converting will become bigger. The farms converting to organic production used to be hobby farms of 5-10 ha, but they are now part time farms of 20-50 hectares.

Results

- The economic results on organic dairy farms with a livestock density under 1,25 LU per hectare are better than conventional farming
- The opposite is the case for farms with more than 1,25 LU per ha.

It does not seem profitable for intensive dairy farms to convert to organic farming at the existing cost and prices

- The 20% drop in the organic grain prices in 2002 increase the income on dairy farms with a high stocking rate buying feedstuff and reduce the income on dairy farms with a low stocking rate selling cash crops
- Organic farms have a lower N-surplus per hectare compared to conventional farms with the same stocking density.

The farming system is important for environmental impacts as e.g. pig farms using deep litter systems have a larger N-surplus than systems based on slurry as the N-loss in stable, storage and application is higher

Discussions and perspectives
Based on the preliminary results and experiences in the project the following perspectives are given:

- Continued need for improved productivity and research and development in organic farming
- The return to labour, capital and land need to be as profitable as conventional production (or organic farming will diminish)
- A market driven expansion is recommended from an economic perspective to reflect consumers' willingness to pay both domestically as well as abroad
- Important that the prices for both organic and conventional products reflects "the true cost of production", including both positive and negative impacts on e.g. the environment
- Important to target the policy instruments as closely to the aim of the regulation as possible

Discussion
Juha Helenius: This assumption in the model – that conversion to and from organic farming is dependent only on profitability – may not hold in reality.
Søren: I believe that the assumption actually holds.

Juha: How do you include environmental and even multifunctional aspects?
Søren: In form of scenarios where we add taxes or subsidies.
Gerold Rahman: Can the multifunctionality of agriculture be included in the model?
Søren: We do not intend to include the benefit side (e.g. in form of expected utility)

Christine Watson: How is the link between your farm scale model and e.g. the FASSET model?
Søren: The experiences from the FASSET modelling are used in our project.

Els Wynen: Does DARCOF pay most of the costs for this model development? Is it worth the money?
Søren: Yes. And even though they are very difficult to make, they are worth the money.

Els Wynen: Have you done any sensitivity analyses on the general equilibrium model? Do you get more out of it than what you can get from simpler models?
Søren: There has been a long discussion of partial versus general equilibrium models. Partial models cannot take care of e.g. competition for land. Others can argue just as convincingly against general models – this is how economics is – but experiences from the work in the Bichel Committee shows, that they can show something that other model cannot.

Jan Holm Ingemann: The models are estimated from historical data – therefore the scenarios are methodologically dubious – what is your view on this?
Søren: You are right. We do, however, incorporate new technologies as we go along, but still, you are right.

Mette Wier: You could ask the same question – could you have used another approach – to all the other projects, but it is always asked to the economic projects. Why is it not asked to the other projects?

Gerold Rahmann: Have you made a cross-check to earlier models of e.g. the shift from pull to push?
Søren: Yes. We also want the model to say whether it can replicate the history from 1995 and on.

4 DARCOF II as a whole – questions to be discussed

At the meeting in Viborg the evaluators were invited to present their evaluation of DARCOF II as a whole. To cover the main aspects in the programme a set of themes was chosen:

- What does DARCOF II contribute to the development of a rational organic production – and could it be done better by changing the way research is done?
- What does DARCOF II say about the organic process qualities of organic products (environment, nature quality, animal welfare, and the organic principles) – and what can research say?
- Does DARCOF II give better animal production and products? Can inherent qualities (nutrient composition, food safety, product quality, etc.) be secured through the production process?
- What does the remit of DARCOF II mean for the role of organic agriculture in society? Are there important aspects that are not included in the remit?
- Strengths and weaknesses of the research effort in DARCOF II – in light of the international development

Each evaluator gave thus a short presentation of their evaluation within one of these themes. The presentations were followed by an extensive discussion covering the whole range of subjects. In the following, some of highlights from the presentations and the discussion are summarised. The final, written evaluations are annexed. A full transcript of the presentations and the discussion is available at the secretariat at DARCOF.

4.1 What does DARCOF II contribute to the development of a rational organic production – and could it be done better by changing the way research is done?

The speaker, Juha Helenius congratulated the researchers with their effort. He found that the research, which is well justified, will benefit organic farming at many levels – both in Denmark and elsewhere. Juha Helenius had comments on to major areas:

*1. Contribution to rational organic production? (Production methods)*The resent focus is to increase productivity at the agroecosystem level (= biological primary and secondary production). Additional views could be:

a) Product chain analysis (to identify bottlenecks in increasing the volumes). In Finland bottlenecks for some products are not in the production nor in the demand but somewhere in the chain between.
b) Product (food) system analysis. This means research towards promoting local organic food system alternatives ('local' being one of organic qualities). Localism is a very strong issue in Finland. Local product systems are much more visible and it is easier to understand the whole process.

*2. Could it be done better? (the way research is being done)*The system approach is present in many projects, but absent in others. The systems approach is nothing new, but still needed and you have to look at how it is done.

Lots of knowledge, which could be beneficial to practitioners, is generated. Therefore, decision support systems at the system level should be considered

Systematic case studies in multidisciplinary teams (natural sciences + technology, economics, socio-cultural) at farm level? Again this is nothing new, but there is a need to learn scientifically how to detect problems and improve the system, namely:

a) What seems to be universal in organic farming is that the systems' (because of being less determined by chemical inputs...) behaviour is site specific (complex interactions). In conventional farming, on the other hand, much variation has been homogenised or removed.
b) How to cope with problem of what is appropriate in one case is not so in another case?

Finally, he raised the question: How does DARCOF feed back to organic rules?

4.2 What does DARCOF II say about the organic process qualities of organic products (environment, nature quality, animal welfare, and the organic principles) – and what can research say?

The speaker, Christine Watson expressed admiration on the programme: "The multidisciplinarity is impressive, at least as an aspiration, and there is a clear systems approach", she said.

Christine Watson then commented the content of the programme:

- There is a heavy focus on nitrogen – on losses ↑↓ and on production issues. Especially there is a focus on fixation and slurry. Perhaps you need to focus also on "slower" sources of nitrogen and on other nutrients.
- A number of other issues will be important in the future, like they are in the program, but is there enough emphasis on it? These are issues like: Soil fertility, Non-n nutrients, Energy, Assessments (consumer, indicators on environment and welfare), Biodiversity, Landscape, Welfare strategies, Scaling issues (nature, water quality, VE aspects?), Breeds for organic farming - livestock and crops – (fit for purpose)
- The development of standards is lacking in the programme.

Finally, Christine Watson raised some general questions:

- Is the overall application of organic results to conventional agriculture good enough?
- How do you train "conventional" researchers to do research in organic farming?
- There is a huge pressure for refereed publications everywhere. But should all projects aim for that? Perhaps it is also beneficial to speak of responsibility for knowledge transfer. Are the financers getting the best kind of knowledge transfer and how is knowledge transfer organised in the programme?

4.3 Does DARCOF II give better animal production and products? Can inherent qualities (nutrient composition, food safety, product quality, etc.) be secured through the production process?

Speaker 1

The first speaker, Richard Weller reflected his impression after reviewing six research projects. In his opinion the results from the animal-related projects will:

- Have the potential to improve the efficiency of meat, egg and milk production in organic farming.
- Help to identify some of the health and welfare problems in organic systems.
- The work will provide solutions to some of the problems whether by producing for example new health strategies for on-farm use, better management of the available on-farm feeds (grazed herbage, concentrate sources). The work may also conclude from the results that a major change is needed. For example, one of the projects shows that a different breed of poultry is needed in organic systems rather that just relying on the breeds or hybrids available from conventional systems.
- Most of the experimental work, in addition to testing hypothesis, has a practical focus. Providing that the final reports are comprehensive, with clear conclusions, this should allow the publication of farmer/advisory leaflets that will allow organic farmers to improve the efficiency of their systems and reduce some of the problems including poor welfare.
- There are better links between work packages in some projects than in others.
- Not all research topics in each project are unique and it would be impossible to set up such a large project and expect every study to be completely new. We must accept, for example, that the work on fatty acids in milk is also being investigated in other research organisations. These may be using conventional feeds and herds, but it is unlikely that the differences between the two types of farming will be significant.
- While some of the projects in DARCOF II will be completed, others may need extending if the problem is very complex and needs further investigation.
- The value of the current work will be shown if the final reports for each project do not consider the work in isolation – the results must be compared with other relevant international work whether the is organic or conventional.
- Indeed there is the option of considering reviewing the literature on suitable conventional practices that can be introduced into organic systems. Also as well as having a separate economics project they may benefit from considering carrying out basic economics in some of the individual projects, e.g. costs of production, costs due to ill health, and extra costs in meeting the organic standards.
- Many of the work packages are investigating problems that not only occur on Danish farms but also on organic farms in other countries. Therefore they have both national and international importance. The investigations of animal health are a good example. Some of the work will also benefit many conventional farms – again animal health is a good example.

Speaker 2

The second speaker on the subject, Gerold Rahmann had positive and negative comments on DARCOF II:

Positive

- DARCOF II has acknowledged the importance of animal husbandry in organic farming.
- Problems of animal husbandry at the recent state of the art are well identified and implemented in the 12 projects.
- Research is at a good stage and well funded.
- Good research is carried out in the 'without walls' context.

Negative

- 4-5 years are a very short time for solving the identified problems

- The systems approach is not really observable (interdisciplinarity). It is not actually fulfilled in the research projects. There is a step into the organic, but quickly a step out again. I miss a think tank (it is discussed in the frame of 5 years but not in a longer frame).
- International cooperation could be better – with whom do we discuss? I have a bit of a feeling of an island of Denmark.

On the question "Does DARCOF II give better animal production and products?" Gerold Rahmann answered both yes and no. He found that there are problems occurring with standards and real farms (situations), and some problems have not been solved. On the other hand, the understanding of organic animal husbandry has increased, all though animal husbandry in general probably needs a revision/reversion in targets.

4.4 What does the remit of DARCOF II mean for the role of organic agriculture in society? Are there important aspects that are not included in the remit?

The speaker, Els Wynen found that the remit is very general. So she picked up on some economic/social issues in the general mid-term report, which relate to program III.

Imports/exports: there is an inconsistency in the research challenges (section 2.1 of this report) with which DARCOF seems faced. If imports are 'in contravention of the organic principles', then exports must also be - by definition. Yet, DARCOF feels it needs to take action to curb imports and to encourage exports. However, the notion that imports are against organic principles is erroneous. International trade decreases the use of resources in the production of the same amount of output. Neither imports nor exports *per se* are against organic principles. It is the total use of resources in getting the product from producer to consumer (the total life-cycle) that determines whether goods (either domestically produced or imported) violate the principle of organic agriculture - efficient use of resources. It is for this reason, that knowledge about the whole-life-cycle is important, and research in this area could be encouraged.

Food quality: some differences in food quality (for example vitamins and proteins) between organically and conventionally grown products may not be very significant, especially not when sufficient quantities of food are consumed anyway. More research in that area may therefore not be warranted. There may, however, be other qualities, e.g. those found with the crystalisation-technique which could be of more relevance and therefore may deserve more attention in future research.

GMO: GMOs are banned in organic agriculture. Yet, there may well be aspects of the GM technology that could be acceptable within the organic philosophy. The debate is still to be had about what exactly is unacceptable and what is acceptable – a serious philosophical study may well be warranted.

Consumer prices consist of farm gate prices plus mark-up for the wholesale and retail sector, covering e.g. transport, insurance, waste. With increased organic production, these marketing costs (and therefore consumer prices) could go down without the producer price going down. Research could be warranted to estimate the magnitude of these possible consumer price decreases, which are important in estimating future demand. This knowledge could then be used in economic modelling.

Finally, Els Wynen expressed appreciation of the use of **reflexive objectivity** in the evaluation process, which she took as being the researchers declaring their own values that they bring with them into the research. What these values mean for the research becomes especially important in work where much is dependant on included assumptions. Especially with that kind of work, emphasis is needed on peer

review (by peers well-versed in organic agriculture) and co-operation (especially with other researchers in organic agriculture). From a number of the projects examined, it is not clear whether a literature review is part of the work. If it is not, inclusion of literature reviews in those projects should be considered.

4.5 Strengths and weaknesses of the research effort in DARCOF II – in light of the international development

Speaker 1
The first speaker on the theme, Urs Niggli suggested that there are strong points and some questions:

Strong points
- Many researchers are involved from many institutions – this is really unique.
- Clear overall research strategy – I am very impressed with this. There is no comparable strategy – maybe the federal German strategy, but they do not have the same efficient structure to implement it, and Austria also, but they got no money to carry it out.
- Many and excellent review papers, covering long-term aspects of organic farming such as food safety and research methodology, coming out of the secretariat of DARCOF.
- Good controlling procedure (management)

No weak points, only questions
- What is the impact on the progress/success of organic farming practice?
- What is the involvement of advisors and farmers? Is it too little – you should not, in your without-walls-centre, respect the walls of DIAS?
- What are the capacity building effects (especially human resources)?
- Is there enough synthesis work? Organic farming is much about benefit weighing – e.g. do we want more animal welfare or more environmental benefits. Who is doing this work?
- Is there a real organic environment for complex work (such as modelling) – it is essential in this type of work where the assumptions are so important, that they are done in accordance with the organic ideas.
- Designing organic systems?

Future
- DARCOF as a centre with semi-permeable walls? Which sucks in a lot of researchers and does not let them out again.
- The role of DARCOF in **transnational** research. DARCOF is the biggest organic research funder in Europe. DARCOF could enter it activities into transnational EU work and EU would double the money, and some other countries could join in. Here Denmark has a very important role to play.

Speaker 2
The second speaker on the subject of "Strengths and weaknesses of the research effort in DARCOF II – in light of the international development" was Ralph Martin. He suggested that there were both strengths and weaknesses in DARCOF II:

Strengths

- I like the idea about 'without walls' and the e-based information, which makes your work immediately available for international distribution. We, in Canada, really appreciate that.
- Interdisciplinary work – organic agriculture is a system and should be studied as such.
- Training of graduate students – we need well-trained scientists in the future.
- Good to have international internet sites and the eprints archive.
- Good with the strong links to other EU countries.
- Good to publish in international reviewed journals so that also 'conventional' researchers can benefit from the results.
- Good to have an international evaluation of DARCOF - and the part about reflective criticism in the evaluation is a good model.
- Denmark has a good reputation for critical analysis and problem solving – a good international model.
- Awareness of the interplay between values and facts. We should not pretend that our research is value-free.
- Organic research results mostly also benefits conventional farming – you should stress that funds for organic research is good for all of agriculture. Funds for conventional research often does not benefit organic farming.
- Good to use dynamic models, primarily because they show us data deficiencies.

Weaknesses

- Some research is "prescribed" (it does not want to go too far from the way organic farming is done in Denmark). You should try some unusual treatments in each experiment, e.g. compost.
- It is not clear how the e-forum facilitates "dialogue" – you should implement real dialogue.
- Most links are with the EU. It is a good start to include a Canadian evaluator and I hope we can go further – we, in the Organic Agricultural Centre of Canada, would like to form a link to North America.
- Current research is at the farm level or field level. You should go to the **watershed** level too – and include social scientists, tourism experts, etc. Perhaps you could work with towns who accept no pesticide policies, the use of municipal solid waste for compost for organic farms, the use of organic food in schools, hospitals, etc.
- With regard to nutrients, the focus is on Nitrogen. You should consider phosphorous excess and deficit, other nutrients, and study compost.
- You assume that imports of soy, cereals and vegetables will continue. More research should be done on self-sufficiency in these crops (and, in relation to what Els said, this would mean that you would also have to lower your export targets).
- Ecological economics seems to be weak in the programme. From the perspective of ecological economics you would use a model to assess how brittle or resilient an organic system is, and how well organic farming restores soil, water, air. There is also a link between organic farming and tourism. How can international agreements improve ecological practices and food quality, and reduce production surplus? Denmark is in a good position to lead the way.

4.6 General discussion

Following the presentations there was a general discussion with emphasis on the topics brought forward by the evaluators.

Animal husbandry
John Hermansen commented on Gerold Rahmanns reflections on the role of livestock in organic farming: "In the work we do, we focus on the role of the manager for livestock production. You could also ask: How does livestock benefit organic farming?"

Gerold Rahmann answered: "You have shown a lot of problems, but you need to look at: what is the place of different kinds of animals in organic systems in Denmark? Instead of just looking at organic farm types that are similar to the conventional farm types, you need to look at alternative types that may from the beginning avoid the problems that you now find. Very extensive farms do not have these problems (but they are not economically viable)".

Jan Tind Sørensen agreed with Gerold Rahmann: "We should try something more unusual. Up till now we have been very 'conventional' in our thinking. Why not try new things?"

Poul Sørensen remarked that the maximum flock size according to Danish rules is 3000 hens, but the behaviour researchers say they should be no more than 50 – can there be any economy in this?

Education of researchers
Kirsten Brandt explained shortly the Danish system concerning Ph.D. students and she invited evaluators to exchange Ph.D. student. This would benefit both them and the Danish research projects.

Søren Frandsen viewed Ph.D. mobility as a good thing: "You should not keep people to long inside. Teaching them the paradigm is ok, but avoid in breeding. You should keep on to good researchers in the classical way, by making good research environments, and keep challenging the ideas. Let us not grow into 'conventional' organic researchers".

Alternative treatments
In a comment to Ralp Martin and Christine Watson, Jørgen E. Olesen explained that there was a lot of compost work done in DARCOF I. "Here, large losses in low C/N compost were shown. This is in fact why this practice was given up in Denmark. The research on environmental impacts has primarily focused on Nitrogen leaching – this is actually a flaw, there is a lack of focus on e.g. energy questions such as the use of residues in the production of bio-energy".

Kristian Thorup-Kristensen supported this view, as he found that there are loads of publications on compost – so composting can hardly be the "unusual treatment", which was ask for.

Ralph Martin answered that it might still be useful to including just one treatment with compost. Likewise, Christine Watson maintained that we have to look for alternatives.

Urs Niggli remarked: "I support Kristian Thorup-Kristiansen in that this approach is in front and needed. Can we sell all that we produce in a complex (diverse) system? Right now, the development goes towards simple systems that fulfil market demands".

Organisation of DARCOF
Jan Holm Ingeman asked for suggestions on how to improve the organisational structure of the research programme: "You say that we lack imaginary power. The grassroots are very important here. Look at the birth of the windmill industry and organic farming. Back then everybody would say: there is no economy in that. But now they are large industries, the windmill industry is the 5th largest export industry in Denmark. In DARCOF there is a user committee, but that organisational structure does not keep the connection with the grassroots. Do you have any suggestions for a more adequate organisational structure?"

Gerold Rahmann: The organisation is good, but still it needs recommendations for improvements, otherwise it will die. It is not enough to include grassroots and ideologically convinced people - you also need others.

Christine Watson: You should gather people from a lot of different industries (e.g. standards, education, food processing) – broadening the user committee (as is, the committee is mostly farmers). Or perhaps establish a larger group with a meeting once or twice a year.

Ralph Martin: I find that the organisation here is very good. But farmers are not always visionary. They can sometimes restrict us by focusing on immediate problems, where we, as researchers, have to see 5 to 10 years ahead (hence the 'unusual treatments').

Urs Niggli stated that he did not suggest an organic paradise: "Even in FiBL I have to work hard to all the time bring the researcher together again. Also under the same roof it is very difficult to bring scientists into an interdisciplinary setting. Each researcher should really have 40% of his time to think about the work of other researchers – how can they understand each other's work if they do not spend time on it?" But of course – Urs remarked - no one will pay for this.

Urs Niggli also stated, that for the future we also need a kind of think tank for developing the future organic farming research – that's why we need some kind of walls (but not necessarily brick walls).

Richard Weller: You could suggest for instance two international people on the board to keep up with the international development, but this is maybe spreading resources too thin. All organisational structures have benefits and drawbacks.

Research approach and methodology
Jakob Magid found that there are many different views on what systems approach is? It will be a challenge for DARCOF III to improve the system approach.

Jan Holm Ingeman to Ralph Martin: You push for a more holistic approach. How can we make DARCOF meet that?

Ralph Martin: E.g. by emphasising the watershed level, and by starting with the model. Models help predict, and even if they do not, they show us where there is data deficiencies.
Hanne Østergaard: Have you thought about the size of our projects? Can it be done in them?

Kathryn O'Doherty: I'm a sociologist, and I am surprised of the agreement that the projects are multidisciplinary. There is still very little dialogue across the natural-social science border.

Juha Helenius: It is important to identify the issues here. Holism has a philosophical weight that I do not necessarily agree with. But it points towards systems research and the concepts of emergence. Most DARCOF II projects work with hard systems, but social aspects, values and moral issues are also real and this point to the need to work with soft systems. This does not entail a weaker science. We should try to identify the relevance of our research issues in the systems frame.

Ralph Martin: Social scientists talk too much. But we have to adjust to that and become more mature so that we can talk with them.

Bent Tolstrup Christensen: Organic farming research does benefit conventional farming. But there are also benefits the other way. Most of us are part time organic researchers and organic farming research has drawn heavily on the expertise of conventional researchers.

Gerold Rahmann: 250 million DKR is very little compared to for instance the cost of developing a new car model. Maybe it was better to address just one problem, e.g. parasites, in a five-year period.

Stig Milan Thamsborg: Knowledge transfer is important. Do we have too few visiting scientists?

Christine Watson: What I am asking is: how do you explain to people what is different about working in organic research.

Søren Frandsen: Danish research funding is in a severe situation. It is therefore necessary to demonstrate the value of what we do right now. Implementing new ideas might jeopardize getting to do those things in a DARCOF III.

5 Conclusions

As it appears in chapter 4 the evaluators gave a tentative, oral presentation of their evaluation on the meeting at the 23rd of October in Viborg. Following the meeting the evaluators clarified their opinion through written evaluations (enclosed as appendixes).

In the following, an attempt to make conclusions and reflections based on the individual evaluations is made.

5.1 The quality of the research process

Firstly, the evaluators were asked about their evaluation of the quality of the research process: How is the quality of the formation of DARCOF II? And does the allocation of resources reflect the need for research and is the progress sufficient to meet the remit of DARCOF II?

The general opinion is that the overall formation of DARCOF II has been of a high standard. The programme includes a wide range of subject areas, which appear to have been funded without a bias towards one particular area. The allocation of resources reflects the need for research. The flexibility and adoption on recent developments of organic market was shown in the programme changes and programme development.

According to the evaluators, the individual projects generally seems to focus on important study areas where there is a lack of knowledge in relation to a number of factors - including the levels of production from organic systems, efficiency of production within systems, animal health and quality of the products produced within the organic systems.

It is also noted that the number of excellent researchers involved in improving the basis of organic farming is worldwide unique. That shows that the concept of a research institute without walls was the right one.

It is also found that there is a clear and strong overall strategy in the program of DARCOF II and that - with the exception of Austria - no comparable effort has been made until now elsewhere.

Several evaluators found that the remit is well justified, as it is motivated by present days' acute need to increase productivity in organic farming, to ensure inherent quality of the organic food products, and to justify claims of organic (external) quality of the food products.

However, the tasks derived from the remit emphasize primary production and processes in agriculture. This means that the goal of increasing productivity as well as the 'environmental organic quality' is well represented in the projects. The goal of inherent quality including research in the whole food chain system is much less represented.

It is also noted, that the controlling procedures including the current midterm evaluation are exemplary, and that the courage to present the research in a thorough, international evaluation is admirable.

5.2 The quantity and quality of research products

Secondly, the evaluators were asked about their assessment of the quantity and quality of different kinds of research products: Are the different product categories appropriate and adequate to ensure high scientific quality and to meet the needs of organic farming? Is the scientific productivity and mediation satisfactory?

Generally, the quantity and quality of research products are assessed as being of a very high standard, meaning an important contribution to European organic science. In the evaluation the production of refereed papers is regarded as extremely important, not only for individuals, but for the scientific credibility of organic farming research.

One evaluator note: "This is a large research programme both in terms of the work involved, funds required to undertake the work and diversity of study areas. No research projects will ever achieve the total funds that the researchers require or demand to undertake all the areas they wish to study. However, this is a focused project that has the key objective of benefiting the organic industry. I am confident that with good overall co-ordination and with the researchers and co-ordinators making sure they achieve their milestones on time - including not only producing comprehensive final reports but also ensuring dissemination is high through published papers, workshops and field meetings – the targets can be achieved."

It is also noted, that the output of excellent review papers, made or co-ordinated by the DARCOF secretariat is impressive. These papers help to back up the ideals and integrity of organic farming in the long run.

It is suggested, that it would be very helpful to see publication targets for the whole projects, including refereed publication outputs and more farmer-based literature. And it should be noted, that in cost terms, refereed paper production from DARCOF II is currently very expensive.

The evaluators agree that the organic E-prints initiative is excellent and will help to make the outputs from DARCOF available to a wide audience.

5.3 Other aspects

The evaluators were then asked if they had found any important aspects that were not included in DARCOF II, and if they had any suggestions for adjustments. At the individual evaluations a number of suggestions for research emphases are given. For example more research in composting, whole-life-cycles, food quality, environmental issues, reduction of imports, nutritional management, etc. In the following only the suggestions for DARCOF II as a whole is highlighted.

Shift in emphasis?

One evaluator suggests a shift of emphasis in DARCOF. This is due to, that from a systems perspective, the organic food sector (chain, or even better, system) is more than organic agricultural production. Organic food system analysis might reveal bottlenecks other and more acute than those now addressed in DARCOF II. Moreover, it might bring important 'emergent' points for judging relevance. Therefore it is suggested to consider steering DARCOF towards DARCOFS, Danish Research Centre for Organic Food Systems.

In contras, another evaluator remarks, that more could be done to address the goal of reducing imports of organic cereals, protein crops and vegetables: "The issue will only become more important and Denmark would be well advised to approach self sufficiency in these crops. In order "to raise the natural component" I suggest that research focus on clean air, clean water and biologically active soil. The latter may require more inputs of compost. I acknowledge there is much to be done to reduce losses of C and N during the composting process and it should be researched rather than forgoing compost. Nutrient Management Planning should be conducted for P as well as for N. In this regard, it seems to me as an outsider that farms in Denmark could be more associated such that livestock farmers trade land with cash crop farmers. In this way, the risk of P excess on livestock farms could be moderated by some cash crops. I think some of the organic research should anticipate such co-operation".

The shrinking market demand
To address "shrinking market demand' it is suggested to include ecological economists in the research and link markets (people who want to support genuine regeneration of ecological capacity) to production. Ecological economists should address externalities and the brittleness of some systems and account for the resilience of organic systems. Ecological economists and social scientists should have serious inputs to the design of experiments and should model the feasibility of governments using organic food in hospitals, schools and other public institutions.

Communication of research results
One evaluator remarks that it is unclear where exactly the responsibility for communicating research results to the organic farming community lies. Both individual projects and co-ordinating projects (EXUNIT, SYNERGY etc) appear to have a role in this. What are the precise relationships with the advisory sector and how is continuity of information exchange assured? Are advisors working within the projects for example? This allows a two-way communication in terms of ideas for R&D.

In order to ensure end-user involvement, and thus the inclusion of issues of direct relevance to the organic industry, in the research programme, DARCOF may wish to consider broadening the range of stakeholders involved in the steering committees. Links in to certification/standards issues are rarely mentioned in the projects, so involvement of the Danish certification organisation is encouraged. Also, inclusion of the food processing industry might provide an interesting input to production chain and societal issues.

International collaboration
Generally the level of international collaboration in DARCOF was acknowledged. However, a higher emphasis on international networking of the individual projects as well as DARCOF II is suggested.

It is noted, that DARCOF is the biggest national fund for organic farming research in Europe. In order to strengthen collaboration EU-wide, transnational research activities will become more important in the 6th Framework. DARCOF will have a special responsibility and a huge potential in order to develop transnational research activities on organic.

One evaluator – the Canadian - encouraged international collaboration beyond Europe.

Educational aspects
The provision of funding for training of staff and associated students through higher degrees, in part fulfils the education role of DARCOF.

However, the provision of on-going training on organic issues, both holistic issues and policy/certification issues is less obvious and should be addressed.

Questions
Finally, one evaluator addresses some points with questions without having evidence that these points might be problematic or not

- Is the impact of the DARCOF research activities on the progress of organic farming and the individual success of organic farmers guaranteed? A systematic feed back of farmers and advisors reflecting input/output ratio of the DARCOF program would be helpful in order to maintain the political consensus for such an ambitious research program.
- Are agricultural advisors and organic farmers well enough involved? How many research projects are with participation of this 2 stakeholders and how many are carried out on research stations? It would be nice to have this figure documented.
- Does DARCOF build permanent organic farming research capacities? Would the major part of the researchers continue to commit themselves to the progress of organic farming once the special focus of the funding ceased?
- Are the secretariat's capacities sufficient to do all the synergy work of so many researchers? Such as:
    - Benefit weighing between advantages and disadvantages of specific scientific progress? This is especially important, because OF does never maximise or optimise branch-wise but goes for farm-wise or even macro economically clever solutions.
    - Is there enough "organic environment" for modelling and economic research groups? Although brilliant, the modelling work gave some questions concerning the in-depth-knowledge of the organic system.
    - Who does the designing of novel organic systems? Are - as far as organic farming is concerned - loosely bound researchers able to improve and redesign organic systems. A task which will become more important within the next decade.

Appendixes

Midterm evaluation 2002 of DARCOF II as a whole

Christine Watson

Evaluation criteria*		Evaluation
1.	**The quality of the research process** How is the quality of the formation of DARCOF II? Does the allocation of resources reflect the need for research and is the progress sufficient to meet the remit of DARCOF II?	The flexibility to initiate new research as needed is very helpful (e.g. introduction of GM issues). The breadth of the programme, interdisciplinary nature, consideration of holistic and scaling issues are all critical to the success of DARCOF II. The recognition of the need for co-ordination, and allocation of funds for this, is admirable (EXUNIT+SYNERGY 20% programme funds). This is a quality often lacking in European and national programmes. Scaling issues i.e. the impact of large scale conversion to organic farming on environmental and biodiversity benefits is very important for policy makers across Europe – more emphasis may need to be given to this in the future. 13% of DARCOF funds are being spent on breeding and producing GM-free seed. Given the importance of this topic currently in European agriculture this is probably justified. The only question is whether this problem is so near-market that more of this funding should be coming from industry. In the environmental and crop systems research there is great emphasis on leaching and N use in general. This is, of course, very important but maybe in the future research should also include more on other nutrients. In the long-term P and K import is likely to be of major concern in organic systems. Much work also is on the use of slurry, the use of other nutrient sources should receive more emphasis in future. The provision of funding for training of staff and associated students through higher degrees, in part fulfils the education role of DARCOF. The provision of on-going training on organic issues, both holistic issues and policy/certification issues is less obvious. There don't appear to have been any internal DARCOF seminars in 2001, this would have provided a major opportunity for training. This is a particularly important issue in relation to staff working for the first time in organic research – as would have happened with the larger number of organisations involved in DARCOF II.

* Section numbers refer to the report about DARCOF II as a whole

2.	**The quantity and quality of different kinds of research products** Are the different product categories appropriate and adequate to ensure high scientific quality and to meet the needs of organic farming? Is the scientific productivity and mediation satisfactory?	In cost terms, refereed paper production from DARCOF II is currently very expensive (mean 2670,000 DKK per paper, range 547,500 to 1,127,000 (range calculated accounting for projects with 1 or more)) – this is clearly only an indicative figure as refereed publications are always greater later in projects. However, it is clear that DARCOF scientists have already made an important contribution to European organic science. Production of refereed papers is obviously extremely important, not only for individuals, but for the scientific credibility of organic farming research. It would be very helpful to see publication targets for projects, perhaps on a whole project rather than an annual basis. Of course, some deliverables relate to outputs but perhaps this does not give adequate emphasis to published outputs. Clearly, some projects will produce a lot of refereed publication outputs while others will provide more farmer-based literature. It would be helpful to categorise projects in some way. The organic E-prints initiative is excellent and will help to make the outputs from DARCOF available to a wide audience.
3.	**The reflexive objectivity of the project** Are the mentioned topics appropriate and adequate?	It is clear that projects have taken on board the need for interdisciplinarity, although in some cases this still appears to b an aspiration rather than a reality – this does of course take time to achieve. The shift in emphasis of DARCOF II towards the consumer end of the food chain is clearly very important in terms of developing the organic market, and in gaining consumer trust of the organic food chain. Thus topics like food quality and safety, which have been much discussed in the European public arena are very important. There are many good scientific and socio-economic issues which still need to be addressed here. In terms of research quality and integrity, it is important to constantly bear in mind where and how organic research is relevant to the conventional agriculture sector. Publication of organic research, particularly systems oriented research, is often difficult and met with criticism by scientific referees from the conventional sector. The types of journals that will publish systems based research are also often those with lower impact factors. It is important for the scientific credibility and careers of scientists involved that they are encouraged to interpret and publish their results in ways which not only further the development of organic farming but also the underlying science and the application of the information in conventional journals.
4.	**Important aspects not included / suggestions for adjustments (optional):** One thing that is unclear in relation to communicating research results to the organic farming community is where exactly responsibility lies for this. Both individual projects and co-ordinating projects (EXUNIT, SYNERGY etc) appear to have a role in this. What are the precise relationships with the advisory sector and how is continuity of information exchange assured? Are advisors working within the projects for example? This allows a two-way communication in terms of ideas for R&D. In order to ensure end-user involvement, and thus the inclusion of issues of direct relevance to the organic industry, in the research programme, DARCOF may wish to consider broadening the range of stakeholders involved in the steering committees. Links in to certification/standards issues are rarely mentioned in the projects, so involvement of the Danish certification organisation is encouraged. Also, inclusion of the food processing industry might provide an interesting input to production chain and societal issues.	

Midterm evaluation 2002 of DARCOF II as a whole

Els Wynen

Evaluation criteria*		Evaluation
1.	**The quality of the research process** How is the quality of the formation of DARCOF II? Does the allocation of resources reflect the need for research and is the progress sufficient to meet the remit of DARCOF II?	I am most impressed about the evaluation process which accompanies this program. The writing up of the projects by project leaders, the evaluation by two outsiders, the chance to defend against comments made by the evaluators, and a meeting in which all issues are open for discussion - with part of the whole process made available on the website, make it all rather transparent. Progress is different in the different projects, and is sometimes dependent on external factors which - as I understand it - also reflects the availability of funding up until now. It is difficult to evaluate, from having read only 6 projects, whether the progress is sufficient to meet the remit. However, the progress in some of the projects is quite impressive. Having read through the midterm status report by Erik Steen Kristensen, I note some issues where allocation of future funding could be considered: - Imports/exports within considerations of efficient use of resources: the whole-life-cycle - Inherent food quality other than the conventional measurements such as vitamins/proteins (as, for example, carried out at FIBL) - GMOs and their possible place in organic agriculture (philosophical/scientific paper of where the limits are for organic agriculture and GMO technology, and reasons for those limits) - Expected development of consumer prices taking into account structural changes in pricing due to unit cost decreases e.g. in transport, handling and insurance (due to an increase in supply of organic products).
2.	**The quantity and quality of different kinds of research products** Are the different product categories appropriate and adequate to ensure high scientific quality and to meet the needs of organic farming? Is the scientific productivity and mediation satisfactory?	In most projects, I found little evidence of literature reviews, so that the Danish research possibly builds too little on other research. It may well be that everybody includes a literature review in their work, and that it is just not mentioned in the progress reports. But in case this is not generally done, the Board may want to consider insisting that a thorough literature review is routinely carried out for each project, where appropriate.

* Section numbers refer to the report about DARCOF II as a whole

		There is quite a range in peer reviewed papers per project. I imagine that this is partly due to the nature of the particular project, where some lend themselves to publications of results early in the piece, and others don't. However, I imagine that it also depends somewhat on the nature of the management. Although I can't see from the list whether there is a problem, I wonder whether this is an area where more management attention is warranted/needed.
3.	**The reflexive objectivity of the project** Are the mentioned topics appropriate and adequate?	As I understand it, 'reflexive objectivity of the project' should include the evaluation (by the project leaders/participants) of how the researcher's own values affect the research. I believe that many project leaders have had difficulty in filling out this section adequately. In other words, it may be worth while to explain this concept again, if it is to be included next time.
4.	**Important aspects not included / suggestions for adjustments (optional):** PhD-students: on 23 October there was some discussion about the desire for Danish institutions to have foreign PhD students working with them. Given the progressive situation in which research in organic agriculture in Denmark finds itself, would it be worthwhile for DARCOF to provide information to foreign students (possibly at universities where undergraduate courses in organic agriculture are conducted?) about topics researched at different Danish institutions? That is, make it clear that, if students have funding, it may not be too hard to find a suitable research place in organic agriculture in Denmark? I understand that this was the first time that this kind of evaluation has been carried out by DARCOF. As mentioned, I am very impressed about the process in general, but have some minor comments about the logistics. In no sense are the remarks meant in a critical way. 1. I wasn't aware of the second task (the evaluation of DARCOF as a whole) until it arrived. Although I found that the most enjoyable part of the 'job' in many ways, the work requirement felt a bit much at the end. This was partly due to the fact that the task arrived unexpectedly so that I had not included it in my time plan, and partly because it was sent rather close to 23th October. 2. I was/am not clear whether your intention on 23 October for project leaders was to discuss the whole Program of which their particular project was a part, and for the evaluators to comment on this. The formulation of the question about my task , for example, was such that I didn't understand that. Nor was the presentation of the Program III projects such that all (or the main) projects were covered. If it indeed is the intention that the presenter would give a synopsis of the whole of the program, and the evaluator to react to that presentation, then a rephrasing of that part of the program may be all what is needed to obtain that outcome next time. 3. There seemed too much detailed results presented in the first three presentations. (soils, plants, animals) on 23 October. This comment may well reflect the fact that these are not my areas of special expertise, so others who work in that field may have a totally different opinion. I can not judge whether the presenters only discussed their own projects or a combination of all the projects in their Program - see my point 3. May it be worthwhile to rethink what is required from the project (or program) presenter - or in what form? For example, is it important that results are presented, or should an overview be given of the funded studies and how the projects in each program relate to one another?	

Midterm evaluation 2002 of DARCOF II as a whole

Gerold Rahmann

Evaluation criteria*		Evaluation
1.	**The quality of the research process** How is the quality of the formation of DARCOF II? Does the allocation of resources reflect the need for research and is the progress sufficient to meet the remit of DARCOF II?	The quality of DARCOF II is high. The allocation of resources reflect the need for research. The flexibility and adoption on recent developments of organic market was shown in the programme changes and programme development. There is a deficit of international networking of the individual projects as well as DARCOF II.
2.	**The quantity and quality of different kinds of research products** Are the different product categories appropriate and adequate to ensure high scientific quality and to meet the needs of organic farming? Is the scientific productivity and mediation satisfactory?	The output of DARCOF II as whole is excellent. All target groups are sufficiently informed about of DARCOF II. The mediation is satisfactory.
3.	**The reflexive objectivity of the project** Are the mentioned topics appropriate and adequate?	The objectivity is appropriate and adequate.
4.	**Important aspects not included / suggestions for adjustments (optional):** Better international networking.	

* Section numbers refer to the report about DARCOF II as a whole

Midterm evaluation 2002 of DARCOF II as a whole

Juha Hellenius

Evaluation criteria*		Evaluation
1.	**The quality of the research process** How is the quality of the formation of DARCOF II? Does the allocation of resources reflect the need for research and is the progress sufficient to meet the remit of DARCOF II?	The remit is motivated by present days' acute need to increase productivity in organic farming, to ensure inherent quality of the organic food products, and to justify claims of organic (external) quality of the food products. The tasks derived from the remit emphasize primary production, i.e. processes in agriculture, with an exception of one food system, consumer oriented study. Especially, the goal of increasing productivity is well represented in the projects, as well as the 'environmental organic quality'. Without the exception of the mycotoxin project (I.12, this also being within-agriculture, plant pathology one), the goal of inherent quality is not represented.
2.	**The quantity and quality of different kinds of research products** Are the different product categories appropriate and adequate to ensure high scientific quality and to meet the needs of organic farming? Is the scientific productivity and mediation satisfactory?	The diverse products are and no doubt will be of (in general) good or high quality. The idea of creating a DARCOF net site for results (publications) is a promising one: it will be interesting to follow and hopefully meets the goal of reaching an even wider community of users.
3.	**The reflexive objectivity of the project** Are the mentioned topics appropriate and adequate?	In some cases, the reflective objectivity of the individual projects was better than that of DARCOF II mid term status report itself! In fact, the self-reflection section was missing in the report.

* Section numbers refer to the report about DARCOF II as a whole

4.	**Important aspects not included / suggestions for adjustments (optional):** What is an added value in ORGANIC agricultural research? Beyond the point that it is welcomed that DARCOF servers as a vehicle to the larger Danish agricultural research community to familiarise and legitimate research into solving agricultural problems in organic production, is there added value to what is conventionally being done in agricultural research? It is noteworthy that the productionistic view is as emphasised here as always has been in conventional side. Even if this is well motivated in formulating the remit, it also points to an obvious way to shift emphasis in the coverage of DARCOF: from a systems perspective, organic food sector (chain, or even better, system) is more than organic agricultural production. Organic food system analysis might reveal bottlenecks other and more acute than those now addressed in DARCOFII. Moreover, it might bring important 'emergent' points for judging relevance. In practice: I'm slightly concerned about the lack of contribution from food scientists dealing with processing, lack of marketing analysis, and rarity of consumer research. (The one consumer project, III.3 is welcomed). Understanding that DARCOF is about Organic Farming, I'm not suggesting (necessarily) that the funding is being spread over the whole chain, but rather that DARCOF should provide the agricultural scientists with a convenient platform to find consultancy – relevance analysis - from colleagues 'up the chain'. Another aspect is the collaboration with the stakeholders: I found the way this was considered in project I.4 as a good model. This is not to say that the current projects are not relevant: they are relevant to organic farming, no doubt. This is being raised more from the understanding of organic farming being, not a production system as such, but rather, an alternative food production culture: I is justified by 'organic values', values being contestable and political issues. Conventional agricultural science, somewhere in its recent past, forget to be explicit in expressing and repeating the values (in the society) on which it built our agriculture and food systems. The recent clashes with public were an obvious consequence, and now it seems difficult to some in the scientific community to regain the value base, and to understand that science is ment to serve the society and not vice versa. This became a long story about a simple thing: It would be worthwhile to consider steering DARCOF towards DARCOFS, Danish Research Centre for Organic Food Systems. I would like to end by thanking the Danish agric. Research community for this very significant and positive effort into (still in many countries) underdeveloped sector of organic farming. Very many important scientific results with high relevance to the society have already been achieved, and more will no doubt be generated by the end of DARCOFII.

Midterm evaluation 2002 of DARCOF II as a whole

Ralph Martin

Evaluation criteria*		Evaluation
1.	**The quality of the research process** How is the quality of the formation of DARCOF II? Does the allocation of resources reflect the need for research and is the progress sufficient to meet the remit of DARCOF II?	I think more could be done to address the goal of reducing imports of organic cereals, protein crops and vegetables. The issue will only become more important and Denmark would be well advised to approach self sufficiency in these crops. In order "to raise the natural component" I suggest that research focus on clean air, clean water and biologically active soil. The latter may require more inputs of compost. I acknowledge there is much to be done to reduce losses of C and N during the composting process and it should be researched rather than forgoing compost. Nutrient Management Planning should be conducted for P as well as for N. In this regard, it seems to me as an outsider that farms in Denmark could be more associated such that livestock farmers trade land with cash crop farmers. In this way, the risk of P excess on livestock farms could be moderated by some cash crops. I think some of the organic research should anticipate such co-operation. To address "shrinking market demand' include ecological economists in the research and link markets (people who want to support genuine regeneration of ecological capacity) to production. Ecological economists should address externalities and the brittleness of some systems and account for the resilience of organic systems. Ecological economists and social scientists should have serious inputs to the design of experiments and should model the feasibility of governments using organic food in hospitals, schools and other public institutions.
2.	**The quantity and quality of different kinds of research products** Are the different product categories appropriate and adequate to ensure high scientific quality and to meet the needs of organic farming? Is the scientific productivity and mediation satisfactory?	Generally very good. More research on vegetables might help to address the goal of reducing vegetable imports.
3.	**The reflexive objectivity of the project** Are the mentioned topics appropriate and adequate?	I encourage international collaboration beyond Europe. In Canada we will be pleased to work with you. Thanks for inviting me to be a part of this process. I hope we can collaborate more.
4.	**Important aspects not included / suggestions for adjustments (optional):** Keep in mind long term ecological goals for organic agriculture. Consider models to assess organic agriculture at the water shed level. Pesticide-free towns should also be part of the model so that Municipal Solid Waste and perhaps even urine from source separated sewage can be applied to organic farms for nutrient cycling. Social and political scientists could develop plans to bring landowners on side. Denmark is in a good position to lead the way.	

* Section numbers refer to the report about DARCOF II as a whole

Midterm evaluation 2002 of DARCOF II as a whole

Richard Weller

Evaluation criteria*		Evaluation
1.	**The quality of the research process** How is the quality of the formation of DARCOF II? Does the allocation of resources reflect the need for research and is the progress sufficient to meet the remit of DARCOF II?	Overall the formation of DARCOF 2 has been of a high standard. The project has included a wide range of subject areas, which appear to have been funded without a bias towards one particular area. The individual projects have been focused on important study areas where there is a lack of knowledge in relation to a number of factors - including the levels of production from organic systems, efficiency of production within systems, animal health and quality of the products produced within the organic systems.
2.	**The quantity and quality of different kinds of research products** Are the different product categories appropriate and adequate to ensure high scientific quality and to meet the needs of organic farming? Is the scientific productivity and mediation satisfactory?	This is a large research programme both in terms of the work involved, funds required to undertake the work and diversity of study areas. No research projects will ever achieve the total funds that the researchers require or demand to undertake all the areas they wish to study. However, this is a focused project that has the key objective of benefiting the organic industry. I am confident that with good overall co-ordination and with the researchers and co-ordinators making sure they achieve their milestones on time - including not only producing comprehensive final reports but also ensuring dissemination is high through published papers, workshops and field meetings – the targets can be achieved.
3.	**The reflexive objectivity of the project** Are the mentioned topics appropriate and adequate?	The range of topics that are currently being studied are relevant to the problems and lack of information in organic systems, not only in Denmark but also in other countries. To date the workers have used their initiative and where necessary modified their approach to a problem without losing sight of the original objectives of the work. Some individual projects will be complete at the end of DARCOF 2 but others may either not complete their investigations of specific problems or raise new areas where further work is required. Therefore, future work will need to be based on new topics, not previously studied, and possibly also some further work on some of the current individual projects.
4.	**Important aspects not included / suggestions for adjustments (optional):** Before there is any future funding of these types of large-scale projects all projects should be assessed to avoid duplication with the work being carried out in other countries.	

* Section numbers refer to the report about DARCOF II as a whole

Midterm evaluation 2002 of DARCOF II as a whole

Urs Niggli

The DARCOF research program impresses me as a whole. It's focus covers the priority 1 problems of organic farming and the research work is very relevant for both Denmark and other Scandinavian countries as well as for Middle and Northern Europe. The output of results - already in the midst of the planned research period - reflects that the research teams were well chosen and that the methodology has been state-of-the-art.

Especially good and efficient is the co-ordination done by a rather small scientific secretariat. The work of this staff reflects both a strong strategic orientation and an in-depth-perception of the scientific content of the projects and work packages.

The major strong points of DARCOF are:

- The number of excellent researchers involved in improving the basis of organic farming is worldwide unique. That shows that the concept of a research institute without walls was the right one.
- There is a clear and strong overall strategy in the program of DARCOF 2. No comparable effort has been made until now elsewhere with the exception of Austria (Research Initiative for Organic Farming in 1994, never started because of lacking funds) and Germany (Federal Program Organic Farming, planned only for 2 years).
- The output of excellent review papers, made or co-ordinated by the DARCOF secretariat is impressive. These papers help to back up the ideals and integrity of organic farming in the long run.
- The controlling procedures including the current midterm evaluation are exemplary.

It is always difficult to evaluate a program or single projects from outside a system. Especially difficult was it this time, because there were no possibilities to see researchers "in action" or to get a feeling from spontaneous discussions with the project managers and staff.

Therefore, I try to address some points with questions without having evidence that these points might be problematic or not:

- Is the impact of the DARCOF research activities on the progress of organic farming and the individual success of organic farmers guaranteed? A systematic feed back of farmers and advisors reflecting input/output ratio of the DARCOF program would be helpful in order to maintain the political consensus for such an ambitious research program.
- Are agricultural advisors and organic farmers well enough involved? How many research projects are with participation of this 2 stakeholders and how many are carried out on research stations? It would be nice to have this figure documented.
- Does DARCOF build permanent organic farming research capacities? Would the major part of the researchers continue to commit themselves to the progress of organic farming once the special focus of the funding ceased?
- Are the secretariat's capacities sufficient to do all the synergy work of so many researchers? Such as:
    - Benefit weighing between advantages and disadvantages of specific scientific progress? This is especially important, because OF does never maximise or optimise branch-wise but goes for farm-wise or even macroeconomically clever solutions.
    - Is there enough "organic environment" for modelling and economic research groups? Although brilliant, the modelling work gave some questions concerning the in-depth-knowledge of the organic system.
    - Who does the designing of novel organic systems? Are - as far as organic farming is concerned - loosely bound researchers able to improve and redesign organic systems. A task which will become more important within the next decade.

Conclusions for the future work

DARCOF is the organic research centre without walls. An excellent concept in order to bring as much competence as possible into organic farming research. Would a research centre with semi-permeable walls be the concept for the next phase? (Sucking in researchers and not letting them out).

DARCOF is the biggest national fund for organic farming research in Europe. In order to strengthen collaboration EU-wide, transnational research activities will become more important in the 6th Framework. DARCOF will have a special responsibility and a huge potential in order to develop transnational research activities on organic farming.