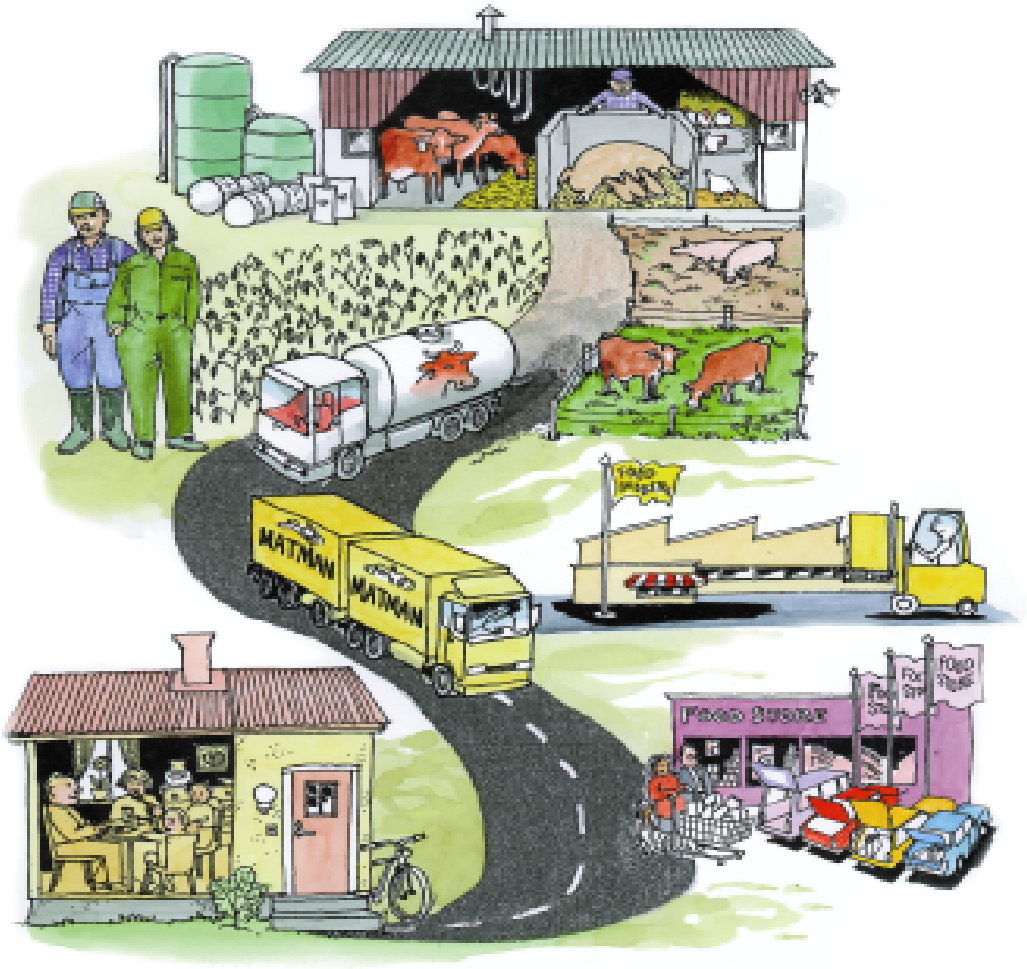
A MISTRA PROGRAM

FOOD 21

Sustainable Food Production
PROGRAM PLAN

Year 2003 (2001-2004)



Uppsala November 2002 Second revision

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Section 1

1.1 The vision and program approach

The program has passed its first phase and is now proceeding in its second during 2001 – 2004. The sustainability problems of the food chain are thoroughly discussed in the Program plan for the first period. Thus, they are assumed to be known and will not be further discussed here. The focus of the present plan will be mainly program activities and deliverables.

The vision and goals for sustainable food production were presented in the original program plan dated 16th of September 1996. What was proposed there is highly valid for guiding the second phase and will be summarised as below.

"The overall long-term goal of the FOOD 21 Program is to define optimal conditions and to develop systems and technologies for a sustainable food chain that offer the consumers high quality products".

The program philosophy

The philosophy for guiding our research and synthesis work towards more sustainable methods in the food chain is *to search for prophylactic solutions rather than corrective measures*. For the farming activities, this means that future agriculture will be managed in a way that enhances natural processes and nature's ability to produce healthy crops and animals, rather than focusing on control tools to deal with and combat the negative effects of inappropriate methods. New technical solutions in line with such a development will be based on biological and ecological requirements, taking advantage of both existing and emerging technologies.

Solutions in sight

Some examples of plausible solutions to sustainability problems are given below together with suggestions for successful implementation of relevant solutions.

Nitrogen pollution of ground waters and eutrophication of surface waters is one of the major non-sustainable aspects of modern agriculture. Thus, nutrient leaching to waters is a main research concern in the subprogram on arable soils and crop production. In this respect, decomposition of soil organic matter and nitrogen turnover are some of the main issues. The guiding vision is to grow green manure crops with different decomposition patterns in order to direct mineralisation to periods of active crop uptake. Initial studies on the characterisation of crop residues in terms of their decomposition pattern seem promising, and the next step will be to go from laboratory studies to field trials. Data have also been collected about emissions of greenhouse gases from a variety of crops and from crop rotations. Such knowledge will be useful for meeting the challenge of modifying cropping practices to avoid leaching losses of nitrogen to waters without a concomitant increase of air emissions.

The most common opinion is that phosphorus (P) losses occur, bound to particles with surface runoff. Elaborate studies on undisturbed soil columns have shown that internal P transport in the macro-pores of clay soils can be a hundred times higher than from sandy soils, amounting to several kg per hectare. Therefore, buffer strips along open waterways alone will not be sufficient to reduce the phosphorus load to surface waters. Preliminary results show that the

incorporation of P fertiliser within the topsoil is an important measure to reduce P losses. In addition, reducing internal P transport by promotion of a well developed soil structure, and breaking the soil cracks by shallow cultivation at the soil surface are important. Preliminary data suggest that high concentrations of phosphorus in soil profiles, found mainly in association with high livestock density, promote phosphorus leaching. Identification of threshold values for the relationships between soil concentration and phosphorus losses would provide arguments for adjustment of the phosphorus levels in soils to match crop demand, without unacceptable loads on waters.

Initial studies on element balances and fluxes on a dairy farm have provided valuable knowledge about risks for element accumulation and the depletion of soils, and the corresponding risks for negative effects on product quality and losses to waters. System studies have been conducted on several levels, i. e. the whole farm, the field, the feed-animal-manure level and the soil level. These have demonstrated that a specific element flux, which is of no importance on one level, turns out to be highly salient on another level. Furthermore, a survey of manure quality has shown that there is a high variation in element concentrations of manure. This suggests that it is necessary to introduce element flow bookkeeping on the farm level in sustainable agriculture.

One example of the above problem is the fact that several sources contribute to the continuous increase of cadmium levels in arable soil. The two most important are deposition and phosphate fertilisers. Studies within FOOD 21 have demonstrated that some feed components, used in pig production, although quantitatively small, contribute large proportions of cadmium in the feed. Due to the low intestinal absorption of cadmium, most of the cadmium from these ingredients are excreted in the manure and will be added to arable soil through application of farmyard manure. By controlling even the minor feed components for levels of contaminants and restricting the use of highly contaminated ingredients, the increase of cadmium levels in soil will be reduced.

To approach the goals for animal welfare, it seems that allowances for a closer relationship between mother and offspring would be beneficial for udder health as well as for calf health. Furthermore, this seems to offer possibilities for reducing the use of antibiotics. This would require new types of constructions of stables for dairy production. Our research collaborators in Colombia and Mexico have demonstrated very promising results in this area, which is also true for some experiences from Finland.

The co-operation between researchers on genetics and animal behaviour within FOOD 21 has contributed new opportunities for more precise and skilful breeding by which negative side effects may be avoided in breeding for productivity. Increased knowledge has been gained about how breeding mainly for increased production efficiency can threaten animal welfare and severely limit the sustainability of animal production. Extensive resources and facilities for analysis of genetic effects on animal welfare have been acquired, and co-operation has been established between the Animal Production and Product Quality sub-programs.

Studies on consumer attitudes and behaviour, and the role of established habits, have made valuable contributions to the understanding of consumer choice of organically produced foods. In particular, it has illustrated the limited importance of general attitudes, and the central role of consumer perceptions of various purchase criteria for the choice of food products. One conclusion is that organically produced food items need to match or surpass conventional products with respect to those food choice criteria that are given high priority by

consumers. Other studies illustrate the potential importance of activating specific attitudes in crucial choice situations (e.g. in food stores). Health, as well as the motive of “environmental friendliness” appears to be central for consumer choice of organic food items. Preliminary analyses indicate that health is the stronger of these two motives, even in “environmentally conscious” groups. Another practical implication concerns the differential use of health and environmental arguments in the marketing of such products. Consumers in an early phase of the transition to new purchase habits are sensitive to other criteria than are consumers later in the process.

Crops and animal products leaving the farm gates are often transported over long distances and most of them are processed in the food industry before reaching retailers and consumers. Along this line, finite fossil energy is consumed giving rise to environmental pollution. A more sustainable national food supply system would operate on several scales from local to nation-wide. Some products such as milk and cereals will preferably be processed and distributed in regional and nation-wide systems. Because of increasing concerns for food security, the need for minimal transports and the growing interest among consumers in the traceability aspect of food, local supply solutions are likely to expand. This will concern mainly grazing-based meat, potatoes and a range of niche products.

The implementation of innovative, environmentally sustainable methods on the farm level has proceeded relatively slowly in Sweden as of today. One reason for this may be that farmers do not share the views of the authorities on the major problems facing farming today. New methods may also be costly and difficult to implement in practice. Bringing concerned stakeholders together to deliberate a common agenda and to decide on priorities appears to be a promising way to facilitate implementation. In the farmer subprogram, we include these processes under the concept of collaborative learning and decision making processes in natural resource management.

Participation in problem clarification and analysis of desirable and feasible changes enables the development of general guidelines, site-specific solutions and a higher commitment among stakeholders engaged in the agri-food system. A couple of collaborative processes, involving farmers, as well as ongoing implementation of environmental management schemes, have been studied in detail within the farmer subprogram of FOOD 21. The findings suggest that participation in the identification of reasonable remedial actions is crucial. The participatory action research approach will result in concrete measures within the Swedish agricultural sector, but also promote the development of applicable conceptual models.

Comments on sustainability

Three aspects are of main concern when dealing with sustainability: system boundaries, system characteristics/properties, and system indicators.

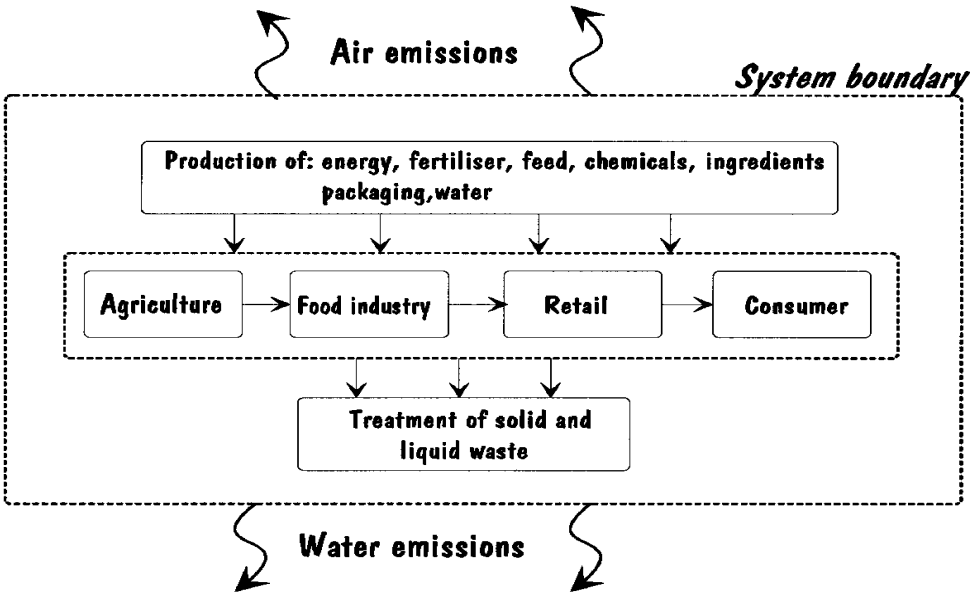

Figure 1. The system boundaries of the FOOD 21 Research Program.

A prerequisite for an analysis of system sustainability is a clear description of system boundaries. For the FOOD 21 program, these boundaries were identified as a basis for systems analysis and are here illustrated in Figure 1.
The sustainability of the food chain can be analysed with respect to three aspects:

- ability to satisfy contemporary and future goals in terms of; productivity, economy, natural resources etc
- efficiency in the use of production means; energy, fertilisers, pesticides, animal feeds etc
- ability to withstand disturbances; buffering capacity or robustness.

At the start of the FOOD 21 Program, a set of Sustainability goals were formulated with the objective to serve as a compass for guiding research on the ability of proposed solutions to improve food chain sustainability. These goals have been complemented with a set of economic and social goals at the start of Phase II. Furthermore, as a basis for the scenario work, visions will be set up describing future more sustainable production systems and a sustainable food chain.

In order to enable measurement of current system status and results of corrective measures with respect to sustainability, there is a need for appropriate indicators. During the first phase of the program, farm indicators have been developed for crop and animal production. Indicators for product quality are under preparation. This work will be finalised at the beginning of the second phase of the program.

Research and synthesis activities related to the food chain will include the topics covered by the sub-programs Crop production, Animal production, Product quality and Systems analysis. Individual sub-area topics and deliverables are presented in Section 2 below.

1.2 Deliverables at program level

Deliverables at Program Level concern issues related to the entire food chain or larger portions than those that are dealt with in individual projects. Results from individual projects as well as synthesis outcomes, will provide the basis for program level deliverables. The deliverables are therefore listed under two headings “Synthesis work” and “Research projects”.

Project	**Outcome on Program Level**
Project leader	Prof. Rune Andersson;SLU
Collaborating scientists	The Program Management Group: Msc. Mona Nordberg, SLU Prof. Bo Algers, SLU Prof. Lars Bergström, SLU Prof. Kerstin Lundström, SLU Prof. Thomas Nybrant, SLU Prof. Per-Olow Sjödén, Uppsala university
Project deliverables for the total project	**Synthesis work** · Sustainable concepts and plans for farm production systems with emphasis on crops, beef/milk and pork. · Analytical methods at system level to assess and evaluate sustainability characteristics of different food chain solutions (primary production, food industry, transports, retailers and consumers). · Methods based on scenario techniques to develop such solutions together with researchers and stakeholders. · An economic analysis of biological and sociological driven requirements for sustainability of farm operations - driving forces and implications for the structural organisation of the primary sector of the Swedish agriculture. · Indicators for measuring the degree of sustainability along the food chain. **Research projects** · Knowledge about the role of personal environmental values and earlier purchase habits in food choice, and the impact of environmental labelling and priming information in food stores. · Quantitative estimates of consumer contributions to the environmental impact of food purchase and food/waste handling in the home environments. · Innovative and applied approaches which enhance farmers' and other local actors' participation in the development of sustainable agri-food systems. · Knowledge about farmers' adoption behaviour and strategies in farming in relation to perceived social and institutional environment. · A decision support system for selection of “Best Management Practices” to reduce P emissions to natural waters. · Management strategies to steer the mineralization of N from organic manures to periods of high crop uptake and thereby avoid losses of N. · A system to assess element fluxes and balances in dairy-, pig- and crop production at farm level to avoid accumulation and depletion of elements within farms. · Guidelines on how to design well functioning housing and management systems for suckling calves in dairy herds. This will lead to improved cow and calf health and welfare, which will decrease the use of antibiotics in milk production. · Suggestions on how to improve the breeding programmes for commercial poultry stock, to reduce the risk of behavioural disorders and related health problems. This will be based on detailed knowledge about the link between poultry genetics and behaviour. · A description of sustainable housing systems for farm animals (cows, pigs and laying hens) enhancing natural behaviour, animal health and environmental quality. · Conclusions regarding the effect of more sustainable production systems on overall product quality. · Knowledge about safety aspects of cadmium in the food chain, from soil, via feed and livestock to man. Basic knowledge on bioavailability of cadmium in the food chain will also be compiled. · Twenty-four graduated PhD students trained in interdisciplinary research.

Deliverables for year 2001; · Revision of the FOOD 21 goals for a sustainable food chain. · Sustainability indicators for crop production, animal production and product quality (wheat). · Seminars about "Perspectives of sustainability" with internationally invited speakers arranged in co-operation with the Centre for Sustainable Agriculture, SLU. · An international conference dealing with sustainability issues of the Food Chain.	**Results year 2001;** · Revised sustainability goals for the food chain (Annual report 2000). · Eight indicators for measuring environmental status and changes in relation to crop production (SLU FAKTA Jordbruk nr 4, 5, 6 and 7; 2001). · A framework for indicators on product quality – exemplified with wheat (MAT 21 Rapport nr 2). · An international EU conference "Food Chain 2001- safe, sustainable, ethical", Uppsala (Conference Report to the EU Agricultural Ministers, SLU). · A seminar about the effects of calculated climate change on agriculture (Report on the FOOD 21 Web Home Page). · Two seminars about "Perspectives of Sustainability". · Start of a PhD project on co-operation between firms. · Four graduated PhD students (4 Theses).
Deliverables for year 2002; · Two seminars about "Perspectives of Sustainability" · A series of seminars bridging traditional discipline boundaries. · Sustainability indicators for animal production. · Start of a PhD project on root uptake of Cd in crops. · Outcome from the synthesis and scenario work as it is described in chapter 1.4. · Five graduated PhD students.	**Results year 2002;** · Two seminars about "Perspectives of Sustainability" · Two seminars bridging traditional discipline boundaries; one illuminating "consumer choice of organic food" and one dealing with "Urban waste nutrients- quality requirements for food chain recycling". · Sustainability indicators for animal production. A FOOD 21 report Nr 6. · A PhD project on root uptake of Cd in crops has started. · Six PhD students have been examined (6 Theses). · Outcome from the synthesis and scenario work as it is described in section 1.4.
Deliverables for year 2003: · A series of seminars bridging traditional discipline boundaries. · Seven graduated PhD students. · Outcome from the synthesis and scenario work as it is described in chapter 1.4.	

In order to successively bridge the gaps between traditional disciplines along the food chain, a number of seminars will also be held covering larger parts of the food chain; e.g. from grain to bred, from pig breeding to bacon on the plate.

1.3 The program structure and management

The program structure of Phase I will be largely maintained. However, systems analysis will expand from its current status as a separate research field into a central tool for the synthesis work. Furthermore, the research sub-programs will be more highly integrated than in Phase I.

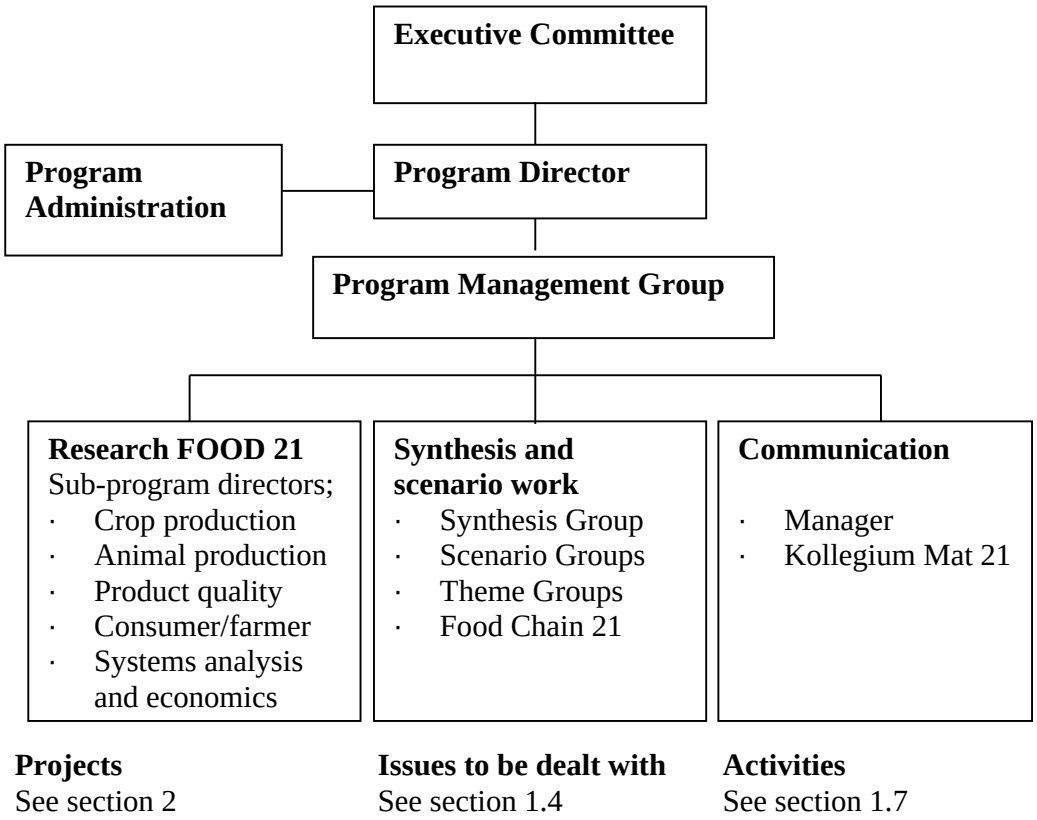

Figure 2. Program organisation during Phase II.

The Executive committee, and a Program Management Group is managing the Program, supported by a Kollegium MAT 21 representing the stakeholders (figure 2).

The Program Director together with the Sub-Program Directors and the Program Administrator constitute the Program Management Group (PMG). A Synthesis Management Group is running the synthesis work in close co-operation with the PMG.

The results from the individual projects will to a large extent be processed within the scenario and synthesis work. Together with results from other research, this will be employed in an analysis of how suggestions for new solutions may fit into larger food chain systems with respect to economic competitiveness, ecological acceptance and practical applicability. Another information flow goes in the opposite direction into the synthesis box from the stakeholders, e.g. members of Kollegium MAT 21.

Communication activities, with the objective to make the results of the FOOD 21 Research Program known among the food chain stakeholders, is an essential part of the Program.

1.4 Synthesis work

In the Letter of Intent it was proposed that the synthesis work should be organised around a number of scenarios which could be seen as *foci for the development and evaluation of proposed production systems*. This idea was fully supported by the Scientific Review Panel that concluded that: "The proposed scenario approach is appealing and will be instrumental in the implementation phase". In the MISTRA board decision, it was stated that the main focus of the Phase-II activities within FOOD 21 should move towards synthesis with less emphasis on discipline-oriented research.

Structure of the Synthesis Work

The synthesis work consists of two parts. The first deals with ***theme work*** where different problems that have been identified to be important are dealt with. This work has been in progress in Phase I and has, for example, concerned "Indicators for sustainability in food production" and "Beef production based on grazing". In Phase II, the theme work can be similar but will also deal with the integration of research results emerging within FOOD 21.

The second part of the synthesis work is the ***scenario work.*** This work consists of working groups organised as "round table discussions" in which people from different disciplines, as well as stakeholders, meet. The task is to analyse sustainability issues and to develop solutions according to principles and concepts such as low input systems, high technology farming, improved animal welfare etc.

System boundaries

The research in FOOD 21, as already stated in the first Program Plan for Phase 1, covers in principle the whole food chain from the producer to the consumer. However, the main focus of the research has been on the farms and the remaining part of the food chain has been dealt with through the product quality and consumer aspects sub-programs.

In 1999 MISTRA funded a new project, Food Chain 21, which has been carried out in close co-operation with FOOD 21. Food Chain 21 deals with environmental systems analysis of the food industry, packaging, transports, retailers etc; rather than research and development regarding the different processes and activities involved. It relies on a reference/working group in which researchers and stakeholders participate together in a continuous process where different scenarios and system solutions are suggested and evaluated. In Phase 2, Food Chain 21 is incorporated in FOOD 21 as part of the Synthesis work and consists of three projects.

Organisation

The Synthesis Group (SG), headed by Thomas Nybrant, consists of seven people who represent general, as well as more specific competences, with respect to the food chain. The group works in very close contact with the Program Management Group (PMG) and has also a wide network of people (stakeholders and researchers) for support and participation in the synthesis activities. The "Kollegium MAT21" has a crucial role since it includes key persons representing important stakeholders.

Theme Work

As described earlier, the theme work in Phase II can be seen as a continuation of the theme work activities that were carried out in Phase I *(General themes)* and themes on integration and synthesis of research results emerging within or close to the program (*FOOD 21 Research Themes).*

General themes

There are various reasons for dealing with a subject or an issue in the form of a theme work. Some examples are:

- State of the art and future development of a relevant area need to be analysed.
- The subject is important to the overall synthesis but is not subject to Food 21 research.
- Some special production concepts are developed and evaluated.
- Stakeholders need to meet, communicate and harmonise their views regarding important issues.

Some examples of themes in Phase II identified and initiated so far are

- Sustainable farm structures.
- Strategies for sustainable pest management.
- Sustainability issues in feed production and consumption.

It is anticipated that more themes will be initiated during the course of Phase 2.

FOOD 21 research themes

An already initiated theme dealing with integration of research results within the program is "Integrated nutrient management". In this theme researchers working in the Crop Production sub-program are developing field management strategies based on integrated views of nitrogen, phosphorous and trace element issues.

Scenario work

The scenario work is conceptualised in terms of working groups organised as "round-tables" around which researchers from different disciplines, each representing specific fields of competence, will assemble to discuss their findings. The scenarios/round-tables will also serve as meeting points for the discussion of sustainability issues, the "state-of-the-art", and feasible solutions to problems raised by the scenario in question. Other stakeholders in the food chain will participate in the synthesis of feasible solutions. This is especially important with regard to synthesis and evaluation of proposed new solutions.

The scenarios will be set up to allow analyses of food production and supply problems on several scales. Furthermore, the scenarios will be formulated to represent different degrees of intensity, e.g. in terms of dependence on external resource inputs.

Products and communication of results

The results of the theme works will be compiled in packages based on the needs of the main problem owners of the respective themes. The scenario work is anticipated to yield concepts of possible solutions for non-sustainable issues along the food chain, or parts of it. These concepts will be presented in the form of guidelines or as a collection of examples encompassing important stakeholders such as farmers and their organisations, food industries, wholesalers, retailers, authorities and consumers.

The form of these packages will vary and be adapted to the actual content and the respective target groups. Besides publication in scientific journals, reports, seminars and fact sheets we will consider how the Internet, CD-rom and possibly TV can be used for communication of results.

Deliverables from the scenario and synthesis work are an essential part of the deliverables specified at the Program level.

Project	**Synthesis and scenario work**
Project leader	Prof. Thomas Nybrant, SLU
Collaborating scientists	Prof. Rune Andersson, SLU Dr. Lotta Berg, SLU Dr. Stefan Gunnarsson, SLU Dr. Carl-Johan Lagerkvist, SLU Dr. Ulf Sonesson, SIK Dr. Susanne Stern, SLU Dr. Ingrid Öborn, SLU
Project deliverables for the total project	**Scenario work** · Sustainable concepts and plans for farm production systems with emphasis on crops, beef/milk and pork. · System analytical methods to assess and evaluate sustainability characteristics of different food chain solutions (primary production, food industry, transports, retailers and consumers). · Methods based on scenario techniques to develop such solutions jointly together with researchers and stakeholders. · Formulation of operative sustainability goals to be used in the analysis of food chains **Theme Work** · Management practices based on integrated views of nutrients and trace elements in cropping systems. · Operative tools to evaluate chemical and non-chemical plant protection strategies from a sustainability perspective. · Production economy and the FOOD 21 sustainability goals - analysis and conclusions regarding different structures of the primary production and the food chain. · Evaluation of different strategies for the production and use of animal feed in beef/milk and pork production. · Analysis of other possible critical sustainability issues in all parts of the food chain identified during the course of the program, such as food security, use of antibiotics in animal production, cadmium etc.

Deliverables for year 2001: · A detailed plan for the scenario and synthesis work, i.e. appropriate methods, management and scenario descriptions (visions). · Analysis and suggestions for the use of urban organic rest products in agricultural production. · Analysis and suggestions for chemical pest control and its alternatives in agriculture.	**Results year 2001:** · A detailed plan for the scenario and synthesis work (Synthesis Plan, May 2001). · Formation of an operational Synthesis Group. · A problem inventory report (under preparation). · A project plan for synthesis work within the sub-program crop production (see section 2.3). · Initiation of three problem oriented synthesis themes (agricultural structure, sustainable feeding, sustainable plant protection). · Preliminary conceptual scenario models.
Deliverables for year 2002: · Development and evaluation of alternative scenarios and concepts for the three prototype farms (a dairy farm, an arable farm and a pig farm). · Development and evaluation of production concepts in long term future scenarios. · Preliminary results from the three synthesis themes (agricultural structure, sustainable feeding, sustainable plant protection). · An international workshop and first drafts of scientific articles in the theme dealing with Integrated nutrient management in crop production.	**Results year 2002:** · Development and evaluation of alternative scenarios and concepts for two prototype farms (an arable farm and a pig farm). · Development of production concepts in long-term future scenarios. · Preliminary results from the three synthesis themes (agricultural structure, sustainable feeding, sustainable plant protection). · An international workshop and first drafts of scientific articles in the theme dealing with integrated nutrient management in crop production.
Deliverables for year 2003: · Development and evaluation of alternative scenarios and concepts for the three prototype farms (a dairy farm, an arable farm and a pig farm). · Development and evaluation of production concepts in long-term future scenarios. · Methodologies based on scenario techniques to develop such solutions jointly with researchers and stakeholders. · For deliverables from the respective synthesis themes, please see Section 2.3.	**Results year 2003:**

1.5 Collaboration

International co-operation
During the first phase, there has been extensive collaboration with international research partners on the level of individual research projects. Several FOOD 21 researchers have also been actively involved in applications to the European Union (EU). Collaboration partners are listed in the plans for individual projects.

International collaboration has been established within the subprograms concerned with crop and animal production. Most of this has been funded by MISTRA and organised by the International Foundation for Science (IFS), entailing collaboration with strong research groups in Colombia and Mexico. There are several fundamental differences in climate and production methods between these countries and Sweden. In spite of this, the overall approach to sustainability issues, and visions about urgent corrective measures have to a large extent been found to constitute a common meeting ground. It is our experience that this collaboration has been very profitable for the FOOD 21 program, especially when it comes to principles for efficient food production with low resource input and efficient re-circulation systems. Collaboration with Mexico will continue. Funds are allocated by the IFS. The collaboration with Colombia has come to a halt mainly due to the unstable situation in the country.

SLU and UU are also partners within a large EU project “Sustainability in the production of pork with improved nutritional and eating quality using strategic feeding in out-door production” (SUSPORKQUAL). Within this project, a large number of pigs are being produced in various ecological systems in different countries. Both rearing, product quality and consumer aspects are included and experience from this EU project will be of use within FOOD21.

Several attempts have been made to identify other research programs on an international basis, sharing the same goals, visions and scope as FOOD 21, with which to initiate collaboration. So far, this search has achieved very little. Some similar interdisciplinary programs are under way but these have not yet been initiated. Contact has been established with a Dutch program (directed by dr. Gerrit Merdink, Wageningen), and we will continue to strive for co-operation with additional programs during the second phase. We do believe that collaboration with other similar research programs will be beneficial for both parties, and contribute to a stimulating research environment.

National co-operation
Besides co-operation within the SLU and other national universities, mainly on program level, co-operation with three other MISTRA programs is firmly established;

- **Urban Water** concerning recycling of urban organic wastes to arable land.
- **HagmarksMISTRA** within the fields of “analysis of the adjacent political and legislative landscape” and the synthesis work.
- **VASTRA** about phosphorus transport from field to waters aiming at a decision support system for selection of “Best management practices” to reduce P emissions to natural waters.

1.6 Internal education

To improve the skills of the people involved in the scenario and synthesis work and to initiate the building of scenarios, a number of meetings and group discussions will be conducted. Discussions and training of skills will partly be elaborated with synthesis people participating in other MISTRA programs.

The PhD students recruited at the start of Phase I are approaching their doctoral exams, most of them within a year or two. Courses for the theoretical part of their work have in most cases been completed. However, some courses focusing on more practical aspects such as "How to meet the media" and "Agricultural EU policies and environmental subsidies" will be considered.

<table>
<tr><td>Project</td><td colspan="2">Internal education</td></tr>
<tr><td>Project leader</td><td colspan="2">Prof. Rune Andersson, SLU</td></tr>
<tr><td>Collaborating scientists</td><td colspan="2">The Program Management Group (PMG)</td></tr>
<tr><td>Project deliverables for the total project</td><td colspan="2">· Competence building in identified strategic subjects</td></tr>
<tr><td colspan="2">Deliverables for year 2001:
· A course on how to meet media
· Lectures on Life Cycle Analysis (LCA) and Systems Analysis</td><td>Results year 2001:
· A course for the scientists and PhD students on "How to meet media" (Journalist Lars Åkerman at Blidö, October).
· Three lectures on Life Cycle Analysis (LCA) and Systems Analysis (AgrD Ulf Sonesson, SIK).</td></tr>
<tr><td colspan="2">Deliverables for year 2002:
· A course on; " The political and legislative EU-landscape where Swedish agriculture is obliged to operate" in co-operation with the MISTRA Program "Management of Seminatural Grasslands".
· Lectures on Environmental Systems Analysis.
· A course for scientists and PhD students on advanced interdisciplinary research and synthesis.</td><td>Results year 2002:
· The PhD course about the political arena was conducted November 25 to 29.
· Lectures on Environmental Systems Analysis were continued.</td></tr>
<tr><td colspan="2">Deliverables for year 2003:
· An advanced course on "synthesis work".
· A one-day-course for senior scientists on "communication".</td><td>Results year 2003:</td></tr>
</table>

1.7 Communication

Owing to the fact that there are a great number of stakeholders in the program, communication has become very important as a tool to fulfil the Program aims. Communication in traditional academic media like scientific journals, fact sheets, annual reports etc. will constitute important channels. In addition, other more public forms such as seminars, workshops, special events, synthesis and scenario works will all take place under the common sign *Meeting Point Food 21.* Furthermore, all participants in FOOD 21 (the Executive Committee, the program management group, the researchers, and the Ph.D. students) has a continuous commitment to and responsibility for the communication in his or her special field. The PMG will provide communication training in order to stimulate and involve the researchers in this work (section 1.6).

Results are foreseen to be delivered not only as final products at the end of the program but rather as inputs to the stakeholders' scene during the whole program time. To participate in debates and to arrange seminars on sustainability issues are thus regarded to be important alongside the production of thesis and other types of results.

The following activities constitutes the communication work:

- Co-ordination of all communication activities
- Journalistic support in preparing stakeholder oriented products
- Continuous monitoring of emerging sustainability issues among the food chain actors

A communication plan has been developed as a totally integrated part of the overall program of Phase II.

Stakeholders and their needs

The needs for information of the stakeholders must be the starting point for all communication.

The following groups of stakeholders were identified at the Program start:

- The agricultural community of Sweden, The food industry, The retailers, The wholesalers, Consumer groups, The political system

The agricultural community of Sweden

Most of the resources of the program are allocated to non-sustainable issues of primary production. The main objective is to find more sustainable management practices at the farm level. Consequently, the farmers and their immediate partners e.g. sector authorities, extension services, Farmers' Union and the suppliers of production means are the main target groups for the achievements reached within this research field.

The expected outcomes concern crop and animal production and are presented as project deliverables from these research fields (section 2). The outputs from the scenario work addressing different types of production systems have also the agricultural community as a main target group. Those deliverables are described in section 1.4.

The food industry

The sustainability of the food industry is analysed by a research group at SIK in Gothenburg. Energy consumption and environmental pollution associated with the production, packing and distribution of individual food products are quantified. Results obtained will help the food industry to find out where in the food chain energy consumption can be saved as well as waste and pollutants minimised.

The relevant deliverables are found within the sub program Food Chain 21 in Section 2 but, also as an outcome from the scenario work (section 1.4).

The retailers, the wholesalers and the consumers

These groups constitute the food market actors. Research within this part of the food chain is aiming at a better understanding of consumer attitudes and behaviour. Consumer willingness to pay for added product values (e.g. improved animal welfare, cereals produced without using pesticides etc) are other relevant subjects for the market as well as for the farmers. Will such values be sufficient to motivate a higher food price? The consumer research projects (section 2) and parts of the synthesis work (section 1.4) will deliver this type of information.

The political system

The needs of the policy makers are more general compared to the previous groups. Also, the input needed is strongly related to the EU time schedule such as mid term revision of the existing CAP and the creation of the next EU agricultural policy in 2007. On a national basis, inputs will be delivered to the politicians on our own initiatives. This should be organised as

"breakfast meetings" at relevant ministries or by inviting politicians to seminars or other program activities. During the coming years, intensified efforts will be made in this respect.

The stakeholder deliverables are described in detail in a communication plan available at the FOOD 21 secretariat.

Kollegium MAT 21

The most important issue in communication is to have a proper network. That is why the Program Management Group and the Executive Committee, in accordance with the suggestions of the reviewers, have invited representatives of stakeholders which has created a focused and effective group acting as a communication link between the researchers and the stakeholders. Their commitment is to act as a bridge in both directions.

Project	**Communication**
Project leader	Msc Mona Nordberg, SLU
Collaborating staff	Msc Anna Blomberg, LRF
Project deliverables for the total project	· Annual reports, publications and special activities for target groups · Development of an information network promoting stakeholder participation in program activities.

Deliverables for year 2001;	**Results year 2001;**
· A more detailed communication plan will be elaborated and presented in the beginning of the year. · Three meetings with Kollegium MAT 21. · An annual report. · A brochure about Food 21 (Swedish/English). · Two seminars on Sustainability in collaboration with other organisations. · An updated Web site including an English version. · Special events/seminars/workshops directed at target groups including press seminars. · Four fact sheets. · Collaboration with SLU Info will be continued and extended to include media contacts. · Monthly Newsletters.	· A more detailed communication plan (under prep.). · Three meetings with Kollegium MAT 21 held at the stakeholders arenas with presentations of results obtained within the sub-programs. · An annual report 2000. · Brochure: A Taste of Food 21 (Swedish/English). · EU conference; FOOD CHAIN 2001. · Two seminars on "Perspectives on Sustainability". · An updated Web site. · Two seminars. · Seven fact sheets (SLU Fakta Jordbruk). · Monthly Newsletters. · Two Food 21 reports. · Poster presentations at conferences and other arrangements in the country e.g. Swedish championship in ploughing, Elmia, farmer oriented activities etc.
Deliverables for year 2002:	**Results year 2002:**
· Two seminars on "Perspectives on Sustainability". · An annual report 2001. · A Web site (English version). · Special events/seminars/workshops directed at target groups. · Three meetings with Kollegium MAT 21. · Monthly Newsletters. · Four Food 21 reports. · Three fact sheets.	· A detailed communication plan has been elaborated. · Two seminars on "Perspectives on Sustainability". · An annual report 2001. · An updated Web site including an English version. · Six open seminars. · Three workshops. · An internal seminar at the Ministry of Agriculture. · About fifteen appearances in radio and TV · Two meetings with Kollegium MAT 21. · Monthly Newsletters. · Five Food 21 reports. · One fact sheet (SLU Fakta Jordbruk). · Four seminar and workshop notes on the FOOD 21 web site.
Deliverables for year 2003	**Results year 2003**
· One seminar on "Perspectives on Sustainability". · An annual report 2002. · Special events/seminars/workshops directed at target groups. · Two meetings with Kollegium MAT 21. · Monthly Newsletters. · Eight Food 21 reports. · Five fact sheets.	

1.8 Beyond FOOD 21

In this section we present ideas on how the various types of Program achievements so far can best be further exploited.

This question can be analysed concerning the following aspects: What has been the most salient program success? What sustainability aspects of the food chain have been either poorly addressed or not at all? What are the stakeholders' opinions? Are there aspects that should preferably be developed further on a national scale and others that mainly concern the international market?

An important result of FOOD 21 will be the delivery of working methods and researcher competence in synthesis work on sustainable food production. This will constitute a resource for future research programmes. Another important output from FOOD 21 is knowledge about how the total food chain can be better adjusted to long-term sustainability. However, from a societal point of view, a macro economic approach is an urgent future development, not the least as the EU enlargement and the revision of the CAP are underway. Macro economic approaches have already been successfully applied in transport and localisation analysis leading to decisions on a national level e.g. on how to allocate railroad resources near airports or subway systems and highway routes in densely populated areas.

The national perspective

It has been claimed by many people that the holistic program approach of FOOD 21 has been rather unique. The whole food chain, from plant to plate, has been addressed. Systems analysis and synthesis work is used to find out whether changes in management practices or in the use of production means will improve the sustainability of the food chain. There is little information in literature on how to carry out an efficient synthesis. However, useful synthesis and scenario tools have been made available within FOOD 21 and the scenario work has started. It can be envisaged that at the end of the Program, further essential synthesis tasks will not have been dealt with.

From the very start of the Program, unique and appreciated communication with the stakeholders has been carried out. Stakeholder oriented reports, cross-disciplinary seminars and stakeholder participation in synthesis themes and Program reference groups are the main ways of communication used. An efficient network and a communication platform are now at hand where bridges are built between scientists and stakeholders but also between the different actors along the food chain.

There are two areas: the FOOD 21 synthesis work and the communication activities, that are essential to continue after the FOOD 21 Program has come to an end in order to properly harvest from the investments made. A stakeholder oriented activity may preferably be organised as a national investment. A plausible leader may be the SLU, fitting well into its present efforts to become stronger within this field of action (the third commitment). An obvious cooperating partner is the food chain sector representing the other end of the communication bridge.

The synthesis work may also be continued and developed as a research project, including work on macro economic models addressing the whole food chain. Discussions have been

initiated with the Department of Infrastructure, Section for systems analysis and economy, KTH, and a project proposal summary will be produced during the fall of 2002.

Besides these suggestions, innovative research activities can be identified within and at the interfaces between the individual FOOD 21 sub-programs.

These proposals are regarded as urgent national follow-ups.

The international perspective

An international follow-up will probably be best addressed within the European DG 6 Program. In cooperation with Professor Thomas Olsson, SIK, an expression of interest has been prepared and sent to Brussels in June 2002. This proposal suggests a research program similar to the FOOD 21 Program but on a EU level, including the whole food chain.

Our experience shows that a holistic approach and interdisciplinary research and synthesis have a very weak tradition in most academic contexts. Scientists are also inexperienced in collaboration and communication with stakeholders. This is true also within the rest of the European research community, and it is likely that it will take time to alter such conditions.

Consequently, it ought to be better to build up a group of researchers in synthesis activities similar to those of the second phase of FOOD 21 but on a EU level, with the objective to achieve a similar improved synthesis and communication skills also among European researchers and food chain stakeholders. In the end, this will enable the implementation of more sustainable food chain methods all over Europe. The research projects of such a program will naturally be identified on the basis of present knowledge.

A European FOOD 21 Program is also motivated from the point of view that we are all members of the same Union, and food production and trade are regulated by a common agricultural policy. Further more, twelve applicant countries will enter the EU and this will to a large degree also affect the agriculture and food production within those countries. Thus, in order to compete on the food market on a fair and equal base it is important to implement similar sustainable methods in the member countries.

Section 2

2.1 Research on new subjects

In the planning of Phase II, the scope of the program was reconsidered with respect to subjects not dealt with. Such considered fields are: pesticide use and its environmental consequences, human health aspects of sustainably produced food, recycling of urban organic waste to arable land, and social aspects on farmers' situation in sustainable agriculture.

Much international and national research concerns studies of benefits and risks of pesticide use in crop production. The initial analysis of research, made at the start of Phase I, resulted in the conclusion that it would not be profitable to perform environmental pollution studies given available program funds. This conclusion is still held to be valid. Furthermore, within the MISTRA program "Microbial Antagonism against Fungi", possibilities to replace chemical pest control by biological control are in focus. That work runs successfully and seems promising for a range of different areas of pest control. Pesticide use is an important issue in sustainable food production and our conclusion is that we will include this as a part of the synthesis work.

A similar conclusion has been drawn with respect to suggestions on extended studies of human health effects of food produced in more sustainable agricultural systems. Diet intervention studies of selected human populations, which have been considered, appear to be too expensive and are judged to give only marginally relevant knowledge. Consequently, health aspects will be included in our synthesis work. Expertise in this field already participate in the FOOD 21 Program both on the scientific level and in the Kollegium -MAT 21.

In Phase I, recycling of organic urban waste to arable land has been dealt with within one of our eight Synthesis Themes. In Phase II, recycling will be processed as a synthesis issue.

Project on social aspects
The social aspects related to the farmer and his family have been the subject of a new project " The social aspects in sustainable agriculture" (See project CF6).

Project on economy
At the beginning of Phase II, a doctoral project was started within the field of sustainable economy, with the project title "Co-operation, integration and economic adjustments in the agricultural firm".

To share machinery and to make joint purchases of production means are examples of already existing forms of collaboration between farmers. What is new in this project is the aim to analyse whether collaboration between two or more specialised enterprises may create advantages when environmental and social goals are addressed besides the economic outcome. For example, collaboration between a dairy farm and an arable farm may lead to a more sustainable use of manure and of soil resources in general. Another question is: will the market competitiveness improve as a consequence of the achieved added values? Special competence of involved parties may also create benefits for all.

A project plan has been elaborated and is available at the FOOD 21 secretariat. Project characteristics and deliverables are presented within the subprogram Systems Analysis (see project SA4). LRF (Federation of Swedish Farmers) and FOOD 21 share the financing of the project.

Project on cadmium crop uptake
A second doctoral project has also started regarding crop uptake of cadmium. The title is "Regulating mechanisms in crop uptake of cadmium from soils".

This subject has been identified in discussions with representatives of the agricultural sector, especially Cerealia. The background is that the cadmium content of cereals often exceeds health limits and the average concentration is increasing over time. The reason for this is both a continuous release of bedrock cadmium through mineral weathering and input to soils through atmospheric fallout and fertilisers. No clear relationship has been found between the concentration in the soil solution and crop uptake, suggesting an existing lack of knowledge about mechanisms behind root uptake.

The costs for this new project are shared between LRF and FOOD 21. Project characteristics and deliverables are presented within the subprogram Crop Production (see project CP4). A project plan is available at the FOOD 21 secretariat.

Project on consumer segmentation in terms of food-related lifestyles
Previous studies both within the FOOD 21-programme and elsewhere have indicated that only a minority of consumers buy the organic variety of staple food items (milk, meat, potatoes and bread) regularly. Such data are typically computed and presented in terms of mean values characteristic of entire samples. Although some differences between subgroups based on demographic characteristics have been reported, these are typically small (e.g. women > men, young > old). However, there is reason to believe that there are rather substantial differences with regard to the purchasing frequency of organic staple foods between groups characterized along other dimensions. So far, one of the most promising alternative principles of subgroup segmentation appears to be in terms of food-related lifestyles. The present project will employ a recently developed questionnaire for characterizing consumers in such terms and will study differences between such groups with regard to attitudes, beliefs, purchase criteria, intentions to buy, motives for buying and self-reported purchase of organic staple foods.

Project characteristics and deliverables are presented within the subprogram Consumer/Farmer (see project CF 7). A project plan is available at the FOOD 21 secretariat.

Individual and situational determinants of organic food consumption
Earlier studies within FOOD 21 have demonstrated that the strength of an individual´s environmental values is one of the determinants of the choice of environmentally labeled food items. However, in a choice situation in a food store, several other values (e g price, convenience, taste) compete for attention. Thus, several situational and individual factors affect the likelihood of choice of organic foods. Another individual factor is the strength of the habit of choosing products with specific characteristics. The present project includes attempts to determine the interaction between these factors in a simulated food store context. Also, the importance of time pressure and limited economic resources will be explored. The importance of the health motive has been demonstrated by project CF2. Therefore, effects of positive and negative health information in the food store situation will also be investigated.

Project characteristics and deliverables are presented within the subprogram Consumer/Farmer (see project CF 8). A project plan is available at the FOOD 21 secretariat.

Health, environmental friendliness and animal welfare in the minds of Swedish consumers
Findings in project CF 2 have shown that health and environmental friendliness are the two major motives for choice of organic milk, meat, potatoes and bread. These results are based entirely on responses to questionnaire items, why the lines of reasoning employed by consumers remain to be elucidated. It is likely that there are complex links between these two concepts. A "healthy" food item may mean that it possesses characteristics that improve health when consumed. However, it is also possible that positive "health" effects of organic foods may be perceived to originate in its less detrimental effects on the environment: health effects may thus be mediated environmental impact. In a similar fashion, the motive of animal welfare may be an end in itself, but may also be perceived to mediate health effects for humans. In the present project, qualitative data will be collected by individual interviews and focus group discussions in order to explore the lines of reasoning connecting these concepts in the minds of Swedish consumers.

Project characteristics and deliverables are presented within the subprogram Consumer/Farmer (see project CF 9). A project plan is available at the FOOD 21 secretariat.

Further monitoring of consumer attitudes to organic foods
Two questionnaire surveys were performed in 1998 and 2001 within project CF2. Another survey, including segmentation of the respondents according to their food-related life style, was carried out in the fall of 2002 (CF7). It is of great importance to be able to trace consumer attitudes, beliefs, intentions and self-reported purchase with the same methodology during a period of several years. Therefore, a third survey will be performed in 2004, including segmentation of the respondents in accordance with the 2002-study. This will give information on attitudes to organic foods among Swedish consumers during the period 1998-2004. It will also provide information on the relative stability of the consumer segments between 2002 and 2004.

Project characteristics and deliverables are presented within the subprogram Consumer/Farmer (see project CF 10). A project plan is available at the FOOD 21 secretariat.

2.2 Research projects

A project plan has been developed for each research project. These plans will serve as "contracts" between the PMG and the individual researchers. All plans are available at the FOOD 21 secretariat.

Figure 3 illustrates the total food chain, and the main points at which FOOD 21 research activities are concentrated.

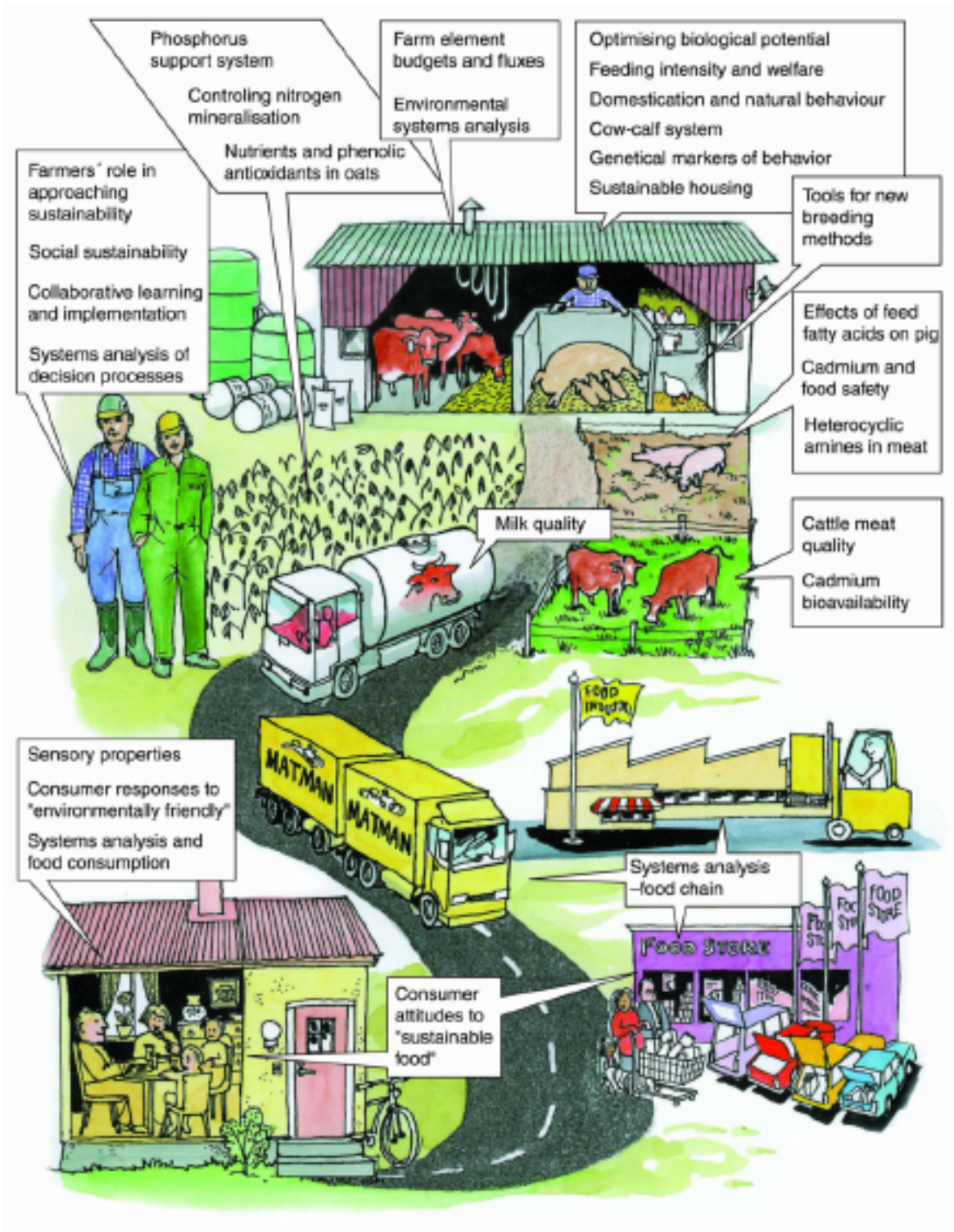

Figure 3. An overview of the FOOD 21 Research Program, from plant to plate.

Crop Production (CP) – Projects

CP1 a) Decision support system for selection and evaluation of 'Best Management Practices' to reduce P emissions to natural waters.
b) P sorption and desorption in relation to leaching losses from some cultivated Swedish soils – PhD project
c) Displacement of P in structured soils – PhD project

CP2 a) Optimising mineralisation of N from organic materials
Field implementation
b) Optimising mineralisation of N from organic materials - PhD project

CP3 a) Fluxes and balances of nutrients and trace elements in different farming systems
b) Fluxes and balances of nutrients and trace elements in the soil-crop system in organic and conventional dairy farming – PhD project
c) Contribution from mineral weathering – PhD projects
d) Modelling fluxes and balances of heavy metals in farming systems

CP4 Methods to better predict and to lower Cd content in wheat/cereals – a PhD project

CP1a

Project	**Decision support system for selection and evaluation of 'Best Management Practices' to reduce P emissions to natural waters**
Project leader	Prof. Lars Bergström, SLU
Collaborating scientists	Dr. Faruk Djodjic, SLU PhD stud. Katarina Börling, SLU PhD stud. Monica Kling, SLU Dr Erasmus Otabbong, SLU Prof. Adel Shirmohammadi, Univ. of Maryland (UVM) Dr Lennart Torstensson, SLU Dr Barbro Ulén, SLU
Project deliverables for the total project	· Based on the P related research done in Phase 1, we will develop and apply a multi-component 'Decision Support System' to identify sensitive areas for which probable causes behind P losses can be evaluated, and appropriate 'Best Management Practices' can be prescribed and tested.
Deliverables for year 2001: · The project will be started during the 2nd year and will last for 2 years.	**Results year 2001:** · According to plan, no results have yet been obtained.
Deliverables for year 2002: · During the first year of the project (year 2), a database with information on a selected watershed will be compiled. · A tested and evaluated software package to be used for various applications will be selected.	**Results year 2002:** · A decision support system for P management at a watershed scale was developed and tested. The results are described in J. Environ. Qual. (2002, 31:937-945).
Deliverables for year 2003: · The selected software package will be applied on a number of Swedish soils to obtain a more general instrument for selection of proper 'Best Management Practices'.	

CP1b

Project	**P sorption and desorption in relation to leaching losses from some cultivated Swedish soils**
Project leader	Dr Erasmus Otabbong, SLU
Collaborating scientists	Prof. Elisabetta Barberis, Turin Univ PhD stud. Katarina Börling, SLU Dr Gerd Johansson, SLU
Project deliverables for the total project	· Methods to identify P-AL and Olsen-P values critical for P losses, and soils prone to P losses, as a basis for reduction of such losses.
Deliverables for year 2001: · Publish an article containing information on 'P sorption and desorption on 10 Swedish soils, each of them fertilized at four different P levels'.	**Results year 2001:** · Results related to phosphorus sorption in relation to soil properties in some cultivated Swedish soils were compiled and published in Nutrient Cycling (2001, 1:1-8).
Deliverables for year 2002: · Publish articles containing information on 'Comparison on soil-P methods with particular reference to the resin-, Olsen- and AL-methods in Swedish soils', and 'Sorption/desorption properties and potential P leaching in non-calcareous Swedish soils'.	**Results year 2002:** · A method to predict P release from soil to solution in cultivated Swedish soils has been developed and tested. The results are described in a manuscript which will be submitted to J. Environ. Qual.
Deliverables for year 2003: · Publish articles containing information on 'P sorption/ desorption properties of subsoils' and 'P leaching in response to long-term differentiated P applications'. · PhD thesis by Katarina Börling ('P sorption/ desorption properties as related to P losses in some cultivated Swedish soils.	**Results year 2003:**

CP1c Terminated

Project	**Displacement of P in structured soils**
Project leader	Prof. Lars Bergström, SLU
Collaborating scientists	PhD stud. Faruk Djodjic, SLU Prof. Adel Shirmohammadi, UVM Dr Barbro Ulén, SLU
Project deliverables for the total project	· Evaluation of the role of macropores for leaching of P through soils. This knowledge will be used for development of counter measures to reduce P leaching.
Deliverables for year 2001: · PhD thesis by Faruk Djodjic, which contains information on 'Displacement of P in structured soils'. This is the final year of the project, which was started in autumn 1997.	**Results year 2001:** · The PhD thesis ('Displacement of P in structured soils') was completed and successfully defended by Faruk Djodjic on Sept. 21, 2001.

CP2a

Project	**Optimising mineralisation of N from organic materials - Field implementation**
Project leader	Dr Håkan Marstorp, SLU
Collaborating scientists	Dr Sigrun Dahlin, SLU
Project deliverables for the total project	· To identify and evaluate quality properties of plant materials that may be used to steer or manipulate net N mineralisation under field conditions. This research is based on the results obtained in model experiments in the first phase of the project. · To develop knowledge of how crop management affects these plant material quality properties. · To suggest management strategies that optimise the mineralisation of N from organic materials.
Deliverables for year 2001: · Identify quality properties of legumes and grasses that may be used to steer or manipulate net N mineralisation under field conditions. · Develop knowledge of how crop management affects these plant material quality properties.	**Results year 2001:** · Screening of the variation in chemical composition and degradability of a number of grasses and legumes has been performed. A micro-plot experiment has been started in the field. · A literature review dealing with 'how the quality of plant materials is affected by management practices' is being completed.
Deliverables for year 2002: · Evaluate quality properties of legumes, grasses and other plant materials that may be used to steer or manipulate net N mineralisation under field conditions.	**Results year 2002:** · Quality properties that may be used to manipulate N mineralisation under field conditions have been evaluated in a lysimeter experiment.
Deliverables for year 2003: · Data on quality properties of plant materials from a two-year field experiment that may be used to steer or manipulate net N mineralisation under field conditions.	

CP2b Terminated

Project	**Optimising mineralisation of N from organic materials PhD project**
Project leader	Dr Håkan Marstorp, SLU
Collaborating scientists	Dr Ernst Witter, SLU PhD stud. Sophie Gunnarsson, SLU
Project deliverables for the total project	· To identify quality properties of plant material that may be used to steer or manipulate net N mineralisation. · To develop knowledge of how crop management affects these plant material quality properties. · To develop methods to steer net N mineralisation in model experiments by means of the quality of the plant material.
Deliverables for year 2001: · Identify quality properties of plant material that can be used to steer or manipulate the net N mineralisation. · Knowledge of how crop management affects these plant material quality properties. · Develop methods to steer net N mineralisation in model experiments by means of the quality of the plant material.	**Results year 2001:** · Results on how carbohydrate composition of plant materials determines N mineralisation have been compiled and are in the process of being published in the journal Nutrient Cycling in Agroecosystems. · A literature review is being completed (see above). · PhD-thesis by Sophie Gunnarsson will be completed during 2002.
Deliverables for year 2002: · PhD-thesis by Sophie Gunnarsson.	**Results year 2002:** · Three new articles containing information on how to steer N mineralisation are in the process of being completed. · PhD-thesis by Sophie Gunnarsson will be completed during December.

CP3a

Project	**Fluxes and balances of nutrients and trace elements in different farming systems**
Project leader	Dr Ingrid Öborn, SLU
Collaborating scientists	PhD stud. Helena Bengtsson*, SLU PhD stud Johan Holmqvist*, Lund University (JH will continue in this project as post doc). Dr Gunnela Gustafson, SLU PhD stud. Anna-Karin Modin*, Lund University Prof. Ingvar Nilsson, SLU MSc Anna Richert Stintzing, JTI Dr Eva Salomon, JTI Prof. Harald Sverdrup, Lund University *) see separate project plans
Project deliverables for the total project (excl PhD students)	· Knowledge about flows and balances/imbalances of elements in a variety of production systems on field, farm and regional scale will form the basis for recommendations and measures to avoid long term soil accumulation or depletion. · Sampling/monitoring strategy for farm specific input data to farm and field balances. · Methods to evaluate the output from farm and field budgets and suggest measures both related to efficiency in the production system and the potential environmental impact. · Methods to predict the inherent capacity of different soil types to deliver essential nutrients for crop growth

Deliverables for year 2001:	**Results year 2001:**
· Further evaluation and writing up of results from Phase 1, 'Fluxes and balances of nutrients and trace elements in conventional and organic dairy farming systems'. These papers will form a basis for system analyses and implementation. · Evaluation and publication of data from Phase 1 dealing with partitioning of 17 nutrient and trace elements in feed among growth, faeces and urine by growing dairy breed steers. · Survey of feeding strategies and identification of hot spots regarding flows and balances of nutrients and trace elements in production of fattening pigs.	· The results have been presented at national and international conferences and a manuscript ('Field balances of some mineral nutrients and trace elements in organic and conventional dairy farming - a case study at Öjebyn, Sweden') is being published in the Eur. J. Agric. A 2-day workshop has been held as a starting point for the systems analyses. · The data on partitioning of 17 nutrients and trace elements in feed has been evaluated and a manuscript is under preparation*. · The work on feeding strategies has been started.
Deliverables for year 2002:	**Results year 2002:**
· Data on annual variations (3years) in fluxes and balances of nutrients and trace elements in conventional and organic dairy farming will be estimated and published. · Estimates of the weathering potentials of agricultural soils at a regional scale. · Data on fluxes and balances of nutrients and trace elements at a farm which is based on fattening pigs in Southern Sweden.	· A manuscript on partitioning of nutrients and trace elements from different feeding strategies in growing dairy breed steers (animal biomass-manure/urine) has been submitted to Acta Agric. Scand.* · The chemical analysis of feed, manure, crops etc from 3 years sampling and monitoring have been completed. Data evaluation has started. · A manuscript on farm-gate balances including a comparison between farm-gate, barn and field balances is under preparation. · Long-term fertility experiments form the basis for extrapolated estimates of the weathering potential. Long-term data are being evaluated and field and laboratory studies are conducted. This work has been expanded (see **). · A literature review has been conducted which forms the basis for calculations of fluxes and balances of N, P, K, Mg, Ca, Zn, Cu and Cd in fattening pig production systems.
Deliverables for year 2003:	**Results year 2003:**
· Evaluation and publication of studies of annual variations in fluxes and balances of nutrients and trace elements at farm and field level in conventional and organic dairy farming, conducted during 3 years. · Evaluation and extrapolation of mineral weathering based on data sets from the long-term soil fertility experiments including scenario-testing using simulation models**. · Evaluation and publication of fluxes and balances of N, P, K, Mg, Ca, Zn, Cu and Cd in fattening pig production systems with focus on 'hot-spots'. · Fattening pig sub-model, 'Partitioning of nutrients and trace elements in feed among growth, faeces and urine by fattening pigs'.	

*****Additional funding has been received from the Swedish Agricultural Board.
**Additional funding has been received from Formas.

CP3b

Subproject	**Fluxes and balances of nutrients and trace elements in the soil-crop system in organic and conventional dairy farming**
Project leader	Dr Ingrid Öborn, SLU
Collaborating scientists	PhD stud. Helena Bengtsson, SLU Prof. Ingvar Nilsson, SLU Prof. Arne Andersson, SLU
Project deliverables for the total project	· One PhD thesis, including 4 publications dealing with fluxes and balances of elements in soil/crop systems in organic and conventional dairy farming.
Deliverables for year 2001: · Quantification of soil content of nutrients and trace elements at the Öjebyn farm. · Evaluation of soil quality and fertility with respect to element balances and the influence of historical management practices.	**Results year 2001:** · The work has proceeded according to the plan. A manuscript ('Field balances of some mineral nutrients and trace elements in organic and conventional dairy farming - a case study at Öjebyn, Sweden') is under preparation to be published in the Eur. J. Agric. · Soil water has been sampled by tension lysimeters and the chemical composition has been analysed*.
Deliverables for year 2002: · PhD thesis by Helena Bengtsson, which contains information on 'Fluxes and balances of nutrients and trace elements in the soil-crop system in organic and conventional farming systems'.	**Results year 2002:** · A paper dealing with 'field balances of some mineral nutrients and trace elements in organic and conventional dairy farming - a case study at Öjebyn, Sweden' has been accepted for publication in the Eur. J. Agric. · A manuscript including 3 years data focusing on variations and uncertainties is under preparation. · A manuscript on farm-gate balances including a comparison and discussion with barn and field balances is under preparation.
Deliverables for year 2003: · PhD thesis by Helena Bengtsson, which contains information on 'Fluxes and balances of nutrients and trace elements in the soil-crop system in organic and conventional farming systems'.	**Results year 2003:**

*Additional funding from Formas (SJFR) has been received for this part of the study.

CP3c Terminated

Subproject	**Contribution from mineral weathering**
Project leader	Prof. Harald Sverdrup, Lund University
Collaborating scientists	PhD stud. Johan Holmqvist, Lund University Dr Ingrid Öborn, SLU
Project deliverables for the total project	· One PhD thesis, including 5 publications dealing with the contribution from mineral weathering to soil nutrient status.
Deliverables for year 2001: · PhD thesis by Johan Holmqvist. 'Chemical weathering in different scales' (partly financed by FOOD 21).	**Results year 2001:** · The PhD thesis ('Modelling Chemical Weathering in Different Scales') has been completed and successfully defended on Nov. 23, 2001.

CP3d

Subproject	**Modelling fluxes and balances of heavy metals in farming systems**
Projectleader	Prof. Harald Sverdrup, Lund University
Collaborating scientists	PhD stud. Anna-Karin Modin, Lund University PhD stud. Helena Bengtsson, SLU PhD stud. Johan Holmqvist, Lund University Dr Ingrid Öborn, SLU Dr Gunnela Gustafson, SLU Prof. Ingvar Nilsson, SLU MSc Anna Richert Stintzing, JTI Dr Eva Salomon, JTI Prof Agneta Oskarsson, SLU
Project deliverables for the total project	· One PhD thesis, consisting of about five peer-reviewed publications dealing with modelling heavy metals in the system soil-crops-livestock-manure-soil.
Deliverables for year 2001: · A calibrated and tested dynamic process-oriented biogeochemical model, describing the uptake of cadmium from soil to plant at field scale.	**Results year 2001:** · The Cd model has been developed and tested, and presented at an international conference. An article describing the model will be submitted to an international journal before the end of 2001.
Deliverables for year 2002: · A dynamic model describing fluxes and balances of P at farm scale will be developed, calibrated and tested, using data from Öjebyn. · The model will be extended to also include N, K, Zn and Cd.	**Results year 2002*:** · The model is under development for a dairy farm including P, N, K, Zn and Cd. Special emphasis has been put on the feed-animal-manure/animal product component.
Deliverables for 2003: · A dynamic model describing fluxes and balances of P, N, K, Zn and Cd at farm scale for dairy production will be developed, calibrated and tested, using data from the Öjebyn farm.	**Results year 2003:**

CP4

Project	**Methods to better predict and to lower Cd content in wheat/cereals – a PhD project in soil and plant science**
Project leader	Assoc. Prof. Jan Eriksson, SLU
Collaborating scientists	PhD student Håkan Wångstrand Assoc. Prof. Ingrid Öborn, SLU
Project deliverables for the total project	· One PhD thesis, consisting of about four peer-reviewed publications on methods to predict Cd content in wheat/cereals from soil and plant analyses. Effects of fertilisation on plant availability of Cd and on correlation between conditions in the rhizosphere and plant uptake of Cd will be investigated.
Deliverables for year 2002: · Data on correlations between Cd content in harvested grain and Cd content of the crop at earlier growth stages and how it varies with seasonal conditions and soil type.	**Results year 2002:** · The project was started during 2002, and no results are therefore yet available.
Deliverables for year 2003: · Poster presented at the 7th ICOBTE conference in June, 2003. · Results dealing with prediction of grain cadmium concentration in wheat from plant cadmium concentration at different growth stages, will be compiled.	**Results year 2003:**

Animal Production (AP) - Projects

AP1	Animal welfare and sustainable breeding: Behavioural and genetical markers
AP2	”Cow-calf systems” - effects of dairy calf rearing systems on present and future health, behaviour and production of cow and calf
AP3	Sustainable housing systems for farm animals
AP4	Domestication and natural behaviour – completing project from Phase 1 (Terminated)
AP5	Feeding intensity in relation to animal welfare and productivity
AP6	Optimising the animals biological potential
AP7	Animal welfare and sustainable breeding: mapping of Quantitative Trait Loci (QTL) in an intercross between the Red Jungle Fowl and White Leghorn chicken (Terminated)

AP1

Project	**Animal welfare and sustainable breeding: Behavioural and genetical markers**
Project leader	Prof. Per Jensen, SLU
Collaborating scientists	Prof. Leif Andersson, SLU Prof Linda Keeling, SLU Prof. Kerstin Lundström, SLU
Project deliverables for the total project	· Detailed genomic analysis of behavioural disorders in poultry, with identification of candidate genes for stress susceptibility, feather pecking and cannibalism.

Deliverables for year 2001:	**Results year 2001:**
· Second and third generation of breeding population of F2 intercrosses between jungle fowl and laying hens. · First genome analysis of feather pecking in poultry. · First results from genome analysis of meat and egg quality parameters. · Identification of behavioural markers for decreased stress tolerance in relation to production capacity in poultry. · Development of behavioural tests for stress tolerance and behavioural disorders.	· Second generation hatched, and third generation under planning. · QTL for feather condition (as a result of feather pecking) identified. Analysis of phenotypical traits correlated to feather pecking almost finished. · Meat and egg quality parameters not analysed yet. · Contrafreeloading and social behaviour has been identified as one behavioural marker for adaptability. Other markers still being analysed are open field reactivity, tonic immobility, and novel object reactivity. · Behavioural tests for contrafreeloading and social behaviour have been developed.
Deliverables for year 2002:	**Results year 2002:**
· Maintainance of progressive generations of fowl intercrosses. · Further analysis of candidate genes for feather condition. · Data from behavioural tests of parental generations. · First preliminary analyses of gene expression data for different behavioural parameters. · 1-2 scientific papers.	· Progressive generations maintained, and a back-cross planned for fine-mapping of interesting chromosome areas. · A gene identified for feather condition (so called *Dominant White* gene) · Data from behavioural tests of parental generations have been obtained and published. · Gene expression analysis pending the micro-array construction in a parallel project, expected to be available in January 2003. · 2 scientific papers published, another 5 submitted
Deliverables for year 2003: · Breeding of a backcross F3xleghorn for fine-mapping of the most interesting QTL-regions. · Breeding of an F4-generation · At least one QTL (Growth1) finemapped down to a region containing about 50 genes. · Candidate gene identification in that region by means of homology analyses · First analysis of differential gene expression using DNA microarrays · 3-4 scientific papers · One PhD thesis	

AP2

Project	**"Cow-calf systems" - effects of dairy calf rearing systems on present and future health, behaviour and production of cow and calf**
Project leader	Dr Charlotte Berg, SLU
Collaborating scientists	**An already formed working group consisting of (among others)** Dr Lena Lidfors, SLU Dr Kerstin Svennersten-Sjaunja, SLU AgrL Michael Ventorp, SLU Dr Ingemar Olsson, SLU PhD stud. Annette Herrloff, SLU
Project deliverables for the total project	· A presentation of well functioning systems for suckling calves in dairy herds. Evaluations and descriptions of different types of housing systems, which promote calf health and welfare. · Knowledge about the important behavioural components to take into consideration during the weaning process. · Suggestions on calf rearing systems, which improve udder health and decrease the use of antibiotics in milk production. · Scientific and popular publications related to the optimal suckling period and weaning methods for dairy calves suckling their own mother, and the effects on udder health and milk quality when dairy calves are allowed to suckle their dams or other cows. · Results on the effect of early interaction between cow and calf on the physiology, behaviour and growth of the calf and the behaviour, milk production and udder health of the cow. · In co-operation with a commercial medium sized dairy farm, some of the results achieved will be applied and demonstrated in practice.

Deliverables for year 2001:	**Results year 2001:**
· A presentation of well functioning systems for suckling calves in dairy herds. · Results on the effect of early interaction between cow and calf on the physiology, behaviour and growth of the calf. · Results on the effect of early cow-calf interaction on the behaviour, milk production and udder health of the cow.	· Results on the effect of early interaction between cow and calf on the behaviour and growth of the calf and on the behaviour, milk production and udder health of the cow. The practical part of this study has now been fully completed. · Popular presentations: The FOOD21 cow-calf project has been presented on posters at the following exhibitions: FoodChain2001, Uppsala, March 2001; Elmia Lantbruk 2001, Jönköping, October 2001. · A slide and video presentation of different methods of milk feeding dairy calves, aimed at agriculture students, farmers and advisors. · A sheet of facts about milk feeding methods on organic dairy farms, and results from a study of foster cows. · We have initiated discussions with several farmers who want to try keeping cow and calf together. · A study on effects of cow-calf separation after 1, 4 or 7 days with or without visual-auditory contact have started as a co-operation with the University of Prague. · Participation in an application to EU to study suckling calves in a larger project.
Deliverables for year 2002:	**Results year 2002:**
· A book with presentations of well functioning systems for suckling calves in dairy herds (slightly delayed due to the restrictions on farm visits during the outbreak of FMD in Europe in spring 2001). · Two scientific papers on the effect of early interaction between cow and calf on the behaviour and health of the calf and cow. · Results on the effect of different calf age at separation on cow and calf behaviour. · A seminar for advisors about rearing of dairy calves. To be held during autumn. · Study of the effect of different suckling and separation regimes on milk quality, udder health, onset of ovarian activity and welfare in cattle raised under tropical and highland conditions in Mexico. · Continue discussions with several farmers who want to try keeping cow and calf together. Establish some as	· A booklet with presentations of well functioning systems for suckling calves in dairy herds will be printed by the end of 2002. · Conference participation: a presentation of the FOOD21 projects on cow-calf systems given at the BSAS conference on global animal production, held in Mérida, Mexico, November 2002. · Co-organisation and participation in a two-day workshop, together with the International Foundation for Science, in conjunction with the BSAS conference in Mérida, Mexico. · Results on the effect of different calf age at separation on cow and calf behaviour. · Seminar for advisors postponed until June 2003 · First results from the study of the effect of different suckling and separation regimes on milk quality, udder health, onset of ovarian activity and welfare in cattle

exhibition farms for advisors and farmers to visit.	raised under tropical and highland conditions in Mexico. Graduation report to be presented by the end of 2002. · Continued contacts with farmers interested in keeping cow and calf together.
Deliverables for year 2003: · Results and publications related to the optimal suckling period and weaning methods for dairy calves suckling their own mother. · Results and publications on the effects on udder health and milk quality when dairy calves are allowed to suckle their dams or other cows. · A seminar for advisors about rearing of dairy calves will be held in June 2003. · Continued contacts with farmers interested in keeping cow and calf together. · Continued co-operation with research groups in Mexico, related to restricted-suckling issues. · A fact-sheet about optimal calving conditions for dairy cows in different Swedish housing systems.	

AP3

Project	**Sustainable housing systems for farm animals**
Project leader	Prof. Bo Algers, SLU
Collaborating scientists	Prof. Pascal Oltenacu, Cornell University Vet Lic. Jan Hultgren, SLU Prof Linda Keeling, SLU Dr Stefan Gunnarsson, SLU PhD stud. Vonne Lund, SLU Dr Michael Ventorp, SLU Msc Ann-Charlotte Olsson, SLU Msc Eva von Wachenfeldt, SLU
Project deliverables for the total project	· A description of a housing systems for cows, pigs and layers respectively that meets the FOOD 21 sustainability goals on behaviour and health.

Deliverables for year 2001: · Results from a workshop on housing systems for pigs.	**Results year 2001:** · Workshop on housing system for cattle. · Contacts with farms and planning of demonstration housing system for cattle. · Additional research competence attached to the project.
Deliverables for year 2002: · Workshops on housing systems for pigs, cattle and poultry.	**Results year 2002:** · Workshops on housing systems. · Participation in an international symposium on sustainable animal production in Mexico, febr 2002. · The project ”Values and ethics in organic animal husbandry” has been closer connected to Food21 trough reallocation of resources from AP 6 which has enabled the final production of the PhD-thesis ”Ethics and Animal Welfare in Organic animal Husbandry – an interdisciplinary approach”.
Deliverables for year 2003: · Initiation of synthesis processes of knowledge on housing systems for cattle, pigs and poultry.	

AP4 Terminated

Project	**Domestication and natural behaviour** (completing project from Phase 1)
Project leader	Prof. Per Jensen, SLU
Collaborating scientists	Prof. Leif Andersson, SLU PhD stud. Karin Schütz, SLU
Project deliverables for the total project	· Results on behavioural effects of selection for increased production in broilers, together with a first QTL-analysis of the behavioural variables recorded.

Deliverables for year 2001: · Totally five scientific papers (two are already available) on the relationship between production capacity, behavioural strategies in relation to feeding, and the genetical bases for these strategies and their inter-relations.	**Results year 2001:** · Two more scientific papers (two of the planned papers were merged to one) submitted, i e totally four papers produced.
Deliverables for year 2002: · A PhD thesis to be presented in February 2002.	**Results year 2002:** · A PhD thesis "Trade-off Resource Allocation Between Behaviour and Production in Fowl." (Karin Schütz)

AP5

Project	**Feeding intensity in relation to animal welfare and productivity** (completing project from Phase 1**)**
Project leader	Prof. Bo Algers, SLU
Collaborating scientists	PhD stud. Margret Wülbers-Mindermann, SLU Dr. Charlotte Berg, SLU PhD stud. Eva Persson, SLU Prof. Kerstin Uvnäs-Moberg, SLU
Project deliverables for the total project	· Recommendations on how to use behavioural and physiological indicators as a measure of health to better utilise the animals' biological potential.

Deliverables for year 2001: · Results from a workshop on effects of feeding frequency on physiology and health.	**Results year 2001:** · PhD-student on maternity leave, project postponed.
Deliverables for year 2002: · Results from a workshop on effects of feeding frequency on physiology and health.	**Results year 2002:** · Results from a workshop on effects of feeding frequency on physiology and health published.
Deliverables for year 2003: · Production of scientific papers on feeding intensity.	

AP6

Project	**Optimizing the animals biological potential** (completing project from Phase 1)
Project leader	Prof. Bo Algers, SLU
Collaborating scientists	PhD stud. Jonica Östlund, SLU Dr Erling Strandberg, SLU Prof. Yrjö Gröhn, Cornell University Dr Ulf Emanuelsson, Interbull
Project deliverables for the total project	· A model taking into account effects of rearing methods, disease incidence at different production levels, etc. on the overall economical outcome of dairy farms. · A model describing effects on early or late separation (weaning) in cattle on future production capacity and health of the animal.

Deliverables for year 2001: · Models on effects of calf housing on later performance of dairy cows.	**Results year 2001:** · PhD-student on maternity leave. Project postponed.
Deliverables for year 2002: · Models on effects of calf housing on later performance of dairy cows.	**Results year 2002:** · No results (PhD-student leaving the project as a result of illness). Project cancelled.
Deliverables for year 2003: · Summary paper on optimization of animals biological potential.	

AP7 Terminated

Project	**Animal welfare and sustainable breeding: mapping of Quantitative Trait Loci (QTL) in an intercross between the Red Jungle Fowl and White Leghorn chicken**
Project leader	Prof. Leif Andersson, SLU
Collaborating scientists	Prof. Per Jensen, SLU Prof. Kerstin Lundström, SLU PhD stud. Örjan Carlborg, SLU
Project deliverables for the total project	· Mapping of Quantitative Trait Loci (QTL) in an intercross between the Red Jungle Fowl and White Leghorn chicken. · The provision of tools for new breeding methods, by which breeding for productivity could be performed without negative effects on behaviour, health and welfare.

Deliverables for year 2001: · Final development of software for QTL analysis including search for gene interaction. · QTL analysis of phenotypic data (behavioural traits, egg production, growth, etc,) from the F2 generation.	**Results year 2001:** · Final development of software for QTL analysis including search for gene interaction. · QTL analysis of phenotypic data from the F2 generation.
Deliverables for year 2002: · One PhD thesis on the mapping of Quantitative Trait Loci (QTL) in an intercross between the Red Jungle Fowl and White Leghorn chicken. · The provision of tools for new breeding methods, by which breeding for productivity could be performed without negative effects on behaviour, health and welfare.	**Results year 2002:** · One thesis published "New methods for mapping quantitative trait loci" (Örjan Carlborg). · Tools provided for new breeding methods, by which breeding for productivity could be performed without negative effects on behaviour, health and welfare.

Product Quality (PQ) - Projects

PQ1	Nutrients and phenolic antioxidants in oats which are produced in ecological and conventional systems
PQ2	The effect of genetic and environmental variation on the formation of heterocyclic amines in meat
PQ3	Meat quality in a sustainable production system utilising various cattle breeds and crosses – a comparison with conventional feeding systems
PQ4a	Effect of different rearing conditions on the fatty acid composition, antioxidant content and oxidation stability of pig meat
PQ4b	Effect of feed fatty acid composition on metabolism and welfare, a model
PQ5	Milk quality in sustainable systems
PQ6	Evaluation of sensory properties
PQ7	Food Safety Aspects of Cadmium
PQ8	Food Safety Aspects of Cadmium with focus on bioavailability

PQ1

Project	**Nutrients and phenolic antioxidants in oats which are produced in ecological and conventional systems**
Project leader	Dr Lena Dimberg, SLU
Collaborating scientists	Prof. Per Åman, SLU
Project deliverables for the total project	· Publications of data on the levels of proteins, starch, glucans and phenolic antioxidants in oats grown under ecological and conventional conditions and from controlled experiments with different fertilisation regimes. · Evaluation of avenanthramides (phenolic antioxidants), as non-specific marker for cultivation conditions.
Deliverables for year 2001: · Analysis of proteins, starch, glucans and phenolic anti-oxidants in oats samples (ca 60 samples) grown with different cultivation conditions will be performed.	**Results year 2001:** · Project start delayed 6 months. · Oat groats and hulls cultivated due to “Svenskt sigill” or to KRAV- specifications (in total 48 samples) have been analysed for avenanthramide levels. Furthermore, oat samples (10 cultivars), susceptible or resistant to fungal infection, with varying score of fungal infection have been analysed for avenanthramides.
Deliverables for year 2002: · Continuation of chemical analysis.	**Results year 2002:** · Avenanthramides in samples from 3 cultivars, grown according to standards for both conventional and organic farming and with 2 nitrogen levels, have been analysed (in total 108 samples). Proteins and glucans have also been analysed. · Results have been presented at 28th Nordic Cereal Congress, May 6-8, 2002, Sweden.
Deliverables for year 2003: · Evaluation and publication of data	

PQ2

Project	**The effect of genetic and environmental variation on the formation of heterocyclic amines in meat**
Project leader	Prof. Kerstin Lundström, SLU Prof. Magaretha Jägerstad, SLU
Collaborating scientists	PhD stud. Viktoria Nilzén, SLU
Project deliverables for the total project	· Effect of more sustainable rearing systems for pigs on the overall meat quality. · Monitoring the effect of environmental and genetic variation on the formation of heterocyclic amines (HCAs) in pork. · Design of a study accounting for consumer preferences of cooked pork to evaluate exposure of HCAs. · One PhD thesis including 4-5 peer-reviewed publications on environmental and genetic effects on overall pig meat quality and the formation of HCAs in pork.

Deliverables for year 2001: · Publication of data from a study monitoring the effect of environmental and genetic variation on the formation of HCAs. · Design of a study accounting for consumer preferences of cooked pork to evaluate exposure of HCAs.	**Results year 2001:** · Submitted a scientific publication on how natural variations of precursors in pig meat affect the yield of heterocyclic amines, · Manuscript on how meat quality will be affected in sustainable pig meat production. · Publication of several abstracts on the effect of more sustainable rearing systems for pigs on the overall meat quality.
Deliverables for year 2002: · Publication of data on the effect of more sustainable rearing systems for pigs on the overall meat quality. · Completion of a study on the relative importance in precursor levels and frying temperatures on the formation of HCAs.	**Results year 2002:** · Development of a questionnaire to assess consumer preferences for surface browning of fried pork chops from colour photographs to be linked to formation of HCAs. · Preliminary results from pilot testing of the questionnaire · Publication of several popular papers on quality aspects of pig meat related to genotype and sustainable rearing
Deliverables for year 2003: · Validation of the use of colour photographs for estimation of heterocyclic amine intake from fried pork chops of different RN genotypes. Manuscript to be submitted. · Final report submitted as a part of the project: Heterocyclic amines in cooked foods- role in human health (QLK1-CT99-001197) within the 5th RTD program of the Commission of the European Communities, specifically Quality of life and management of resources to be finished in 2003.	

PQ3

Project	**Meat quality in a sustainable production system utilising various cattle breeds and crosses – a comparison with conventional feeding systems**
Project leaders	Prof. Kerstin Lundström, SLU Dr Ingemar Hansson, SLU Dr Lucia Ballerini, post doc SLU
Collaborating scientists	Dr Sölve Johnsson, SLU Dr Gunnar Malmfors, SLU PhD stud. Anna Hessle, SLU
Project deliverables for the total project	· Meat quality in general from young bulls, steers and heifers on various feeding systems and feed intensity. · Meat quality from steers and heifers slaughtered directly after grazing in comparison with after a finishing period. · The effect of various feeding intensity on eating quality. · The effect of various feeding intensity on instrumental tenderness. · The importance of animal sex and intra-muscular fat content on eating quality. · Use of image analysis for estimation of intra-muscular fat.

Deliverables for year 2001:	**Results year 2001:**
· Meat quality in steers and heifers slaughtered after grazing or after a finishing period.	· Sensory and functional meat quality in steers slaughtered after grazing or after a finishing period. First trial slaughtered; meat collected and sensory tested; several instrumental and chemical analysis will be performed; preliminary results presented at board meeting. · Sensory and functional meat quality in heifers slaughtered after grazing or after a finishing period. First trial slaughtered. · Computer program finished for estimation of intra-muscular fat with the use of image analysis. · Student project work on effect of ageing and salt injection on tenderness of meat from young bulls and heifers. · PhD-student working with beef meat quality accepted; will be associated to Food21.
Deliverables for year 2002: · Continuation: Meat quality in steers and heifers slaughtered after grazing or after a finishing period. · The effect of various feeding intensity on instrumental tenderness. · The importance of animal sex and intra-muscular fat content on eating quality. · Use of image analysis for estimation of intra-muscular fat. · Publication of data.	**Results year 2002:** · Sensory and functional meat quality in steers and heifers slaughtered after grazing or after a finishing period. Second trials slaughtered. · Sensory analysis with expert panel of meat from steers and heifers done on trial 1 and 2. · Study on interaction between hanging method (achilles or pelvic suspension) and degree of finishing in steers and heifers. · Erasmus project work on effect of finishing feeding and body size on eating quality in steers.
Deliverables for year 2003: · Continuation: Sensory and functional meat quality in steers and heifers slaughtered after grazing or after a finishing period, 3rd trial. · Publication regarding the importance of animal sex and intra-muscular fat content on eating quality. · Publication of data on the effect of hanging method on improving tenderness · Report on use of image analysis for estimation of intra-muscular fat.	

PQ4a Terminated

Project	**Effect of different rearing conditions on the fatty acid composition, antioxidant content and oxidation stability of pig muscle**
Project leader	PhD stud. Anders Högberg, SLU
Collaborating scientists	Dr Jana Pickova, SLU; Prof Kerstin Lundström, SLU; Prof Ann-Christin Bylund, SLU, Ass Prof Paresh Dutta, SLU; Dr Jakub Babol, SLU; Prof Kerstin Uvnäs-Moberg, SLU
Project deliverables for the entire project	· To evaluate the effect of outdoor rearing, different feed stuffs and sex on the fatty acid composition in different lipid classes of pig muscle. · To evaluate the effect of outdoor rearing, different feed stuffs and sex on the antioxidant content and oxidation stability of pig muscle. · One PhD thesis including 4-5 peer-reviewed publications on environmental and genetic effects on fatty acids in pig muscle.

Deliverables for year 2001: · Two articles in international scientific journals.	**Results year 2001:** · One scientific article published and one in press on muscle lipids, vitamin E and A, and lipid oxidation as affected by diet and RN genotype.
Deliverables for year 2002: · 2-3 articles in international scientific journals. · PhD thesis Anders Högberg.	**Results year 2002:** · PhD thesis by Anders Högberg completed (Fatty Acids, Tocophenols and Lipid Oxidation in Pig Muscle). · One scientific article published and one in press on fatty acid composition and tocopherol content of muscle in pigs fed with organic and conventional feed.

PQ4b

Project	**Effect of feed fatty acid composition on metabolism and welfare, a model study on pig**
Project leader	Dr Jana Pickova, SLU
Collaborating scientists	Dr Maria Neil, SLU Dr Anders Högberg, SLU
Project deliverables for the entire project	· To evaluate the importance of n-3/n-6 fatty acids on animal health and welfare in general. · To evaluate to which extent C 18 fatty acids can replace C22 fatty acid (DHA) in pig dietary requirements. · To draw conclusions between the above mentioned factors, with regard to importance for human health.

Deliverables for year 2001: · Samples on sow milk and piglet tissue (nervous tissue and liver) will be analysed for fatty acids in piglets from sow groups fed four different diets.	**Results year 2001:** · Project start delayed 6 months. · Feed trials on pregnant sows initiated.
Deliverables for year 2002: · Samples on sow milk and piglet tissue (nervous tissue and liver) will be analysed for fatty acids in piglets from sow groups fed four different diets	**Results year 2002:** · Samples have been collected as planned, 4 dietary groups · Behaviour in a sub-sample of the piglets has been studied · Fatty acid analyses of piglets from 4 dietary groups samples are being analysed
Deliverables for year 2003: · Evaluation of sow dietary fat influence on piglet performance in terms of fatty acid n-6/n-3 ratio. Publication of data will be made in collaboration with etologists and animal scientists.	

PQ5

Project	**Milk quality in sustainable systems**
Project leader	Prof. Lennart Björck, SLU
Collaborating scientists	Prof Anders Andrén, SLU PhD stud. Patricia Toledo, SLU
Project deliverables for the total project	· Detailed information regarding the composition of milk from KRAV certified dairy farms. · Increased understanding between the relation between "ecological dairy farming" and raw milk composition. · Results published in international journals. · PhD thesis on "Sustainable milk production – effects on raw milk quality.

Deliverables for year 2001: · Publication on composition of ecological raw milk. · Dissemination of obtained results to stakeholders.	**Results year 2001:** · One scientific publication in press on composition of raw milk from sustainable production system. · Seminar April 2001, presentation of results.
Deliverables for year 2002: · Investigation of spontaneous off-flavour in organic milk. · Publication of results in international journal. · Translate results into advice on feeding practices.	**Results year 2002:** · Msc-thesis on α-tochopherol concentration in organic milk produced at Swedish dairy farms. · Congress report on composition of organic milk in relation to spontaneous off-flavours.
Deliverables for year 2003: · Publication regarding content of ß-carotene in organic milk · Licentiat thesis: "Sustainable milk production – some effects on raw milk quality.	**Results year 2003:**

PQ6

Project	**Evaluation of sensory properties**
Project leader	Prof. Einar Risvik, Uppsala University
Collaborating scientists	Associate prof. Åsa Öström, Uppsala University Prof. Kerstin Lundström, SLU PhD stud. Iwona Kihlberg, Uppsala University
Project deliverables for the total project	· Appoint a panel and training according to international standards. · Evaluate performance of panel. · Run tests on ecological beef and plant products. · PhD thesis on "sensory quality and consumer perception of bread processed of wheat from different growing systems".

Deliverables for year 2001:	**Results year 2001:**
· Appoint a panel and training according to international standards. · Evaluate performance of panel. · Run tests on ecological beef and plant products. · Two scientific publications submitted.	· New panel appointed, trained and evaluated. · Run tests on white bread baked of wheat from different growing systems. · Consumer test performed on attitudes, values and preferences for bread baked of wheat from different growing systems. · Image analysis of bread correlated to sensory texture perception. · Sensory test performed on beef meat from young bulls and steers. · Two scientific publications in manuscript.
Deliverables for year 2002:	**Results year 2002:**
· Sensory tests performed on beef meat from young bulls, heifers and steers. · Three scientific publications submitted. · PhD-thesis on sensory quality of wheat products finished, Iwona Kihlberg.	· Sensory test performed on beef meat from young bulls, heifers and steers. · One scientific publication submitted on effect of information on liking of bread. · One scientific publication in manuscript on sensory quality of wholemeal pan bread baked of wheat grown in conventional and organic farming systems. · Two scientific publications in manuscript on sensory quality and consumer values of white pan bread baked of wheat grown in conventional and organic farming systems.
Deliverables for year 2003:	**Results year 2003:**
· Sensory tests performed on beef from young bulls, heifers and steers. · PhD-thesis on sensory quality of wheat products finished, Iwona Kihlberg.	

PQ7 Terminated

Project	**Food Safety Aspects of Cadmium**
Project leader	Prof. Agneta Oskarsson, SLU
Collaborating scientists	Dr Ingrid Öborn, SLU Dr Gunnela Gustafson, SLU Prof. Staffan Skerfving, Universitetssjukhuset Lund PhD stud. Ing-Marie Olsson, SLU PhD stud. Anna Lindén, SLU
Project deliverables for the total project	· Publication of data on the cadmium and zinc levels in bovine kidney, liver and mammary tissue and the impact of agricultural system as well as age of livestock. · Analysis and compilation of pig and human data from 49 farms in Skåne. · Two PhD theses (partly financed from FOOD 21) including 8 to 10 peer-reviewed publications, on cadmium in the food chain from soil, via feed and livestock to man.

Deliverables for year 2001:	**Results year 2001:**
· Publication of data on the cadmium and zinc levels in bovine kidney, liver and mammary tissue and the impact of agricultural system as well as age of livestock. · Analysis and compilation of pig and human data from 49 farms in Skåne.	· Three scientific articles published on cadmium and zinc in kidney, liver, muscle and mammary tissue from dairy cows in conventional and organic farming and cadmium in organic and conventional pig production. · Lindén et al. Pig kidney as a bioindicator of cadmium in the environment. In manuscript. · Olsson et al. Dietary cadmium exposure, blood levels and renal function in men and women living at pig-producing farms. In manuscript.
Deliverables for year 2002:	**Results year 2002:**
· PhD thesis: Ing-Marie Olsson, Cadmium in the chain: crops-animal-man. · PhD thesis: Anna Lindén, Pig kidney for biomonitoring of cadmium in the agricultural environment.	· PhD Thesis by Ing-Marie Olsson completed (Biomonitoring of cadmium in cattle, pigs and humans). · PhD Thesis by Anna Lindén completed (Biomonitoring of cadmium in pig production).

PQ8 Terminated

Project	**Food Safety Aspects of Cadmium with focus on bioavailability**
Project leader	Prof. Agneta Oskarsson, SLU
Collaborating scientists	
Project deliverables for the total project	· Basic knowledge on bioavailability of cadmium from different food and feed sources.

Deliverables for year 2001:	**Results year 2001:**
The project will be started during the 2nd year and will last for 1 year.	· Method development has started.
Deliverables for year 2002:	**Results year 2002:**
· Method development for *in vitro* studies on cadmium solubility after gastric digestion and cellular uptake of cadmium in Caco-2 cell. · Publication of data on cadmium solubility in different pig feed components after gastric and intestinal digestion and cellular uptake in intestinal epithelial Caco-2 cells.	· Manuscripts submitted on cadmium solubility after *in vitro* digestion of pig feed and bioavailability of cadmium from *in vitro* digested infant food studied in Caco-2 cells.

Consumer/Farmer (CF) – Projects

CF1 Consumer acceptance of ecological and sustainable food products
CF2 Health, environmental impact and animal welfare: Determinants of consumer responses to "environmentally friendly" food production
CF3 Environmental aspects of food consumption
CF4 Farmers' role in developing sustainable food production systems
CF5 Collaborative learning in the agri-food system
CF6 The social aspects in sustainable agriculture
CF7 Consumer segmentation in terms of food-related lifestyles: its relevance for attitudes to organically produced foods
CF 8 Individual and situational determinants of consumption of organic food products
CF 9 Consumer perceptions of health, environmental friendliness and animal welfare – their interactions in the choice of sustainably produced foods
CF 10 Further monitoring of consumer attitudes to organic foods

CF1 Terminated

Project	**Consumer acceptance of ecological and sustainable food products**	
Project leader	Prof. Anders Biel, Göteborg University	
Collaborating scientists	Lektor Ulf Dahlstrand, Göteborg University Dr Gunne Grankvist, Göteborg University	
Project deliverables for the total project	· Data on: the role of personal environmental values and earlier food purchase habits in food choice, the interaction between such values and types of environmental food labels, the impact of priming information in food stores, and the extent of "spill-over" effects between categories of environment-related behaviour. · Evaluation of a model for change of food purchase habits. · Two PhD theses.	
Deliverables for year 2001: · Data on effects of positively and negatively designed environmental labels and on effects of positive and negative priming on product choice.		**Results year 2001:** · Data on positive and negative environmental labeling in consumer food choice. · Data on the role of values in moderating the effects of positive and negative environmental labeling.in consumer food choice. · One PhD-student completed the Licentiate exam (Gunne Granqvist).
Deliverables for year 2002: · Two PhD-students to have completed their studies. · Data on priming information on product choice in the food store environment. · Data on the role of morality and obligation as determinants of choice of organic foods.		**Results year 2002:** · One PhD thesis (Gunne Granqvist) completed and one Phd manuscript finalized (Ulf Dahlstrand). · Data on effects of priming information on product choice in the food store environment. · Data on interaction between personal environmental values and food purchase habits in food choice. · One PhD thesis completed (Ulf Dahlstrand) (2003) · Data on stability and changes in consumer choice of environmentally labelled food products (2003) · Data on value-based choice in the food store environment (2003)

CF2

Project	**Health, environmental impact and animal welfare: Determinants of consumer responses to "environmentally friendly" food production**
Project leader	Prof. Per-Olow Sjödén, Uppsala University
Collaborating scientists	Dr Ulla-Kaisa Koivisto-Hursti, Uppsala University PhD student Maria Magnusson, Uppsala University
Project deliverables for the total project	· Quantitative estimations of: the impact of health, environmental and animal welfare motives, the relative stability of consumer responses to organic foods, and the willingness to change food selection with a more environmentally "sustainable profile". · One PhD thesis.

Deliverables for year 2001: · Data from first replication of questionnaire study (original data collection 1998). · Interview data on motives for purchase of organic foods.	**Results year 2001:** · Replication study completed: results forthcoming successively from December 2001 on. · Methodology for interviews developed. · Data published on the role of health and environmental motives in organic food purchase (British Food Journal). · Questionnaire data on perceptions of animal welfare in food production. · Half-time control completed for one PhD-student.
Deliverables for year 2002: · Data on comparisons of original (1998) and replication (2001) questionnaire studies. · Interview data on motives for purchase of organic foods. · Methodology for the study of changes of food habits and consumers "willingness to change".	**Results year 2002:** · Data on basic comparisons of 1998- and 2001-results organized and presented. · Plan for interview study finalized. · Methodology finalized for study of changes of food habits and "willingness to change".
Deliverables for year 2003: · One PhD-thesis completed (Maria Magnusson). · Data on further comparisons of 1998- and 2001-data concerning purchase motives. · Data from interview study on motives for purchase of organic foods. · Data on relation between food habits and "willingness to change".	

CF3

Project	**Environmental aspects of food consumption** (Collaboration with: Environmental systems analysis of consumer-related activities in the food chain, FC2)
Project leader	Prof. Per-Olow Sjödén, Uppsala University
Collaborating scientists	Prof. Thomas Nybrant, SLU Dr Ulf Sonesson, SIK
Project deliverables for the total project	· Quantitative estimations of consumer contributions to the environmental impact of food purchase and food/waste handling in the home.

Deliverables for year 2001: · Interview and diary data concerned with consumer behavior. · "Consumption Diary" and "Questionnaire" developed.	**Results year 2001:** · Review completed of methodology for collecting data on food-related consumer behaviour with potential environmental impact. · Collaboration initiated with FC 2.
Deliverables for year 2002: · Interview and diary data concerned with consumer behaviour. · "Consumption Diary" and "Questionnaire" developed. · Questionnaire data on consumers´ food-related behaviour with potential environmental impact.	**Results year 2002:** · Interview and diary data collected in a pilot sample and organized · "Consumption diary" and "Questionnaire developed · Data on a larger group of households collected – used for final validation of questionnaire
Deliverables for year 2003: · Data on consumer activities related to food purchase, preparation and waste handling in a representative sample of the Swedish population	

CF4 Terminated

Project	**Farmers' role in developing sustainable food production systems**
Project leader	Prof. Ulrich Nitsch, SLU
Collaborating scientists	Dr Magnus Ljung, SLU
Project deliverables for the total project	· Literature review and empirical data on farmers' attitudes and values related to sustainable production systems. · Data and case studies concerning farmer participation in ongoing environmental schemes and dialogue processes. · Innovative and applied, but theoretically based approaches which enhance farmers' and other local actors' participation in the development of sustainable agri-food systems. · Empirical data on farmers' participation in new approaches organised within Food 21. · One PhD thesis.

Deliverables for year 2001: · PhD dissertation covering the deliverables specified in the project description..	**Results year 2001:** · A PhD dissertation completed (Magnus Ljung). · Literature review on farmers´ views on environmental work and sustainable development (department report series) (2002). · Fact sheet on "Farmers´ dialogue" (2002). · Popular version of dissertation, focusing on practical implications (in Swedish) (2002).
	Results year 2002: · Two congress presentations on collaborative learning for sustainable food-chains · Two papers in Swedish journal on organic farming

CF5

Project	**Collaborative learning in the agri-food system**
Project leader	PhD student Lotten Westberg, SLU
Collaborating scientists	Dr Magnus Ljung, SLU
Project deliverables for the total project	· The primary focus of this research is outcome oriented—the products are implementable improvements applicable to the different situations at hand. The deliverables are thus both concrete improvements of sustainability problems in the agri-food system, and deeper and sustained relations among the participating stakeholders.

Deliverables for year 2001: · Empirical data from three case studies concerned with collaborative learning in the agri-food system.	**Results year 2001:** · Report on evaluation of the Gotland project**.** · Report on formative evaluation of the Skåne project.
Deliverables for year 2002: · Master´s thesis on constraints and possibilities for collaborative learning on local and regional scales. · Fact sheet on collaborative learning for sustainable development of agri-food systems. · Empirical data on how actors manage constraints and opportunities in collaborative processes.	**Results year 2002:** · Master´s thesis (Martin Sylwan) completed. · Report on evaluation of the Näreko project (Västra Götaland) · Report on final evaluation of the Skåne project ("Jordbruket gör Skåne skånskt")
Deliverables for year 2003: · Fact sheet on collaborative learning for sustainable development of agri-food systems. · Chapter on action (practitioner) research in educational research. · PhD thesis (Lotten Westberg) on collaborative learning in the agri-food system finalized (to be presented 2004).	

CF6

Project	**The social aspects in sustainable agriculture**
Project leader	Prof. Ulrich Nitsch, SLU
Collaborating scientists	Dr Magnus Ljung, SLU PhD student Helena Nordström Källström, SLU
Project deliverables for the total project	· Knowledge about farmers' adoption behaviour and strategies in farming in relation to their perceived social and institutional environment, with respect to farming in the past, present adaptation strategies, expectations for the future and suggestions for appropriate measures.

Deliverables for year 2001: · Literature review on farmers' adaptation behaviour and strategies in farm management practices with respect to their social, ecological and institutional environment. The institutional environment includes markets, agricultural policies, legislation, subsidies as well as technology. · Interview instrument based on exploratory interviews with farm families.	**Results year 2001:** · Literature review report on farmers´adaptation behaviour and strategies published by the Swedish Board of Agriculture. · Exploratory interview data from three case studies in Småland and Västerbotten.
Deliverables for year 2002: · Case studies on farmers´ coping and adaptation**.** · Initiation of collaboration on socio-economic synthesis theme (SA 4). · Data concerning farmers´ perceptions of their social and institutional environment.	**Results year 2002:** · Data on preconditions of farming in three rural areas (National Board of Agriculture report series). · Half-time research seminar on social aspects of sustainable agriculture · Data on how farmers´ views on quality of life bring about structural changes. · Two presentations at seminars/conferences with farmers.
Deliverables for year 2003: · Data on social sustainability in agriculture · Seminar presentation at National Board of Agriculture. · (Doctoral student on parental leave part of 2003).	

CF7

Project	**Consumer segmentation in terms of food-related lifestyles: its relevance for attitudes to organically produced foods**
Project leader	Prof. Per-Olow Sjödén, Uppsala University
Collaborating scientists	PhD-student Maria Magnusson, Uppsala University PhD-student Lone Bredahl, Aarhus School of Business, Denmark
Project deliverables for the total project	· Data on differences between groups of consumers, based on segmentation in terms of food-related lifestyles, with regard to attitudes, beliefs, intentions and purchase of organically produced foods.

Deliverables for year 2002: · Data collected on segmentation of a random sample of Swedish consumers and on differences between segments with respect to the study variables.	**Results year 2002:** · Data from survey study collected, organized and computerized.
Deliverables for year 2003: · Data on segmentation in terms of food-related life-styles. · Data on differences between segments with regard to attitudes, beliefs, intentions and purchase related to organically produced foods. · Data on differences between segments on major motives and purchase criteria related to organically produced foods.	

CF8

Project	**Individual and situational determinants of consumption of organic food products**
Project leader	Prof. Anders Biel, Göteborg University
Collaborating scientist	Lektor Ulf Dahlstrand, Göteborg University
Project deliverables for the total project	· Data from a simulated food store on factors that promote and obstruct consumers´ disposition to act in line with their environmental values · Two scientific papers
Deliverables for year 2003: · Data on the effects of interaction between consumer values and habit strength on information attention and food product choice	

CF9

Project	**Consumer perceptions of health, environmental friendliness and animal welfare – their interactions in the choice of sustainably produced foods**
Project leader	Prof. Per-Olow Sjödén, Uppsala University
Collaborating scientist	PhD-student Maria Magnusson, Uppsala University
Project deliverables for the total project	· Qualitative data on consumer perceptions of health, environmental friendliness and animal welfare, and their interactions as related to the choice of sustainably produced foods
Deliverables for year 2003: · Individual interview data on consumer perceptions of health, environmental friendliness and animal welfare · Focus group interview data on consumer perceptions of health, environmental friendliness and animal welfare	

CF10

Project	**Further monitoring of consumer attitudes to organic foods**
Project leader	Prof. Per-Olow Sjödén, Uppsala University
Collaborating scientist	PhD-student Maria Magnusson, Uppsala University
Project deliverables for the total project	· Results of a third wave of collection of questionnaire data in a nationwide survey study of Swedish consumers´ attitudes, beliefs, intentions and self-reported purchase of organic foods (to be performed in 2004) · Comparisons with results of studies performed in 1998 and 2001 (CF 2) and with a consumer segmentation study performed in 2002 (in 2004)
Deliverables for year 2003:	

Systems Analysis and Economics (SA) – Projects

SA1 Systems Analysis of Physical Flows at Farms
SA2 Systems Analysis of Decision Processes at Farms
SA3b Scenario modelling
SA4 Co-operation, integration and economic adjustments in the agricultural firm

SA1

Project	**Systems Analysis of Physical Flows at Farms**	
Project leader	Prof. Thomas Nybrant, SLU	
Collaborating scientists	PhD stud. Helena Elmquist, SLU PhD stud. Ingrid Strid Eriksson, SLU	
Project deliverables for the total project	· System analytical methods to assess and evaluate sustainability characteristics of different farm production methods. · Two doctoral thesises.	
Deliverables for year 2001: · 3 articles in peer-reviewed scientific journals, seminars. · Executable models and results regarding sustainability of all the three prototype farms (arable, specialised animal and combined dairy and beef farms).		**Results year 2001:** · 3 manuscripts to be submitted. · Executable models of an arable farm and a pig farm.
Deliverables for year 2002: · Further refined models of an arable farm and a pig farm. · Executable model of a combined dairy and beef farm. · 6 articles in peer-reviewed scientific journals.		**Results year 2002:** · Further refined models of an arable farm and a pig farm. · 3 articles submitted to peer-reviewed scientific journals
Deliverables for year 2003: · 2 PhD thesises on Environmental Systems Analysis (ESA) of arable farms and pig production farms, respectively. · A simulation model (SALSA) facilitating ESA of alternative scenarios developed in the synthesis work. · Case studies and results on solutions proposed in the scenario work.		**Results year 2003:**

SA2 Terminated

Project	**Systems Analysis of Decision Processes at Farms**	
Project leader	Prof. Sture Öberg, Uppsala University Prof. Einar Holm, Umeå University	
Collaborating scientists	Dr Urban Lindgren, Umeå University Fil. kand. Kalle Mäkkilää, Umeå University	
Project deliverables for the total project	· Computer models describing the strategic decision taking at a farm as affected by farm specific and external factors.	
Deliverables for year 2001: · Two articles in peer-reviewed scientific journals, executable models of decisions at an arable farm and a pig farm.		**Results year 2001:** · One article ready to be submitted. · An executable model of strategic decision taking.

SA3

Project	**Environmental systems analysis of prototype farms**
Project leader	Dr Berit Mattsson
Collaborating scientists	Msc Britta Nilsson, Dr Christel Cederberg
Project deliverables for the total project	· Analysis of sustainability at the three prototype farms: arable farm, pig farm and dairy farm. · Sustainability analysis of production systems developed in the scenario work.

Deliverables for year 2003: · Report on environmental analysis of pig farming. · Inventory of 20 dairy farms and environmental analysis based on the data including report and scientific paper. · Inventory of farming systems for production of arable farming systems (potatoes, sugar beets, cereals etc.) including report.	**Results year 2003:**

SA4

Project	**Co-operation, integration and economic adjustments in the agricultural firm.**
Project leader	Prof. Hans Andersson, SLU Acting associate prof. Carl-Johan Lagerkvist, SLU
Collaborating scientists	PhD student Karin Larsén
Project deliverables for the total project	· A theoretical and empirical analysis of factors contributing to successful co-operation between agricultural producers. Special emphasis is devoted to the introduction of biological, social and economically motivated quality policy programs. · A graduated PhD student (Thesis).

Deliverables for year 2002: · An empirical analysis of optimal risk sharing contracts between dairy and crop farmers. (Master thesis). · An analysis of evolutionary stable contracts between producers – effects of sustainable cost and risk sharing arrangements. (Working paper).	**Results year 2002:** · An empirical analysis of optimal risk sharing contracts between dairy and crop farmers. (Master thesis).
Deliverables for year 2003: · An analysis of risk return and incentive aspects on partnerships in agriculture where special emphasis is given to time dynamics and preferences. · An economic analysis of sustainable partnerships for agricultural firms focusing on cost structural and risk-sharing implications.	**Results year 2003:**

Food Chain 21 (FC) - Projects

(In phase 2 organised in the synthesis and scenario work)

FC1 Environmental Systems Analysis of Food Industries

FC2 Environmental Systems Analysis of Consumer-related Activities in the Food Chain

FC3 Environmental systems analysis of Combined Food Chains.

FC1

Project	**Environmental Systems Analysis of Food Industries**	
Project leader	Dr Ulf Sonesson, SIK Göteborg	
Collaborating scientists	PhD student Johanna Berlin, SIK Göteborg	
Project deliverables for the total project	· System analytical tools to evaluate sustainability of the part of the food chain ranging from the farm gate to the consumer. · Doctoral Thesis by Johanna Berlin.	
Deliverables for year 2001: · Basic models of dairy production systems. · One article in international scientific publication. · Presentation of the project and results at an international conference. · One seminar in the Food 21 seminar series.		**Results year 2001:** · Models of dairy production systems. · One article submitted to Journal of Cleaner Production · One oral presentation at ”SETAC Europe 12th Annual Meeting, Madrid” · ”One poster presentation at The International Conference on LCA in Foods, Göteborg”
Deliverables for year 2002: · Refined models of dairy production systems. · Models of systems based on potatoes as raw product. · Two articles in international scientific publication. · One Licentiate exam, including an open seminar. · One presentation of the project and results at an international conference.		**Results year 2002:** · One licentiate exam, including thesis and an open seminar · Model for process planning in dairies · Inventory of pasta production · One article accepted for publication in Journal of cleaner production · One article accepted for publication in Dairy Science · One article submitted to Journal of cleaner production · One oral presentation at SETAC Europe 13:th annual meeting in Vienna, May · One oral presentation at GIN 2002, Greening of industry network, Göteborg June
Deliverables for year 2003: · Models for pasta production · Inventory and models for industrial potatoe processing · One article submitted · Updated bread LCA		**Results year 2003:**

FC2

Project	**Environmental Systems Analysis of Consumer-related Activities in the Food Chain** (Collaboration with the project "Environmental aspects of food production" in the Consumer/Farmer sub-program).
Project leader	Dr Ulf Sonesson, SIK Göteborg
Collaborating scientists	Msc Magnus Stadig, SIK Göteborg Msc Erica Wallén, SIK Göteborg
Project deliverables for the total project	· Models for assessing the environmental impact of the later parts of the food chain (retailer to consumer plate).

Deliverables for year 2001: · Preliminary models and results. · One article in international scientific publication. · Presentation at one international conference. · One seminar in the Food 21 series.	**Results year 2001:** · One article submitted to the Journal of Industrial Ecology. · Data for energy consumption for cooking.
Deliverables for year 2002: · Model and method to assess sustainability of the consumer related part of the food chain. · Two articles in international scientific publications. · Presentation at one international conference.	**Results year 2002:** · Models for energy consumption for home cooking · Report on cooking models · Literature rewiev of cooking and home transports of food · Input to questionary used in CF3 · Contacts established with logistic researchers at Lund university
Deliverables for year 2003: · Models for home transports of food · Data on wastage, cooking and storage use in households collected within CF3 transformed into useable LCA inventory models · One seminar · One article submitted to an international scientific journal	**Results year 2003:**

FC3

Project	**Environmental systems analysis of Combined Food Chains.** (Collaboration with the project "Environmental aspects of food production" in the Consumer/Farmer sub-program).
Project leader	Dr Ulf Sonesson, SIK
Collaborating scientists	Dr Johanna Berlin, SIK
Project deliverables for the total project	· Models describing resource consumption and environmental impact of entire food chains from farm gate to consumer plate (including detailed consumer models). · Results on sustainability characteristics of the chains.

Deliverables for year 2001: · The project will be run during year 3 and 4 of Phase 2.	**Results year 2001:**
Deliverables for year 2002: · The project will be run during year 3 and 4 of Phase 2.	**Results year 2002:**
Deliverables for year 2003: · Methods for addressing several food products in the same analysis · Pilot study on environmental impact of consumption of products derived from potatoes and wheat · Methods for scenario construction for the food chain from farm to consumer, close cooperation with the synthesis group. · One article submitted to an international scientific journal · One presentation at an international conference	**Results year 2003 :**

2.3 Synthesis Themes

As a part of the overall synthesis work for the whole food chain (Section 1.4) partial synthesis themes are also proposed to deal with specific sustainability issues (*General themes*) or with the purpose to integrate research results within individual FOOD 21 sub-programs (*Research Themes*). In the case of animal production, the synthesis has closely been integrated with the research project from the start of the program.

FOOD21 General Themes

Theme 1

Theme	**Cow-calf, theme work**
Theme leader	Dr Charlotte Berg, SLU
Collaborating scientists	Dr Lena Lidfors, SLU Dr Kerstin Svennersten-Sjaunja, SLU AgrL Michael Ventorp, SLU Dr Ingemar Olsson, SLU Gösta Andersson, deLaval Doc Sven Viring, SLU
Project deliverables for the total project	· The working group is integrated into the FOOD21 AP2 project ”Cow-calf systems” - effects of dairy calf rearing systems on present and future health, behaviour and production of cow and calf. The theme work is related to travel and meetings to make the AP2 projects and sub projects run smoothly, It aims at facilitating cooperation between the researchers and students involved, and also with farmers and representatives from the dairy industry.
Deliverables for year 2003: · Six meetings with the group (and invited guests) to discuss AP2 project plans, results, analyses and presentation. · For scientific details, see AP2	**Results year 2003:**

Theme 2

Theme	**Sustainable farm structures**
Theme leader	Dr. Carl Johan Lagerkvist, SLU
Collaborating scientists	Dr. Peter Frykblom, SLU Dr. Fredrik Karlsson, Handelshögskolan i Göteborg Dr. Olle Pettersson, SLU Dr. Magnus Ljung, SLU Dr. Lars Jonasson, Lantbruksekonomen AB (as consultant)
Project deliverables for the total project	· To provide an analysis for the current and prospective economic structure of Swedish farm operation. The project ranges over the following issues: a) economic efficiency analysis, b) farm-level and sector-level structural consequences of imposing socially and biologically motivated sustainable practices and/or behaviour, c) socially driven structural changes, and d) marketable value added in food production – a study of consumers and industry.
Deliverables for year 2003: · A report publication of the risk analysis survey of 1000 Swedish farm operators focusing on conflicts of various types of risks. To be used in the part b) of the project (see above). · A workshop based on the 2002 consumer survey focusing on willingness to pay for factors explaining the choice of food products, using a choice experiment approach. · An efficiency (economic) analysis of the Swedish agriculture (by farm categories). · A case study analysis of structural consequences of sustainability motivated ecological constraints in Swedish agricultural production. · A pre-study of socially driven structural changes.	**Results year 2003:**

Theme 3

Theme	**Sustainable plant protection**
Project leader	Dr Berit Mattsson
Collaborating scientists	Msc Johan Widheden, Dr Maria Wivstad Agr L Kjell Ivarsson Msc Peter Bergkvist Dr Christel Cederberg
Project deliverables for the total project	· Models for decision making aiming at sustainable practices for pest management in plant production.

Deliverables for year 2003:	**Results year 2003:**
· Choice of risk assessment models and application on the pig farming, arable farming and dairy farming cases. · Assessment of the crop protection implications linked to the crop rotations in the case studies. · Principal discussions on the impact of pesticides on the environmental sustainablilty of farming systems.	

Theme 4

Theme	**Animal feed in a sustainable food chain**
Theme leader	Dr. Susanne Stern, SLU
Project deliverables for the total project	· To provide an analysis of feed ingredients used in animal production and the effects on environment, animal welfare and food quality. The project ranges over the following issues: · Feed born hazards · Feed production in Sweden or imported feedstuff, consequences and hazards from a sustainable viewpoint. · Recycling of rest products in animal feed, pros and cons.

Deliverables for year 2003:	**Results year 2003:**
· A literature review of the risks with feed born hazards and contamination within the feed chain. · A workshop on how to use rest products from the food industry in animal feed to increase sustainability without jeopardizing human or animal health and animal welfare. · Working material on imported contra home produced feedstuffs, product quality and sustainability. · A working material for control of feed quality on the farm level.	

FOOD 21 Research Themes

SG 4 Crop production

Project	**Integrated nutrient management in sustainable cropping systems**
Project leader	Docent Håkan Marstorp, SLU
Collaborating scientists	Docent Ingrid Öborn, Prof. Lars Bergström
Project deliverables for the total project	· The outcome of two workshops will be published as scientific articles including results from Food 21 projects as well as reviews in a special issue of an international journal. Well-established scientists within the different areas of nutrient management will be invited to the workshops together with Food 21 scientist. · On the basis of the workshops a problem/solution oriented information material will be produced in collaboration between scientists and stakeholders.

Deliverables for year 2002: · An international workshop. · First drafts of scientific articles. · Outline of the information material.	**Results year 2002:** · An international workshop was held at Ekenäs where outlines of a scientific publication and information material, dealing with nutrient management, were discussed.
Deliverables for year 2003: · An international workshop in which the scientific contributions to a publication will be discussed. · A publication on 'Nutrient management in sustainable farming systems' .	**Results year 2003:**

2.4 Program Budget

BUDGET 2003-2004

	MISTRA Funded								Sektor funding 2001-2004
	Budget 2001	**Payment 2001**	**Budget 2002**	**Payment 2002**	**Budget 2003**	**Budget 2004**	**Reser-vation**	**Total**	
Program management	2 925 000	2 663 194	2 975 000	2 722 000	3 237 000	3 300 000	857 337	12 779 531	
Communication	700 000	585 000	615 000	395 000	740 000	1 080 000		2 800 000	800 000
Internal education	300 000	100 000	200 000	0	150 000	0		250 000	
Synthesis	4 970 000	2 470 870	4 963 000	3 810 000	5 054 000	4 222 130		15 557 000	420 000
Research projects									
Crop production	2 459 000	2 231 500	3 293 000	2 991 000	2 327 000	670 500		8 220 000	360 000
Animal production	2 228 000	2 078 000	2 347 000	1 873 000	1 359 000	770 000		6 080 000	
Product quality	2 393 000	1 849 000	2 206 000	1 610 000	1 162 000	0		4 621 000	
Consumer/Farmer	1 972 000	1 685 000	1 988 000	1 649 000	2 053 000	969 000		6 356 000	
Systems analysis & economics	1 368 000	1 368 000	1 200 000	1 050 000	1 140 000	750 000		4 308 000	742 000
SUMMA	**19 315 000**	**15 030 564**	**19 787 000**	**16 100 000**	**17 222 000**	**11 761 630**	**857 337**	**60 971 531**	**2 322 000**

Budget 2003

	PLG	Commu-nication	Internal education	Synthesis	Crop production	Animal production	Product quality	Consumer Farmer	System analysis & economics	TOTAL
MISTRA funded	**SEK**	**SEK**	**SEK**	**SEK**	**SEK**	**SEK**	**SEK**	**SEK**	**SEK**	**SEK**
Senior researcher	2 034 000			2 708 000	800 000	290 000	225 000	505 000	360 000	6 922 000
PhD students				80 000	556 000	347 000	170 000	510 000	382 000	2 045 000
Technician etc						145 000	255 000	379 000		779 000
External costs	210 000	570 000	50 000	423 000	150 000	40 000	50 000	53 000		1 546 000
Consumables, travel etc	190 000	170 000	100 000	737 000	280 000	159 000	182 000	106 000	134 000	2 058 000
Office costs	393 000			319 000	209 000	89 000	123 000	123 000	51 000	1 307 000
Overhead costs	405 000			787 000	332 000	258 000	128 000	373 000	213 000	2 496 000
Depreciation	5 000					31 000	29 000	4 000		69 000
TOTAL MISTRA	**3 237 000**	**740 000**	**150 000**	**5 054 000**	**2 327 000**	**1 359 000**	**1 162 000**	**2 053 000**	**1 140 000**	**17 222 000**