Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Framtidens lantbruk / Future Agriculture

Future Agriculture

– *Livestock, Crops and Land Use*

Report from a multidisciplinary research platform.
Phase I (2009 – 2012)

FRAMTIDENS LANTBRUK
Future Agriculture

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Report from a multidisciplinary research platform.
Phase I (2009 – 2012)

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Summary

Future Agriculture – Livestock, Crops and Land Use is a multidisciplinary research platform at the Swedish University of Agricultural Sciences (SLU). Within the platform researchers, together with representatives of the agricultural sector, authorities and non-governmental organisations, identify, discuss and examine issues regarding the sustainable use of natural resources. The emphasis is on agricultural production including livestock, crop production, and land use, within a global context.

The objectives of *Future Agriculture* are:

- To initiate and develop multidisciplinary research, focusing on food supply and land use;
- To provide a hub for dialogue with the agricultural sector, authorities, non-governmental organisations and other societal sectors, and for synthesis of knowledge;
- To foster a new generation of agricultural researchers;
- To deliver scientifically-based knowledge as a basis for strategic decisions.

Future Agriculture has a broad spectrum of activities, all conducted with the aim of strengthening agricultural research and the dialogue between academia and other sectors of society. The platform is used for:

- Scenario development;
- Identification of knowledge gaps, formulation of research issues and priorities;
- Analyses and syntheses of complex, cross-cutting issues, e.g. through thematic working groups and projects;
- Funding of post-doctoral research projects;
- Initiating and supporting research grant applications;
- Networking among researchers and also between researchers and representatives from the agricultural sector, authorities and non-governmental organisations;
- Stimulating young researchers to extend their networks and gain experience of multidisciplinary research.

Among the research activities, six thematic working groups have been initiated and tasked with writing a review or synthesis article, based on research areas originating from the challenges described in the *Future Agriculture* research program. The areas are (i) reduction of the environmental impact of agriculture and mitigation of climate change. (ii) adaptation of agriculture to a changing climate, (iii) management of present and potential risks, (iv) responses to societal values and contributions to policies, (v) agriculture and rural development, and (vi) resolution of conflicting goals of agriculture and land use.

Seminars, workshops and conferences are arranged within the platform. Researchers within *Future Agriculture* are also having a dialogue, nationally and within EU, with the policymaking and funding agencies concerning subjects such as research needs and priorities.

Future Agriculture is led by a steering committee and has an advisory board with representatives from the agricultural sector, authorities and non-governmental organisations. Its activities are primarily financed by strategic funding from SLU.

1 Introduction

Finding sustainable ways to feed the world in the future is mankind's greatest challenge. This is reflected in the overarching UN Millennium Development Goal (MDG 1), which is 'to halve extreme poverty and hunger from 1990 to 2015' (UN, 2000) and statements released following the IAASTD (International Assessment of Agricultural Knowlegde, Science and Technology for Development) meeting in Johannesburg (IAASTD, 2009). Clearly, agriculture must play a key role in reaching this goal. Equally important, agriculture, as well as trade and the distribution of food, are global businesses. Therefore, local and regional agricultural activities and food markets must be considered in a global context.

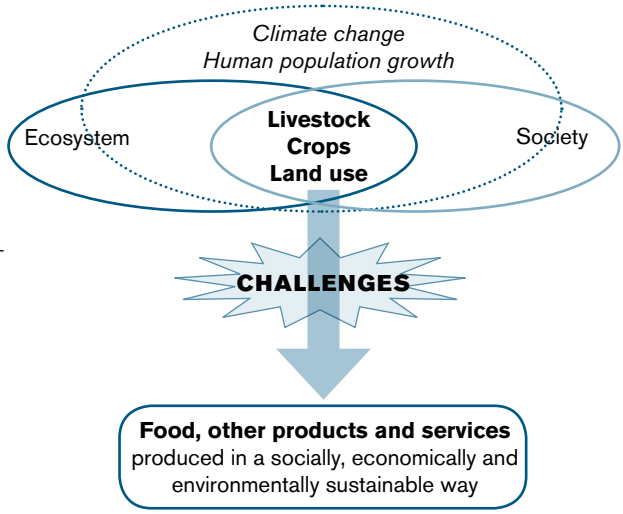

Figure 1. The context of the Future Agriculture platform.

The changes and challenges facing agriculture in the future will be substantial, not only in Sweden but globally. The conditions for animal husbandry and cultivation of crops for food and other products are strongly affected by climate, resource availability and societal demands in a global context. All of these factors are changing and imposing increasing pressures on global ecological and agricultural production systems. Thus, to meet the challenges, the development of more diverse agricultural systems, multi-functional strategies, and improvements in nutrient, water and energy use efficiency are urgently required (IAASTD, 2009), all of which must be underpinned by robust, scientifically-based knowledge. Further, since the challenges are multi-dimensional, multi- and inter-disciplinary research and international collaboration are essential. In addition, strong stakeholder involvement and constructive dialogue between academia and policymakers are needed. This requires arenas for discussions and collaboration in order to facilitate dialogue and initiate cross-cutting research. The research platform *Future Agriculture – Livestock, Crops and Land Use* provides such an arena (Figure 1).

2 Background

In 2008 the Faculty of Natural Resources and Agricultural Sciences at the Swedish University of Agricultural Sciences (SLU) identified a need to further strengthen agricultural research at the university to meet future demands and decided to make a strategic investment within the area. Financial support was allocated from 2009 to support a strategic research program on *Future Agriculture*, tasked with identifying key research issues and further developing agricultural research at SLU. Since a multidisciplinary approach is essential for tackling future challenges related to agriculture and food production, the Faculties of Veterinary Medicine & Animal Science and Landscape Planning, Horticulture & Agricultural Sciences were invited to participate in the program.

The investment in *Future Agriculture* was inspired by Future Forest, a joint research program between SLU, Umeå University and the Forestry Research Institute of Sweden (Skogforsk), funded by the Swedish Foundation of Strategic Environmental Research (Mistra), the forest industry and the universities. The effort has also built on experience gained from SLU's participation in previous cross-disciplinary programs on agriculture and food production Food 21- Sustainable Food Production funded by Mistra (Andersson et al., 2005), the Strategic Analysis of Swedish Agriculture: Production Systems and Agricultural Landscapes in a Time of Change (FANAN) financed by the Faculty of Natural Resources & Agricultural Sciences at SLU (Fogelfors *et al.,* 2008) and work on livestock in a changing environment within the Faculty of Veterinary Medicine & Animal Science at SLU (Lundström *et al.* 2008).

The quality and impact of SLU's research were evaluated in 2009 (KoN09, 2009). As a result of the evaluation, the Vice-Chancellor decided to support the development of four *Future areas*, one of which is *Future Agriculture*, from 2010. These platforms are highlighted in the new strategy for SLU as cross-faculty centres for analyses and syntheses of complex issues and stakeholder dialogue (Strategy for SLU 2013-2016, 2012).

A steering committee for *Future Agriculture* was appointed by the Vice-Chancellor in December 2009 and an advisory board was formed in October 2010. Lists of the present members of the steering committee and advisory board are presented in Appendices A1 and A2. In accordance with intentions, *Future Agriculture – Livestock, Crops and Land Use* has developed into a multidisciplinary research platform, where researchers, together with representatives of the agricultural sector, authorities and non-governmental organisations (hereafter called stakeholders), identify, discuss and examine issues regarding the sustainable use of natural resources. The emphasis, from the start, has been on agricultural production (the first, absolutely critical step in food production and processing chains), including livestock, crop production and land use, within a global context.

3 Tasks and goals

The following tasks for *Future Agriculture* were formulated by the steering committee in 2009:

- To initiate and develop multidisciplinary research, focusing on food supply and land use;
- To provide a hub for dialogue with the agricultural sector, authorities, non-governmental organisations and other societal sectors, and for synthesis of knowledge;
- To foster a new generation of agricultural researchers;
- To deliver scientifically-based knowledge as a basis for strategic decisions.

In the SLU evaluation KoN09 (KoN09, 2009), it was stated that four Future platforms should be formed with the overall aim to provide opportunities for SLU research units to find a place within a larger scientific framework. According to KoN09, all four Future platforms should:

- Provide advanced platforms for continuous analysis of national and global trends;
- Enable SLU to efficiently contribute to meeting global challenges and national needs;
- Make SLU activities more visible to stakeholders and society at large;
- Enhance SLU's image;
- Strengthen SLU's internal identity;
- Make SLU education programs more attractive to students;
- Develop horizontal and interdisciplinary science from strong disciplinary bases;
- Improve links between fundamental and applied research;
- Better integrate Foma (Environmental monitoring and assessment) activities in research;
- Strengthen internal and external cooperation;
- Provide syntheses of research of vital importance to society;
- Improve SLU's funding competiveness, particularly in international research applications and major national strategic programs.

4 Overview of the Future Agriculture research platform

Future Agriculture is a multidisciplinary platform for a broad spectrum of activities, all aiming to strengthen agricultural research and the dialogue between academia and other sectors of society. The platform is used for:

- Scenario development;
- Identification of knowledge gaps, formulation of research issues and priorities;
- Analyses and syntheses of complex, cross-cutting issues, e.g. through thematic working groups;
- Dialogue, nationally and within EU, with the policymaking and funding agencies, e.g. about research needs and priorities;
- Funding of post-doctoral research projects;
- Initiating and supporting research grant applications;
- Networking between researchers, e.g. through associate projects to the platform;
- Networking between researchers and the agricultural sector, representatives from the authorities and non-governmental organisations;
- Stimulating young researchers to extend their networks and gain experience of multidisciplinary research;
- Arranging seminars, workshops and conferences.

The *Future Agriculture* platform and its activities have developed over time. Several of the key tasks set for the *Future Agriculture* platform have already been largely accomplished in Phase I (2009 – 2012). Scenarios have been developed, several projects have been initiated, and valuable networks have been established. Some of the platform's activities and progress during this phase are illustrated in Figure 2.

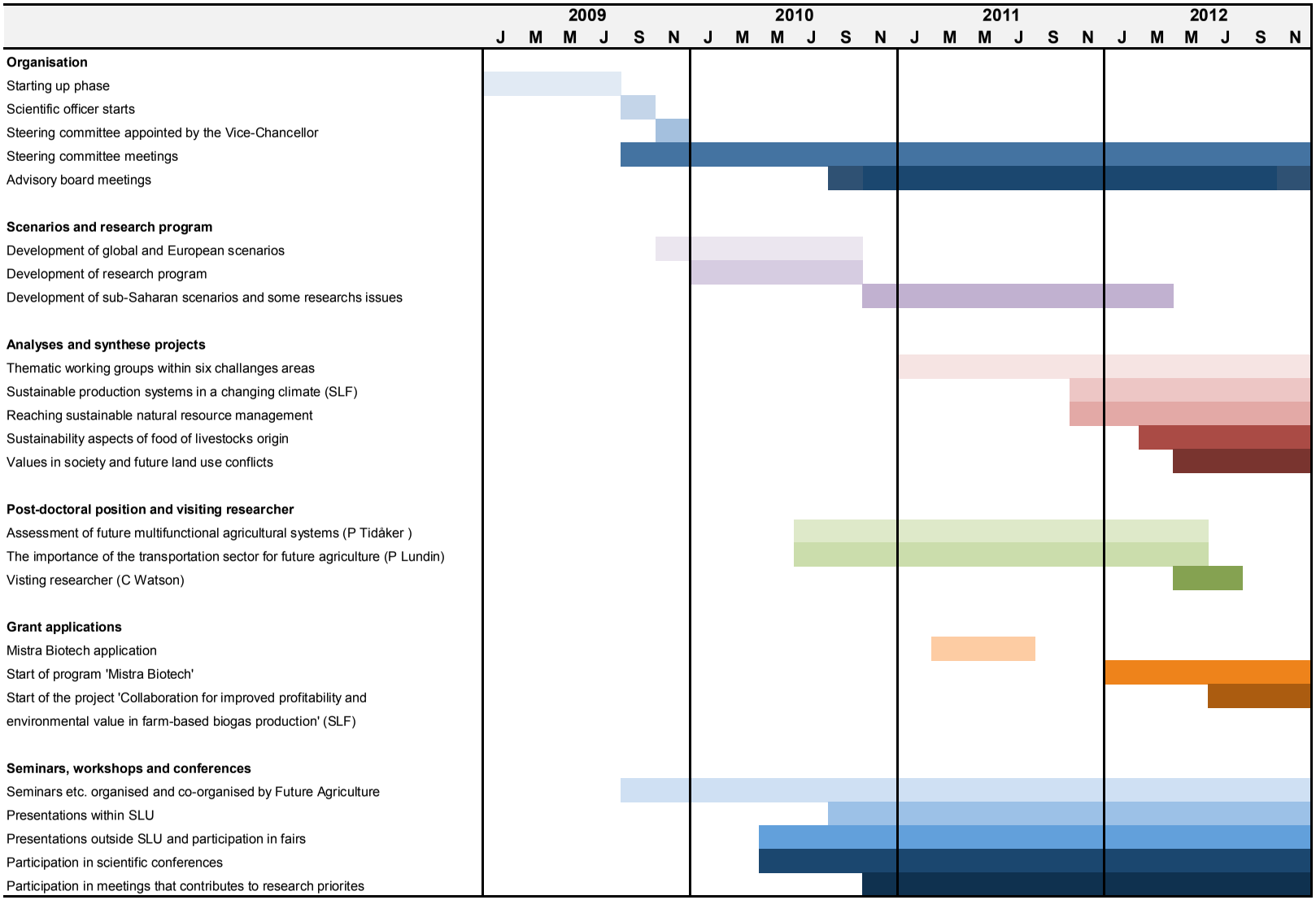

Figure 2. Development of the Future Agriculture platform and its main activities during Phase I.

5 Development of a research program

5.1 The Future Agriculture research program

The focus of research is often on present-day and urgently upcoming issues. It is often reactive rather than proactive. In order to foster a broader, longer-term perspective when drafting the research program, major future challenges were identified as the basis for the work. The challenges were identified through a thorough process, in which five global and corresponding European scenarios for 2050 were constructed (Öborn *et al.*, 2011). These scenarios are not necessarily likely or desirable, but they are all considered to be possible. Three workshops were arranged with researchers and stakeholders. The scenarios were used as starting points to discuss and identify future demands, gaps in knowledge and emerging research issues from global and European perspectives. Conclusions reached in the workshops provided foundations to formulate six challenges confronting future agriculture and identify several research issues that must be addressed to meet each challenge. These issues provided the basis for the strategic program of agricultural research covering livestock, crops and land use that was developed and reported during 2010 (Bengtsson *et al.*, 2010). The aims of the program are: to strengthen agricultural research, inspire researchers to establish productive new collaborations, facilitate joint applications for research projects, and inspire educational initiatives.

5.1.1 Global and European scenarios for 2050

The five global and European scenarios for 2050, named *An overexploited world, A world in balance, Changed balance of power, The world awakes* and *A fragmented world*, are described in detail in Öborn *et al.* (2011). The scenarios were developed by a group of researchers with expertise in the following disciplines; agronomy, soil science, ecology, veterinary medicine, animal science, agricultural economics, demography, peace and development, energy and environmental science. The researchers came from SLU, Stockholm University, Gothenburg University and Chalmers University of Technology. The scenarios were created using a method called morphological analysis in cooperation with the Swedish Defence Research Agency (FOI), as described by Stenström (2012). The five scenarios were created to get a wide range of different possible future developments during the coming 40 years.

5.1.2 Research issues

With the scenarios as starting points, a set of challenges was identified that would have to be overcome in order to produce enough food, other products and services for the growing human population, and address other global problems and regional issues, in a changing global context. These challenges are described in the strategic program for *Future Agriculture – Livestock, Crops and Land Use* (Bengtsson *et al.,* 2010), and summarised in Figure 3 and the following text.

Reduction of the environmental impact of agriculture and mitigation of climate change

In order to reduce the environmental impact of agriculture and its contribution to climate change, research is needed on a range of topics, such as the design of efficient highly productive systems with minimized use of resources, better ways to utilize ecosystem services in agricultural production and land use, the impact of consumption patterns, and the implications of structural changes in the food production chain.

Adaptation of agriculture to a changing climate

Adapting agriculture to climate change requires the development of new skills, strategies and

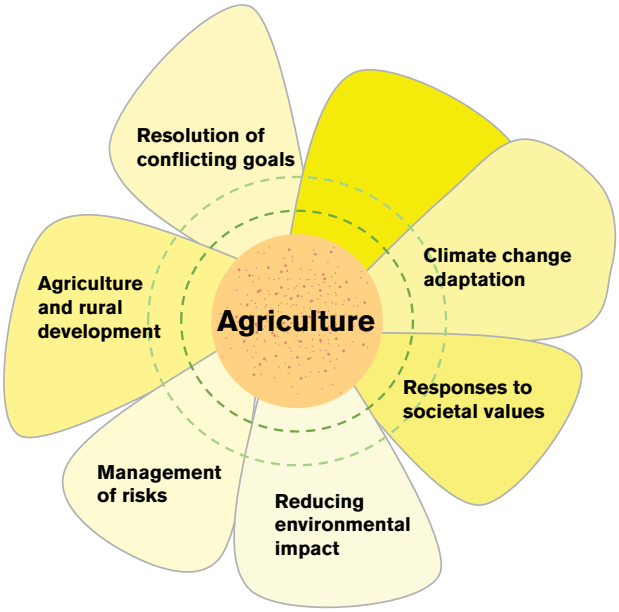

Figure 3. The six challenges described in the Future Agriculture research program.

systems, *inter alia*: more efficient water use and recycling techniques; alternative crops and cropping systems; genetically adapted or modified strains and varieties; measures to improve protection against animal and plant diseases and pests; and robust facilities, e.g. farm buildings, that can withstand extreme weather events such as heat waves, floods and drought.

Management of present and potential risks

Management of actual and potential risks requires more knowledge of hazards, acceptance of new and advanced technology, and advanced studies on the resilience of production systems. Greater knowledge is needed to cope with the diverse changes that are occurring (and will occur in the future), to prepare for extreme situations and pandemics, and to provide opportunities for human populations to produce food self-sufficiently.

Responses to societal values and contributions to policies

To understand community values and provide a basis for policy decisions, studies on different stakeholders' ethical concerns related to food production and its environmental impact are needed. Important questions are related to the import of cheap food and export of pollution, impacts of increased food prices and effects of policy instruments.

Agriculture and rural development

Meeting this challenge requires increased knowledge of the interrelations between rural development and agricultural land use. It calls for increased understanding of the socio-economic organisation of agricultural production and land use, together with greater knowledge of the factors promoting and hindering communities and sustainable productive activities in diverse rural areas. Core issues include ownership, labour requirements, governance of natural resources, synergistic effects of production and other aspects of the rural economy, and the quality of life in rural areas, not least in relation to urban areas.

Resolution of conflicting goals of agriculture and land use

Solving conflicts of interest related to agriculture requires rigorous research to identify effective approaches for resolving situations where there are conflicting goals, or conclusions differ due to profound differences in stakeholders' values. Such conflicts may arise from differences in interests or perceptions related to production intensity, impacts of activities on climate and the environment, or animal and human health, land use and land ownership conditions, all of which are also related to values and power relations in society.

Based on these challenges, knowledge gaps were identified, which were used to formulate 37 key research questions that illuminate the kinds of studies that need to be initiated now, in order to prepare for an unknown future (Box 1).

Box 1. Thirty-seven research questions identified within Future Agriculture.

Thirty-seven research questions

In the strategic research program for *Future Agriculture – Livestock, Crops and Land Use* (Bengtsson *et al.*, 2010) six major challenges are identified:

- Reduction of the environmental impact of agriculture and mitigation of climate change
- Adaptation of agriculture to a changing climate
- Management of present and potential risks
- Responses to societal values and contribution to policies
- Agriculture and rural development
- Resolution of conflicting goals of agriculture and land use

Based on these challenges, knowledge gaps were identified and used to identify key research questions. The 37 questions listed below illuminate the kinds of studies we need to initiate now, in order to prepare for an unknown future.

Reduction of the environmental impact of agriculture and mitigation of climate change

1. How and by which methods can agriculture mitigate climate change?
2. How can agriculture mitigate land degradation and environmental pollution?
3. How can nutrients, water and wastes at different scales be recycled more efficiently?
4. What are the environmental and climate impacts of structural changes in agriculture – specialization versus integration, small scale versus large scale, and geographic localisation?
5. What is the potential for increasing efficiency and productivity by innovative technologies and in agricultural production?
6. What are the environmental and climate impacts of different consumer preferences and consumption patterns?

Adaptation of agriculture to a changing climate

7. How vulnerable, adaptable and resilient are different agricultural production systems?
8. What are the functions of different kinds of organisms and populations in real production systems?
9. How can crop species and varieties, and livestock species and breeds, be adapted to new climatic conditions, such as higher temperatures, longer drought periods and extreme weather events, and what is the potential for domesticating 'new' species, e.g. to utilize marginal areas or organic waste?
10. How can resource use efficiency and production be increased on agricultural land while maintaining ecosystem services, biodiversity and animal welfare?
11. Which management options and technologies are available to combat emerging pests and diseases in crop and livestock production?
12. How can integrated systems, at different scales, for crop, livestock and energy production be designed and evaluated?
13. Which options for new land uses are available and what are the potential advantages and disadvantages of using more land for different types of agricultural production?

Management of present and potential risks

14. What threats to food security do diseases and pests emerging in crops and livestock pose, and how can they be managed?
15. How can threats to food security caused by climate change and other ecosystem changes or collapses be managed and avoided?
16. How does the use, or refusal to do so, of new technologies and farming systems affect food security?
17. What are the consequences of poor food security for social unrest and local conflicts?

18. How do agricultural production systems constitute threats for ecosystem resilience, and affect risks of ecosystem and environmental collapse, and climate-induced catastrophes?
19. How do agricultural production systems increase or decrease the risks of zoonotic pandemics?

Responses to societal values and contribution to policies

20. What is the normative status of different forms of agricultural production of food, feed, energy etc, i.e., are they perceived as right or wrong in society?
21. Which different sets of values related to agriculture, food and technology can be identified?
22. What are the consequences of different sets of values, with regard to the actions, or absence of actions, of producers, consumers and politicians?
23. How do political processes related to climate, the environment, biodiversity, trade, rural development, animal health and welfare etc. lead to international, regional and national agreements, policy instruments and laws supporting or restricting agricultural land use and production?
24. What are the effects and consequences of various international agreements, policies and laws on agricultural production and land use?

Agriculture and rural development

25. How do changes in agricultural and food production systems affect rural communities and rural economies?
26. What are the effects of increased competition for land-based resources on producer prices and the economy in the agricultural sector, e.g. more large-scale and specialized production, or integration of production in new kinds of ownership and collaboration?
27. What is the importance of different forms of land tenure, ownership, and collective action for agriculture and rural development?
28. How do urban and rural areas interact through flows of natural resources, goods, energy, ideas, capital, people, and through means of transportation?
29. How can economic and social sustainable development in rural areas and food security in cities be combined?
30. What are the effects of different policies on rural livelihoods and entrepreneurship?
31. How can new knowledge on communication and collaboration be applied in agricultural production and natural resource management?

Resolution of conflicting goals of agriculture and land use

32. What are the conflicts and trade-offs between different agricultural land uses, including conflicts between goals, different techniques and land management systems?
33. How can conflicts over water resources and water use regionally and locally be addressed and resolved?
34. What are the possibilities for resolving conflicts between urbanisation and agriculture, e.g. urban planning, urban farming and small-scale production in urban or peri-urban areas?
35. How can trade-offs and synergies between ecosystem services, production, climate impact, biodiversity, animal and human welfare and health be identified and managed?
36. What are the possibilities for multiple-use and multifunctional systems to resolve conflicts in agriculture and land use?
37. How do human values affect the means and methods for managing and resolving conflict?

5.2 Further development of scenarios for identification of research priorities

5.2.1 Sub-Saharan Africa

Scenarios for sub-Saharan Africa were developed based on four of the global scenarios; *An overexploited world*, *A world in balance*, *Changed balance of power* and *A fragmented world*. The same methodology, morphological analysis, was applied as in the development of the global and European scenarios (Stenström, 2012). The work was carried out by a group of researchers with different areas of competence, including economic, social, political and agricultural sciences. The researchers came from SLU, Lund University, the Nordic Africa Institute and FOI. The scenarios were used as starting points to discuss and identify future demands, gaps in knowledge and research issues at a workshop with researchers and stakeholders.

Following this workshop, four areas critical for the future of agriculture, and thus food security and poverty reduction in sub-Saharan Africa, were identified:

- Governance and infrastructure for agriculture;
- Sustainable and productive farming systems;
- Investment and risk management in agriculture;
- Innovation and adoption of technology in agriculture.

A set of critical research issues was formulated for each area. The scenarios for sub-Saharan Africa, and the critical areas and research issues, will be presented at a seminar in April 2012 and are described in detail in Magnusson *et al.* (2012).

5.2.2 Regional scenarios

Both the process of developing scenarios and the scenarios themselves have attracted great interest from researchers and stakeholders. It is foreseen that the global and European scenarios (Öborn *et al.,* 2011) will be used as starting points for developing scenarios for regions, such as various parts of Sweden and the Baltic Sea region. Such work could, for example, stimulate discussions about research on rural development or reducing eutrophication of the Baltic Sea.

5.3 Contributions to national and international research priorities

The research issues identified and described by *Future Agriculture* can be used as a basis for setting research priorities at SLU and organisations funding agricultural research, in both Sweden and internationally. The global and European scenarios, and the research programme *Future Agriculture – Livestock, Crops and Land Use*, have been presented at national level and in the EU sphere on several occasions. In addition, members of the steering committee have participated in various meetings where future research issues and priorities have been discussed. More details on some of the occasions in which representatives of *Future Agriculture* have been invited to attend and participated are presented in the text below, and a complete list is given in Appendix B1.

5.3.1 National level

Future Agriculture personnel were invited to the Swedish Ministry of Agriculture[1] in 2010 to present the scenarios and the research program to representatives of the Ministry of Agriculture, Ministry of Environment and the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas). In 2011, *Future Agriculture* held a seminar for all employees at the Ministry for Rural Affairs, together with the Mistra program Future Forest.

The steering committee of *Future Agriculture* provided input to SLU's new strategy for research and education (Strategy for SLU 2013-2016), stressing the need for multi- and inter-disciplinary research in order to address complex issues. Ideas for future agricultural research calls were also submitted to the research council Formas in 2011.

5.3.2 International level

Food-KIC – Food4Future

Ingrid Öborn participated, together with several other SLU representatives, at a workshop in Copenhagen (February 27, 2012) on Business Opportunities to Tackle Global Challenges. The workshop was organised by Foodbest, an EU

1 The Ministry of Agriculture changed name to The Ministry for Rural Affairs on January 1, 2011.

Interreg project aiming to bring together the most innovative companies and universities in Europe in order to create a platform, Knowledge and Innovation Community (KIC). The platform includes research, innovation and education covering the entire food chain. The KIC is called Food4Future – Sustainable supply chain from resources to consumers. Denmark and Sweden will create one of the hubs and SLU will be one of the participating universities. *Future Agriculture* and SLUFood (a strategic SLU investment aiming to strengthen food science research) will provide important foundations when developing the SLU contribution to Food4Future. A call is expected in 2013, and the KIC activities are expected to commence in 2014.

Joint Programme Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI)

A Joint Programme Initiative on Agriculture, Food Security and Climate Change (JPI-FACCE) has been initiated within the EC by SCAR (the Standing Committee on Agricultural Research). Sweden is actively participating in the initiative through the Ministry for Rural Affairs and the research council Formas, together with representatives from the research community. Ingrid Öborn participated together with Formas as a Swedish representative at the Mapping Meeting on Adaptation to the Climate Change (one of five highly prioritized areas in the FACCE JPI) in Madrid February 22-23, 2012. In the Mapping meetings funders and researchers come together to identify overlaps, and gaps, and explore possible areas for further joint research on the prioritized issues.

The future of farming

Cecilia Waldenström was one of 40 senior, invited participants in a roundtable debate entitled The Future of Farming held in Brussels, November 9, 2011, organized by the Greening Europe Forum (GEF) and the Ecosocial Forum. The three themes of the discussion were: 1) Reforming the Common Agricultural Policy, 2) Reaching ecological sustainability, and 3) Thriving rural communities and affordable food.

Warsaw Consensus Statement on Europe as a key player in global food security

Jan Bengtsson participated in a workshop, in Warsaw on October 5-6, 2011, in which a small group of prominent academics and opinion formers from a range of disciplines and across Europe discussed issues related to agricultural production and environmental sustainability in Europe over the coming decade. The aim was to identify the extent to which scientists from different disciplines could agree on the relative needs of agriculture and the environment (ecology, water, land use, pollution), whether their needs could be aligned, and the extent to which the productivity of European agriculture needs to be increased in the future. Following the meeting a written consensus statement was issued (Appendix A3), a press release was posted on the participating universities' homepages and a short communication was published in Nature (Benton *et al.,* 2011).

NKJ meeting

Erik Steen Jensen and Jan Bengtsson participated in the Nordic Agricultural Research in the Bio-based Knowledge Economy – Future Opportunities and Challenges meeting, July 6, 2011, in Tavastehus, Finland, arranged by the Nordic Joint Committee for Agricultural Research (NKJ). It was held in conjunction with the Nordic Agricultural Ministers' summer meeting, July 7-8, 2011.

The aim of the meeting was to discuss Nordic priorities and Nordic cooperation on agricultural research related to The knowledgebased bio-economy, and how such Nordic activities can contribute to sustainable development. The discussions were based on the SCAR document on Sustainable Food Production and Consumption in a Resource Constrained World, which had a similar outlook, in several respects, to the *Future Agriculture* research program. The participants from *Future Agriculture* discussed relevant issues with several policymakers and researchers informally. The *Future Agriculture* research program was made available to the delegates.

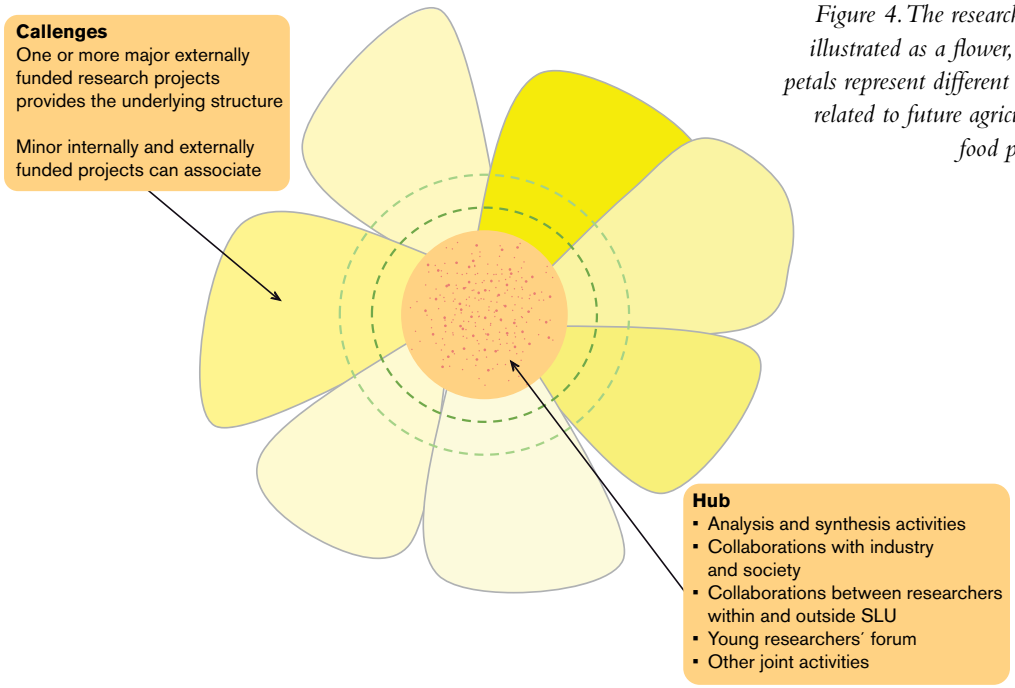

Figure 4. The research platform illustrated as a flower, where the petals represent different challenges related to future agriculture and food production.

SCAR meeting in Budapest during the Hungarian presidency

Following an invitation from the Swedish Ministry of Agriculture and the research council Formas issued to *Future Agriculture*, Ulf Magnusson represented Sweden in a SCAR meeting in Budapest, May 2011, together with the DG of Formas. The meeting gathered about 200 people from the EU Commission and both ministries and national research agencies from the member states. The agenda was to discuss and advance the overall theme of agricultural research in Horizon 2020. The scenario work, challenges and research issues identified by *Future Agriculture* were presented at a plenary session by Ulf Magnusson. Printed material about the scenarios and the research program (Bengtsson *et al.*, 2011; Öborn *et al.*, 2011) were then distributed on request to key persons within SCAR and representatives of some member states.

RURAGRI

Cecilia Waldenström participated in the first RURAGRI workshop, March 21-22 2011, in The Hague, The Netherlands. A panel of 40 national experts from the RURAGRI partner countries plus 10 other experts were invited to develop and discuss the strategic research agenda for a coming ERA-NET (European Research Area-NET) call on the topics of agriculture, rural areas and sustainable development.

UK Foresight

Future Agriculture, represented by Ingrid Öborn and Erik Fahlbeck, was invited to a lunch seminar on science, foresight, and policymaking at the British Ambassador to Sweden's Residence (February 27, 2009) with the UK Chief Scientific Advisor, Professor John Beddington. The UK Global Food and Farming Foresight Programme was one of the initiatives discussed during the seminar. The science attaché at the British Embassy, Dr Hazel Gibson, visited SLU to follow up the discussions with *Future Agriculture* in July 2009. This contact also led to a SLU scientist (Ingrid Strid) being invited to one of UK Foresight's workshops on food waste.

6 Ongoing research

Future Agriculture is a research platform and thus differs from large research programs such as EU research programs. While the main task of those programs is to conduct research, *Future Agriculture*'s key objectives are to initiate research, strengthen analyses and foster multidisciplinary syntheses and create strong networks.

Future Agriculture is being driven and coordinated in a hub that has several functions. Research projects of various scales can 'associate' with *Future Agriculture* and participate in activities in various ways. The flower in Figure 4 illustrates the interactive and synergistic effects of the associations and activities within the platform.

The hub aims to initiate and support:

- Multidisciplinary synthesis and analysis activities, through arranging and supporting thematic workshops, seminars and 'writeshops';
- Collaboration with the agricultural sector, authorities, non-governmental organisations and other sectors of society, through arranging seminars and workshops, and supporting joint projects.
- Collaboration between researchers (within SLU and other national and international universities), through thematic working groups, workshops and seminars that lead to joint applications, publications, staff exchanges, etc.
- A *Young Researchers´ Forum*. Within the framework of this forum, various activities will be arranged to develop individuals, and the research, and to strengthen different types of networks.

6.1 Analyses and syntheses

Multidisciplinary working groups have been initiated and tasked with writing a review or synthesis article based on research areas originating from the challenges described in the research program (Bengtsson *et al.,* 2010). Other synthesis projects within the *Future Agriculture* umbrella are externally funded, one of which is run in cooperation with the Future Forest program. New thematic working groups focusing on *Sustainability Aspects of Livestock Based Foods* and *Climate Smart Agriculture* will be started during 2012. There are also plans to initiate synthesis projects in cooperation with the newly funded Mistra Biotech program (see section 6.4).

6.1.1 Thematic working groups originating from the six challenges

In 2011 thematic working groups were formed, and each group was assigned one of the challenges described in the *Future Agriculture* research program to address (Bengtsson *et al.,* 2010). Criteria applied in the groups' formation were that they should be multidisciplinary, and their task was to write a review or synthesis article on key issues (Appendix A4).

The process began by discussions of the challenges and related research issues in open seminars. Relevant speakers were invited to several of the seminars, e.g. farmers, experts, representatives of policymaking bodies or scientists, to provide inspiration, although the form of the seminars differed. Twenty to 50 researchers participated in these seminars. The thematic groups were formed after the seminars. Since the need for a multidisciplinary approach was stressed in the task description given to the groups, a few people were especially invited to join some groups to ensure there was a good mixture of researchers with expertise in pertinent disciplines. Several of the groups have had (or will have) dialogue with representatives from the agricultural sector, governmental authorities and non-governmental organisation during their work on the articles. All groups have presen-

ted and received input on their work in a joint workshop organised to consider all of the themes in June 2011 and during the *Future Agriculture Day* (open seminar) in October 2011, and from the advisory board of *Future Agriculture*. The groups will submit their papers in spring or autumn 2012. The subjects that the thematic groups have chosen to work on are summarised below and described in more detail in Appendix A5.

Restricting reactive nitrogen losses from agriculture

This work focuses on aspects of the challenge *Reduction of the Environmental Impact of Agriculture and Mitigation of Climate Change*, and more specifically on ways to restrict losses of reactive nitrogen (N_r) in agricultural production, by increasing N-use efficiency and/or reducing N inputs in food production. Emphases are on the 'key actions' for improving management of the nitrogen cascade in food production proposed by the European Nitrogen Assessment (ENA, 2011). These are: 1) N-use efficiency in crop production, 2) N-use efficiency in animal production and 3) N-losses related to food consumption and food waste, including recycling from waste and wastewater systems. Critical issues and challenges for each of these actions are being addressed and it is discussed how to choose measures and policies for curbing N_r emissions from food production.

Adaptation of agriculture to climate change – Challenges and possibilities from a Nordic perspective

This work focuses on aspects of the challenge *Adaptation of Agriculture to a Changing Climate*, especially the adaptations required in agricultural systems, including crop and livestock production systems, from the perspective of farmers in northern latitudes (especially the Nordic countries). The ability to manage high-yielding agricultural production in a complex and unpredictable environment requires both planned adaptation and risk management through the development of robust and flexible systems that can make farming less vulnerable to climate change. Since annual weather variations exceed projected climate changes, many components and practices of suitably robust, flexible adaptive systems can probably be found in farmers' practices today.

Risk management of threats to future agricultural production

This work considers aspects of the challenge *Management of Present and Potential Risks*. Management of actual and potential risks to future agriculture is highly variable between different economic settings and between different threats. This working group has subjected several threats to agricultural production of food to a risk analysis in three economic settings, taking into account the risk *per se*, risk perceptions and the capability of risk management. The aim of the work is to contribute to setting more refined and better adjusted priorities in the research agenda for future agriculture and food security.

Ethics of different food production systems and relations between technologies and values

This work addresses aspects of the challenge *Responses to Societal Values and Contribution to Policies*. A number of factors affect the acceptability of food products and new technologies related to food production. Analyses of different stakeholders' ethical evaluations of three contrasting production systems for meat, vegetables and cereals will show how these factors should be considered when developing new food products, food technologies and regulations for such products.

Bioenergy from farmland: Potential contribution and institutional barriers to rural development

This work within the challenge *Agriculture and Rural Development* focuses on farm-based bioenergy and is Major issues explored include the technological choices available to farmer-entrepreneurs contemplating bioenergy production, their effects on the environment and possible greenhouse gas mitigation, political support at EU level for their implementation, and the potential for farm-based bioenergy to promote local rural development. Institutional barriers that may explain the low implementation (as yet) in Sweden, and the roles adopted by farmers are focal points of the analysis.

Resolution of conflicting goals of agriculture and land use

The aims of this work are to analyse and exemplify problems hindering the *Resolution of Conflicting*

Goals of Agriculture and Land Use. The exploration is based on three case studies, in which problems relating to prioritization, disagreements and conflicts of interest, interest groups and organisations, and actors with power to influence decisions, are defined and analysed. In order to do this, it is important to clarify the concepts of land use conflicts and solutions to such conflicts.

6.1.2 Sustainable production systems in a changing climate

This project is funded by the Swedish Farmers' Foundation for Agricultural Research (SLF). It will explore the extent to which integrated systems of crop and livestock production can: more readily adapt to a more variable climate than non-integrated systems; improve the utilization of resources with regard to future access to energy, plant nutrients and other purchased inputs; and enhance rural development and the economic and social viability of agricultural practices. The analysis of integrated crop and livestock production systems will consider both farm level and landscape scale practices, and include collaboration between rural and agricultural enterprises with various kinds of specialization. See Appendix A5 for further details.

6.1.3 Reaching sustainable natural resource management – Is resilience science a valuable tool?

Together with the Future Forest program and researchers from Stockholm Resilience Centre, *Future Agriculture* is participating in a thematic working group called *Reaching Sustainable Natural Resource Management – Is Resilience Science a Valuable Tool?* This working group will address current knowledge gaps with regard to the practical utility of resilience concepts by applying them in a cross-comparison of multiple production systems; namely forestry, agriculture and fisheries. The work started in December 2011. See Appendix A5 for further details.

6.1.4 Collaboration for improved profitability and environmental value in farm-based biogas production

Difficulties associated with establishing economies of scale are one of the major bottlenecks hindering the increased production of farm based biogas in Sweden. As a result, farmers have become interested in collaborating with one-another. In this study we explore how different kinds of collaboration among farmers affect farm profitability, environmental and energy outcomes as well as local networking, local innovation and contributions to local rural development. The study will map all of Sweden's currently active farm based biogas collaborative enterprises and will explore 4-6 cases in more detail. The project is financed by the Swedish Farmers' Foundation for Agricultural Research (SLF) and will start in August 2012. It was initiated as a result of the work done by the *Agriculture and Rural Development* thematic working group.

6.1.5 Future studies

Future Studies is not a scientific discipline unto itself. Rather, it involves developing and applying tools and methodologies for discussing the future, such as scenario studies. It is important to bear in mind that the possible futures that are discussed are political; they co-create the actual future. It is therefore necessary to be reflexive when conducting future studies; questions of normative assumptions, power and responsibility have to be considered. A group of researchers at the Department of Economics at SLU have participated in a project under the auspices of the Institute of Futures Studies in order to discuss these matters.

6.1.6 Thematic groups initiated in 2012

Sustainability aspects of foods of livestock origin

A new thematic working group will start considering sustainability aspects related to the consumption and production of foods from livestock, such as meat, milk and eggs, during spring 2012. The theme will include economic, social and environmental aspects of the global asymmetries of the consumption and production of these kinds of food.

Values in society and future land use conflicts

This is a planned series of seminars and discussion meetings scheduled for spring-autumn 2012. The aim is to identify factors and processes influencing present and future land use, especially societal va-

lues that may affect land use decisions, to improve understanding of societal values related to food, agricultural production and land use. Challenges for future land use decisions will be identified that can be used in the design of future investigations. This activity will be carried out in cooperation with the research program Mistra Biotech.

Other thematic groups

During 2012 scenarios for the rural areas of Sweden will be developed in cooperation with the Board of the Swedish Rural Network. There are also plans to establish a thematic working group on the theme *Climate Smart Agriculture*.

6.2 Post-doctoral positions

Two 2-year post-doctoral positions were advertised (Appendix A6) and Drs. Pernilla Tidåker and Per Lundin were engaged and took up these positions in summer 2010. Their work is briefly described below, and their publications and participation in conferences are presented in Appendix B2. In addition, the Faculty of Veterinary Medicine & Animal Science at SLU financed 10 post-doctoral researchers (2+2 years) from 2009. These post-doctoral researchers have been invited to attend seminars and participate in various other *Future Agriculture* activities since most of their projects are highly relevant to agriculture and food production. Their projects focus on e.g. ways to reduce gas emissions from animal production, and global domestic animal genetic resources.

6.2.1 Assessment of future multifunctional agricultural systems

Dr. Pernilla Tidåker

Can more integrated and multifunctional agricultural systems meet future needs for food, feed and fuel within the context of finite resources of plant nutrients and fossil fuels? In order to address this question a systems analysis approach is required for evaluating different scenarios and suggesting improvements or changes in the production chain.

This post-doctoral project focuses on assessment of future multifunctional agricultural systems. Two major themes have emerged within this overarching topic. The first, addressed in two studies, is multifunctional bioenergy production on farmland. The aims of the first study are to explore how farm-based bioenergy system can contribute to rural development, then identify and discuss institutional barriers for such development. This is being done in collaboration with researchers from a wide range of disciplines within the *Future Agriculture* thematic working group *Agriculture and Rural Development* (see section 6.1.1 and Appendix A5).

The second study within this theme is considering the potential benefits of including leys as energy crops in a cereal crop rotation, using life cycle assessment (LCA) methodology. Two main functions of such ley crops are to provide feedstock for biogas production and an organic fertilizer through digestion for allocation among the cereal crops. Particular consideration is being paid to the crop sequencing effects and nitrogen management. Replacing annual crops with perennial crops such as leys may increase the soil's organic carbon contents, and thus enhance carbon sequestration. However, if the feedstock for bioenergy production comes from dedicated crops rather than residues, and the demand for feed and food remains, indirect land use changes might occur due to the displaced crop having to be replaced by production elsewhere. Modelling such changes is a delicate issue and to date no consensus has been reached on the appropriate manner to include indirect land use changes in LCA. The results from this study reveal that some of the negative indirect impacts might be countered through carbon sequestration and increases in the potential yield of subsequent grain crops in rotations when ley is used as a bioenergy crop.

The second theme is sustainable supply of plant nutrients to agricultural systems. Pernilla Tidåker was invited by the research council Formas to co-author a book released in 2011 on recovery of phosphorus. The chapter dealt with ways in which phosphorus could be more efficiently used in future agriculture. Another subproject is a joint study with researchers from Linköping University and Chalmers University of Technology on how use of plant nutrients in local organic waste could increase global food security. Functional crite-

ria for optimizing nutrient-efficiency in various sectors is proposed in this study. Pernilla Tidåker is also co-supervisor for a PhD student in a Formas project on optimal ways to supply organic farmland with external plant nutrients. The focus is on assessing different plant nutrient resources using a life cycle perspective. So far, the project has resulted in one published paper dealing with the environmental impact of using meat meal as fertiliser (Spångberg *et al.,* 2011). A forthcoming paper will evaluate the environmental aspects of the potential use of mussels for soil fertilisation.

Another co-authored paperevaluates the utility of carbon footprints of meat production systems as indicators of their environmental impact, by combining results from 43 livestock production scenarios.

During 2012, two other projects have started. The first, financed by SLF, is entitled *Sustainable Production System in a Changing Climate*, for which Pernilla Tidåker is project manager. In a series of multidisciplinary workshops various aspects of integrated and non-integrated production systems will be explored (see section 6.1.2). The second project is considering, in collaboration with the research program Future Forest, if resilience science is a valuable tool for sustainable natural resource management (see section 6.1.3).

6.2.2 The importance of the transportation sector for future agriculture and rural areas

Dr. Per Lundin

The research focuses on the dynamic relationship between tourism and recreational activities on the one hand, and transportation, on the other. This focus is motivated by two overarching observations. Firstly, the historical tendency for the proportion of national production devoted to food to decrease, which implies (among other things) changes in both the agricultural 'assignment' and the utilization of rural landscapes. The changes are likely to include increases in tourism and recreational activities. Secondly, the transportation sector will probably change radically in the near future. Since the 1970s, energy consumption has declined within other sectors, but it is still increasing in the transportation sector, mainly due to increases in air transport and mass motoring. How can the sustainability of current transportation systems be enhanced, and what would be the consequences of such fundamental changes on agriculture and rural landscapes in general, and on tourism and recreational activities in particular? Historical investigations of the development of tourism and recreational activities, and their close relationships to transportation, will provide increased knowledge of the fundamental challenges agriculture and rural landscapes face today.
The research can be divided into three main areas:
– a meta perspective on futures studies;
– a system perspective on transportation (and tourism);
– a historical perspective on tourism (and transportation).

A meta perspective on futures studies

A key issue here is the importance (and constraints) of visionary thinking. Visions are dangerous since they delimit the number of possible future presents, but a lack of visions imposes even greater restrictions. Visions provide means to reduce complexity, and historical examples can help to foster visionary thinking (see also section 6.1.5).

A systems perspective on transportation (and tourism)

According to theory, three phases of large-scale technological systems can be identified: establishment, expansion and stagnation. The focus here is on the car system and how it interacts with other transportation systems. It is currently expanding, although it has substantial, identified failings. Why it is so difficult to re-direct the system? To address this issue, transportation systems of the past and transport visions of the future are analysed.

A historical perspective on tourism (and transportation)

This part of the project will consider how different types of tourism regimes have emerged during the 20th century. Transportation and leisure ideologies will be brought together in order to explore and understand the concept of tourism regimes.

6.3 Visiting researchers

Dr Christine Watson from the Scottish Agricultural Collage (SAC) has been awarded an OECD Fellowship to spend three months (May - July 2012) at SLU to work with *Future Agriculture*. The overall theme of the fellowship is Sustainability in Practice and the main question that will be addressed is whether complexity affects the sustainability of farming systems. In the collaborative research nutrient balance methodology will be used to assess nutrient flows and pools at different scales and levels of complexity, such as integration of arable and livestock production. Dr Watson is also taking part in the thematic working group on *Sustainable Production Systems in a Changing Climate* (see section 6.1.2). She will be hosted by Ingrid Öborn at the Department of Crop Production Ecology.

6.4 Mistra Biotech

During 2011, members of the *Future Agriculture* steering committee, together with other researchers, coordinated an application to the Mistra's call Mistra Biotech: Sustainable Development of Agricultural and Food Systems Using Biotechnology as a Tool. In this context, the term 'biotechnology' is used in a broad sense that includes (*inter alia*) the use of genomics technologies, selective breeding, biomolecular markers and genetic modification, as well as cell and tissue culture and animal cloning technologies.

About 40 researchers from SLU, the Royal Institute of Technology (KTH), Lund University, Aarhus Business School, Roskilde University, and University of California were co-applicants of the application, which was entitled Mistra Biotech – Biotechnology for Sustainable and Competitive Agriculture and Food Systems. The application was approved and the program started on January 1, 2012. It is co-funded by Mistra and SLU and has a total budget of 80 MSEK for four years.

The technical work in the program focuses on barley (*Hordeum vulgare* L.), potato (*Solanum tuberosum* L.), lepideum (*Lepideum campestre* L.) and Swedish Red dairy cattle, using (*inter alia*) genetic modification for plant breeding purposes, site-directed mutagenesis of plants and molecular based, non-GM selective breeding of plants and livestock. Mistra Biotech includes strong research in ethics, consumer attitudes and behaviour, governance and economics of the Swedish agri-food system and the regulatory environment.

The collaboration between Future Agriculture and Mistra Biotech will mainly be mediated through the Centre for Agriculture and Food Systems Analysis and Synthesis, which will provide a platform for integrating sustainability issues related to the use of biotechnology in agriculture. It will form a centre for discussions, analyses and syntheses, where researchers will work together with stakeholders and experts on food production systems and methods for systems analyses (e.g. scenario development, life cycle assessment and cost-benefit analysis).

6.5 Initiating and supporting grant applications

6.5.1 Research grant applications

When the application to Mistra (Mistra Biotech) was developed, the experience gained from multidisciplinary scientific discussions and networking within *Future Agriculture* substantially facilitated the process.

The ideas behind the project *Sustainable Production Systems in a Changing Climate*, financed by SLF, were also a result of the discussions and networking within *Future Agriculture*.

One aim for the thematic working groups is to act as seedbeds for new cooperation and thus generate new research proposals. This is an expected outcome of the writing process in the groups, but it is still too early to summarize the results. However, the project, *Collaboration for Improved Profitability and Environmental Value in Farm-based Biogas Production*, that starts in August 2012 is a direct result of the thematic working group *Agriculture and Rural Development*. The project is funded by SLF.

A meeting to discuss ideas for a research applica-

tion to BONUS (a joint Baltic Sea research and development program financed by participating countries and the EU) has been arranged. Researchers involved in *Future Agriculture* activities were invited to the meeting. BONUS will open the call in May 2012.

6.5.2 Letters of support

Researchers who apply for funding for projects which, if granted, are designed to be associated with the platform, may attach a letter of support from *Future Agriculture*. Nine such letters have been written to date. Examples of research areas for these applications are rural development and means to reduce environmental impact from agriculture.

6.5.3 Associated projects

Funded projects can associate with *Future Agriculture*. By joining the platform, researchers obtain access to a large multidisciplinary network and various activities. Associated projects must be focused on one or several of the areas described in the research program. The projects should be financed by direct government grants or external funds, and they must be temporary, i.e. have a defined timeframe.

For a project to be associated with *Future Agriculture*, researchers who are employed or otherwise clearly linked to SLU must be involved in it. Researchers in associated projects have to be willing to contribute to the development of the platform, e.g. to organise or participate in workshops, seminars and other multidisciplinary activities.

Ten projects have associated with *Future Agriculture* to date, some of which have directly originated from activities within *Future Agriculture* while others have different origins. The associated projects below are described in more detail on the Future Agriculture homepage www.slu.se/future-agriculture:

- Bio-indicators for increased risk of N_2O production by denitrifying bacteria in the rhizosphere. Project leader: Sara Hallin. Funded by Stiftelsen Oscar and Lili Lamms minne.
- Breeding strategies for organic animal husbandry. Project leaders: Anna Wallenbeck and Therese Ahlman**.** Funded by Formas.
- Can reduced soil tillage mitigate nitrogen losses and increase carbon sequestration in arable cropping systems? Project leaders: Erik Steen Jensen and Maria Ernfors. Funded by Formas.
- Effects of land use change on multifunctionality in agroecosystems: Biodiversity and ecosystem services after transition to organic production. Project leader: Jan Bengtsson; Ingrid Öborn and Henrik Smith (Lund University). Funded by Formas.
- Integrating renewable energy production and strategic nutrient management in stockless organic cropping systems. Project leaders: Erik Steen Jensen and Tora Råberg. Funded by Formas.
- Genetic evaluation based on genomic data, to reduce the environmental impact of milk production. Project leader: Lotta Rydhmer. Funded by Swedish Farmers' Foundation for Agricultural Research.
- PlantComMistra. Sub-project leaders: Robert Glinwood and Velemir Ninkovic. Funded by Mistra.
- Reduced food wastage in grocery stores – measures and their impact on economy and environment. Project leader: Ingrid Strid. Funded by Formas.
- Reproduction: the bottleneck in organic pig production – is there a biological management solution? Project leader: Ulf Magnusson. Funded by Formas.
- Yield stability in varietal mixtures of faba bean, *Vicia faba*, Project leader: George Carlsson. Funded by SLU Ekoforsk.

7 Young researchers

Future Agriculture allocates funding for two post-doctoral positions (see section 6.2). In addition, young researchers participate in most of the thematic working groups (see section 6.1), and the lunch seminars (see section 9.3) often have a young audience. Twenty-five young researchers were invited to a scenario workshop in the spring of 2010, at which knowledge gaps and research issues were identified. The results of the workshop were used, with information from several other sources, to formulate the research program described in section 5.

7.1 Young Researchers´ Forum

The *Young Researchers' Forum* aims to give young researchers a broad multidisciplinary frame of reference and access to a larger network of both researchers and stakeholders.

Every year, several activities, ranging in duration from a day to a week, will be arranged within the framework of the *Young Researchers' Forum*. These activities, for example workshops or field trips, will build on participants' needs and wishes. The *Young Researchers' Forum* is aimed at young researchers, primarily those who have recently obtained a doctoral degree and are on the way to becoming an associate professor, but PhD students are also welcome. In general, SLU's PhD students belong to thematic research schools organised at SLU and thus are not the main target group for the *Young Researchers' Forum*.

The initial idea was that the young researchers would organise the activities within the forum themselves. However, time pressures made it difficult to get people involved in the organisation. Therefore, a coordinator has been recruited and will start work (20 % of full time) in April 2012. The coordinator's tasks will be to plan, organise and follow up activities of the *Young Researchers´ Forum* during 2012. Planning of a workshop connected to the Royal Swedish Academy of Agriculture and Forestry's Bertebos Conference 2012 has already started.

8 Education

Although the primary aim of the *Future Agriculture* platform is to strengthen agricultural research, various outcomes should have high educational value. The global and regional scenarios have already been used in courses at SLU, Umeå University and Gothenburg University.

Students at SLU are invited to attend lunch seminars (see sections 9.3), some of which have attracted great interest among students. Many of the seminars have been located in the Student union's building, most of them have been filmed, and the recordings are available at *Future Agriculture*'s homepage. These films have been used in various courses at SLU. *Future Agriculture* has also initiated and arranged two lunch seminars on the subject Education for Sustainable Development (ESD), in cooperation with Student Affairs and Learning Development personnel (Appendix B5).

The future scenarios have also been presented by Lotta Rydhmer to pupils from an upper secondary school in Uppsala, in 2011 and 2012. This school is highly engaged in ESD and its pupils undertake a multidisciplinary project about global food security. In accordance with the theme, the scenario presentation aimed to give them food for thought at the start of their project.

As part of a two-day fair (May 22-23, 2011) about the 'mysteries of life' process for the public and high school students, Jan Bengtsson was invited to talk at the session Where are We Heading: Future Challenges together with researchers on Peace & Conflict Research and Physics.

9 Communication

Future Agriculture provides a platform for researchers, together with stakeholders, to identify and address issues regarding the sustainable use of natural resources. Interaction and cooperation between researchers from different disciplines is very important in order to tackle the challenges that agriculture is facing in a sustainable way. Constructive dialogue between academia and other sectors of the society is also vital for the research to address real societal needs, and for efficient communication of research results.

The outline of *Future Agriculture*'s communication strategy describes the communication channels being used and the target groups they are intended to reach (Appendix A7). Communication with and to both groups within SLU and external groups (notably the agricultural sector, governmental authorities, funding agencies, and researchers at other universities) has been identified as important. Dialogue has been recognized as a very powerful and efficient channel of communication, others include the Web and articles, especially for communication between researchers.

During development of the *Future Agriculture* platform, strenuous efforts have been made to raise its profile among researchers and stakeholders. From the start, open invitations to participate in different activities have been widely disseminated, to both researchers and other potentially interested groups.

Representatives of *Future Agriculture* are increasingly being invited to participate and lecture at seminars and conferences (Appendices B1, B3 and B4). These requests and invitations come from both within SLU and organisations outside the university.

Future Agriculture has an e-mail list that anyone who is interested can sign up to and receive information about its activities. Today, almost 600 people are on the list, including researchers, PhD students and other SLU employees, SLU students, stakeholders and interested citizens. Researchers and PhD students at SLU are the largest groups on the e-mail list.

9.1 Networking between researchers

Target groups of most activities are researchers, but they also often include stakeholders. The lunch seminars (see section 9.3) have been regular meeting points for researchers and other interested parties. The open seminars in which each of the challenges identified in the research program were discussed, and sessions of the thematic working groups formed after these seminars, have provided important foundations for multidisciplinary discussions and research. These activities have also resulted in new collaborations and applications.

9.2 Dialogue with stakeholders

Livestock and crop production, indeed all kinds of land use, and all steps in the production and consumption of food, are affecting people and ecosystems in diverse ways. Thus, there are numerous kinds of stakeholders within the agricultural sector, authorities and non-governmental organisations. To ensure that the work maintains high relevance and facilitates the implementation of research results, good contact with the main stakeholders is important. Consequently, various stakeholders were involved in the process of identifying research issues. The six thematic working groups have also worked together with stakeholders, e.g. in workshops. The lunch seminars, at which representatives from the agricultural sector, authorities and non-governmental organi-

sations have been invited to lecture, have provided further arenas for productively interacting with stakeholders (see section 9.3).

Future Agriculture has an advisory board (see section 10.2) with members representing the agricultural sector, governmental authorities and non-governmental organisations. The current composition of the advisory board is described in Appendix A2.

In February 2012, together with an association for Swedish beef production, *Future Agriculture* organized a workshop to identify high-priority areas for research and development related to sustainable beef production. Representatives of various stakeholder groups and academics took part in this event, and the *Future Agriculture* scenarios were used as starting points for the discussions.

Representatives of *Future Agriculture* have also been invited to give seminars and participate in workshops organised by other organisations (Appendices B1 and B4). These requests have increased as knowledge about *Future Agriculture* has risen. Since the beginning agricultural fairs have been other important arenas for meeting stakeholders from different organisations (Appendix B4).

9.3 Seminars

More than 20 seminars with invited speakers have been arranged from September 2009 to March 2012 (Appendix B5). The speakers have included national and international researchers and stakeholders. The seminars have had a broad target group, including students, researchers and others employed at the university. People from outside SLU have also been welcome to attend them. To accommodate students and teachers (groups whose time is heavily scheduled), most of the seminars have been arranged at lunchtime and a light lunch has been served. The subjects of the seminars vary widely (Appendix B5). Consequently, the participants also differ from seminar to seminar, but some people attend most of them. The size of the audience has varied between 20 to 80 persons, averaging around 50. Usually the invited speaker gives a talk of about 40 minutes, which is followed by a 20-minute discussion. Most of the seminars have been video recorded and are available at the *Future Agriculture* homepage.

9.4 Homepage and printed matter

Future Agriculture has a homepage, in both Swedish and English, with the URLs www.slu.se/framtidenslantbruk and www.slu.se/futureagriculture, respectively. Among other details and links, the homepage provides general information about the platform and its activities, a calendar of events, contact information and video recordings of most of the seminars.

Future Agriculture has also produced reports that are available in printed format, and several are available in pdf-format on the homepage.

All printed matter, PowerPoint-presentations, pdf-documents etc. are customized to the graphic design policy of SLU. They are also, through some common features, designed to clearly identify *Future Agriculture* as the sender.

10 Organisation

10.1 Steering committee

Future Agriculture has a steering committee consisting of a scientific officer and six senior researchers from the Faculties of Natural Resources & Agricultural Sciences; Veterinary Medicine & Animal Science, and Landscape Planning, Horticulture & Agricultural Sciences (Appendix A1). It is led by a program director and has a deputy program director. The steering committee meets monthly, and minutes of these meetings are taken.

A management group, consisting of the program director, deputy program director and scientific officer, also meets monthly to prepare the agenda for the steering committee meetings and to handle various other issues between the steering committee meetings. This group is also responsible for the meetings with the advisory board.

The steering committee discusses ideas and is in charge of prioritizing, planning and following up the platform's activities. The steering committee has also been strenuously engaged in developing the scenarios and writing the research program. Most of the members of the steering committee also lead a thematic working group and some are also members of other groups. All members of the steering committee give seminars about the *Future Agriculture* program both at SLU and outside the university.

10.2 Advisory board

Future Agriculture has an advisory board with members from the agricultural sector, governmental authorities and non-governmental organisations. Its tasks are to:

- contribute different perspectives to *Future Agriculture*;
- give advice for the development of *Future Agriculture*
- exchange information, especially about research funding;
- support the communication of research results;
- raise questions about the role of agriculture in Sweden;
- inform others in their organisations and networks about *Future Agriculture*.

The members represent a cooperative dairy association, a farmers organisation, a retailers association, two non-governmental organisations (a consumer organisation and an environmental protection organisation) and three governmental authorities (the Swedish Environmental Protection Agency, the Swedish Civil Contingencies Agency and the Swedish Board of Agriculture). The current composition of the advisory board is detailed in Appendix A2. The board's first meeting was in October 2010 and since then it has met four times per year. At these meetings ongoing research within *Future Agriculture*, such as the work of the thematic working groups and post-doctoral projects, are presented and discussed. Recent activities are reported and coming events are presented by *Future Agriculture* participants and members of the advisory board. There is also time for discussions about various issues of current interest in agricultural production and consumption. The members of the advisory board take turns in hosting the meetings, which provides an effective way of tightening the bonds between the advisory board members and *Future Agriculture* participants, as well as between the members of the board. Minutes of the meetings are taken.

10.3 The Office

A scientific officer works full time, two communicators work in total 25 % of full time and one administrator works 10 % of full time in the platform (Appendix A1).

The scientific officer is a member of the steering committee and coordinates the *Future Agriculture* activities. This includes (*inter alia*) planning, budgeting, following up activities, arranging seminars and maintaining contacts with researchers and stakeholders, including the advisory board. The scientific officer has also been involved in the scenario development and writing the research program. All these tasks are carried out in close cooperation with the program director.

The communicators are responsible for developing and updating the homepage and posting news on it. They prepare invitations to seminars and workshops, reports and brochures. The communicators also participate in other information-dissemination activities and exhibitions about *Future Agriculture*, taking the initiative to arrange various forms of activities and produce printed material. The administrator is in charge of booking and practical matters at seminars and workshops as well as the e-mail list.

11 Budget

The platform has a total budget of 17.9 MSEK for the 4-year period (2009-2012), including contributions in kind for the members of the steering committee (Table 1). The Faculty of Natural Resources and Agricultural Sciences have granted the platform 12.9 MSEK. The Vice-Chancellor will contribute 3 MSEK for the period 2010-2012. The Faculty of Veterinary Medicine and Animal Science will contribute 0.8 MSEK and the Faculty of Landscape Planning, Horticulture and Agricultural Sciences will provide 0.6 MSEK. 0.5 MSEK has been granted from the Swedish Farmers' Foundation for Agricultural Research (SLF) for the project Sustainable Agricultural Systems in a Changing Climate. The Sustainable Agriculture and Forestry for Development (Agri4D) and Agricultural Sciences for Global Development initiatives at SLU have supported the work on scenarios and research issues relating to sub-Saharan Africa by providing contributions of 0.01 and 0.05 MSEK respectively.

The costs for the period 2009-2011 are presented in Table 2. The first half of the year 2009 was a planning phase and activities involving seminars and scenario development started in autumn 2009. As a result, some of the money that had been budgeted for 2009 was moved forward. The number of activities undertaken increased in the following years and 9.4 MSEK of the total budget had been spent by the end of 2011.

The steering committee members spend between 10 and 35 % of their working hours within the program, with the directors contributing the greatest proportion. The cost for the steering com-

Funders	**2009–2011**	**2012[a]**
Faculty of Natural Resources and Agricultural Sciences	9000	3000
Vice-Chancellor support to Future platforms	2000	1000
Faculty of Veterinary Medicine and Animal Science	100	
Agricultural Sciences for Global Development (SLU)	50	
Agri4D (for development of scenarios and research issues for sub-Saharan Africa)	10	
Project Sustainable agricultural systems in a changing climate (financed by SLF)		500
Total (excluding contributions in kind)	**11160**	**4500**
Faculty of Natural Resources and Agricultural Sciences (in kind)[b]	612	312
Faculty of Veterinary Medicine and Animal Science[c]	492	246
Landscape Planning, Horticulture and Agricultural Sciences (in kind)[d]	405	209
Total (including indirect salary payments and contributions in kind)	**12669**	**5267**

a Estimate for 2012.
b 10 % of the work by I Öborn and J Bengtsson are in-kind contributions.
c Salaries are paid directly to L. Rydhmer and U. Magnusson.
d 10 % of the work by ES Jensen is in-kind contribution.

Table 1. Funding for Future Agriculture, 2009–2012 (TSEK).

mittee is therefore relatively high. However, the members have spent about half of their time with the platform on developing scenarios and research programmes during 2010 and, initiating and working in the thematic working groups during 2011. Thus, relatively little of their work is directly related to the duties of the steering committee.

The cost of running the office includes salaries for the scientific officer (100 %) and communicators (25 %). It has been very beneficial to have a full time scientific officer and communicators working in the platform.

Much of the expenditure on the development of scenarios and the research programme was due to the consultancy fees charged by FOI, who facilitated the workshops. However, their work was very valuable for the process. The development of the scenarios and the research program are closely related and the costs are therefore not easy to separate.

During 2012 the funds will be invested in ongoing and newly initiated thematic working groups, other analyses and syntheses activities and the Young Researchers' Forum. The work to initiate and develop research proposals will be strengthening just as the communication and outreach activities.

Activity	**2009–2011**
Steering committee (salaries)	2108
Office (including scientific officer's, communicators' , administrator's salaries, costs for office, steering committee, advisory board)	3182
Two post-doctoral positions	2475
Development of global and European scenarios	364
Development of research program	206
Development of scenarios and research issues for sub-Saharan Africa	222
Six thematic working groups	319
Communication (salaries not included here)	189
Seminars and workshops (including films)	153
Travel (travel costs for all activities are included)	151
Total	**9369**

Table 2. Costs for Future Agriculture 2009–2011 (TSEK).

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Appendices

Appendices A

Appendix A1. Steering committee and office of Future Agriculture

Steering committee

Prof. Ingrid Öborn, Program director
Department of Crop Production Ecology, SLU

Prof. Lotta Rydhmer, Deputy program director
Department of Animal Breeding and Genetics, SLU

Prof. Jan Bengtsson
Department of Ecology, SLU

Prof. Erik Steen Jensen
Department of Agrosystems, SLU

Prof. Ulf Magnusson (Deputy program director 2010–2011)
Department of Clinical Sciences, SLU

Assoc. prof. Katarina Vrede, Scientific officer
Department of Crop Production Ecology, SLU

Dr. Cecilia Waldenström
Department of Urban and Rural Development, SLU

Office

Katarina Vrede, Scientific officer
Pelle Fredriksson, Communicator
Karin Ullvén, Communicator
Kristin Thored, Administrator

Appendix A2. Advisory board of Future Agriculture

Christel Benfalk
The Swedish Dairy Association

Jan Byman
The Swedish Civil Contingencies Agency

Åsa Domeij
Svensk Dagligvaruhandel (association for retailers)

Maggie Javelius
The Swedish Environmental Protection Agency

Bengt Persson
The Federation of Swedish Farmers

Gun Rudquist
The Swedish Society for Nature Conservation

Harald Svensson
The Swedish Board of Agriculture

Louise Ungerth
Stockholm Consumer Cooperative Society

Appendix A3. Warsaw Consensus Statement

Warsaw Consensus Statement on Europe as a key player in Global Food Security: 6th Oct 2011

A group of leading academics, covering agriculture, economics, sociology, environment, ecology, conservation, water and food consumption, from across Europe, met in the Polish Academy of Sciences on October 5th-6th 2011, to discuss the role of Europe in meeting the demands of sustainable global food security looking ahead to 2050. These are our conclusions:

Times of global change

We are in a period of rapid global change, encompassing climate, land use and population growth. Food security (obtaining enough calories) and nutrition security (obtaining a nutritionally balanced diet) are important global challenges as the demand for food has potential to outstrip the supply. This imbalance will be reflected in rising prices and more volatility in the markets. As the right to food is a central human right, as defined by the UN, food and nutrition needs to be central to societal and policy aims.

The EU in global context

The EU is one of the largest global importers and exporters of food, and therefore has considerable leverage in, and responsibility for, the global food and nutrition agenda. European food security is intrinsically linked to global food security. As such, the EU needs to break away from an inward-looking focus. While global food security will be most positively impacted by increasing production in developing countries, the EU must play its part in producing food for its citizens and people elsewhere.

Whilst changing human consumption pattems may change the demand for food, any growth in production should be undertaken in a sustainable way with full understanding and minimisation of environmental impacts both within Europe and on the rest of the world.

Sustainable intensification

In order to ensure food and nutrition security into the future, in the face of increasing competition for land, water and other resources, agriculture needs to protect the environment for future generations, produce a growing supply of food and also be socially sustainable. Sustainability must encompass assessing all the costs and benefits of agriculture, locally, regionally and globally, and in both the short and long-term future. Given the limited potential for expanding agriculture into new land, any increase in demand for food requires increasing average yields from existing land, but this must be undertaken sustainably.

"Sustainable intensification" is therefore about increasing the efficiency of production (producing more with less resources), whilst minimising and mitigating environmental impacts, near and far. Consequently there is an urgent need to develop ways of measuring the extent to which growing productivity is environmentally sustainable.

While biotechnology may play a role in global food security it is unlikely to be the main solution. Innovations and institutions concerning management of farming systems and agricultural landscapes in an environmentally sensitive way may well provide greater scope in addressing this issue globally.

Cross-sectoral institutions and policies

We recognise an urgent need to institutionalise sustainable intensification into the agricultural debate. Food production and consumption is a complex system that crosses many disciplinary boundaries. We therefore need to develop a cross-sectoral and interdisciplinary approach to research, public debate and policy formulation. For example, common frameworks that jointly consider nutrition and health, environment and agriculture are desirable.

The EU also needs to promote, within trade negotiations, environmental issues and the multiple roles of agriculture in society. Furthermore, education and research is required: linking food, nutrition, agriculture and the global food system; additionally governments need to invest in extension services to help farmers implement sustainable intensification.

Developing a trans-sectoral institutional framework necessitates consultation with, and the participation of, a very large number of stakeholders and organisations across global society. We also need to encourage consideration of human values and the widespread effects of our behaviour on the earth system.

From local to global

Global change arises from the sum of individual choices played out on local, regional and global scales. Therefore, as local actions can have distant impacts, a multiscale approach is needed such that local interests do not conflict with those at larger scales (regional, global). For example, under-production of food in one area inevitably means that other areas have to compensate in their food production, and these distant effects need consideration. Within the EU we need to encourage and assist local decision making according to a set of principles set at a larger scale in the governance hierarchy, such that there is subsidiarity but with reference to sustainability and equity across scales.

Coping with future uncertainty

The future is more uncertain than it has ever been, but we know that natural resources are increasingly constrained globally. The EU should maintain its productive agricultural land in order to meet future food demands, whether for the EU or the rest of the world.

Despite the uncertainty in the future, it is clear there are many "win-win" actions that are likely to make a positive difference whatever the future trajectory. These include taking a landscape view to manage agricultural systems (for example, to develop instruments to promote ecosystem service provision in agricultural landscapes), reducing food waste at all points in the supply chain, encouraging a diversity of agricultural products within regions, and encouraging a nutritionally balanced diet rather than one that only considers calorie sufficiency (for example, this may encourage demand for fruit and vegetables, locally and sustainably produced). On the other hand, one certain "lose-lose" solution would be agricultural intensification without being driven to be sustainable.

Only by having environmental sustainability at its heart will growth in food yields meet our future global responsibilities and needs.

Signed

Prof Timothy Benton
University of Leeds, UK

Prof. Jerzy Wilkin
University of Warsaw, PL

Prof Jan Bengtsson
Swedish University of Agricultural Sciences, SE

Prof. Josef Settele
Helmholtz Centre for Environmental Research - UFZ, DE

Dr John Kearney
Dublin Institute of Technology, IE

Dr Juan Antonio
Rodriguez Diaz
University of Cordoba, ES

Dr Tibor Hartel
Mihai Eminescu Trust, RO

Dr Iwona Nurzynska, Polish Academy of Sciences, PL

Appendix A4. Task for thematic working groups

This document, written in November 2010, describes the task for the thematic working groups that are initiated in order to address the six challenges identified in the *Future Agriculture* rederach program (Bengtsson *et al.,* 2010).

Our expectations of the working groups

Objectives:

- To prepare a synthesis article, or the equivalent, about new perspectives and important research questions within the respective area.
- Contribute supporting data and participate in drafting up a research application on behalf of *Future Agriculture*.
- Provide opportunities for multidisciplinary scientific contacts.

For each challenge, a smaller planning group is to be created and tasked with organising a workshop to develop important research questions and ways of addressing the challenge, the starting point being the research program *Future Agriculture – Livestock, Crops and Land Use*. An invitation to participate is to be sent to all those who have expressed an interest in Future Agriculture. Personal invitations to other key figures at the Swedish University of Agricultural Sciences (SLU) are also appropriate to ensure their participation. An external inspirer may also be invited. After the workshops, working groups are to be established to continue the work.

The working groups' tasks:

1. To choose a convenor for the group.
2. To establish a plan for the work (including a time schedule and budgetary requirements) to be approved by the steering committee.
3. To synthesize current knowledge, starting from the identified research questions, in order to identify gaps, i.e. define what is and what is not known but needs to be known, and important multidisciplinary areas of research related to the challenge. Ideally, this should be done by writing a review or synthesis article for a relevant scientific journal, which ought to be submitted to the journal by August 2011.
4. To create networks of researchers and representatives of other groups interested in the research questions the participants consider are important to address. These networks can also be utilized when making own research applications.
5. In response to appropriate calls for tender made during 2011 – 2012, contribute supporting data and participate in composing large-scale research applications within the SLU *Future Agriculture*.

Funding is available for working in the groups.

The challenges:
- Reduction of the environmental impact of agriculture and mitigation of climate change
- Responses to societal values and contribution to policies
- Adaptation of agriculture to a changing climate
- Management of present and potential risks
- Agriculture and rural development
- Resolution of conflicting goals of agriculture and land use

(For more information see the research program at www.slu.se/framtidenslantbruk)

Appendix A5. Thematic working groups

Thematic working groups have been formed to address the six challenges described in the *Future Agriculture* research program. The work of the six thematic groups that consists of SLU researchers from different disciplines is described below. In addition, a project on *Sustainable Production Systems in a Changing Climate* and one on *Resilience as a Tool for Natural Resource Management* are presented.

Restricting reactive nitrogen losses from agriculture

Subject

This work focuses on aspects of the challenge *Reduction of the Environmental Impact of Agriculture and Mitigation of Climate Change*, more specifically on ways to reduce reactive nitrogen (N_r) losses in food production, which in itself is a broad subject. The focus is on methods to minimize losses of N_r e.g. by increasing N-use efficiency or reducing inputs in food production, and the scope has been limited by not considering transport. The work takes a starting point in relevant 'key actions' to improve management of the nitrogen cascade in food production which can provide the additional benefits of climate change mitigation and better management of phosphorous and other nutrients proposed by the European Nitrogen Assessment (ENA 2011; Sutton *et al.*, 2011). These 'key actions' are improving: 1) N-use efficiency in crop production, 2) N-use efficiency in animal production and 3) N-losses related to food consumption and food waste, including recycling from waste and wastewater systems. Critical issues and challenges for each of these actions are considered, and then ways to identify optimal measures and policies for curbing N_r emissions from food production are discussed.

Process

The topic for the working group defined in the *Future Agriculture* research program was very broad and encompassed a number of environmental problems caused by agriculture. To identify an area that could be productively addressed in a research program and/or review paper, a workshop was convened in January 2011. More than 40 researchers with expertise in a wide range of disciplines discussed environmental challenges for future food and feed production. The themes were: 1) Mitigation measures in the Swedish food chain required to reach official climate goals by 2050, 2) Minimizing nitrogen losses in crop production, 3) Improving the efficiency of bioenergy production and other ecosystem services in agriculture, 4) Management of functional biodiversity in agricultural production to reduce inputs and emissions of greenhouse gases while increasing resource use efficiency, 5) Integrated ecosystem services between urban and rural areas, and 6) Minimizing losses connected to the flows of nitrogen, phosphorous and carbon in the feed cycle.

Most of the challenges were in some way related to nitrogen, and the core group at the time decided to focus on mitigation of nitrogen losses, because nitrogen is the most important nutrient in crop production and its losses are among the most crucial environmental problems affecting all biomes and causing climate change. Researchers who had been identified at the workshop were invited to continue the process and to identify key questions/aspects with promising potential for detailed consideration in a review or opinion paper. Several others who had not participated in the workshop, but had complementary expertise and interest in the topic, were also invited to help continue the work. The group grew 'organically' in the spring and fall of 2011, and today it comprises a multidisciplinary group of seven researchers. The group had several meetings to define the subject for an opinion paper. This in itself was a process. By the end of 2011 a draft outline was agreed, based on contributions written by each group member on his/her own, and together with the entire group at a workshop in the fall of 2011.

Results

The group has decided to write an opinion paper rather than a review of the subject. An outline of the article with the tentative title Restrictin-

reactive nitrogen (N_r) losses from agriculture was agreed in November 2011.

Group members

Sara Hallin, Dept. of Microbiology (group leader)
Göran Bergkvist, Dept. of Crop Production Ecology
Ing-Marie Gren, Dept. of Economics
Erik Steen Jensen, Dept. of Agrosystems
Håkan Jönsson, Dept. of Energy & Technology
Ingrid Strid, Dept. of Energy & Technology
Maria Wivstad, EPOK - Centre for Organic Food and Farming

References

European Nitrogen Assessment. 2011. Eds. Sutton et al. Cambridge University Press, Cambridge, UK.

Sutton, M.A., Oenema, O., Erisman, J.W., Leip, A., van Grinsven, H. & Winiwarter, W. 2011. Too much of a good thing. Nature 472:159-161.

Adaptation of agriculture to climate change – Challenges and possibilities from a Nordic perspective

Subject

This work is addressing aspects of the challenge *Adaptation of Agriculture to a Changing Climate*. More specifically, a working group of 17 researchers from different disciplines is considering challenges and possibilities for adapting agricultural systems, including crop and livestock production, to climate change in northern latitudes (especially the Nordic countries), from a farmers' perspective. The group have identified areas in need of further studies, including monitoring changes in pest and disease occurrence in crops and animals, climate-ecosystem-wildlife-domestic animal-human interactions, and impacts of climate variability and extreme weather events such as heat waves, drought and flooding. The adaptive potential of agricultural systems is also linked to understanding of the timescales of responses to processes in the systems to changes, e.g. pathogen generation times, plant and animal breeding cycle times, and the time perspective of some soil formation processes (e.g. weathering). Some critical responses may be too slow to prevent negative impact, for instance. The ability to manage high-yielding agricultural production in a complex and unpredictable environment requires both planned adaptation and risk management through the development of robust and flexible systems that can make farming less vulnerable to climate change. Decisions regarding measures to balance short-term economic interests with long-term ecological vulnerability have to be taken at both individual farm levels and broader societal and political levels. The group argues that as the annual variations in weather exceed projected climate changes in the Nordic area, many components and practices of the robust, flexible systems required can be found in farmers' practices today. However, in order to develop climate adaptive productions systems there is an urgent need to integrate knowledge within and between research areas as well as with farmers' practical experiences on how to handle variable weather conditions.

Process

A planning group of four people was appointed in late 2010, tasked with organising an open workshop as the starting point for the development of the *Adaptation to Climate Change* theme. Thirty researchers participated in the workshop, which was held on January 24, 2011. During the workshop, three practitioners were invited to give introductory talks about how farmers do and may adapt to climate change today and tomorrow, using examples from their own experiences. The invited speakers were Kjell Sjelin, Elisabeth Gauffin and Ingmar Gruveus. Their presentations were followed by group discussions to identify challenges and important areas for adaptation, and a final plenary session. The group and plenary discussions were documented and used as a basis for the following work, in which all workshop participants were invited to take part. A working group with about 10 people was formed directly after the workshop and a coordinator was recruited. Since then, there have been a number of meetings of the entire group and between the meetings various sub-groups have been assigned issues to address. During the year further researchers

joined the team as new aspects of the theme, and a need to address them in the manuscript, were identified. The work focused on the development of some diagrams forming the back-bone of a manuscript, which was drafted in February 2012. In the final paper not only challenges but also opportunities related to climate change adaptation are highlighted.

Results

The main activities to date have been discussions about the topic, possible effects of climate change on agricultural production and adaptation measures, among researchers with expertise in relevant disciplines. The ongoing work was presented to, and discussed with, other researchers during the *Challenge workshop* (June 13, 2011) and to stakeholders and researchers at the *Future Agriculture Day* (October 27, 2011). A poster has also been produced.

The working group is also serving as a meeting place for sharing networks and ideas that can lead to joint applications, e.g. within the frame of an anticipated ERA-Net plus program related to the theme Climate Change Adaptation in agriculture. The team has contributed to the Swedish input to the FACCE-JPI Mapping meeting in Madrid (February, 2012) on Climate Change Adaptation, where a group member also participated as the scientific representative from Sweden.

Articles

Lehrman A, Ahnström J, Albihn A, Andersson L, Beckman M, Djurle A, Eckersten H, Fikse F, Gyllenstrand N, Herrmann AM, Jonsson A, Lewan E, Marquardt K, Milestad R, Nilsson C, Rydhmer L, Westbergh A, Yuen J, Öborn I. Adaptation of agriculture to climate change – challenges and possible solutions: A Nordic perspective. (To be submitted)

Group members

The researchers listed below have been involved in the discussions and are co-authors of the manuscript.

Ingrid Öborn, Dept. of Crop Production Ecology (group leader)
Anna Lehrman, Dept. of Crop Production Ecology (coordinator)
Johan Ahnström, Dept. of Ecology
Ann Albihn, National Veterinary Institute
Lars Andersson, Dept. of Crop Production Ecology
Malin Beckman, Dept. of Urban & Rural Development
Annika Djurle, Dept. of Forest Mycology & Plant Pathology
Henrik Eckersten, Dept. of Crop Production Ecology
Freddy Fikse, Dept. of Animal Breeding & Genetics
Niclas Gyllenstrand, Dept. of Plant Biology & Forest Genetics
Anke Herrmann, Dept. of Chemistry
Anders Jonsson, Dept. of Soil & Environment
Lisbet Lewan, Dept. of Soil & Environment
Kristina Marquardt, Dept. of Urban & Rural Development
Rebecka Milestad, Dept. of Urban & Rural Development
Christer Nilsson, Dept. of Rural Building & Animal Husbandry
Lotta Rydhmer, Dept. of Animal Breeding & Genetics
Anna Westerbergh, Dept. of Plant Biology & Forest Genetics
Jonathan Yuen, Dept. of Forest Mycology & Plant Pathology

Risk management of threats to future agricultural production

Subject

This work considered aspects of the challenge *Management Present and Potential Risks*. The initial idea was to be very comprehensive and cover most of the obvious threats to future agriculture. However, the task force (see below) judged some of these threats, for instance some related to economic development and governance, to be too complex to assess in the chosen time perspective, i.e. to 2050. Instead, threats within the clusters environmental degradation, climate change, and animal and plant diseases, were analysed in three

types of countries: a low-income country with a tropical climate; a medium-income country with an emerging economy and tropical climate; and a high-income country with a temperate climate. The analyses addressed the risks *per se*, risk perceptions and the capability of risk management, and the rationale for considering the threats in the selected types of countries is that they may vary substantially, in both nature and degree, among different types of countries.

Process

Initially, the *Future Agriculture* steering committee assigned four people, including a member of the steering committee, to a task force. This group arranged an open starting seminar about risks and invited everyone on the *Future Agriculture* e-mail list to attend. Mr. Carl Hedin from the Swedish Crime Authority, and previously the armed forces, gave a talk entitled 'The Swedish armed forces' common model for risk management' at the seminar. Following the meeting a writing group was formed of about 10 researchers, who had two subsequent meetings to agree upon the layout of a review article. Some authors dropped out and some were recruited to cover critical areas. The task force has led and commented on the writing, and one of its members has been assigned to edit it, assume the main responsibility for it, and paid a one-month salary. For some threats it was difficult to engage colleagues with the desired expertise to work in this format.

Results

In addition to a scienticic paper, good cross-disciplinary contacts between researchers at SLU and the National Veterinary Institute on topics related to risks and agriculture have been established. As a spin-off, a paper with four authors has been accepted by EMBO Reports (Fagerström *et al*. 2012).

Articles

Fagerström T, Dixelius C, Magnusson U and Sundström JF, 2012. Risk Research on GM crops is a Dead Parrot. EMBO Reports (Accepted for publication).

Sundström J, Albihn A, Boqvist S, Eckersten H, Ljungvall K, Marstorp H, Martiin C, Nyberg K, Vågsholm I, Yuen J, Magnusson U. Threats to future agricultural food production from environmental degradation, climate change, and animal and plant diseases – a risk analysis in three economic settings. (To be submitted).

Group members

Ulf Magnusson, Dept. of Clinical Sciences (group leader)
Jens Sundström, Dept. of Plant Biology & Forest Genetics (secretary/writer)
Ann Albihn, National Veterinary Institute
Sofia Boqvist, Dept. of Biomedicine Sciences & Veterinary Public Health
Henrik Eckersten, Dept. of Crop Production Ecology
Kalle Ljungvall, Dept. of Clinical Sciences
Håkan Marstorp, Dept. of Soil & Environment
Carin Martiin, Dept. of Economics
Karin Nyberg, National Veterinary Institute
Ivar Vågsholm, Dept. of Biomedicine Sciences & Veterinary Public Health
Jonathan Yuen, Dept. of Forest Mycology & Plant Pathology

Ethics of different food production systems and relations between technologies and values

Subject

This work focused on the aspects stated in the above heading of the challenge *Responses to Societal Values and Contribution to Policies*, particularly on how values of different stakeholders can influence the technological development of production systems, and hence ways in which agriculture can meet its main goals of providing the world with food and services sustainably. In these analyses the following food production cases are being compared:

- Extensive beef production with high climate impact versus intensive chicken meat production with low climate impact;
- Intensive high-technology tomato production versus extensive, small-scale organic production;
- Biological versus chemical pest control in crop production.

Stakeholders' opinions about these different cases are being studied, using the ethical matrix developed by Mepham *et al.* (2006). In each case two different technologies or technological paradigms for achieving similar goals are being analyzed, facilitating identification of areas of agreement between individuals who might differ in their overall judgments, and clarification of the basis of disagreements. The group are also making explicit the reasoning that underpins ethical decisions taken by different stakeholders.

Process

The work started with a few meetings of a small group, in which it was concluded that sustainable development of the agricultural sector requires research that helps us to understand different sets of values, their origin, justification and implications. In January 2011 an open workshop was organised, at which different research areas related to societal values and policies were proposed and research questions that need to be answered in order to overcome future challenges in agricultural production were identified. Approximately 20 people participated in the workshop, from 10 departments. The workshop started with a short lecture by Gunnela Ståhle (representing the Swedish organisations Svenskt Sigill and We Consumers and the international organisation Eurogroup for Animals) entitled 'Agriculture policies – built on science or on scandals?' Notes from the workshop were sent to all participants and some other people who had shown interest in the work, together with an invitation to join the further work.

A group of approximately 10 researchers showed interest in writing a scientific article on the theme. The kind of article that would be most suitable to write and the methodology to apply was identified in several further meetings. It will focus on ethical values that different stakeholders hold, in relation to different systems based on varying degrees of advanced technology. After a few months the group was reduced to five people who continued to work on the article. The group has video meetings approximately once a month to discuss the content and methods, and to improve drafts of the text.

Three workshops will be organised in April 2012, one for each case described above. Different kinds of stakeholders, e.g. consumers, producers, retailers and representatives of non-governmental organisations, will be invited to attend each workshop. The ethical matrix by Mepham *et al.* (2006) will be used during the workshops, and the conclusions from the discussions will be included in the scientific article.

Results

The main result will be a scientific article. In addition, the work has been presented at a conference.

Articles

Sandin, P. *et al.* Ethics of different food production systems and relations between technologies and values (In preparation).

Conference publications and abstracts

Sandin P, Bergeå H, Blokhuis H, Ekelund L, Hansen K, Hansson H, Nordström Källström H, Rydhmer L, Röös E, Sundh I, Ulén B. 2011. Attitudes to food production systems and food products. 24th NJF Congress. 2nd Nordic Feed Science Conference. Food, Feed, Fuel and Fun. Nordic Light on Future Land Use and Rural Development, Uppsala, Sweden, 14-16 June, 2011 (Invited oral "reflection" and poster).

Group members

Per Sandin, Faculty of Natural Resources & Agricultural Sciences (group leader)
Lena Ekelund, Dept. of Work Science, Business Economics & Environmental Psychology
Lotta Rydhmer, Dept. of Animal Breeding & Genetics
Elin Röös, Dept. of Energy & Technology
Ingvar Sundh, Dept. of Microbiology

References

Mepham, B. *et al.* 2006. Ethical Matrix: Manual. The Hague, Netherlands. [On line]. Available from: http://www.ethicaltools.info/content/ET2%20Manual%20EM%20(Binnenwerk%2045p).pdf)

Bioenergy from farmland: potential contribution and institutional barriers for rural development

Subject

This work has focused on aspects of the challenge *Agriculture and Rural Development*. Instead of aiming to prepare a synthesis or overview article, the group decided to choose a theme that could encompass elements of all of the key issues related to the challenge. The identified theme was farm-based bioenergy, since it encompasses energy and climate concerns, and issues related to the environment and landscapes, farm entrepreneurship and rural development that could be approached in a coherent and concrete way. Major issues explored include the technological choices available to farmer-entrepreneurs contemplating bioenergy production, their effects on the environment and possible greenhouse gas mitigation, political support at EU level for their implementation, and the potential for farm-based bioenergy to promote local rural development. Institutional barriers which may explain the low implementation (as yet) in Sweden, and the roles adopted by farmers are focal points of the analysis.

Process

The process began with a small group of four people planning a workshop, which was held on 20 January, 2011. The workshop attracted about 25 people. It began with a presentation about future studies by Prof. Erik Westholm (SLU), which was followed by a discussion on:

a) Trends and important preconditions in agriculture and rural development;
b) Research questions at the intersection of agriculture and rural development.

The working group, established after the meeting, chose the theme farm-based bioenergy. The group consisted of six researchers with complementary scientific backgrounds and interests in the chosen theme. Each of these researchers produced a short text on farm-based bioenergy, from their respective disciplinary backgrounds, which collectively formed the backbone for discussions in subsequent meetings and later joint writing. It was decided from an early stage to submit abstracts to the NJF conference in June 2011 and to the conference of the European Society for Rural Sociology (ESRS) in August 2011. These deadlines and fora have set the schedule, and provided feedback that has informed the work. A poster was presented at the NJF conference and a paper at the ESRS conference. The paper is being refined and reformatted as an article to be submitted to Sociologia Ruralis. It focuses on farm-based bioenergy and compares EU rural development policy (which includes environmental, rural development and farm business objectives) and the development of farm-based bioenergy in Sweden. Institutional barriers for such development are emphasized.

The group has also written two joint research applications (see Results), built on collaboration with the Swedish Rural Economy and Agricultural Society.

Results

A poster was presented at the 24th NJF Congress, 2nd Nordic Feed Science Conference. Food, Feed, Fuel and Fun. Nordic Light on Future Land Use and Rural Development, Uppsala, Sweden, 14-16 June, 2011, and a paper was presented at the XXIV European Society for Rural Sociology Congress, Chania, Greece, 22-25 August, 2011. An application was submitted to the Swedish Energy Agency in June 2011 on the theme 'Energy grass – from technical solutions to sustainable business', however it was not funded. Another application, with the title 'Collaboration for Improved Profitability and Environmental Value in Farm-based Biogas Production' has recently been funded by the Swedish Farmers' Foundation for Agricultural Research (SLF). The aim of this project to explore different kinds of farm based collaborations in biogas production. An interactive research design, including a reference group with stakeholders as well as farmers, will be included in this study.

Articles

Waldenström C, Ferguson R, Sundberg C, Tidåker P, Westholm E, Åkerskog A. 2012. Bioenergy from farmland: potential contribution and in-

stitutional barriers for rural development (To be submitted to Sociologia Ruralis).

Conference publications and abstracts

Ferguson R., Sundberg C, Tidåker P, Waldenström C, Westholm E, Åkerskog A. 2011. Institutional barriers for rural development; the example of agriculturally-based bioenergy. 24th NJF Congress. 2nd Nordic Feed Science Conference. Food, Feed, Fuel and Fun. Nordic Light on Future Land Use and Rural Development, Uppsala, Sweden, 14-16 June, 2011. p. 249. (poster).

Waldenström C, Ferguson R, Sundberg C, Tidåker P, Westholm E, Åkerskog A. 2011. Institutional barriers for rural development; the example of bioenergy from farmland. The XXIV European Society for Rural Sociology Congress, Chania, Greece, 22-25 August 2011. (oral).

Group members

Cecilia Waldenström, Dept. of Urban & Rural Development (group leader)
Richard Ferguson, Dept. of Economics
Cecilia Sundberg, Dept. of Energy & Technology
Pernilla Tidåker, Dept. of Crop Production Ecology
Erik Westholm, Dept. of Urban & Rural Development
Ann Åkerskog, Dept. of Urban & Rural Development

Resolution of conflicting goals of agriculture and land use

The UN predicts that there will be at least two billion more people on earth by 2050, while the land area that can be used for food production is predicted to remain approximately the same. At the same time, competition for land for other purposes (for example, bioenergy, recreation and urbanization) will increase, hence natural resources are predicted to be scarcer than now. This poses major questions about how society can prepare to decrease, avoid or manage conflicts concerning land and water use, and learn to use the available land area more flexibly.

Subject

This work is addressing aspects of the challenge *Resolution of Conflicting Goals of Agriculture and Land Use*, with the aims to analyse and exemplify problems regarding various types of land use conflicts. More specifically, problems relating to prioritization, disagreements and conflicts of interest, interest groups and organisations, and actors with power to influence decisions, are being defined, explored and analysed in three case studies. For these purposes, it is important to clarify the concepts of land use conflicts and solutions to such conflicts.

The cases will be used to discuss possible solutions to local land use conflicts, how these may relate to sustainable global and national food production and food security, and how potential solutions depend on ways in which actors in society define the sources and nature of conflicts. The cases are situated in: southern Sweden, where there are possible conflicts of interest regarding urban development, recreation and food production; southwest Sweden, where agricultural production and biodiversity conservation can be antagonistic or synergistic; and northern Sweden, where reindeer herding has historically been in conflict with forestry and other land use sectors. A fundamental question that the cases will illustrate and help scrutiny is whether there is a need for a long-term food production goal for Sweden that could be used to ensure that enough land for agriculture is available, if anything should happen in the future that makes a higher degree of self-sufficiency of food production desirable.

Process

The work was initiated with an open workshop that attracted approximately 20 participants in early 2011. After this a smaller group of people interested in investing time in the work crystallised. In several subsequent meetings the concept of conflict was discussed and clarified, and the cases were laid out. The focus of work since then has been on drafting a paper addressing the focal concerns.

Results

The main result will be an article with the preliminary title 'Identifying Conflicts in Land Use and Food Production: Three Cases Studies from Sweden'.

Group members

Jan Bengtsson, Dept. of Ecology (group leader)
Cristián Alarcón Ferrari, Dept. of Urban & Rural Development
Lars Hallgren, Dept. of Urban & Rural Development
Mattias Qviström, Dept. of Landscape Architecture
Elin Röös, Dept. of Energy & Technology
Anna Skarin, Dept. of Animal Nutrition & Management,
Anders Wästfelt, Dept. of Economics

Sustainable production systems in a changing climate

This project is funded by the Swedish Farmers' Foundation for Agricultural Research (SLF).
It will explore the extent to which integrated systems of crop and livestock production can: more readily adapt to a more variable climate than non-integrated systems; improve the utilization of resources with regard to future access to energy, plant nutrients and other purchased inputs; and enhance rural development and the economic and social viability of agricultural practices. The analysis of integrated crop and livestock production systems will consider both farm level and landscape scale practices, and include collaboration between rural and agricultural enterprises with various kinds of specialization.

The project is run as a series of workshops, with participants working between meetings. The participants are a multidisciplinary group of around 10 younger and more senior researchers. The aims of the first workshop, held in February 2012, were: to formulate criteria for evaluating different production systems in relation to environmental impact, efficiency, food security, rural development, and other societal goals; and to discuss how multiple goals that are not directly comparable can be handled in an evaluation process. In the second workshop, the goal is to formulate integrated crop and livestock production systems at different scales that could be evaluated with respect to multiple criteria, and compared with current specialized systems. After a stakeholder meeting and work in smaller groups, the final workshop will outline and test a multi-criteria analysis of different production systems with varying degrees of integration. Knowledge gaps and research needs will be identified. The planned outcome is a report to SLF and a scientific article.

Members of the project

Pernilla Tidåker, Dept. of Crop Production Ecology, SLU (steering group member)
Cecilia Waldenström, Dept. of Urban & Rural Development, SLU (steering group member)
Jan Bengtsson, Dept. of Ecology, SLU (steering group member)
Johanna Björklund, Örebro University
Georg Carlsson, Dept. of Agrosystems, SLU
Richard Ferguson, Dept. of Economics, SLU
Cecilia Kronqvist, Dept. of Animal Nutrition & Management, SLU
Rebecka Milestad, Dept. of Urban & Rural Development, SLU
Anna Näsholm, Dept. of Animal Breeding & Genetics, SLU
Eva Spörndly, Dept. of Animal Nutrition & Management, SLU
Christine Watson, Scottish Agricultural College, UK

Resilience as a tool for natural resource management

Together with the Future Forest program, *Future Agriculture* is participating in a thematic working group called *Reaching Sustainable Natural Resource Management – Is Resilience Science a Valuable Tool?* This working group will address current knowledge gaps with regard to the practical utility of resilience concepts by applying them in a cross-comparison of multiple production systems; namely forestry, agriculture and fisheries. It started, in December 2011, by reviewing existing use of resilience concepts and assessment methods.

It will continue by examining case studies, and finally generate recommendations regarding the utility of resilience science with respect to the goal of achieving sustainable forestry, agriculture and marine fisheries management.

Project leaders are Lucy Rist (Future Forest), Jon Moen (Future Forest) and Jan Bengtsson (*Future Agriculture*). The group members are from SLU, Umeå University and the Stockholm Resilience Centre, Stockholm University. The participants from *Future Agriculture* are Jan Bengtsson, Dept. of Ecology, Pernilla Tidåker, Dept. of Crop Production Ecology and Rebecka Milestad, Dept. of Urban and Rural Development.

Appendix A6. Advertisements for the two post-doctoral positions

Analysis of future multifunctional agricultural systems

Swedish agriculture is facing major challenges and changes. Conditions for livestock farming and crop production for food, other bioresources and utilities in Sweden are increasingly affected by global events and climate change. To meet these challenges scientifically-based knowledge is required. The Swedish University of Agricultural Sciences (SLU) is now developing a strategic research effort *Future Agriculture – Livestock, Crops and Land Use* and as part of this we are looking for a postdoctoral researcher.

Duties: Synthesis of existing knowledge about and methodology for research into multifunctional agricultural systems that integrate crops, livestock and ecosystem services. Duties mainly consist of using literature syntheses to develop tools and criteria for analysing integrated and multifunctional agricultural systems from the perspective of sustainability and resilience. The work is connected to different scenarios for agriculture and land use that are being developed within the research initiative *Future Agriculture*. The work will be done in close collaboration with colleagues within the project.

Qualifications: A Ph.D. in biology, an agricultural science, economics or a social science. Experience of inter- or multidisciplinary work or synthesis work is a requisite. For applicants who have a background in natural science, knowledge of a social science or economics is advantageous; for social scientists or economists additional qualifications in natural science subjects are an advantage. You should be able to cooperate easily with other researchers, and be used to expressing yourself in speech and writing in both a Scandinavian language and English.

The successful applicant will work at 'the Ecology Cluster' on the SLU campus, Uppsala (Department of Ecology or Department of Crop Production Ecology according to agreement with the applicant).

The position is full time and guaranteed for a period of two years, starting as soon as possible. The successful applicant can be appointed to a post-doctoral position if he/she received a Ph.D. within three years prior to the application.

The transport sector's importance for future agriculture and rural areas

Swedish agriculture is facing great challenges and changes. Conditions for livestock farming and crop production for food, other bioresources and utilities in Sweden are increasingly affected by global events and climate change. To meet these challenges scientifically-based knowledge is required. The Swedish University of Agricultural Sciences (SLU) is now developing a strategic research effort *Future Agriculture – Livestock, Crops and Land Use* and as part of this we are looking for a post-doctoral researcher.

Future agricultural and rural development is closely connected to the development of future transport systems. Today's environmental problems, not least carbon dioxide emissions, have led to a global debate, which in turn may lead to radical changes in the entire transport sector in the future. Throughout history radical changes have occurred in the design of various transport systems. A study of the dramatic changes in transport systems throughout history can provide a background to several of the changes that modern society is facing. The transport sector's importance for future agriculture and rural areas may also be effectively analysed by modelling, especially as this allows the results to be transferred to the future in a transparent way.

The Swedish University of Agricultural Sciences (SLU) is looking for a post-doctoral researcher to follow some of the key historical trajectories from the 19th until well into the 21st century, as well as backcasting, when modelling possible futures for transport in Sweden.

Duties: The work entails studying how a radical reduction in the transport of people and goods can be introduced without a drastic cut in welfare standards and quality of life. In particular, the effects on rural areas and food production will be studied.

Qualifications: The successful applicant will have a Ph.D. in history or a related subject. Proficiency in modelling or skills relevant to model analysis would also be advantageous. A multidisciplinary approach with history and sociology, geography, economics or the equivalent would be an additional merit. We would also like the applicant to formulate ideas about how this sort of investigation could be done in his/her application.

The successful applicant will work at the Department of Economics within the agrarian history section. The position is full time and guaranteed for two years, starting as soon as possible. The successful applicant can be appointed to a post-doctoral position if he/she received a Ph.D. within three years prior to the application.

Appendix A7. The Future Agriculture communications strategy

Adopted by the Future Agriculture steering committee August 23, 2010.

Future Agriculture's communications strategy is based on appropriate sections of the communications policy of the Swedish University of Agricultural Sciences (SLU). We have identified target groups (internal and outside of SLU) that are important for *Future Agriculture* to reach, and clearly formulated criteria for prioritising between target groups, the aims of the communications strategy and how they might change in the future. In addition, the communications strategy describes the principal channels to be used for communication.

The strategy provides guidelines for supporting the prioritisation and establishment of concrete plans, to be updated when required.

Communications are managed in close cooperation with the Division of Communication at SLU and the Faculty communications officers.

Channels

Dialogue is important, therefore direct meetings, for example seminars, are invaluable.

The Web is another effective channel that is strongly prioritised. However, the Web is not very suitable for establishing dialogue. It is more of an archive. We are therefore endeavouring to maintain a lively website that is frequently updated with 'news', regarding activities and events in which *Future Agriculture* is directly involved. We also provide a simple newsletter for subscribers to the 'news' via email (with no promise of regular issues). The English version is not as extensive, but there are links to more comprehensive material in Swedish.

It is sometimes worthwhile to contact mass media, such as newspapers, radio and TV when a particular synthesis work is published. We are also aware that some material that will not be of interest for the general news media may be of great interest to more specialised and popular science media.

Printed matter will mostly be produced in the form of presentation materials (brochures and leaflets etc.), rather than as reports or the equivalent. As regards research, scientific publication will be the priority.

Target groups

Before starting each activity we think carefully about the target groups we wish to reach and the kind of relationships we want to foster with them. It should also be apparent from the outside which target groups we are concentrating on for each activity or product. We also carefully consider the order in which news, issues and material are presented, so that those most directly affected are informed before we proceed further. (This must, however, at all times be balanced against the need to maintain high transparency.)

Internally:

An important aim for *Future Agriculture* is to strengthen research at SLU. Therefore, internal communication has high priority:

- with researchers to improve research collaboration
- with other SLU employees to create goodwill and smooth the way for good cooperation
- with students with a view to future recruitment to research efforts and for future networks in the agricultural sector

– 'our own activities' are also needed to create a sense of cohesion and facilitate good dialogue between those who are directly involved in the platform.

Externally:

– it is clearly essential to build good relations with funders, by networking, inviting them to attend appropriate *Future Agriculture* events, and including individuals with extensive contacts in the advisory board.
– to obtain research inputs and facilitate their implementation it is important to maintain lively, ongoing dialogue with authorities and the agricultural sector. These target groups are regularly invited to participate in discussions about the implications of results in the 'real world'. Since the demand from these target groups is often primarily for solutions to current, acute problems (which *Future Agriculture* is unlikely to be able to provide), we concentrate principally on forging contacts with forward-thinking individuals within the groups. An additional aim of communicating with these target groups is to market the skills and abilities within *Future Agriculture*, so that the platform becomes a natural partner in discussions on future agricultural questions
– networks have been, and will continually to be, actively developed with researchers iat other universities, both in Sweden and abroad. In addition, the research program is carefully profiled with this target group in mind in order to establish collaboration.

Appendices B.

Appendix B1. Presentations for policymaking and funding agencies within Sweden and the EU

Date	Activity	Participant(s) from Future Agriculture
10-12-06	Presentation of the Future Agriculture research program at the Ministry of Agriculture[1]. Representatives from the Ministry of Environment and the research Council Formas were present. (in Swedish)	Ingrid Öborn, Ulf Magnusson, Katarina Vrede.
11-03-21 – 22	Presentation at RURAGRI (ERA-Net) Workshop, Haag, The Netherlands.	Cecilia Waldenström
11-05-04 – 05	Presentation of the Future Agriculture research program and the scenarios at the SCAR[2]-meeting 'Transition towards sustainable food consumption and production in a resource constrained world' in Budapest.	Ulf Magnusson
11-06-10	Invited speaker at the conference The Future rural areas (Framtidens landsbygd) arranged by the Ministry for Rural Affairs. Johannesbergs slott, Rimbo. (in Swedish)	Ingrid Öborn
11-07-06	Participated on the conference 'Nordic Agriculture Research in the Bio-based Knowledge Economy – Future Opportunities and Challenges' in Finland, arranged by The Nordic Joint Committee for Agricultural Research (NKJ).	Jan Bengtsson, Erik Steen Jensen
11-09-07	Presentation of Future Agriculture at Ministry for Rural Affairs – breakfast meeting for all staff (in Swedish). Together with the research program Future Forest.	Lotta Rydhmer, Jan Bengtsson, Cecilia Waldenström
11-10-05 – 06	Participation in a workshop resulting in the Warsaw Consensus Statement on Europe as a key player in global food security.	Jan Bengtsson
12-02-22 – 23	Participated in the EC FACCE JPI (Food security, agriculture and climate change, Joint Programming Initiative) mapping meeting on Adaptation to climate change.	Ingrid Öborn
12-03-13	Presentation of Future Agriculture and Mistra Biotech for the Parliament Committees on Environment and Agriculture, and Education during their visit at SLU. (in Swedish)	Ingrid Öborn

[1] The Ministry of Agriculture changed name to The Ministry for Rural Affairs January 1, 2011.
[2] SCAR is EU:s Standing Committee for Agricultural Research

Appendix B2. List of publications and presentations at conferences

The publications and presentations listed below are produced within the *Future Agriculture* thematic working groups, the analyses and syntheses centre (scenario work, research program development etc) and by the two post-doctoral researchers fully funded by *Future Agriculture*. All publications by the post-doctoral researchers P. Lundin and P. Tidåker during the period 2010-2012 are included. Some of their publications are the result of work that started before they became post-doctoral researchers within *Future Agriculture*.

Peer-reviewed articles

Published

[1] Benton T, Hartel T, Settle J. 2011. Food security: A role for Europe. Nature 480: 39.

Fagerström T, Dixelius C, Magnusson U and Sundström JF. 2012. Risk Research on GM crops is a Dead Parrot. EMBO Reports (Accepted for publication)

Lundin P. 2011. Den globala staden. Rig, nr 1, 55-58.

Lundin P. 2011. Driven by Morality: Systems and Users in the Historiography of the Car in Sweden. Mobility in History: The Yearbook of the International Society for the History of Transport, Traffic and Mobility, 119–131.

Peterson H and Lundin P. 2011. Documenting the Use of Computers in Swedish Health Care up to 1980. IMIA Yearbook of Medical Informatics, 169–174..

Philippot L, Hallin SG. 2011. Towards food, feed and energy crops mitigating climate change. Trends in Plant Science, vol 16, nr 9, 476-480

Spångberg J, Hansson P-A, Tidåker P, Jönsson H. 2011. Environmental impact of meat meal fertilizer vs. chemical fertilizer. Resources, Conservation & Recycling, nr 55, 1078-1086.

In progress (submitted)

Lundin, P. The Agrarian History of Sweden: 4000 BC to AD 2000. (Submitted to the Journal of Interdisciplinary History).

Öborn I, Rydhmer L, Bengtsson J, Vrede K, Stenström M, Westin C, Hedenus F, Magnusson U. Scenario development as a basis for formulating a research programme on future agriculture – livestock, crops and land use: A methodological approach. (Submitted to Ambio).

Spångberg J, Hansson P-A, Tidåker P, Jönsson H. Bringing nutrients from sea to land – mussels as fertilizer from a life cycle perspective. (Submitted to Journal of Cleaner Production).

Röös, E, Sundberg C, Tidåker P, Strid I, P-A Hansson. Can carbon footprint serve as an indicator of environmental impact of meat production? (Submitted to Ecological Indicators).

In preparation

Drangert J-O, Tonderski K, McConville J, Rausch S, Tidåker P, Schmid Neset T. Local organic waste for global food security: Functional criteria to guide nutrient-efficient urban sanitation. (To be submitted to Resources Conservation and Recycling).

Lehrman A, Ahnström J, Albihn A, Andersson L, Beckman M, Djurle A, Eckersten H, Fikse F, Gyllenstrand N, Herrmann AM, Jonsson A, Lewan E, Marquardt K, Milestad R, Nilsson C, Rydhmer L, Westbergh A, Yuen J, Öborn I. Adaptation of agriculture to climate change – challenges and possible solutions: A Nordic perspective. (To be submitted to International Journal of Agricultural Sustainability)

Lundin P. Emanuel M. STF som ungdomsfostrare: Sportlovets föregångare. (To be submitted to Historisk tidskrift).

Lundin P, Sjöblom S. Understanding Scandinavian Exceptionalism. (To be submitted to Transfers: Interdisciplinary Journal of Mobility Studies)

Sandin P. et al. Ethics of different food production system and relations between technologies and values. (To be submitted to Journal of Agricultural and Environmental Ethics.)

[1] Nature only accepted 3 authors in the correspondence section, so the rest of the authors listed in Appendix A3 were omitted from the authorship list, although they all contributed to the final text.

Sundström J, Albihn A, Boqvist S, Eckersten H, Ljungvall K, Marstorp H, Martiin C, Nyberg K, Vågsholm I, Yuen J, Magnusson U. Threats to future agricultural food production from environmental degradation, climate change, and animal and plant diseases – a risk analysis in three economical settings. (To be submitted to Agricultural Systems)

Tidåker P, Bergqvist G, Sundberg C, Öborn I. Rotational clover grass as energy crop in grain production system – a life cycle perspective. (To be submitted to Agricultural Systems).

Waldenström C, Ferguson R, Sundberg C, Tidåker P, Westholm E, Åkerskog A. Bioenergy from farmland: potential contribution and institutional barriers for rural development. (To be submitted to Sociologia Ruralis).

Books

Published

Åhrén U, Lundin P. (Eds.). 2011. Bilstaden.

Impagliazzo J, Lundin P, Wangler B. (Eds.). 2011. History of Nordic Computing 3.

Lundin P, Gribbe J, Stenlås N. (Eds.). 2010. Science for Welfare and Warfare.

In progress

Lundin P. Computers in Swedish Society: Documenting Early Use and Trends. 151 pp.

In preparation

Lundin P, Kaiserfeld T. (Eds.). Technologies of Consumption: Cold War Europe in the American Century.

Book chapters

Published

Dussuage I, Gribbe J, Kaijser A, Lundin P, Peralta J, Sjöblom G, Thodenius B. 2011. Precursors of the IT Nation: Computer Use and Control in Swedish Society, 1955–1985. In: History of Nordic Computing 3: Third IFIP WG9.7 Conference, HiNC 3, Stockholm, Sweden, October 18-20, 2010: Revised Selected Papers. 425–432

Gullberg A, Lundin P. 2011. Future Cities - Possible Changes. In: Images of the Future City: Time and Space for Sustainable Development. 101-108

Impagliazzo J, Lundin P, Wangler B. 2011. Preface. In: History of Nordic Computing 3: Third IFIP WG9.7 Conference, HiNC 3, Stockholm, Sweden, October 18–20, 2010: Revised Selected Papers. vii–viii

Jönsson H, Tidåker P, Richert Stintzing A. 2010. Role of farmers in improving the sustainability of sanitation systems. In: Social Perspectives on the Sanitation Challenge. 179-188.

Lundin P. 2011. Att tänka om staden med historia: En introduktion till Bilstaden. In: Bilstaden: USA visade vägen. 9-22

Lundin P. 2011. Designing Democracy: The UTOPIA-project and the Role of the Nordic Labor Movement in Technological Change during the 1970s and 1980s. In: History of Nordic Computing 3: Third IFIP WG9.7 Conference, HiNC 3, Stockholm, Sweden, October 18–20, 2010: Revised Selected Papers. 187–195

Lundin P, Gullberg A. 2011. Stockholm's Urban Development. In: Images of the Future City: Time and Space for Sustainable Development. 77-99

Tidåker P. 2011. Kretsloppet i jordbruket kan förbättras. In: Återvinna fosfor - hur bråttom är det? Formas Fokuserar. 163-175.

Lundin P. 2010. Bilsamhället: Ideologi, expertis och regelskapande i efterkrigstidens Sverige. In: Klimatets krav på samhället. 159-176

Lundin P, Stenlås N. 2010. Technology, State Initiative and National Myths in Cold War Sweden: An Introduction. In: Science for Welfare and Warfare: Technology and State Inititiative in Cold War Sweden. 1-34

In Progress (submitted)

Wästfelt A. Framtidens jordbruk – en teoretisk utmaning. In: Alm S. *et al.* (Eds.) Framtidsperspektiv.

In Preparation

Lundin P. European Consumption Regimes and the American Challenge. In: Lundin P. Kaiserfeld, T. (Eds.). Technologies of Consumption: Cold War Europe in the American Century.

Lundin P. The Rise and Fall of an American Icon: The Motel in Europe. In: Lundin P, Kaiserfeld T. (Eds.). Technologies of Consumption: Cold War Europe in the American Century.

Scientific reports

Öborn I, Magnusson U., Bengtsson J., Vrede K., Fahlbeck E., Jensen E.S., Westin C., Jansson T., Hedenus F., Schulz H.L., Stenström M., Jansson B., Rydhmer L. 2011. Five Scenarios for 2050 - Conditions for Agriculture and Land Use. Swedish University of Agricultural Sciences (ISBN 978-91-9032-6). (Is also available in Swedish, ISBN978-91-576-9023-4).

Bengtsson J, Magnusson U, Rydhmer L, Jensen ES, Vrede K, Öborn I. 2010. Future Agriculture – livestock, crops and land use. A strategic programme for research. Swedish University of Agricultural Sciences (SLU). ISBN: 978-91-576-9008-1.

In Preparation

Lundin P. Effektivisera eller förändra? En analys av femtio års svenska transportvisioner

Magnusson U, Andersson-Djurfeldt A, Håkansson T, Hårsmar M, MacDermott J, Nyberg G, Stenström M, Vrede K, Wredle E, Bengtsson J. 2012. Critical research issues for future sub-Saharan African agriculture — opportunities and challenges.

Contribution to conferences / Proceedings

Bengtsson J. 2011.Organic farming, biodiversity, multi-functionality and sustainability. 12th EEF (European Ecological Federation) Congress, Avilá, Spain 2011. (Invited talk)

Magnusson U, MacDermott J, Stenström M, Andresson-Djurfeldt A, Nyberg G, Wredle E, Hårsmar M. 2011. Some critical research issues for future Sub-Saharan African Agriculture. Agricultural research för development – scales and diversity, Uppsala. September 28-29, 2011.

Waldenström C, Ferguson R, Sundberg C, Tidåker P, Westholm E, Åkerskog A. 2011. Institutional barriers for rural development; the example of bioenergy from farmland. the XXIV European Society for Rural Sociology Congress, Chania, Greece, 22-25 August 2011.

Bengtsson J 2011. Challenges for future agriculture and land use. 24th NJF Congress. 2nd Nordic Feed Science Conference. Food, Feed, Fuel and Fun. Nordic Light on Future Land Use and Rural Development, Uppsala, Sweden, 14-16 June, 2011. (Key-note speaker)

Ferguson R, Sundberg C, Tidåker P, Waldenström C, Westholm E, Åkerskog A. 2011. Institutional barriers for rural development; the example of agriculturally-based bioenergy.

24th NJF Congress. 2nd Nordic Feed Science Conference. Food, Feed, Fuel and Fun. Nordic Light on Future Land Use and Rural Development, Uppsala, Sweden, 14-16 Juni, 2011. p. 249. (poster)

Sandin P, Bergeå H, Blokhuis H, L Ekelund L, Hansen K, Hansson H., Nordström Källström H., Lotta Rydhmer L., Röös E., Sundh I, Ulén B. 2011. Attitudes to food production systems and food products. 24th NJF Congress. 2nd Nordic Feed Science Conference. Food, Feed, Fuel and Fun. Nordic Light on Future Land Use and Rural Development, Uppsala, Sweden, 14-16 June, 2011. (Invited oral "reflection" and poster)

Tidåker P. 2011. Multifunctional ley for biogas production – a life cycle perspective. 24th NJF Congress. 2nd Nordic Feed Science Conference. Food, Feed, Fuel and Fun. Nordic Light on Future Land Use and Rural Development, Uppsala, Sweden, 14-16 June, 2011.p. 156.

Öborn I., Bengtsson J, Jensen ES, Magnusson U., Rydhmer L, Vrede K. 2010. Challenges and Future Scenarios for Agricultural Production and Land Use. Nordic Association of Agricultural Scientists Seminar 430: Climate change and agricultural production in the Baltic Sea region – focus on effects, vulnerability and adaptation, Uppsala, Sweden, May 4-6, 2010, p 45 (oral)

Rydhmer L, Magnusson U, Öborn I, Jensen ES, Bengtsson J, Vrede K. 2010. Future agriculture – a research initiative on livestock, crops and land use. Nordic Association of Agricultural Scientists Seminar 430: Climate change and agricultural production in the Baltic Sea region – focus on effects, vulnerability and adaptation, Uppsala, Sweden, 4-6 May 2010. p 41 (oral).

Other printed matter

Future agriculture – Livestock, Crops and Land Use. An interdisciplinary research programme (also available in Swedish)

Future Agriculture – Livestock, Crops and Land Use. An integrated research programme (also available in Swedish)

Appendix B3. Presentations at seminars arranged by SLU

Date	Activity	Participant(s) from Future Agriculture
2010-10-27	Presentation about Future Agriculture at the annual Environmental monitoring and assessment day. (in Swedish)	Katarina Vrede
2011-01-24	Presentation and discussion about future scenarios and global food security with pupils from the upper secondary school Rosendal. (in Swedish)	Lotta Rydhmer
2011-03-03	Presentation and roll-ups at the 'Alnarp day' arranged by Partnerskap Alnarp. (in Swedish)	Erik Steen Jensen
2011-05-13	Presentation at European Framework Research Programs - the world´s largest research support instrument – now and in the future (with Dr Christian Patermann). Arranged by Grants Office and the Vice-Chancellor, SLU.	Ingrid Öborn
2011-08-25 – 26	Presentation at the seminar Four future platforms at SLU, arranged by SLU. (in Swedish)	Ulf Magnusson, Lotta Rydhmer, Katarina Vrede
2011-09-19	Presentation to a delegation from Cornell University, in Uppsala.	Lotta Rydhmer, Katarina Vrede
2012-03-01	Presentation and discussion about future scenarios and global food security with pupils from the upper secondary school Rosendal. (in Swedish)	Lotta Rydhmer

Appendix B4. Other presentations outside SLU and participation in fairs

Date	Activity	Participant(s) from Future Agriculture / Target Groups
2010-06-04 – 06	Seminar at Future Forum (seminar organisers and speakers) and exhibition at the fair På Landet, Axvall (On the Countryside). (in Swedish)	Jan Bengtsson, Lotta Rydhmer, Karin Ullvén / Target groups: agricultural sector, authorities, public.
2010-06-30 – 07-01	Exhibition at the Borgeby fair (Borgeby Fältdagar). (in Swedish)	Ingrid Öborn, Katarina Vrede, Karin Ullvén / Target groups: agricultural sector, authorities, public.
2010-05-04 – 06	Exhibition at Climate change and agricultural production in the Baltic Sea region – focus on effects, vulnerability and adaptation. NJF Conference, in Uppsala.	Ingrid Öborn, Lotta Rydhmer, Katarina Vrede / Target groups: researchers and authorities.
2010-09-28 – 29	Roll up at Production and carbon dynamics in sustainable agriculture and forest systems in Africa, in Stockholm.	Ingrid Öborn, Katarina Vrede, Pelle Fredriksson. / Target groups: researchers and authorities.
2011-05-12 – 14	Exhibition at World Championship in ploughing, in Östergötland. (in Swedish and English)	Karin Ullvén, Anna Lehrmann / Target groups: agricultural sector, public.
2011-05-23	Seminar at Biotopia knowledge fair, Uppsala. (in Swedish)	Jan Bengtsson / Target groups; the public, high school students.
2011-06-29 – 30	Exhibition at the Borgeby fair (Borgeby Fältdagar). (in Swedish)	Karin Ullvén, Anna Lehrmann / Target groups: agricultural sector, authorities, public.
2011-07-04	Participated in panel debate at Almedalen, Visby arranged by Sida. (in Swedish)	Ulf Magnusson. / Target groups: Swedish politicians, stakeholders in the environment/agriculture interface.
2011-09-21	Oral presentation at Climate adaptation Sweden 2011. (in Swedish)	Ulf Magnusson. / Target groups: Representatives from Swedish regional officials, governmental authorities and non-governmental organisations.
2011-09-28 – 29	Roll up and oral presentation at the conference Agricultural research for development – scales and diversity, at SLU, Uppsala.	Ingrid Öborn, Ulf Magnusson, Katarina Vrede, Pelle Fredriksson / Target group: researchers and authorities.
2011-10-19	Seminar at Byateatern in Kalmar (in Swedish)	Ingrid Öborn / Target group: public
2012-03-20	Oral presentation of Future Agriculture and Mistra Biotech followed by discussion with the Food 21 Board at the Swedish Farmers' Federation (LRF), Stockholm.	Ingrid Öborn / Target group: stakeholder representatives from private sector and organisations working with agriculture and food.

Appendix B5. Seminars and conferences organised and co-organised by Future Agriculture

Date	Title	Name and organisation	Form
2009-09-23	A Global Perspective on Future Food Security 50 years into the Future (in Swedish) Presentation of Future Agriculture (in Swedish)	Lennart Båge, former Director General of International Fund for Agricultural Development (IFAD) Janken Myrdal, Professor in Agrarian History at SLU Steering committee of Future Agriculture	Half day seminar, Uppsala
2009-10-16	Reconnoitring the future for milk – what new knowledge is needed? (in Swedish)	Lennart Andersson, Vice President of the Swedish Dairy Association	Lunch seminar, Uppsala
2009-11-19	A new perspective on environmental objectives (in Swedish)	Pirjo Körsén, Ministry of the Environment	Lunch seminar, Uppsala
2009-12-11	Integrated natural resource management – evolution and applications in international agricultural research	Jeffrey Sayer, Science Advisor to the IUCN Forest Conservation Programme (co-organized with Agri4D)	Lunch seminar, Uppsala
2009-12-14	Considering agriculture as applied ecology	Professor Jacob Weiner, University of Copenhagen	Lunch seminar, Alnarp
2010-02-10	Scenarios for future agriculture – Starting points for future research (in Swedish)	Workshop for invited representatives from the agricultural sector, authorities and non-governmental organsations.	Full day workshop, Stockholm
2010-02-12	Scenarios for future agriculture – Starting points for future research (in Swedish)	Workshop for invited researchers	Full day workshop, Stockholm
2010-02-16	Ethical questions in future agriculture (in Swedish)	Dr Per Sandin, Senior Lecturer in Bioethics and Environmental Ethics at SLU	Lunch seminar, Uppsala
2010-03-16	Future agriculture starting today (in Swedish)	Maria Dirke, Swedish Organic Farmers Association	Lunch seminar, Alnarp
2010-04- 21	Future challenges for Swedish agriculture (in Swedish)	Helena Jonsson, Vice President of the Federation of Swedish Farmers	Lunch seminar, Uppsala
2010-04- 22	Scenarios for future agriculture – Starting points for future research	Workshop for young researchers	Full day workshop, Uppsala
2010-05-18	Trends in agricultural research in the EU (in Swedish)	Hans-Örjan Nohrstedt, International Director at the Swedish Research Council Formas	Lunch seminar, Uppsala
2010-06-04 – 06-06	Seminar at Future Forum at the fair På Landet, Axvall. (in Swedish)	Organiser of one seminar	Seminar, Axvall
2010-09-28 – 09-29	Production and carbon dynamics in sustainable agriculture and forest systems in Africa.	Co-organised with Agri4D, SIANI and Focali.	Conference, Stockholm

2010-10-10	Integrated approaches to developing more sustainable farming systems – pleasure or pain?	Dr. Christine Watson, Scottish Agricultural College (co-organized with the Department of Crop Production Ecology)	Seminar, Uppsala
2010-11-03	Educating for sustainable development (in Swedish)	Mattias Alveteg, Associate Professor at the Department of Chemical Engineering at Lund Technical University	Lunch seminar, Alnarp
2010-11-12	Climate tax on meat and milk – an effective climate policy instrument? (in Swedish)	Dr Fredrik Hedenus, Chalmers University of Technology	Lunch seminar, Uppsala
2010-12-01	Education for sustainable development - an issue for SLU (in Swedish)	Barbro Robertsson, Lecturer at the Institute of Health and Care Sciences at the University of Gothenburg's Sahlgrenska Academy	Lunch seminar, Uppsala
2011-01-18	Management of present and potential risks	Kick off for a thematic working group	Workshop, Uppsala
2011-01-20	Agriculture and rural development	Kick off for a thematic working group	Workshop, Uppsala
2011-01-21	Reduction of the environmental impact of agriculture and mitigation of climate change	Kick off for a thematic working group	Workshop, Uppsala
2011-01-24	Adaptation of agriculture to a changing climate	Kick off for a thematic working group	Workshop, Uppsala
2011-01-25	Responses to societal values and contribution to policies	Kick off for a thematic working group	Workshop, Uppsala
2011-01-27	Reducing greenhouse gas contribution from ruminant livestock – options and constraints	Karen Beauchemin & Sean McGinn, Agriculture and Agrifood Canada, Alberta, Canada (co-organized with the Department of Animal Nutrition & Management, SLU and Royal Swedish Academy of Agriculture and Forestry)	Seminar, Uppsala
2011-02-10	Resolution of conflicting goals of agriculture and land use	Kick off for a thematic working group	Workshop, Uppsala
2011-03-08	Agriculture – a new environmental movement? (in Swedish)	Svante Axelsson, the Swedish Society for Nature Conservation	Lunch seminar, Uppsala
2011-03-15	Future challenges and research areas for agriculture in sub-Saharan Africa	Workshop for invited representatives from authorities and non-governmental organsiations	Full day workshop, Stockholm
2011-04-15	Is Sweden a country for livestock production? (in Swedish)	Harald Svensson, Chief Economist at the Swedish Board of Agriculture	Lunch seminar, Uppsala
2011-05-19	Unravelling the complexity of African smallholder farming systems	Professor Ken Giller, University of Wageningen, The Netherlands	Lunch seminar, Uppsala
2011-05-19	Future harvest – the fine line between myopia and utopia	Associate Professor Martin van Ittersum, University of Wageningen, The Netherlands	Lunch seminar, Uppsala
2011-06-11	'Challenge workshop'	Worrkshop for Future Agriculture thematic working groups	Workshop, Uppsala

2011-06-14 – 06-16	The NJF congress Food, feed, fuel and fun. Nordic light on future land use and rural development 2011.	Organizer of the final session	Conference, Uppsala
2011-09-14	Global shifts of land use: Natural resources and the future	Florian Kraxner, Deputy Program Leader, Ecosystems Services and Management Program (ESM) at International Institute for Applied Systems Analysis (IIASA)	Lunch seminar, Uppsala
11-09-28 – 09-29	Agricultural research for development – scales and diversity.	Co-organised with Agri4D, SIANI and Focali	Conference, Uppsala
2011-10-17	Can a small Swedish family-owned business make a difference globally? (in Swedish)	Pär Larshans, Sustainability manager at Max Hamburgerrestauranger AB	Lunch seminar, Uppsala
2011-10-18	A day on Future Agriculture (in Swedish)	Presentations by Anita Lundström, the Swedish Environmental Protection Agency, Titti Jöngren the Federation of Swedish Farmers and SLU researchers active in Future Agriculture	Full day seminar, Uppsala
2011-11-24	Industrial estates versus industrial fields – Rethinking the urban fringe	Trevor Graham, Head of Sustainable Communities & Lifestyle, City of Malmö	Lunch seminar, Alnarp
2011-12-07	Belief in the future and anxiety about the future as driving forces of environmental research (in Swedish)	Erik Westholm, professor of Rural Studies, Department of Urban and Rural Development, SLU	Lunch seminar, Uppsala
2012-02-08	Workshop about future Swedish beef production	Workshop with researchers and representatives from the agricultural sector. Co-organised with Tillväxt Nötkött. http://www.slu.se/sv/centrumbildningar-och-projekt/framtidens-lantbruk-/publikationer-och-trycksaker/	Full day workshop, Stockholm
2012-02-09	You can make a difference – you just need to know how… (in Swedish)	Louise Ungerth, Stockholm Consumer Cooperative Society	Lunch seminar, Uppsala
2012-03-29	Shrinking the livestock's long shadow	Dr. Henning Steinfeld, Chief, Livestock Information, Sector Analysis and Policy Branch (AGAL) – FAO, Rome	Seminar, Uppsala

Finding sustainable ways to feed the world in the future is mankind's greatest challenge

The Swedish University of Agricultural Sciences operates all over Sweden. Campuses are Alnarp, Skara, Umeå and Uppsala.
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