Agriculture Food Security and Climate Change

FACCEJPI

# Report on FACCE Cluster-2-Workshop

# »Support by policy and research for adaptation to climate change in farming systems and food-related industries«

## 19 – 20 October 2016

## Bonn, Germany

AGRICULTURE, FOOD SECURITY & CLIMATE CHANGE

The sectors of agriculture and forestry are highly exposed to climate change, since they directly depend on climatic conditions, while emissions from agriculture in the Union account for 14% of global greenhouse gas emissions. Climate change is also one of the main challenges to agriculture in feeding the world's population, which is expected to reach 9 billion by2050. Global demand for food is expected to have increased by 50% by 2030 and to have doubled by 2050, at a time when demand for biomass for non-food purposes is predicted to grow strongly. Concerted actions are needed to prevent these combined risks from leading to irreversible damage, and to achieve sustainable food supply under changing climate conditions. The Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI) brings together 22 countries and aims to improve their collaboration in research policies and research effort to tackle these global challenges for Europe by aligning research programmes among Member States.

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Report by BMEL, compiled and edited by Martin Köchy (Thünen Institute), Florian Bittner (Julius Kühn-Institute) and Stefan Lange (Thünen Institute)
This report could not have been conceived without all efforts and dedication of all the participants in the workshop of the Cluster on *Support by policy and research for adaptation to climate change in farming systems and food-related industries*.



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**Content**



## Executive Summary

The workshop of FACCE Cluster 2 was designed to complement the earlier workshops of Clusters 1 and 3. Therefore, it addressed how models and modelling activities can contribute to integrate existing knowledge and how research can fulfil the needs of decision-makers at national and European level. In line with the time-horizon of policy-making in relation with climate change, the workshop took a long-term perspective.

Workshop participants considered **what needs to be improved for developing policy instruments for supporting and controlling mitigation and adaptation strategies with respect to climate change**. These policies should facilitate long-term planning by politicians, producers, industry, consumers, and society.

Long-term planning is facilitated by **prioritising of likely future scenarios**, which requires a solid **integration of information along with a hitherto not existing communication format**. Currently, there is no **holistic collection of relevant information** that can be used as basis for decisions. On the one hand side, all groups of key players **require specific information** for their respective decisions, but on the other side they **all have to (and should) rely on the same set of (quality-assured) information.**

Workshop participants suggested that **resources should be concentrated on**

- **monitoring and assessment of long-term processes across several thematic dimensions** for addressing synergies and trade-offs
- **forming joint groups of scientists, policymakers and other stakeholders, building an interface between policy and science**, and on
- **supporting training for addressing policymakers**.

The common aim must be to establish **new formats of stakeholder dialogue that allow full transparency of the process from science to decision-making.**

## Introduction

Agriculture in Europe, as in other parts of the world, is facing the challenges of progressing climate change. This means on the one hand side to reduce its own, negative contribution to climate change in crop and animal production, by, e.g., reducing emissions of greenhouse gases (mitigation). On the other hand side, crop production must adapt to a changing climate (adaptation).

Climate change affects land use in two ways:
a) Long-term climate change will lead to continuously changed environments for crop, livestock, and dairy production. Climatic regions favourable for specific farming systems and for specific crops will shift, some crops may lose significance in the long run, other crops may provide new opportunities. These changes will have ecological impacts beyond the individual farm. They will impact land use systems, their ability to deliver ecosystem services (e.g. carbon sequestration in the soil, biodiversity). Furthermore, projected long-term climate change will also be felt by its impact on the structure of agricultural systems and agricultural markets, i.e. by its economic consequences.

b) Studies show that short extreme weather events will increase in number with the progress of climate change. This is rather certain for extreme heat and intensive drought. Reasonable assumptions exist that the increase also applies to hailstorms, frosts, storms and floods. Agriculture with its predominantly annual crops is in a better position of adapting to long-term climate change by corresponding measures than, e.g., forestry. Short-term extreme weather events, however, can damage considerably the agricultural sector within weeks or a few hours.

The Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI) brings together 21 countries that are committed to building an integrated European Research Area addressing the interconnected challenges of sustainable agriculture, food security and impacts of climate change. FACCE's biannual implementation plan describes the topics that are considered having the highest priorities and the joint actions that are to be undertaken in the two-year period. Joint actions are developed around three *clusters* that integrate priority topics of different core themes of FACCE (Fig. 1).

The overarching aim of the cluster workshops was to provide the FACCE governing board with a base for deciding on the development of future FACCE activities and to provide recommendations to other boards (EU Commission, SCAR, etc.). Two cluster workshops had already been held: Cluster 1 – *Land and water management (including soil systems) for climate adaptation and mitigation*; and Cluster 3 – *Increasing resilience of food value chains under climate change*. The workshop of FACCE Cluster 1 focused on the scientific analysis, identification of research questions and optimisation measures at farm level with respect to mitigation and adaptation. Therefore, Cluster 2 would not reconsider climate-related optimisation

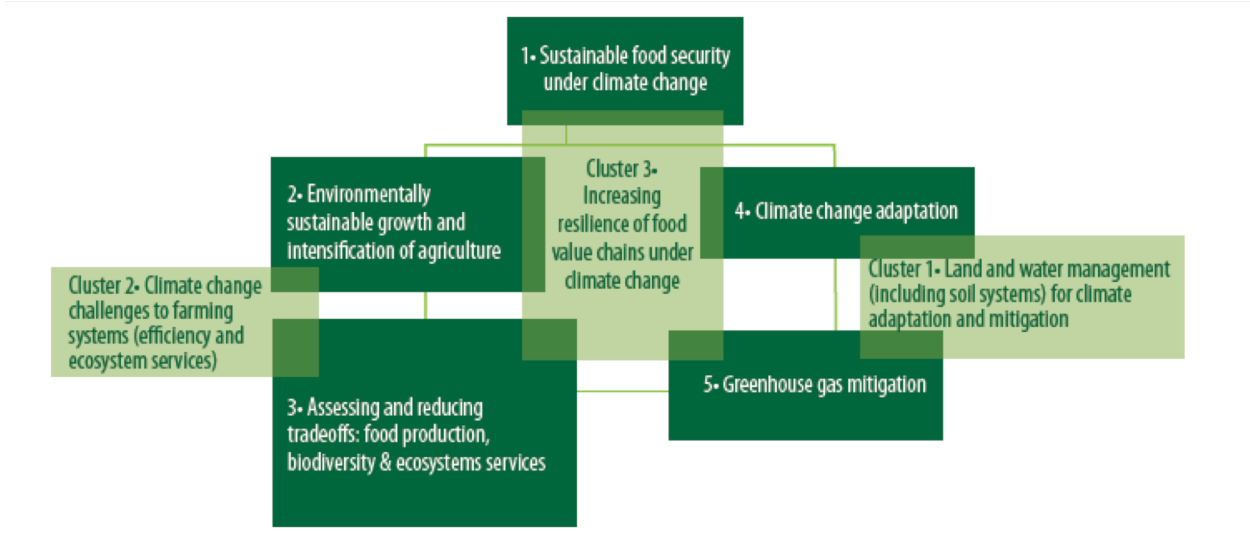



Fig. 1. Relationship among FACCE Core Themes (dark green) and Clusters (light green).

measures at farm level such as soil management, crop rotations, plant protection, irrigation, fertilisation, choice of varieties or management of organic soils. The workshop of Cluster 3 addressed the resilience of food value chains under climate change. Key messages of this workshop were

- A more integrative way of working between the food chain levels is needed to overcome the fragmentation between relevant research communities;
- Access to the right data and integrated data would help develop a holistic understanding of the resilience of food value chains under climate change;
- There are various instruments available to facilitate joined up working across Europe and potential thematic areas that can help focusing efforts.

The Cluster-2-workshop was set to explore how models and modelling activities can contribute to integrate existing knowledge and how research can fulfil the needs of decision-makers at national and European level.

There was a need for action for both aspects of climate change (mentioned in the first paragraph) beyond adaptation measures at farm or regional level (which were the focus of the earlier workshops of Cluster 1 and Cluster 3). At a higher level, economy, science, and politics need answers to the following questions:
— What are the right adaptation strategies for the agricultural sector?
— Which political instruments are suitable to support these strategies and (how) can they take into account regional differences across Europe?
— How can a reliable risk management be established by the public and private sector to deal with the effects of extreme events?
— Which scientific forecast and projection tools exist to provide directions, impact assessments and the base for necessary changes of management and policy strategies?

### *Rationale of the Cluster-2-workshop*

Answering the above questions requires:

- Identifying the appropriate methods to best assess the effect of climate change in different regions and crops and related risks in terms of yield security
- Reviewing existing legal frameworks for their support to adaptation strategies and regional flexibility
- Scrutinising existing adaptation and risk management strategies for their suitability to the projected (modelled) changes
- Capabilities for continuously updated forecasts of climate change impacts

The workshop of Cluster 1 indicated the need for cooperative model development, model exploitation and data repositories. In the workshop report, the chapter on water quality calls for cooperative modelling for improving the analysis of effects of climate change and the assessment of policy options. This is echoed in other parts of the Cluster-1-report. These needs suggested that Cluster 2, as an interface between FACCE Core Themes 2 and 3 (Fig. 1), required a broad approach to address sustainable intensification and the assessment of trade-offs originating from climate change.

Based on the above named challenges, the focus of the Cluster-2-workshop was the identification of policy instruments that enable adaptation strategies for the agricultural sector. The workshop's aim was to provide the FACCE governing board with a suggestion that represents the experiences of a broad range of stakeholders and reflects the diversity of agricultural systems and conditions across Europe.

## Methods

In order to base the conclusions of the workshop on the experiences of a broad range of stakeholders and reflecting the diversity of agricultural systems and conditions across Europe, we used an iterative discussion process with a panel of experts (a modified Delphi method). We identified five stakeholder groups who have a strong interest in agricultural policy under climate change: farmers (producers), industry, research, policy-making, and NGOs. Each group was to be represented by 5-6 persons. For each of these groups (except research and policy making) we selected two to three representatives already engaged in FACCE,

preferably persons who also had additional function in other programmes and could represent a wide view. We searched additional European or national interest groups to represent a broad diversity of experiences with agricultural systems (Table 1). Researchers and policymakers were exclusively recruited from within FACCE because FACCE already reflects a broad diversity of these groups. In addition, members of the FACCE governing board and the FACCE secretariat were invited to attend.

Since the invited participants were assumed to have different backgrounds and different experiences with modelling and climate change, the workshop had two parts (Appendix 1). Part 1 was intended to familiarize all participants with the topic and provide an opportunity to think broadly about aspects of a long-term nature in agriculture and external impacts. Part 2 was intended to put the focus on ways to improve policy support for adaptation and mitigation in farming systems.

Table 1. Targeted interest groups and invited organisations.

| Interest group | Organisation | Country |
|---|---|---|
| Environment NGOs | European Environmental Bureau | EU |
| Environment NGOs | WWF Spain | ES |
| Environment NGOs | Federation of Environmental Organizations of Cyprus | CY |
| Environment NGOs | Fundatia ADEPT | RO |
| Environment NGOs | REC Poland | PL |
| Producers | COPA-COGECA | EU |
| Producers | European Forum for Agricultural and Rural Advisory Services | EU |
| Producers | Agri-food Cooperatives | ES |
| Producers | European Council of Young Farmers | EU/PL |
| Producers | AgriCord | IT |
| Industry | Irish Cooperatives | IE |
| Industry | Danish Agriculture & Food Council | DK |
| Industry | FoodDrinkEurope | EU |
| Industry | Animal TaskForce | EU |
| Industry | Yara | NO |
| Industry | European Federation of Food Science & Technology | EU |
| Policy | BMEL | DE |
| Policy | Lebensministerium | AT |
| Policy | Ministère de l'agriculture, de l'agroalimentaire et de la forêt | FR |
| Policy | Ministry of Agriculture | IL |
| Policy | Ministry of Science and Education | PL |
| Research | University of Reading | UK |
| Research | Norwegian Institute of Bioeconomy Research | NO |
| Research | Thünen | DE |
| Research | Agrifood Campus - ceia3 | ES |
| Research | University of Leeds & Eötvös-Loránd-University | UK/HU |
| Research | Uni Bonn/ZALF | DE |

Starting points for integrating climate change effects on crops and livestock in political and socio-economic strategies in different regions are calibrated models (when available) that are based on reliable data and methods. Therefore, part 1 started with an overview of climate impacts and adaptation measures in regional case studies in FACCE's knowledge hub *MACSUR*[1] and results of the project *Agricultural Extreme*

[1] http://macsur.eu

*Weather and Risk Management Possibilities*[2] (each in the form of oral-visual presentations). They were complemented by reflections of the European food industry.

*MACSUR* is an interdisciplinary knowledge hub covering crop, grassland, farm, and socioeconomic models by a consortium of 70 institutions in 18 countries. Its aim is the improvement of models, modelling methodologies, and the integration of models across disciplines for assessing impacts of climate change and options for adaptation and mitigation in European agriculture.

The project *Agricultural Extreme Weather and Risk Management Possibilities* defined thresholds for classifying extreme events and quantifying their frequency. These statistics, additional data analyses on yield losses as well as economic analyses were used to estimate the future relevance of extreme events on food and feed crops, specialised crops and silvicultural tree species. The project developed adaptation strategies and recommendations for practitioners, insurers, and policy. Both projects, *MACSUR* and *Agricultural Extreme Weather and Risk Management Possibilities*, make use of regional or crop-specific case studies.

The introductory presentations were followed by consecutive group discussions that identified (1.1) long-term investments or strategies in agriculture, (1.2) important external impacts on these investments, (1.3) the information that affected decisions regarding these investments or strategies and (1.4) the actors that are involved with providing the information. The group discussions were to engage all participants with the subject and produce a wide view on the posed questions. The progress of the discussions required changing the planned order of presentations in part 2 and a rephrasing of questions. We report here the changed order and rephrased questions.

In part 2, participants were introduced to the use of models and scenarios, linking of models and results based on several projects of Julius Kühn-Institute, followed by a reflection of the production and use of models in the socio-economic Thünen baseline as an example of policy support through models (both in the form of oral-visual presentations). The socio-economic *Thünen baseline*[3] is provided by Thünen Institute to the German government. It is produced every two years and projects for the next ten years the expected trends in the German agricultural sector based on

- existing (agricultural) regulations and environments and
- assumptions for the development of exogenous impacts.

The Thünen baseline provides a reference scenario for analysing impacts of alternative policies and developments.

In the following group discussion (2.1–2.2), participants were asked to identify what information was or was not available for developing policy instruments for supporting and controlling strategies related to climate change and how the information reached those who needed it. An oral-visual presentation of the use of modelling studies in EU policy impact assessments (based on a study related to the SEAMLESS/LIAISE projects) introduced the next group discussion (2.3) about what could be done to improve the use of scientific results in policy-making.

Of the 27 invited representatives of stakeholder groups (Table 1), four researchers and one policymaker attended the workshop. Six members of the governing board delegated researchers to attend the meeting as substitutes. In total, twenty persons (including presenters and colleagues of the organising institutes) attended the workshop. Consequently, most participants of the workshop had a research background (Table 2). Three persons had a strong personal or family link to farming and could represent a farming perspective. Thus, groups for discussions were assembled in a way that they included 1 farm-related person, 1 policy-related person, researchers and represented a mix of countries.

[2] http://www.agrarrelevante-extremwetterlagen.de

[3] https://www.thuenen.de/en/infrastructure/the-thuenen-modelling-network/the-thuenen-baseline/

Table 2. Actually represented interest groups and affiliations.

| Interest group (main association) | Affiliation | Number* | Country |
|---|---|---|---|
| Policy | BLE | 1 | DE |
| Policy | BMEL | 1 | DE |
| Policy | INRA | 1 | FR |
| Policy | Projektträger Jülich | 1 | DE |
| Research | Wageningen University and Research Center | 1 | NL |
| Research | University of Leeds & Eötvös-Loránd-University | 1 | UK/HU |
| Research | University of Bonn & ZALF | 1 | DE |
| Research | Agroscope | 1 | CH |
| Research | Department of Agriculture, Food and the Marine | 1 | IE |
| Research | IFAPA-INIA | 1 | ES |
| Research | Julius Kühn-Institute | 4 | DE |
| Research | Luke | 1 | FI |
| Research | Teagasc | 1 | IE |
| Research | Thünen Institute | 3 | DE |
| Research | University of Aarhus | 1 | DK |

* including presenters

The two parts of the workshop were held on two consecutive days. Two persons had to leave after the first day, one person could attend only on the second day. Due to further temporal constraints and professional commitments, there were four groups on day 1 with 5–6 participants each and 2–3 groups with 4–8 persons on day 2.

Group discussions had the format of "placemat discussions". The topic of discussion was presented to the participants. They had 3 minutes to themselves to reflect on the question. The members of the groups were asked to present their thoughts to each other (6 min.) and agree on a common list (10 min). These lists were presented to the other groups (5 min.) with the possibility to add spontaneous thoughts. The lists of each group (Appendix 2) were displayed or were accessible throughout all discussions.

After the workshop, the authors of this report summarised the lists independently of each other and agreed on the overall summary of the workshop. Workshop participants had the opportunity to review the final version of the report and to add comments. No comments on the content have been received though.

## Results

*Part 1 – Setting the scene*

### *1.1 Important long-term investments or strategies in agriculture*

High importance was attributed to **investments in technical** (machines, irrigation, drainage), **land use** (ownership, land sale) and **building infrastructure** (e.g. for livestock), and **securing availability of production material** (land, cultivars/breeds, suppliers). Also, **water and soil management** appear to be high-ranking issues with particular focus on preservation and improvement of quality. Moreover, **education** that sensitizes for climate change and its consequences was identified as target for investments, ideally starting at early stages, e.g. in kindergarten and school, rather than late at university or as in-service training.

### *1.2 Identification of impacts on long-term investments or strategies*

Rapidly progressing **developments in technology, IT, and breeding sectors** were considered to have strong influence whenever long-term decisions have to be made. **Producer-consumer relationships** were

identified as critical issue, i.e., social and socio-economic aspects but also price vs. demand and dietary changes will impact the behaviour of producers and consumers. **Societal choices**, e.g. dietary changes, level of nature conservation, might also have strong effects. Another critical issue could be the **legal implementation of policies and possible trade barriers**, which cannot be foreseen and which is connected to risks for producers.

### *1.3 Information relevant for long-term investments or strategies*

The basis of planning is the consideration of scenarios (pathways, storylines) and their certainty. Therefore, a reliable **prioritisation of scenarios in combination with a multidisciplinary risk analysis and a minimisation of spatial and regional uncertainties** would greatly support decision-making. These scenarios should address **prices, policy decisions, legal implementations, markets, and long-term policy perspectives including finances** (> 5 years). For developing more than simplistic scenarios, one needs **improved understanding of interactions at all relevant scales** within agriculture but also with sustainable development goals **and identification of key factors across all involved economic and societal sectors**. The various sources of information should be available in a **compatible format**.

### *1.4 Involved actor groups (stakeholders)*

A broad stakeholder perspective beyond the food-chain is necessary for obtaining the information.

*Part 2 — Support for policy-making*

### *2.1 Information already available/not available for developing policy instruments*

Available information (literature, databases, projections) is too often restricted to individual sectors, scales, regions, time periods and inconsistent or incompatible. There is currently no **holistic collection of relevant information** that can be used as basis for decisions. On the one hand side, all groups of key players **require specific information** for their respective decisions, but on the other side they **all have to (and should) rely on the same set of (quality-assured) information.** At small scales (fine-grained resolution) data privacy often prevents integration of existing data. Fine-grained data, however, is necessary for developing new technologies (e.g. precision farming), exploring interactions among processes, and targeted, adaptable policy instruments. There is also a lack of **monitoring of processes with comprehensive, long-term data collection across several dimensions (biophysical agronomy, societal, food chain, ecology) for addressing synergies and trade-offs**.
This all requires a solid **integration of information along with a hitherto not existing communication platform or format**, respectively.

### *2.2 Information flow*

The flow of information was considered very diverse and specific for the various stakeholder groups. The process from science to policy-making was regarded as intransparent.

### *2.3 Suggestions for improving the situation*

Policy and research work at different speeds and have different objectives. The available information from disparate sources (physical observations, policy, socio-economy) require integration by expert groups, with a clear policy-driven question that transcends the typical length of a project. Workshop participants mentioned the IPCC process, the German socio-economic baseline, commissioned meta-analyses, and a co-management process by fishers and policy in Germany[4] as examples. The workshop participants suggested that resources be concentrated on forming joint groups of scientists, policymakers and other stakeholders, **building an interface between policy and science**, and on **supporting training for addressing policymakers**. The collaboration might be facilitated by new education lines, e. g. a master in “science communication”. Similarly, internships of scientists at ministries could support a better “understanding” on both sides for mutual benefit. The common aim ought to be to establish **new formats of stakeholder dialogue that allow full transparency of the process from science to decision-making.**

[4] https://www.thuenen.de/de/thema/langfristige-politikkonzepte/reformen-fuer-die-reform-neue-ideen-fuer-das-fischereimanagement/co-management-was-motiviert-fischer/ (in German)

## Summary and conclusion

The aim of the Cluster-2-workshop was to take a long-term perspective for addressing the needs of policy development targeting the sustained productivity of farming systems. Workshop participants found that the object of such policies should be investments in infrastructure (in the widest sense) and capacity building. The latter should relate not only to the producers of agricultural products, but also to the infrastructure for linking producers, researchers and policy-makers for integrating available information and providing. The design of these policies should consider interactions with SDGs beyond food security. In order to achieve this, all interested and affected parties (stakeholders) require relevant information that allow strategic planning. All involved groups, researchers, policymakers, producers, industry, and environment NGOs, consumers, should collaborate in a trustful way.

For an effective continuous support of the policy-making process for enhancing the sustained and responsible productivity in agriculture, workshop participants suggested the creation of institutionalised dialogue groups (transcending typical project funding periods) representing all interest groups, responding to clear policy questions, summarizing scientific evidence, and advising policy in a transparent way. As examples, several participants referred to the IPCC processes for producing reports or to the German socio-economic base line. Commissioned, funded meta-analyses were mentioned as alternative or complementary actions.

FACCE JPI is in a position to support the implementation of such a transparent policy-advise mechanism or structure. It could provide the institutional background for coordinating the question(s) and processes; it provides technical and financial resources and it could engage in dissemination. Regular European assessment reports based on scientific rigour and stakeholder engagement in setting scenarios or questions would presumably be attractive to a wide range of audiences within Europe and globally. An important component of the infrastructure for the assessment reports would have to be, in the opinion of the workshop participants, the brokerage of information, with the training of “science translators”.

An institutionalised assessment process could be linked to many European and global initiatives and programmes. Specific links would depend on the focus question(s) and cannot be determined at this stage. Similarly, the process could be set up such that regional aspects are included appropriately. An institutionalised process for assessments could also be expected to lead to an alignment of national and European research programmes by defining state-of-the art scenarios, quality requirements, and data infrastructures. Overall, it would contribute to FACCE’s objectives of research alignment, increase of high-quality research activities and raising the impact for meeting the societal challenge of food security, agriculture, and climate change.

The next step would now be to suggest concrete actions for specific political goals, also considering the outcomes of the workshops of clusters 1 and 2, and discuss it with the more directly affected stakeholder groups for potential implementation.

### Appendix 1: Agenda, 19–20 October

| Time | Agenda | Presenter |
|---|---|---|
| | **19 October 2016** | |
| 12:00 | Registration/Lunch | |
| 13:00 | Welcome | Stalb |
| 13:10 | Aims of the workshop, Introduction to FACCE | Köchy |
| 13:20 | Tour de table | |
| 14:05 | Presentation "FACCE MACSUR" | Köchy/Lehtonen |
| 13:45 | Presentation "Agricultural extreme weather …" | Krengel |
| 14:25 | Presentation "Agrofood chain adaptations to climate change impacts" | FoodDrinkEurope |
| 14:45 | Break | |
| 15:05 | Group discussions:<br>What (costly) investments/strategies have a lifetime > 20 years?<br>Are they affected directly or indirectly by climate change? | |
| 16:15 | Break | |
| 16:35 | Group discussion:<br>What information would affect the decisions?<br>Which actors are necessary or involved to provide the information? | |
| 17:55 | End | Bittner |
| c. 19:00 | Joint dinner | |
| | **20 October 2016** | |
| 9:00 | Morning welcome, summary of day before, plan for today | Bittner/Köchy |
| 9:10 | Presentation "What models and scenarios are good for (and what not)" | Feike |
| 9:30 | Presentation "The Thünen baseline" | Köchy |
| 9:50 | Group discussions:<br>What information is available, what form?<br>What does not work, what works? | |
| 10:45 | Break | |
| 11:00 | Presentation "Knowledge gaps in integrated assessment of agricultural systems at the European level" | Janssen |
| 11:20 | Group discussion:<br>What can be done (methods, formats, initiatives)? | |
| 12:30 | Break | |
| 12:45 | Preliminary summary | Bittner/Köchy |
| 12:55 | Thanks - Goodbye | Stalb |
| 13:00 | Lunch | |
| 13:30 | End | |

## Appendix 2: Documentation of group discussion notes

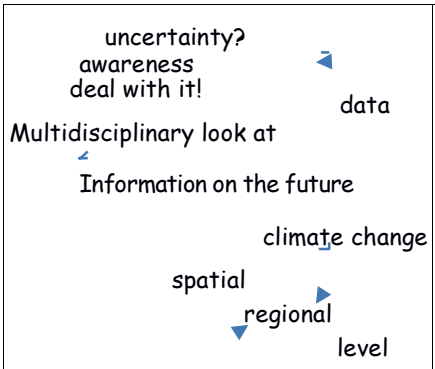
Question 1.1: What costly investments/strategies in agriculture have a lifetime >20 years?

| | | |
|---|---|---|
| • education<br>• adaptive capacity building<br>• soil quality management<br>• water management<br>• land use change<br>• breeding | • buildings<br>• infrastructure (drainage, irrigation, etc.)<br>• land sale/purchase<br>• large machinery … (depreciation)<br>• perennial crops<br>• co-operative strategies (human, economic)<br>• insurance ∑annual vs perennial crops<br>• supplier contracts/conditionality<br>• livestock systems<br>• breeding [plants, livestock] (cultivars, germplasm, genomes)<br>• rural advisory service<br>• agri-education (secondary and tertiary level) + research<br>• monitoring infrastructure<br>• systems research (esp. long-term)<br>• institutional structure (lots!) | • irrigation systems + draining<br>• soil improvement<br>• water infrastructure (water reservoirs, interregional transport systems)<br>• environmental impact assessment (before starting a new factory)<br>• land use changes<br>• insurances<br>• farmer networks (machines, sharing)<br>• investments in dairy farming<br>• investments in research |

Question 1.2: Are they affected by climate change/food security/agricultural production/agricultural policies/global issues (e.g. population growth, trade barriers, research)?

| | | |
|---|---|---|
| • Development of rural areas (human resources) (producer-consumer-relationships)<br>• Information technology will improve the Adaptive Capacity (sensors – big data – GIS – new breeding technologies)<br>• Genetic resources?<br>• Dietary changes<br>➢ crops<br>➢ LUC | markets: price/demand<br>climate: means/extremes<br>supply (spatial changes)<br>demand changes: diet<br>quantity × popn.<br>social structure: succession<br>cultural structure: local identity + policy + CAP<br>CAP +<br>EU + national policies<br>innovation → options<br>legal implementation of policies<br>political choices→ global stewardship<br>→ vs.<br>societal choices → parochial issues<br>supply of natural resources (+ES)<br>biophysical limits<br>new (+dispersal of) diseases/pests | • best practice at local level benchmarking |

Question 1.3: What information would affect these decisions or strategies?

| | | |
|---|---|---|
|  | • Improved certainty and scenario-planning about key factors (bigger picture)<br>• Improve understanding about interactions among priority factors (social, environmental, economic, governance)<br>• Relative priority of the factors<br>• Feedback effects following decisions/actions<br>• What are relevant performance thresholds/tipping points for these food chains/systems<br>• Understanding effects across different scales (space, time), systems<br>• ↑ clarity$_{(politicians)}$ about longer-term **policy** objectives (> 5-year)<br>• level of price fluctuation | • spatial data (maps):<br>➢ weather, soil changes<br>➢ high resolution<br>➢ standardisation<br>• priorization of scenarios<br>• research findings (new, existing)<br>• valuable information on prices & markets<br>• upcoming policy regulations<br>• relevant, urgent, most relevant topics for (→priorization) research and funding<br>• reliable models targeted to local need<br>• benefits for society, ecosystem services, …<br><br>A) Cause (Input) B) Output |

Question 1.4: Which actors are necessary or involved to provide the information? (plenary discussion)

- Scientists
- Policymakers
- Farmers
- Bankers
- Consumers
- Producers,
- Industry
- Insurances
- Educators
- Extension services
- Visionaries
- (who not)
- Psychologists
- Marketing people
- Social economists
- Journalists
- NGOs
- Knowledge brokers
- Weather services

Question 2.1: What information (knowledge, data, resources) is available/not available for developing policy instruments for supporting and controlling mitigation and adaptation strategies?

| | | |
|---|---|---|
| Better data integration of<br>• remote sensing (Copernicus)<br>• statistical data<br>• farmer specific information of fields & management<br>↳link to precision farming<br>• near sensing: drones, farm machinery<br>Access to data:<br>• farm manure management<br>• farmer to field link<br>• variety trials<br>↳pesticide application<br>• feedbacks between subs-systems<br>• ↳policy targeting ⇒ more granular?<br>↳different farm types<br>↳different regions<br>↓<br>farm scale model<br><br>accounting | • Monitoring data I<br>◦ Thünen baseline (economic)<br>*NB: FADN as an existing platform: can we add new variables? e.g.:*<br>*– biophysical data*<br>*– environmental impacts*<br>*– mitigation practices*<br>*– adaptation practices*<br>*– soil*<br><br>• Monitoring data II (processes→practices)<br>◦ biotic (pests, diseases, weeds)<br>◦ abiotic (soil, extremes, $\overline{x}$ )<br>◦ biotic × abiotic<br>◦ long-term<br>• Integrated Modelling Platforms<br>• System-scale research & long-term<br>• System-scale: comprehensive & across multiple dimensions **simultaneously**<br>e.g.<br>biophysical + societal/cultural<br>+<br>yield + food industry +<br>+<br>economics + ecological<br><br>This ⇒ trade-offs, synergies, interactions<br>• Currently available research/info not always **informs** policy instruments<br>or is not used | • available<br>➢ Thünen baseline (economic)<br>➢ policy briefs/expert's reports<br>➢ Co-management experience from fisheries sector (dialogue with fishermen: "What would you do **if** …"<br>• not available<br>➢ information what is already existing<br>➢ sharing culture [**open access data**]<br>➢ high resolution (output data) (**summary**)<br>➢ **impact of policies**<br>➢ **information on reliability** of output/models<br>➢ one priorized scenario = mean scenario<br>➢ **Climate baseline** (incl. farmer behavior, farmer reaction)<br>➢ **indicators** |

Question 2.2: How does the information reach the actors?

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| ➔ institutional collaboration<br>➔ expert group<br>➔ beyond the project<br>➔ sharing practices on ag. adaptation<br>↳ online | EU Commission<br>◦ info flow is not transparent<br>◦ decision-making happens, but by whom?<br>National/regional<br>◦ transparency?<br>◦ need wider dissemination + platforms<br>Food industry<br>◦ depends on size of MS + network<br>◦ stakeholder consultations<br>Farmers<br>… | |

Question 2.3: What can be done to improve the situation? (Methods, formats, initiatives, research …)

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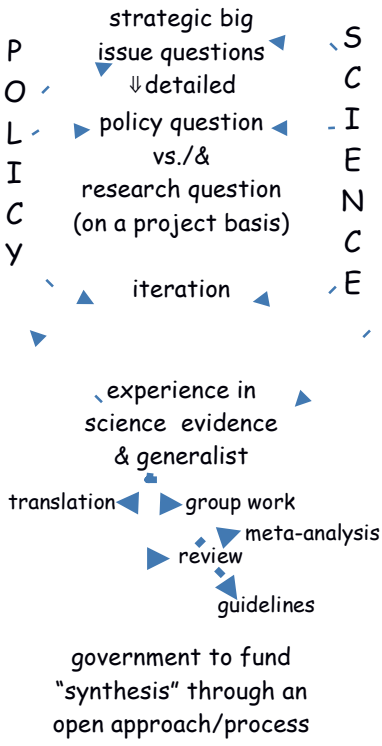
|  <br>government to fund "synthesis" through an open approach/process | discipline-specific:<br>university ∗ stakeholders<br>institutional reward structures<br>→incentivise ↑dissemination | • forming common **groups** (e.g. IPCC)<br>➔ scientists (+policy makers)<br>➔ interface between both<br>• **training** (of scientists) to address policymakers<br>• **education**, e.g. master course<br>• **internships** at policy making institutions<br>• **shared employees** |