Agriculture Food Security and Climate Change

Report of

FACCE-JPI Mapping and Foresight

on

Environmentally sustainable growth and intensification of agriculture

Options for strategic collaboration

FACCE CSA Mapping Meeting 5

10th and 11th April 2013

Berlin, 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 by 2050. 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 21 countries and aims to improve the collaboration in research policies and research effort of its member countries to tackle these global challenges for Europe by aligning research programmes among Member States.

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This report could not have been conceived without all efforts and dedication of all the participating Member States of FACCE-JPI and all participants of the Mapping Meeting.

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Contents

Summary

Joint Programming is a Member State-driven initiative to join forces in research and education to tackle societal challenges of common interest. *Food security, Agriculture and Climate Change* (FACCE) is such an area.

In order to identify joint programming opportunities and activities, *mapping* exercises are performed through meetings in which delegates from participating countries meet to exchange information and views in order to create a common context. At mapping meetings *posters* are used to provide information on the research efforts and policy framework of each participating country.

This report describes the outcome of the fifth mapping meeting, which brought together fifty participants. Thirty-three country delegates from nineteen countries participated in moderated breakout sessions, among them members of the FACCE-JPI Governing Board. Speakers and representatives of the next bodies and organisations contributed to these discussions as well: the JPI Secretariat, the Scientific Advisory Board, the Horticulture Working Group of EPSO (European Plant Science Organisation), FABRE-TP (The Sustainable Farm Animal Breeding and Reproduction Technology Platform), Technology Platform 'Plants for the Future', FP7 project LIAISE (Linking Impact Assessment Instruments to Sustainability Expertise) the ERA-NET Core Organic. The main aim of the break-out sessions and concluding plenary session was to identify gaps and overlaps, and opportunities for collaboration.

The topic debated was *Environmentally sustainable growth and intensification of agriculture*. It was generally accepted that agricultural intensification is as a positive process (as it results in an increase of outputs per hectare cultivated), but it can produce negative effects on the sustainability of the environmental, economic and social systems. Hence the difficulty arises from joining sustainable growth with intensification of agriculture. Will it be possible to maximize plant and animal production without damaging biodiversity and ecosystem services? This is a critical topic that is starting to be addressed at policy and science forums across Europe.

The main issues identified to move towards more environmentally sustainable growth and intensification of agriculture are:

- The need to work in a multi-disciplinary way to get a **systems approach**, taking into consideration not only technological issues but also socio-economic and policy aspects at farm level as well as at landscape level;

- **diversification** in combinations of crops, livestock and bioenergy at farm and landscape levels as a key point to foster resilience of the agro-systems (to both economic and environmental fluctuations) and to achieve the desired growth and intensification in a sustainable manner;

- to focus on new perspectives for **plant and animal breeding**, due to the need to have more resilient varieties with higher production and lower input needs;

- to step up the research on **farming systems**, focusing on the efficient use of inputs (reducing the amount of water, nutrients, pesticides, etc.) through the development of new technologies, which can help sustainable intensification;

- to foster the resource/data availability and **mutual learning** through the development of common methodologies.

Tools for and towards joint research are focussed on the sharing of resources, be it money, infrastructure, expertise, or data. Based on the issues raised, the main recommendations with regard to sharing resources are:

- to set up **networks for inter-regional exchange** of knowledge and technologies;

- **knowledge sharing** and co-design of research and innovation among researchers and farmers and among organic farmers and conventional farmers;

- to initiate joint **experimental farming** through long term experimental/demonstration farms;

- to open access to **genetic resources (**envisaged by Eurisco and FAO) and to breed and select for environmentally sustainable agricultural systems with higher productivity;

- for **FACCE-JPI to establish collaborations** with other initiatives and organisations such as AnaEE (an ESFRI infrastructure), JPI water, EIP-water, EIP agriculture, SUSFOOD, JPI HDHL and the EC.

1. Introduction

Strategic collaboration between Member States

The Joint Programming Initiative on Food Security, Agriculture and Climate Change (FACCE-JPI) brings together 21 countries with the aim to enhance the cooperation and alignment of research efforts and policies among the member countries. This is essential to tackle the global challenges that Europe is facing.

Within the Coordination and Support Action for this JPI (FACCE CSA), Work Package 2 (WP2) is conducting Mapping and Foresight activities for Strategic Collaboration. The goal of WP2 is to support the FACCE-JPI in the development of a strategic research agenda that should be implemented through the collaboration among Member States.

The mapping and foresight activities of FACCE-JPI are organised in the framework of the coordination and support action FACCE-CSA, coordinated by INRA and BBSRC. These mapping activities are organised by three of the CSA partners: Wageningen University and Research Centre (Wageningen UR); the Ministry of Economic Affairs (EZ) from The Netherlands; and the National Institute of Agriculture and Food Research and Technology (INIA) from Spain.

This report describes the aim of the mapping and foresight activities, the scope and boundaries for the fifth mapping meeting on *Environmentally sustainable growth and intensification of agriculture,* the output of the break-out groups and the general conclusions drawn. It also provides a compilation of information resulting from a desk study. The report ends with conclusions and recommendations to the Governing Board of FACCE-JPI.

Mapping and foresight for strategic collaboration

The objectives of WP2 are:

- Identification of complementarities, duplications, and gaps (in current and future research).

- Identification of areas for improved coordination, cooperation and exchange (information, people, practices).

- Creation of a common context and opportunities for networking.

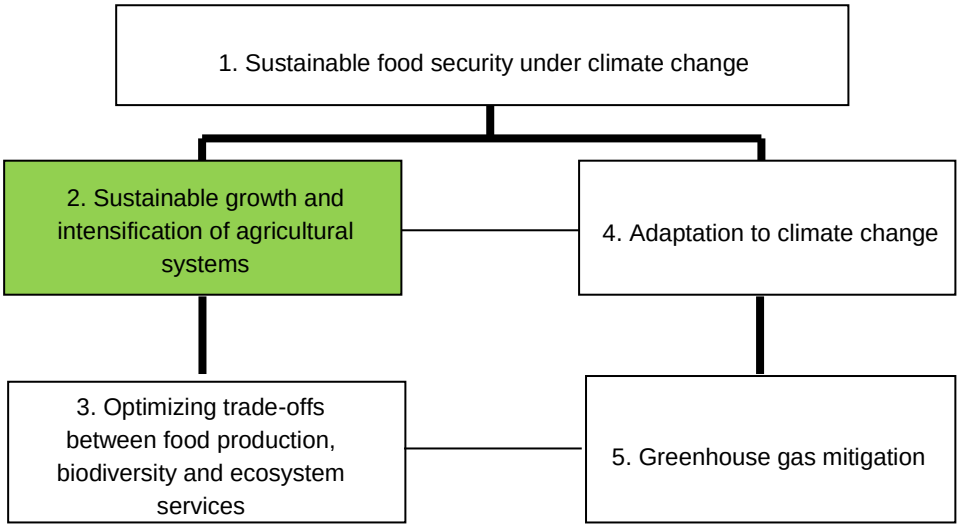
- Identification of perspectives and possibilities for pooling research resources (funding, people and facilities).

- Proposal of joint programming activities.

The mapping approach is based on the information provided by the participating countries which is discussed during the mapping meetings and compiled following a desk study. For more detailed information on the approach see reports on mapping meeting 1, 2, 3 and 4: http://www.faccejpi.com/Document-library/Mapping-meeting-reports

Five core themes; five mapping meetings

The five core themes (CTs) and their interconnections adopted by the Scientific Advisory Board (SAB) are as follows:



The theme of the first mapping meeting was on CT5 *Greenhouse gas mitigation*. The meeting was held on 20th and 21st June 2011 at the Ministry of Economic Affairs, Agriculture and Innovation in The Hague, the Netherlands.

The theme of the second mapping meeting was on CT4 *Climate change adaptation*. The meeting was held on 22nd and 23rd February 2012 at the National Institute of Agriculture and Food Research and Technology (INIA) in Madrid, Spain.

The theme of the third mapping meeting was on CT3 *Assessing and reducing trade-offs between food supply, biodiversity and ecosystem services.* The meeting was held on 11th and 12th July 2012 at the facilities of the Department of Agriculture, Food and Marine of Ireland at Backweston Campus, Celbridge, near Dublin.

The theme of the fourth mapping meeting was on CT1 *Sustainable food security under climate change.* The meeting was held on 17th and 18th October 2012 at the National Institute of Agriculture and Food Research and Technology (INIA), in Madrid, Spain.

This report describes the results of the fifth mapping meeting, on CT2 *Sustainable growth and intensification of agricultural systems* that took place at the Federal Ministry for Food, Agriculture and Consumer Protection in Berlin, Germany, on 10th and 11th April 2013.
All reports are available at http://www.faccejpi.com/Document-library/Mapping-meeting-reports.

Posters

In the mapping meeting we used the information that was provided on structured posters. Each participating country was asked to provide information in two posters; one poster containing information on on-going scientific research programmes and the other poster on research policy/funding. The Governing Board members of the participating countries were responsible for the nomination of delegates and the accuracy of the information provided.

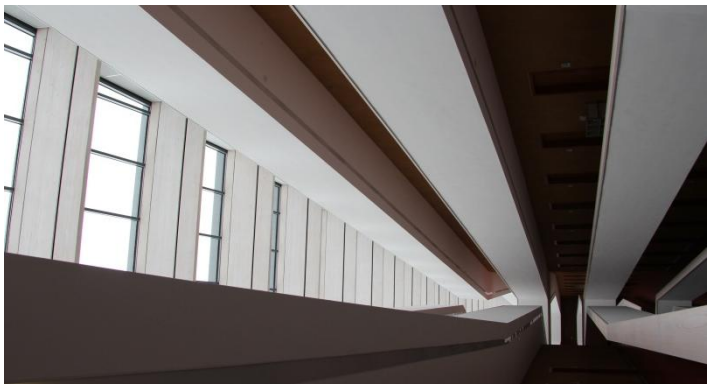
Group discussions

The country delegates and experts attending the mapping meeting had the opportunity to request clarification from their counterparts and to highlight in a consensual manner the most relevant issues and conclusions. The organisation of the group discussions is described in Annex 3.

Desk Study

In addition to the outcomes generated during the meeting, the information available in the posters was subjected to a desk study, following the same approach used in conventional mapping exercises based on information gathered through questionnaires. This provided additional insight for identifying/verifying complementarities and gaps.


Núria Duran



2. Fifth mapping meeting on *Environmentally sustainable growth and intensification of agriculture*

2.1 Meeting approach

The meeting was hosted by the Federal Ministry for Food, Agriculture and Consumer Protection of Germany and it was opened by Martin Köhler, Head of the Directorate on Consumer Policy in Society & Coordination of Research of this ministry. The meeting brought together research policy representatives and science experts from nineteen countries, two SAB members and a representative of the ERA-NET Core Organic. Furthermore, the Horticulture Working Group of EPSO (European Plant Science Organisation), FABRE-TP (The Sustainable Farm Animal Breeding and Reproduction Technology Platform), the Technology Platform 'Plants for the Future' and the FP7 project LIAISE (Linking Impact Assessment Instruments to Sustainability Expertise) were invited to give presentations on their objectives and achievements and to participate in the overall meeting activities.
After the introductory presentations, the participants analysed the information on funding programmes and research projects of the participating countries. This information, for which each of the Member States was responsible, was shown in a series of posters. These posters (for which formats were elaborated by the organising team of the meeting) were filled in advance by country delegates. The posters were distributed to all participants a week before the meeting and were included in the meeting binder. There was also a poster on FP7 projects and a poster on bioeconomy ERA-NETs. Country delegates, invited speakers and other participants were distributed into six working groups in which the funding and scientific information of the participating countries was analysed with the aim of identifying gaps and overlaps, and of proposing recommendations and topics for future joint actions. Each group presented a report in the plenary discussion afterwards.

2.2 Scope and boundaries

The thematic scope of the fifth mapping meeting was the CT2 of the Scientific Research Agenda: ***Environmentally sustainable growth and intensification of agriculture***

This topic as defined by the Scientific Advisory Board includes the following aspects:

- providing new approaches for improving farm management and for the sustainable intensification of agricultural systems, but also for low-input high natural value systems in Europe under current and future climate and resource availability;
- understanding recent yield trends in Europe, taking into account changes in costs and prices and research investments as well as changes in environment, management and genotypes;
- benchmarking efficiencies of resource use (water, N, energy) according to Genotype x Environment (including climate) x Management combinations across Europe;
- assessing and raising biological resource use efficiency of crop and livestock systems; increasing total factor productivity;
- combining crop, livestock and bioenergy systems for sustainable intensification;
- low input, higher efficiency seeds and breeds;
- knowledge based IT innovations in agriculture;
- improved understanding and control of soil functioning and biotic interactions at field to landscape scales.

According to the FAO definition "Sustainable crop production intensification (SCPI) aims to increase crop production per unit area, taking into consideration all relevant factors affecting productivity and sustainability, including social, political, economic and environmental impacts. With a particular focus on environmental sustainability through an ecosystem approach, SCPI aims to maximize options for crop production intensification through the management of biodiversity and ecosystem services".

During the meeting an initial discussion on the meaning of "intensification of agricultural production" and "sustainable intensification" was undertaken. It was recognised that different definitions can be used affecting the dimensions of CT2 (the subject of MM5). In this regard, it was recognized that sustainable intensification must take into consideration many issues such as agricultural production, energy, use of water and nutrients, labour, knowledge, economic values, ecosystems services of the agro-ecosystem complex, social coherence and natural resources. Their impact should be considered at plot level, farm level as well as on landscape level, taking into

account the potential of each region within Europe. The challenge is to undertake all these issues and establish how they can be integrated in the overall agro-system, in order to reach sustainable growth and intensification taking into account dependency on the local, regional and national conditions. On most of the single issues, research is already undertaken, however additional research is needed to make innovation go faster and to integrate different aspects and disciplines, throughout the whole food chain. Besides the academic knowledge, farmers' experience is critical to achieve the challenge of growth and sustainability in the agro-systems of European countries.

Following the summary of the results of the first break-out session, the second session provided an opportunity for further discussion, focussing on identifying further messages, and deepening of the following main areas:

- systems approach to integration;
- diversification at farm and landscape levels;
- plant and animal breeding;
- farming systems;
- social and economic aspects of sustainable intensification;
- resource/data availability and mutual learning.

3. Additional information from a desk study on the poster information

In order to gain additional insight, the information provided in the posters was subjected to a desk analysis in order to identify complementarities and gaps. Therefore the desk analysis focused on two main objectives:

1. Identification of research priorities on *environmentally sustainable growth and intensification of agriculture* as well as gaps, overlaps and emerging research lines.
2. Identification of Financing Agencies and Research Programmes.

The analysis of the information provided in the posters from the 18 participating countries (Austria, Belgium, Cyprus, Denmark, Germany, Estonia, France, Finland, Ireland, Italy, The Netherlands, Norway, Poland, Romania, Spain, Switzerland, Turkey and United Kingdom) is summarised below.

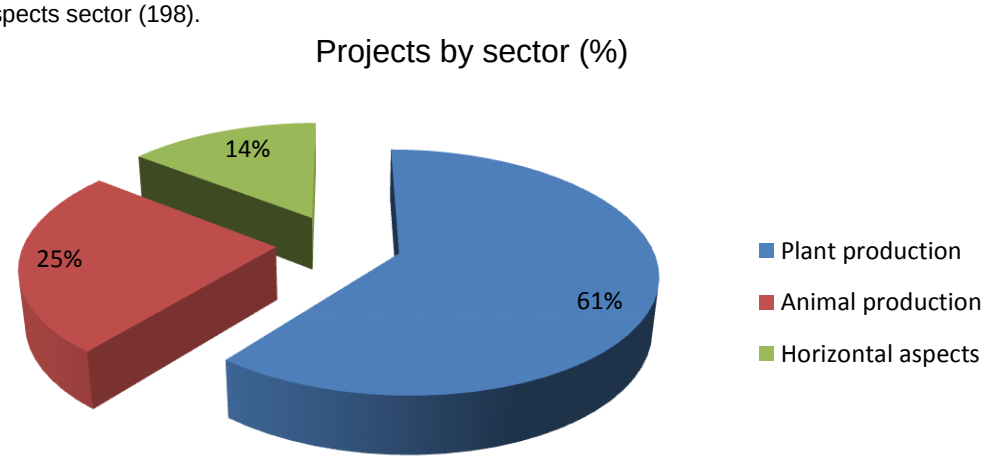
3.1 Overall analysis

The posters analysed provide information about the projects carried out in this area in each of the participating countries (on-going or during the last three years).

3.1.1 Projects

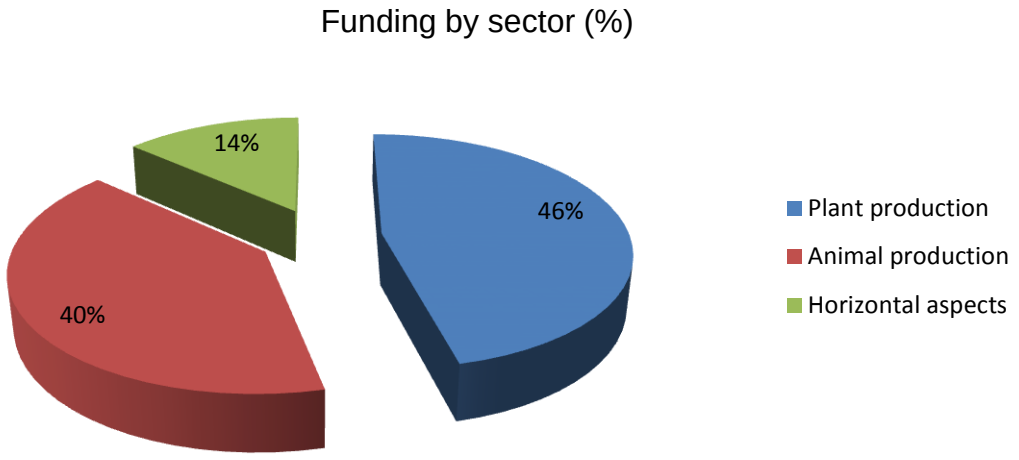
In the poster formats provided to the experts (that they filled in according to the information of their national research and funding agencies), projects on *environmentally sustainable growth and intensification of agriculture* were classified into three sectors: Plant production (cropping systems), Animal production and Horizontal aspects. Thus the 1371 **projects** have been classified into these three sectors (Figure 1): Plant production is the sector where more projects are being carried out in the last three years (833), then Animal production (340) and finally Horizontal aspects sector (198).

Figure 1



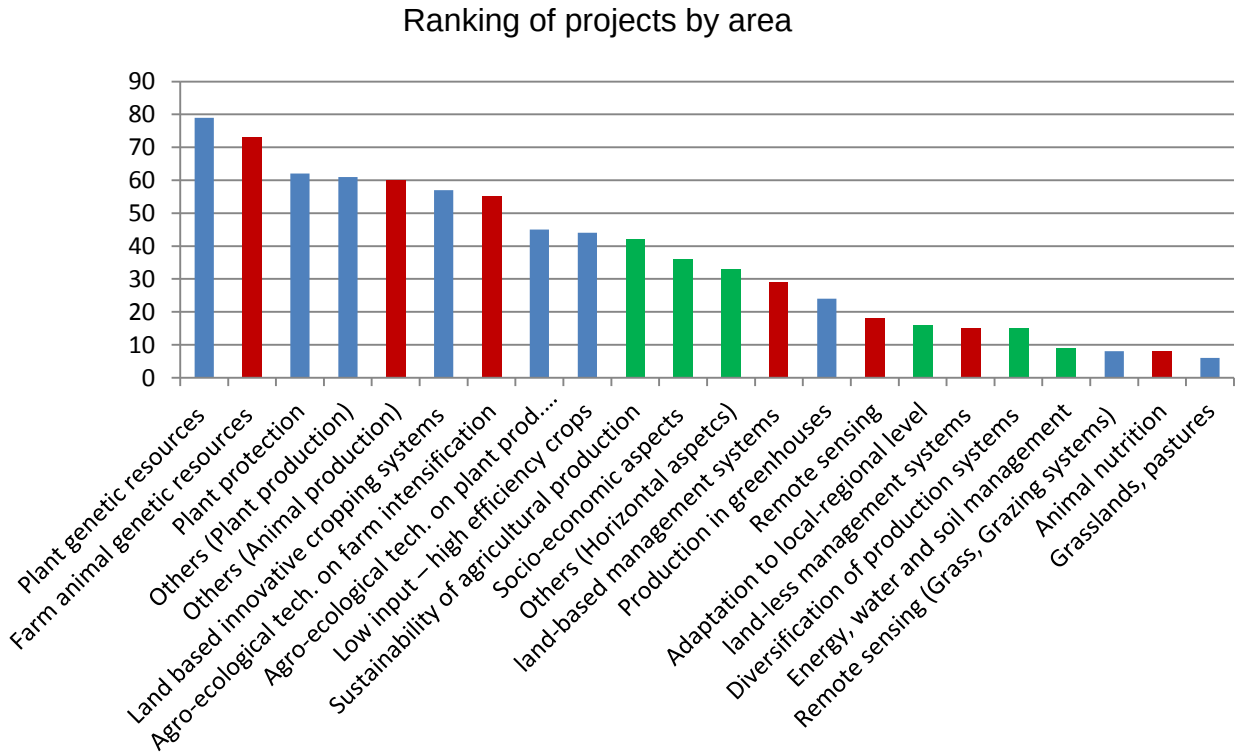
Regarding the **funding by sector** (Figure 2), Plant production is the most funded sector (314 M€) closely followed by Animal production (273 M€). Horizontal aspects (92 M€) is the least funded sector. From this information, it can be inferred that projects on animal production are on average highly funded compared to the plant production ones.
Some countries have provided incomplete data about their total funding (BE, CH, DE, and RO). Therefore the results provided here do not take or take only partly into account the information of these above-mentioned countries.

Figure 2



The ranking (Chart 1) illustrates the **areas with more projects** within the different sectors (keeping the colour pattern used in the previous graphs; plant production areas in blue, animal production areas in red, horizontal aspects in green,). A total of 22 research areas have been identified. The most important ones regarding the number of projects are Plant genetic resources, Farm animal genetic resources and Plant protection. Plant production and Animal production are the sectors with more areas within the important ones (nine out of the top ten).

Chart 1



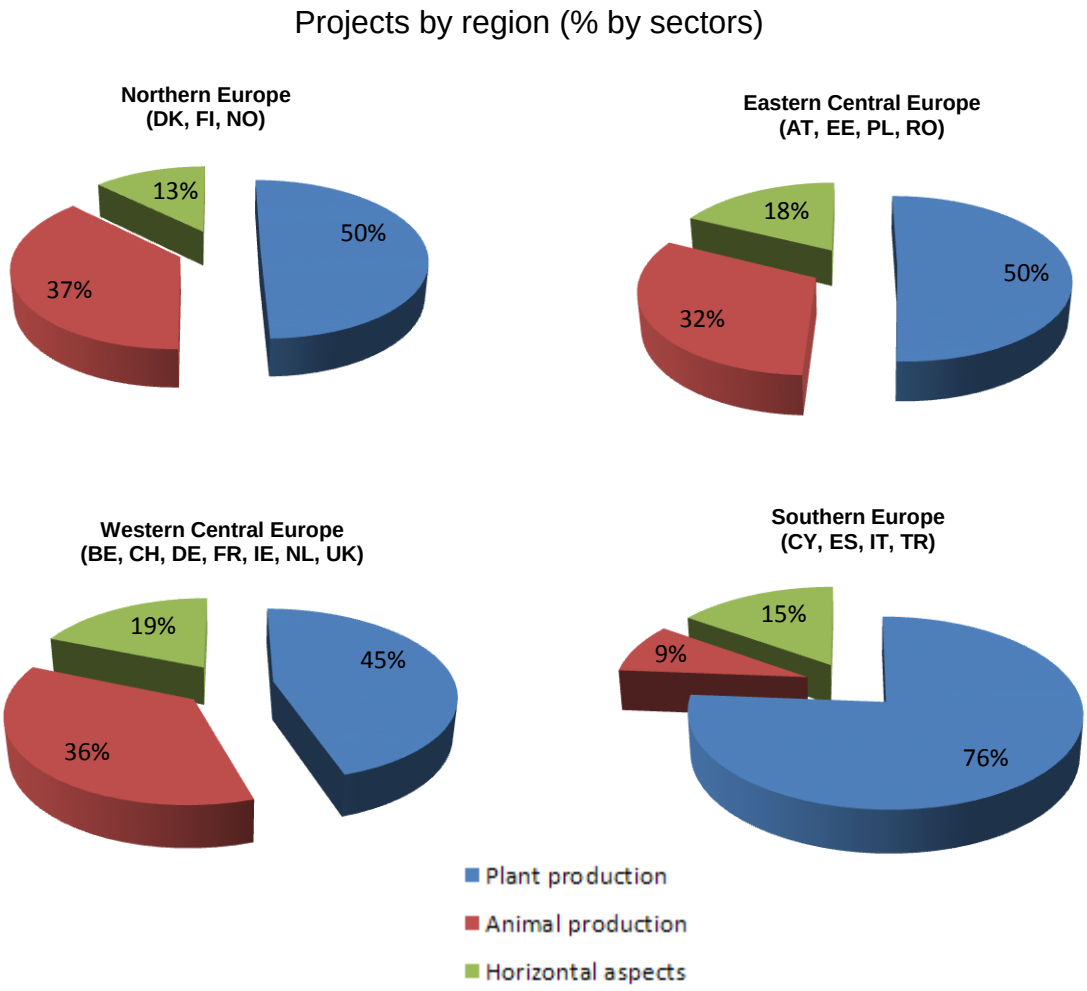
Although there was a section in the posters devoted to **research effort by area,** unfortunately, only few countries provided complete information about it. Hence, due to the lack of reliable information no analysis has been carried out on this topic.

3.1.2 Distribution by regions

The analysis of the previous information from a regional perspective (taking into consideration different clusters of countries within Europe) provides the following information. **The distribution of projects (considering each sector) within the different regions** is shown in Figure 3.

It is remarkable that Plant production is the most important sector in all the regions, representing half of the total of projects in Northern, Eastern Central and Western Central Europe and even more in Southern Europe (76%). Regarding Animal production it has a similar share of importance (around 35%) in three regions (Northern, Eastern Central and Western Central Europe) while in Southern Europe appears to be the least important sector (9%). Horizontal aspects have a similar importance in all the regions (ranging from 13% to 19%). These results illustrate that there are important differences in the share of sectors between Southern Europe and the rest of European regions.

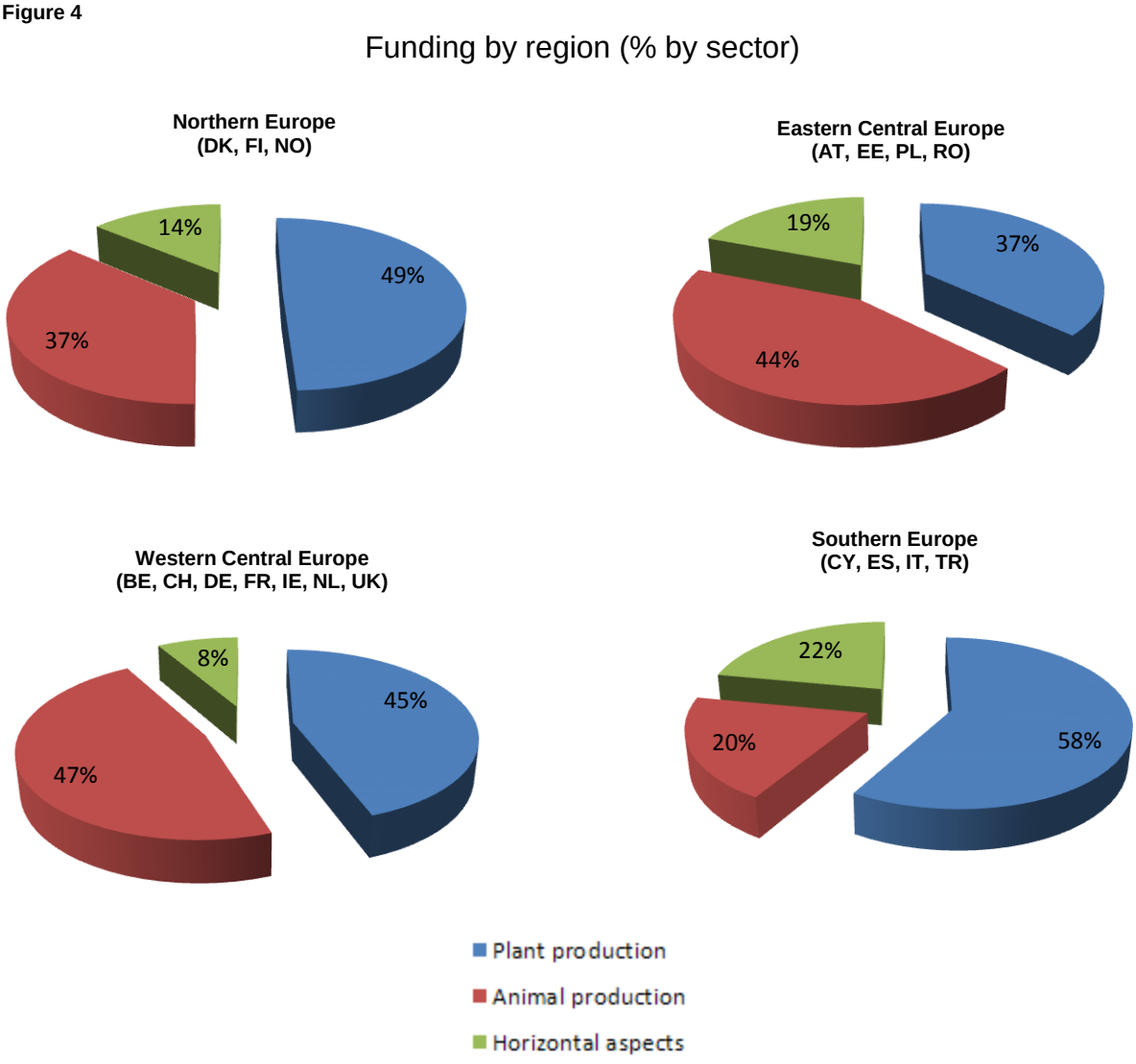
Figure 3



The analysis of **funding information by region** (Figure 4) shows that in Northern Europe there is correlation among the number of projects and the percentage of funding devoted to each sector (Plant production is the most funded sector). This appears not to be the case in the rest of the regions. Thus, it is remarkable that Animal production is the most funded sector in Eastern Central (44%) and Western Central Europe (47%), despite not involving a high number of projects. In Southern Europe Plant production is the most funded sector (58%) whereas Animal production receives 20% of the funding (although this area represents only 9% of the projects). Hence we can conclude that Animal production projects tend to attain more funds that the others.

Some countries have provided incomplete data about their total funding (BE, CH, DE and RO). Therefore the information provided below does not take into account all the information of the above mentioned countries.

Figure 4

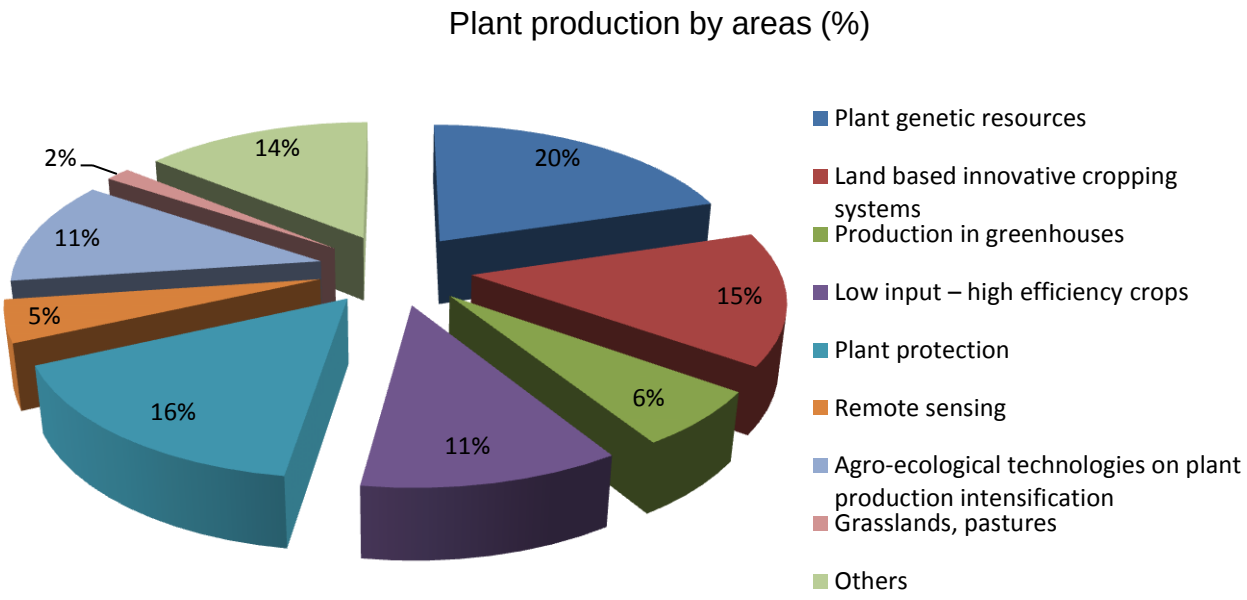


Plant production, Animal production and Horizontal aspects could be divided into specific areas. Hereunder a summary of the projects carried out in the last three years in each of these three sectors is provided:

3.2.1 Plant production

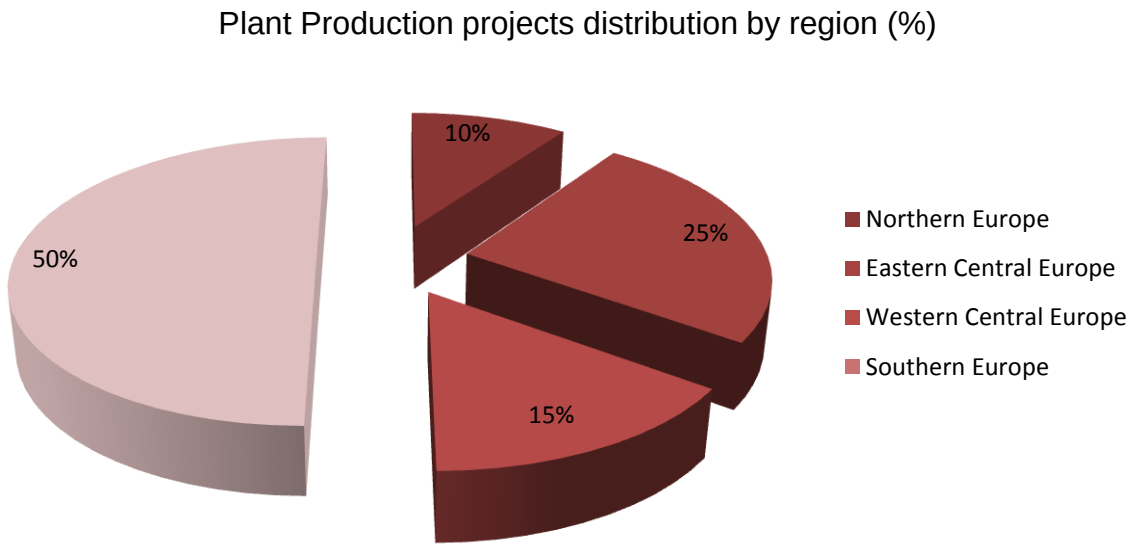
A total of **9 research areas** with 833 projects have been identified within the Plant production sector.
As illustrated below (Figure 5), four areas have a similar share of importance, with **Plant genetic resources**, being the most important one (20% of the projects carried out in the sector). Similar activity has been identified in the other areas: **Plant protection** (16%), **Land based innovative cropping systems** (15%) and **Others** (14%, including topics such as organic farming and soil protection). The remaining of areas are poorly represented: **Agro-ecological technologies on plant production intensification** (11%), **Low input-high efficiency crops** (11%), **Production in greenhouses** (6%), **Remote sensing** (5%) and **Grasslands, pastures** (2%).

Figure 5



As shown below (Figure 6) it should be noted that half of the projects undertaken in the Plant production sector are carried out in Southern Europe (417 projects).
Eastern Central Europe is the second in the ranking (209 projects), while Western Central Europe and North Europe have only 125 and 82 projects, respectively.

Figure 6

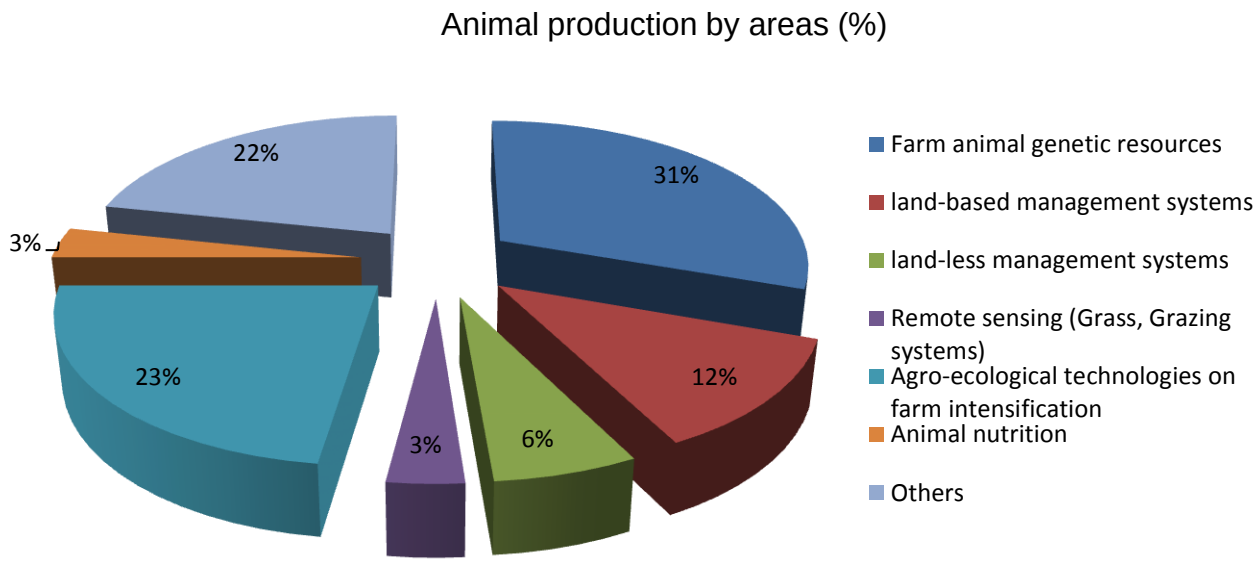


3.2.2 Animal production

Seven research areas with 340 projects have been identified within the Animal production sector. As shown below (Figure 7), the three major areas identified are **Farm animal genetic resources** (31%), **Agro-ecological technologies on farm intensification** (23%) and **Others** (22%), including topics such as organic farming. The other four areas have much less importance regarding number of projects, being 24% of the total: **Land-based**

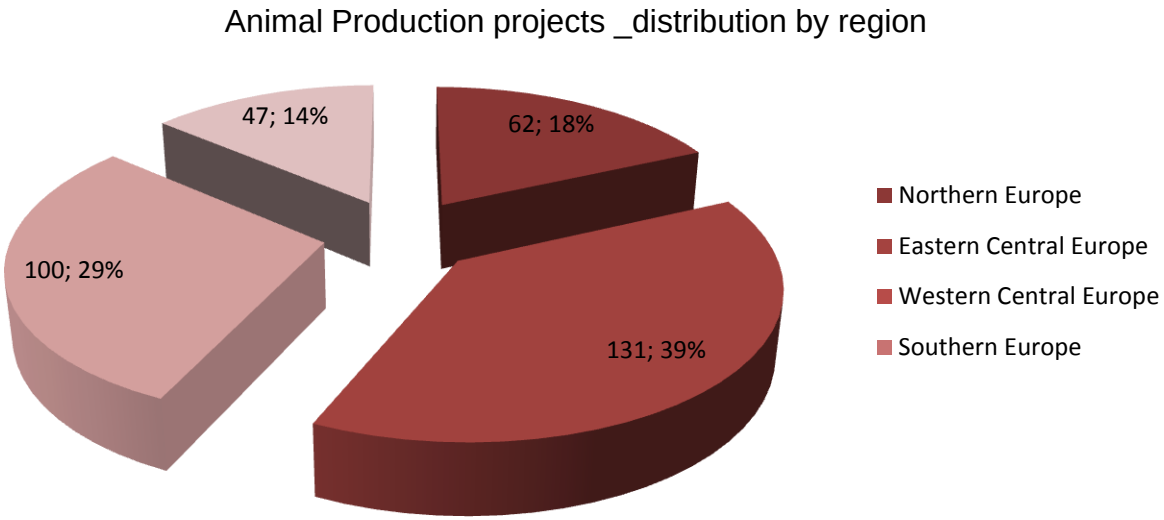
management systems (12%), **Land-less management systems** (6%), **Remote sensing (grass, grazing systems)** (3%) and **Animal nutrition** (3%).

Figure 7



Regarding the distribution by region (Figure 8), most of the projects undertaken in the Animal production sector are in Eastern Central Europe (131 projects) and Western Central Europe (100 projects). In Northern Europe (62 projects) and Southern Europe (47 projects) Animal production appears to be less important in terms of the research carried out.

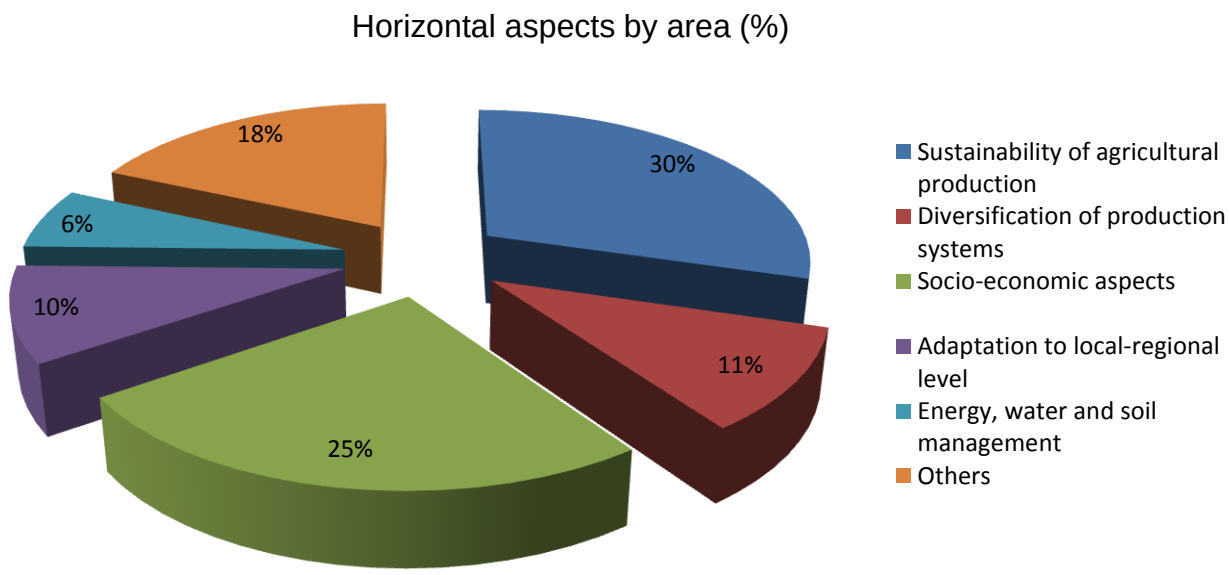
Figure 8



3.2.3 Horizontal Aspects

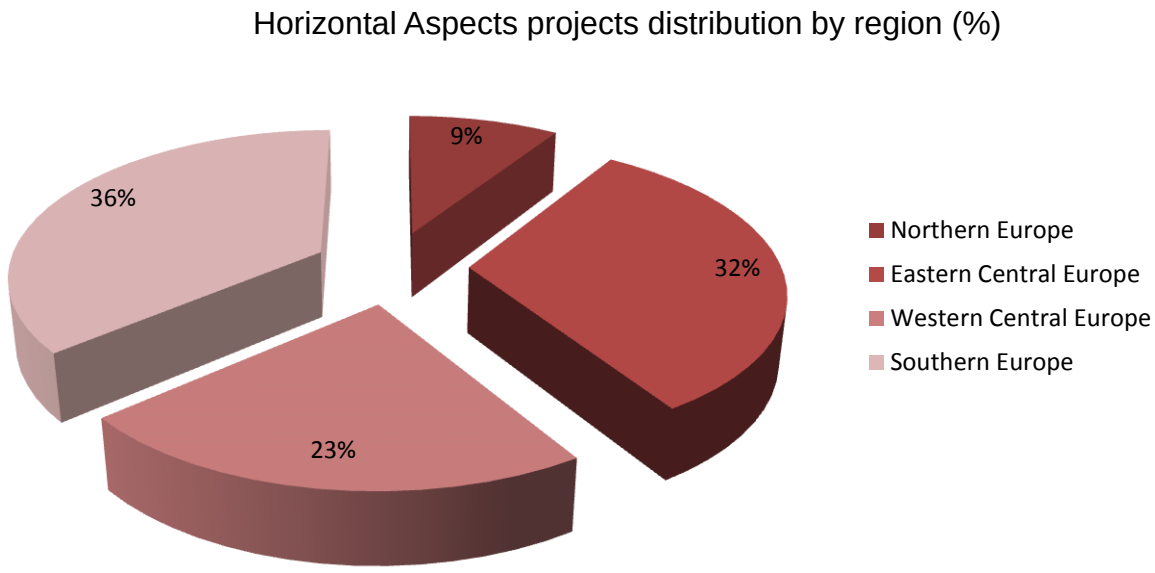
Six research areas with 196 projects have been identified within the Horizontal aspects sector. As illustrated below (Figure 9), **Sustainability of agricultural production** is the most important area (30%), followed by **Socio-economic aspects** (25%) and **Others** (18%). The remaining areas (27% of the total) are: **Diversification of production systems** (11%), **Adaptation to local-regional level** (10%) and **Energy, water and soil management** (6%).

Figure 9



As illustrated below (Figure 10), in the Horizontal aspects sector most of research activity takes place in Southern Europe (83 projects), followed by Eastern Central Europe (73 projects) and Western Central Europe (52 projects). Finally, only 9% of the projects are carried out in Northern Europe (21 projects).

Figure 10



3.3 Additional remarks

Based on the number of projects carried out between 2009 and 2013, the following areas can be considered as current **research priorities**: Plant genetic resources (79 projects), Farm animal genetic resources (73 projects), Plant protection (62 projects) and Land-based innovative cropping systems (57 projects).

The next areas should be considered as **gap areas** (with 16 or less projects in the last three years): Adaptation to local-regional level (16 projects), Land-less management systems on animal production (15 projects), Diversification of production systems (15 projects) and Remote sensing (grass, grazing systems) (8 projects).

In order to evaluate the **effort made by each country** in specific areas, it is remarkable that thePlant production sector has more weight in Southern Europe than in the rest. Regarding Animal production, Western Central Europe is the region where this sector is more important.

It should be noted that the information provided regarding funding and research effort (person-months) was not as complete as desirable to draw reasonable conclusions. Given that the costs of certain research means (personnel in particular) vary from country to country, it would have been necessary to have accurate data for comparison purposes.

Regarding FP7, 10 projects related to *environmentally sustainable growth and intensification of agriculture* have been identified, with a total budget of 63.5 M€. The average EC funding has been of around 75 % of the total cost (more information in annex 4).

Regarding ERA-NETs, there is a number of networks in the domain of agriculture supported by the directorate E (KBBE). When broadening the scope, including ERA-NETs in a bioeconomy –wide perspective, the number of actions that could contribute to the coordination and collaboration in Europe on topics that have an impact on sustainable growth and intensification of agriculture is substantial. (See annex 5; CORE Organic, ERA-CAPS and ICT AGRI are among the core initiatives in this respect).

As in the cases of the previous Mapping Meetings (1, 2, 3, and 4) the attempts to identify/quantify the **Financing Agencies** and Research Programmes of the participating countries have shown a high heterogeneity and diversity of the existing financing and accounting systems. Thus comparison is a very difficult exercise that could provide inexact and unreliable conclusions.

4. Conclusions and recommendations to the FACCE-JPI Governing Board

4.1 Recommendations for a better understanding of Environmentally sustainable growth and intensification of agriculture.

The main issues addressed in the group discussions and in the final general discussion can be outlined as follows:

1. **Systems approach to integration.** There is a consensus about the need to work in a multi-disciplinary way (integrated, systems and multisystem approaches) taking into consideration not only technological issues but also socio-economic and policy aspects, at farm level as well as at landscape level. Aspects that have to be considered in the context of all disciplines affecting agro-systems are changes in land-use, business planning, farm management, introduction of adaptive breeds of plants and animals and a more effective use of water, nutrients and soil. Methods for integrative approaches are to be further developed and should take into consideration their social coherence. Long term trials are needed to develop integrated farming systems by combining effective crop and livestock management approaches through identification of best practices.

2. **Diversification.** Research and innovation on diversification at farm and landscape levels is a key point to potentially reach and test more resilient agro-systems (to both economic and environmental fluctuations) and to achieve the desired sustainable growth and intensification. It concerns plant and

animal production (including fish, insects, algae, etc.) for food as well as non-food uses (fuel, bioenergy, etc.). In this regard, new plant varieties and management systems must be efficient in the use of water and nutrients and must allow a reduced use of pesticides and the implementation of non-chemical pest management strategies. In addition the reintroduction of species that could be associated with new farming systems and the use of new ones may help to reach more outputs with less input. Legumes are a good example of reintroduction of species, as they are an excellent source of proteins for food and animal feed as well as a way to improve soil fertility through nitrogen fixation. There are many examples of new farming systems linked to diversification: crop rotation, intercropping, livestock and aquaculture integration, mosaics, agroforestry, and eco-agricultural management methods.

3. **Plant and animal breeding.** The discussion focussed on new perspectives for plant and animal breeding, due to the need for more resilient species with the same or even higher production while reducing the use of resources (water, nutrients, use of soil, pesticides, etc.) and undesirable outputs such as GHG emissions from animals. Various companies and research institutes in different Member States have considerable plant and animal genetic resources collections as well as genomic and phenotypic data. The challenge is to develop plant and animal breeding strategies in order to deliver sufficient genotypes, and assuring the breeders access to this larger pool of genotypes. Open databases and sharing plant and animal genetic resources would be an effective collaboration instrument for faster innovations towards new varieties. In addition, more collaboration on phenotyping for disease resistance and reduction in the use of antibiotics, traits for resilience and robustness in the framework of climate change is needed. There is a debate about pros and cons of genetic modification and similar biotechnology approaches; hence research on this area has to be addressed case by case, taking into consideration different policy frameworks.

4. **Farming systems.** The efficient use of resources (water, nutrients, pesticides, etc ...) can be supported through the development of new technologies, which can help sustainable intensification: i) precision farming (including remote sensing) integrating technical and environmental aspects as well as management and productivity to improve water management both at farm and supply scales as well as animal production systems; ii) water, soil fertility and nutrient recycling through the value chain should also be entertained in support of an efficient use of inputs. In fact, water management is a cross-cutting issue that must take into consideration all perspectives, from genomics to landscape management; iii) emerging farming systems such as soil-less greenhouse technologies applied outdoors (including associated pests and diseases) and organic and low input farming; iv) agricultural systems in urban areas (the majority of Europeans living in cities and the current drive for "green cities" will become an important area of research and innovation in the next years); v) animal behaviour and welfare research towards increasing production (including aquaculture and crop-livestock integration).
   New findings can be used to decrease the yield gap between present and potential production of eco-agro-systems taking into account all the aspects that influence their complexity. Social and economic aspects are critical and new collaboration strategies among farmers are needed. Sensor technologies in combination with ICT instruments should be adapted to situations in the field but it will require additional financial support to design adequate implementation methods (collaboration with the EIP should be promoted).

5. **Methodologies, standards, and mutual learning.** Common methodologies are needed in areas such as: i) data collection (environmental and production) and creation of open data systems; ii) measurement of the sustainability of intensification in combination with certification and; iii) generation of knowledge-based approaches on intensification.
   The information being generated in certain regions can be useful for others, as new climate change scenarios arise. On the other hand, it is essential to foster mutual learning between organic and conventional systems for an eco-functional intensification, reduction of inputs, animal welfare, etc.

4.2 Recommendations for tools to deal with Environmentally sustainable growth and intensification of agriculture.

Based on the thematic considerations mentioned above, the following recommendations with regard to the tools to be developed were considered as relevant:

1. **Set up of networks for inter-regional exchange of knowledge and technologies:**

    a. Networks with existing infrastructure projects e.g. AnaEE (Infrastructure for Analysis and Experimentation on Ecosystems).
    b. Dialogue platforms among farmers and researchers as well as among stakeholders from different countries. This will allow to better use farmers' knowledge.
    c. The creation of new Knowledge Hubs.
    d. Round table discussions in order to harmonise? Agricultural products, produced under sustainable conditions.
    e. Joint actions and funding to decrease the gap between high performing European regions and regions that have low performing research and innovation systems.

2. **Knowledge and data sharing in order to:**

    a. Support knowledge-based intensification through mechanisms to improve the integration of end users in research prioritisation. Design and transfer of knowledge to different stakeholders.
    b. Encourage the cooperation and communication between organic farmers and conventional farmers. This may lead to more efficient systems with reduced inputs per unit of product.
    c. Improve knowledge-based livestock production to reduce use of antimicrobials and feed competing with food.
    d. Make existing data, including research results, available through the use of common databases.
    e. Stimulate the use of tools such as cloud computing and crowd sourcing.
    f. Foster basic research addressing issues related to strategic research and agricultural innovation programmes.

3. **Genetic resources:**

    a. The web-based catalogue Eurisco (provides information about *ex situ* plant collections maintained in Europe) and FAO are tools to share genetic resources.
    b. Genomic selection at pre-breeding (with access to sufficient numbers and genotypes).
    c. Development of tools for genomic selection (bioinformatics). Make existing data including research results more easily available (through databases).

4. **Experimental farming in order to:**

    a. Support long-term demonstration in farms and phenotyping facilities.
    b. Advocate the need for demonstration farms as a tool to provide examples of best practices to farmers.
    c. Develop methods to catalogue 'normal' (commercial, private) farms that experiment with new approaches for demonstration purposes.

5. **Collaborations that FACCE-JPI should establish with:**

    a. SUSFOOD and JPI HDHL focusing on food quality and safety.
    b. JPI water, EIP-water and/or EIP agriculture to capitalise on development of water management strategies.
    c. CORE Organic ERA-NET to secure alignment of future research and development needs and efforts in organic agriculture in liaison.
    d. The Common Agricultural Policy (CAP) to study the impact of the CAP on the ecosystem management (soil, water, pesticide use) and land management, in order to provide scientific basis about sustainability, linking it with sustainable innovation efforts in agriculture. *Could FACCE - JPI pose this question to the EC? Should CAP impacts on agriculture should be studied.*


FACCE-JPI
MAPPING MEETING 5
working group 2: room 3.1.050
working group 3: room 3.3.050
working group 4: room 3.4.130
working group 5: room 2.3.390
working group 6: room 2.3.030
LIAISE brainstorm: room 3.1.050
room 3.4.130
room 3.1.050


Systems
Approaches to integration
Integrated systems based approach
land use / business planning
land-
farm
market
Outcomes
scenes of income (market)
multidisciplinarity
we need
Address funding to be inclusive

Annexes

Annex 1. Programme of the mapping meeting

FACCE JPI Mapping Meeting on Core Theme 2

Environmentally sustainable growth and intensification of agriculture

10th and 11th April, 2013.
Federal Ministry for Food, Agriculture and Consumer Protection
Wilhelmstraße 54, 10117 Berlin, Germany
Chairs: Hartmut Stalb (BMELV; FACCE-JPI Governing Board member)
Christine Bunthof (FACCE-CSA WP2)

Wednesday 10th April	
9:30–10:15	Registration and coffee (valid identification document required since there is a security check)
10:15–10:45	**Opening by chairs** **Welcome** by Martin Köhler from the Federal Ministry of Food, Agriculture and Consumer Protection. Head of Directorate "Consumer Policy in Society & Coordination of Research". **Welcome** by organisers (Christine Bunthof, FACCE-CSA WP2)
10:45 -12:00	**Introduction and background presentations** Introduction FACCE-JPI Isabelle Albouy (FACCE-CSA coordinator) Introduction on the theme of the meeting 'Environmentally sustainable growth and intensification of agriculture' Pirjo Peltonen (MTT Agrifood Research Finland; FACCE-JPI SAB member) Scope and aim of mapping exercises and this mapping meeting Núria Duran (FACCE-CSA WP2) Programme for today and tomorrow and guidance for break-out session Christine Bunthof (FACCE-CSA WP2)
12:00-13:00	**Studying posters**
13:00–14:00	Lunch
14:00–15:30	**Break-out session 1** *For distribution in groups and rooms, see scheme in meeting binder* Group discussion: i. Share information of countries around the table on national research policies, programmes, funding and projects. ii. Identify gaps and overlaps and propose-prioritize areas and tools for joint action. iii. Give recommendations for prioritized areas towards coordination between Member States (defining scope, scale, modalities – i.e. sharing resources, defining funding available and funding needed, etc.) ➔ Summarize the discussion outcomes in an electronic version of the *Break-out session Report Form* for the presentation.
15:30-16:00	Coffee break
16:00-17:00	**Reports by short presentations from break-out groups**
17:00-17:30	**Guest presentation** Research for impact assessment of policies in agriculture Katharina Helming (FP7 LIAISE)
17:30	**End of day 1**
17:45-19:15	A small group invited by LIAISE to have a brainstorm session on research needs for policy support
20:00	Meeting dinner at Restaurant Dressler (Unter den Linden 39; Berlin city centre)

Thursday 11th April	
9:00-9:30	Registration (valid identification document required since there is a security check)
9:30-10:30	**Plenary start of Day 2** Sustainability and intensification in the horticulture sector Eckhard George (IGZ and Humboldt University Berlin; EPSO Horticulture Working Group) Potential for environmentally sustainable growth and intensification in the animal production sector Dawn Howard (FABRE-TP, EFFAB; co-vice-chair of the FACCE-JPI StAB) Potential for environmentally sustainable growth and intensification in the plant production sector Jean-Paul Judson (European Seeds Association; ESD;ETP-Plants for the Future) Summary of break-out reports Day 1 and focus for Day 2
10:30-11:00	Coffee break
11:00-12:30	**Break-out session 2** *For distribution in groups and rooms, see scheme in meeting binder* New groups following the same discussion approach as in Break-out session 1 ➔ Summarize the discussion outcomes in an electronic version of the *Break-out session Report Form* for the presentation.
12:30-13:30	**Reports / short presentations from break-out groups**
13:30–14:30	Lunch
14:30–15:45	**Summary of breakout and general discussion**
15:45-16:00	**Concluding remarks**
16:00	Closing

Annex 2. List of participants

	COUNTRY DELEGATES		
	Country	**Name**	**Representative**
1	Austria	Ika Darnhofer	Science
2	Austria	Maria Keuschnigg	Policy
3	Belgium	Julien Minet	Science /Policy
4	Cyprus	Rebecca Chrysafi	Policy
5	Denmark	Per Nielsen Kudsk	Science
6	Denmark	Iver Thysen	Policy
7	Estonia	Evelin Loit	Science
8	Estonia	Aile Otsa	Policy
9	France	Marie-Hélène Jeuffroy	Science
10	France	Maurice Héral	Policy
11	Finland	Roy Tubb	Science
12	Finland	Elina Nikkola	Policy
13	Germany (Speaker)	Katharina Helming	Science
14	Germany	Johannes Bender	Policy
15	Germany	Babette Breuer	Policy
16	Ireland	Rogier Schulte	Science
17	Ireland	Dale Cramond	Policy
18	Italia	Anna Maria Marzetti	Policy
19	Italia	Domenico Ventrella	Science
20	Netherlands	Ferry Leenstra	Science
21	Netherlands	Puck Bonnier	Policy
22	Norway	Kirsti Anker-Nilssen	Policy
23	Norway	Audun Korsaeth	Science
24	Romania	Nastasia Belc	Policy/Science
25	Poland	Monika Rzepecka	Policy /Science
26	Spain	Rocio Lansac	Policy/Science
27	Spain	Paloma Melgarejo	Policy/Science
28	Spain	Mª José Delgado	Policy/Science
29	Sweden	Jan Svensson	Policy
30	Switzerland	Andreas Aeschlimann	Policy/Science
31	Turkey	Fatih Evrendılek	Science
32	United Kingdom	Daniel McGonigle	Science
33	United Kingdom	Mike Roper	Policy
	OTHER PARTICIPANTS		
34	INRA	Isabelle Albouy	
35	SAB	Pirjo Peltonen-Sainio	
36	CORE Organic	Niels Halberg	
37	BBSRC	Gabriela Pastori	
38	BBSRC	Anke Arkenberg	
39	FABRE-TP (Speaker)	Dawn Howard	
40	ETP-Plants for the Future ((Speaker)	Jean-Paul Judson (European Seeds Association, ESD)	
41	EPSO (Speaker)	Eckhard George	
42	ZALF	Angelika Wurbs	
43	ZALF	Aranka Podhora	
44	BMBF	Ramon Kucharzak	
	FACCE CSA WP2 TEAM & LOCAL ORGANISERS		
45	Wageningen UR	Christine Bunthof (Co-Chair)	
/	INIA	Paloma Melgarejo	
/	INIA	Mª José Delgado	
/	INIA	Rocio Lansac	
46	INIA	Núria Duran	
47	INIA	Pablo Aller-Morán	
48	EZ	Louis Fliervoet	
49	BMELV	Hartmut Stalb (Co-Chair)	
50	BMELV	Till Schneider	
/	BLE	Babette Breuer	

Annex 3. Break-out sessions

Approach

During the two days of the mapping meeting the participants discussed in small working groups the content of the posters, opportunities for more collaboration and coordination between countries, and the most urgent areas for joint actions. The distribution in groups was such that 5-6 countries were represented, and that each group included science delegates as well as policy delegates. To enhance interaction within the whole group of participants and the exchange of information between countries, the distribution in groups on the second day was different from the first day.

The groups were moderated by members of the FACCE WP 2 team and the FACCE CSA coordinator, with participation experience from the four previous Mapping Meetings. Through the guidance of these moderators, people in the groups discussed the content of the posters (mainly focusing on their own countries) and trying to reach the following objectives:

- to identify gaps, overlaps, complementarities, synergies, emerging research topics, research facilities;
- to define recommendations on research topics for joint actions, tools to undertake cooperation (research, coaching, communication, sharing facilities) and other possible suggestions.

As a result of this process, each group came up with suggestions and conclusions. They were collected by one reporter per group, using a pre-defined template. The reporters gave a presentation of the results in the plenary session that immediately followed the break-out session. The same approach was applied on the second day break-out. Moreover there was a plenary final discussion.

OUTCOMES OF THE BREAK-OUT SESSION ON DAY 1

Group 1

Participants:
Pablo Aller (moderator)
Dale Crammond (IE ; P) [reporter]
Babette Breuer (DE; P)
Per Nielsen Kudsk (DK; S)
Domenico Ventrella (IT; S)
Natasia Belc (RO, P/S)
Niels Halberg (CORE Organic)

To identify				
Gaps	Overlaps	Synergies	Emerging research topics	Research facilities
Greenhouse production is a regional issue Protected cropping systems are not well developed in Europe Landless management systems were seen an obvious gap.(not seen a priority for future research) Diversification of production systems.	Animal breeding issues	Genomic Selection at pre breeding Water and nutrients efficiency, especially nitrogen.	Diversification of production systems is recognised both as a gap and a potential emerging area.	Long term experimental farms

Recommendations		
Research topics for joint actions	Tools to undertake cooperation (research, coaching, communication, sharing facilities)	Other suggestions
Diversification of production systems is recognised both as a gap and a potential emerging area	It is important to develop tools for genomic selection (pre breeding stage) e.g. bioinformatics. Identify mapping exercises previously completed or currently on-going to identify some major issues such as infrastructures/ databases.	Country specific topics in this core theme, unlike some of the other core themes such as Core theme 5. It was difficult to identify strong overlaps. Some projects at a low level of funding, makes it difficult to make comparisons

OUTCOMES OF THE BREAK-OUT SESSION ON DAY 1

Group 2

Participants:
Nuria Durán (moderator)
Elina Nikkola (FI; P)
Paloma Melgarejo (ES; P/S)
Marie-Helene Jeuffroy (FR; S)
Ferry Leenstra (NL; S) [reporter]
Aile Otsa (EE; P)
Jan Svensson (SE; P)
Till Schneider (BMELV)
Angelica Wurbs (ZALF)

To identify				
Gaps	Overlaps	Synergies	Emerging research topics	Research facilities
Integrated approach, system approach and multisystem approach (not only Tech but also Socio-Ec.). Legumes for soil fertility, feed and food. Methods for co-creation. Methods on how to measure outputs. Sensor technology in animals.		Grassland utilization and remote sensing.	NGOs and Biotech approaches for sustainability: Trying new radical tools. How to incorporate animal welfare research towards robust animals.	

Recommendations		
Research topics for joint actions	Tools to undertake cooperation (research, coaching, communication, sharing facilities)	Other suggestions
Legume production. Identify best practices and understand why.	Cooperation with other JPIs, ERA-Nets (Healthy diet for healthy life, SUSFOOD,……	Encourage cooperation and communication between Organic farmers and conventional farmers.

OUTCOMES OF THE BREAK-OUT SESSION ON DAY 1

Group 3

Participants:
Isabelle Albouy (moderator)
Iver Thysen (DK;P)
Daniel McGonigle (UK; S)
Ika Darnhofer (AT; S)
Monika Rzepecka (PL; P/S)
Andreas Aeschlimann (CH; P/S)
Johannes Bender (DE; P)
Anke Ankerberg (BBSRC) [reporter]

To identify				
Gaps	Overlaps	Synergies	Emerging research topics	Research facilities
Integrating systems-based research (incl. social sciences) Remote sensing Integrating cropping and livestock systems at regional level	Plant breeding Plant protection (integrated pest management) Animal nutrition (environmentally impact) Low tillage/soil fertility	Organic/low-input systems Animal nutrition (low input, grassland use)		

Recommendations		
Research topics for joint actions	Tools to undertake cooperation (research, coaching, communication, sharing facilities)	Other suggestions
	Platform: concentrating experts from different fields at specific sites monitoring various aspects (social economic, environmental and production performance); concept currently developed by DEFRA (Sustainable Intensification Platform)– potential for EU-wide application) Data sharing (cloud computing)	

OUTCOMES OF THE BREAK-OUT SESSION ON DAY 1

Group 4

Participants:
Gabriela Pastori (moderator)
Roy Tubb (FI; S)
Julien Minet (BE; P/S)
Puck Bonnier (NL; P) [reporter]
Fatih Evrendilek (TR; S)
Pirjo Peltonen-Sainio (SAB)
Hartmut Stalb (BMELV / Co-Chair)

To identify				
Gaps	Overlaps	Synergies	Emerging research topics	Research facilities
Minor/new crops, pests and diseases. -------- Better integration of crop and animal production. System level impacts, including social and landscape aspects at all levels.	Genetics: Collection and conservation and research on key crops species: wheat, barley, rye, potatoes, legumes. -------- Livestock breeding and nutrition under climate change: bovines, pigs, poultry, goats and sheep.	Genetic diversity in the context of climate change and diseases. Innovation in ICT and other related technologies. --------	Phenotyping Bio-control to be addressed by breeding, precision farming, integrated management, bio-technology, high information and communication technology. -------- Linking animal welfare to enhancing productivity	Phenotyping facilities -------- Integration in animal facilities for welfare, health and native breeds. Modelling tools on system level. Research platforms and platforms for experimental/demonstration farms.

Recommendations		
Research topics for joint actions	Tools to undertake cooperation (research, coaching, communication, sharing facilities)	Other suggestions
See gaps and emerging research.	Integrating research and facilities.	

OUTCOMES OF THE BREAK-OUT SESSION ON DAY 1

Group 5

Participants:
Louis Fliervoet (moderator)
Audun Korsaeth (NO; S)
Evelin Loit (EE; S) [reporter]
Katharina Helming (DE; S)
Anna Maria Marzetti (IT; P)
Maurice Héral (FR; P)

To identify				
Gaps	Overlaps	Synergies	Emerging research topics	Research facilities
Water management – technology/breeding-agronomy/property rights (rented land long term management q)/organizational question. Forgotten technological studies – we have the knowledge, but we need to place it into the complex agronomic management system. Increase greenhouse studies (feasibility?) Precision agriculture – field and greenhouse Alignment of present studies in precision agriculture Remote sensing (depends on the definition) Horizontal aspects- economic and social	Low input – high efficiency especially on fertilizer use (conventional ones – NPK)	Genetic resources collection (currently underexploited) Long term experiments (crops, grassland…)– collaboration needed on sharing the data; training… Integrated studies (through entire production line); interaction between more than 2 factors.	Exploration how to make farming more attractive – shortening the production line (trade-off? - from environ point of view it is better to have one big unit; socio-economic aspect is smaller better). New model for agricultural value chain (keyword: bio-economy) (To increase the selection of raw material and introducing a new role for the farmer)	European water management research centre Good education and training system

Recommendations		
Research topics for joint actions	Tools to undertake cooperation (research, coaching, communication, sharing facilities)	Other suggestions
Water management, including technological and socio-economic aspects. (to identify the borderline with Water JPI) Soil management Precision agriculture, including remote sensing (improving efficiency of input factors) Integration of socio-economic factors - link to SusFood, RurAgri Protein production and quality - substitute protein import. Reduce the waste in the food production chain (susfood link?)	Education and training and knowledge transfer (two-way- researcher and farmer) Knowledge Hub Courses for policy makers and scientists (together) Joint research projects	Question about genetic technology – more about politics. But should it be considered? Develop criteria for agricultural research assessment in addition to science metrics Interaction between suppliers and consumers (coordination) Protein – feed, food, production. We import it from. Problem with meat production and consumption. Solution- to produce more, better quality, reduce import. EIP interaction to focus on knowledge transfer and new research

OUTCOMES OF THE BREAK-OUT SESSION ON DAY 1

Group 6

Participants:
Christine Bunthof (moderator)
Kirsti Anker-Nilssen (NO; P)
Rogier Schulte (IE; S)
Maria Keuschnigg (AT; P)
Rocio Lansac / Mª José Delgado (ES; P/S)
Mike Roper (UK; P) [reporter]
Dawn Howard (FABRE-TP)
Eckhard George (EPSO)

To identify				
Gaps	Overlaps	Synergies	Emerging research topics	Research facilities
Land-less management systems and GIS and remote sensing are gaps. Design of cropping systems not mentioned sufficiently Diversification of agricultural activity not covered directly. Socio-economic aspects not covered sufficiently Aquaculture not included Aquaculture appears to be a gap and should be included (include in FACCE JPI SRA) Diversity of solutions across systems under different conditions = need to facilitate discussion on this. Need coherence in this The big challenge is to bring together the environmental and production disciplines and existing research into models and produce decision support tools at farm and landscape scale.	At European level – greater overlaps on horticulture – doesn't appear in European programmes sufficiently	Breeding and genetic resources.	Methods for faster implementation of research outcomes and technologies by Extension services	Plant and animal genetic resource facilities need strengthening

Recommendations		
Research topics for joint actions	Tools to undertake cooperation (research, coaching, communication, sharing facilities)	Other suggestions
Impact of more intensive agriculture on aquaculture. What are the issues for the sustainable intensification of aquaculture?	Find mechanisms for improving transfer of knowledge to advisory services from research Knowledge intensification and exchange is also important – need models for achieving this Need a new set of tools to encourage diversity across systems but to provide coherence in the way this is done and the messages that are put out to farmers.	Aquaculture should be included in the Strategic Research Agenda and represented in the FACCE JPI SAB more strongly. Implementation of initiatives is important. Nothing is more incentivising than having to report and be accountable to stakeholders and policymakers. Important to have link between IPM ERANET and FACCE JPI

OUTCOMES OF THE BREAK-OUT SESSION ON DAY 2

Group 1

Participants:
Christine Bunthof (moderator)
Audun Korsaeth (NO; S) [reporter]
Rebecca Chrysafi (CY; P)
Dale Cramond (IE; P)
Iver Thysen (DK; P)
Monika Rzepecka (PL; P/S)
Pirjo Peltonen-Sainio (SAB)

To identify				
Gaps	Overlaps	Synergies	Emerging research topics	Research facilities
			The practical use of precision farming, making it easy to use for the farmer. Remove technological and other barriers. Increased efficiency of input factors. Tools for monitoring legislative regulations? Social aspects. Diversification in agriculture. Legumes (import, GMO issue. New plants (e.g. bioenergy) Integrated crop management systems/ alternative disease control strategies Animal breeding for reduced GHG emissions	

Recommendations		
Research topics for joint actions	Tools to undertake cooperation (research, coaching, communication, sharing facilities)	Other suggestions
Water managment Precision agriculture Integrated plant and animal production systems Legume / proteins production systems „Sky farming" Animal breeding Integrated crop production systems	Demo farms / best practices for farmers / networks	

OUTCOMES OF THE BREAK-OUT SESSION ON DAY 2

Group 2

Participants
Nuria Durán (moderator)
Roy Tubb (FI; S) [reporter]
Babette Breuer (DE; P)
Domenico Ventrella (IT; S)
Ferry Leenstra (NL; S)
Paloma Melgarejo (ES; P/S)
Mike Roper (UK; P)
Hartmut Stalb (BMELV/ Co-Chair)

To identify

Gaps	Overlaps	Synergies	Emerging research topics	Research facilities
Integrated approach, system approach and multisystem approach (not only Tech but also Socio-Ec.) at farm level and at landscape level. Integrating cropping and livestock systems (at regional level ***and taking account of different scales***). ***Stock-taking of tools for integrated approach, and current efforts; common methodologies and data sharing.*** ***Greater exploitation of legumes for*** biodiversity, crop rotations, soil fertility, feed and food. Food: legumes as an a alternative to animal protein. Feed: legumes as an alternative to imported ***soya bean; greater use of forage legumes.*** ***Mapping the*** diversity of solutions for a diversification of production systems under different conditions. Identification of best practices, ***understanding why, developing and validating models, and decision support systems.*** ***Development and implementation*** of new water management technologies and methods at farm and catchment scale. ***Assessment of minor/new crops and their susceptibility to pests and diseases in the context of climate change (Needs elaboration and examples!)*** ***Methods on how to measure the value of outputs (in order to value e.g. eco-systems services, multifunctional systems, carbon/water footprints)*** Sensor technologies for animal production.	In certain issues (genetics, breeding, integrated pest management, soil fertility, animal nutrition.....) there is a lot of activity across Europe. However, is there any overlapping? This issue should be further explored.	***Availability of plant and animal genetic resources in different countries. More phenotyping is needed. (e.g. disease resistance, traits for resilience and robustness in the light of climate change)*** Genomic selection at pre-breeding ***(access to sufficient numbers and genotypes)*** Water and nutrient efficiency.	Precision farming – both livestock and crop – taking into account socio-economic, dynamic modelling and value chain. Remote sensing for monitoring and management ***Evaluation (case by case) of GMOs and biotech approaches for problem solving and sustainability. (Europe is getting behind).*** Soil-less greenhouse technologies applied outdoors. Study emerging pests and diseases associated with these production systems. Animal behaviour and welfare research towards increasing production including aquaculture. Methods on how to measure sustainability outputs	***Long term experimental and demonstration farms and phenotyping facilities.***

Recommendations

Research topics for joint actions	Tools to undertake cooperation (research, coaching, communication, sharing facilities)	Other suggestions
Legume production (Cooperation with other JPIs and ERA-Nets) Healthy diet for healthy life, Susfood.	See Eurisco FAO to share genetic resources. Cooperation through an international treaty. Availability of plant and animal genetic resources in different countries. More phenotyping is needed. (e.g. Disease resistance, traits for resilience and robustness in the light of climate change) ***Inter-regional exchange of knowledge and technologies*** Genomic selection at pre-breeding (access to sufficient numbers and genotypes) ***Collaboration on nutrient efficiency.*** Water management through EIP-water or EIP agriculture. Development of tools for genomic selection (bioinformatics) Make existing data including research results available (databases). Consider also results of previous mapping exercises. Develop mechanisms to improve transfer of knowledge from research to different stakeholders.	Development of harvesting machinery. A regional problem? Encourage cooperation and communication between organic farmers and conventional farmers. This may led to low input systems.

OUTCOMES OF THE BREAK-OUT SESSION ON DAY 2

Group 3

Participants
Louis Fliervoet (moderator)
Daniel McGonigle (UK ; S)
Marie-Helene Jeuffroy (FR ; S)
Nastasia Belc (RO; P/S)
Andreas Aeschlimann (CH; P/S)
Katharina Helming (DE; S)
Jan Svensson (SE; P) [reporter]
Anke Ankerberg (BBSRC)
Eckhard George (EPSO)

To identify				
Gaps	Overlaps	Synergies	Emerging research topics	Research facilities
Integration nutrient, pest management, product and services management – Data collection , creating open data system- environmental, practices and production data Co-design, participatory research programs/projects, New methods for knowledge transfer?	Suspected overlaps? Plant breeding, pest management, nutrient efficiency Is it a problem? Awareness, better communications what's going on, alignment, international peer-reviews, etc.	Any overlaps?	Resilience to fluctuations in environment and economy	Data settings, Knowledge sharing Mobility tools Both researcher and policy people

Recommendations		
Research topics for joint actions	Tools to undertake cooperation (research, coaching, communication, sharing facilities)	Other suggestions
Sustainable management at landscape level to farm level Ecosystems services to markets – sustainability Soil processes scaled to landscape levels. Sustainability indicators for agriculture Recycling residues and avoiding waste	Data sharing-visualisation, common standards, Knowledge networks Platforms for dialogues between farmers and researchers – co-design.	Labour intensification?

OUTCOMES OF THE BREAK-OUT SESSION ON DAY 2

Group 4

Participants
Gabriela Pastori (moderator)
Johannes Bender (DE; P)
Per Nielsen Kudsk (DK; S)
Ika Darnhofer (AT; S) [presenter]
Puck Bonnier (NL; S)
Aile Otsa (EE; P)
Dawn Howard (FABRE-TP)

<table>
<tr><th colspan="5">To identify</th></tr>
<tr><th>Gaps</th><th>Overlaps</th><th>Synergies</th><th>Emerging research topics</th><th>Research facilities</th></tr>
<tr><td>integration of social economics (participatory approaches)</td><td></td><td>increase resource efficiency (need of a modern definition of efficiency) in terms of animal health, animal nutrition, rotations, soil, water, precision agriculture, …)

plant breeding

livestock breeding

Genetic preservation/ collection, diversification</td><td>precision agriculture</td><td>link to precision agriculture (data, infrastructure)
Link to genetic collection
- skills, inventories
- Data sharing
- integrated systems
- Services, training, communication</td></tr>
<tr><th colspan="5">Recommendations</th></tr>
<tr><th>Research topics for joint actions</th><th colspan="2">Tools to undertake cooperation (research, coaching, communication, sharing facilities)</th><th colspan="2">Other suggestions</th></tr>
<tr><td></td><td colspan="2">Building the infrastructure
Cloud computing
Crowd sourcing
→ SHARING
-between countries, but also
- between farmers</td><td colspan="2">Defining criteria for “efficiency”: improving outputs is not only improving quantity, but landscape, quality, eco-services etc.

Does agriculture include aquaculture, great potential

Try to use farmers knowledge, huge potential</td></tr>
</table>

OUTCOMES OF THE BREAK-OUT SESSION ON DAY 2

Group 5

Participants
Pablo Aller (moderator)
Elina Nikkola (FI; P)
Evelin Loit (EE; S)
Julien Minet (BE; S) [presenter]
Anna Maria Marzetti (IT; P)
Fatih Evrendilek (TR; S)
Till Schneider (BMELV)

To identify				
Gaps	Overlaps	Synergies	Emerging research topics	Research facilities
More investment in plant research, not in livestock and horizontal issues	Overlap vs. synergies. Be positive. Are there any opportunities to align national programs already on going? Common ground on which collaboration can start instead of overlaps	Focus on livestock quality and sustainable production, not on increase of production Recommendations for healthy diet are changing constantly. Inputs for health researchers are needed. Water management is a Cross cutting issue: it includes technology, efficiency, socio-economic (including rising awareness and sharing knowledge), aspects and policy commitment	Sharing information on on-going long term experiments, build up network with existing projects like e.g. AnaEE (Infrastructure for Analysis and Experimentation on Ecosystems)	More investment in plant research, not in livestock and horizontal issues

Recommendations		
Research topics for joint actions	Instruments? to undertake cooperation (research, coaching, communication, sharing facilities)	Other suggestions
	Propose new Knowledge hubs and sharing information (workshops) on genetic research and breeding taking advantage of FACCE expertise on this kind of instruments. Collaboration with SUSFOOD and JPI HDHL focusing on food quality and safety. FACCE JPI area of action is between them. Promotion of a healthy diet is part of HDHL.	Not to lose the perspective and main objective of JPIs: to align and coordinate national programmes and research, rather than only generate new calls with fresh money. JPIs should be different than ERA-NETs. Study the impact of CAP on ecosystem management (soil, water) and land management. Can FACCE JPI pose this question to EC?

OUTCOMES OF THE BREAK-OUT SESSION ON DAY 2

Group 6

Participants
Isabelle Albouy (moderator)
Maurice Heral (FR; P)
Rocio Lansac / Mª José Delgado (ES; P/S)
Rogier Schulte (IE; S)
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Kirsti Anker Nilssen (NO; P)
Niels Halberg (CORE Organic) [reporter]

To identify

Gaps and research topics with potential for joint actions	Overlaps	Synergies	Emerging research topics	Research facilities
Integrated approach, system approach and multisystem approach (not only Tech but also Socio-Ec.) at farm level and at landscape level. Integrating cropping and livestock systems (at regional level). ***Agro-ecological methods for improving crop and livestock systems at various levels of scale (soils and non-chemical pest management) including*** Diversity of solutions for a diversification of production systems ***(intercropping, rotations, livestock integration, mosaics, agroforestry …)*** under different conditions. Identification of best practices and understanding why. Legumes for biodiversity, soil fertility, feed and food. Food: legumes as an alternative to animal protein. Feed: legumes as an alternative to imported GMO proteins. Implementation of new water management techniques. And other problems. Minor/new crops. New pests diseases ***Protected cropping (non greenhouse production) for higher quality of horticultural production*** Methods on how to measure outputs. ***Defining intensification from different perspectives (eco-functional intensification) and funding research to support knowledge based intensification*** ***Recycling of nutrients (and water) in the value chain, cradle to cradle thinking in developing food systems including socio-economic aspects*** Sensor technologies for animal production.	In certain issues (genetics, breeding, integrated pest management, soil fertility, animal nutrition.....) there is a lot of activity across Europe. Is there any overlapping? This should be further assessed.	***Availability of plant and animal genetic resources in different countries. More phenotyping is needed*** ***The information being generated in certain regions can be useful in the future for other regions (after changes due to climate change).*** ***Genomic selection at pre-breeding including aspects to reflect animal welfare and product quality?*** ***Water and nutrient efficiency.*** ***Water management in holistic perspective from genomics to landscape management*** ***Soils: recycling, fertility (humus), eco-functional intensification through integration of new methods, cross-disciplinary research,*** ***Livestock: improving knowledge based livestock production to reduce use of antimicrobials and protein feed competing with food.*** ***Mutual learning between organic and conventional systems for eco-functional intensification, reduced use of inputs, animal welfare, etc.***	Precision farming (remote sensing) ***integrating technical, management, environmental aspects, productivity vis-à-vis inputs*** and socio-economic aspects. ***(ICT-AGRI is covering this)*** GMOs and Biotech approaches for problem solving and sustainability. Europe is getting behind. Soil-less greenhouse technologies applied outdoors. Study emerging pests and diseases associated with this production systems. Animal welfare research towards increasing production including aquaculture. ***Need to consider specific inclusion of Aquaculture and selection/clarification of specific parts of this industry to be covered by FACCE*** Methods on how to measure sustainability outputs.	Long term experimental farms and phenotyping facilities.

Recommendations

Research topics for joint actions	Tools to undertake cooperation (research, coaching, communication, sharing facilities)	Other suggestions
Legume production (Cooperation with other JPIs and ERA-Nets) Healthy diet for healthy life, Susfood.	See Eurisco FAO to share genetic resources. Cooperation through an international treaty. Water management through EIP-water or EIP agriculture. Development of tools for genomic selection (bioinformatics) Make existing data including research results available (databases). ***To maintain, share, facilitate use results of previous mapping exercises of research infrastructure and facilitate access to infrastructure.*** ***Supporting knowledge based intensification through* mechanisms to improve *the integration of end users in research prioritisation and design*** and transfer of knowledge from research to different stakeholders. ***Securing alignment of future research and development needs and efforts in organic agriculture in liaison with CORE organic ERA net***	Development of harvesting machinery. A regional problem? Encourage cooperation and communication between organic farmers and conventional farmers. This may led to low input systems.

Annex 4. List of FP7 projects related to Environmentally sustainable growth and intensification of agriculture (2007-2012 calls)

Project	Project cost EUR	End date	Partners & countries
SMARTSOIL - Sustainable farm Management Aimed at Reducing Threats to SOILs under climate change	3 748 927	31/10/2015	**DK**, UK, DE, BE, ES, NL, HU, PL, IT
CATCH-C - Compatibility of agricultural management practices and types of farming in the EU to enhance climate change mitigation and soil health	3 656 270	31/12/2014	NL, ES, DE, AT, IT, PL, BE, FR
REFERTIL - Improvement of comprehensive bio-waste transformation and nutrient recovery treatment processes for production of combined natural products	4 150 926	30/09/2015	HU, NL, SL, DE, UK, ES, IT, PL, DK, IE
FERTIPLUS - Reducing mineral fertilisers and agro-chemicals by recycling treated organic waste as compost and bio-char products	4 035 827	30/11/2015	NL, DE, UK, ES, BE, IT
FIGARO - Flexible and precise irrigation platform to Improve farm scale water productivity	8 057 923	30/09/2016	IL, DK, IT, PT, NL, UK, GR, DK, ES
BIOFECTOR - Resource Preservation by Application of bio effectors in European Crop Production	7 692 853	31/08/2017	DE, IT, UK, IL, HU, IE, NL, RO, DK, CH, CZ
PURE - Pesticide Use-and-risk Reduction in European farming systems with Integrated Pest Management	12 373 501	28/02/2015	FR, UK, DE, IT, DK, SL, PL, NL, BE, ES, HU
CO-FREE - Innovative strategies for copper-free low input and organic farming systems	3 994 513	30/06/2016	DE, IT, NL, FR, ES, UK, DK, PL, BE, CH, GR
LOWINPUTBREEDS - Adapting livestock to low-input farming	8 910 739	30/04/2014	UK, FR, DK, NL, CH, BE, NZ, BR, IT, CA, GR, DE, SL, ES, TN
REDNEX - Reducing nitrogenous pollution by cattle	7 107 604	30/06/2013	NL, FR, BE, DK, IT, UK, DE, ES, SK, UK

Annex 5. List of ERA-NETs relevant to the bioeconomy, with elements related to environmentally sustainable growth and intensification of agriculture

ERA-NET	Coordinator	Partners & countries
ANIHWA _Animal Health and Welfare.	French National Institute for Agricultural Research (INRA), FR	AT, BE, CY, CZ, DK, FI, FR, DE, GR, IE, IL, IT, LT, NL, NO, ES, SE, CH, UK.
ERA CAPS_ERA-NET for Coordinating Action in Plant Sciences.	Biotechnology and Biological Sciences Research Council (BBSRC), UK	AT, BE, CA, DE, DK, EE, ES, FR, IL, IT, HU, LT, NL, NO, NZ, PO, PT, RS, UK
CORE ORGANIC II_Coordination of European Transnational Research in Organic Food and Farming Systems.	Aarhus universitet, DK	AT, DE, BE, CH, CZ, DK, EE, ES, FI, FR, IE, IT, LT, LU, LV, NL, NO, SI, SE, TR, UK.
EUPHRESCO II_European Phytosanitary Research Coordination II.	The Secretary of State For Environment, Food and Rural Affairs (DEFRA), UK	AT, BE, BG, CH, CZ, DE, DK, EE, ES, FI, FR, GR, IE, IT, LT, NL, PT, RU, SI, TR, UA, UK
RURAGRI_Facing Sustainability: New Relationships between Rural Areas and Agriculture in Europe.	French National Institute for Agricultural Research (INRA), FR	AT, FR, BE, CY, DE, HU, IE, IT, IL, LV, LT, PL, SI, ES, SE, CH, NL, TR, UK, DK

ERA-ARD II_The Agricultural Research for Development Dimension of the European Research Area.	Ministry of Economic Affairs (EZ), The Netherlands, NL	AT, BE, CH, DE, DK, ES, FI, FR, LT, NL, PO, TR, UK.
ARIMNET_Coordination of Agricultural Research in the Mediterranean.	French National Institute for Agricultural Research (INRA), FR	CY, ES, FR, GR, IL, IT, PO, TN, DZ, EG, MO.
ICT-AGRI_Coordination of European research on ICT and robotics in agriculture and related environmental issues.	Ministry of food, agriculture and fisheries, Danish food industry agency (DASTI), DK	BE, CH DE, DK, ES, FI, FR, GR, IL, IR, IT, LT, MT, NL, TR
ERA-IB-2_ERA-Net for Industrial Biotechnology 2.	Agency for Renewable Resources (FNR), DE	BE, DK, DE, ES, FR, HR, IL, NL, NO, PO, RO, PT, RU TR, UK
BIODIVERSA 2_Cooperation and shared strategies for biodiversity research programmes in Europe.	Foundation for Research on Biodiversity (FRB), FR	AT, BE, EE, FR, DE, HU, IE, IT, NL, NO, PT, ES, SE, UK
CIRCLE-2_Climate Impact Research & Response Coordination for a Larger Europe - 2nd Generation ERA-Net -Science meets Policy.	Foundation of the Faculty of Science of Lisbon University (FFCUL), PT	AT, BE, DE, EE, ES, FI, FR, GR, HU, IL, IR, IT, NL, PT, SE, TR, UK
SYNBIO Development and Coordination of Synthetic Biology in the European Research Area	Jülich Research Centre, DE	AT, CH, DE, DK, ES, GR, FI, FR, LT, NL, NO, PT, SL, UK
ETB-PRO_European Programme for Trans-national R&D&I cooperations of Biotech SMEs.	Federal Ministry of Economy, Family and Youth (BMWFJ), AT	AT, BE, ES, DE, FI, FR, IT, HU, NL
WoodWisdom-Net+ Pacing Innovation in the Forest-Based Sector	The Finnish Funding Agency for Technology and Innovation (TEKES), FI	AT, CH, DE, FI, FR, IE, LV, NO, SE, SI, SK, UK
ERASYSBIO+_The consolidation of systems biology research stimulating the widespread adoption of systems approaches in biomedicine, biotechnology, and agri-food.	Jülich Research Centre, DE	AT, DE, ES, FI, FR, IL, LX, NL, SL, UK
ERASysAPP Systems Biology Applications	Jülich Research Centre, DE	AT, CH, DE, DK, ES, GR, FI, FR, LT, NL, NO, PT, SL, UK
SUSFOOD_Sustainable Food.	Institut national de la recherche agronomique	BE, DE, DK, ES, FR, EE, ES, FI, IT, NL, NO, PL, RO, SE, SL, TR, UK
COFASP Strengthening cooperation in European research on sustainable exploitation of marine resources in the seafood chains- ERA-NET	Danish Agency for Science, Technology and Innovation (DASTI), DK	BE, DE, DK, ES, FI, FR, GR, IC, IE, IT, NL, NO, PT, RO, UK
PLANT-KBBE* Transnational Plant Alliance for Novel Technologies – towards implementing the Knowledge-Based Bio-Economy in Europe	** This network is self-organised without EC grant*	CA, DE, ES, FR, PT

ERA-NET topics in the FP7 call KBBE.2013

- Sustainable Forest management and Multifunctional Forestry ERA-NET
- Integrated Pest management (IPM) ERA-NET
- Mediterranean agriculture ERA-NET
- Information and Communication Technologies and robotics for sustainable agriculture ERA-NET
- Marine biotechnology ERA-NET
- Climate smart Agriculture: adaptation of agricultural systems in Europe ERA-NET Plus
- Innovative solutions in organic food and agriculture for next generation of food systems seeking synergies between rural development, natural resource management and food security and quality ERA-NET Plus

Annex 6. List of documents from FACCE-JPI Mapping and Foresight on Environmentally sustainable growth and intensification of agriculture

A. **Summary of Conclusions and Recommendations**_FACCE JPI Mapping Meeting on Core Theme 2: Environmentally sustainable growth and intensification of agriculture

B. **Final Report**.FACCE JPI Mapping Meeting on Core Theme 2: Environmentally sustainable growth and intensification of agriculture. Berlin, 10th -11th April, 2013.

C. **Presentations**

1. Introduction FACCE JPI_Isabelle ALBOUY (INRA; JPI FACCE CSA coordinator)
2. Introduction on the theme of the meeting '*Environmentally sustainable growth and intensification of agriculture'*_Pirjo Peltonen (MTT Agrifood Research Finland; FACCE-JPI SAB member)
3. Scope and aim of mapping exercises and this mapping meeting_Núria DURAN (IVIA; JPI FACCE CSA WP2)
4. Programme for today and tomorrow and guidance for break-out session_Christine BUNTHOF (Wageningen UR; JPI FACCE CSA WP2)
5. Research for impact assessment of policies in agriculture_Katharina Helming (FP7 project LIAISE)
6. Sustainability and intensification in the horticulture sector_Eckhard George (IGZ and Humboldt University Berlin; EPSO Horticulture Working Group)
7. Potential for environmentally sustainable growth and intensification in the animal production sector_Dawn Howard (FABRE-TP, EFFAB; co-vice-chair of the FACCE-JPI StAB)
8. Potential for environmentally sustainable growth and intensification in the plant production sector_Jean-Paul Judson (ETP Plants for the Future, European Seeds Association; ESD)

D. **Posters**

Austria	Funding Poster	Science Poster
Belgium	Funding Poster	Science Poster
Switzerland	Funding Poster	Science Poster
Cyprus	Funding Poster	Science Poster
Denmark	Funding Poster	Science Poster
Estonia	Funding Poster	Science Poster
Finland	Funding Poster	Science Poster
France	Funding Poster	Science Poster
Germany	Funding Poster	Science Poster
Ireland	Funding Poster	Science Poster
Italy	Funding Poster	Science Poster
The Netherlands	Funding Poster	Science Poster
Norway	Funding Poster	Science Poster
Poland	Funding Poster	Science Poster
Romania	Funding Poster	Science Poster
Spain	Funding Poster	Science Poster
Turkey	Funding Poster	Science Poster
United Kingdom	Funding Poster	Science Poster
European	Commission FP7 Projects	
F7 PLATFORM	Bioeconomy ERA-NETs	


5th Mapping Meeting on Core Theme 2:
"Environmentally sustainable growth and intensification of agriculture"
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