

Strategic Implementation Plan European Innovation Partnership "Agricultural Productivity and Sustainability"

Adopted by the High Level Steering Board on 11 July 2013

1. Introduction

The European Innovation Partnership (EIP) 'Agricultural Productivity and Sustainability' aims to foster a ***competitive and sustainable agriculture and forestry that works in harmony with the environment***. This objective and the general EIP conception were first stated in the Commission Communication of 29 February 2012 and have subsequently been endorsed in the Agriculture and Fisheries Council Conclusions of 18 June 2012. EIPs pursue the mission of building a bridge between research and the application of innovative approaches in practice.

The Council Conclusions also invite the Commission "to undertake concrete steps toward having a strategic implementation plan of the EIP prepared with the aim of involving all stakeholders in delivering specific results and innovation in the agri-food sector". To this end, a High Level Steering Board, involving 42 key stakeholders from across the agricultural research and innovation landscape as well as Member State representatives, was nominated by the European Commission. This Strategic Implementation Plan (SIP) is the result of the work undertaken by the High Level Steering Board.

With this SIP, the High Level Steering Board delivers its strategic advice and gives orientations to the EIP in terms of issues, bottlenecks, solutions and the question of how to create an innovation culture in European agriculture bridging between science and practice. The SIP should be considered as a general recommendation in order to leave sufficient room for the EIP to remain open to new insights throughout its implementation and to rely on bottom-up initiatives.

In this SIP, the term agriculture includes various types of biomass based primary production, in particular agriculture, horticulture, forestry and animal husbandry. The term farmers includes all kind of owners, managers of land, and workers used in these primary production types.

2. Meeting the challenges

. The evolution of demand for food and non-food products at a global scale requires coordinated policy responses and efforts of all stakeholders in order to address the challenges concerning health, environmental, and social issues. Major research and innovation efforts are needed to ensure that any productivity gain is achieved in a sustainable manner. This includes the requirement for a sustainable management of natural resources, the preservation of the environment, sustainable consumption, and waste reduction. But it also requires that solutions are economically viable and accessible to by different types of farm and regions. A pro-active rural society is crucial in order to

develop new ideas and to reach a good uptake of already available innovations. Actions taken under the umbrella of the EIP must take into account global initiatives and developments.

There is a general consensus about a need for a favourable innovation culture, which implies a change of the mind-set at all levels. Positive attitudes towards innovation, risk taking and entrepreneurship can be boosted in particular through:

- facilitating exchanges between all actors,
- sharing traditional and scientific knowledge,
- relying on a bottom-up approach and strengthening networking,
- engaging in developing practical solutions,
- identifying and developing lighthouse projects,
- mobilising innovation brokering
- developing social and institutional innovation.

The EIP will have this overarching mission in mind when pursuing the implementation by the means made available by Rural Development Policy and Horizon 2020.

It will combine a holistic approach with tangible innovation actions; it will ideally target whole farming systems, but also support specific solutions and practices. Specific environmental, economic, and social concerns will be looked at in their wider context. To achieve this aim, the EIP needs to build bridges between research and the end-users of research results, especially farmers, businesses, advisory services, and civil society wherever possible by making use of existing networks and groups.

The orientations of the agricultural EIP reach beyond the "linear innovation model" of speeding up transfer from laboratory to practice. The EIP pursues the "interactive innovation model" which focuses on forming partnerships: using bottom-up approaches and linking farmers, advisors, researchers, businesses, and other actors in Operational Groups that engage in practical projects. It will generate new insights and ideas and mould existing tacit knowledge into focused solutions. Such an approach will not only help with encouraging the co-creation of innovation and applicable solutions from research but also speed up the spreading of innovative ideas. Moreover, it will also contribute to focusing the activities under Horizon 2020 and in general raise the attention and understanding of researchers to practical problem-solving.

The interactive nature of the EIP is based on the creation of a specific agricultural innovation network at EU level (the EIP network) which will facilitate communication and knowledge exchange across borders, sectors and different groups of actors from research to practice.

In the Commission Communication of 29 February 2012, two headline targets have been identified:

- To reverse the recent trend of diminishing productivity gains by 2020 (indicator for productivity and efficiency).
- To secure soil functionality in Europe at a satisfactory level by 2020 (indicator for sustainability of agriculture).

Innovative solutions are needed, combining and putting into value science and traditional knowledge in order to create value-added for the agricultural sector and society as a whole. These targets will be used to assess to what extent the EIP delivers on its objectives.

3. Policy context

The concept of European Innovation Partnerships, as set out in the 2010 Commission Communication 'Innovation Union', refers to a tool that pools forces and interlinks different actions. EIPs are not policy instruments of their own; they aim to achieve synergies and EU value added by basing themselves on existing policies and fostering co-operation among partners. These principles are reflected in the design of the agricultural EIP and laid out in the Communication on the EIP 'Agricultural Productivity and Sustainability' of 29 February 2012.

This Communication outlines the challenges that the agriculture, food and forestry sectors will have to address in the coming decades. These are to ensure economic viability by increasing productivity while improving sustainability and resource efficiency. It highlights the importance of smart networking to enhance communication and exchange between all agricultural innovation actors and announces the creation of an EIP network at EU level. It also identifies Rural Development Policy and the Research and Innovation Framework as the main policies delivering towards the implementation of the EIP through co-funding innovative actions.

The general principles of the EIP have been outlined in the EIP Communication, in line with the strategic orientations of Europe 2020 – in particular regarding the flagship initiatives Innovation Union and Resource Efficient Europe - and the CAP towards 2020. The legal proposals for a Rural Development Regulation and for Horizon 2020 provide further orientation.

The proposed Rural Development Regulation emphasises innovation as a strategic priority for programming and specifies the overall objectives of the EIP in Article 61. The Commission proposal for a future Multi-annual Financial Framework underlines the political importance of research and innovation actions in the area of food security, sustainable agriculture and the bio-economy.

The legal proposals for a Rural Development Regulation and for the Horizon 2020 Framework Programme for Research and Innovation for the period 2014-2020 provide further orientation. Both proposals foresee opportunities for interested actors to engage in actions on developing, testing and applying innovative approaches. The complementarity of the two policies results from the fact that actions under Rural Development Programmes are normally applied within the boundaries of programme regions, whilst the Horizon 2020 research policy goes beyond this scale by co-funding innovative actions at cross-border and EU-level. Other EU policies, such as the regional policy, and national public budgets or private entities may also provide opportunities for innovation actions.

Whilst the EIP has a strong focus on stimulating innovation in the EU, it may connect to international actors on issues where there is an interest and scope for mutual learning.

4. Implementing mechanisms

Action under the EIP can be funded from several sources; rural development funds, national funds, Horizon 2020, private funds, etc. The Member States and regions have a key role in ensuring that the appropriate funding mechanisms are in place and that the activities under the EIP are encouraged. The High Level Steering Board strongly suggest to set high levels of ambition regarding the EIP when designing the funding programmes and to allocate appropriate funding.

The proposed rural development regulation outlines a list of measures targeted at innovation actions. Under the rural development policy several measures have been designed to stimulate innovation, in particular the cooperation measures (Article 36) supporting both the establishment of "Operational Groups" and funding for projects, knowledge transfer and information actions (Article 15), advisory services (Article 16), investments in physical assets (Article 18), and farm and business development (article 20), setting up of Producer Groups (Art.28). In addition investments in the forest sector (Art. 22 and 27) can be used. Provisions for the establishment of the EIP network are made in Article 53.

Operational Groups will involve actors such as farmers, researchers, advisors, businesses, NGOs, etc. who together will design and implement certain projects and test new ideas. The size and composition of Operational Groups will vary and depends on the topic addressed and actions to be undertaken. Support under RD for innovation brokering could be used to connect actors in operational groups but may also prove valuable to link RD operational groups to Horizon 2020 multi-actor projects or thematic networks.

Specific attention is given to the EIP in the Commission proposals for the Horizon 2020 Framework Programme for Research and Innovation for the period 2014-2020. Article 12 of the Horizon 2020 regulation states that "*full account shall be taken of the relevant aspects of the research and innovation agendas established by the EIPs*". Furthermore the Horizon 2020 regulation proposes to implement project approaches that fully match with the EIP interactive innovation model, mirroring the concept of RD Operational Groups as follows "*A multi-actor approach will ensure the necessary cross-fertilising interactions between researcher, businesses, farmers/producers, advisors and end-users*". The proposed Council Decision establishing the Specific Programme Implementing Horizon 2020 foresees specific implementation actions to improve the impact of research results through supporting "*specific actions on communication, knowledge exchange and the involvement of various actors all along the projects*".

The Standing Committee on Agricultural Research (SCAR) with its coordinating role between Member States has already been very active in preparing EIP instruments for the Horizon 2020 period, in particular through its dedicated Collaborative Working Group on Agricultural Knowledge and Innovation Systems. Other existing networks and structures at EU level, such as Joint Programming Initiatives, ERA-Nets and Technology Platforms, as well as existing or emerging structures in Member States, are expected to further provide valuable input for innovative actions and the sharing of knowledge, contacts and experience.

Research actions and practice-oriented approaches are provided for in the proposed Horizon 2020 regulation, notably under the Societal Challenge "Food security, sustainable

agriculture marine and maritime research and the bio-economy". The undertakings of Horizon 2020 will be complementary to the work undertaken by the "Operational Groups" under Rural Development and will integrate a continuum from basic to applied research, with cross-border initiatives such as thematic networks and multi-actor approaches, demonstration projects. The needs of the primary production sector for innovation support centres, as intermediaries to connect farmers and stakeholders with research, will be taken into account.

An EIP Service Point is set up at EU level to collect and disseminate the results of the work of Operational Groups and of the dedicated Horizon 2020 projects. The network will also provide help to find partners and information and facilitate exchange of knowledge and experience. The EIP network will liaise with other, existing networks in order to gather all relevant expertise and information about innovation initiatives.

The EIP network facility will also animate discussion on innovation in certain areas via focus groups. In these groups, experts will discuss potential ways forward on how to address specific challenges in specific areas of action. The results of these focus groups will be also disseminated via workshops and seminars.

The implementation of the EIP via Rural Development Policy and actions under Horizon 2020 will be steered and monitored, using the existing, well established instruments. The High Level Steering Board will regularly take stock of the implementation of the EIP and make recommendations.

5. Valorising diversity throughout the value chain

Dimensions / concepts of diversity

European food production is characterised by a huge diversity. Economic operators, including farmers, can specialize on their comparative advantage while targeting societal benefits and preserving the environment. EU Agriculture can provide inputs to the Horizon 2020 Policy by drawing on the diversity of agricultural systems as well as innovations and techniques (e.g. organic farming, low-external input systems, sustainable intensification, integrated production, traditional, extensive farming, modern biotech-based crops), and diverse types of food supply chains like the short supply chains.

Diversity from the "farm to the fork" or throughout the whole food chain is becoming a major driver for competitiveness of future European Food and Agriculture sector. Diversity in agricultural research and innovations, production methods, techniques, agricultural systems, types of food supply chain and products can benefit all parties by, for example, allowing technology spill-overs, raising farm income, producing more with less, maintaining and/or improving ecosystems (instead of loss of diversity). One of the consequences is that a wide range of food at affordable prices is at the disposal of consumers who are increasingly interested in regional origin, diversity of taste, animal welfare, fairness to farmers and farm workers, and transparency. Diversity adds value to the entire value chain (food and non-food). Another consequence is that farming and forestry do not just provide food, feed, fibre and biomass but provide also other services such as public goods.

The European agricultural and forestry sectors include a wide mix of farm types (including size) and production systems. These farms operate in a mix of different climatic conditions, terrains and with different methods of getting produce to market. The aim of the EIP should be to develop ideas and approaches which retain and even develop this diversity, whilst allowing the differences to be complimentary – to allow farmers and foresters to learn from each other and develop their businesses together. This should be the common thread through the EIP.

On farm level, the relevant dimensions of diversity are to increase productivity while improving genetic diversity (in particular), plant and livestock diversity, functional diversity surrounding the farm and the diversity of farm and forestry activities (on farm and off-farm income). This can increase resilience against external shocks (e.g. droughts, pests, price volatility). On landscape level diversity is the result of a balanced mix of different elements of natural, semi-natural and intensively as well as extensively farmed land. These elements need to be better integrated and linked with each other. This will also make rural areas more attractive.

Finally, diversity can also be raised beyond the farm gate throughout the rest of entire food and feed chains, e.g. with regard to processing, retail practises, distribution, consumption, disposal of food and diversity of diets/food habits.

Because of this diversity at all levels of the chain, there is no single pathway to sustainable agriculture and forestry. In order to achieve the required diversity of approaches a broad understanding of innovation should be adopted. Innovation is not only about new technology, but has also other dimensions: know-how innovation (combinations of new and existing knowledge around methods and practice), organisational innovation (change in management) and social innovation (change of behaviour).

Sectors involved

All sectors within and directly or indirectly related to the food chain and forest value chain have to be involved in innovative solutions. The following sectors, yet not exclusively, have to be considered in any strategy of innovation: primary (agriculture, horticulture, livestock, forestry) sector including input producers, the secondary (food industry, food disposal, non-food – up to pharmaceuticals - and wood based industry) and the tertiary (food services, e.g. catering; forest-based services).

Structures

The following structural diversity is in particular relevant for the implementation of the innovation partnership

- a) Different types and sizes of farms across Europe, using different underlying concepts and restrictions regarding use of inputs and technologies as well as different quality orientations.
- b) A highly concentrated upstream industry.

- c) Market channels/logistics: the European food market is on the one hand characterised by high concentration of the few players with a majority of the food. However still a huge diversity of market strategies exist.
- d) Research structure: science will play an important role in the implementation of the innovation partnership. Therefore the research structures in place are essential to get involved and to contribute with a new spirit of innovation culture, be it the huge potential of European universities, institutes of applied science or private institutions. The diversity of approach should be reflected in the diversity of project size and actors involved, including by calls for proposals for projects with smaller budgets.
- e) Advisory services: advisory service will play a crucial role in transferring scientific knowledge into practical innovations and therefore the advisory structure must be strengthened if the European innovation partnership wants to be a success, be it international, national or regional, non-for-profit or profit advisory services).
- f) Legal, trade, cultural, structural and environment conditions: innovation needs to happen in the existing legal framework existing.
- g) Governmental structures: authorities concerned with Rural Development, either local, regional or national, should embrace involvement in making the EIP a success, a supportive attitude could be expressed by seeking flexibility in applying policy and rules, by creating an open innovation system, by giving support and by helping connecting researchers, entrepreneurs and other stakeholders to further improve productivity and sustainability in different dimensions.
- h) Different links between actors in the food chain towards consumers and civil society.

It is important that policymakers consider both: incentivise innovation by cutting red tape and regulatory barriers where appropriate and on the other hand, respect the interest of civil society to be fully involved in the innovation process and to provide legal protection for consumers' interest. Trade and production structures are quite different among the EU countries, and many of them must be improved. Innovation process can be absolutely useful for this important challenge.

Farming methods and systems

All farming systems as practiced in Europe have the potential to be economically and ecologically improved by applied research through better understanding of plant and animal nutrition, integrated plant and livestock health strategies, improved soil conservation techniques or the use of novel technologies. In addition to that, alternative/specific methods arise with great potential measured as share of the total European agricultural land.

Alternative/specific methods and systems (e.g. integrated farming, low external input systems, organic farming or quality food production systems) can have a different impact on the economy (e.g. farm and off-farm income), on the society (e.g. citizen's/consumer's benefits) and on the environment (e.g. on biodiversity). Their contribution to diversity in all aspects in different regional contexts needs to be researched. Traditional farming systems and their knowledge base need to be valorised. Particular with regard to diversity

these alternative/specific methods show interesting strategies and potentials for further development and mainstreaming through new forms of collaborations of farmers with market and society actors, supported by research and advisory services.

An important research topic is the development of a commonly accepted methodology and models for the assessment of the three dimensions of sustainability (ecological, economic, and social) with both improved quantitative and qualitative indicators. In addition to indicators and models, real-live impact assessments have to be carried out using and improving cutting-edge methods and basic research, which deal with the different dimensions of diversity. All in all, this will enable decisions of policy makers, will guide scientists, advisors, technicians and farmers towards improved farming systems resp. value chains and will facilitate communication along the food chain.

Knowledge systems

Agricultural Knowledge and Innovation Systems (AKIS) are evolving towards innovation networks or forms of organizations (multiple actors, multiple relations and exchanges, multiple foci). It is important to involve the different supply chain and civil society actors in identifying the specific knowledge gaps and research needs and how to address these.

The new agricultural knowledge and innovation system must adapt to the emerging economic, social and environmental challenges by making the best use of diversity in technologies and innovations that can achieve more with less while respecting the environment. Social innovation stresses the need for social and political changes in the context of rural development and producer-consumer relationships. Social innovation includes collective and creative learning processes, in which actors from different social groups and rural and urban contexts participate. Together they develop new skills, products and /or practices, as well as new attitudes and values that make a difference in addressing the sustainability challenge in rural societies.

The diversity of knowledge (local / traditional know-how and practices, common knowledge and expert knowledge) in the definition of research problems, the definition of people concerned, and in finding solutions should be valorised. EU Agriculture needs a suitable agricultural knowledge system where alternative roles and interactions of the private and public sectors lead to efficient and equitable outcomes, which enhances the diversity on all levels both in the agro ecosystems, in social systems and in the use of technologies.

Innovation should be understood as a social process, more bottom up or interactive than top-down. A better interaction in between the different actors of the agricultural knowledge system is needed. The process of knowledge transfer and exchange has to become more transparent. There is also key role of professional education of present and future operators and the strengthening of life long education. The EIP should help to better knowledge sharing in different areas and between different actors.

Science-practice interaction

The EU needs increased public/private collaboration to optimise the information exchanges via different networks to make the link between policy makers, researchers,

operators, advisers and farmers to promote diversity. Public-private partnerships ventures can foster socially beneficial research. Joint research opportunities must attract companies and civil society organisations. Public research for public goods needs to be strengthened in order to complement private and public/private research.

Benefitting from diversity

Diversity is an asset to fight against challenges in farming vulnerability by making use of genetic resources and using different cultivation methods and livestock systems adapted to different climatic conditions that should, at the same time, contribute to an enhanced European agricultural biodiversity. Research on ecosystem functions needs to be strengthened in order to identify strategies which increase ecosystems benefits.

Through innovation partnership groups farmers can benefit from diversity, e.g. through more appropriate and locally adapted seed varieties (for different farming systems) and breeds (robustness, longevity, adaptability to local conditions), special plants with added value with regard to their nutritional characteristics, better functional diversity (site-specific habitat management and companion plants), new or better payments systems for valorisation of ecosystem services and reduced economic vulnerability. Market actors and consumers benefit from a broader range of products with different added values such as special qualities, different tastes and cultural values.

6. Challenge Resource efficiency

Key challenges, main obstacles and possible opportunities

The coming decades will be characterized by many challenges including human population growth, increased food and feed demand, growing scarcity and likely higher prices of resources needed in agriculture (e.g. fertile land, freshwater, energy, nutrients). Environmental limits put further constraints on agricultural production, as evidenced by the need to reduce agriculture's carbon, soil, land and water footprint and negative impact on biodiversity, including the need to prevent, detect and control pests and diseases both in plants and animals. In order to respond to these challenges, several major issues will have to be tackled in a holistic way. Sustainable use and conservation of natural resources are pre-conditions for achieving social goals such as food security. Increased productivity and sustainability of agriculture call for improved resource efficiency in the use of water, land, energy, fertilizers, and pesticides. Increased and sustainable agricultural output will be achievable through optimal use of traditional knowledge and major research and innovation efforts. In addition, greater farm profitability is essential in meeting all aspects of sustainability.

The way these challenges have to be dealt with is subject of scientific and political debate resulting from divergent approaches and views towards these challenges. This is well summarised by the 3rd SCAR Foresight Exercise¹ that distinguishes between the Productivity and Sufficiency narrative:

¹ http://ec.europa.eu/research/agriculture/scar/pdf/scar_feg3_final_report_01_02_2011.pdf

- a) According to the Productivity narrative rising income levels in emerging countries will shift diets to more protein rich food and will increase energy demand. Hence, there is a serious threat that global food demand will not be met in 2050. Therefore supportive policies and increased R&D investments need to be made to create new varieties, breeds and technologies that sustainably boost productivity and at the same time overcome resource scarcities and environmental problems.
- b) According to the Sufficiency narrative, the earth system will not have the capacity to support further increases in the rates of consumption and production. It promotes the design of low external input agro-ecosystems that are productive, respectful for ecosystems and save resources, however this would not be enough to stay within the carrying capacity of the earth. Per capita demand needs to be reduced through structural changes in food systems driven by internalisation of external environmental and social costs.

The two narratives are also present in the EIP for Agriculture, but agreement exists on the ultimate goals of improving, at the same time, agricultural productivity and sustainability.

In order to reach both goals simultaneously, priority should be given for instance to access to innovation, improving farmers' economic viability, reducing the impact of food production on the environment, promoting public health and improving food quality. It is with these goals in mind, that action should be taken to increase land, nutrient and water use efficiency with sustained or increased productivity while ensuring the conservation/improvement of soil fertility, water quality, biodiversity conservation and genetic resources and reducing the global warming impact of consumption and production of all agricultural goods.

Areas of action

Climate change adaptation and mitigation

Agriculture both contributes to climate change and is affected by it. This means action should be taken in two areas: mitigation and adaptation. Strategies for adaptation and mitigation of climate change vary among the different countries of the EU due to the large variation in the climatic conditions across the continent. Whereas adaptation can be achieved at country or regional scale, mitigation must be addressed at a global scale. It is critical to identify region specific adaptation needs. As regards mitigation, the use of fossil fuels and other carbon-intensive inputs, such as nitrogen mineral fertilizers and chemical pesticides must become more efficient and on the long term external inputs will have to be reduced in line with the requirements of farming sustainability and the environment.

Bio-based-energy can to a certain extent replace fossil fuels, but should not conflict with food production and the conservation of soil fertility and biodiversity. Improved animal feed conversion and better upstream feed processing can result in lower energy requirements and reduce methane emissions of the livestock sector. Priority should be given to energy efficiency, sustainable production and consumption and waste reduction. Additionally, active mitigation measures for carbon storage and emissions off-setting can be put in place so that agriculture can contribute to reaching climate goals. As regards adaptation, increasing diversity at farm level (intercropping, crop rotations, mixed cropping, biological control) and in forest management (afforestation, reforestation, tree

species composition, selected proveniences) as well as agro-forestry systems help to increase resilience against erratic weather patterns and outbreaks of pests and diseases. Measures to sequester carbon into the soil (e.g. conservation of grassland, use of farm residuals, incorporation of organic matter into soils, agro-forestry systems or conservation tillage) mitigate climate change, but can also help agriculture to adapt by improving water infiltration (prevention of floods) and water storage (prevention of droughts). In addition, traditional and modern biotechnology can help to reduce input requirements (pesticides, fertilizer) and to develop plants that are better resistant against biotic (pest and diseases) and abiotic stresses (water/temperature related, drought, flooding, high salinity). Finally, making use of new and traditional, locally adapted plant varieties and breeds can be another successful strategy.

Resilient and healthy plants/animals

Animal and plant health threats associated to climate change will also represent a challenge for food security and food safety. Those threats call for innovative actions in view of early and effective detection control and mitigation strategies, including actions targeted towards the conservation and sustainable use of genetic resources and improvements of soil fertility.

Creation of a resilient system through optimisation of biodiversity, enhancing soil biological activity and soil structure can improve soil fertility and plant resilience, ultimately leading to better plant health, and a more effective use of inputs. Advances in genetics, including the plant and animal meta-genome, plant and animal protection, knowledge of biology and agronomy, harmonized preventing strategies, selection of locally adapted crops/grasslands and livestock types, bio-control methods and appropriate grassland management are efficient strategies for reducing health problems and creation of more resilient farming systems. Focus on new and traditional locally adapted plant varieties with increased efficiency in the capture of energy, more efficient use of water, mineral resources and chemical inputs, and self-protection against pest and pathogens can enhance resource efficiency. Tackling the issue of existing, evolving as well as invasive insect and pathogen species is of crucial importance as they are a major threat to plant and animal health and are considered to be one of the main direct drivers of several detrimental effects on biodiversity, human and animal health, and plant production. Likewise, improved animal resistance to disease should be achieved by enhancing animal welfare conditions, improved feed crops, feeding systems and farm management via breeding as well as by using preventive measures and to be implemented through veterinary health plans at farm level.

Sustainable and more efficient input use

Different approaches exist on how to achieve more sustainable and efficient input use.

On the one hand, the output/input ratio of single resources needs to be maximised to gain in productivity and sustainability. This can for instance be achieved by technologies such as precision farming, crop breeding or improving water irrigation technology and water efficiency.

On the other hand, resource conservation and whole chain resource use efficiency needs to be improved. This can for instance be achieved by making better use of ecosystem services (see 'using self-regulating capacities'), precision techniques, reducing external inputs, biocontrol methods combined with a holistic package of agronomic measures and developing short supply chains. In forest management, e.g. facilitating natural regeneration and environmentally sound logging techniques are suitable approaches. Optimal output should be regionally determined by criteria of maximum allowed external input, land use and whole chain resource use efficiency.

Optimising and diversifying agricultural and forestry output and cascading use of biomass

Expanding and diversifying the use of agricultural and forest output without neglecting the importance of food production is one of the key areas for future developments in agriculture and forestry, in particular in relation to biomass production for bio-based products. However, production of all biomass must be subject to respect of sustainability criteria. By fostering the cascading uses of agricultural and forest products, favouring highest value added and resource efficient products, farmers and foresters have the potential to diversify their revenues. Innovative approaches facilitating the use of by- and co-products and residues and biodegradable waste as well the development and management of the new value chains and markets are key. Research and innovation are crucial in this area and require long-term investments, innovative and targeted breeding approaches and involvement of the primary sector. Innovation of plant varieties for food production can be combined with research into other parts of the plants that are not used for food or feed. The integration of temporary grasslands in crop rotations could combine the production of biomass for feed and to substitute fossil-based products. The use of crop residues should however not compromise the incorporation of organic matter into the soil and competition with food production should be avoided. The energy return of liquid bio-fuel is the lowest of all renewable energy resources. A cascading approach should therefore be adopted that prioritizes the conversion of agricultural and forestry by- and co-products as well as industrial, and municipal bio-waste into bio-materials followed by energy use.

Using self-regulating capacities

Enhancing the self-regulating capacity of farming systems by making use of functional biodiversity and ecosystem services (eco-functional intensification), combined with modern tools, agronomic practices and techniques, improves resilience, sustainability, and productivity. Important tools to enhance self-regulating capacities are for instance: mixed cropping and crop rotation, conservation tillage, multispecies forage mixtures, conservation and development of natural landscape elements to support natural enemies, biocontrol methods, use of innovative varieties and breeds adapted to local conditions, use of nitrogen-fixing legumes, innovative mixed farming, in combination with early warning systems and use of manure. Innovation aimed at enhancing self-regulating capacities should combine several of these techniques and involve farmers in a participatory approach. Particular experience with eco-functional intensification can be found in integrated farming, or low external input and organic agriculture.

Increased productivity along the protein chain

Most of the proteins used in animal feed, in particular soy, are imported from outside the EU. In order to reduce Europe's reliance on commodity markets and to mitigate the negative impact of protein cultivation in exporting countries as well as to increase the fertility of Europe's soils, the competitiveness and productivity of protein production in Europe should increase. This includes growing of nitrogen-fixing legumes in grasslands (e.g. alfalfa, clovers, medick), integration of annual pulses (beans, peas, lupines, etc.) in crop rotations as well as soybean cultivation in suitable regions in Europe. A cascading use of crops that are not a primary protein source would allow to produce more protein (e.g. rapeseed and potato when extracting oil or extracting starch). A package of solutions is needed to achieve this: Major breeding efforts are needed to develop varieties that are adapted to local conditions and climate and are containing highly digestible protein. Effective means of weed control have to be developed also in view of avoiding the spreading of herbicide resistant weeds. Further, improved pest and disease control systems and the development and integration for specific machinery is needed in order to increase productivity and attractiveness of legume cultivation. Livestock breeds that are well adapted to grass and legume forage intake should be promoted as well as processing of protein feed in view of improving uptake by animals. Finally, dependency on animal feed import can be reduced by increasing the share of plant products in diets, including direct consumption of legumes.

Nutrition and quality issues

Better linkage of resource efficiency on one hand and nutrition and quality issues on the other hand is needed. Developing food and suitable agricultural commodities that contribute to improved nutrition and health, while keeping production costs low and making them available for a broad public at affordable prices are of major importance. For example, protein crops such as legumes benefit not only soil fertility, but also human health. Enhanced innovative solutions for cultivating minor crops such as fruits and vegetables will also benefit the availability of products which are part of a healthy diet. Nutritional value and quality should become a central focus of agricultural and research policies. Beneficial health effects of plant primary and secondary components need to be studied and enhanced in cereal, fruit and vegetable crops. Further on these compounds need to be preserved and in some cases also enriched during processing so that their bioavailability in human nutrition is increased. In addition, most of the quality traits that are relevant for animal nutrition also carry benefits for human nutrition and grassland-based animal products have interesting nutritional characteristics for human health as well. Technological innovations need to take the concerns of EU consumers for food safety and security into account.

Consumer-driven demand can act as a driver for industry to improve the nutritional value of foodstuff and to reduce potentially unhealthy substances. Given the increasing evidence of diet effect on health, it has the potential to substantially reduce health service costs of EU member states.

7. Challenge Provision of public goods

‘Public goods’ are characterized by a certain degree of non-rivalry in consumption and technical difficulties to exclude people from use. The absence of ownership and working mechanisms of cost allocation associated with public goods can lead to free rider behaviour which in turn discourages individual efforts to ensure supply. As a result, public goods suffer from a systematic undersupply or, in the case of natural resources, a heavy tendency towards over use and depletion. However, public goods such as clean and ample supply of water, clean air, fertile soils, stable climate, diverse landscapes, pollination, biodiversity (incl. genetic diversity) of plants and animals are matters of joint interest; they should be seen as key elements that underpin our agro-ecosystems. They secure the long term capacity to produce a sustainable supply of safe quality food. Public goods also provide other services like public health and cultural services from which the rural areas and the society at large benefit. Furthermore, the generation and exchange of knowledge in itself is an important public good.

Farming and forest management have real potential when it comes to the provision and maintenance of environmental public goods including ecosystem services and long term food security. There is a challenge to encourage the provision of public goods and services on the scale required to meet societal needs for biodiversity, protection of natural resources, animal welfare and public health and wellbeing. Given the above-mentioned characteristics of public goods and the resulting absence of functioning markets, there is insufficient delivery of public goods. Therefore, intervention through social action or public policy is needed to encourage enhanced provision of public goods. The CAP has considerable potential to influence the delivery of public goods. The use of legislation or regulation has limitations. Therefore, the private sector, public authorities as well as other actors have their role to play in identifying, developing, spreading innovative approaches in order to incentivise additional provision of public goods. A variety of different new and collaborative ways of delivering and finally rewarding public goods should be developed in the frame of the EIP.

Key challenge, main obstacles and possible opportunities

Both, problems and opportunities are key motivators in the innovation process. Typical environmental problems are the degradation or scarcity of natural resources such as water, soil, genetic resources and biodiversity. Beyond the purely environmental problems, animal and crop diseases and the consequences these have for our environment, should ultimately not compromise public health. This is reinforced by structural changes at farm level causing environmental and health pressures. The lack of trust, knowledge and consensus on how to deal with environmental protection and other public good issues has often exacerbated the problem. In addition innovations often make investments necessary, which is often a real obstacle for the uptake in farming practice. Other important aspects such as the more resource efficient use of fossil fuels and chemical inputs of the farming sector have to be addressed. The provision of public goods by farmers and foresters, on a mandatory or voluntary basis, in particular when it comes to environmental benefits, has to be addressed in a manner that ensures their economic viability.

To be more competitive the EU farming and forestry sector is more and more characterised by intensification, specialisation of production and increases in economies of

scale, putting pressure on water, soil, biodiversity, animal health and welfare, plant health and public health. At the same time, some agricultural production systems that provide environmental public goods such as High Nature Value farming systems (HNV) including extensive grazing, are in decline. They need particular attention in view of modernization without losing their economic, social and environmental value. Solutions to preserve genetic diversity of plants and animals developed by relevant stakeholders over generations should be found, including their use and further development of these varieties/populations. Resilience and management of our natural resources should be put forward as a means to achieve a sustainable farming and forestry system and healthy society.

It will be crucial to make use of rural development measures to provide focused public goods suitable for the different farming systems across the EU. This will require sufficient flexibility on the ground for the choice of measures, their implementation and where necessary their improvement and adaptation while taking into account the need for monitoring the outcomes. In order to extend the provision of public goods by the agriculture and forestry sector, it is essential to promote cases where economic, social and environmental synergies exist.

Societal demand for the provision of public goods can be achieved efficiently using policy measures supported by economic mechanisms. Farmers are certainly willing to engage if they see a possibility of diversifying their income by delivery of public goods and ecosystem services. There are already good experiences with payments for environmental services or more holistic management practices. This approach should be further developed. Public money could also be used to support the establishment of a market-mechanism where policy measures incentivising the provision of ecosystem services are combined with market-compatible approaches which seek to establish user fees, reflecting the willingness to pay for those services. This would help to reinforce the financial means needed to incentivise the provision of certain services such as biodiversity (natural and cultivated, above and below ground), landscape conservation and/or improvement, clean water, soil fertility, bio-control methods and carbon storage. On the supply side, initiatives could come from farmers advised by experts or farmers working with local communities proposing public goods and services. In addition, pilot experiences should be supported for developing and assessing innovative demand and supply mechanisms.

Legal requirements on environmental protection together with public health and food safety laws are often perceived as negatively affecting farm competitiveness, therefore innovative approaches should be developed in both advisory (to work with the perception) and incentive structures, e.g. short term targeted support, with the aim to change this.

The pace of uptake of innovation is closely linked to economic and social success and acceptability to farmers together with their environmental and public health impacts. The economic return will be based on the market opportunities created and any economic compensation it brings with it. In cases where maintaining and enhancing the environment and ecosystem services can be associated with particular production methods such as organic agriculture leading to a premium price at the market, the uptake of such production methods should be facilitated.

When dealing with measures with only a minor commercial value or which are not rewarded by the market at all, direct support from public authorities is to be seen of great

importance. Therefore it is crucial to look for ways to make this possible and allow innovations in the environmental field to become self-sustaining. The involvement of other stakeholders than farmers along the value chain could lead to the development of new market opportunities. Ecosystem services provided on the basis of public-private cooperation should be considered. On the social side, it is important to understand and work with the socio-economic functions that are present in the rural communities, e.g. cooperative businesses, holiday farms, care farms etc. On the innovation side, there are gaps to be bridged between science and practice. Testing research outcomes on a commercial/farm scale to verify their acceptability and value should be prioritised. The involvement of multiple stakeholders in collaborative projects contributing to enhanced provision of public goods is important.

Areas of action

The provision of societal and environmental goods and ecosystem services must be based on improving the economic viability of farmers, foresters and wellbeing of society. It should be recognized that public health and wellbeing is inextricably linked to animal and plant health and the responsible use of plant protection products and veterinary medicines. Therefore, innovations leading to healthy crops and animals, resilient to environmental challenges and changing environments and with increased nutritional value, are essential. Understanding of societal demand is essential when taking decisions about the level of provision of public goods. Therefore, estimates of the value of public goods and the cost of inaction, is crucial. There is also a need to establish new forms of cooperation between farmers/foresters and citizens. Priority should be given to innovations that improve economic return and/or citizens' wellbeing while contributing to the provision of environmental and societal goods.

Trust building and knowledge exchange involving the processes for capturing, collecting and sharing explicit and tacit knowledge and the advancement of skills and competences are of utmost importance. The development of effective knowledge exchange in a cost efficient manner should be a significant part of the innovation process. Involvement of farmers in generating scientific output can influence the adoption of practices by individual farmers, processor/ supply side organization, industry and society.

The coordinated generation, development and management of key and open source data and monitoring output for all actors in the supply chain is extremely important. Examples of relevant data sets are: plant and animal genetic data (gene banks) and associated performance / quality data (a digital seed bank including phenotypic data), geo-physical data including soil analysis data, land parcel, pesticides and nutrient use, land productivity data e.g. grass growth and utilization, plant yields etc., but also technical and financial performance benchmark data, as well as data on environmental indicators.

Focus should be put on whole of agriculture and forestry to provide public goods. Never the less, the targeting of measures to locations where the supply of public goods is particularly concentrated or where the need is particularly high is desirable. When it comes to the environment particular attention should be given to NATURA 2000 areas in order to better align conservation objectives with farming and forestry reality. The need to protect the environment will lead to innovation including the development, demonstrating, exchanging and adopting of alternative farming or forestry practices. One option might be

to further develop the concept of functional agro-biodiversity and to develop wider crop rotations, where possible.

Collective and participatory approaches involving diverse stakeholders should contribute to a better delivery of better public goods. Initiatives might be undertaken by advisers, industry, research organisations, universities, specialized NGOs, rural development offices or local communities working together with farmers' organisations, farmers and agri-cooperatives, to spread knowledge through on-farm research, to test and develop innovative solutions, and to disseminate the new information.

8. Challenge: Establishment of a sustainable consumption and supply chain

Main obstacles and possible opportunities

Food and raw material scarcity is increasing due to growing population and changing dietary habits, withdrawal of productive land for other purposes and a large share of the food (approximately a third) which is not used or consumed. Competition for biomass between food/feed, industrial and energy applications is expected to worsen with the decline of fossil resources and its associated price increase. At the same time there are unwanted impacts on and of climate change, environment, natural capital and ecosystem services, human and animal welfare, and tough international competition. Concerning the latter, there is an asymmetry of market power between consumers, retailers, food processors, trade, agro-industry and primary producers, reflected in non-efficient value chains. The primary producers have suffered a declining share of value-added in the value chain over the past decade and the increase in output must go hand in hand with improved economic viability for primary producers. Without greater profitability, ecological sustainability will become even more challenging.

Innovation processes must focus on the aim of building new alliances, reliable and balanced commercial relations within the value chain.

Given the strong concentration in the retail sector, it is important to restore the conditions for survival of a plurality of typologies of food chains, so to give primary producers new income sources.

Through collaboration, the different actors in these chains should learn from each other and innovate together to make the primary production, industry and consumption better integrated and more sustainable. The actors should consider including potential new partners - also partners from other sectors - to the benefit for a creative approach in the farming, horticultural and forestry sector.

At the household level, a shift towards sustainable food consumption is related to social and environmental challenges. Food waste is a crucial component with two dimensions. On the one hand, food waste at the household level needs to be considered. On the other hand, focus needs to go to consumers' actual choices. In this context, it is the lack of economic incentives for reducing externalities in production and consumption which is a key obstacle for improving the environmental sustainability of consumption.

New approaches have to be established to ensure confidence from the consumers. In general, there is a lack of transparency towards consumers, as well as in Business to

Business relations on the consequences of food choices. New concepts and tools are required to guarantee transparency – including about the price setting – along the entire food chain. Responding to these challenges, a collective effort in networks is needed. A partnership approach, where knowledge sharing and cooperation among all stakeholders along the value chain (including consumers) is key, should be stimulated and hence, support co-creation of knowledge and co-innovation (e.g. food price observatories).

Three dimensions of sustainability (economic, social, environment)

Future innovation in the supply chain must build on the three dimensions of sustainable consumption, i.e. the interaction between its economic, social and environment aspects. A varied range of healthy food has to be at the disposal of consumers at affordable prices (economic sustainability). In addition, the ability to achieve more from less, in respect of people, the environment and our nature will be a very important parameter for competitiveness in the future. It is crucial that we create jobs and produce healthy, safe and sustainable food and other products to supply the demand. That will secure wealth and social well-being whilst reducing the level of impact of agricultural, horticultural, forestry and food industry production on landscape, soil, water, climate, biodiversity on animal welfare, not forgetting that farmer`s economy and farms viability must be absolutely taken into account.

Sustainability and food safety will be in increasing demand in the years to come. Therefore supply chain actors need appropriate multi-criteria sustainability assessment systems (and not single issue orientation) for the whole food supply chain both as decision tools and for monitoring as well as communication. Best use should be made of public-private cooperation to stimulate demand for sustainable products, for instance through sustainability requirements and by international standardization. One of the means to document compliance with sustainability requirements is via marked-based sustainability initiatives such as voluntary certification schemes. Environment and social indicators and criteria must generally be integrated in business models. Similarly, innovations are about setting up a new business that can deliver on all the three aspects of sustainable development.

Sustainable consumption

The development of new ways and initiatives to encourage the shift of consumption patterns away from resource demanding products towards less resource demanding products is a way to enhance the sustainability. This will also have large long term implications for global food security and hence to global equity and social stability. Consumption changes will however have repercussions on social and economic aspects in the food sector, both within the EU and globally, which need to be better understood.

New knowledge and development of new technology and processes, organizational models for a more sustainable and resource efficient production of food and non-food in the whole chain is needed. An example is the role of protein crops (legumes), both for soil fertility closing nutrient cycle; reduce pests and diseases but also for reducing climate gas emissions. Another example is the production of fruit and vegetables, which are important for the orientation to a more healthy diet. Sufficiency of consumption, production of high quality and tasty food, diversity of regional and seasonal food can be regarded as key

targets. Given the increased relevance of food insecurity, focus needs to be put on food and nutrition security for all European citizens, with special attention for vulnerable groups like people at risk of poverty, communities in rural areas lagging behind or minorities.

Other aspects are promoting sustainable food as a marketing brand both in EU and globally. Social innovation is crucial; this can be reached by using methods such as co-creation and co-innovation where consumers are involved in the innovation process.

Food production and processing

Developing and promoting sustainability (economic, environment, social) at all stages of the food chain is important and requires – in particular for smaller firms – food and nutrition information and transparency. Enforcing sustainable innovations implies investment to close the gap between researchers and medium and small (traditional) farms and food processing firms.

Traceability systems and effective control systems need to be included and further developed to improve trust and guarantee transparency on all aspects of food supplies (quality, safety, environmental and social issues and costs).

Applying new technologies is also a new opportunity for food processing and food packaging. Focusing on processing, there are several paths that should be explored: the exploitation of raw materials that are not currently used by implementing plant-based new technologies, the saving of water and energy, the use of enzymes for catalysing chemical modification of a food constituent, strategies to minimize pathogenic bacteria in fresh food, minimal processing maintaining the authenticity and quality of products, etc. With respect to resource saving and efficiency, technological innovation should aim at the development and implementation of more sustainable food packaging solutions and food processing systems, contributing also to a reduction of food waste, energy and water use along the entire food chain while safeguarding and improving food quality.

Short supply chains and rural urban partnerships

With more than 70% of Europe's population living in cities, rural areas have to establish a new form of partnership with urban areas. Active involvement of all actors of the food supply chain bares the potential of a range of social, ecological and economic benefits. However, a lack of awareness, modern lifestyles and institutional arrangements limit the involvement of city dwellers in the food system. Citizen's interest to become involved can be strengthened by different incentives like sharing experiences with existing innovative food systems, adapted institutional arrangements and logistical concepts. One example is the rising consumer demand and political interest in short food supply chains with appropriate policy frameworks and support policies (national, regional, and community city levels). Locally adapted, short chains between consumers and producers need to be developed in particular for fresh and low-processed products in order to strengthen health and wellbeing of European citizens, support resource efficient food systems, while at the same time creating economic benefits for producers and processors.

Short food supply chains are considered as a great opportunity for many small farmers among the EU member states that can directly or indirectly via cooperatives (or other forms) sell their products more locally. These products represent a big and diverse list of traditional products not easy to find in the cities. So, micro-logistic and organisational innovation is needed in order to facilitate the access to these products for all consumers. The combined value of preserving traditions and products from an irrecoverable loss and reduction of CO2 increasing processes (for transports, storage and conditioning) strongly contributes in seeing this possibility of innovation as a leading one. Cooperation with public authorities is central to consider the future degree of flexibility of regulation - especially hygiene regulations.

Non-food (demand)

Innovative solutions to maximise the value derived from non-food use of biomass and to increase the raw material production with sustainability as a guiding principle are in demand, e.g. smart use, prioritising high-value applications with use of residual biomass for ones with lower added value but without creating shortages in food and feed supply needs to be developed by reinforcing cooperation along the value chain and across sectors. New or improved solutions focusing on collection transport, pre-treatment (for instance, extraction of water), refining and storage for different types of biomass and establishing new value chains and products are among the possible actions. Public-private cooperation about stimulating demand for sustainable products through sustainability requirements and by international standardization is another aspect.

Waste management

Food waste is problematic for a number of reasons, including the loss of a potentially valuable food source or resource for use in other processes (e.g. energy generation or composting), wasted resources and emissions in the food supply chain, and problems associated with the disposal of organic waste to landfill. Innovative solutions create added value from food waste such as the optimization of different recycling systems with co-benefits, the involvement of consumers in the solution through innovative packaging and distribution systems, by-product valorisation, energy generation (biogas production) or as a source of nutrients for animals if hygienic aspects are controlled; using by-products for functional ingredients (instead of additives). The cycle of material (especially macro- and micro-nutrients and organic matter) has to be positioned in the centre of food and farming systems. It comprises intra- and inter-farm cycles which have to become closed regionally as well as the recirculation of high quality waste from all links of the food chain especially processing industry, retailers and consumers.

One of the most important and efficient way to enhance sustainability is to create innovative solutions to avoid or minimize waste in the supply chain – both in the short chains and chains targeting the global market.

Public health

Sustainable production and consumption must be stronger linked with public health. Innovation should help production system to increase food safety, e.g. linked to mycotoxins or bacterial pathogens in food and reduce the risks associated with the use of

pesticides and antibiotics. Innovation should also help producing food for healthy, diverse and nutritionally balanced diets and make it easily accessible for the consumers and thereby increase the public health. One way could be to increase the amounts of beneficial components of plants and animal products.

Education and information campaigns to promote sustainable and healthy nutrition and consumption, through promoting balanced diets in terms of quantity and quality, starting from school canteens and green public procurement, need new forms of public-private partnerships.

9. Innovation culture

With the aim to facilitate the implementation of the EIP, the promotion of an innovation culture is needed along the whole value chains from research to market and through multi-stakeholder approaches, to help address challenges agriculture, horticulture, forestry and food systems are facing.

Key challenge, main obstacles and possible opportunities

There are various definitions of innovation which can be useful references². However, the EIP shouldn't be restricted to any of them but rather have a broad concept as it is emphasised by the Agriculture and Fisheries Council in its conclusions on the EIP³: *“Innovation may be technological, non-technological, or social, and may be based on new or traditional practices and therefore innovative actions should take these differences into account”*.

The market and implementation component of innovation are critical aspects, therefore entrepreneurship must be promoted. Innovation also requires a certain “mind-set change” and “out-of-the-box thinking” amongst all actors in the supply chain. Equally, no solution/idea should be discarded without proper consideration.

An innovation culture faces several challenges such as:

- Natural and cultural barriers between stakeholders from the same or different groups. There is a need to develop a common working culture and language, in particular between farmers, foresters and scientists. There are huge opportunities in collective approaches and social interactive models, e.g. on-farm research, social media, benchmarking groups, platforms or farmer networks.
- The different nature and composition of each stakeholder group, which will vary in objectives and focus of activities.
- The cultural and understanding gap between rural and urban areas. In a society, with more than 70% of Europe's population living in cities, there is an uninformed understanding of agriculture which is no longer seen as an important sector of the

² For example, the OECD defines innovation as the “implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method.”

³ Council conclusions of 18 June 2012 on the European Innovation Partnership “Agricultural Productivity and Sustainability”

economy. It is critical for rural areas to establish a new partnership with urban areas.

- Innovation implies risk taking and not all engagements will result in successful undertakings. This possibility of failure needs to be acknowledged and should not disadvantage brand new approaches in the evaluation of projects.
- Finding the appropriate balance between public and private funded R&D, ownership of and access to innovation (e.g. Intellectual Property Rights) and the possibility for market development for innovation.
- The unsecured renewal of generations with young, innovative proactive farmers
- The differences between Member States in tackling innovation, including the implementation of the EIP in their Rural Development Programmes, should be taken into account.

Innovation culture as an overarching concept

The very heart of improving the innovation culture is to favour “out of the box” thinking, in which new solutions, inter-linkages and approaches may flourish. This may include tacit knowledge, rediscovering and exchanging information on old and traditional solutions while at the same time developing innovative ways of keeping valuable traditional systems alive.

EIP’s stakeholders could help to promote innovation culture throughout the value chain – and also externally, to the wider public. It is not just about social acceptance of new technologies, but about social awareness of innovations that could take place in agriculture, e.g. through research, rural development or partnership-building under the EIP. Finally, a continuous innovation philosophy should be implanted in the agricultural sector and all relevant stakeholders, as well as a transparent communication with society.

Stimulating holistic approaches: cross sector approaches; valorising scientific, local and tacit knowledge

A holistic approach must be placed at the centre of innovation. Cross-sector and multi-stakeholder approaches can incentivise innovation by integrating and connecting multidisciplinary knowledge, pooling resources, coordinating research, improving the information flow, increasing cooperation and enhancing capabilities across the agri-food chain, mutual learning, offering integrated responses to a specific challenge or demand. “Cross-over” innovations can be achieved through cooperation with different sectors and areas, such as biotechnology, agronomy, space technology, transport, ICT, chemistry, natural and life sciences, energy, retailing, nature conservation, public health or tourism.

Innovation must convey a transition towards systems capable of sustaining the needed levels of production in a socially, economic, and environmental point of view.

Science-based technology is only as useful as the use that is made of it. Hence, it is crucial to accompany technological innovation with appropriate stewardship and advice, in order to optimise the output of technology. It is also crucial to increase research on science-

based innovation focusing on methodologies, processes and practices. Public support is needed to upscale such a non-technological innovation which is highly knowledge-intensive, it often does not provide direct market opportunities and requires careful adaptation at local level. The EIP should also encourage social and organisational innovation in order to ensure compatibility between innovative products and processes with the cultural and social structures surrounding farming. These types of activity should be enhanced under the EIP.

In parallel, traditional knowledge and practices should also be taken into account when developing a new product, innovation support or research project, in order to make sure that the output/products are responding to real needs.

Finally, the EIP can play a major role in speeding up the levels and types of information that are provided at farm-level by fostering collaborative research (including primary producers in the development of research priorities and projects) and collaborative platforms (clusters, networks). Interactive research approaches integrating tacit, local and scientific knowledge will deliver clear advantages.

Stimulating bottom-up and interactive / participatory approaches

Bottom-up approaches will help to build innovation from practical experience and to contribute to the priority setting in research programming in view of addressing problems and needs faced by the practitioners. In addition, research actions established under Horizon 2020 making use of multi-actor projects and thematic networks allowing a participatory approach could further contribute to the implementation of the EIP.

Participatory and interactive approaches will deliver enhanced collaboration and exchange between different stakeholders or partners, complementary knowledge and sometimes synergistic outcomes. These approaches will promote better understanding between researchers, industries, advisers and farmers, including recognition of the importance of local, tacit and scientific knowledge. They will also build on the existing strengths of the farms and farmers, enhance of local capabilities, and accommodate diversity and complexity, as well as exploiting new scientific knowledge and new technologies. Often these approaches where not already in place need an extended preparation phase to establish a solid basis of communication and trust, which should be taken into account in the project funding.

In order to get scientists involved in the whole process from the initial idea to the market and to get engaged in such approaches, they need incentives and it is important that this engagement is rewarded accordingly in the academic reward schemes.

Wide stakeholder involvement and rural - urban partnership

It is vital to include in innovation efforts a wide range of stakeholders and actors, such as farmers, advisers, researchers, scientists, industry, NGOs, consumers, schools and the general public as appropriate. Broad participation and transparent processes help building trust and commitment. Considering the major challenges to be faced, it would also be appropriate to raise a shared sense of urgency and commitment.

The EIP has a key role to play to improve innovation culture, but it is a long-term issue and needs to be supported by education. Universities and schools are important to frame an innovation friendly attitude. Education will play an important role for a better integration of agriculture in society, particularly in the establishment of a new rural-urban partnership. But also communication activities, including shared experiences with existing and innovative food and agriculture systems, are essential. Local, efficient, and transparent communication chains between consumers and producers help to further build trust and knowledge of European citizens in food systems.

Branding and publicising these education and communication initiatives to better capture the interest of wider stakeholders is important.

Exchange, transfer and access to knowledge and experience

Activities, such as facilitated discussion groups, expert meetings, conferences, project groups, field trips and technical tours, visits of research and industrial facilities provide opportunities for improved networking between farmers and foresters and other stakeholders (including advisers, academia and industry). Demonstrations in crop and livestock production, especially in commercial farms, are an important tool to disseminate results and to provide easy access to innovation. Farmer training and support through the process of change should be encouraged and organised. Improving the collaboration and exchange between private and public actors (e.g. in the field of science) should also be encouraged through joint projects/programmes or information-exchange platforms. The EIP should be open to working and collaborating across borders, be they of administrative or sectorial.

In addition, civil society and scientists need incentives, resources and reward to engage more with farmers, such as contract research projects, demonstration farms and assessment of the success of new knowledge in the field. An open mind and co-operation inside the agriculture sector – e.g. to combine advantages of the various technologies – as well as with new partners outside the agricultural sector is important too. Extension and advisory services or innovation brokers have an important role to play in providing farmers with expert advice and in translating farmers' needs to the research sector.

Facilitating exchange between farmers should be prioritised, as neighbouring farmers have huge influence on decision-making by farmers, though it is increasingly difficult due to farming specialisation which creates more isolation and gaps between farmers. One approach to bridge the gap is the creation of groups of pilot farmers which should be formed by farm types and improved with a holistic and participatory approach (e.g. identifying, testing and promoting best practices). Pilot farms would be examples for stimulating innovation in large number of farmers. Researchers, farmers and other stakeholders can be partners, in the design, development and the dissemination of best practices.

Improved farmer access to knowledge should be encouraged, including R&D activities relevant to various breeding results and agricultural practices (e.g. organic, low-input, integrated production, precision farming). Those farmers are confronted by challenges such as diversity of systems, practices and knowledge capacity and are often location and sector-specific. The role of innovation brokers and knowledge exchange facilitators should be strengthened.

Advisors play a crucial role in facilitating the learning process. Advisory support should take into account the view of practitioners and stimulate their thinking. However, advisory interaction needs programming, technical support, branding and co-ordination in order to be effective.

10. Conclusion

- European agriculture and forestry face a number of current and new challenges that will have to be addressed in a sustainable manner. Achieving this will require to mobilise actors across the whole supply chain and in the scientific community and to join efforts for developing innovative solutions and research results ready for application. The European Innovation Partnership offers the opportunity for all stakeholders to get involved in defining new pathways and to share knowledge and experiences. The sharing of information and knowledge and mutual learning will ensure the best use of supporting policies such as Rural Development Policy and the Framework Programme for Research and Innovation Horizon 2020
- Specific challenges have been identified and the EIP will address possible pathways on how innovation could contribute to face them whilst reconciling productivity with the required sustainability. Innovation must also combine new scientific knowledge and traditional knowledge in order to provide value-added for agriculture and society as a whole.
- The wider EU agricultural and forestry sector is characterised by an enormous diversity, with a wide mix of farm sizes, types, and production systems. Farmers operate under different climatic conditions, terrains and with different methods of getting produce to market. Apart from an increasingly concentrated retail sector, the up- and downstream sectors are highly diversified as well. This diversity of EU agriculture is a strength that will be the basis for innovation generation and that will allow easier adaption to new methods and techniques and rediscovery of forgotten practice. Accordingly, the EIP must provide solutions that can be applied successfully under a wide range of natural, structural, and socio-economic circumstances without compromising the environment and public health.
- The key challenge for the EIP is to help the sector to become more resource efficient and economically viable. Increasing yield and yield stability in dynamic environments, increasing resilience and the adaptability of farming systems will have to go hand in hand with more efficient input use. The improvement of productivity must go hand in hand with sustainable consumption. Certain issues such as the cascading use of biomass, increased protein crop productivity, and the preservation and sustainable use of genetic resources in agriculture will require specific attention. Improving soil fertility must also be given priority.
- The agriculture and forestry sector provide public goods in the form of landscapes, biodiversity, etc. Often public goods, such as High Nature Values, are provided as a result of certain farming practices. As those farming practices are not necessarily the most competitive ones, innovation is needed to ensure sustained economic viability. The EIP is called upon to deliver innovative solutions to safeguard the delivery of

public goods and to foster land management systems that are economically viable, socially acceptable, and environmentally sound.

- Innovative solutions have to go beyond the level of primary production. The entire food chain needs innovative solutions and the primary sector cannot be seen in isolation. Resource efficiency can be improved by attacking food waste. New food supply models– for instance rural - urban partnerships - can be developed. Such innovations can reduce input use while improving the economic viability of the actors concerned. Sustainable, diverse, and healthy diets need to be addressed.
- The key assignment for the EIP is to create and foster a working innovation culture in the sector. The enormous diversity that exists in the sector and in the knowledge systems needs to be exploited in an entrepreneurial way, learning from each other and willing to test new ideas in practice. To use this "innovation capital", all stakeholders have to become active in promoting the involvement and use of the EIP.
- The role of EU Member States and regions is crucial in programming EIP actions within their Rural Development Programmes and other programmes. Member States need to take an active role in developing and promoting innovation actions and the EIP network should support Member States in this regard.
- A committed preparation and implementation of research projects and associated innovation actions is needed to provide the necessary knowledge base and tools for solutions applied on the ground. Particular efforts in designing and implementing interactive research projects under Horizon 2020, such as multi-actor projects and thematic networks, are needed. Various also non-scientific actors should be fully and actively involved "all along the project" to enhance co-creation and to generate co-ownership for ready to use solutions from research work. The diversity of approaches should be reflected in the diversity in project size.
- To accompany the implementation of the EIP through instruments under Horizon 2020, rural development and other policy instruments at various levels, attention will be needed for developing an appropriate evaluation approach for project proposals and for engaging adequate experts in this process, taking into account the new needs for involvement of different actors in projects. Specific efforts will also be needed to stimulate researchers to engage in interactive EIP projects via reward systems that go beyond scientific excellence only.
- The EIP must be open to allow uptake of new insights and bottom-up initiatives throughout its implementation. With a view to creating an "innovation driven research", the importance of Art. 12 of the Horizon 2020 regulation is emphasised. An appropriate practical and transparent approach for providing input to the research agenda via the EIP needs to be developed.
- The EIP is committed to advance innovation by facilitating the sharing of scientific knowledge and best practices and fostering the application of innovative solutions at the level of end-users. Accordingly partners will engage in unlocking tacit as well as science-based knowledge, among others by setting up and running operational groups or research projects as well as contributing to discussion groups and the completion of data bases. Effective dissemination with broad and long-term effects beyond project

periods should be developed, integrating and/or connecting with efforts already available at EU, MS, regional or local level.

- The EIP will only be a success if all stakeholders act together and share their ideas and experiences on innovation. Accordingly, emphasis must be given to facilitating knowledge exchange and a working flow of information at all geographical levels and in different working contexts. The stakeholders represented in the High Level Steering Board are fully committed to contribute to the work of the EIP in the different parts of the Union. The EIP is an opportunity we have to seize.