

Building Sustainable Innovation
Leadership in European Agriculture
An Innovation Action Plan to 2020



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The Innovation Action Plan is part of four documents: Part I - Summary of Action Plans, Part II – Innovation Action Plan, Part III – Research Action Plan and Part IV – Education Action Plan. All documents can be downloaded from the website www.plantetp.org



Building Sustainable Innovation Leadership in European Agriculture **An Innovation Action Plan to 2020**

Key actions to meet demand for increased, improved, economic and responsibly produced plant-based food, feed, fuels and materials

Summary of Key Actions

Securing a sustainable global supply of high quality food and feed, and supplying renewable biomass for the production of bio-based products and energy are key priorities for both European and global society. In the coming decades, the European plant sector will play a central and essential role in meeting this challenge and achieving this will depend strongly on the generation and transfer of new knowledge, and greater innovation in the plant sector.

The European Technology Platform 'Plants for The Future' (Plant ETP) has developed three Action Plans based on the pillars of innovation, research and education of which each action plan is part of an integrated strategy for the plant sector to build industrial leadership, boost research and educate the next generation.

Within the **Innovation Action Plan**, Plant ETP identified ten key actions required to deliver sustainable innovation leadership in European agriculture. These actions are clustered according to their impact on innovation success, predictability and coordination.

Actions to ensure innovation success

Action 1 - Promote critical scale in basic and applied research to sustain productivity growth after 2020

Action 2 - Reduce the risk of engaging in product-oriented applied research

Action 3 - Enable use of all processes and technologies considered safe

Action 4 - Reduce cost and time-to-market for innovative technologies and products

Actions to increase innovation predictability

Action 5 - Develop a transparent approach to Intellectual Property management and access to plant genetic resources

Action 6 - Develop public-private interfaces tailor-made for SMEs and large enterprises

Actions to improve innovation coordination

Action 7 - Improve sustainability and global leadership through regulation, standards and procurement

Action 8 - Integrate customers and farmers in the innovation process

Action 9 - Communicate short-, mid- and long-term skill needs in the entire sector

Action 10 - Integrate and make data and knowledge accessible across the value chain

Introduction

European agriculture has a strong track record in innovation. The European plant sector is and always has been a global leader. Today, the combined agricultural and food sectors account for 30 million jobs (13.4% of total employment) and for 3.5% of total Gross Value Added in the EU-28¹. Europe invests some three billion euros in plant-related research annually (private and public sectors), has more than 50,000 scientists actively conducting plant research in the public sector and about 13,000 R&D employees in the private sector. With about 40% of the land area being farmed, European agriculture has a major impact on society, the economy, the environment and overall welfare.

The projected growth of the world population, the expected increase in global welfare, the need for environmentally safe and sustainable agricultural production, the finite acreage available for agriculture and the growing scarcity of natural resources are all interrelated and together pose a major societal challenge. As the FAO pointed out, feeding 9 billion people by 2050 is a long-term challenge, but the expected increase to 8.3 billion people by 2030 is a problem for the very near term. Europe has the opportunity to make a major contribution towards meeting this challenge. First of all, Europe is currently a net importer of agricultural produce, including field crops. Increasing its own production to achieve more self-sufficiency would reduce pressure elsewhere. But beyond that, European innovation could deliver novel production concepts as well as new products, methods and instrumentation for production.

'Plants for the Future' is the European Technology Platform for the plant sector (Plant ETP). The stakeholder groups of the Plant ETP, which represent the industrial, academic and the farming communities, are firmly convinced that Europe is well positioned to shape its own and the globe's future by showing innovation leadership in the plant sector. We propose turning this societal challenge into a coordinated innovation effort by industry, academia and farmers associations. We believe that such

a European effort should be carefully developed in discussion with policymakers, and has the potential to deliver a pipeline of diverse innovations that meets the demands of society.

There are many areas for major improvement across the entire plant production chain (figure 1). Some of these actions which are essential for creating improvements are already widely recognized, and some of them are already being (partially) addressed. However, others need attention, not only from the sector itself, but also from society and policymakers. Examples are the exploitation of natural resources for plant improvement and the deployment of innovative breeding techniques, production methods, and novel farming practices. The large-scale use of data related to weather, environment, and genetics and performance to maximize plant productivity will also be a game-changer.

Translating this enormous societal challenge into a well-coordinated European innovation effort will drive the development of a sustainable, highly productive and competitive European plant sector, and contribute to economic growth and the creation of jobs.

An important factor is that a coordinated European innovation effort is composed of short-, mid-, and long-term deliverables. The reason is the large range of R&D timelines (1-20 years) in the different innovation areas of the plant sector and the variable lag-time for product delivery following adoption of new (European) regulations. It will be essential to determine the impact plant-based innovation in certain of the improvement areas would have on tackling the societal challenge, and over what time frame benefits may be expected.

The ETP 'Plants for the Future' is committed to facilitating this activity. We will assist in resolving this multi-tier, complex challenge into defined areas for targeted improvement. We will also promote an "open innovation" ethos so that the development of improvement plans

¹ Food for Thought Coalition. http://www.ecpa.eu/files/attachments/FoodforThought_2014-04-25.pdf

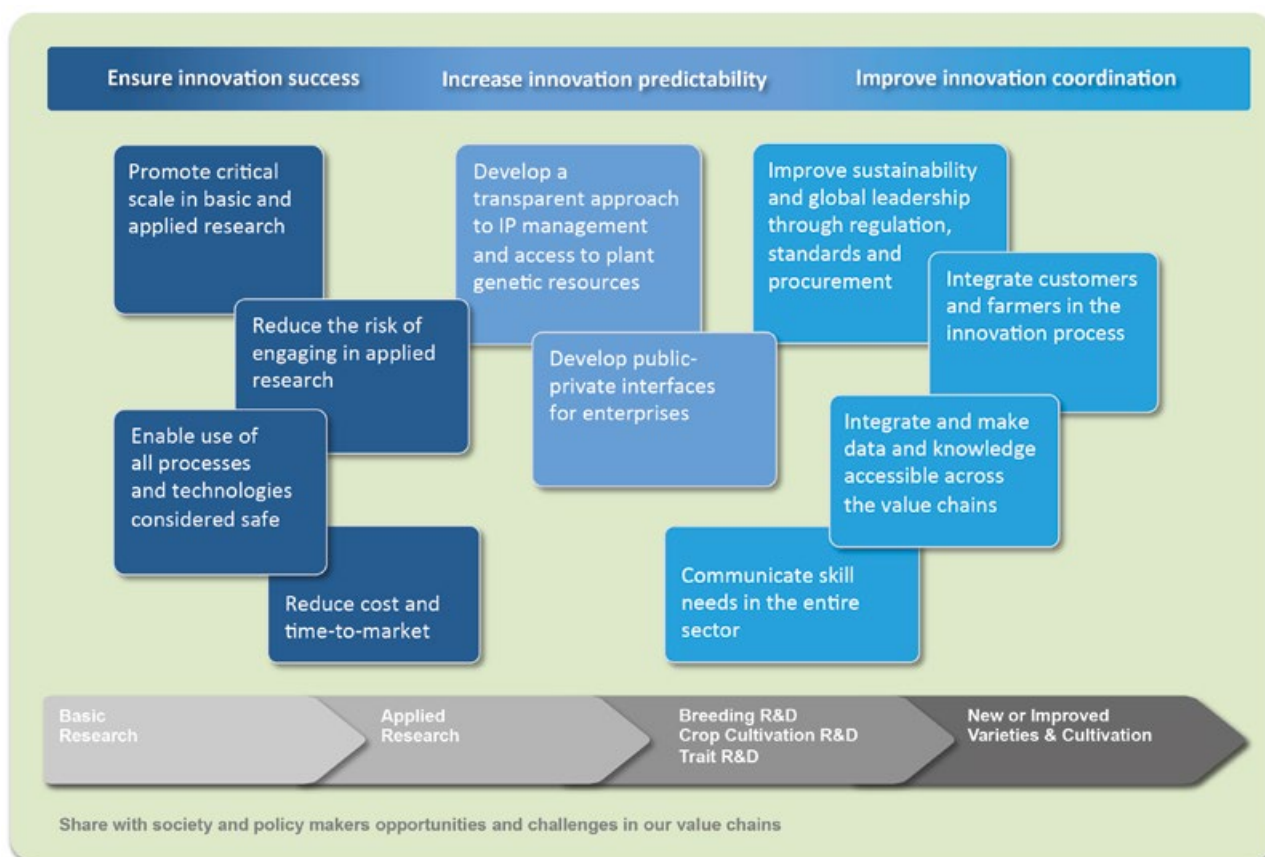


Figure 1: Actions stimulating plant-based innovations. Actions are clustered according to their impact on innovation success (dark blue boxes), predictability (light blue boxes) and coordination (middle blue boxes). *The development and uptake of innovative solutions in the sector will depend strongly on novel research findings, efficient knowledge and technology transfer, greater investment in innovation by venture capital and appropriate regulation. On one hand, while knowledge creation and exchange is the basis for progress, research goals need to be firmly oriented towards the real needs of farmers and end-users, extending beyond knowledge generation per se. At the same time, the regulatory environment must encourage innovation, by stimulating new products to enter the market and lowering barriers to market access. While product safety is vital, it is also essential that regulatory processes are evidence-based, built on the latest knowledge of the biological sciences and enable the best use to be made of biological diversity, including the protection of natural biological resources. A systematic approach needs to be required, in which regulatory process and research outputs are well connected to overcome obstacles to market access and capture the full value of research and investment.*

can benefit from the input of large numbers of experts from diverse disciplines across sectors and countries. We are planning and organising topical events in which we bring influential stakeholders and experts together to identify “next steps”. We will capture the findings and bring these to the attention of our members, policymakers and society. We are open to all constructive proposals.

Key actions required to deliver sustainable innovation leadership in European agriculture have been identified in this Innovation Action Plan and have been clustered

below. The actions are clustered according to their impact on innovation success, predictability and coordination.

The Plant ETP is convinced that the grand societal challenges can only be tackled by considering and interlinking all three elements: innovation, research and education. Therefore, the Plant ETP has developed an Research Action Plan and an Education Action Plan in addition. All three actions plans are part of an integrated strategy and are linked to each other.

Actions to ensure innovation success

Action 1 – Promote critical scale in basic and applied research to sustain productivity growth after 2020

Developing innovation potential for the plant sector requires vision and a long-term commitment to investment. Basic research in plant science must therefore remain a high priority for programmes at both the European Union and Member State level. The Plant ETP gives more details of key research and innovation challenges and key actions in a Research Action Plan. The challenge lies in implementing these efforts successfully as part of an overarching strategy with multiple, independent success factors. For example, better exploitation of natural resources for improvement of germplasm requires the coordinated effort of academia and breeders, with the involvement of farmers at an early stage, to characterize the wealth of genetic variation, but also effective ways to deal with, for example, the Nagoya directive, and a better understanding of the conditions under which farmers would need to operate in future.

Action 2 – Reduce the risk of engaging in product-oriented applied research

A large number of European companies in the plant sector, especially SMEs, are unable to fully fund innovation activities. A number of solutions need to be explored: shared risk models or in-kind contributions of public research, but also transparent processes for access to Intellectual Property (IP), financial instruments for product development and demonstration plants, in combination with new regulatory approaches. The impact of improved measures, better coordinated spending in the public sector and public-private partnerships depends on the innovation area and may become visible in the market in time frames as short as 3-5 years.

Action 3 – Enable use of all processes and technologies considered safe

To sustain the growth of annual yield, enhance quality and enable the development of speciality products, the plant sector has to be open to all innovations in approaches, methods and tools. For example, modern biotechnology is not just a key enabling technology for pharma; in the plant sector, it enables the discovery of traits for plant improvement, and offers precise and efficient ways to introduce desired characteristics in a variety of plants. Depending on the novel technology, tool or approach, the result is a reduced timescale for product development, a safer product, or a better product.

New techniques and technologies should be regulated in a fair and transparent manner on the basis of an independent, objective safety assessment and without political interference. With plant-based innovation needing long-term investment, legal certainty is vital to encourage research and market uptake of new products. The way GM crop regulation has developed has severely limited the innovation readiness of the sector as a whole and it is important that the same approach is not used for other technologies and techniques. European agriculture cannot do without timely adoption of novel approaches, methods and tools, which enable organisations to deal successfully with global competition by offering customers the best performing products at all times. The risk of not seriously considering novel technologies and techniques on a case-by-case basis is that plant-based innovation in Europe will be hampered, resulting in a huge loss of competitiveness for European farmers, growers and processing industries, together with reduced consumer choice.

Action 4 – Reduce cost and time-to-market for innovative technologies and products

Innovation in agriculture may apply to the properties of the agricultural product itself, to how the agricultural product is grown or produced, or to the way the agricultural product was developed during the R&D or breeding period. The Plant ETP notes that, in all three fields of innovation, Europe has opportunities to launch initiatives that reduce cost and time-to-market for stakeholders. These opportunities include access to pre-competitive research, development of standards for description and quality of results from public research, establishment of a predictable environment for IP management, access to IP, regulation and safety, shared centres for discovery and testing of novel product opportunities, novel cultivation methods and novel instrumentation. The Plant ETP plans to organise dedicated meetings with stakeholders to inventorize and rank options that would reduce cost and time-to-market and, together with the stakeholders, bring them to the next level.

Many policy discussions involving European and national decision-makers should take place in the future on several subjects, including the potential revision of the Community Plant Variety Rights legislation, legislation for the production and marketing of plant reproductive material, novel foods and access to genetic resources or new breeding techniques. In view of this, the Technology Platform will inform all stakeholders and provide opportunities for discussions, for example via a series of public con-

ferences and debates to explain why innovation is a key issue affecting, and affected by, the regulatory framework. These events will be supplemented by policy papers – or a revision of existing policy papers – in order to indicate to policymakers and other stakeholders the main position of the plant sector and to point out possible pathways to facilitate plant-based innovation.

The Plant ETP welcomes the setting up of the European Innovation Partnership on Agricultural Productivity and Sustainability, which puts innovation at the heart of the debate on agriculture. However, the structure as well as its main policy tools still lack the strategic focus needed to address the major challenges farmers are facing in terms of enhancing the competitiveness and sustainability of their sector. The Technology Platform remains committed to supporting the European Commission in this initiative, by providing knowledge, input and expertise, but possibilities for engagement with the private sector still remain underexplored.

In addition, the Plant ETP calls upon the European Commission to further tailor the regulatory environment to support long-term research. There is currently too big a separation between the policy goals of research programming, which aims to stimulate innovation in Europe, and the goal of health and consumer protection policy, which seeks to control market access for innovations. This divide is creating a huge gap between those areas of the world that are embracing plant-based innovation and Europe, where many promising innovations remain blocked in the pipeline.

Actions to increase innovation predictability

Action 5 – Develop a transparent approach to Intellectual Property (IP) management and access to plant genetic resources

Plant-based innovation is a time-consuming and high-risk business, with plant breeders alone investing up to 20% of their annual turnover in further research and development. This is a higher rate of investment than most other research-intensive industries. The end-result of research and development is biological material, which is particularly easy to copy and reproduce. Therefore, organisations working with such material require a strong and effective system which, on one hand, enables effective protection of plant varieties of all genera and species in order to obtain a return on investment and, on the other hand, provides access to protected plant material for research and breeding purposes.

Plant genetic resources provide the basis of any breeding programme and determine the genetic diversity of a new plant variety. Guaranteeing access to genetic resources is therefore of crucial importance for plant research and innovation for science, industry and farmers. Ensuring that the access rules and requirements imposed on European companies are reliable, proportionate and simple will be key to the encouragement of plant breeding innovation, in particular for SMEs. Affordable and timely access to new know-how and innovation opportunities is a major challenge for smaller companies.

Seed marketing legislation provides the regulatory framework in which seed companies operate in order to ensure the continuous supply of high quality seed of improved plant varieties. Innovation is the underpinning principle of the legislation. In the future, an innovation-friendly approach to seed marketing legislation must be maintained so that farmers may benefit from continuous innovation, and breeders from a level playing-field.

Action 6 – Develop public-private interfaces tailor-made for SMEs and large enterprises

Research, knowledge transfer, education and innovation are important drivers of rural development. Their importance is set to grow, as they are at the heart of the Europe 2020 strategy which targets smart, sustainable and inclusive growth. Knowledge transfer and innovation is one of the six priorities of the Rural Development Programmes. The Regulation (EU) No 1305/2013 on the European Agricultural Fund for Rural Development (EAFRD) lays out (art.14) the actions supported to achieve this EU priority. Even SMEs operating in rural areas can benefit from EU funding.

The efficiency of knowledge and technology transfer from discovery in plant sciences to farmers and into the market is today a weak point, particularly in Europe. In many countries, and in some important disciplines, the gap between knowledge generation and product development has actually widened in recent decades. Efforts to enhance “excellence” in knowledge generation happened at the expense of application-oriented research including, for example, the development of capabilities for field-based research across Europe. Specific instruments need to be implemented to close this gap, which clearly hampers European competitiveness. Incentive systems need to be adapted to strengthen links between academia, industry and farmers. This is required at all levels of education as well as in the research sector. New incentive systems also need to include criteria for the evaluation of knowledge and technology transfer beyond the publication- and patent-based systems of today. Long-term coordination of public and private efforts in the primary production field is urgently needed to stably align the needs of industry and farmers with the R&D sector and build a basis for innovation in the sector.

The diversity in European pedo-climatic conditions offers a unique opportunity for discovery and testing of novel agricultural products and practices. To leverage this opportunity, the plant sector would require smartly distributed, shared research and breeding infrastructure networking across Europe (and in specific cases even spanning the globe). Such infrastructure networks have – relative to big investments in other sectors – fairly low initial investment costs, but have ongoing maintenance costs during their life-times. To realise such multi-year investment plans, European stakeholders need to develop a shared vision and then to provide long-term commitment.

Public-private partnerships for open innovation in the plant sector can support translational research and

ensure the effective transfer of knowledge into products and uptake of innovative new developments by end-users. The Plant ETP advocates the allocation of a dedicated budget for plant innovation via a European public-private collaboration that can leverage additional private funds as necessary. Such an initiative should be long-term and focused. Priority research and innovation needs in the plant sector should be identified and the initiative should serve to promote the excellence of European plant science. This will attract further talent and skills to Europe. As the main agri-food exporter in the world and the largest net importer, Europe must take a leadership role in order to promote quality agricultural products for consumers, competitiveness for farmers and sustainability for society at large.



Actions to improve innovation coordination

Action 7 – Improve sustainability and global leadership through regulation, standards and procurement

For successful innovation to take place, there is a need for an innovation-friendly, consistent framework of regulation, appropriately targeted incentives, steadily rising safety and performance standards, procurement initiatives, clarity on business risks, etc. In such a landscape, attractive employment opportunities are created in existing and start-up companies, and organisations can leverage Intellectual Property and deliver a proper return on investment. The Plant ETP considers this area as one of Europe's main opportunities to develop long-term innovation leadership in European agriculture.

Action 8 – Integrate customers and farmers in the innovation process

In the plant sector, the time-to-market from research to product launch is more than 10 years for many breeding programmes and other agricultural products. For instance, depending on the biology of the plant, the timeline from the first cross to final market introduction of a new variety can take up to 7 years in the case of lettuce, and up to 20 years in the case of biannual crops like cauliflower. This is not even taking into account breeding for more complex traits. For the plant production value chain to operate effectively, it is therefore essential to have an understanding of the current and future demands of consumers, farmers and other customers so that product development can be tailored to market needs. This requires an ongoing dialogue between the end customer, the farmer and the R&D organisations active in breeding, chemistry, agronomy and agricultural machinery.

In practical terms, it is important to make explicit for all stakeholders what the expected consumer trends and novel uses are, which crops farmers are expected to grow where, and how such crops will be grown. Frequent updates of comprehensive analyses of consumer trends and behaviour in relation to food and non-food products

would help scientists in academia and in the plant and downstream sector to set better targets. In particular, the continuing urbanisation of the world population and novel demands within the emerging models of the bio-economy will have a huge impact on the perception of agriculture and the demand for continuous availability of a wide range of products. A positive example comes from the horticulture sector, where there is a very direct link between scientists, companies and consumer panels to better understand consumer needs and preferences and to build these into research and breeding programmes.

Action 9 – Communicate short-, mid- and long-term skill needs in the entire sector

The plant sector has a complex setting. Plant raw materials find their way into different value chains: food, feed, fibre, bio-based products and bio-energy as well as related public goods. There is a need to increase output, and to develop sustainable ways of producing plant raw materials, within the limitations of a number of serious constraints: fixed acreage, approaching shortages of water and nutrients, climate change and development of new pathogens and diseases. There are also enormous opportunities in the sector: the rapid development of plant sciences, new instrumentation, and new technologies. On the horizon are novel approaches to managing farmland and greenhouses, innovative agronomic practices, novel ways to conduct breeding and other agricultural R&D, improved instrumentation, etc. Consequently, the sector is ramping up its demand for a broader range of skills and expertise, some of which are also typically found in the pharma, banking, engineering, and ICT sectors. The Plant ETP has mapped the areas of skill growth and the demand for novel skills throughout the plant production value chain. Noteworthy findings are the need, for instance, for breeders, mathematicians, eco-physiologists, geneticists, statisticians, biochemists, but also ICT High Performance Computing scientists and programmers. In the "Education Action Plan" of the Technology Platform, the most prominent needs for the plant sector are highlighted.

Action 10 – Integrate and make data and knowledge accessible across the value chain

The use of big data in agriculture may rejuvenate the sector. Developments in ICT, data handling and genomics technologies have revolutionised the way scientists and plant breeders are able to find leads to enhance productivity and to develop novel varieties and plant protection products with reduced time lines. Similarly, farmers today are beginning to have the opportunity to make use of big data related to weather and biotic and abiotic conditions, to better plan and manage the productivity of their farms. Today, the use of big data in agricultural R&D and breeding has already changed the way innovation is done, but it is expected that in the coming 10 years it will also change the way plants are grown.

The development of big datasets, data management and handling, and data access and analysis all come at a cost. This presents specific challenges, in particular for SMEs, which are less able to invest in these technologies. Making big data platforms accessible and affordable would greatly enhance the innovative capacity of all stakeholders in agriculture.

The key challenge is to translate big data into useful and technically feasible and pragmatic recommendations for what to do to meet the needs of the next generation of farmers. In view of the complexity of the subject matter - including climate, weather, plant performance, genetic composition, etc. - it will be essential to build plant and agricultural data platforms through a multi-disciplinary approach, with dedicated integrated projects and infrastructure. The challenge is to integrate disciplines ranging from breeding and genetics, to physiology, agronomy, ecophysiology, precision phenotyping, chemical analysis, biochemistry, as well as climatology, mathematics, statistics and ICT data handling and analysis. Cornerstones are the development of predictive models and of opportunities for stakeholders to participate in the learning curve and the validation of such models in their own setting.

About the ETP 'Plants for the Future'

The ETP 'Plants for the Future' is a key stakeholder in the agri-food chain, representing those organisations which are active in plant science research, companies investing up to 20% of their annual turnover in plant research and innovation, and farmers keen to access the latest technology adapted to their needs.

The Technology Platform focusses its efforts on four domains to help drive successful innovation leadership by the European plant and agricultural sectors:

- 1) Global competitiveness of European innovation
- 2) A sustainable European innovation culture
- 3) Strategic innovation opportunities which can drive mid- and long-term EU prosperity
- 4) Improved flow of innovation to the market

The Technology Platform calls upon the European Commission and Member States to take on board the integrated Innovation, Research and Education Action Plans that aim at enhancing plant-based innovation potential and the societal support needed to implement innovation. The Technology Platform is highly committed to assist in bringing stakeholders together (from industry, academy and farming communities), and participate to the development of a sustainable leadership of European agriculture.



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Some experts have participated in three different workshops organized during the development of this Innovation Action Plan; other experts who are members of the ESA (European Seed Association) Working Group Research & Innovation have contributed to the drafting of this Innovation Action Plan.

All experts who have directly contributed to draft this Innovation Action Plan are highlighted.

Glossary

Agri-Food Sector

The sector of the economy that produces agricultural and food products.

Bioeconomy

The bioeconomy encompasses the sustainable production of renewable resources from land, fisheries and aquaculture environments and their conversion into food, feed, fibre, bio-based products and bio-energy as well as the related public goods. The bioeconomy includes primary production, such as agriculture, forestry, fisheries and aquaculture, and industries using and/or processing biological resources, such as the food and pulp and paper industries and parts of the chemical, biotechnology and energy industries.

European Technology Platform (ETP)

ETPs are industry-led stakeholder fora that develop short to long-term research and innovation agendas and roadmaps for action at EU and national level to be supported by both private and public funding.

Food Security

Food security encompasses the availability of sufficient, nutritious, safe and affordable food

Plant Sector

The plant sector is composed of the public sector - universities and research institutes working on plant science – and the private sector with arable farming, horticulture, forestry as well as agro-chemistry, plant breeding, seed and plant biotechnology industries. The sector is characterised by activities enhancing and stabilizing yield, food production and nutritional security, environmental benefits and the non-food use of plants and plant biomass for bulk as well as high value products.

Small and Medium Enterprises (SMEs)

Small enterprises have fewer than 50 employees. Medium enterprises have fewer than 250 employees and have an annual turnover not exceeding 50 million euro. In 2012, in the EU-27, some 20 million SMEs provide approximately 86.8 million jobs.

Sustainability

This is an economic, social and ecological concept. A sustainable (bio)economy is one that meets the economic and social needs of the present while minimising the impact on the environment, and without compromising the ability of the future generations to meet their own needs.

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This Innovation Action Plan document, as well as the Research Action Plan, the Education Action Plan and the Summary of Action Plans, which outlines the key elements of all three action plans, can be downloaded from the website **www.plantetp.org**

Disclaimer

This Innovation Action Plan has been drawn up through the collaborative effort of a group of experts representing the various stakeholders of the European Technology Platform 'Plants for the Future' (Plant ETP) (industry, academia and farming communities). Whilst the Innovation Action Plan represents the outcome of a series of open workshops and discussions, it is neither exhaustive nor comprehensive and covers only selected aspects of broader issues. This Innovation Action Plan is a living document and will be updated regarding new developments and based on experiences from its implementation.

Views and information expressed in this document do not necessarily reflect the opinions of any single member, their organisations, or of the European Commission.

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