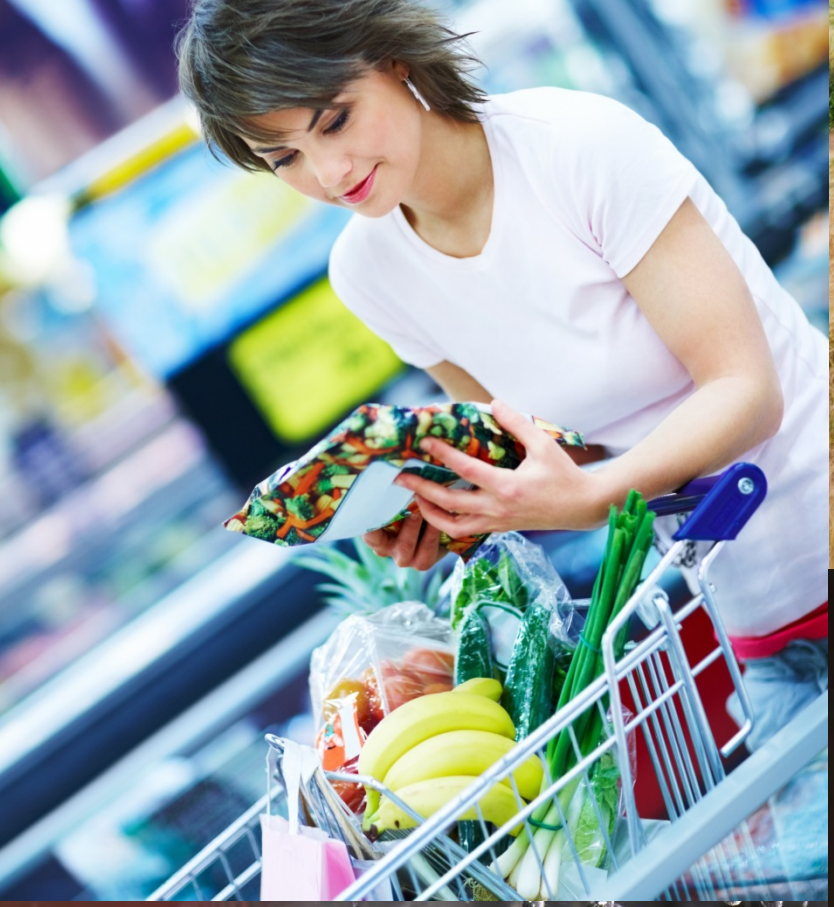
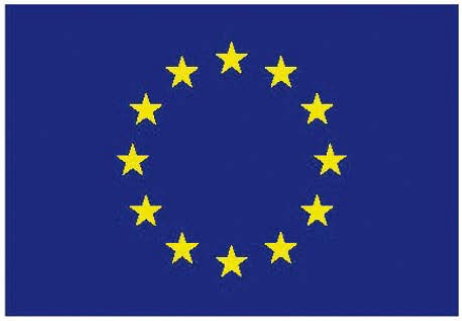



FACCE JPI – JPI HDHL

Priority Joint Actions to contribute to the European Strategy on Food and Nutrition Security

Outcomes of the Grand Debate “Nutrition Security – A whole system approach”



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Contents

1. Introduction

Food and nutrition security (FNS), defined as "a condition under which adequate food (quantity, quality, safety, socio-cultural acceptability) is available and accessible for and satisfactorily utilized by all individuals at all times to live a healthy and happy life" (1), is central to the well-being of people and nations. Until recently, it was predicted that, despite current patterns of climate change, and the increasing world population, there would be several decades with food surplus and low prices ahead (2). At the same time, there was an expectation that, as knowledge about what constitutes a healthy diet for different individuals increased, dietary patterns would shift to "optimal nutrition", which could potentially take account of individual differences. Nevertheless, food and nutrition insecurity continue to be important issues globally.

A key challenge is to develop food production systems which are able to support the sustainable increase of the global supply of nutritious and safe food to meet the needs of a world population expected to reach 9 billion or more people by 2050, while preserving a safe living space for humanity by avoiding dangerous environmental change (3). Climate change is negatively impacting food production (4, 5), and may also have negative impacts on the nutritional quality of food and on food safety. Moreover, the agriculture, land use and the forestry sectors contribute almost one quarter of total greenhouse gas emissions, but also have a high potential for mitigation of emissions and for biological carbon storage in soils (2). At the same time malnutrition, including overconsumption of nutrients and calories, continue to have devastating effects on public health, being particularly negative for some demographic sectors and implying an additional burden on climate. Simultaneous consideration of both caloric adequacy of the diet and nutritional quality is required in terms of both research and policy. We need to provide more food (and reduce food waste through the entire food chain from primary production through to consumption), and at the same time develop interventions and policies to support healthier diets with a lower impact on the environment and the climate. The stability dimension of food security will become increasingly important given trends of increasing food price volatility and large risks of climate shocks to the global food system within the coming decades (6, 7). Moreover, commitments to climate stabilization within a 2°C global warming limit imply that more food will need to be produced with far less greenhouse gas emissions and this will have economic implications for food supply chains and consumers.. Economic and social impacts of new developments, such as promotion of shorter food chains and assessment of the impacts of increased local agriculture on FNS also need to be considered. Although the question of ensuring FNS is not new[1], it is being viewed as an increasingly urgent issue globally, in light of current climate change and political, economic, social and environmental developments. In particular, social inequalities in access to adequate and/ or nutritious food exist. An important goal is therefore to ensure that food security is attained by all, including the most economically disadvantaged (the poor), and geographically isolated.As Beddington et al. (8) stated –business as usual is not an option – but what are the alternatives?

[1] See for example the FAO international symposium on "food and nutrition security: food-based approaches for improving diets and raising levels of nutrition" – December 2010

The theme of the EXPO 2015 Milan: Feeding the Planet, Energy for Life is a call to action. The European Commission (EC) has responded with a series of events looking at the role of research in Global Food and Nutrition Security. The EC launched a discussion paper at the start of the EXPO 2015: 'The role of research in global food and nutrition security' (9). This discussion paper considers those areas where European research can add most value. It highlights priorities for research, development and innovation on the theme of global food and nutrition security, and will serve as a major contribution to the EU legacy of EXPO2015 as it guides future policy actions. Events focussing on FNS were hosted in the EC pavilion, and an online survey is ongoing, providing an opportunity for input into the EC discussion paper, of which an update will be published in October 2015.

In this context, the two JPIs "Agriculture, Food Security and Climate Change" (FACCE-JPI) and "A Healthy Diet for a Healthy Life" (JPI HDHL) organised a day-long event in the pavilion of the EC at EXPO 2015 Milan on "Nutrition Security – a whole system approach". This grand debate focused on the impact of climate change on providing a sustainable food supply that has the nutritional requirements to ensure a healthy population. It brought together 10 international experts in the area of FNS[2].

The objective of this event, and this paper, is to serve as the FACCE-JPI- HDHL contribution toward a European strategy on FNS and to identify priority joint actions that FACCE-JPI and JPI HDHL can develop collaboratively. The content of this paper will feed into the future strategic plans and activities of the JPIs, and will be submitted to the EC public consultation on "The role of research in global food and nutrition security".

[2] Expert panelists: Matteo Bartolini (President CEJA, the European Council of Young Farmers), Claire Bosch (Secretary general Flemish Food and drink Federation), João Breda (WHO, programme manager nutrition, physical activity and obesity), Michael A. Grusak (Research Plant Physiologist, USDA-ARS Children's Nutrition Research Center; Professor, Department of Pediatrics, Baylor College of Medicine), François Houllier (President French National Institute for Agricultural Research), Leslie Lipper (senior environmental economist in the agriculture and development economics division at FAO), Silvia Miret-Catalan (Director Nutrition & Health Discover at Unilever), Winsome Parnell (Associate Professor Department of Human nutrition, University of Otago, New Zealand), Martin Scholten (Managing director Institute for Marine Resources & Ecosystem Studies and Animal Sciences Group), Wageningen University), Duncan Williamson (Food Policy Manager at WWF).

2. Joint Programming Initiatives and the Grand Societal Challenges

Although European national research programmes are among the best in the world, they are unable to tackle today's large societal challenges individually. For this reason, in March 2008, the European Council called on the Commission and Member States to explore the potential of Joint Programming.

Joint programming is a voluntary, long-term, iterative process driven by EU Member States that seeks to make better and more efficient use of a major part of research efforts planned and organised on a national level, in order to provide the long-standing, stable research basis that is required to address grand societal challenges. Joint Programming aims to significantly enhance the efficiency and impact of national public research funding throughout Europe and beyond through reinforced coordination of national research programmes, exchange of complementary knowledge and expertise and sharing of resources. Joint Programming Initiatives (JPIs) specifically seek to identify areas or research activities that would benefit from joint actions: coordination, joint calls for proposals, pooling of resources or other novel means of integration and alignment, in order to reduce fragmentation and duplication and cover research gaps. As one of the objectives of the European Research Area, the aims of JPIs are, on one hand, to export and disseminate knowledge, innovation and interdisciplinary approaches to other parts of Europe and throughout the world and, on the other hand, to ensure the effective use of research outputs in order to foster and facilitate European competitiveness and policy making.

The challenge addressed by FACCE-JPI is ensuring sustainable food production that supports European and global food security under climate change while at the same time protecting the environment and natural resources. JPI HDHL focuses on the health aspects related to food supply and dietary choices. Food production and human nutrition are embedded into rapidly changing scientific, economic and social environments. These are characterised by increasing demand for high quality foods which will promote the health of an ageing and growing world population; increasing competition for resources such as land and water; and increasing demand for crops for production of feed, food and raw materials for fuels and industrial biotechnology.

Both of the JPIs contribute separately to questions related to FNS. General information and a description of the work currently carried out by the two JPIs can be found in Annex 1. At the intersection of these 2 JPIs lies the question of nutrition security in a changing world, where demographic, environmental, social, economic and geopolitical pressures are affecting both the quality and availability of nutritious foods. The FACCE-JPI-HDHL Grand Debate on Nutrition Security resulted in two concrete priority research areas that we propose to develop through collaboration between the two JPIs. These areas are:

I. Coordinating policies to support food and nutrition security in the context of climate change

II. Plant and animal production systems for better human nutrition and resilience to climate change

3. Coordinating policies to support food and nutrition security in the context of climate change

3.1. Specific Challenge

Governance practices and regulations have an important role to play in promoting FNS, and need to simultaneously address public health, food and climate change targets (10). Climate change questions several dimensions of FNS: supply and stability, given risks of climate shocks to the food system (e.g. a -10% reduction in global crop yields would be expected every 30 years (6), nutritional quality, as micronutrients and proteins contents decline, and food safety, given risks of increased food-borne diseases.

Such policies must be underpinned by an evidence base derived from rigorous transdisciplinary scientific research. Through regulations related to dietary guidelines (for example, the labelling of foods), subsidising food production in ways that promote healthy eating practices, introducing regulations to promote efficient food production and encouraging specific food consumption practices, the government can play a large role in ensuring food availability and healthy, non-wasteful consumer food choices (11). However, policies originating in different parts of the food, health and climate change (environment) sectors may have conflicting measures, or due to lack of coordination miss the opportunity to generate synergies between policy areas. Policies which target only a single driver of FNS may have unintended impacts on food systems and interact with climate change. For instance, nutritional security may target reductions in consumption of products with high carbon footprint, creating synergies, or could, conversely require intensive production systems with high climate and environment footprints. It is important to consider the impacts of policies on human and environmental health and socioeconomic factors, at the same time taking due account of ethical concerns associated with, for example, specific production practices, income distribution in value chains or inequalities in health across the population. Policies must be aligned to ensure that they address health, climate, socioeconomic and environmental challenges and are not operationalised independently within sectors. For example, there may be a tradeoff between obtaining optimal nutrition levels for some versus ensuring adequate nutrition for all, and it is important to ensure that the equity of distribution of benefit of policies applies to the most excluded members of society as well as the most affluent. Responding to increasing food demand driven by population growth and dietary change is more than just increasing food supplies and food production, but also entails actions that can shape consumer demands towards more sustainable and healthy diets.

In addition, polices may have unintended consequences which act against the intended policy goals. For example, policies focussing on taxing unhealthy foods (in order to mitigate obesity) are being advocated. Unintended consequences, such as the effects of an increase in the overall cost of food, must be considered, and, where such taxes are already imposed,

their effects on FNS monitored. Generally, policies related to FNS should be monitored and evaluated in the same holistic way, and should consider both supply and demand characteristics of the entire food system and implications for trade and for the impacts on less developed countries (11).This requires the development of research that brings together not only different disciplines (e.g. health, agriculture, aquaculture, psychology, economics and policy sciences), but also ensures that all key stakeholders (e.g. the primary producers, food industry and consumers) are consulted regarding the appropriateness and potential for unintended effects of such policies. Such a holistic approach enables the development of a framework for directing research investment towards science-based evidence which can be translated into effective and actionable FNS policies. Attention should also be paid to supply and demand issues, price volatility, income effects in value chains, interactions between institutions in the private and public sectors, and strategies to develop a portfolio of policy responses which can be utilised in response to different potential food security and system resilience challenges.

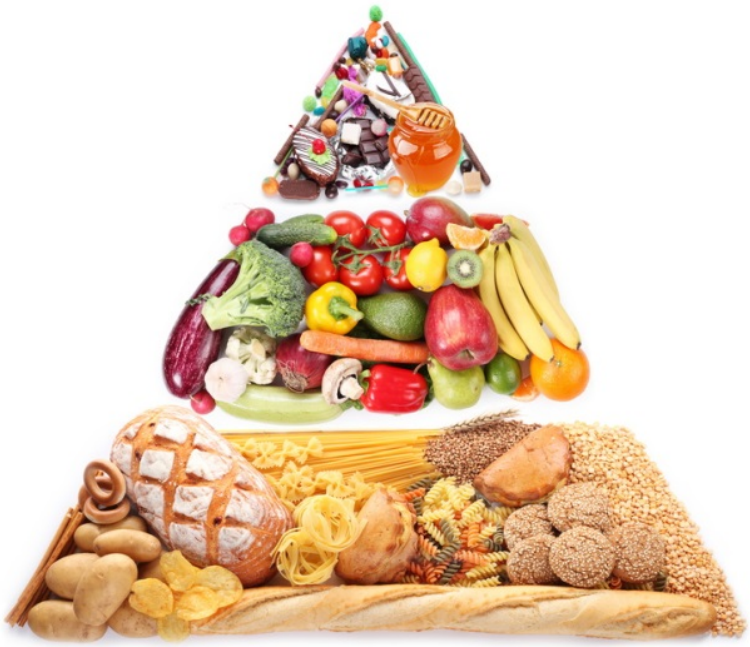


Photo: Wolff

3.2. Scope

An important goal of the holistic approach is to simultaneously consider multiple outcomes, for example, food availability and the nutritional quality of food in the context of climate change. There is a need to integrate existing data sets and models in order to answer some of the urgent questions associated with FNS. Aside from the question of duplication of effort in collecting new data, it is important to collate and integrate data from different disciplines in order to understand the complex interactions which drive food and nutrition (in)security outcomes, in particular across experimental and observational studies, and between the natural and social sciences. It is also important for researchers to discuss, throughout the research cycle, the policy translation of their research with policy makers and stakeholders across multiple sectors, in order to understand the limitations of evidence that can be deliv-

ered through the scientific process. Policy translation of scientific outcomes, including the development and validation of policy tools, should be embedded in future research activities in the area of FNS. All of this, however, is contingent on changes in consumer behaviours. Unfortunately, many policy interventions designed to change dietary choices and behaviours at a population level have met with limited success. They have nearly always focused on improved consumer health, reduced consumer food waste, or other goals such as understanding the consumer acceptance of technological innovations. Future joint research activities might include identification of consistency and tradeoffs between health and sustainability objectives in the composition and quantity of diets, systematic review of existing European policies which target sustainable and efficient food production and waste reduction, healthy dietary choices (and physical activity), and prevention of diet-related chronic disease as well as climate driven policies for agriculture and land use. In parallel, it would be important to evaluate the intended and unintended effects of such policies simultaneously on human health, the environment and climate change. Examples of such policies include the European Common Agricultural Policy (CAP) reforms, soil and water policies, taxation policies on unhealthy foods, public health campaigns focused on increased vegetable consumption or local production practices and interventions promoting reduced consumer waste. It is, however, essential that the impacts of these policies are considered simultaneously, and to this end a holistic analysis is required, after which it can be combined with a better insight into behavioural change to ensure optimal policy implementation.

An emerging question concerns policies related to personalisation of diets. Demographic changes, for example, ageing in affluent European countries, is resulting in changing dietary requirements across the population. At the same time, there is an increased interest in being able to personalise diets in line with phenotypic and genetic differences between individuals. At present, policies related to the personalisation of nutrition are starting to be developed, which raises question about whether such services should be provided by existing health services, governments, or the private sector. It is therefore important to consider at this nascent stage what effects increasingly individualised diets might have on food distribution systems and food localisation policies. More generally, the relation between food distribution systems and localisation of activities with availability, access and composition of diets should be considered.

These questions will require specific collaboration between the two JPIs to contribute to the development of policy tools (e,g, dietary guidelines) which simultaneously address public and environmental health. Information being developed in the current JPI HDHL joint actions DEDIPAC (determinants of diet and Physical activity Choice), BioNH (Biomarkers in Nutrition and Health) and ENPADASI (the European Nutritional Phenotype Assessment and Data Sharing Initiative) as well as the FACCE-JPI Knowledge Hub MACSUR on modelling the impacts of climate change on European food security and the FACCE ERA-NET Plus on Climate Smart Agriculture will begin to provide knowledge to address these questions.

3.3. Expected Impact

The effectiveness of existing policy interventions will be evaluated, and this knowledge will be used to improve future interventions which simultaneously consider the intended and unintended impacts of potential policies on public health, incomes and climate change. It is important to apply holistic approaches which assess multiple policy outcomes and goals originating in the natural and social environments. In addition, future research needs in relation to gaps in existing knowledge required for effective policy development will be defined. The results will deliver improved human and environmental health across Europe, as well as increase the competiveness of European industries (the potential tradeoffs on competitiveness of health and climate policies should be carefully considered) by ensuring that policy implementation relating to climate change goals, labelling or pricing is appropriate and evidence-based.

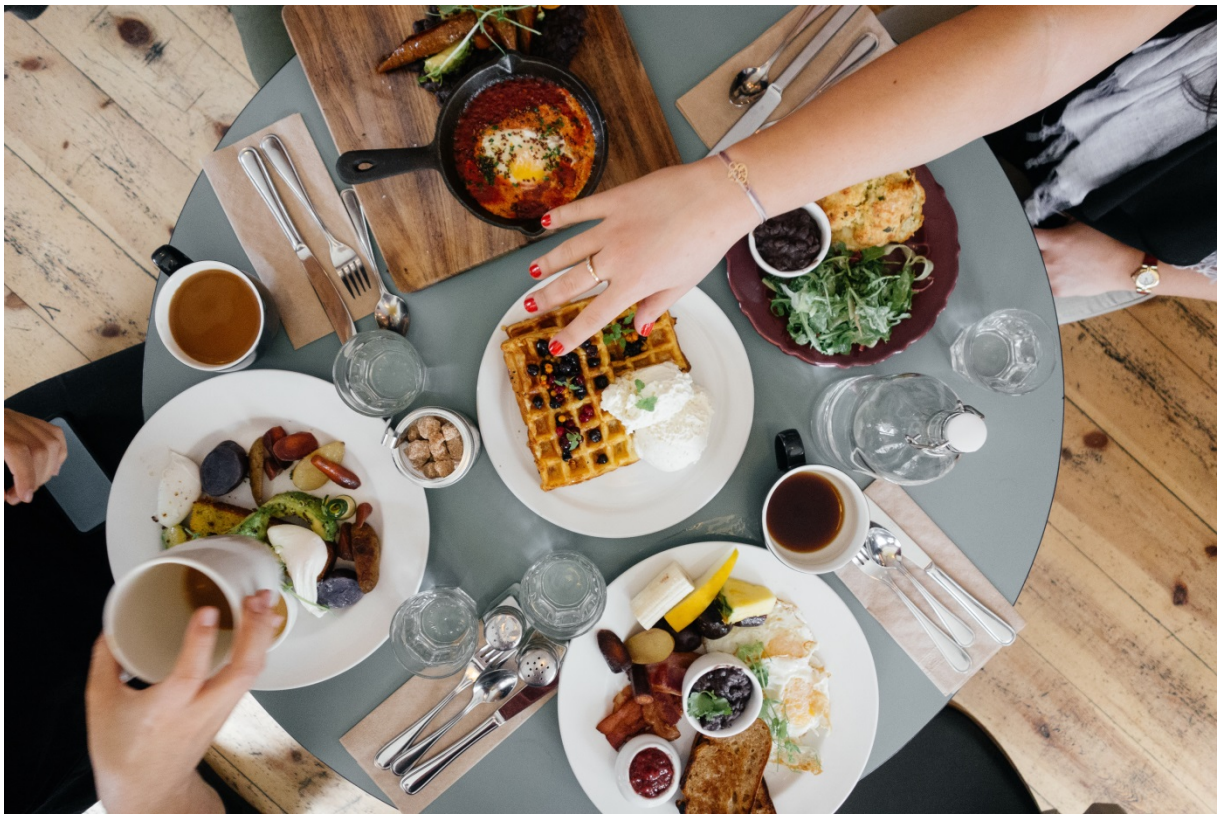


Photo: Ali Inay

4. Plant and animal production systems for better human nutrition and resilience to climate change

4.1. Specific Challenge

Resilience to climate of food systems is a key challenge for the coming decades: on the one hand, the stability of supply chains is increasingly at risk and, on the other, large changes in the agriculture sector will be brought by the demand for a rapid decline in agricultural greenhouse gas emissions and by competing uses of land for bioenergy production. This will place a strong pressure not only on food supply, but also on adjustments in food demand through prices, changes in industries and in consumer behaviours. Therefore, an integrated approach is required to design climate-proofed policies for the European and global food systems. Moreover, to date much research activity has been focused on the production of more food per unit area of land rather than the nutritional quality of, or consumer demand for, the resulting products. While increased production is still a necessity to address Food Security in the immediate future, a greater focus on the nutritional quality of food and the improved use of the whole product is being demanded by a range of organisations to address the real issue of Nutrition Security (9, 13). In particular, 'hidden hunger' resulting from micronutrient deficiencies is estimated to affect 2 billion people globally, while another 2 billion suffer from obesity. We know the amounts of these required for nutritional security, as specified by a Recommended Daily Allowance (RDA) or Adequate Intake (AI) indicator for humans at different stages of life. A deficiency in micronutrients can occur not only when the quantity of the food consumed is too low, but also when the quality and diversity of the diet is inappropriate. This type of malnutrition is often seen amongst humans who also suffer from obesity, and not only prevents individuals from thriving as productive members of society but also constrains the development of societies as a result of poor nutrition, poor health, lost productivity, persistent poverty and reduced economic growth (14). Policy interventions targeting supply, economic contexts, and consumer food choices are required in order to alleviate this problem.

Delivering an improved nutrition implies having healthy soil resources. Soil fertility affects human health via the quantity and quality of food that can be grown on a given area of land. It has been appreciated for centuries that the inherent properties of different types of soil have marked effects on crop productivity (see, for examples, the writings of Cato and Pliny the Elder) and that some soil types are inherently more fertile and productive than others and also influence nutritional quality. Mineral deficiencies and toxicities occur worldwide, with important consequences for animal and human health where food is produced and consumed locally, and so the issue of consumer preferences, values, and "food sovereignty" needs to be addressed when considering soil and food quality. The effects are less evident in more complex food chains with food from different sources and in which processed foods can be (but are not always) supplemented with essential minerals and vitamins to correct any deficiencies. Allied with these issues, on-going changes in climate, affecting both production and the composition of plant and animal products, means that presently resilient food chains may become less stable in the future with profound economic and social conse-

quences (12). Nevertheless, there are large potential synergies between soil restoration, climate stabilisation and human nutrition. The global soil carbon sequestration is estimated at 1.2 Gt C/yr in agricultural soils and increasing soil organic matter increases crop yields, drought tolerance and in a number of case studies, micronutrients in food crops. Designing policies aiming at biological soil carbon sequestration would bring large positive effects on FNS (15).

4.2. Scope

To facilitate better nutritional quality of food (including minerals, vitamins and phytochemicals) more insight is needed at biochemical and metabolomic levels on the interacting effects of soils, climate and genotype and farming practices on crop and animal productivity and nutritional quality as well as the effects of food processing. For example more insight is needed on how mineral requirements of plants change as the environment warms, and how the plant's interactions with its environment (physical and biotic) affect the synthesis of secondary metabolites (vitamins and health-beneficial phytochemicals). Similarly, a better understanding of how the physical and the biotic environments influence the nutritional requirements and resulting nutritional quality of livestock is important. Food processing affects food safety, functionality and shelf life, and can result in improved digestibility and bioavailability of nutrients. The study of the various components of the food supply chain need to be integrated to examine their resilience to climate change and the consequences for human health.

An integrated agroecosystem approach (crops and livestock) is needed to optimise human edible protein production per unit of land use. Such an approach could contribute to agricultural biomass production. The closing of the biomass loop in soil quality in terms of soil organics and soil biota - crops for feed, food, fuels and fine chemicals – livestock production on residual biomass – manure and fertilisers is essential in this perspective. Such an approach will contribute to the mitigation of the C- footprint of agrofood production by 40% or more (16). Important investments in the efficiency of livestock conversion of feed resources, including grasslands, need to be made to reduce the carbon footprint of agriculture and offer land sparing strategies for the development of a biomass-based economy. While land is limited to fulfil the requirements for sustainable nutritional security, it should not be forgotten that the marine environment (70% of the globe) provide large additional perspectives. Sea-

food provides a major source of essential (S-rich) proteins, omega-3 fatty acids and micronutrients, but only 17% of the supply comes from seafood (17). In addition, both capture fisheries and aquaculture are currently not optimally governed to use the ocean production capacity in a sustainable manner.

Key research issues to be addressed via a transdisciplinary research approach including nutritionists and health professionals, plant and animal physiologists and breeders, soil scientists, food scientists, social scientists and economists include the following:

- the identification of precise consequences of climate change scenarios on nutritional composition of existing food and its availability;
- the identification of crop and animal germplasm with superior nutritional traits and those that maintain nutritional quality over a range of edaphic and climatic environments, increasing their tolerance to heat and drought stress and to temporary flooding;
- targeting and modelling of dietary patterns and improvements to those patterns that would have the most impact on health in different populations and improved sustainability through reduced carbon footprints;
- development of novel, improved and integrated crop management and livestock husbandry practices that deliver food of high nutritional quality while simultaneously reducing land use and harmful environmental consequences and maintaining farmer/producer economic sustainability;
- novel insights into the direct use of plant proteins (e.g. pulses) in the human diet;
- integration of production and nutritional data into food chain models to examine resilience and consequences for human nutrition.
- resilience of food systems towards extreme climate events and their impact on food diets and availability
- impact of climate change on zoonosis and food safety;
- modifications of food systems to reduce losses and wastes and their impact on diets
- trade-offs of evolutions of animal and crops traits and farm practices on other challenges, quantity and quality of water, of soils, energy consumption.

In developing research to investigate these issues, it will be important to consider consumer behaviour – and the need to change consumer behaviour - as a potential determinant of healthy and sustainable nutrition, and to link this to better understanding of food quality and dietary diversity on the supply side. Here again, strong cooperation between different research disciplines is required.

4.3. Expected impact

The research proposed would result in new practices, technologies and policies that will improve the food and nutritional security of people in Europe and beyond. Given that the global area of land available for agricultural production is unlikely to increase substantially in the next three decades while the demand for food will increase by at least 50%, it is important that all production areas should be used efficiently to deliver food of optimal nutritional quality to all. The research will aid EU countries in their attempts to improve human health through their nutrition policies and simultaneously aid the development of more resilient food supply chains that improve soil fertility, reduce environmental pollution and cope with

a changing climate.European research on the composition and consumption of foods will not only improve consumer health but also improve food security through reduced waste. Tied to the first research question, knowledge on these questions will help inform policies regarding production.

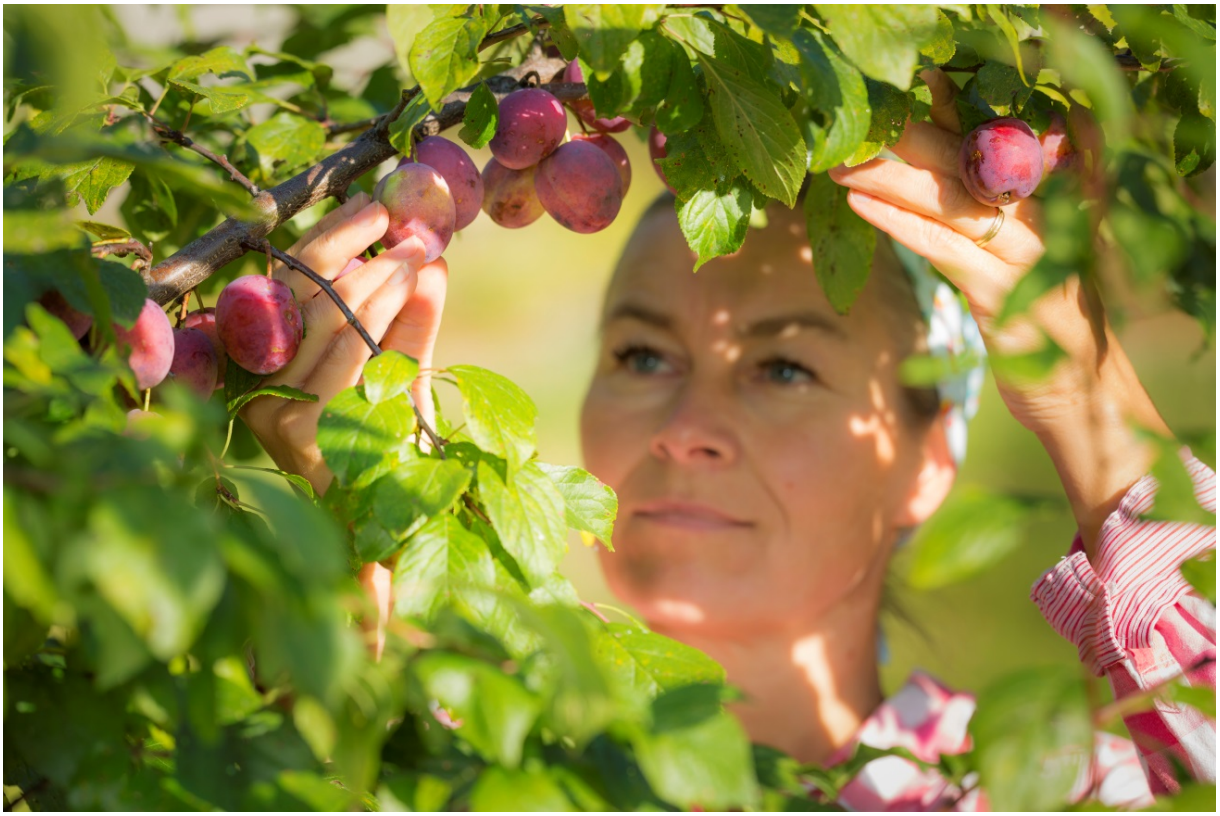


Photo: Petri Jauhiainen/Rodeo

5. How the JPIs will address the transversal issues in these research areas

The primary challenge facing the existing global food system is to meet the rising demand for food in environmentally, socially and economically sustainable ways while simultaneously ensuring foods are safe, nutritious and culturally acceptable. There are many interacting drivers of food insecurity, including:

- Demographic changes such as an increasing world population, population shifts from rural to urban areas and, in some areas, in particular in industrialised nations, an aging population;
- Dietary transitions associated with income increases in developing countries (e.g. shift towards higher consumption of animal based protein)
- Changes to the natural environment, for example climate variability and change, water and energy insecurity;
- The institutional structure of food value chains at local, national and international levels (regulations, standards etc) that has a major impact on consumers and producers as well as waste.
- A broad range of socio-cultural factors including unhealthy or wasteful consumer behaviours;
- Economic changes including an increasingly affluent middle class influencing demand (for example, for animal proteins).

Tackling this challenge requires bringing together multiple research fields, multiple types of partners and different stakeholders, including industry and consumers, as well as different funding institutions. Without this, research and its associated knowledge will be developed in a context that does not reflect the complexity of the challenges that societies face. In short, the JPIs, working together, will adopt a systems approach to FNS research. And once this research is achieved, the JPIs will work to ensure that the results create knowledge and impact in a broader context and thus contribute to meeting the societal challenge that is FNS.

5.1. Multiple Research Fields

It follows that JPIs undertaking this research will need to adopt a holistic, transdisciplinary approach to food and nutrition systems to include:

i) The interactions between, and within, biogeophysical and human environments which determine a set of activities within the food system;
ii) The activities themselves (producing, processing and packaging, distributing and retailing, and consuming food);
iii) The human outcomes of the activities (contributions to food security, nutritional security, environmental security, health etc) and
iv) The complex interactions between the drivers of, and responses to, food insecurity (including unintended effects of policies).

For more detail, see the Strategic Research Agendas and Implementation Plans of HDHL and FACCE-JPI.

5.2. Partnerships

In addition to involving multiple disciplines, FNS research increasingly involves multiple forms of partnership including public/private schemes, multiple agencies and multi-country schemes brokered via government and non-governmental organisations. Partnerships, if established correctly, have the advantage of not only harnessing multiple talents, but also of ensuring the circulation of knowledge within and between groups, so that the new knowledge generated by research can find a route to adoption and/or market, facilitating the innovation process. This is particularly true in private/public partnerships and one reason why such partnerships are encouraged by funders of public research.

Nonetheless, it is important to consider when working in partnerships that in the developed world, private funding of food research has increased substantially in the last 20 years, while public funding has decreased. This has had two significant consequences. First, even if public agricultural R&D spending has not been reduced, its focus has been altered away from greater production per se towards achieving more benign environmental objectives at current yields. Second, private R&D has become relatively more important (in countries where public spending has been cut) and, in some cases, has reduced the equity of distribution of benefits of new technologies to developing countries and to the general public good (18). The consequences of these changes are only just starting to emerge, but the goals of private research, with its need to appropriate the benefits of research for profit, may not match those of the public sector. This means that achieving sustainable production systems and healthy foods may be made more difficult because of competing values, priorities and prices.

FACCE-JPI and JPI HDHL, although both public-public partnerships, are open to participation by private partners with similar goals and objectives to tackle the grand challenges and there are examples of where this is currently happening. The two JPIs consider innovation and knowledge dissemination at the centre of their activities. In developing these research areas, all relevant partners will be considered, both public and private and from Europe or beyond. In doing so, it is essential to respect the public interest and key values of scientific research, e.g. transparency, publication without restriction.

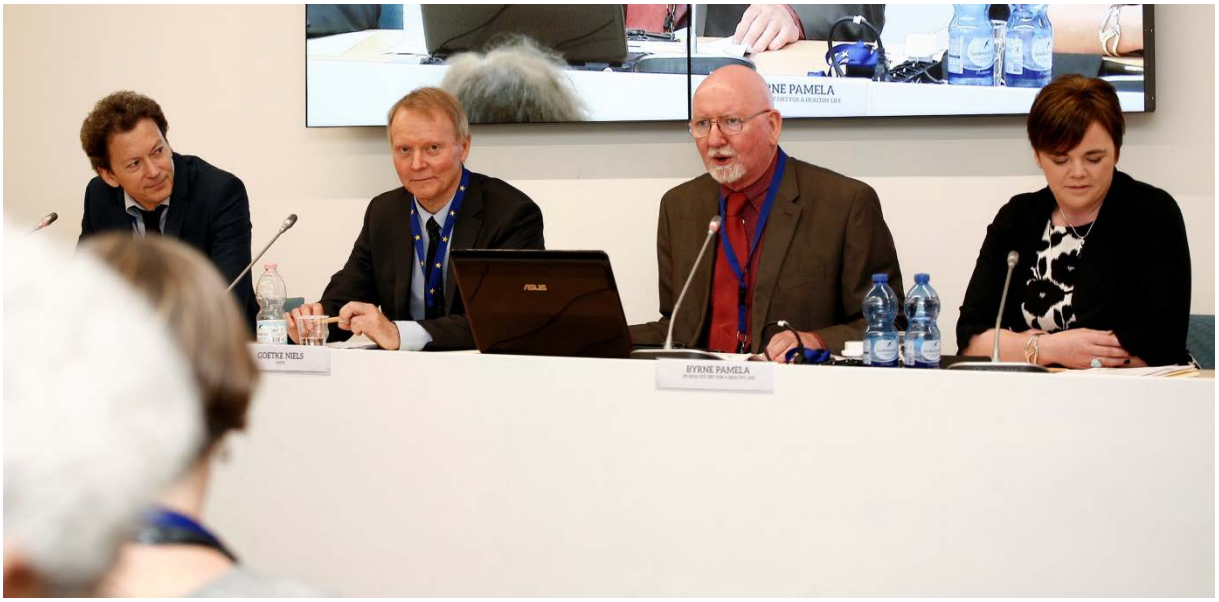
5.3. Spreading knowledge, creating impact

An important element in developing research agendas, conducting the research itself, and translating the results of research into concrete and actionable policy outcomes, is that of knowledge exchange. Knowledge exchange is often promoted as a mechanism that can help to drive innovation and the translation of research into policy and practice for use by policy makers, farmers, food chain stakeholders, and civil society. The concept of “knowledge exchange” is central to the development of effective Responsible Research and Innovation (RRI) practices, not least in the agrifood and health sectors. New technologies, interventions or policies developed from research which have been developed to improve sustainable

production or reduce unhealthy eating practices may not be acceptable to the public. Changes to farming practices may disrupt or change the socio-demographic structure of rural communities. Understanding what factors are likely to contribute to the acceptability of agri-food innovations and policies, and the underpinning science strategy, requires engaging and discussing food security research with all stakeholders. From this, research agendas, policies and/or technological innovations promoting FNS can be refined and adapted to align with stakeholder preferences, which is more likely to result in their successful implementation.

Partnerships can facilitate the iterative exchange of knowledge throughout the conceptual design, writing, implementation and development phases of research, and short-cut the process of developing research outputs into suitable formats for use in different markets and contexts. As part of this process, however, it is often important to solicit and exchange views with other stakeholders, in a process of co-design, facilitating the innovation process. Both JPIs strive to include stakeholders throughout every stage of their work in order to address their needs and meet the great societal challenges they address. Important stakeholders in the area of FNS include farmers, consumers and SMEs in food processing.

In order to build capacity for RRI, both JPIs, working together, will actively take part in knowledge exchange and will promote and secure resources for RRI activities and integrate RRI in the design and implementation of its strategic documents and activities. This is in line with the Rome Declaration on Responsible Research and Innovation in Europe (November 2014)[3].



The Grand debate on Nutrition Security – a whole system approach was opened by Policy Officer François Constantin, European Commission (on the left), with elevator pitches by FACCE-JPI chair Niels Gøtke and JPI HDHL chair Pamela Byrne. The panel was moderated Leo Enright. Photo: Senia Ferrante.

[3] https://ec.europa.eu/research/swafs/pdf/rome_declaration_RRI_final_21_November.pdf

6. Conclusion

FNS is a global issue with multiple drivers, which originate in the natural and social domains. Tackling this extremely complex issue requires transdisciplinary research, novel forms of partnership, the involvement of stakeholders in a co-design approach and the exchange of the knowledge produced to create impact for today's real world problems.

As a result of the "Grand Debate on Nutrition Security – a whole system approach" held in Milan in May 2015 as part of the European Commission's series of events to contribute to the elaboration of a European Strategy on FNS, FACCE-JPI and JPI HDHL have worked together with an expert committee to bring forth two common priority research areas to be tackled together. One area concerns the effects of policies on food and nutrition security and the second is on food production for better nutrition and better resilience to climate change. Although these questions might be considered thematically closer to HDHL (effects of policy) or FACCE-JPI (food production), the complementary approaches and expertise of the two JPIs can provide a much more complete analysis of these problems than either JPI alone. Moreover, both areas will increase the proportion of the population which is food and nutrition secure at regional and global levels.

The proposed research will not only provide knowledge-based evidence for tackling FNS, it will highlight the principles of joint programming: building a common vision, setting a research agenda and implementing it. Stakeholder involvement throughout the research cycle will help to ensure scientifically sound and socially acceptable solutions. Moreover, the proposed actions will create alignment of European research efforts, bringing critical mass, avoiding duplication and creating synergies and filling research gaps. The two JPIs will apply their significant experience in tackling complex research questions, using multi-disciplinary approaches, including stakeholders and using innovative funding models to reach impact.

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Annex 1. Description of JPI HDHL and FACCE-JPI and their ongoing work

JPI HDHL

Many governments are struggling with the growing social and economic burden of diet- and lifestyle- related diseases such as type 2 diabetes, cardiovascular diseases and certain cancers but also of malnutrition and micronutrient deficiencies as for example in elderly and diverse minority groups. The vision of the JPI HDHL is that by 2030 all citizens will have the motivation, ability and opportunity to consume a healthy diet from a variety of foods and to have healthy levels of physical activity, and that the incidence of diet-related diseases will have decreased significantly. This major societal challenge cannot be tackled by single countries.

The JPI HDHL brings together 25 countries[4] that collaborate together to align their research strategies in the area of nutrition and health. The JPI HDHL member countries aim to provide a holistic approach to the development and implementation of a Strategic Research Agenda (SRA) to understand the interplay of factors known to directly affect diet-related diseases, discover new relevant factors, mechanisms and strategies, as well as to contribute to the development of actions, policies, innovative products and diets, with the aim of drastically reducing the burden of diet-related diseases.

The following three key interacting research areas were identified and are described in the SRA:

1. Determinants of diet and physical activity: ensuring the healthy choice is the easy choice for consumers. The challenge is to understand the most effective ways of improving public health through interventions targeting dietary and physical activity behaviours.
2. Diet and food production: developing high-quality, healthy, safe and sustainable food products. The challenge is to stimulate the farmers and the food industry to produce and to market foods with a healthier improved nutritional content, and to stimulate consumers to select foods that fit into a healthy diet and which are also safe, sustainable and affordable.
3. Diet-related chronic diseases: preventing diet-related, chronic diseases and increasing the quality of life. The challenge is to prevent or delay the onset of diet-related chronic diseases by gaining a better understanding of the impact of nutrition and lifestyle on human health and diseases.

[4] Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Latvia, The Netherlands, New Zealand, Norway, Poland, Romania, Slovenia, Slovakia, Spain, Sweden, Switzerland, Turkey, UK (bold = full member).

The promotion of healthy lifestyles with better diets and increased physical activity is of utmost importance for future public health, well-being and prosperity. Therefore the JPI HDHL focuses on the health aspects related to food supply and dietary choices. Health aspects related to the food supply and dietary choices are closely linked to economics, and social and environmental determinants of consumer behaviour. Food production and human nutrition are embedded into rapidly changing scientific, economic and societal environments. These are characterised by an increasing demand for high quality foods for an ageing and growing world population, and an increasing competition for resources such as land, water and crops for production of feed, food and raw materials used for fuels and industrial biotechnology.

JPI HDHL activities and nutrition security

Besides the effort of JPI HDHL and its member countries to align national research programmes and to stimulate knowledge transfer in the area of Nutrition and Health, 7 international research activities have been launched under the JPI HDHL umbrella. In terms of the EC discussion paper (7), JPI HDHL activities strongly relate to theme A. Improve Public Health Through Nutrition: Healthy and Sustainable Consumption and theme B. Increase Food Safety and Quality. The Knowledge Hub on Determinants of Diet and Physical Activity (DEDIPAC) brings together over 46 research groups from 12 countries. DEDIPAC aims to better understand how biological, ecological, physiological, sociological, economic and socio-economic factors influence consumer decision making and how to translate that knowledge into the development of strategies for effective disease prevention in target populations. JPI HDHL has planned a new joint activity that has to build on the knowledge gathered by DEDIPAC which will focus on the effectiveness of existing policies for lifestyle interventions. Besides the clear link with theme A, research activities like DEDIPAC provide valuable insights for certain questions listed under theme G 'Increase equity in the food system' e.g. cultural sensitive interventions. The joint action on Intestinal Microbiomics seeks to provide better insight on the human metabolic system and how it interacts with diet. Some of the research questions mentioned in the discussion paper under theme B, Increase Food Safety and Quality, clearly connect with the aims of the Joint Action Food Processing for Health. This Joint Actions focuses on mechanistic research on the preservation and/or the enhancement of health promoting properties of food as a result of food processing: (1) Food processing for matrix stability and controlled digestibility, bioavailability, bio-accessibility and bioactivity of food compounds, (2) Food structures for appropriate bioavailability of nutrients and bioactives and (3) Optimise food processing for quality and safety.

FACCE-JPI

Agriculture, food security and climate change pose key challenges for the world as has been recently reiterated in the latest report of the IPCC[5]. Rising food demands, globalization, planetary boundaries (e.g. land and water limits, greenhouse gas limits) and global environmental change are all drivers making FNS an urgent challenge. Countries need to build more resilient food systems in order to face the most expected (and unexpected) changes to come in these crucial areas. Twenty-one Member States[6] are currently committed to building an integrated European Research Area addressing the challenges at the crossroads of agriculture, food security and climate change.

Since its inception, FACCE-JPI has made significant progress in its goal of bringing together European countries to identify, prioritise and deliver research, starting with the publication of a Strategic Research Agenda (SRA), and a first Implementation Plan (IP). The SRA describes five evidence based interdisciplinary core research themes, which define the scope of FACCE-JPI actions:

4. Sustainable food security under climate change, based on an integrated food systems perspective: modelling, benchmarking and policy research,
5. Environmentally sustainable growth and intensification of agricultural systems under current and future resource availability,
6. Assessing and reducing trade-offs between food production, biodiversity and ecosystem services,
7. Adaptation to climate change throughout the whole food chain, including market repercussions,
8. Greenhouse gas mitigation: N2O and CH4 mitigation in the agriculture and forestry sector, soil carbon sequestration, fossil fuel substitution and mitigating GHG emissions induced by indirect land use change.

Thus the challenge addressed by FACCE-JPI is ensuring sustainable food production under climate change while at the same time protecting the environment and natural resources. FACCE's main focus is on the production side and thus is complementary to HDHL which focuses on the consumption side.

FACCE-JPI activities and food and nutrition security

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[6] Austria, Belgium, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Ireland, Israel, Italy, The Netherlands, Norway, Poland, Romania, Spain, Sweden, Switzerland, Turkey, United Kingdom

In the five years of its existence, FACCE-JPI has initiated a number of joint actions looking at the impacts of climate change on agriculture and food security, without specifically addressing nutrition security. In terms of the EC discussion paper, FACCE's main priorities relate to themes C "Reduce losses and waste – more efficient food chain", theme D "Manage the land for all ecosystem services – sustainable rural development", and theme E "Increase agricultural outputs sustainably – sustainable intensification" however FACCE research also relates to theme B "Increase food safety and quality" and theme F "Understand food markets in an increasingly globalised food system". FACCE thus has a very broad scope but addresses these subjects primarily in the context of climate change and its impacts. The knowledge hub MACSUR addresses the effects of climate change on European agriculture and food security through the inter comparison and improvement of models concerning crops, livestock and grasslands and trade. FACCE has also run calls for proposals under the ERA-NET scheme: one on climate smart agriculture which specifically targets four areas i) genetics and breeding of animals and plants to increase resilience to climate change, ii) pests and diseases linked to climate and posing significant risks, iii) adaptive management of water and soil resources and iv) options for adapting agricultural systems. Another call on sustainable and resilient agriculture for food and non-food systems (reducing trade-offs between food and biomass production) focuses on integrated systems for food and non-food production and specifically "sustainable intensification of integrated food and non-food systems of agriculture, by developing integrated, systems-based approaches to land management". A joint call with the ERA-NET BiodivERsA addresses the questions of the discussion paper theme D, in particular "Promoting synergies and reducing trade-offs between food-supply, biodiversity and ecosystem services". Two sub-topics looked at the extent that biodiversity can better support agro-ecosystems / agricultural production systems in terms of multi- functionality and outcomes in a global change context and which policies and governance systems can promote the emergence and support of agro-ecosystems / agricultural production systems benefiting from and beneficial to biodiversity and ecosystem services. A further joint call addressed themes D and E: together with the Belmont Forum, FACCE ran a call looking at interactions between land use change and food systems. Additionally, actions are under development on agriculture and water (with the Water JPI), sustainable animal production (with the proposed ERA-NET SusAn), sustainable intensification and agricultural soil quality.