



Agriculture,  
Food Security  
and Climate Change

JPI  
OCEANS

# FOOD AND NUTRITION SECURITY: A MULTI-DISCIPLINARY INTEGRATIVE FOOD SYSTEM APPROACH

**MISSION: TO WORK TOWARDS AN INTEGRATED FOOD SYSTEM APPROACH, FROM FARM TO FORK, THAT PROVIDES SUSTAINABLE, RESILIENT AND NUTRITIONAL FOOD FROM BOTH LAND AND SEA.**

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Food and nutrition security was defined in 2012 at the thirty-ninth session of the World Committee on Food Security as:

*"All people at all times have physical, economic and social access to food, which is safe and consumed in sufficient quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life".<sup>1</sup>*

A food system is defined as:

*"an interconnected web of activities, resources and people that extends across all domains involved in providing human nourishment and sustaining health, including production, processing, packaging, distribution, marketing, consumption and disposal of food".<sup>2</sup>*

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<sup>1</sup> Committee on World Food Security (2012). Thirty-ninth Session Rome, Italy, 15-20 October 2012  
Item V.a COMING TO TERMS WITH TERMINOLOGY Food Security Nutrition Security Food Security and Nutrition Food  
and Nutrition Security <http://www.fao.org/docrep/meeting/026/MD776E.pdf>

<sup>2</sup> [http://www.uvm.edu/~tri/pdf/FoodSystemsFinal\\_Profs.pdf](http://www.uvm.edu/~tri/pdf/FoodSystemsFinal_Profs.pdf)



## Background

Joint Programming Initiatives (JPI) are voluntary, long-term processes driven by Member Countries. They have been established to make better and more efficient use of national research efforts by aligning national priorities around common strategic research agendas. The JPIs have been established to address grand Societal Challenges, which are defined as 'complex and comprehensive issues' that require the cooperation of many actors including ministries, regulatory authorities, research performing organisations, citizens, industry and other stakeholders.

JPIs FACCE and HDHL first proposed to address the issue of Food and Nutrition Security as a result of the grand debate during the Milan international EXPO in 2015. They subsequently published the joint paper Priority Joint Actions to contribute to the European Strategy on Food and Nutrition Security. In 2016, JPI Oceans joined the initiative to ensure the entire food system could be addressed. Two expert workshops were held in 2016 to develop this working paper which will be presented to the Management Boards of each JPI.

Food and Nutrition Security bridges a number of Societal Challenges; it encompasses the entire food system (land and sea) from farm to fork. In their Strategic Research Agendas, each JPI (FACCE, HDHL and OCEANS) has identified different aspects of this challenge and are now coming together to coordinate efforts in this area. Coordination is needed to bring together different research domains and national and international research investments and to ensure involvement of key actors (consumers, primary producers, industry etc.); to stimulate innovation and implementation. Strong stakeholder involvement in JPIs will facilitate knowledge flow from research towards practice.

## Challenge

It is well known that the health, environmental, economic, and societal costs will be substantial if we do not change our course of action when it comes to the food system and the underlying challenge of Food and Nutrition Security.

Ensuring food and nutrition security is a complex issue, requiring an integrated food systems perspective. To achieve food and nutrition security, there is a need to understand what the "ideal diet" is for different specific populations (e.g. elderly, children...) and in different regions to generate profiles of nutritional needs (macro- and micronutrients) and the corresponding diets. There is also a need to understand climate change effects on food composition and the food system as a whole, again looking at macro- and micronutrients in order to develop resilient and sustainable food systems as well as feed for farmed animals on land and sea. With this information available, different interventions should be sought along the whole food value chain to achieving sustainable and resilient food systems – at the level of the farm, of food processing and transformation and at the level of human consumption. Research could include, for example, the potential of diversified food sources, the exploitation of genetic diversity for breeding nutritional and resilient plant and animal food sources, improved management practices, the role of industry and food retailers, with consumer acceptance as the key driver for bringing about change.

## Approach

The coordination between the JPIs aims to define a research programme to address the challenge of Food and Nutrition Security.

In order to achieve sustainable and resilient food systems that provide nutritious food from both land and sea, it is necessary to know both the composition of a nutritious diet and also how climate change will affect food production and the nutritional quality of food, through effects on the quality of agricultural and marine primary products.

With this information, it would be possible to develop effective solutions along the whole food chain. The approach consists of two transversal components: a modeling component and an intervention component consisting of several research activities.

Cross cutting activities should be carried out, including education, outreach, data sharing, standardization and harmonization, to support a knowledge flow from scientific research towards practice. This will support a multidisciplinary approach and ensure the involvement of key stakeholders. Dialogue and co-design with stakeholders is crucial for acceptance and uptake of the research outcomes among the following societal actors:

- Consumers- awareness and acceptance of the consumer towards foods is key. Aspects to be considered are: nutritional quality, food safety, production methods, sensory aspects, ethical and environmental issues.
- Industry- Working with industry to increase diversity in feed and food sources to provide greater nutritional qualities and contribute to resilient production systems, to explore food products which are both ethically and economically viable
- Regulatory authorities- Close cooperation to encourage the authorisation of new products.

A set of key indicators needs to be defined in order to monitor the changes.

## Component 1: Roadmap for Production Systems

Two modeling components will create a roadmap to adapt production systems to ensure adequate, sustainable, and healthy food for all. They will provide knowledge and data needed to direct the research component of this programme.

One component would model nutritional needs regarding macro- and micro-nutrients and needs based on food-based dietary guidelines for different populations and population sub-groups, to generate guidelines for a healthy diet, taking into account age, sex, health status, and regional and cultural aspects.

The other component would model the effect of climate change on food production and its nutritional makeup. This will help to develop an understanding of the consequences for food security and human diets.

The first step will be to develop conceptual models and scenario analyses to make explicit the ways in which composition of food is propagated through the systems and the responses of players in different sectors to secure the outcomes that drive their activities and businesses. Understanding the mechanisms and processes by which climate change affects food systems, and their relative importance, would lead to further predictive modelling on how individuals, businesses and policy-shaping communities could respond.

## Component 2: Improvements to the Food System for Food and Nutrition Security

### Food Production

The first activity focuses on the improvement of food, specifically, taking into account climate impacts and nutritional needs, to breed resilient, nutrient-rich, and resource-efficient plants and animals (land and sea)<sup>4</sup> for food and feed.

It will be necessary to exploit the genetic diversity of domesticated plants and animals and their wild relatives, in order to relate desirable phenotypes with genotypes to improve resilience and nutritional qualities. The use of state of the art technologies and approaches (cisgenesis, gene editing, marker assisted selection, genomic selection) may facilitate this step. This will require a better understanding of nutrient losses or gains and bioavailability under climate change. In addition to improving food quality, it will also contribute to better feed quality which will in turn lead to more nutritious and climate neutral animal products. This aspect will also take into account regional differences in climate, soil and other environmental conditions to tailor outcomes.

<sup>4</sup> Plants including algae... Animals including insects...

Outcomes of such activities can be further improved through adapting management practices. Examples include, but are not limited to, better exploitation of the microbiome (in the soil, the plant and the gut), precision agriculture and aquaculture, and ICT, for example to monitor and adjust water inputs and other resources or to adjust feed sources or housing conditions for livestock for reduced GHG emission (e.g. precision agriculture).

There is a need to develop a broader feed and food base by using a greater diversity of terrestrial sources. This entails a greater use of unexploited or underexploited plant food sources which will help to ensure a resilient, adequate and nutritious food supply. In Europe, a very small number of food sources make up the majority of diets and a growing challenge is to increase the consumption of plant proteins. The major sources of plant carbohydrates and proteins are wheat, maize, rice and soybean. A greater use of other crops as dietary sources of protein, such as legumes or even algae, but also research on novel cereals (like sorghum, teff, khorasan wheat, etc.) could provide a solution.

European fisheries are mostly based on harvesting high trophic level of species. Seafood provides a major source of high biological value proteins, long chain omega-3 fatty acids and micronutrients. In 2013, fish accounted for about 17% of the global population's intake of animal protein and 6.7% of all protein consumed.<sup>5</sup> Research is needed to understand how to exploit lower trophic levels (for example zooplankton) and mesopelagic fish. There is also a potential to improve aquaculture by introducing new marine species, developing multi-trophic aquaculture, as well as using non- animal marine products for feed.

## Food Processing and Transformation

Food processing affects food safety, functionality and shelf life, and can result in improved digestibility and bioavailability of nutrients. Within this topic, food processing (post-harvest practices) will be examined to improve the conservation of nutritional qualities, and at the same time, optimally using the product to reduce energy and resources consumption, avoid waste and contribute to a circular economy. In this context it is important to bring food and food processing closer to the consumer and to involve the consumer in the dialogue on healthy and sustainably produced food.

There is a need to better understand the role of food processing on bioavailability of nutrients and to design tailored-made food matrixes to preserve nutritional properties and ensure bio-availability. There is a need to develop new technologies for harvesting or processing to make more efficient use of sea production and lower the impact on environment.

## Food Consumption

The third level of improving the food systems for food and nutrition security is to understand the basis of food choice and food waste. It is necessary to identify the tensions, barriers, synergies and opportunities, at the level of retail, food service and consumers, to allow sustainable and healthy food consumption

Studies are needed to understand factors influencing consumer choices such as ethics, availability, safety, labelling and price, taking into account the important role that retailers and marketers play. Research should also lead to a better understanding of how consumers make choices when facing tradeoffs, for example between food quality and price, taking into account that not all choices respond to a unique rationality. Furthermore, research is needed to understand incentives to a balanced food intake. It is widely recognized that a diet properly balancing meat, fish and plant source consumption is both the healthy and sustainable choice.<sup>6</sup>

It is estimated that 40% of total food waste is generated at the retail level or by consumers, including the food service sector, which results from factors such as a lack of awareness, knowledge, planning, general attitudes, preferences, labelling, storage, packaging, portion size, and socio-economic factors.<sup>7</sup> Studies should identify consumer barriers, drivers and the role of retailers in reducing waste.

<sup>5</sup> SOFIA 2016, <http://www.fao.org/3/a-i5798e.pdf>

<sup>6</sup> [https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/CHHJ3820%20Diet%20and%20cli-mate%20change%2018.11.15\\_WEB\\_NEW.pdf](https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/CHHJ3820%20Diet%20and%20cli-mate%20change%2018.11.15_WEB_NEW.pdf)

<sup>7</sup> [http://ec.europa.eu/environment/eussd/pdf/bio\\_foodwaste\\_report.pdf](http://ec.europa.eu/environment/eussd/pdf/bio_foodwaste_report.pdf)

## Implementation Options

The aim is to create a sustainable network for coordinating and integrating work throughout the food value chain in order to achieve the goal of food and nutrition security by bringing together researchers from diverse disciplines (e.g. nutrition, food science, medicine, plant and animal physiology and breeding, environment, behavioural science, economics and sociology). This will give rise to integrative activities including workshops, dissemination, harmonization and standardization.

Implementation could be taken forward in four steps:

### 1. Mapping

In order to implement this programme there is an initial need to have an understanding of the ongoing research in Europe in these areas, to mobilise and align existing knowledge. Identifying existing projects and initiatives that are working in this area (e.g. FOODSECURE, SUSFOOD, SusCrop, SusAn, CGIAR) as well as making links to other European and international initiatives.

### 2. Networking

Three JPIs forming a multidisciplinary network to bring together the key researchers identified during the mapping and to foster dialogue and co-design with consumers, industry, regulatory framework and other key actors in the area of Food and Nutrition Security.

### 3. Adding Value to Existing Investments, Supporting International Partnerships and Multidisciplinary Endeavours: Alignment

Bringing together existing research in the areas of the 3 JPIs to add value and strengthening collaboration at the EU and international level.

### 4. New Funding to fill knowledge gaps

Bringing new resource to research questions in the areas described above where knowledge gaps are identified.

A strong partnership is desirable with the European Commission to help implement Food 2030. We also foresee strong links with the SCAR SWG on Food Systems and with the work to be carried out through the CSA SFS18- 2017 (to support Food 2030) which will provide the platform to support dialogue and co-design with stakeholders which is needed to ensure a scientific knowledge flow from research to practice.

## Expected Impact

The research is expected to contribute to the implementation of the European Commission's FOOD 2030 initiative, but also to the UN Sustainable Development Goals, by connecting research communities along the entire food value chain to propose adapted, acceptable and sustainable solutions to achieving food and nutrition security. It will promote the building of lasting transdisciplinary coordination across a range of fields. It is expected that the research will help to provide solutions for providing sustainable, resilient food systems for nutritious food from land and sea to feed an ever-changing world.