EUROPEAN SCIENCE FOUNDATION
SETTING SCIENCE AGENDAS FOR EUROPE

cost

SCIENCE POLICY BRIEFING • March 2009 36

European Food Systems in a Changing World

Contents

Foreword

Food is essential to human wellbeing. For millennia, food has been produced, traded and consumed locally, and, while in some regions farmers, pastoralists and fisherfolk generally still sell their products in local markets, the overall picture of local production and consumption has changed radically over the last few decades. This is especially so in Europe and in other parts of the Western world where society has increased food availability by employing industrial production approaches combined with regional and worldwide exchange of food. These changes in producing, in processing, in packaging and distributing, and in exchanging and consuming food (in short, the "food chain"), have already left their mark on the environment with altered landscapes, water cycling and biodiversity, and also contributing to climate change. They have also affected consumer behaviour and increasingly the consequent changes in consumption patterns are having negative and positive effects on health.

Food safety is a major issue nowadays and is a challenge for the production chain. For example, the epidemic of bovine spongiform encephalopathy (BSE) in the 1990's affected seriously Europe's beef production. Likewise the recent production and consumption of tainted milk-powder in China has had serious consequences locally and raised concern elsewhere due to its global export of the product.

Changes in climate, population growth, energy production and economy closely interact with these food chain activities and hence food security at large. The dynamic interactions between these components can have dramatic effects as witnessed by the recent sharp increase in food prices, which led to food riots in many countries. The increase in food prices is a complex matter of a global nature but one principle contributor is the change in the demand for food. The per capita consumption of food in major emerging economies such as India and China continues to rise in particular due to a more meat-based diet. This is paralleled by the Western world's increasing demand for biofuels, which both compete for land and other resources and/or are derived from food crops themselves. Volatile fossil fuel prices also contribute to food price inflation since many stages of the food chain are highly oil-dependent, with the situation being complicated further by export quotas and trade restrictions on internationally-exchanged food. Underlying all is the need to satisfy the increased food demand of a population which is estimated to grow to 9 billion people by 2050 while minimising environmental degradation. New technologies, management methods, policies and institutional arrangements will all be needed to increase both the availability of food – and access by all sections of societies to food – while reducing the environmental impact of the food chain.

Europe's Food Security: Priorities for Science Policy

The rapidly-growing awareness of major global issues such as climate change and shifts in energy policy are raising fundamental concerns about Europe's food security in relation to other needs of society ("competing claims"). This needs the urgent upgrading, renewal and strengthening both of the complementary parts of Europe's food systems, and of the system as a whole. The ESF/COST Forward Look on "European Food Systems in a Changing World" identified critical areas of research to address this need.

These examples illustrate the dynamic nature and complexity of food systems. It is against this background that ESF and COST joined forces to tackle the issue of European Food Systems in a Changing World through a Forward Look. The objective of the Forward Look was to develop medium- to long-term views of future research need around the thematic focus of food security. It was multidisciplinary in nature, involving the ESF Standing Committees for Life, Earth and Environmental Sciences, Medical Research, Humanities, the Social Sciences and the COST Domain Committees for Food and Agriculture, Earth System Science and Environmental Management and Individuals, Societies, Cultures and Health. Both the Science Policy Briefing and the Final Report have been internationally peer-reviewed, and have been approved by the relevant ESF Standing Committees and COST Domain Committees.

This ESF Science Policy Briefing presents the main recommendations of the Forward Look's Final Report, which describes a research agenda and actions to be taken in Europe for this highly timely and important topic. The action plan addresses the complex challenges ahead and aims to contribute to shaping European food policy.

Professor Marja Makarow
ESF Chief Executive

Professor Francesco Fedi
COST President

www.cost.esf.org
www.esf.org

The Issues

Recent decades have seen dramatic transformations ("megatrends") which have characterised the development in the food systems which underpin Europe's food security. These include productivity increases per hectare, per man-hour and per kilogram of input; an increased industrial approach, where efficiency and efficacy not only count in economic terms but more and more in environmental and social terms; an increase in the vertical integration in the food chains, where the retailer and consumer have a greater influence on what is grown and how, partly due to a better understanding of the effects of nutrition on human health; and a wider set of objectives for primary production where environmental goals, water- and nutrient-use efficiency, biodiversity and landscape conservation are increasingly important.

In addition to these developments, other aspects of the European food system have also been radically changing due to changes in a number of key "drivers". These relate to changes in mobility and cultural mixing (leading to increased variation in diets), and growing consumer pressures especially in relation to food safety, animal welfare and ethical trade. Other drivers relate to changes in technologies, especially in food processing, packaging and distribution, often driven by the desire for convenience foods. Further drivers relate to increased governmental regulations, and changes in retailing and food prices. As a backdrop to all these drivers are changes in climate and other environmental conditions, a topic of increasing political and scientific importance.
These changes prompt a number of questions:

- What does this mean for Europe's agricultural landscape?
- What does this mean for Europe's food-related industries?
- What does this mean for Europe's competitiveness?
- What does this mean for Europe's food security and the health of the population?

How should Europe's research community best respond? Given the complexity of the issues, it is clear that an innovative approach is needed which encompasses the whole food system, not just agriculture; which includes industry and policy, not just researchers; and which is based on clear guidance on research policy. A food systems approach provides a logical and effective framework within which to develop such a policy.

Food Systems Concepts

Food systems underpin the primary societal goal of food security[1]. Food systems comprise a number of activities. These are (i) producing food; (ii) processing food; (iii) packaging and distributing food; and (iv) retailing and consuming food. These four sets of food system activities are influenced by a range of factors, each of which has an associated research community (*Figure 1*).

In addition to underpinning food security (i.e. food availability, access to food, and utilisation of food), these activities also give rise to a number of other outcomes, many of which contribute to – and influence – other societal goals such as employment, health and social and environmental conditions. Both the activities and the outcomes are influenced by the range of interacting drivers, but they also feed back directly and indirectly to modify the drivers themselves (*Figure 1*).

Societal interest in establishing an equitable and sustainable balance between the range of outcomes related to food systems gives rise to much debate on "tradeoffs" within society in general, as well as amongst those involved in the development and delivery of policy and scientists from all disciplines. It concerns the full range of spatial levels from local to Europe as a whole. The debate is hampered, however, by lack of a clear understanding of the outcome of food systems activities specifically related to food availability, food access and food utilisation. The food system approach provides an analytical lens through which food security, and its links to drivers and other food systems outcomes, can be analysed. Changes in lifestyle related to the growth of convenience foods and the growing problem of obesity are also a matter of wide concern (in addition to genetic and environmental factors, diet has a big influence on the presence of several illnesses). The development of specific functional foods and nutraceutical products aimed at the prevention of these problems could result in a considerable improvement for people's quality of life. It is also highly significant that the widely-heralded advances expected from genetically-modified foods only a few years ago have been largely postponed in Europe as public uneasiness mounted. Food safety is also an increasing issue, triggered by a number of recent concerns around the world.

Future European food systems will be different due to changes in the nature and magnitude of drivers. In addition, further changes in the on-going

[1] Food security is defined as: *when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life* (World Food Summit, 1996).

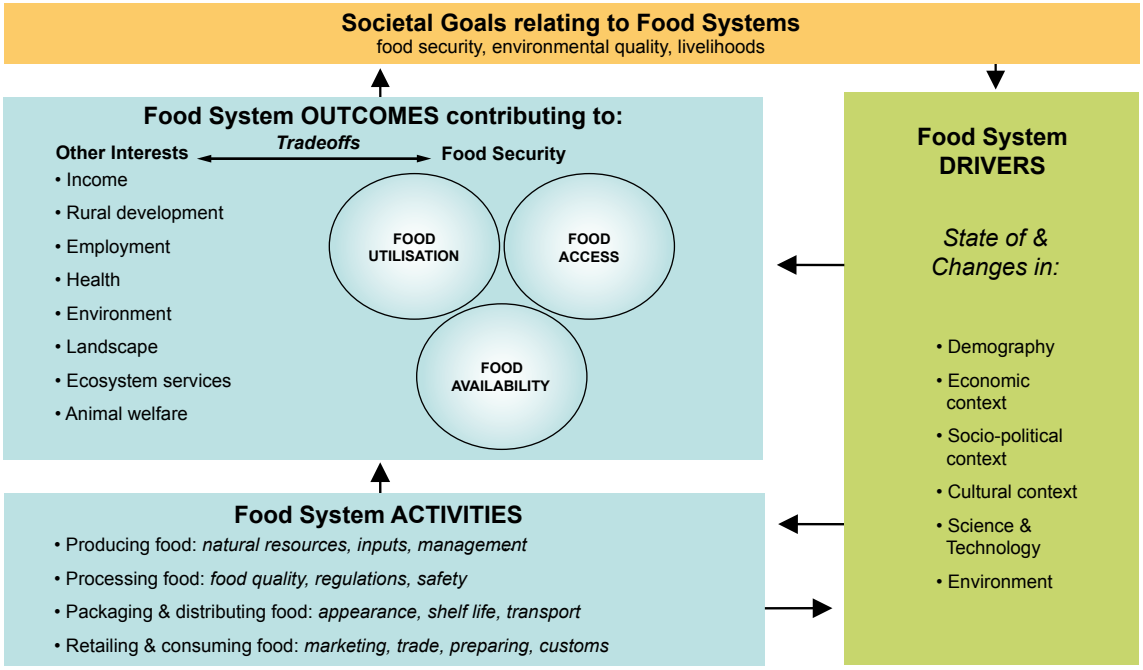

Figure 1: Key Food System Drivers, Activities, Outcomes and Feedbacks. [Derived from Ericksen, P.J. and Ingram, J.S.I. (2005) *IHDP Annual Report 2004-5*, pp. 45-46; and from Ericksen, P.J. (2008) Conceptualizing food systems for global environmental change research. *Global Environmental Change* **18**, 234–245.]

megatrends will be compounded by changes in major uncertainties related to consumer preferences and lobbying (especially related to food safety), reform of the Common Agricultural Policy (CAP) and world trade arrangements, and the shifting influence (power) of big food retailers operating close to the consumer (which are changing the retailers' buying behaviour and which also have the power to set food standards themselves), and global environmental change.

The Need for an Innovative Science Policy Agenda

Much research has been conducted on technical and policy issues for agriculture, fisheries and feed/food in both social and natural sciences. This has generally been of a disciplinary nature, addressing specific aspects of food system activities and sub-components of their outcomes as contributing to food security (*bullet points in Figure 2*). The interactions between key sub-components of food security outcomes (*arrows in Figure 2*) are however insufficiently researched. Improved understanding of these interactions, and how changes in the drivers will affect them, is crucial in being able to address the higher-order issues relating to the food security and the tradeoff debates. This is because many of the sub-components are themselves linked to both drivers and other food system outcomes (*Figure 1*).

Two overarching questions set the scene for integrated European food systems research over the next decade:

1. How will the drivers of the European food system – and the interactions between them – change in the next few decades? Example key issues include changes in CAP, climate, WTO, lifestyle and consumerism. *(cf Figure 1)*
2. How will these changes affect the interactions and conflicts between the food security outcomes of food availability, access to food and food utilisation? *(cf Figure 2)*

These questions were used to set the context for the recently-completed COST/ESF Forward Look "European Food Systems in a Changing World". The Forward Look included a number of distinct, but closely-related, activities. Workshops agreed working questions to guide the development of a set of papers discussing the food system activities.

Papers were drafted for each of the food system activity "sets" (*Figure 1*) which reviewed the current situation and trends in each. Existing European-level scenarios were then reviewed to determine their suitability for food systems analyses. Based

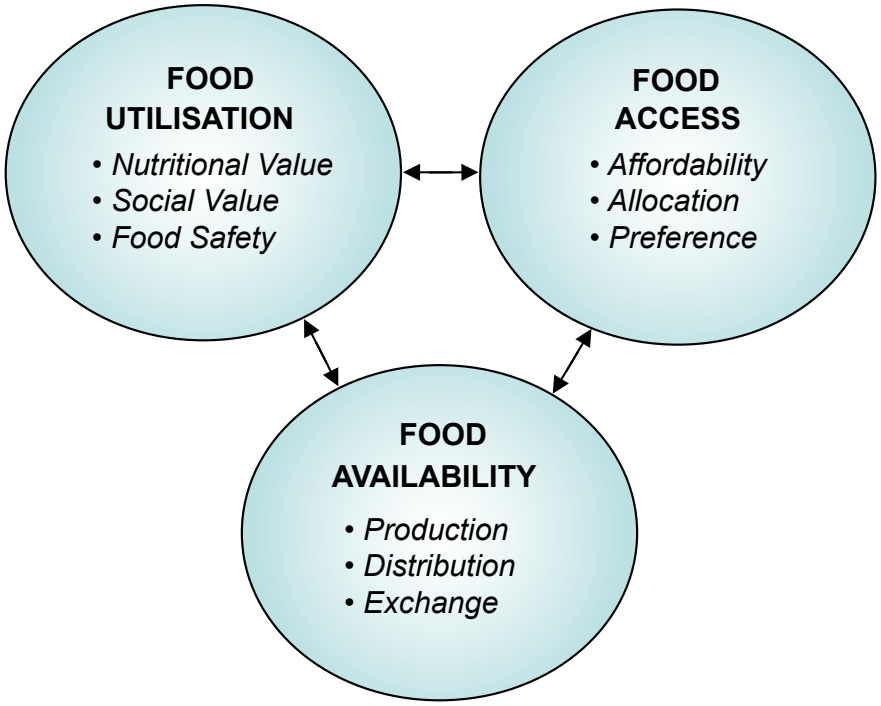

Figure 2: Interactions between food security outcomes. [From: Ingram, J.S.I. (2008) Food System Concepts. In: *ESF/COST Forward Look on European Food Systems in a Changing World.* ESF-COST Final Report.]

on this, a set of new proto-scenarios specifically tailored for food system research were developed. The four papers were then revisited and a final section incorporated in each which discussed possible future trends given each proto-scenario. The systematic approach employed in the Forward Look, and the outcomes and recommendations, were presented in a final conference from which came a set of science policy recommendations.

It is clear from the Forward Look, and supported by earlier scenario studies, that there is ample space for policy choices. There is also an urgent need. A productive, more environmentally-friendly, and internationally more acceptable European food system is possible when the right political choices are made.

- European policy makers should make clear choices based on well-defined objectives and goals. Achievable goals, rather than instruments *per se*, should be the focus of policy discussions.
- European policy should withdraw from policies that undermine the agricultural development in developing countries or that promote unsustainability spirals in terms of land, water and natural resources use.
- European food systems should be considered much more as integrated systems rather than as individual activities.

Setting best policy given the many uncertainties is difficult, and a scenario-based approach would help by analysing implications of policy and management options within a set of coherent, internally-consistent storylines of credible futures at the European scale. Taking a long-term (25-40 year) perspective in addressing European food systems is important, as many key uncertainties are likely to play out strongly over the coming decades – yet responding to these uncertainties already today will reduce future impacts and costs substantially.

Research on Europe's future food systems must be based on the notion of safe foods produced in a sustainable and equitable system. Integrated analyses will need to draw on the many research advances in all the food system drivers listed in *Figure 1*, and while sustainable development takes into account all these aspects, it is not definable in a simple manner, and lacks well-described disciplinary instruments for analysis. This, coupled with the many factors involved, necessitates research in this complex area to be based on a strongly interdisciplinary approach, building on the foundation of disciplinary studies, and guided by the needs of policy formulation and scientific excellence.

Research Priorities

The Forward Look final conference agreed that future research must be geared towards (i) health, particularly prevention of diseases that are related to lifestyle and demographic changes; and (ii) sustainability, including the effects of global warming and of the use of biomass for energy/ fuel production. In so doing, follow-up studies need to include all relevant stakeholders, i.e. not only researchers from universities and knowledge centres, but also people working in the food industry, in consumer organisations and in retail companies. Follow-up studies in education are also critical, as this remains important not only for farmers in relation to more sustainable production techniques, but also for consumers with respect to the relation between food and health, technology perception and awareness about sustainability. Cooperation with ongoing activities is required (e.g. the European Technology Platform, and especially on the food chain/food system concepts) to make follow-up studies efficient and effective, and to offer maximum support to European policy making, notably the reform of the CAP in 2013.

The review of earlier scenario exercises and the results of the preliminary scenarios developed in the Forward Look demonstrate the urgent need for a more comprehensive explorative study specifically designed for food system analyses. Comprehensive scenarios would be based on story lines which are not predictions as such but virtual and imaginary futures designed to inspire policy makers and scientists, and to help in the formulation of further quantitative scenario studies. Such a study should therefore include consistent and scientifically-sound scenarios that go beyond analyses of what could happen when food systems are disrupted by individual “shocks” due to, e.g., the occurrence of global food scares or a world-wide energy crisis; they should encompass a comprehensive set of drivers and be designed in close collaboration with intended users.

Based on the outcomes of the Forward Look the following research priorities were identified for consideration by both national and European agencies:

(1) **Comprehensive explorative scenario studies.** These are needed to help guide analyses of the outcomes of food system activities for different development pathways and to analyse the tradeoffs between food security, other social interests and environment goals.

(2) **Research on the key activities related to food security, in the context of the European food system.** This is needed for in-depth studies on technical coefficients and social, economic and environmental aspects of development paths within each of the food system activities.

(3) **Enhanced consideration of food safety and the links between food and human health.** Consumer confidence in food quality and safety is a growing issue and needs to be backed by reputable and transparent studies including behavioural research on consumption patterns.

Organising Committee for the Forward Look

Co-chairs:

Professor Rudy Rabbinge, Sustainable Development and Food Security, Wageningen University and Research Centre, The Netherlands

Professor Peter Raspor, Department of Food Science and Technology, University of Ljubljana, Slovenia

Members:

Dr. Jana Gasparikova, Institute of Forecasting, Slovak Academy of Sciences, Slovak Republic

Professor Josef Glössl, Institute for Applied Genetics and Cell Biology, University of Natural Resources and Applied Life Sciences, Austria

Professor Kostas Gouliamos, Management and Marketing Department, Cyprus College, Cyprus

Mr. Thomas Henrichs, Policy Analysis Department, National Environmental Research Institute, Denmark

Mr. John Ingram, GECAFS, Environmental Change Institute, University of Oxford, United Kingdom

Dr. Jette Linaa, Institute of Environment, Society and Spatial Change, Roskilde University, Denmark

Dr. Begoña Pérez Villarreal, Food Research Division, AZTI Tecnalia, Spain

Dr. Sally Shortall, Gibson Institute for Land, Food and Environment, Queen's University Belfast, United Kingdom

Professor Miklós Tóth, Section of Medical Sciences, Hungarian Academy of Sciences, Hungary

Project Officer:

Dr. Johan Vereijken, Agrotechnology & Food Science Group, Wageningen University and Research Centre, The Netherlands

COST Office:

Dr. Albino Maggio, Science Officer, Food and Agriculture, COST Office, Belgium

ESF Office:

Dr. Astrid Lunkes, Science Officer for Life, Earth and Environmental Sciences, European Science Foundation (ESF), France

Dr. Arja Kallio, Head of Unit, Life, Earth and Environmental Sciences, European Science Foundation (ESF), France

This ESF-COST Science Policy Briefing has been prepared under the responsibility of:

the ESF Standing Committees for Life, Earth and Environmental Sciences (LESC), European Medical Research Councils (EMRC), Social Sciences (SCSS), Humanities (SCH) and of the COST Domain Committees for Food and Agriculture (EFA), Earth System Science and Environmental Management (ESSEM), Individuals, Societies, Cultures and Health (ISCH).

COST

COST is an intergovernmental framework for European Cooperation in Science and Technology, allowing the coordination of nationally-funded research on a European level. COST contributes to reducing the fragmentation in European research investments and opening the European Research Area to cooperation worldwide.

COST Office
Avenue Louise 149 I 1050 Brussels I Belgium
Tel: +32 (0)2 533 38 00 I Fax: +32 (0)2 533 38 90
www.cost.esf.org

European Science Foundation

The European Science Foundation (ESF) provides a platform for its Member Organisations to advance science and explore new directions for research at the European level.
Established in 1974 as an independent non-governmental organisation, the ESF currently serves 80 Member Organisations across 30 countries.

1 quai Lezay-Marnésia I BP 90015
67080 Strasbourg cedex I France
Tel: +33 (0)3 88 76 71 00 I Fax: +33 (0)3 88 37 05 32
www.esf.org

Latitude : - SPB 36 - Print run: 3000 - March 2009