
SCAR – FORESIGHT IN THE FIELD OF AGRICULTURAL RESEARCH IN EUROPE

Food Scenario

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Preamble:

"Whoever could make two ears of corn or two blades of grass to grow upon a spot of ground where only one grew before, would deserve better of mankind, and do more essential service to his country, than the whole race of politicians put together."

Jonathan Swift (1667-1745)

Today is Feb. 12, 2021. The new sticker shows again and again that we have economic problems. The United States of Europe still exist - they are still in a relatively good shape and try to formulate their policies. Currently, they establish their revised common agricultural policy (http://europa.eu/pol/agr/index_en.htm).

In the twenty-first century, the demand for Food and agricultural products in general reached unprecedented levels. The world population is predicted to be eleven billion people in 2025. Ninety-eight percent of the future population growth still occurs in developing countries. 60 percent of the population stays in urban areas. Some of the world regions had to cope with a five-fold increase in population numbers compared to the 1990 level.

How can world agriculture be able to feed all the people in the future? Agricultural production already increased and until now, it was more a question of distribution if all people on earth can be fed. But now the situation is severe. Among the causes of this imbalance is a shrinking reserve of unused agricultural technologies, the exhaustion of

fisheries and rangelands, a decreasing supply of irrigation water, a decrease of available cropland, social instability and disintegration. On the other hand, estimates of global food supply and demand generated by the World Bank were rather optimistic at the beginning of the century, and predicted declining real prices for food. But that was not in accordance with growth prices for energy. That means, food, especially natural and qualitatively good and secure food is still very expensive. Most people live on low quality food, even synthetic food processed by industry. But here, the production processes improved a lot so that high quantities can be achieved.

In agriculture, there is a severe competition for land which is used for food production and land used for energy crops. Producing for biofuels or biogas facilities provides a better income for farmers, therefore - in spite of agricultural policies - most of the farmers still produce energy crops. Some were convinced that inter-changing the crops - food and energy crops - is a reasonable choice, especially to avoid monocultures.

Providing consumers with safe food is linked with different life styles and food habits. Different responsibilities represent a constant task in developed and developing countries. It took years of research to understand that food and nutrition is a concept which begins with technologies and goes all the way to the legislation, from the producer to the consumer. Eating out, the usage of partly or fully cooked food increased as a reaction to special configurations in time problems. To organize everyday life, more and more functional and convenience food are consumed. People in the USA spent 40 – 50 % of their income for nutrition in different eating out places already in 2006, whereas people in Europe spent around 26 %, and this was and is still very scattered north-west to south-east (Warde, 1999; Soriano et al., 2002; Walker et al., 2003; Raspor, 2004).

Our traditional understanding of foodstuff supplying system is still constantly changing. Incidence and type of food borne diseases (FBD) are also changing. Analysis shows an increase of viral infections in comparison with classical bacterial infections (Raspor, 2004). Huge innovations in health care were made as there was and is still an increasing

demand. Technologies like machines and robots are accepted because there are not enough persons available in health care.

Suitable to human health, safe food is a consumer's basic right. Assuring safe food is the most difficult task in preparation and distribution units, especially in small and medium-size companies (Baş et al., 2005; Ayçiçek et al., 2004; Bermúdez-Millán et al., 2004; Sun and Ockerman, 2004; Walczak and Reuter, 2004; Walket et al., 2003; Walker and Jones, 2002; Worsfold, 2001). It is common knowledge that the number of FBD is increasing in developed and developing countries. They represent an important public health problem in the contemporary world (Tucker, Whaley & Sharp, 2006). Consumers have become very critical about food safety and food quality due to the number of food scandals which have received a great deal of media attention. For example in March 1997, an outbreak of avian influenza caused by the A virus subtype H5N1 killed several thousand chickens in three rural Hong Kong chicken farms. In May 1997, a 3-year-old boy in Hong Kong contracted an influenza-like illness and died 12 days later from Reyes' syndrome — a paediatric complication that is associated with salicylate medication, which he had received. The virus strain resisted characterization with the available reagents; by August, detailed study in The Netherlands and the United States had revealed that the virus was closely related to the avian strains that were prevalent in March. In November, human cases caused by this virus began to occur; by late December, there had been 17 cases, of which five were fatal. Contact with chickens had occurred in all confirmed cases. On 28 December 1997, the slaughter of all chickens in Hong Kong (a total of 1.6 million) began, their import was stopped and the outbreak ceased (Pennington, 2004).

These events have globally resulted in increased government regulatory activities. Federal and international agencies are acting to encourage better public health protection. One of the principal actions has been the development of HACCP (Hazard Analysis and Critical Control Point) based regulations or recommendations by federal agencies and the United Nations Codex Alimentarius Commission (Sperber, 1998). To control and comprehend safety in European Union (EU) »White Paper on Food Safety« is an important document that was published in January 2000 (EC, 2000). After that regulation

178/2002/EC and decision 97/579/EC were published, which exactly define »European Food Safety Authority«. The use of HACCP principles at all levels of the food chain is however compulsory under European Union (EU) Directive 93/43/EEC and Regulation 852/2004/EC (EU, 1993, 2004). It is a responsibility of all included parties in food chain to ensure food traceability and food safety by internal control in all production phases.

In line with food safety requirements, stakeholders laid great stress on ensuring food safety and quality in the entire food supply chain from field to final consumers. Regarding food and health issues which have long tradition in human society, we faced these problems for centuries but we have not been facing so many changes during our entire history with all the starvation crises, as we are facing it in last years (Barendsz, 1998).

Consumers' attitudes towards food safety and their practices related to food are themes of interest to food producers and retailers, public authorities and health educators (Wilcocky et al., 2004). Unusan (2007) cited that people of all ages seem to think that they know how to handle food safety, but their self-reported food-handling behaviours do not support this confidence. Jevšnik, Hlebec and Raspor (2006) found out some discrepancies between actual food handling practices and consumers knowledge about food safety principles. It was shown that half of respondents think that short time of transport is important for raw meat, while only a third of them follow the cold chain principles of perishable foodstuffs. Consumers think that they are not responsible for food safety to the same degree as food professionals (farmers, food industry, retail, catering).

The literature on public perceptions of food related hazards is relatively recent (Sparks & Shepherd, 1994a,b; Fife-Schaw & Rowe, 1996; Grobe et al., 1999; Williams & Hammitt, 2001). Research has suggested that the public's reaction to risk is underpinned by quality hazards not taken into account by experts (Slovic, 1993). Public opinion on the evolution of food safety over the last ten years is divided: 38% consider that it has improved, 29% feel that it has stayed about the same and 28% believe that we are now worse off (Eurobarometer, 2005).

Rosati and Saba (2004) estimated that consumers were more worried about those food hazards that were well known to them and, consequently, less worried about food haz-

ards that were less known. Moreover, the study indicated that perceived personal risk and the individual's own knowledge of potential food risks were two distinct dimensions of food risk perception. It was found that the reliability of knowledge held by agencies about risks associated with food-related hazards to human health and the trustworthiness of the sources of information were two important factors of consumer trust.

However, when consumers are reminded of the possible risks associated with food, concerns appear to be quite widespread. The main finding is that people do not differentiate greatly between the various types of risks although they are more likely to worry about risks caused by external factors over which they have no control. At the top end of the "worry" scale, consumers express concern regarding external factors that are clearly identified as dangerous (pesticides residues, new viruses such as avian influenza, residues in meats, contamination of food by bacteria, unhygienic conditions outside home). In the mid-range, one finds other external factors such as environmental pollutants (e.g. mercury), GMOs, food additives, animal welfare and BSE. Consumers appears to be less concerned about personal factors (such as individual susceptibility to food allergies) or other factors linked to their own behaviour (e.g. food preparation, food hygiene at home and putting on weight) (Eurobarometer, 2005).

Frewer et al. (2004) stated that in a demographic society where choice exists, people will not consume foods that they associate with some negative attribute. Various factors may contribute to concerns. A number of surveys and opinion polls have sought to identify consumer attitudes to food and its safety (O'Fallon et al., 2007; Eurobarometer, 2005; Frewer et al., 2004; Rosati and Saba, 2004; Banati and Lakner, 2003; Frewer et al., 2003). Kuznesof and Brennan (2004) presented the results of exploratory focus group research done by Frewer et al. (2001) where food concerns have been categorised according to hazard type. The results show a range of concerns varying from anxieties relating to each stage of the food chain (e.g. specific food issues, such as GM foods and the use of additives and preservatives in processed foods, were frequently mentioned). O'Fallon, Gursoy & Swanger (2007) examined the data from the Eurobarometer 53 and they ascertained that many (roughly 73% of the sample) of the individuals residing in

the 15 European countries are less likely to purchase a food product with a label indicating the existence of a GM ingredient. Research by Plahuta, Tivadar & Raspor (2007) shown that the opinion of Slovenian consumers, retail chain representatives and professionals (oenologists) about GMO is refusal (e.g. the majority believe that GMO will be on the market within five years). Banati and Lakner (2003) pointed out that the level of knowledge on biotechnology is rather mixed, that's why the Hungarian consumers have not yet a well-defined opinion on the genetically engineered products.

The environmental impact of agricultural activities may be pronounced especially in developing countries where the quest for subsistence has necessarily postponed a priority consideration for mitigation measures. Environmental concerns differ widely between developed and developing countries. The global climate change has underlined the necessity of undertaking mitigating actions designed to limit the emission of greenhouse gases. First activities started in 2010. The processes in the area of food production and processing developed fast and the food supply chain got longer and longer. Global food security is still a matter and will remain a worldwide concern for the next 30 years and beyond. But also the packaging is safe with antibiotic, nanotech-based materials. In 1996, countries at the World Food Summit agreed that food security exists 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 lifestyle (FAO, 2000).

For 20 years, we can remark declining investments in research and infrastructure. As a result, crop yield has fallen in many areas. Water is still scarce – and expensive. Water shortage in Africa and Asia, some parts of the US, droughts, and hot weather make life uncomfortable in many areas of this world. So people are still looking for new chances. Migration is normal. Today here, tomorrow there. If turbulences, even riots occur, one moves. Most countries try to guide these movements but it is useless. Bringing back people means, they are at the door 2 weeks later, again. Moving across borders is a problem, but in countries like China or in the EU, it is even worse. In China, two thirds of the population lives in the eastern coastal regions. They are fully developed. And the

rest? Is still suffering. Even in the EU, the distribution developed to be more and more uneven. And the EU is attractive for people from Arabian countries and from Africa.

We live in a global world; the globalization of food processors and food distributors is a matter of fact nowadays. Climate change evoked new illnesses, especially because of a migration of different insect species to areas where they had not been seen before. Infectious diseases are still increasing, although the medical treatment of the new illnesses is possible. But to keep on track with the development and to prepare for new pandemics seems to be impossible. We, human beings, are more re-acting than acting. Traditional illnesses like tuberculosis re-occurred, they are also crucial factors affecting food security in many regions of the world. By agro ecological approaches yields were improved drastically, but that seems insufficient today.

Looking back to the past and their expectations, we can found following (Table 1):

Table 1. Agricultural and food revolutions and their implications for food-related health

ERA/ REVOLUTION	DATE	CHANGES IN FARMING	IMPLICATIONS FOR FOOD- RELATED HEALTH
Settled agriculture	From 8500 BCE on	Decline of hunter-gathering; greater control over food supply but new skills needed	Risks of crop failures dependent on local conditions and cultivation and storage skills; diet entirely local and subject to self-reliance; food safety subject to herbal skills
Iron age	5000-6000 BCE	Tougher implements (plows, saws)	New techniques for preparing food for domestic consumption (pots and pans); food still overwhelmingly local, but trade in some preservable foods (e.g., oil, spices)
Feudal and peasant agriculture in some regions	Variably, by region/continent	Common land parceled up by private landowners; use of animals as motive power; marginalization of nomadism	Food insecurity subject to climate, wars, location; peasant uprisings against oppression and hunger
Industrial and agricultural revolution in	Mid-18th century	Land enclosure, rotation systems; rural labor leaves	Transport and energy revolutions dramatically raise output and spread foods; improved range of

Europe and U.S.		for towns; emergence of mechanization	foods available to more people, emergence of commodity trading on significant scale; emergence of industrial working-class diets
Chemical revolution	From 19th century on	Fertilizers; pesticides; emergence of fortified foods	Significant increases in food production; beginning of modern nutrition; identification of importance of protein; beginnings of modern food legislation affecting trade; opportunities for systematic adulteration grow; scandals over food safety result
Mendelian genetics	1860s; applied in early 20th century	Plant breeding gives new varieties with "hybrid vigor "	Plant availability extends beyond original "Vavilov " area; increased potential for variety in the diet increases chances of diet providing all essential nutrients for a healthy life
The oil era	Mid-20th century	Animal traction replaced by tractors; spread of intensive farming techniques; emergence of large-scale food processors and supermarkets	Less land used to grow feed for animals as motive power; excess calorie intakes lead to diet-related chronic diseases; discovery of vitamins stress importance of micronutrients; increase in food trade gives wider food choice
Green revolution in developing countries	1960s and after	Plant breeding programs on key regional crops to raise yields; more commercialized agriculture	Transition from underproduction to global surplus with continued maldistribution; overconsumption continues to rise
Modern livestock revolution	1980s and after	Growth of meat consumption creates "pull " in agriculture; increased use of cereals to produce meat	Rise in meat consumption; global evidence of simultaneous under-, over-, and malconsumption
Biotechnology	End of 20th century	New generation of industrial crops; emergence of "biological era "; crop protection, genetic modification	Uncertain as yet; debates about safety and human health impacts and whether biotechnology will deliver food security gains to whole populations; investment in technical solutions to degenerative diseases (e.g. nutrigenomics)

Source: Hawkes, C. & Ruel, M. T, 2006

The table underlines that fundamental changes have taken place within the health sector, food supply chain and environmental changes due to change of life style and urbanization. All this is connected to new discoveries in all sectors related to food and new treatments in health care, novelties in food availability, in nutrition practices and a greater awareness of the effects of the environment on population health. Essential developments outside the food supply chain (food production and distribution) and/or nutrition and health sector, will be caused by globalization, migration streams and social (in)tolerance. There is an increasing difference in incomes. High values lie on private properties. Intellectual properties and property rights are severely protected. Individuality and individual wealth of all the consumers are in the forefront. This is the case of EU country.

In 2007, it was decided that a long-term, strategic view on European food and health perspectives is necessary. The policy makers of the EU accepted this necessity and decided that in spite of the disagreements among the countries, the shift in policy is a must. Several approaches were followed. As food was regarded the major challenge due to tide connection to health and the new possibilities coming from science and technology, four scientific target fields based on three visions were formulated and worked out strategically. These are:

- Earth sciences- environment and sustainability
- Life sciences- nutrition decrease and well-being for all
- Technological sciences- food and pharmacy for all
- Societal sciences – education governance and economics

Link up of food, people, society and resources

Food consumption is vital to human survival. Food, eating and nutrition are shaped by culture. Therefore, making cultural comparison provides important understanding as

well as practical applications for work on food preferences and eating patterns in Europe. Dietary patterns have evolved and changed throughout history and it is recognised that food intakes (particularly from the perspective of nutrition) vary across different EU member states. More than half of the Europeans believe that healthy nutrition has a positive effect on staying healthy and prevention of diseases. Greater cross-cultural variability was observed in the perceived barriers to healthy eating. The most important barrier categories reported were lack of time and self-control. The majority of Europeans believe there is no need to change their eating habits as they already were healthy enough (Saba, 2002).

Fast way of living and constant lack of time is a global problem that dictates objective changes in everyday environment. As the global food-marketing environment becomes more and more turbulent and competitive, marketers must 'follow' and understand the changes in consumers' food-related attitudes and behaviours, and be willing to react and adapt to this information (Reid et al., 2005). There is a steady stream of conferences and lectures on the consumer of the future, on trends in food consumption, about the rapid changes in consumer demand, about the need for innovation of food producers as a way to survive. Major topics mentioned in this context are usually health concern, the role of convenience, the importance of variety and new experiences, linking 'stories' to food, ethical and environmental issues (Grunert, 2006). Grunert et al. (2001) have documented food-related lifestyle concept that are connected with food culture. Changing consumer needs have led to a rapid growth of convenience food sales in recent years. These changing consumer needs were a result of major macro-economic changes that occurred in developed countries in the last few decades (Jago, 2003). We experienced an explosion in the supply of new food products in most markets (Grunert et al., 2001). Prepared consumer foods (convenience foods) has an important role in developed countries (De Boer et al., 2004). Sociological and economical issues entered food arena recently since we realized that human factor is key player in food safety issues (Clayton et al., 2002; Clayton and Griffith, 2003; Enz, 2004; Jevšnik et al., 2004; Strohbehn et al., 2004; Taylor and Taylor, 2004; Eves and Dervisi, 2005; Azanza and Zamora-Luna, 2005; Jevšnik et al., 2006). On the other hand Jannadi (1995) emphasized that food handlers are the ones who carry out the work in a company, and they can be an impor-

tant factor in making the company profitable or bankrupt. Human behavior is very important, and it is difficult to control, so handling people requires situational leadership. Hazards can not be solved and eliminated just through engineering control. They also need to be recognised by employees who will minimize their effects (Jannadi, 1995). Human resource management and education of food safety managers in food premises has not captured the strong attention of researchers.

Developments in production area cover many of the exciting new scientific discoveries relating to health, such as post genomic area which promises cures in untreatable areas, drug discoveries, screening and treatment and new nutrition approaches with personalised diet. Mergers, growth and consolidation will taking place within the pharmaceutical food industry and private health care sector which will serve proactive approach to keep healthy consumers. Developments in bioengineering and biotechnology are able to make useful products for medical treatment, such as artificial blood and artificial organs to enable reactive approach for consumers who do not have genetic structure to cope with proactive attitude. But finally we shall not forget that “In the next 50 years, mankind will consume as much food as we have consumed since the beginning of agriculture 10,000 years ago” (Clive James, 2000). And also that world has food reserves for 48 days; 30 years ago we had food reserves for 77 days (From FAO data).

However on global perspective we can see also different development in the area of arable land.. We are loosing every year 1,4 top soil, what means that arable land will fall from today 0,26 ha to 0,15 ha/ per head till 2050. In 1961 we had 0,44 ha/ head. Food production moved from collecting and hunting to planting and breeding as is indicated in Table 2 to intensive production and was stabilised with “green revolution” and upgraded with GMO revolution and expected that we will have in water “blue revolution” in food production from watery resources also due to problems with soil and land management. We moved from thousand of edible plants to selection of three like corn, rice, wheat, which cover more than 50% of our diet calories. We are loosing diversity of foods as basic ingredients in food production what is connected with disappearing of traditional knowledge and skills in traditional food preparation. This is culminated in extinction of 50 Species of plants and animals every year.

This consequence of loading environment with pollutants is reflected in food contamination status which can be tolerated by healthy and unhealthy consumer. All pollutants are finally transferred to our daily spoon. Selection of known pollutants is growing with technical and technological capacity and potential to produce them. Unfortunately we can trace those we created, those which were created by past changes we are not even aware of.

Food production is not any longer only primary production it is integrated cluster of activities which is not very easily separated to make transparent view. For that purpose we do not need just food staff, we also need development of low energy consumption processes/technologies and transports but ensuring safety issues. For that reason we will need to ask ourselves very specific questions regarding what we need in food processing technology.

1. Food processing equipment optimization for minimum energy use
2. Food processing automation and control to minimize the time spent on food preparation
3. New edible and biodegradable functional packaging materials using nanotechnology
4. RFID technology for logistics , quality and safety monitoring
5. Fast microbial counting technologies using biochips to ensure food safety
6. Role of new food preservation technologies and protective measures to reduce food spoilage and to reduce nutrition capacity reduction.
7. More Structure/function understanding for future food plants
8. Creating accurate and comprehensive databases for food processing/preparation data
9. System analyses and design of integrated food processing systems; better integration of food processing with regenerative life support technology
10. Creating computerized designs and virtual simulation of food processing to increase the rate of optimized food processing discovery
11. Minimization of variability of crop to crop variation of nutritional values
12. Nutrigenomics -Metabolomics - for life needs

13. Food preparation (microwave, food heating, food freezing, refrigeration)
14. Optimisation of food storage, transport, from nutrition and from energy point of view

The visions for the next ten to fifteen years on are:

1. Global supply through multinational companies

All foods are GMO origin. The food primary production, processing and distribution is controlled by few multinational companies like it is the case with pharmaceuticals for years. Farming has moved from the land to aqua systems in order to introduce the production of cheap foods in large quantities. Food production is completely industrialized. Only few global companies trade food products globally. They developed different quality and safety standards for different regions of the world respecting the affordability by the consumers.

In the cheap and affordable category, the diversity of foods we had in former times dropped drastically. However, the expensive category did not change for years, now. If you can pay for it, you can get whatever you like. Food and water are the most essential commodities in the 2025. All food is processed and preserved. Due to mono-nutrition, allergies are the main problem in health issues. World food reserves are kept at low level to reduce space and energy for food preservation and manipulation and transport. Global suppliers "educate" consumers to be able to cope with a rational diet respecting good nutritional practice in the food supply chain. Consumers will understand only basic principles of good practices what will help global suppliers to control system.

2. Self supply through localized food systems

The current situation can be characterized as self-reliance for rural communities, low external input agriculture, and the re-localization of food production, markets and local economies. Long distance trade of goods that are surplus to production or not produced locally do not play an important role in the society of today. The diversity of local foods

is very high. Small farms are consolidated; they established new forms of technology, mechanization and modernization. Production enhancing technologies such as genetic modification were introduced in farming and food processing in a sustainable way. The number of people who were necessary to produce food and maintain the land decreased drastically. Many of them left the countryside.

Due to different attitudes of the well-educated consumers, producers and food dealers the new focus lies on the development of safe and nutritious foods which supports health proactively. Educated consumers, the major part of the population in the United States of Europe, who have a good understanding of their personalized diet are assisted by avatars to practice what they know. A food supply chain is actively developed which - also in the future - will serve educated consumer respecting their good practices.

3. Balanced food supply system

Environmentally friendly farming linked to national and international markets is normality. Food production and distribution are balanced on demand of regional supermarkets and support cheap supply of food products. Thanks to RFID, all products can be totally traced, and new eco-labeling standards were developed. Diversity of food products stabilized on a manageable level, quality and safety are of primary importance. Safe and nutritious foods support the health of people proactively. They are standard and completely accepted. Functional food is normal food on the market, some is already serving as a kind of "medicine". In fact, it is difficult to differentiate between medicine and foodstuff.

Consumers are educated well. They were educated by the principle of teaching the whole family via children's attitudes. Fully developed personalized diet criteria are the pace makers of the society, the society are back to primary and secondary production with the principle "from fork to farm". Food supply chain has shortened and the consumer understanding is fundamental.

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