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A Technology Foresight Project in Bulgaria, Croatia, Czech Republic, Hungary, Romania and Slovakia

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Executive Summary

How would the supply and demand sides of food markets look like around the year 2020 in Central and East European countries? The **FutureFood6** project invited a large number of experts from six Central and East European countries (Bulgaria, Croatia, the Czech Republic, Hungary, Romania and Slovakia) to deal with this question. The response was intensive and manifold: A large number of experts participated, coming from the different disciplines that are of relevance in this context, and from different positions within this important segment of today's economies. Managers of food producing companies, representatives of chambers of commerce, and experts working in consumer organisations, ministries or certification agencies accepted the invitation to contribute to the topic either via questionnaires, oral interviews or as workshop participants. Teams of experts took care that sound techniques were applied to information gathering, processing and analysis. This very comprehensive undertaking was based on **Technology Foresight**, a new scientific methodology, which has proved to be a highly successful approach when it comes to addressing complex scenarios with a multitude of stakeholders involved. It is an adequate tool for dealing with potential long-term development paths of an entire industry including horizontal and vertical dimensions, supply and demand side aspects, or policy options and requirements.

By getting all major stakeholders involved, Technology Foresight is able to identify which technological, economic and social developments are in sight under different potential frameworks. The result includes the experts' expectations regarding the market infrastructure to be established and maintained by governments. The approach offers ample opportunity to discuss food policy issues. The project's focus was on food safety and security from a long-term prospective.

The Technology Foresight methodology used in this project employed the following set of tools: socio-economic future scenarios, interviews, key-technology surveys, future visions and road-mapping. Socio-economic future scenarios and future visions differ from each other substantially. In the case of the agro-food industries of the Central and East European countries, socio-economic future scenarios serve in identifying situations which might result from inherited demand and supply side characteristics and their collision with ongoing geo-economic, geo-social and geo-political development tendencies. The individual countries' influence on such tendencies is marginal at best. By contrast, future visions are defined as something desirable, which through adequate efforts may well be achievable in the longer run. Generally speaking, in all kind of fields different stakeholders can meet to develop visions and discuss how to promote them. In this project, different types of food experts as described above gathered in workshops to develop such *visions* and to reflect on road maps, which stakeholders may use as orientation for progress in the

envisaged direction. Whereas some *scenarios* are supportive to the realisation of *visions*, others are not.

The experts distinguished between four scenarios, which differ in the degree of development with regard to conditions on the demand and supply side. At some point of time, in some of the Central and East European countries the actual situation could resemble a 'consumer paradise scenario', in which a large proportion of the population can afford to act as quality-oriented food consumers, whereby preferences for quality food is high and knowledge about food and food producers is very developed. In this scenario, a core of consumers is satisfied with the response of the supply side, which is characterized by strong competition and high technological standards. Diversity on the supply side fits to multilayer demand. In a second scenario, quality-oriented and sophisticated demand of consumers is not met by adequate supply ('frustrated consumers scenario'). Neither domestically produced nor imported food fully meets expectations of the demand side. This is attributable to structural deficiencies and trade barriers. In a third scenario, the supply side would be quite capable, but faces poor challenge from the demand side, as the core of consumers have to content themselves with simple low-price food; gathering of information and more profound knowledge about food is hardly on their agenda. A few large trans-national producers and distribution chains have an easy game ('multinational golden pond scenario'). Finally, in a 'black obelisk scenario' consumers have to be content with low-price food, whereby at the same time the supply side is also poorly developed. Main reasons for the latter could be inflexibility due to lack of competition, and technological backwardness because of poorly developed human resources and physical capital.

It depends on a large number of factors, how developed the agro-food sector is currently in Central and East European countries, and in which direction the sector will move in the long-term. The countries will have influence only on some of these factors, as for example on the European integration processes. Mainly via the European Union (EU), they can also exert some influence on the international community of states' ability to agree on market regulations, especially in a World Trade Organization (WTO) context. The latter could establish, among many important things, free trade of food, and could be supportive to food quality (diversity, taste, healthiness, safety).

About thirty oral **interviews** per country plus over 400 questionnaires (**key technology survey**) placed with different types of food experts and stakeholders in the six countries offered them an opportunity to express their views. Interviews addressed the present situation with regard to certain aspects of food safety and healthiness, whereas the key technology survey collected expert views regarding the development and application level of a catalogue of technologies. The analysis of results allowed for a classification of technologies. As "key technologies" figure those from which the respondents expect strong

positive impact on food quality, consumers' health, employment, economic growth and food safety. 'Strategic' is a technology, which is just emerging, whereby the country seems to be well-positioned. Finally, a technology is labelled as 'consolidated, if it has reached a level, which is regarded as sufficiently high. Four technologies were identified as 'key technologies' in all six countries: one referred to control systems, two belonged to the group of package technologies and the fourth one was nanotechnology applicable as an instrument of dosage control. None of these four technologies, however, reached 'strategic' status, whereas three of them qualified as at least 'consolidated'. This means that in many aspects the Central and East European food industry is still characterized by technological backwardness and will have a long way to go to fully catch up with Western European standards.

In workshops, experts from the six countries concluded that they regarded four special states as highly desirable long-term targets (so-called '**future visions**'):

- Increased availability of high-quality region-specific and traditional food products ('Vision 1')
- A lead position of their countries in Europe with regard to the production of healthy and safe food ('Vision 2')
- National development plans acknowledging high priority to food-related research in combination with intensive cooperation alongside food chains paying special attention to functional food ('Vision 3')
- High knowledge intensity in the agri-food sector ('Vision 4')

In Vision 1, through their purchases consumers reveal their preference for a significant portion of regional products in their total food portfolio, and especially local producers are able to make best use of this opportunity thanks to favourable preconditions prevailing in the entire food chain and its infrastructure. Local production helps to protect the environment thanks to short transportation journeys, supports cultural diversity and strengthens local economies. Local producers benefit from EU promotion of Protected Designation of Origin (PDO), Protected Geographical Indication (PGI), and Traditional Speciality Guaranteed (TSG). To become reality, this vision will have to overcome a number of barriers such as high costs of production, distribution and brand development, or an inadequate regulatory framework in its own country as well as in potential export destinations.

In Vision 2, the food industry of the Central and East European countries manages to reach within Europe a strong position as a producer of healthy and safe food of premium quality. The countries' food industry enjoys EU consumers' confidence thanks to knowledge-intensive production, high quality thanks to strong competition and the application of strict quality rules and controls alongside the whole food chain, which guarantees traceability from farm to fork. Cooperation between the individual elements of

the food chain is strong, and the industry operates at the forefront of technological development. The participants of the expert forum, which developed this vision, have identified a number of factors, which might hinder the vision's realisation, such as predominance of small and medium-sized local producers, whereby they have difficulty to gain shares in international food markets. Main reasons for that could be complex and costly certification requirements or difficulties to make it to the shelves of large retail chains in an oligopolistic market.

The third future setting, which the experts qualified as highly desirable, is national development strategies, which put emphasis on support of food-related research and development as well as on cooperation within the food chain paying special attention to functional food (Vision 3). Such strategies would be the adequate response to socio-economic developments characterized by shifts of consumer preferences towards functional food in societies, which increasingly are becoming knowledge-based.

Vision 4, finally, sees the Central and East European agro-food sector characterized by a properly trained workforce capable to operate new knowledge-based farming systems that are profitable at farm level; the agro-food industry is based on knowledge and intellectual assets and capable to produce competitive market-required food products, that are environmentally sustainable, that cope with emerging climate changes and that are, with increasing importance, energy efficient. To develop in such a direction, the region will have to remove barriers such as deficiencies in the educational system, in training-on-the-job schemes, in access to information; barriers such as continued underdevelopment of rural areas and of the SME sector; and barriers between research and its practical application.

Expert forums dealt extensively with **road mapping**, i.e. the identification of driving forces, key actors and major action to be taken to promote the realisation of the four visions. Such driving forces could be (to degrees differing from vision to vision): forces on the demand and supply side of food markets; policy; technology, science & education; and public awareness e.g. thanks to information via the media. Within each of these driving forces, key actors can promote certain actions or measures. For instance, on the demand and supply side of food markets, NGOs dedicated to consumer protection, producer associations or individual companies can be key actors. With regard to policies, governmental and non-governmental policies on EU, national or regional levels - as for example competition policy, promotion of rural development or SME support - can play a key role. Within the driving force 'technology, science & education', the expert forum regarded research institutes (universities and others) and food safety institutions as the main actors. The experts point to a pattern, which is common to all countries under consideration: Research and development activities are under performing because of several reasons. The companies' investment into such activities is relatively low, as foreign-owned companies tend to concentrate these activities at their headquarters,

whereas domestically owned companies often are short of funds, both from own sources and borrowing, and are mainly concentrated on solving problems of a short-term nature. The latter tends to be true both for larger companies, which have been more or less successfully restructured, and for SMEs. Research institutes are in a similar situation: Due to inadequate resources of all kind, most of them could not yet fully catch up to western standards. Not surprisingly, cooperation between companies within the food chain and research institutions is still underdeveloped. Especially SMEs could profit enormously from improvement in this respect, as they tend to be dynamic and have potential to be successful in market niches, but are constrained by high fixed costs of own research activities. When dealing with road mapping for each of the mentioned four visions, the expert forums came to conclusions, which are similar in terms of suggested instruments, but differ considerably with regard to their relative importance. The experts tend to attribute an important role to improvements in the regulatory framework at different levels; to governments' more active support for SMEs, to research institutions and cooperation between them; or to better food-related knowledge of all stakeholders thanks to easier access to information, improved supply of educational services to both infant and adult citizens; and to stronger civil society organisations.

The project has opened the floor to thinking about long-term development trends with regard to food taste, safety and healthiness in Central and East European countries. At the same time it also has initiated reflection about desirable long-term goals and ways of realisation. And, it has managed to mobilize cooperation among a large number of stakeholders from different angles and countries.

1 FutureFood6 Project

Food quality and safety are crucial aspects of human life and are, therefore, prime policy objectives of the European Union (EU). Food quality and safety have to be secured through regulations with regard to inputs, production processes, outputs, transportation, storage, packaging, labelling, documentation of origin and the like, for creating an adequate infrastructure for food markets and their smooth development. The food industries in Central and Eastern European countries are undergoing sweeping ownership, technological, organizational and financial changes. The new decision-making processes should put a strong emphasis on safety and quality standards. Substantial changes in financial services, wholesale markets, commodities exchange, price information, transportation facilities and infrastructure are also needed. A second crucial aspect to be dealt with is the development of diversity in supply as a response to the evolution of demand diversity. Food policies can support or restrict diversity and creativity.

This document constitutes the Final Report on the project **"Healthy and Safe Food for the Future – A Technology Foresight project in Bulgaria, Croatia, the Czech Republic, Hungary, Romania and Slovakia**" (No. Proposal 43005, Project acronym: FutureFood6), coordinated by the United Nations Industrial Development Organization (UNIDO) and financed by the European Commission's (EC) 6th Framework Programme. The project started on the 1 February 2007 and finishes on the 31 January 2009.

The first part of this final report introduces the **FutureFood6** project, stating its objectives, scope, methodology and the project consortium. The second part gives a short overview on the current state of the agro-food sector in the target counties. The third part summarizes the major foresight results: Following the workflow, first socio-economic scenarios for the future of the total food chain are described, and then the state-of-the-art of certain food quality and safety issues are outlined including the results of the key technologies survey, thereafter future visions and road mapping results are illustrated. Finally, the fourth part draws policy recommendations from these integrated results.

1.1 Objectives

The objectives of the project were as follows:

a) To promote a new decision-making culture among managers and policy-makers in order to put quality and safety issues at the centre of the total food chain management.
b) To identify future key technologies and new business models to promote the quality and safety requirements in food production, by establishing a Food Quality and Safety Platform in Central and Eastern European countries (CEE).

The ultimate goal of the project was to assist the **total food chain in the CEE in general and the food industry in these countries in particular** to reach international quality and safety standards, and in turn, to enhance European competitiveness vis-à-vis the rest of the world by supporting further evolution of this industry. In this context, safety, diversity, sophistication and products of high quality will play a decisive role. This leads to identify specific needs and to develop a number of common actions to strengthen the food industry of the countries involved in the project. Likewise, the project aimed to support New Member States in their EU-integration efforts and to assist candidate countries in the adaptation of their food industries to EU requirements.

1.2. Scope

The **geographic coverage** of the project includes six Central and Eastern European countries: Bulgaria, Croatia, the Czech Republic, Hungary, Romania and Slovakia.

The **thematic coverage** of the project extends to the following areas:

- Total food chain, following the "farm-to-fork" concept.
- Key horizontal technologies affecting the future of the sector, such as biotechnology, preserving technologies, packaging, cleaner technologies and ICT.
- Societal demands as one of the key drivers influencing the future of food products.

1.3 Methodology and strategy

The methodology used for achieving these objectives was **technology foresight**. Foresight is a systematic, participatory process that gathers future intelligence and builds medium to long-term visions. By bringing together the relevant stakeholders – business, researchers, policy-makers, consumers, NGOs – with their wide range of expertise and accumulated skills it is possible to identify emerging technological and market opportunities and threats, consider Science and Technology (S&T) and socio-economic factors in their entirety, and thus devise appropriate policies and strategies, based on consensus among these stakeholders.

The main features of the foresight process can be summarised as follows:

- **Future oriented,** by identifying and systematically analysing possible future states (opportunities and threats) by taking into account the social, technological, economic, environmental and political factors and drivers, as well as the value systems of the stakeholders.

- **Involvement** of a great number of specialists and stakeholders with different fields of expertise, skills and accumulated knowledge, like consumers, businessmen, technology experts, researchers, policy-makers and NGOs.
- **Intense communication** among these stakeholders, potentially leading to consensus on the nature of major factors and drivers, and shared visions about the future.
- **Co-operation and networking:** intense communication among businesses, researchers and policy-makers is likely to lead to closer co-operation and networking of various sorts, e.g. joint Research, Technological Development and Innovation (RTDI) projects with participants from industry and academy; regular discussions among businesses and researchers on the one hand, and policy-makers, on the other often yield new, improved policy measures.
- **Commitment** to act upon the proposals stemming from the foresight process: by having been included in intense dialogues, participants feel ownership of the ideas generated, and thus willing to co-ordinate their future actions.

Technology foresight is based on a specific methodology, which differs from natural sciences, where testing of hypotheses through experiments plays an important role, whereby tests can be repeated any time. It also differs from econometric approaches, which uses data from the past as a basis for forecasting likely future short- or long-term future developments. The approach that technology foresight uses is the collecting and processing of information and assessments from all major categories of stakeholders. The results allow for the formulation of scenarios and, ultimately, policy recommendations. In other words, technology foresight uses methods that have been developed in social and other human sciences. This implies that results would not be completely identical if different teams elaborated on the same topic independently. One team might attribute more weight to, say, NGOs in the sphere of consumer protection, whereas other teams' approaches might focus more on expertise collected from food processing technicians, food marketing experts or farmers. The approach used here focused on expertise being collected from food quality and security stakeholders coming from Ministries, Research Institutes, Universities or Associations in the target countries; another feasible approach would have been to also ask experts from other countries how they assess the target countries with regard to food quality and security. The technology foresight methodology has a certain degree of freedom built in, a fact that enhances the debate-creating power of this approach. There is no better way to deal with the future under very complex circumstances.

FutureFood6 used the following **foresight tools** (see also work plan flowchart, Appendix A.1):

1. **Mobilization** of a variety of actors from different stakeholders groups with experience in the relevant science and technology fields, business, societal issues

and policy-makers from Bulgaria, Croatia, the Czech Republic, Hungary, Romania and Slovakia to share their assessment and expectations of the future of the total food chain in these countries.

2. A **socio-economic scenario building exercise** to collect the views of consumers and other societal groups concerned with the food industry and the impact of different technologies. This exercise also identified the major drivers for the food chain.
3. **Interviews** with specialists from different disciplines and affiliation (industry, academic institutions, public authorities, etc.). The goal of these interviews was to gather information about the current situation of the sector, the industry needs, problems and future prospects.
4. A **survey on key technologies** to address challenges associated with the future of the industry. Special attention was devoted to identify and analyse all aspects relevant to food quality and safety. Traceability and sustainability issues were of specific concern throughout the project.
5. **Vision building exercise** to depict multiple possible future states, based on the views, experience and aspirations of stakeholders, consumers and other societal groups, business people, researchers and policy-makers.
6. **Technology road mapping** to consider in detail S&T implications of possible future states and identify appropriate actions to exploit opportunities and alleviate threats.

Points 2-6 above constitute the core project strategy of the FutureFood6 project. Results obtained from these foresight activities are described in Part 3 of this report. Part 4 then deals with policy recommendations for the food industry.

In addition, **dissemination activities** were considered of special significance during the whole project in order to facilitate awareness building on the future perspective of the food industry and the impact of its products on human health and safety. The main achievement was the creation of the project website www.futurefood6.com: The website supported the establishment of a knowledge community by providing means of effective public communications. It served as a forum for an exchange of opinions between project participants and the public as well as between members of the new knowledge community. The website offers the results from the project (scenario report, vision report, results from key technologies survey, etc), documents the workflow (workshop documentation) and gives also related information (e.g. events in the food sector). Besides the webpage, more conventional approaches for dissemination were used as well, including press releases and press conferences, newsletters, publishing the project on partners' websites, etc. At the final stage of the project, dissemination activities include this Final Report, a short manual for SMEs and a Final Conference. The short manual should assist companies, especially SMEs, using the project results for long-term strategic development. The Final

Conference is held in order to present and discuss the key findings and policy recommendations of the project and was held in January 2009 in Vienna.

1.4 Project consortium

FutureFood6 was implemented through ten work packages (WP), each of them under the responsibly of one partner of the project consortium. The consortium consisted of the following partners and functions: The United Nations Industrial Development Organization (UNIDO) acted as the coordinating partner to the project; two institutions operated as main advisers: OPTI working as a methodology adviser and WIIW as a socio-economic adviser. Six foresight and innovation expert institutions covered the target countries. Table 1 shows the composition of the consortium (see Annex A.2 for a short description of the individual project partners).

Table 1: Consortium

Short name	Full name	Country
UNIDO	United Nations Industrial Development Organization	International Organization
OPTI	Fundación Observatorio de Prospectiva Tecnológica Industrial	Spain
WIIW	The Vienna Institute for International Economic Studies	Austria
IEHAS	Institute of Economics, Hungarian Academy of Sciences	Hungary
TC AS CR	Technology Centre of the Academy of Sciences CR	Czech Republic
BIC Group	BIC Group, s.r.o.	Slovakia
NWMC	National Wholesale Market Company Inc.	Croatia
UEFISCSU	Executive Agency for Higher Education and Research Funding	Romania
ARC Fund	Applied Research and Communications Fund	Bulgaria

2 Current state of the agro-food sector in the target countries

Food industry

Generally, the food industry[1] plays a significant role in the economies of the CEE countries (see Table 2): in the year 2007, it featured a total production volume of 37.9 billion euros, calculated at exchange rates, and a workforce of nearly 600,000 persons in the CEE-6. Compared to the EU-27[2] however, the size of the CEE countries' food industry is relatively small: it accounted for 4.5% of EU-27 production only but for 13.2% of total EU-employment. Labour productivity in the food industry (converted at current exchange rates) is about 34% of the EU-27 level (28% of the EU-15 level)[3], whereby differences between individual countries are substantial. As average wages are much below one third of the EU level in most of the CEE countries, labour costs can hardly be qualified as hindering CEE food producers in their international competitiveness. Gross monthly wages are highest in Croatia (EUR 961 in 2007), but lowest in Bulgaria (EUR 220).

Compared to total manufacturing in the individual countries, the food industry is a key sector in Central and Eastern Europe in terms of production. It has a particular important role in Croatia, Bulgaria and Romania, where the food industry accounts for 23%, 19% and 18% of manufacturing production (at current prices, 2007) and hence is the largest sector in the manufacturing industry (second in Bulgaria behind the metals sector), even larger than in the EU on average with 14%. In Bulgaria and Romania this is due to other 'high tech' industries being underdeveloped. In Hungary and particularly the Czech Republic and Slovakia the position of the food industry is less prominent; its share in total manufacturing is smaller - 11%, 9% and 7% respectively. While in the Czech Republic and Slovakia this has a long tradition, in Hungary the food industry lost its traditionally superior position when 'high-tech' industries such as electrical & optical equipment and the transport equipment industry expanded rapidly during the last decade. Internal problems of the Hungarian food industry played a role as well: such as a declining domestic market share due to increasing imports and decreasing export competitiveness, so that the trade balance of processed

[1] Food industry here denotes 'Food products, beverages and tobacco' according to the NACE rev.1 classification system (Statistical classification of economic activities in the European Community) subsection DA (including division 15 and 16). The subsequent quantitative analysis is based on the wiiw Industrial Database-Central and Eastern Europe (IDB-CEE) and the wiiw Database on Foreign Direct Investment.

[2] EU-27: Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Italy, Ireland, Latvia, Lithuania, Luxembourg, Germany, Greece, Hungary, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

EU-15: Austria, Belgium, Denmark, Finland, France, Italy, Ireland, Luxembourg, Germany, Greece, the Netherlands, Portugal, Spain, Sweden, United Kingdom.

[3] Throughout the region, food labour productivity is above the average of the entire manufacturing sector, except in the Czech Republic and especially Hungary (here it reaches only 65% of manufacturing average).

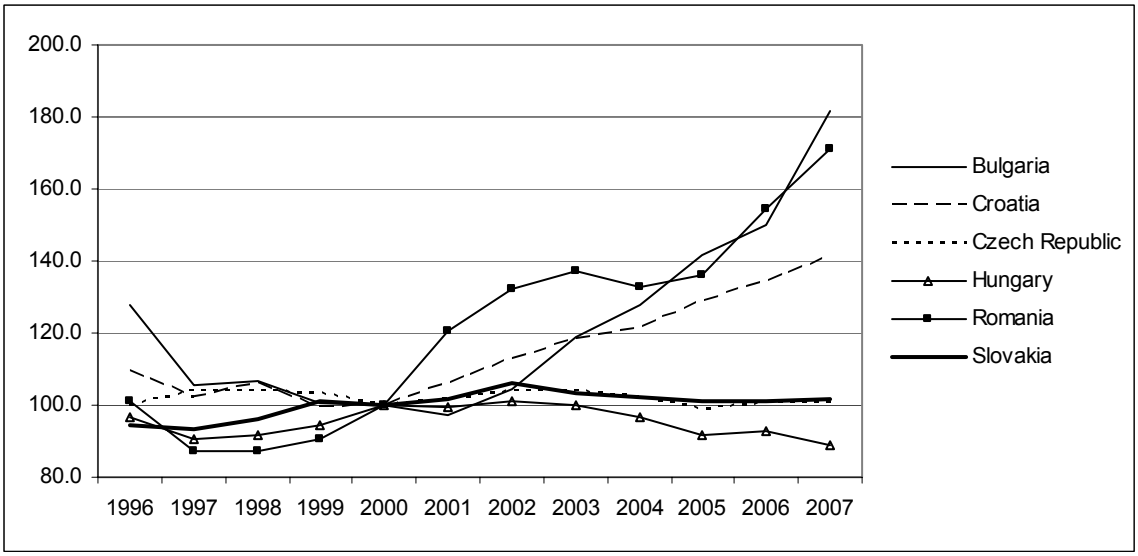
food turned negative since 2005. In the course of this development, a number of trans-national food producers left Hungary or shifted part of their activity to other countries[4].

As is the case in the West too, the food industry is a major employer in the CEE region, accounting for manufacturing shares between 8% in Slovakia and 18% in Bulgaria and Croatia.

In the period 2000-2007, the food industry expanded dynamically in Romania, Bulgaria and Croatia with average output growth rates of 8.3%, 7.6% and 4.5% per year. In Romania, production soared until 2003, stagnated in the next two years, but turned upward significantly again in 2006 and 2007. The Croatian food performance was backed by the state supporting and protecting the domestic agro-food sector. In the Czech Republic and Slovakia output of the food industry stagnated and in Hungary it even declined over that period (see Figure 1).

Development trends in employment largely resembled those in production: While in the food industry of Bulgaria, Romania and Croatia employment has been growing since 2004, employment is constantly declining in Slovakia, the Czech Republic and Hungary. However, there were more ups and downs in employment trends than in production patterns.

Figure 1: Development of food, beverages & tobacco industrial production, 1996-2007, 2000=100



Source: wiiw Industrial Database.

[4] Szabó (2008) states that the Hungarian milling, sugar, confectionery and tobacco industries shrank to a fraction of their former sizes due to changing regional policies of multinational food firms, and as a consequence of the EU sugar reform. There are hard times also behind the meat, poultry and dairy industries – but even harder ones ahead of them.

Table 2: Main indicators food, beverages & tobacco, 2007

	Bulgaria	Croatia	Czech Republic	Hungary	Romania	Slovakia	EU-15	EU-27
Production (at current prices)								
in mn EUR at exchange rates	4051	3620 [1)]	8931 [2)]	7967 [3)]	9935 [1)]	3418	760673 [4)]	834948 [4)]
in mn EUR at PPS CAP[5)]	6940	5173 [1)]	11968 [2)]	10241 [3)]	15259 [1)]	4703	737930 [4)]	834948 [4)]
in % of manufacturing production	18.5	22.7 [1)]	8.7 [2)]	10.5 [3)]	17.6 [1)]	7.1	14.1 [4)]	14.3 [4)]
2000=100 (at constant prices 2002)	181.5	141.3	100.3 [2)]	88.8 [3)]	170.9	101.4	109.5 [6)]	111.5 [6)]
Value added								
in mn EUR at exchange rates	604 [1)]	1072 [7)]	3083	2008	5649 [1)]	760 [1)]	198335	223553
in % of GDP	2.4 [1)]	3.7 [7)]	2.4	2.0	5.8 [1)]	1.7 [1)]	1.7	1.8
Employees								
persons	111837	45753	102000 [2)]	101056 [3)]	184000	42215	3289413 [4)]	4448442 [4)]
in % of manufacturing employment	17.8	17.8	9.5 [2)]	14.9 [3)]	13.4	7.8	13.2 [4)]	13.7 [4)]
in % of total employees	4.8	3.8	3.1 [2)]	3.7 [3)]	3.8	1.9	.	.
2000=100	117.6	101.7	85.0 [2)]	82.3 [3)]	106.4	75.7	.	.
Productivity								
in thous EUR at exchange rates	36.2	79.1 [1)]	87.6 [2)]	78.8 [3)]	54.0 [1)]	81.0	231.2 [4)]	187.7 [4)]
Number of enterprises	5659 [4)]	577 [1)]	1028 [2)]	1938 [3)4)]	10588 [1)]	1297	257694 [4)]	310000 [4)]
Inward FDI stock								
in mn EUR	383 [4)]	1017	1927 [1)]	2009 [1)]	1908 [1)]	487 [4)]	.	.
in % of manufacturing FDI	12.6 [4)]	16.5	8.8 [1)]	10.3 [1)]	16.2 [1)]	5.1 [4)]	.	.

Notes: 1) 2006. - 2) Units with 20 and more employees. - 3) Enterprises with 5 and more persons employed. 4) 2005. - 5) PPS CAP = Purchasing power standards for fixed capital formation at constant prices 2006. - 6) Data adjusted by working days. - 7) 2004.

Source: wiiw Industrial Database, wiiw Database on Foreign Direct Investment, Eurostat, SBS.

The food industry has been a prominent target for foreign direct investment in the CEE region, especially in the early years of transition. Still today, the food industry accounts for between 5% to 16.5% of the FDI stock of total manufacturing in 2006/2007. This share is highest for Croatia and Romania, somewhat smaller but still above 10% in Bulgaria and Hungary, and falls below 10% in the Czech Republic and especially Slovakia (see Table 2). FDI was mostly recorded in the segments of tobacco, beverages, distilling, beer, vegetable-oil, sugar, and confectionery (see Hanzl (2000)). Besides entering into food processing, foreign investors directed their activities towards the downstream end of the food chain, i.e. the retailing sector. Large retail chains from the West, such as Tesco, Metro, Kaufland, and Carrefour are now present in the CEE-6 countries, domestic supermarket chains being rather rare among the top-4 retailers (except Croatian Konzum and Hungarian CBA).

Grocery trade is becoming increasingly concentrated in the CEE-6 countries influencing private lives in different ways (e.g. changing consumption and shopping patterns, the convenience of shopping worsens for elderly people). First of all, the share of hypermarkets plus supermarkets in total grocery retail trade corresponds mostly with the income level in these countries: It is very high in the Czech Republic, Croatia and Slovakia (about 49%), somewhere in the middle in Hungary (40%) and smaller for Romania and Bulgaria (31% and 20%) (all shares for the first half year 2008; GfK (September 2008)). Hypermarkets have taken the lead in the Czech Republic with a 34% share. In Romania and Bulgaria, retail trade is still more fragmented and small grocery shops prevail (42% and 60% respectively). However, there is fast concentration process going on in Romania: the share of hyper & supermarkets climbed from 19% to 31% between 2005 and 2008, while that of small grocery shops fell from 56% to 42% during this time period. Second of all, ongoing concentration is also mirrored by growing shares of the top-10 retailers: While the top-10 retailers accounted for 40-45% of overall sales in 2001 in Hungary, the Czech Republic and Slovakia, this share climbed to 60% in 2004 and to 70% in the Czech Republic in 2008 and even almost 80% in Slovakia (see Table 3). In Hungary it remained about 60%. Concentration is smaller again in Bulgaria and Romania, where the top-10 retailers account for 22% and 25% of total sales.

Table 3: Shares of Top-4 and Top-10 retailers 2008, in % of total sales

	Bulgaria	Croatia	Czech Rep.	Hungary	Romania	Slovakia
Top-4	16.9	42.8	38.5	39.1	14.2.	58.0
Top-10	21.8	63.6	67.9	63.1	25.4	79.0

Source: GfK Consumer Scan / Household Panel (22 September 2008)

In the food chain, it seems that retailers are taking over the role of key players (see Table 4): In the list of TOP-500 companies in Central & Eastern Europe[5], retailers are dominating the picture while food companies (either domestically or foreign owned) are practically missing, except in Croatia and to some extent in the Czech Republic. In Croatia, the food industry currently appears to be dominated by two major Croatian players: Agrokor and Podravka. Both companies together account for about 78% of total food employees. The larger of these entities is Agrokor, which holds a significant portion of the industry at the raw material, processing, and retail stage of the value chain. It owns orchards and citrus fruit production facilities, branded processing companies producing ice creams and frozen foods as well as several food distribution chains (including Konzum)[6]. Among the few food companies on the list, only tobacco firms were large enough to be included.

[5] See Financial Times (Sept 11, 2008).

[6] See World Bank Group (2006).

Table 4: Major food and retail companies in Central and Eastern Europe, 2007

Rank	Name	Sector	Sales revenues EUR m	Revenue change	Employees	Ownership
Bulgaria						
499	Metro Cash & Carry Bulgaria	Retail	444.88**	.	.	Switzerland
Croatia						
32	Agrokor	Food conglomerate	2,821.51	37.1	28,930	Croatia
103	Konzum	Retail	1,354.58	10.2	11,138	Croatia
422	Podravka Group	Food company	467.80	-1.2	6,754	Croatia
Czech Republic						
27	Agrofert Holding	Chemicals, agriculture and food processing group	3,004.49	19.3	172	Czech Republic
94	Makro Cash & Carry	Wholesale and Distribution	1,416.04	13.6	3,297	Switzerland
95	Ahold Czech Republic	Retail	1,415.78	11.4	13,500	Netherlands
109	Kaufland	Retail	1,308.98	42.8	6,390	Germany
120	Tesco Stores	Retail	1,251.23	39.8	12,000	Great Britain
254	Globus	Retail	713.91	16.9	5,600	Germany
329	Penny Market	Retail	571.62**	.	2,170	Germany
367	Plzeňský Prazdroj	Brewery	519.53	8.7	2,450	South Africa
378	Agropol Group	Agriculture and food processing group	507.87	14.9	3,017	Czech Republic
379	Lidl Ceská republika	Retail	506.98	12.9	2,754	Germany
405	Geco Tabak	Tobacco	483.87	24.2	1,204	n.a.
483	Plus - Discount	Retail	413.68	1.4	1,768	Germany
Hungary						
56	Tesco-Global	Retail	2,116.21	16.2	20,266	Great Britain
143	Spar	Retail	1,131.94*	32.0	10,610	Austria
201	Metro	Retail	852.67	5.6	3,010	Switzerland
207	Auchan Magyarország	Retail	830.77**	5.1	.	France
332	British American Tobacco	Tobacco	568.25	17.9	896	International
361	Kite	Agriculture services; wholesaler for agri. & general machinery and equipment	522.57	43.3	667	n.a.
364	Penny – Market Kereskedelmi	Retail	520.63	12.4	.	Germany
Romania						
91	Metro	Wholesale and Distribution	1,503.67*	-5.0	10,987*	Switzerland
161	Interbrands Marketing & Distribution SA	Distribution	1,013.53	28.0	2,336	n.a.
217	British American Tobacco	Tobacco	778.58	34.5	275	International
219	Selgros	Retail	776.84	23.0	5,001	Germany
233	Carrefour	Retail	748.37	29.2	5,006	France
306	Kaufland Romania	Retail	606.79	153.3	5,896	Germany
380	Philip Morris	Tobacco	506.71	0.2	315	USA
398	Coca-Cola	Beverages	487.79	29.0	2,859	Great Britain
Slovakia						
240	Tesco Stores	Retail	739.17	21.2	8,300*	Great Britain
393	Metro Cash & Carry Slovakia	Wholesale and Distribution	492.17*	21.3	1,218	Switzerland

Notes: *Estimate; **2006 data.

Source: Financial Times (Sept 11, 2008), TOP 500 Companies Central & Eastern Europe.

Agriculture

A development gap between the six Central-East European Countries under consideration (CEE-6: Bulgaria, Croatia, Czech Republic, Hungary, Romania and Slovakia) and leading EU countries is visible from a number of indicators such as the very different level of GDP per capita and share of agriculture in both total employment and GDP. The CEE-6' population amounts to 59 million (or 12% of the EU-27), of which above one third live in rural areas. In the CEE-6, agriculture employs 3.7 million persons compared to 12.2 million in the entire EU-27. While agriculture in the EU-27 accounts for less than 6% of total employment, the share in the CEE-6 is four times higher. However, there are significant differences among individual countries: the largest country Romania reports the highest share of agriculture in total employment (29.5%) and the Czech Republic the lowest (3.6%).

Agriculture in the CEE-6 countries went through a substantial transformation process, and the same is true for the sectors upstream and downstream. Due to different initial conditions and reform strategies, the CEE-6 now displays strong differences in farm structures, as for example with regard to farm size and operational schemes. Small-scale family-owned farms dominate first of all in coastal parts of Croatia, whereas in the Czech Republic and Slovakia we can observe a predominance of large farms – joint stock companies and new-type cooperatives, which have evolved from former state-owned agro-enterprises or cooperatives. The agriculture of Bulgaria, Hungary and Romania is characterized by a dual-farm structure: Very large corporate farms with an average size of several hundreds hectares coexist with small private family farms. Whereas some of the latter are market-oriented, others operate on a subsistence or semi-subsistence level.

A major part of the large market-oriented corporate farms cultivate land, which is owned by a large number of small land owners living in urban centres. They have to pay a rent, which is on the rise since five of the countries[7] – all except for Croatia - have become EU members (EU-5). Prices of agricultural land are increasing, a fact that is stimulated by area-based EU support in the context of the European Union's Common Agricultural Policy (CAP). Land holders want to share the CAP financial cake with the farmers.

When they became EU members, the EU-5 had to adopt the Common Agricultural Policy (CAP) with key instruments such as:

a) control over domestic markets for agricultural products through intervention prices and purchases, production quota, protection against imports and subsidisation of exports – these instruments still play a major role, but are supposed to expire in the not too remote future;

[7] The Czech Republic, Hungary and Slovakia joined the EU in 2004; Bulgaria and Romania became members in 2007. Croatia has candidate status and is negotiating conditions for membership.

b) direct payments to farmers, whereby a phasing-in period of a ten-year transition period was agreed – not all of them are 'decoupled' yet, a fact that causes market distortions;
c) promotion of rural development (the so-called second pillar of CAP), whereby farmers are not supposed to be the only beneficiaries.

Starting from the first day, the new members had unrestricted access to the single EU market as far as farmers and food processors were capable to fully comply with all EU standards. Initially, part of the EU-5 farms and especially food processing enterprises had trouble to fully cope with the EU sanitary and phytosanitary standards and their products were excluded from export. After accession, agro-food good trade started booming both between the EU-15 and the EU-5 and among EU-5 countries. Vis-à-vis the EU-15, the EU-5 balance of agro-food trade has deteriorated after EU accession. The main reason for this was an exceptionally strong expansion of imports: Domestic producers and distributors especially of processed food were weak in competing with their counterparts in the EU-15.

Currently, the CEE-6 region as a whole is a net importer of agro-food products. In Romania, the largest country of the region, the share of agriculture both in total employment and in GDP is higher than in all other countries. At the same time, Romania is the country with the highest deficit in foreign trade with unprocessed and processed agricultural products. Two of the countries are net exporters: Hungary to a larger degree and Bulgaria at least to some degree. Vis-à-vis EU countries, only Hungary's exports exceed imports, but here too, the balance has deteriorated in recent years.

In the EU-5, agriculture has experienced an economic upswing after accession to the EU. According to the Eurostat estimate, real agricultural income per person employed has strongly increased, whereas in the EU-15 it stagnated or rose only marginally. Higher income offers opportunity to invest more into farming technology and in this way to fight technological backwardness. In this respect, within the EU-5 a strong north-south contrast is prevailing. Compared to Bulgaria and Romania, land and animal productivity is much higher in the Czech Republic, Hungary and Slovakia.

From a long-term global perspective it seems likely that the era of cheap food is over, notwithstanding major temporary ups and downs. Within the farming sector, grain producers are likely to be the main beneficiaries of such development, as overall grain demand will expand strongly, whereas supply expansion will face negative economies of scale. Producers of fruit and vegetables are likely to benefit less, and most insecure are benefits the sphere of animal production receives, as it uses grain as input.

Table 5: Main indicators agriculture, 2007

	Bulgaria	Croatia	Czech Republic	Hungary	Romania	Slovakia	EU-15	EU-27
Total territory, mn hectare	11.1	8.8	7.9	9.3	23.8	4.9	323.7	432.5
Utilized agricultural area (UAA)								
mn hectare	5.1	1.2	4.3	5.8	13.8	1.9	128.1	181.2
in % of total	46.1	13.7	53.9	62.4	58.0	39.4	39.6	41.9
Hectare per person employed in agriculture (LFS data)	21	6	24	32	5	19	21	15
Arable land total, mn ha	3.1	0.8	2.6	4.5	8.8	1.3	70.4	106.4
in % of UAA	59.8	70.5	61.7	77.4	63.7	69.6	54.9	58.7
Value added in agriculture								
in mn EUR at exchange rates	1739 [1)]	2246	2729	3481	7614 [1)]	1748	160520	192444
in % of GDP	6.9 [1)]	6.0	2.1	3.4	7.8 [1)]	3.2	1.4	1.6
Employment in agriculture (LFS data)								
mn persons	0.2	0.2	0.2	0.2	2.8	0.1	6.1	12.2
in % of total employment	7.5 [4)]	13.0	3.6	4.6	29.5	4.2	3.5	5.6
Agri-food trade [2)]								
exports to the EU(27), 000 EUR	713	386 [3)]	3196	4027	784	1578	215468	236565
in % of total exports to the EU(27)	8.7	8.0 [3)]	4.2	7.3	3.7	4.3	9.2	8.9
imports from the EU(27), 000 EUR	981	1043 [3)]	4249	2899	2378	2299	207851	232070
in % of total imports from the EU(27)	7.7	7.9 [3)]	6.2	6.0	6.6	7.1	9.3	9.0
trade balance, 000 EUR	-267	-657 [3)]	-1053	1128	-1594	-721	7617	4495

Notes: 1) 2006. - 2) EU 27 intra trade according to Harmonized system groups 01-24 (2 digit codes) except 03 (fish and crustaceans). - 3) Mirror statistics. 4) This figure seems to be not representative. Wiiw estimate 20%.

Source: wiiw Database incorporating national statistics; Eurostat.

Rural areas may or may not gain from farm incomes catching up with other industries' averages, especially where farmers are merely a small fraction of the total rural population. More likely, rural development will remain mainly dependent on the degree of investment into rural infrastructure and the extent and efficiency of rural development policies.

Macroeconomic context and prospects of long-term food demand

Looking at the GDP per capita in PPPs (Purchasing Power Parities) as an indicator for the relative development level of countries, one can find that the CEE-6 are less well off than the EU-27. Within the EU, Bulgaria has indeed the lowest GDP per capita with 38% of the EU-27 average in the year 2007.[8] The other countries range from 40% in Romania, to 53% in Croatia, 64% in Hungary, 68% in Slovakia and 81% in the Czech Republic (see Table 6). GDP growth is faster in these countries, indicating that they are catching-up with the rest of Europe.

Price levels (measured as ratios of PPPs to exchange rates) are significantly lower in the CEE-6 than on the EU-27 average. The price level is lowest in Bulgaria (40%) and Romania (56%) and lies slightly above 60% of the EU-27 average in the other four countries investigated. The difference in prices is mainly attributable to low prices of non-tradable goods and services. In the case of internationally traded food, the gap is much narrower.

Agriculture and food industries together form a very important part of the CEE-6-economies. Their share in GDP is much higher in these countries than in the EU-27 on average. While in the EU-27 only 3.5% of total value added were accounted for by agriculture and food industries in the year 2007, in the CEE-6 shares range from 5% in the Czech Republic, Slovakia and Hungary, to almost 10% in Bulgaria and Croatia and even 13.6% in Romania. In all countries, except the Czech Republic, agriculture has a higher contribution to GDP than the food industry which is again not in line with the overall EU-27 picture, where the share of agriculture and food industries are of similar size.

The share of food and beverages in household consumption varies across the CEE-6 but is still significantly above the West European level in all countries. While the EU-27 average lies at 12.7% of household consumption being spent on food and beverages in 2007, shares range between 15% in the Czech Republic, about 18% in Hungary and Slovakia, 20% in Bulgaria and 30% in Romania and Croatia. In the latter case, the share is definitely bloated by food purchases of tourists.

[8] See also Eurostat (2008) for a comparison of all 27 EU countries.

Table 6: Main indicators policy context, 2007

	Bulgaria	Croatia	Czech Republic	Hungary	Romania	Slovakia	EU-15	EU-27
Population								
Total, mn persons	7660	4436	10323	10056	21538	5398	392624	496286
Employed persons - LFS, thousands, average	3253	1614	4922	3926	9353	2358	175249	219129
Unemployment rate - LFS, in %	6.9	10.0	5.3	7.4	6.4	11.0	7.0	7.1
Gross domestic product (GDP)								
Euro billion at current exchange rates	28.9	140.6	1815.8	13.0	206.9	947.3	10902.8	12339.7
Per capita (euro at current exchange rates)	3773	8453	12388	10059	5631	10161	29200	24900
Per capita (euro at purchasing power parities)	9490	13200	20120	15990	10000	17020	27800	24900
Price level, EU-27=100 (PPP/exch.rate)	40	64	62	63	56	60	105	100
Average gross monthly wages, EUR at exch. rates	220	961	781	736	422	596	3304 3)	2821 3)
Foreign trade								
Exports of goods in % of GDP	46.6	24.5	69.7	67.9	24.2	76.7	29.5 4)	31.1 4)
Imports of goods in % of GDP	72.1	49.7	66.4	66.5	38.8	77.8	29.7 4)	31.7 4)
FDI stock per capita in EUR	3252	6841	6612	6606	1914	5900	.	.
Average share of food and non-alcoholic beverage purchases in total household income, in %	21.8 1)2)	31.6	15.4 1)	17.3 1)	29.1 1)2)	17.9 1)2)	12.1 1)2)	12.7 1)2)

Notes: 1) According to final consumption expenditure of households by consumption purpose – COICOP 2 digit. - 2) 2006. - 3) Gross wages plus indirect labour costs, whole economy, national account concept.- 4) Data for EU-15 and EU-27 include flows within the region.

Source: wiiw Database incorporating national statistics; Eurostat.

In the EU-25 (European Union in the base year 2005, i.e. not including Bulgaria and Romania) as a whole, long-term growth of total demand for food will be only marginal, in spite of fast growth in the eight central European countries that became members in 2004 (EU-8[9]). Still faster will be the growth of food demand in South-Eastern Europe (SEE including the following nine countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, Montenegro, Romania, Serbia and Turkey) thanks to their low GDP per capita initially (2005), assumed high GDP growth in subsequent years and high population growth in Turkey.

Table 7: Forecast of Food Consumption in the EU, in New Member States and in the South-eastern Countries Bulgaria, Croatia and Romania in 2015 and 2020 (3 Scenarios – Low, Medium and High Growth)

Year	2005		2015			2020	
Scenario		LOW	BASE	HIGH	LOW	BASE	HIGH
Food Consumption in 2015 and 2020; 2005 = 100							
EU-8	100	112	115	116	116	119	120
EU-25	100	103	103	103	102	102	101
Bulgaria	100	117	130	135	126	142	148
Croatia	100	120	131	137	129	145	153
Romania	100	120	136	144	133	155	166
Food Consumption in 2015 and 2020; Food Consumption in EU-25 = 100							
EU-8	11.8	12.8	13.1	13.3	13.3	13.7	13.9
EU-25	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SEE-9	15.3	17.6	19.8	20.8	19.2	22.3	23.8
Bulgaria	0.8	0.9	1.0	1.1	1.0	1.1	1.2
Croatia	0.8	0.9	1.0	1.1	1.0	1.1	1.2
Romania	3.6	4.2	4.8	5.0	4.7	5.5	5.9

Source: wiiw estimates based on national statistics.

The number of citizens is likely to decline both in the EU-8 and in the three countries Bulgaria, Croatia and Romania – but not also in the EU-25.[10] Real growth of GDP per capita is the engine of growth of food demand, and estimates of long-term real GDP per capita growth stem from a comprehensive study prepared for the United Nations (UN) and EU Commission by the Independent Center for Economic Studies NOBE (2004).[11] The NOBE study has modelled growth along the lines of the so-called new (endogenous) growth theory. It considers three scenarios called base, low-growth, and high-growth.

[9] The Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Slovakia and Slovenia.

[10] Estimates of population growth stem from the 2006 Revision of the UN World Population Prospects. See UN (2007).

[11] See NOBE (2004).

The European Comparison Project (ECP), which is run by Eurostat in cooperation with the Organisation for Economic Co-operation and Development (OECD), provides consumption-related data for a large number of countries in the year 1996. Data analysis leads to the following conclusions: (1) The share of food expenditures is – in line with the classic Engel Law - negatively correlated with the real income level. (2) At the same time, the relative price of food is also negatively correlated with the real income level; in other words, food is relatively more expensive in poor countries; (3) The demand for (and consumption of) food is high (relative to the demand for non-food) in low-income countries; whereas in EU high-income countries the share of food in total consumption was around 10% in 1996, this share was around 20% in the two more developed transition countries the Czech Republic and Hungary, but between 25 and 30% in Bulgaria, Croatia and Slovakia and as high as 40% in Romania. As the three mentioned relations can be assumed to be of a long-term nature, they are the basis of the consumer-demand forecast for 2015 and 2020.

To food processors the CEE-6 region may give a mixed impression: The markets are small, and heterogeneous, as consumer preferences differ from country to country. On the other side, these are markets, where demand will grow over time, so that a company has the chance to expand sales even without engaging in cut-throat competition.

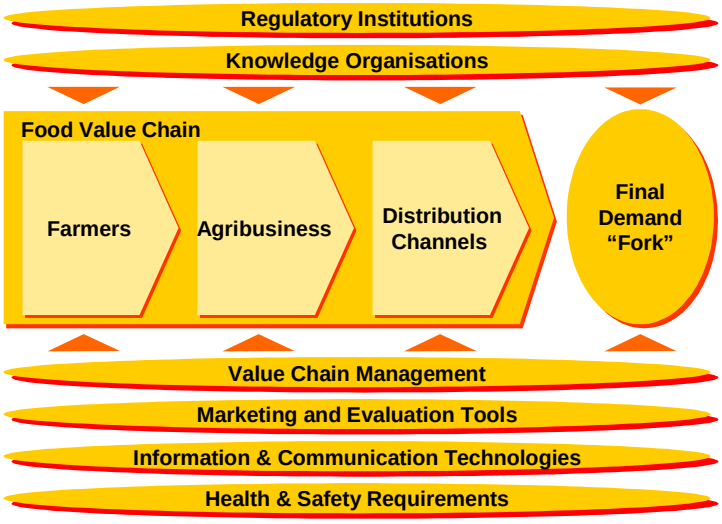
3 Technology Foresight results

This part summarizes the major results of the foresight activities: First, the extended value chain of the food sector will be described, setting the framework for the project in general and the following socio-economic scenarios building in particular. Second, four different socio-economic scenarios are described as well as implications for the value chain depicted. Then the state-of-the-art of certain food quality and safety issues is outlined including the results of the key technologies survey. Finally, future visions and the road mapping results are illustrated.

3.1 Scope

FutureFood6 covers the **total food chain**, following the "farm-to-fork" concept of the EU. According to this concept, two value chains were developed in the project: a basic food value chain and an extended one. The basic food value chain includes all participants involved in food production from primary production (farmers), processors, and retailers to final consumers. The extended value chain encompasses the basic food sector's value chain plus a number of horizontal issues which affect all the chain's links. On the one hand, there are regulatory institutions (policy makers and consumer associations) and knowledge organisations (universities, R&D centres etc.), which influence or give support to the operational process of the food value chain ("public agents"). On the other hand, there are several management, marketing, technology and quality requirements which obliviously determine strategies and operations of any food company ("private agents" or related industries and services).

Figure 2: Extended value chain of the food sector



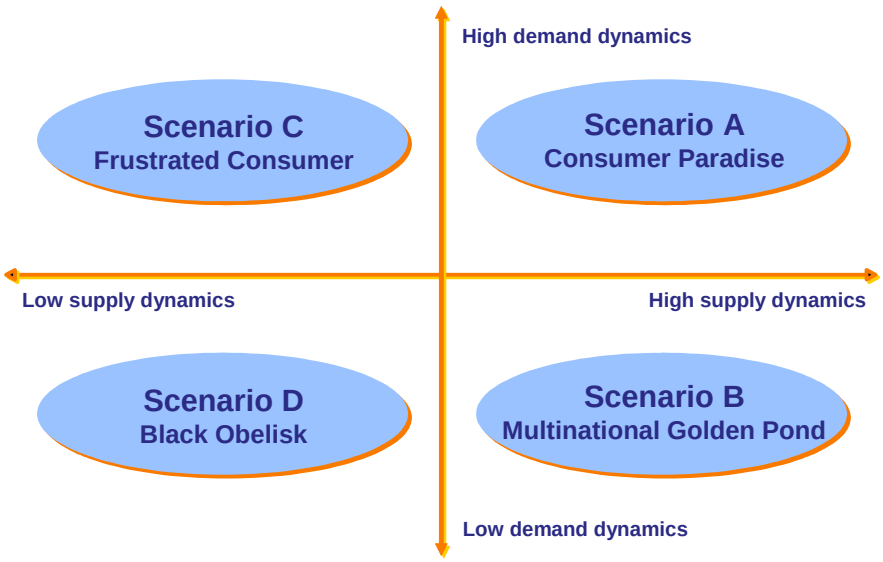
3.2 Socio-economic Future scenarios[12]

This exercise was devoted to the identification of the major social, economic, technological, environmental and political drivers in order to map the **broad context of the food industry** in the year 2020.

In the first step, future trends which may affect the food industry were identified and evaluated according to their importance and uncertainty level. Those trends, which were highly important and uncertain, nurtured alternative scenarios thereafter. In this second step, variables for the two axes were selected: the behaviour of local demand for the vertical axis, supply conditions for the horizontal axis. This scheme formed the base for building the four scenarios in which the food industry could hypothetically operate in the year 2020 horizon. Main scenarios found were (see Figure 3): Consumer Paradise (Scenario A), Multinational Golden Pond (Scenario B), Frustrated Consumer (Scenario C), and Black Obelisk (Scenario D). In the third step, implications of these four scenarios were explored for the food sector, including business, technology and consumers' implications. In addition, special attention was paid to the industry's value chain implications as well as to quality and safety implications.

In order to get a full picture on future trends in the food industry, two workshops were organized within this exercise in which representatives from consumer associations, industry, food technologists and policy-makers were thoroughly involved.

Figure 3: Food industry's scenarios

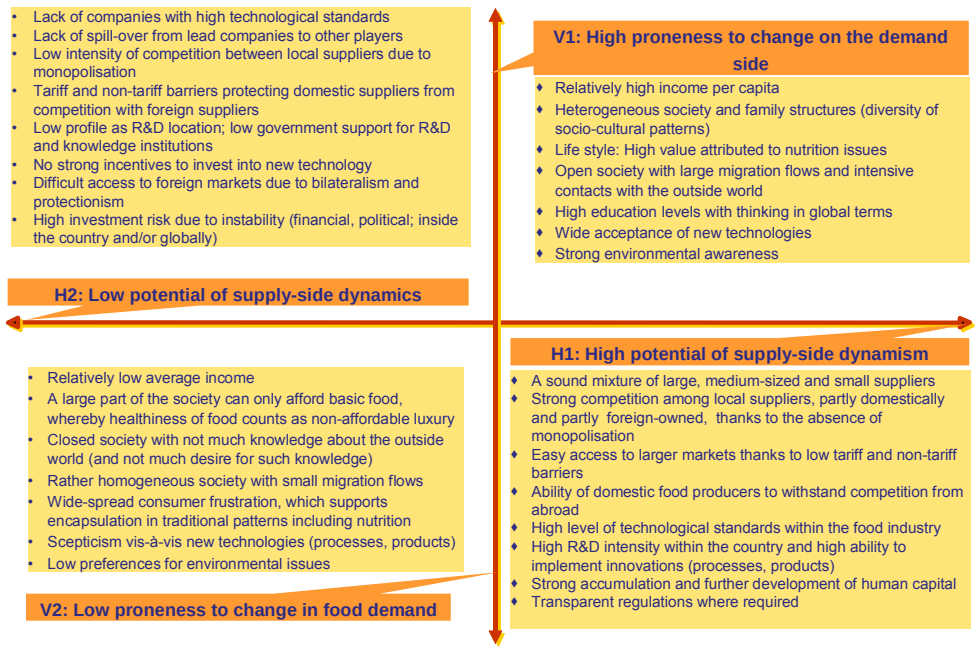


[12] Deliverable 4: Scenarios Report, OPTI Foundation, available on the Internet-Homepage www.futurefood6.com.

Looking at Figure 3, the **vertical axis** refers to the demand side's potential to be dynamic. Dynamics can either result from endogenous processes or represent response to parameter changes. A number of factors are decisive for the speed and intensity of change on how the demand side can develop: average real income, income distribution, family structures, degree of urbanisation, degree of mobility including migration flows, the degree of heterogeneity or homogeneity of the society, life style and buying preferences such as for example 'consumer chauvinism', weight attributed to nutrition within a society, other social-cultural patterns and values, environmental awareness, and acceptance of new technologies in food production. The **horizontal axis** refers to the supply side's dynamic potential, again either resulting from endogenous processes or changes in external parameters. The factors most decisive for the speed and intensity of change on the supply side are know-how accumulated within the sector, knowledge and technology transfer, R&D intensity, government support for R&D and knowledge institutions – as all these factors have an influence on the degree of technological development in the food sector and product and process innovation. Another key factor is industry structure in the sense of degree of competition between local suppliers, exposure to competition from abroad, market shares of the largest food producers or share of foreign capital. Additional factors to be mentioned are food quality and safety regulations and geopolitical constellations.

The explicative attributes of both axes reached different values in the extreme of each axis (see Figure 4):

Figure 4: Building Blocks for Scenarios



The main features and drivers for each scenario as well as implications for the value chain are described below.

Scenario A: Consumer Paradise - Thanks to positive economic development in recent years, a large number of consumers have an income that allows them to behave quality-oriented. In their majority, they have good information not only about quality criteria, but also about suppliers. They have preferences for suppliers who observe certain standards related not only to food healthiness, safety and taste, but also to environmental protection, labour relations and other aspects of political correctness. Preferences are characterized by diversity, which is in line with the coexistence of different lifestyles within the country. There is demand for food in the country's or region's tradition, or for new variations of traditional food. There is also strong demand for food in the tradition of other countries and regions of the world. Both organic food and vegetarian life-style play a significant role. A large proportion of customers like to experiment with new products or new variations of existing products.

The supply side is characterized by a large number of suppliers and a large variety of products. Products of companies operating on a worldwide scale are there, but also brands of local producers, whereby most of the latter are of small and medium size.

A situation like this is not merely prevailing in the capital cities, but countrywide. Rural areas, too, are quite well developed. The supply side is both eager and able to respond to the preferences of the demand side, so that the development of the food market can be understood as a process of a permanent interplay between the demand and supply side. Competition between producers of food and also between distributors is high. Of course, some of the players are quite strong, but did not reach a degree of strong monopolisation or oligopolisation, no matter that part of the country's food producers are affiliates of trans-national companies. Diversity on the demand side creates market niches, which are an ideal field for the operation of SMEs, as they can profit from their flexibility and creativity. Direct links between farmers and consumers enjoy institutional support as a way of stimulating competition and product diversity.

Food markets offer a large variety of products both from domestic and foreign sources. Domestic producers are able to withstand competition from abroad, and some of them are strong exporters. The whole food sector is eager to take over new technologies developed elsewhere, but research and development activities in the country are also strong. Thus, knowledge plays a key role both on the demand and supply side.

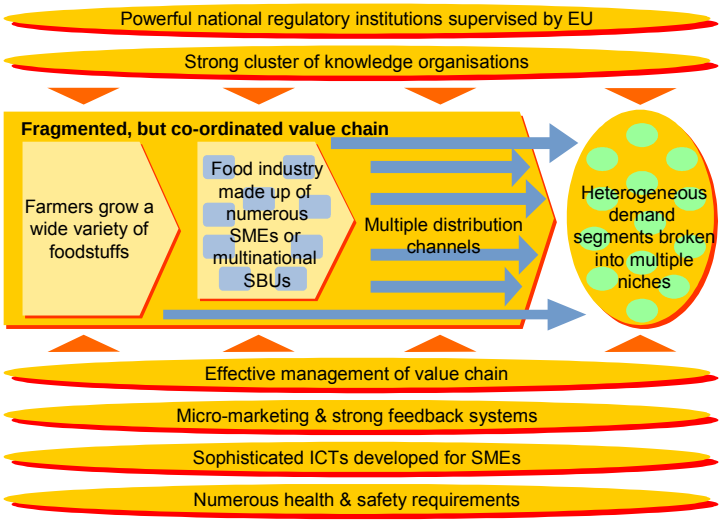
Access to information about food is easy. Product labels contain information about the content, aspects of processing and price in a form, which non-experts can understand, so that it is easy to compare supply from different sources. Confidence in the suppliers' is high.

A number of factors could make it more likely that the food market will develop in a way, which to a large degree could correspond to the consumer paradise scenario. The background to this food paradise scenario could be as follows: Governments' cooperation on the international stage is high and institutional development corresponds to this fact. Thanks to this positive geo-political climate, the development of global income is positive and free of major setbacks. Benefits from this positive development include also poorer countries. This leads to a declining number of persons who found living conditions in their home countries unbearable, and governments introduced more liberal migration rules. Free trade makes strong progress, and non-tariff barriers come closer to their unavoidable minimum. International agreement is achieved in important matters. This helps to establish energy policies supportive to investment into energy savings and long-term development of environmental-friendly technologies. As a result, long-term economic development is not threatened by a shortage of energy and unprocessed agricultural products. In negotiations about international trade with food, the European Union supports clear rules regarding product information and protection of brands with geographical connotation, and this turns out to be supportive of supply diversity. Rules guaranteeing easy access to information about food and food companies as well as consumer protection have raised food producers' quality awareness. They are eager to prevent, within their entire industry, activities that could damage the sector's reputation. All parties – supply side, consumers and governments - are supportive to fair and efficient control.

A high degree of trade liberalisation is only one influence in favour of competition within the food industry as well as in up- and downstream industries. The other major influence stems from an active competition policy both on the national and supranational level (e.g. EU, WTO), which includes support for SMEs as one of its most important pillars. This support consists mainly in focusing on rules, which create a positive business environment for SMEs. Competition policy also takes care of easy market access for new suppliers, e.g. by allowing for a larger variety of supply channels including open air markets and direct sales of farm products, taking account that this requires flexibility of control institutions.

The Consumer Paradise Scenario will be represented by a multilayered value chain with numerous agents in each link (see Figure 5). The food market will be demand driven – in other words the market is guided by a bottom-up approach – and food demand will originate from a constellation of niche markets. In this scenario, a great number of farmers will grow products for niche markets; the food industry will be broken into numerous specialities and niches, which are to a considerable degree supplied by SMEs and multinational Small Business Units (SBUs); and there will be multiple distribution channels shaped to satisfy different consumer needs.

Figure 5: Extended value chain in Scenario A

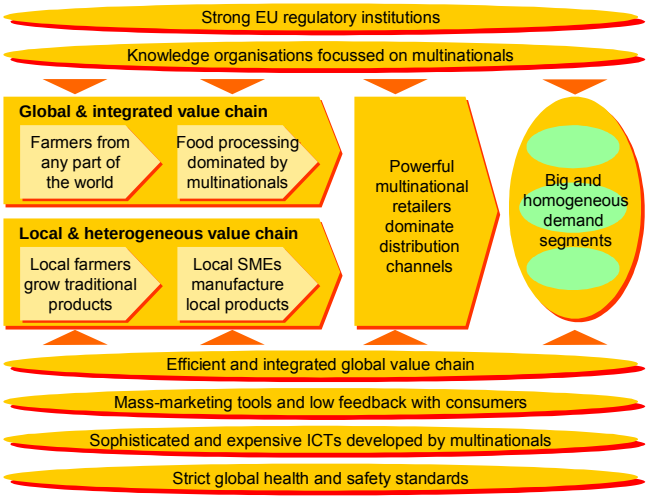


Scenario B: **Multinational Golden Pond** - Some time between 2020 and 2040, the CEE countries can look back to a positive economic development that has, however, been accompanied by a change in income distribution, with a small fraction of citizens earning a large proportion of total income, whereas the majority of the population remain close to the poverty line. Even more imbalanced is the distribution of wealth. The global situation is similar: The gap between poor and rich countries, as well as between poor and rich citizens has widened. Attempts to move from poorer to richer countries had become widespread, and rich countries have taken protective measures against the immigration of poor people from other countries or regions. The EU cohesion policy has lost momentum. In the CEE countries, affluent consumers behave quality oriented, whereby internationally known brands play a major role. The majority of other consumers have to economize, so their main focus is on price. For them, it is not that important what exactly a food product's ingredients are, and political correctness of suppliers is not much of an issue. The same is true for environmental issues. Food quality becomes a topic mainly in the context of occasional larger food scandals. The majority tends to abstain from more systematic collection of information, so that vague suspicion about supply side deficiencies is prevailing. Consumers of luxury food tend to have cosmopolitan food preferences, and the younger generation within the poorer population has the inclination towards international species of fast food. Older citizens prefer traditional food. Consequently, basic food in different variations plays an important role. Only more affluent consumers have interest in higher quality and new variations.

On the supply side, a small number of shops offer luxury food for affluent clients. A high share of the total is imported food. The core of shops, however, offers food for price-conscious customers. The market is dominated by several retail chains. They try to attract consumers through 'sales of the century' techniques, whereby the product range is relatively narrow. Products of companies operating on a worldwide scale coexist with local producers and retailers, whereby most of the latter are of small or of medium size. The overall situation is not much of a challenge for the large trans-national companies. Thanks to rather uniform consumption patterns, they can sell large quantities of a limited range of products. They can earn profits without much investment into new technologies and production sites. Where needed, they can implement new technologies that were developed elsewhere. On the other hand, the situation is rather difficult for small and medium-sized enterprises. Faced with supply of internationally traded standard products by trans-national companies, they need to service market niches, but these niches are rather small, and their number is low, as not too many consumers want to spend money on high-quality domestic products. SMEs try to be innovative under tough conditions. To gain significant shares in foreign countries, these SMEs would need more funds than they have at their disposal. All in all, the supply side has development potential, but conditions do not allow them to make full use of it. Food processors would be capable and eager to respond to demand side impulses, but these are rare. The markets for standard food are oligopolistic, whereas imperfect competition prevails in niche markets. There is a gap between a few urban areas where suppliers can make good money from selling high-priced food and a large variety of products, and the rest of the country, where the product range is limited to predominantly low-price products.

There are a number of factors, which are likely to push developments in such a direction. In the geopolitical sphere, the countries would not manage to achieve big progress in developing a system of multilateral agreements that would regulate important political and economic issues. Bilateralism fills the gap in an incomplete way, as this means a multitude of regulations packed in a large number of bilateral agreements. Lack of multilateral cooperation has had negative consequences in terms of energy saving and in keeping energy supply and demand balanced. This has had an impact on crops prices too, as the food and energy sector are competing for certain types of unprocessed agricultural products, and part of agricultural land has become dedicated to energy generation. As a result, prices of energy and cereals are high compared to other prices, and this is one of the reasons why the distribution of income and wealth has become very unbalanced. In a system of predominantly bilateral agreements, economically hardly justified non-trade barriers have survived, a fact that boosts costs for SMEs that want to go international.

Figure 6: Extended value chain in Scenario B



The Multinational Golden Pond Scenario will generate a food value chain driven by multinationals and public bodies, which will correspond to a top-down market approach (see Figure 6). In this scheme, two value chains will coexist: a multinational and a local one. The multinational value chain will be tightly integrated and will have a global scope; meanwhile the local one will be made up of multiple local agents, especially SMEs. Although food processing will be dominated by big multinational corporations, SMEs will survive in local markets manufacturing traditional products. Global and local distribution channels will be dominated by big multinational retailers. Final demand will be made up of large segments, which will have marked differences among them, but they will observe homogeneous patterns within the same segment.

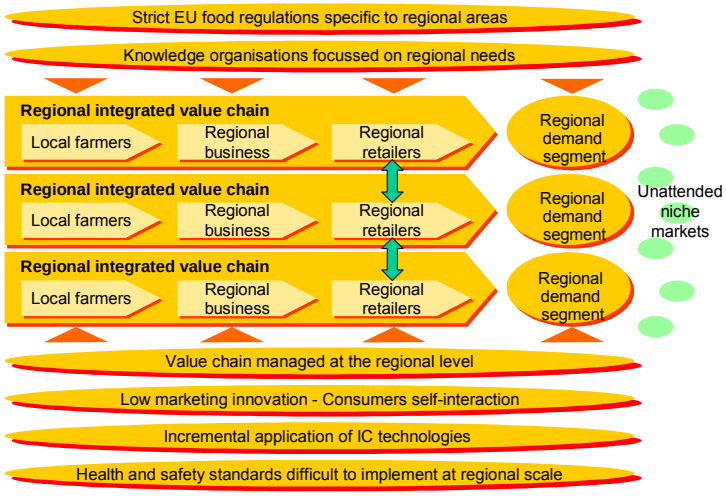
Scenario C: Frustrated Consumer - Thanks to positive economic development in recent years, a large number of consumers have an income that allows them to behave quality-oriented. In their majority, they have good information not only about food quality criteria, but also about suppliers. They have preferences for suppliers who observe certain standards related not only to food healthiness, safety and taste, but also to environmental protection, labour relations and other aspects of political correctness.

After the country's EU accession, citizens have intensified contacts with foreign countries, and both inward and outward migration has become more frequent. Different lifestyles have established. With regard to food too, consumers' preferences are characterized by diversity. There is demand for food in the country's or region's tradition and for new variations of traditional food. At the same time, there is also strong demand for food in the tradition of other countries and regions of the world. Organic food, functional food and vegetarian life-style play a significant role. A large proportion of consumers like to experiment with new products or new variations of existing products.

The consumers' confidence in local food producers and distributors is very limited – for good reasons. Compared to other parts of the economy, the country's food sector is in a bad shape. Reliable information about what is going on within the food industry is hardly available, apart from occasional leaks about something having gone wrong. The supply side is characterized by a dichotomy between a large number of poorly developed small companies and a small number of large companies that are lacking flexibility because of unsuccessful restructuring. Both types of enterprise are using old equipment and technology; they operate below the state of the art. Knowledge about up-to-date technology is incomplete, research and development is almost non-existent at least within the food industry. The enterprises are trapped by low profits, as only a series of high profits would enable them to finance comprehensive modernisation. Trans-national companies are active in only a few segments of food processing, such as beverages and tobacco. In the retail sector, a few companies, many of them foreign-owned, have a high market share. Direct marketing channels between farmers and consumers have developed, but have to operate under semi-legal conditions. A large proportion of food comes from abroad, no matter that consumers regard imported food as not sufficiently adapted to their preferences. There are assortments they would like to find, but cannot, or at least not in the quality they would expect.

A future reality resembling this scenario could have the following background: On the geopolitical floor, the countries were only partially capable to achieve multilateral agreements. Nevertheless, this was enough to stimulate energy-saving technologies and to secure a rather balanced development of demand and supply on markets for energy and unprocessed agricultural products. International cooperation was, however not sufficiently intensive to remove all unnecessary trade barriers in the agro-food sphere. In addition, economic policy has not succeeded in laying the foundation for successful enterprise restructuring, and has introduced regulations ignoring requirements of small and medium-sized enterprises. Incentives for food-related research and development are insufficient. Regulations dealing with reporting standards have not led to a culture of dialogue between management and stakeholders. Economic policy has not done enough to establish or maintain a competitive environment, which would be the best protection against supply side immobility.

Figure 7: Extended value chain in Scenario C



In the Frustrated Consumer Scenario, the value chain will be driven by regional private and public food agents (see Figure 7). In this context, food companies will have serious difficulties to access global markets due to high energy costs and non-tariff barriers; therefore, value chain margins will be very narrow. Nevertheless, this scenario will offer opportunities to local SMEs because food production will be regionalised and dominated by local farmers, and big food processors will focus on large market segments and will ignore niches. Distribution channels will be networked, but broken into regional branches to access more easily local markets. Final demand will be heterogeneous, but driven by common concerns, such as cost and quality. Consumers with specific needs will not always get the food they wish.

Scenario D: Black Obelisk - Consumers are split into a small minority of rich households and a large majority of low-income households. There is not much of a middle-class. Prices of energy and unprocessed agricultural products have increased in relation to many other goods and services. Affluent households spend a high share of their food budget for imported quality and luxury food, whereby their quality assessment is led by brand names. The majority of households see themselves forced to buy mainly basic food, whereby their decisions are guided by price comparisons. As they do not have much of a choice, they do not investigate the ingredients and production methodologies of food. The atmosphere is rather xenophobic, as many citizens fear that migrants could take their jobs or have a depressing impact on wage levels. In this way, lifestyle is rather uniform for the majority of the population, and xenophobia is mirrored in nutrition habits. The older generation sticks mainly to traditional food, whereas the younger has become used to cheap fast food.

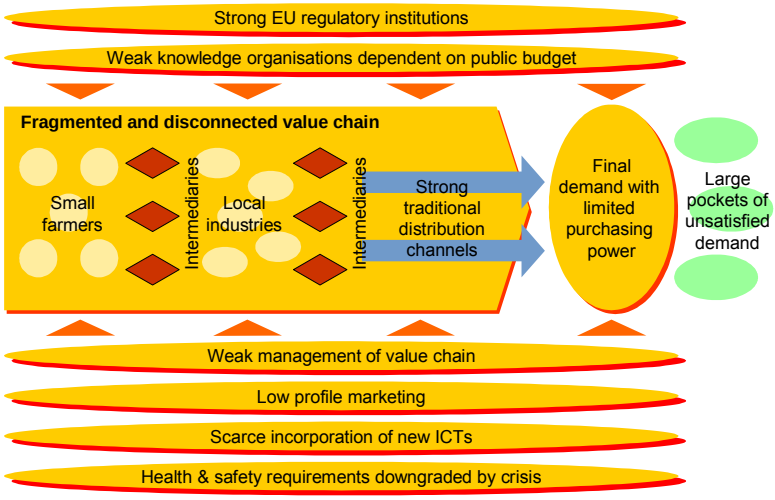
The supply side, both in the food processing and retailing sphere, is characterized by oligopolistic market structures. A few large companies dominate the scene, whereby most

of them are subsidiaries of trans-national companies. Domestic small and medium-sized companies have all together a low market share. Whereas the large companies do not see a need to implement newest technologies and to develop them further, the small enterprises are not able to do so. As the markets do not offer many niche opportunities, the room of manoeuvre of SMEs is limited. No matter that many consumers prefer domestic food; a high proportion of food is imported. This is especially true for luxury food. The food produced for the majority of consumers suffers from the use of low-quality ingredients. Only in larger cities, can the consumer choose between a larger number of shops or shopping centres, whereas in suburbs and rural areas they do not have much of a choice; provided they are not inclined to travel long distances.

In a CEE-6 country, in the longer run reality could come close to this scenario in the case of lack of geopolitical cooperation, a split of the world's economies into several blocks and political tension in international relations. The main body of agreements between countries would be of bilateral nature, so that exporters would have to observe regulations which vary from country to country of block to block. Even the situation within the EU might be characterized by low regulatory activity of the Union, so that many of the regulations would be designed at a national level, with the effect of *de facto* barriers within the common market. Minimalism in economic policy terms could make such a scenario more likely. It could be motivated by the belief that non-interference would be the best policy to let market forces fully develop. In this case, markets would lack rules, market imperfection would spread and the market leaders would gain the power to eliminate competitors – or put them under control. An inefficient educational system, too, could help to push an economy in such a direction.

The Black Obelisk Scenario will present a fragmented value chain with significant disconnection among its agents, which will be driven by public policies, following a centralised top-down approach (see Figure 8). Global markets will be disrupted by economic recession and high energy costs. Farmers will be focused in satisfying local-regional food needs and agri-industries will have to comply with production quotas for local markets. Although there will be strong traditional distribution channels at the local level, there will be a proliferation of intermediates at all levels of the food value chain. There will be large pockets of unsatisfied demand in very regulated markets, while niche food markets will disappear because lack of purchasing power.

Figure 8: Extended value chain in Scenario D



3.3 Interviews and survey[13]

This part of the project collected the opinion of experts from the six countries involved in the project through interviews and a key technologies survey regarding the future of food quality and safety. Approximately 30 experts were interviewed per country, 434 experts (technologists, food companies' technology managers and other R&D experts) replied to the online questionnaire on key technologies. Six national reports were delivered and then summarized into one integrated report.

Interviews addressed the following issues of food quality and safety (interview guidelines, see Annex A.3): current concerns from the supply and demand side on food quality and safety ('awareness' of consumers, retailers & producers, policy makers), the current legal and physical infrastructure in the six countries, as well as socio-economic factors affecting food quality and safety.[14]

The key technologies survey investigated the development and application of technology categories in the six countries and selected individual key, strategic and consolidated technologies for the region. Twenty-eight technologies were examined in the survey (see Annex A.4. List of technologies covered in the key technologies survey), which can be grouped into the following categories:

[13] Deliverable 12: Six national reports, IE HAS and Deliverable 14: Report on interpretation of results from interviews/questionnaires, IE HAS. Both documents are available on the Internet-Homepage www.futurefood6.com.

[14] Technological issues included in the interviews were summarized under the results of the key technologies survey.

- Test, measurement and diagnostic technologies (1-5)
- Food packaging technologies (6-10)
- Biotechnology (11-15)
- ICT technology (16-20)
- Nanotechnology (21-24)
- Other technologies (25-26)[15]
- Functional food (27-28)

3.3.1 Interviews[16]

As regards **awareness**, throughout the six countries, the overall opinion of the experts interviewed is that *consumers' awareness* about food quality and safety is less developed in CEE countries than in most Western European countries – although, during recent years, it has been raised significantly. Nevertheless, most of the interviewees think the consumers of these countries still remain to be the least aware of health and safety issues amongst the actors of the agro-food chain; that price is still the most important factor for the largest share of CEE countries' population when buying food products. The experts think that media plays a significant role in informing consumers and in communicating trends and many people tend to accept with high sensitiveness warning news from unprofessional sources. Food safety and quality awareness appears to be directly correlated with the consumers' social position and income level in every country.

The experts from the region differed with regard to the characterisation of their countries' consumers:

- According to Slovak experts, their country's consumers tend to behave as if choosing the right retail sale store, or chain of stores was sufficient for making sure food is healthy and safe.
- Romania's experts complain that awareness about food safety is still limited and sometimes reduced to the naturalness of products. There is a strong tradition of self-supply and domestic agriculture and food products have a better quality image than imported ones, based on taste evaluation.
- Hungary's experts regard Hungarian consumers' awareness as mostly a media-driven phenomenon.
- Bulgaria's experts see Bulgarian consumers as becoming keener on buying food with proven quality. Allegedly, they do not trust 'blindly' the label on the product but ask for scientific proof.

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[15] This category was left out in the integrated report (Deliverable 14) but can be found in the six national reports (Deliverable 12).

[16] Deliverable 14: Report on interpretation of results from interviews/questionnaires, IE HAS, available on the Internet-Homepage www.futurefood6.com.

- Among Czech consumers, so the country's expert's state, awareness grows with the size of a town and its population; in the countryside it is usually lower. Social status plays a role as well.
- Croatia's experts characterize their country's consumers as preferring domestic products over imported ones as they are convinced of their higher quality and safety.

In all countries, experts stressed that compared to consumers, quality and safety awareness is higher among *farmers, food processors and retailers*. This is especially true, so the experts state, for large retailers, which have the most significant share in the overall revenue of their countries' food chain. Many experts considered large retailers as the driving force in food quality and safety issues. While there was broad consensus about this fact, some experts consider it as feasible that large supermarket chains are not unhappy about stricter regulations, as they cause trouble among smaller competitors and in this way can have a market-clearing effect. Frequently, smaller groceries or corner shops are lacking capital and infrastructure as required to fulfil all quality and safety requirements.

One question asked about the level of awareness of the food quality and safety issues among *policy makers.* Answers varied from country to country; no statements were made for Slovakia and Bulgaria. Croatian and Czech experts are confident that their countries' policy makers and food legislation specialists have reached a very good level of awareness, while Hungarian experts stress that in their country too much political influence is involved in these issues and scientific or professional knowledge is not very often used in decision making. Hungarian policy makers, so the experts state, lack a good, coherent strategy in supporting the development of the agro-food industry. Romania also lacks, so the country's experts state, a long-term approach of policy making for food safety, whereas policy makers paid larger attention to agricultural, biotech, and food safety research.

Referring to **regulatory issues**, the interviewees do not see differences between the new member states and the EU15 countries: All new member countries have adopted the EU acquis and regulations; Croatia is in the process of harmonization. However, the accession countries have the experience that in some fields previous food and safety regulations were stricter than those applied by the EU. In such cases, accession led to some dilution. In fields such as environmental protection or animal health and welfare, stricter EU regulations threatened the competitiveness of CEE exporters.

In all countries, the most important problem is the enforcement of these regulations, i.e. the system of supervision of the enforcement of laws, as well as the system of sanctions for violations. Other problems include the complexity of regulations, also in regard to national regulations: In Hungary, for example, the symbiosis of national and EU regulation produced a complicated, at times incomprehensible framework.

As regards the **physical infrastructure for securing food quality and safety,** it is defined as "equipment, instruments and other relevant hardware and software used for checking, assuring and controlling food quality and safety by any relevant private, public or 'hybrid' organisations" in the interview guidelines. Hence, experts were asked about the availability of state-of-the-art control equipment in private companies, in public institutions, as well as in hybrid organisations i.e. about the reliability of the entire food quality and safety control system. Because of this broad focus and differences between individual countries, answers varied considerably, as the following brief summary of expert assessments indicates.

In *Hungary, Slovakia, and the Czech Republic* the food quality and safety control system is relatively well developed. Nevertheless, further developments in technology and personnel qualification could be welcome, as it is necessary to keep up with technological advances.
In these three countries, equipment in the private sector is on a sufficient level as regards food safety and control. Companies have invested a lot of money to improve their control facilities (mainly in multinational companies). Each producer has to fulfil specific standards as HACCP, ISO standards, and traceability in the food chain has to be secured. However, in all three countries, a dual picture emerges from the answers: While big processors posses their own well-equipped laboratories with qualified personnel, smaller ones cannot afford to have their products *in situ* analysed and certified. In Croatia as well, large food companies are well equipped, while SMEs lack equipment and a well educated workforce.

Referring to the state food quality and safety control system, the following information was obtained:

- In Hungary, the creation of a new state authority in 2007 embracing all activities in the field of agri-environment, health, safety and animal welfare is likely to further improve the situation.
- The Czech structure of state control is divided between several ministries (food by the Ministry of Agriculture, meals by the Ministry of Health). Control organizations have separated competencies and have to coordinate their activities. The level of the state system and the institutions involved are relatively well developed, but certainly there is room for improvement.
- In Slovakia, the issue of food quality and control is regulated by two ministries: the Ministry of Agriculture and the Ministry of Health. They are in charge of ensuring the control of the whole food chain from farm to fork. The two main public control institutions are the State Food and Veterinary Administration and the Public Health Authority.

In *Croatia,* currently the physical infrastructure for securing food quality and safety in laboratories is not sufficient to deal with food quality issues and meet all safety standards.

According to experts the required changes concern primarily equipment, instruments, hardware and software. Laboratory equipment is not satisfactory at all to meet the new standards in food control.

In *Bulgaria*, the existing system of equipment, instruments, software and hardware for checking and control of the quality and safety requirements of foodstuffs is not satisfactory. The equipment of a great number of laboratories dealing with the analysis and identification of food quality and safety is not yet updated. Many of the well-known laboratories that existed in the past were changed or closed operations, and as a consequence the severe lack of professional experts is currently observed. Recently, some of the laboratories have been supplied with the equipment needed thanks to funding received under the Phare projects.

In *Romania*, the network of certification and testing laboratories is underdeveloped. The national infrastructure for ensuring food safety is in the making (in 2004, the National Sanitary Veterinary and Food Safety Authority was created as a central body, uniting the former fragmented control system). Hence, the control over the companies is not pervasive, nor pushy for transformation. Additionally, Romanian companies need to develop their organizational culture in order to implement complex food safety systems.

Concerning **socio-economic issues**, two major issues were found in the interviews that will determine future demand preferences and affordability in the region. Firstly, the most prominent socio-economic issue affecting the food industry is the ageing and changing of the population demographic structure. Ageing has strong consequences upon affordability and demand for safe and quality food. The population of all countries involved in the project is decreasing; birth rates are significantly lower than a few decades ago. At the same time, people live longer, and older people have more skills and time to prepare food, which in turn increases demand for safe, healthy food, fresh and quality products. With decreasing birth rates, family size is becoming smaller than a few decades ago, and that trend is expecting to continue, greatly affecting food consumption habits. There will be more and more people living permanently or most of the time alone, which tend to spend less time preparing their food, but can afford to buy semi-prepared or ready cooked meals. A major consequence is the appearance of smaller food packages, enough for one person only.

Secondly, the expected improved socio-economic status of the majority of the population is a major factor affecting demand preferences and affordability, which is strongly connected to a tendency of increasing awareness of food quality and safety. Higher purchasing power and a growing segment of higher educated and well-informed consumers will expand the market for functional and healthy food. With the increase of consumer income, demand is expected to shift towards healthier and higher quality food. At present, food prices (quite

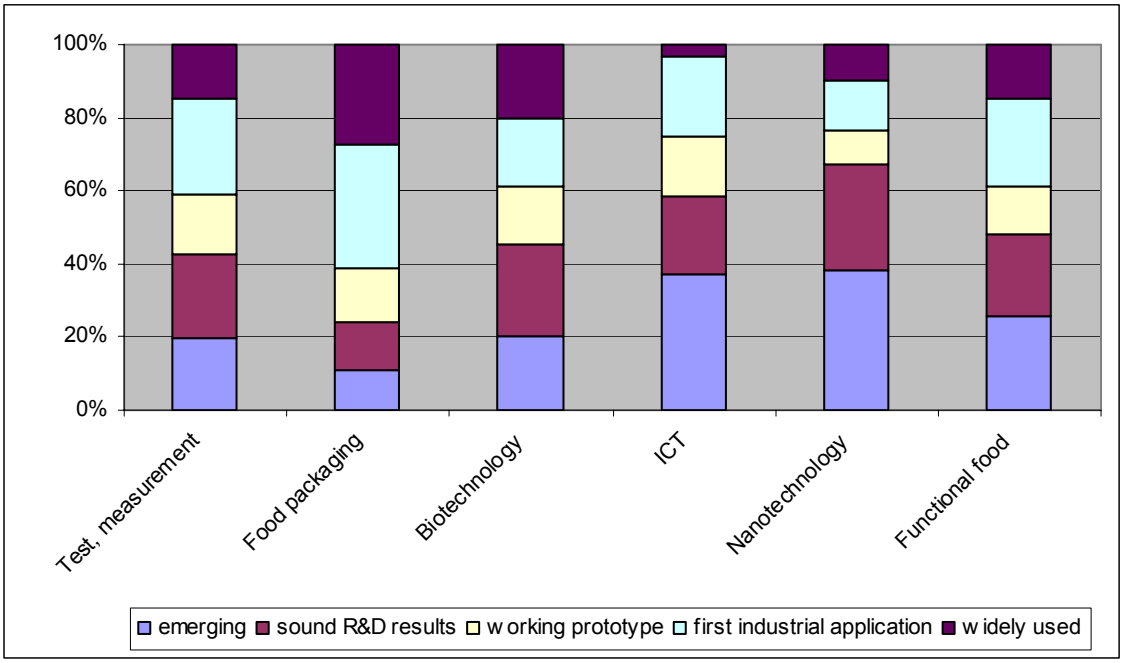
important driver for the present day consumer in the region) in the participating countries are comparable. However, population income and share of income spent on food items varies across the involved countries. However, it is expected that not only prices but also incomes will converge on the mid to long term.

3.3.2 Key technologies survey[17]

In the key technologies survey (see Annex A.5 Key technologies survey questionnaire) experts were invited to evaluate the current level of global development of given technologies (which was then used as a benchmark for the national position), the current position of *development* of technologies at national level, the current position in the *application* of the given technologies at national level, as well as potential impacts of given technologies on health and food quality, employment, economic growth, and food safety (by types of hazards: biological, chemical, physical).

Regional experts believe that the most widely used technologies on a *global scale* were food packaging technologies, whilst the less developed ones are the ICT and nanotechnologies – they are still at an earlier stage of development. Test & measurement, biotechnology and functional food are at the middle level of development (see Figure 9).

Figure 9: Current level of global development



[17] Deliverable 14: Report on interpretation of results from interviews/questionnaires, IE HAS, available on the Internet-Homepage www.futurefood6.com.

Figure 10: Current position in the *development* of the technology at regional level

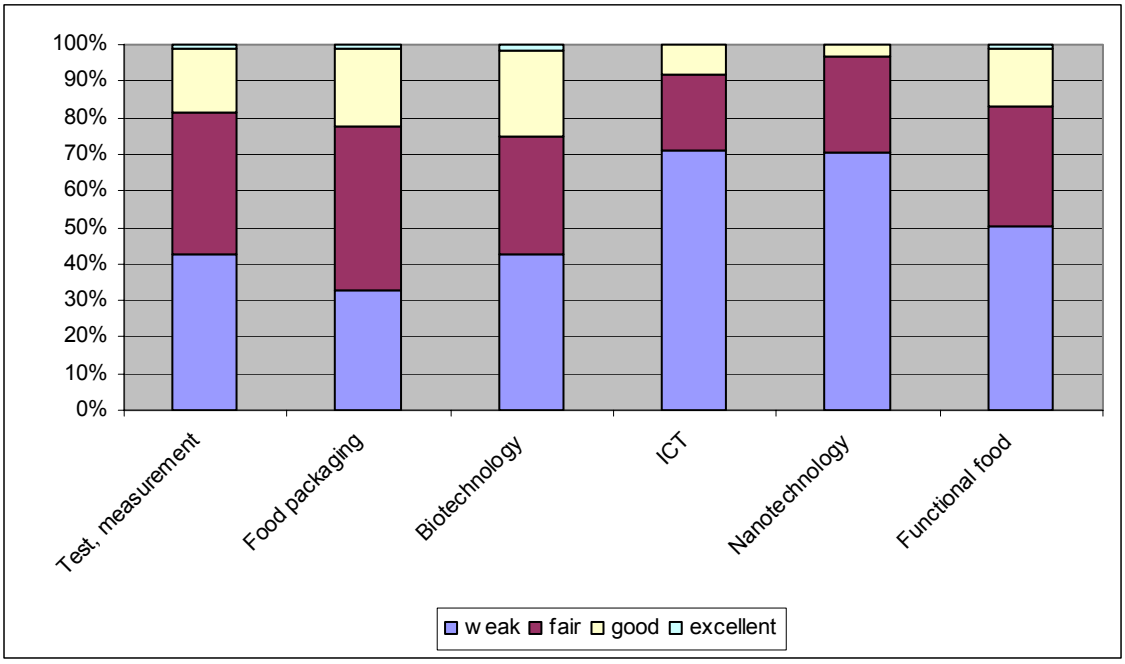
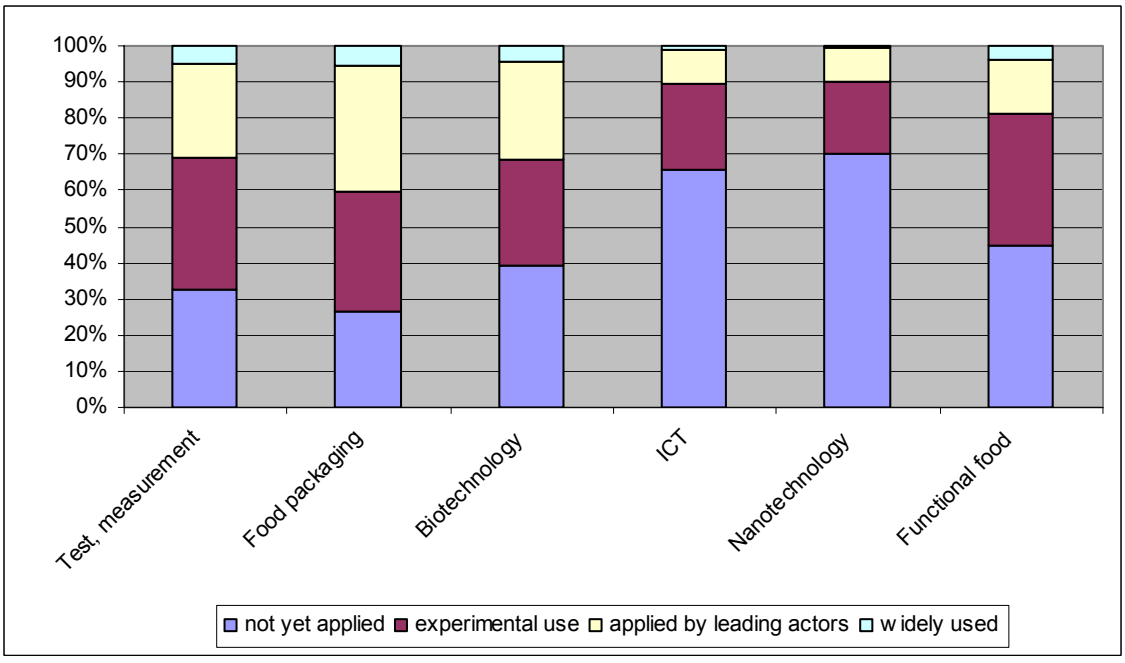


Figure 11: Current position in the *application* of the technology at regional level



In the CEE-region, the *development level* of most technologies is rather weak. The least developed technology is ICT. Only food packaging and biotechnology are better situated, with a share of good or excellent level of development slightly above 20% (see Figure 10). The current level of *application* in the region exhibits a slightly favourable situation compared to the level of development. The least applied technologies are ICT, nanotechnology, and functional food (see Figure 11).

Comparison to the global level of development (see Figure 12 and Figure 13) shows that *development* of all technology groups in the region is positioned in the fair category, the most developed being food packaging technologies. There is no technology at a good or even excellent level of development. In the *application*, nanotechnology, ICT and functional food are only at an experimental use level, whilst food packaging and to a lesser extent biotechnology and test & measurement are applied by leading actors.

Figure 12: Current level of global technology development versus current position of the region in the *development* of the technology

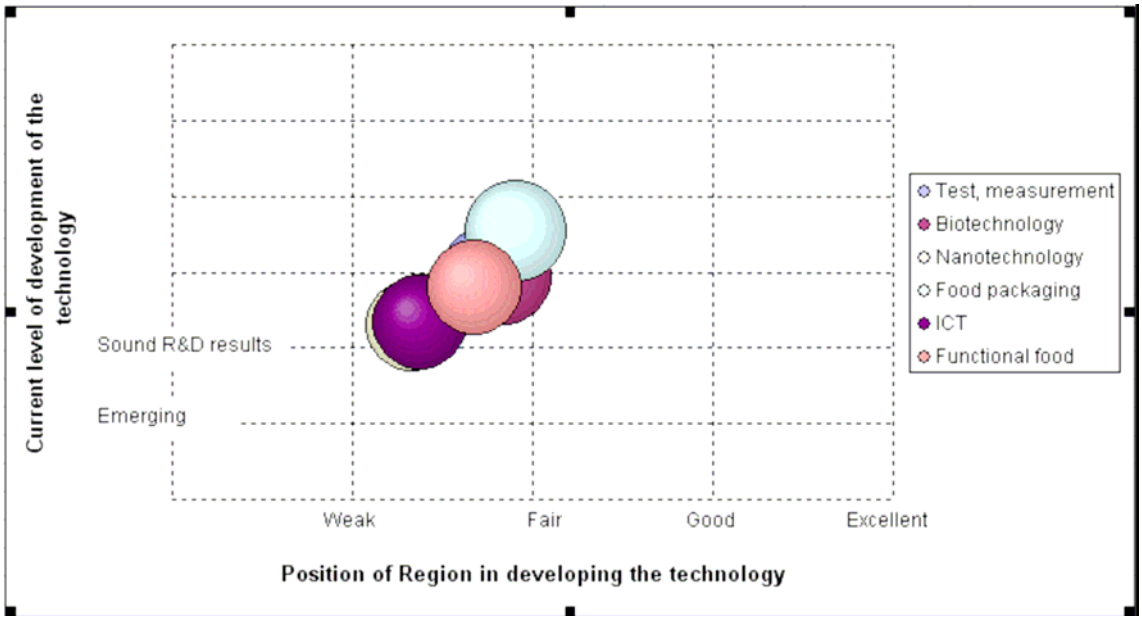
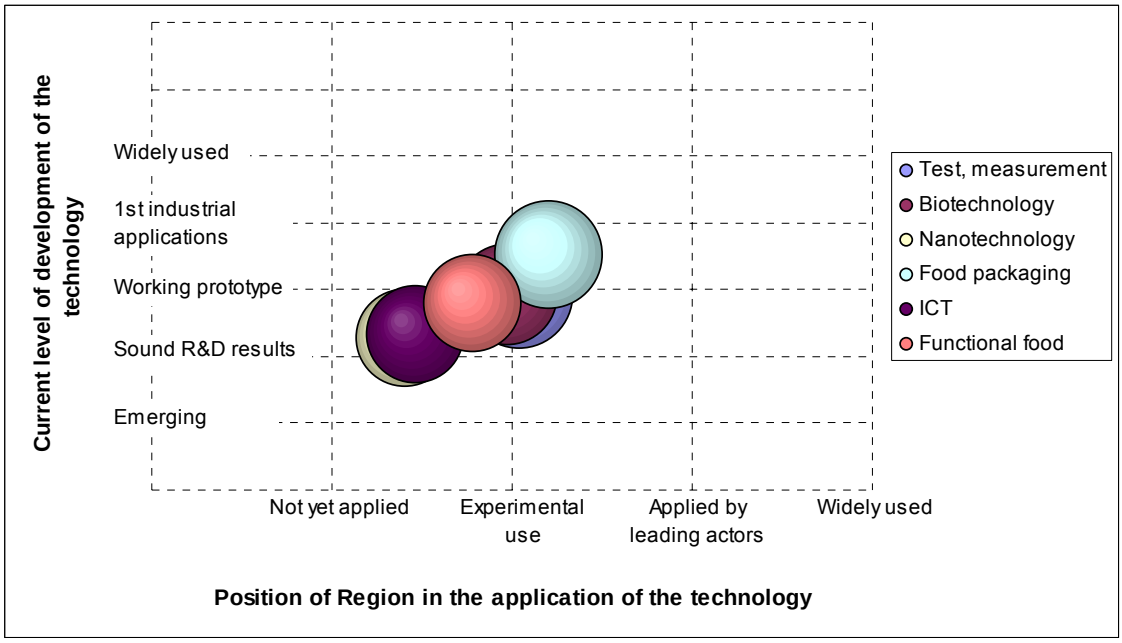


Figure 13: Current level of global technology development versus current position of the region in the *application* of the technology



Potential impacts on health and food quality, employment, economic growth are perceived as positive across all technology groups: Significant positive effects are seen for health and food quality, neutral to weak positive effects are observed on employment and on growth. Potential impacts on biological, chemical and physical hazards differ across technology groups but are also situated at a neutral to positive level.

Common key technologies

Two procedures were applied to identify the common key technologies for the whole region. The first method was the pooling of the samples (i.e. data from all respondents of the key technologies questionnaire was used regardless of the country of origin), to determine the common key technologies. Because of the significantly larger sample than in the individual country reports, using the same selection criteria as for national reports (general rule: technologies with higher than 5 overall positive impact were selected), resulted in 23 common key technologies. Thus, almost all individual technologies discussed would become key technologies for the region, which, considering the individual country results is not likely.

The unsatisfactory result of this first approach provoked search for a more pragmatic selection criterion, i.e. those technologies were selected as common key technologies for the region, which proved to be relevant key technologies for all participating countries. Four

technologies were identified as key for the region, since they are to be found in all countries. These are:

- **KT-2** - New in line non-destructive methods and control systems, integrated and pervasive sensor networks throughout factories for assessing the quality and safety and recording their fluctuations during processing.
- **KT-6** - Active packaging capable of changing either package permeation properties or the concentration of various volatiles and gases in the package headspace during storage, or adding small amounts of microbial, anti-oxidative or other quality improving agents via packaging material.
- **KT-8** - Development and application of new packaging systems allowing to fully utilise benefits of new food packaging technologies and better food packaging materials used in modern food processing.
- **KT-23** - Nanomaterials to control the dosage of growth hormones in livestock.

KT-2 belongs to the test and measurement technologies category. KT-6 and KT-8 to food packaging technologies, whilst KT-23 to nanotechnology. These results are very much in line with the results obtained above, where it was determined that the region has a relatively good position in the development and application of food packaging technologies.

Strategic and consolidated technologies

In order to determine the importance of these common key technologies and their future prospects, i.e. whether they are strategic or consolidated technologies, development and application of technologies in the CEE countries was compared to the global level of development:

- *Strategic technologies* are those technologies in which the country seems to have a good / excellent position in the development of the technology, which by the way is at an early stage of development globally.
- *Consolidated technologies* are those technologies in which the country seems to a have a good position in the development and / or application of the technology, which is at an advanced stage of development globally.

Table 8: Strategic and consolidated technologies

KT	2 control systems		6 packaging I		8 packaging II		23 Nanomaterials	
Position	Strat.	Cons.	Strat.	Cons.	Strat.	Cons.	Strat.	Cons.
Bulgaria	no	no	no	**yes**	no	**yes**	no	no
Croatia	no	**yes**	no	**yes**	no	**yes**	no	no
Czech R.	**yes**	**yes**	**yes**	**yes**	no	**yes**	**yes**	No
Hungary	**yes**	**yes**	no	**yes**	no	**yes**	no	No
Romania	**yes**	**yes**	no	**yes**	no	**yes**	no	No
Slovakia	no	**yes**	no	**yes**	no	**yes**	no	No

Of the four key technologies identified, KT-6 and KT-8 are consolidated technologies in all countries and KT-2 is a consolidated technology in 5 countries. Only KT-23 is not a consolidated technology in any country of the region. As pointed out before, it seems that countries in the region focus more on the adoption of new, ready to be used technologies rather than developing them. Thus, there is no identified key technology to be strategic in all countries. KT-2 is the technology that is considered strategic by three countries, followed by KT-6 and KT-23, with 1 country selecting each KT as strategic. KT-8 was not positioned as a strategic technology by any of the participating countries. As was shown previously, it seems that the region has a relatively good position in developing, and especially applying food packaging technologies.

Reasons why CEE-countries are better in the application of technologies than in their development include:

- The socialist past of these countries implies that they were excluded from front line international research for decades.
- The development of the food industry was not a top priority of socialist market economies, except for Hungary, which possessed strong export positions in not only raw agricultural products but also highly processed food items.
- During the transition period from the early 1990's until present, old socialist structures, including agricultural farm structure, state run food processing and research plants were dismantled or transformed.
- The privatisation of the agri-food sector started late, and at the beginning it did not attract significant capital.

- The educational system, as all sectors and institutions of national economies, also experienced a serious lack of funds, migrating researchers (brain drain) and institutional changes.
- Nationally owned companies are most frequently of smaller size, and very few possess the needed R&D infrastructure to be in the front line of technological development. Foreign owned companies mostly have their research base located in their home countries, and only import sound research results, already ready to be applied on the local market.
- All these countries (except perhaps for Romania) are relatively small sized, therefore it seems a logical strategy to take over technologies supporting better food quality and safe food already being applied in developed economies.

Conclusions and general trends

The key technologies survey results show that food packaging is an important issue in the participating countries. They are well positioned for applying and further developing relatively advanced food packaging technologies. Besides developing new packaging materials (safer with increased preserving capabilities and environmentally friendly) the most obvious trend is to be found on the labelling of food products. In all participating countries, packaging carries more and more information, and this trend is likely to continue. Some national experts even argued that there is already too much information on some packages, which do not help consumers to make their choices, but on the contrary, make the selection more difficult. With the incursion of intelligent packaging (signalling changes of temperature, or carrying a microchip with all available information about the product from its geographical origin and exact producer, to details of its processing and storage, etc.) consumers will have much more information about a particular product than in the past. Although quite expensive, innovative packaging technologies are expected to play an increasingly important role not only in assuring to perfectly preserve the quality properties and to insure no external materials may contaminate the product, but also for their esthetical aspect. With the ageing of the population and changing eating habits, the need for smaller sized packages is likely to increase in the region.

New in-line-non-destructive methods and control systems (KT-2) belongs to test and measurement technologies, and was selected as a key technology for the entire region. The test and measurement technologies are quickly developing. For some factors that could not be measured just few years ago, accurate measurement is now widely available (e.g. iron content, GMO residuals). This trend is expected to last for the forthcoming decades, mostly driven by global trade and thus, the need to assess the quality and safety properties of foreign products. Progress will go in the direction of quick screening, specific methods and sensing devices capable of non-invasive testing. As some experts pointed out, state of the art test and measurement technologies – even if available – are quite

expensive to implement, therefore they are expected to become widespread only after the application reaches a critical level, and thus the technology becomes more affordable. A significant shift towards more mobile test and measurement devices is expected.

None of the biotechnologies listed in the key technologies survey was selected as a common key technology. National reports, however, identified some biotechnologies as key technologies for their countries. According to experts interviewed, a clear distinction should be made between biotechnologies already widely accepted, researched and applied and technologies based on genetically modified organisms (GMO). The trend of using biotechnology to control the fermentation and enzymatic processes is likely to continue and even to increase since the demand for healthy, fermented products is growing. Biotechnology is also strongly linked to functional food technologies, since the technology is used to obtain food products with different or modified properties.

If GMO products manage to pass through the barrier of public rejection, the expectation of the interviewees is that they will radically change the agricultural production sector, and make all previously used methods obsolete.

Experts regard nanotechnology as the least developed and applied technology in the participating countries. However KT-23 (Nanomaterials used to control the dosage of hormones in livestock) turned out to be a common key technology in the region. Most likely, future applications of nanotechnology are expected to be nanoscale encapsulation of biologically active substances, nano and micro sensors for detection of toxins, pathogens, pesticides, contaminants and antibiotic residues in food products. At present, as experts from the regions maintain, even globally nanotechnologies are considered as emerging to sound technologies. Experts positioned the likely emergence of widely used nanomaterials technology quite far in future, at around 2020.

Even if the common key technologies analysis, based on the key technologies survey, did not select any ICT technology as key for the region, experts interviewed considered ICT technologies as very important, with widely positive impacts, and to be implemented on a larger scale very soon. Some industries in the participating countries are already widely using ICT technology, and that is expected to affect the food industry as well. Micro sensors, memory chips, data banks and ICTs which connect consumers' mobile devices to product information are all important trends affecting food quality and safety up to 2020. Introduction of sophisticated ICT technologies will enable the use of fully controlled production lines with auto-diagnostic systems of all devices and machines without any human interference and without the risk of a human mistake.

3.4 Future visions[18]

In the FutureFood6 project, future visions were expected to identify a series of objectives to which the food industry in the Central and Eastern European countries should aspire to reach in a 10 - 15 year time timescale, as well as to set the scope and boundaries for the subsequent roadmap (see next chapter).

In addition, the process of defining future visions for CEE countries significantly intensified the communication among the stakeholders participating in the process, reduced uncertainty, as clear goals are set up, and improved the understanding of each other's strategic intentions during the joint deliberations and intense dialogues which took place in the process.

In one general future visions workshop and in six national validations workshops experts decided on four future visions, identified indicators and related milestones as well as obstacles to their realisation. Barriers were classified into conjunctural and structural ones, the former being able to overcome when setting correcting activities while the latter ones are rather fixed and policy can only try to alleviate them.

Experts of the region agreed on the following visions:

- **Vision 1:** Increased availability of high-quality region-specific and traditional food products in the region
- **Vision 2:** The region will be one of the leading producers of healthy and safe food in Europe
- **Vision 3:** Research support will be a priority in national development strategies and higher cooperation levels within the food chain will be achieved (paying special attention to functional food)
- **Vision 4:** Towards a knowledge-intensive agro-food sector

There was much debate among experts on Vision 2 and Vision 3. Vision 2B 'The region will be one of the leaders in the organic food market in Europe' was dropped in favour of the above stated vision. For Vision 3 the focus on functional food was heavily debated but finally remained slightly reformulated in the vision. In addition, in Vision 1, the term 'traditional' was perceived very important and was hence included in the final version of the vision.

The four visions will now be presented as well as major regional barriers to their realisation depicted.

[18] Deliverable 15: Future Visions Report, OPTI Foundation, available on the Internet-Homepage www.futurefood6.com.

Future Vision 1: Increased availability of high-quality region-specific and traditional food products in the region

The objective of this Vision is to boost the supply of traditional high quality food products especially in the regional market. Vision 1 is mainly demand – driven: there is an unexploited market segment demanding an increased number of regional products on the shelves with which the local agro-food industry has the potential to cope.

In addition, the encouragement of a greater availability of quality local/regional traditional foods within the given region is seen as a means of reinforcing existing community values and perspectives. Those stakeholders supporting the development of the local food industry consider local products to be healthier than mass-produced foods, and that local production and consumption helps to protect the environment and cultural diversity, as well as strengthening local economies. Furthermore, promoting traditional products will help the agro-food industry to benefit from all EU systems for promoting and protecting food products known as PDO (Protected Designation of Origin), PGI (Protected Geographical Indication) and TSG (Traditional Specialty Guaranteed). With this in mind, not only will Vision 1 contribute to better satisfying consumers' demands, but will also act as one of the main drivers of the regional economy.

Experts identified a number of barriers for the region to vision 1, with conjunctural (c) and structural (s) barriers equally impeding its realization:

- Low level of support for local producers (c)
- Low level of cooperation at a regional level (c)
- High costs of brand development (s)
- Lack of promotion activities (c)
- Inadequate and/or insufficient capacities for the internationalization of local brands (c)
- Insufficient involvement of the consumers associations into existing branch unions development (s)
- High costs of production and distribution development (s)
- Monopolization of distribution channels by large-scale retailers (s)
- High fragmentation level of the legal framework (c)
- Low level of coordination among the existing regulations (c)
- Strict legal procedures and EU regulations (s)
- Strict requirements of large-scale retailers (SMEs-specific) (s)

Future Vision 2: The region will be one of the leading producers of healthy and safe food in Europe

The objective of this Vision is to develop a regional agro-food industry producing nourishing, secure and first-class food products. Being at a leading position in the European market is certainly a great challenge for the industry of the region but it is also a strategic future investment in a more and more globalized world.

First of all, the regional industry will have to supply a much more demanding European market with safe, healthy and wholesome food products and as a result strict quality controls will have to be included throughout the food chain, in order to guarantee the highest possible standards.

Secondly, and also due to stricter food legislations, the agro-food industry of the region will have to pay special attention to traceability issues. If the leading position of the region is to be guaranteed, the traceability of food products will have to be secured from the farm to the fork (i.e., from the raw materials to the final consumer). Once more, rigorous testing and control systems are needed if an integrated approach in all the steps of the value chain is to be applied to secure the origin of foodstuffs.

Lastly, for all the above mentioned reasons and in order to achieve Vision 2, the regional agro-food industry will have to develop and implement new and emerging technologies which facilitate the production of novel food products having the word “health” as the main driver for their development.

Experts identified a number of barriers for the region to vision 2, with conjunctural (c) and structural (s) barriers equally impeding its realization:

- Uncertainty with regards to the economic viability of moving to new/innovative production processes & procedures (s)
- Lack of confidence (c)
- Lack of a long term/ international strategy (c)
- Fierce competition from Western EU companies (s)
- Rather high marketing costs (s)
- Complex access to the Western marketplace (c)
- Limited experience in international markets (c)
- Perceived higher production costs (s)
- Increase in distribution costs (s)
- Low number of regional retailers (c)
- Complex distribution system (s)
- Complex certification procedures (s)
- Lack of cooperation among SMEs (c)

Future Vision 3: Research support will be a priority in national development strategies and higher cooperation levels within the food chain will be achieved (paying special attention to functional food)

The objective of this Vision is to reinforce and increase the regional R&D contribution on agro-food. Such growth of the R&D contribution should boost the cooperation activities within all agents involved in the agro-food value chain and so strengthen the links among them and to create a culture of collaboration.

Understanding that the world economy is moving towards a knowledge-based economy, the generation of knowledge is increasingly recognised as the driver of productivity and economic growth. With this in mind, support for R&D activities is required at a national level. The establishment of priorities within national development strategies becomes important as it provides a Vision of where research can contribute to the region's future prosperity and well being, whilst also helps to focus the region's research efforts on these key areas, in order to attain specified goals.

Experts believe that one of the fields to focus R&D efforts within the agro-food industry is that of Functional Food. Functional food is considered to be of special importance to improve citizens' health and well-being and to help fighting some of the diseases of new and modern life styles. For this purpose, innovative technologies and improved information mechanisms for the consumer will be needed.

Experts identified a number of barriers for the region to vision 3, with conjunctural (c) barriers mostly impeding its realization, while structural (s) barriers were less prevalent:

- Budgetary restrictions (c)
- Weak lobbing from the agro-ood sector (c)
- Brain drain (c)
- Insufficient number of researchers in the region (c)
- Inadequate R&D infrastructure (c)
- Inefficient technology transfer mechanisms (c)
- Underdeveloped capacity to lead R&D projects (c)
- Lack of interest from the industry in R&D (c)
- Strong opposition from the political side to the establishment of R&D activities as priority (c)
- Lack of a long-term socio-economic development strategy (c)
- Lack of motivation and commitment to R&D from the Public Administration (c)
- National strategies are insufficiently prioritised (c)
- Lack of synergies between the National and European funding for RDT (c)
- Scarce number of experts and researchers in SMEs (s)
- Poor coordination among SMEs to develop R&D projects (s)

Future Vision 4: Towards a knowledge-intensive agro-food sector

The objective of this Vision is to develop a regional agro-food industry which is based on knowledge and intellectual assets to create added value products. It is an industry where knowledge resources, such as know-how and expertise, are as important as other economic resources; an industry which is based on networking and connectivity.

Competitiveness is becoming more and more dependent on goods and services with high knowledge content. That is certainly the case of every economic field, and needless to say for the agro-food industry. Therefore, building up the necessary core technological and related competencies, in conjunction with the development of human capital, is seen as a necessity if the industry of the region wants to remain competitive in the future.

To prosper, the agro-food industry must have a properly trained workforce capable to operate new knowledge-based farming systems that are profitable at farm level, that produce competitive market-required food products, that are environmentally sustainable, that cope with emerging climate changes and, with increasing importance, that are energy efficient.

Experts identified a number of barriers for the region to vision 4, with conjunctural (c) barriers mostly impeding its realization, while structural (s) barriers were less prevalent:

- Lack of educated farmers (c)
- The educational system is not well adapted / developed to satisfy specific training needs of the farmer (c)
- Lack of job opportunities in rural areas (s)
- The regional knowledge infrastructure is insufficient/inadequate (c)
- Lack of interest in the implementation of new technologies within the industry (c)
- Lack of capacities to adopt such technologies (c)
- Cooperation levels among agents are very low along the whole value chain (c)
- Weak partnership among the Government, the industry and knowledge providers (c)
- Public authorities are not developing any specific programs to attract young talents to the industry (c)
- Technology and knowledge is out of reach for small-scale producers (c)
- Lack of resources, capacity, knowledge and network linkages (SMEs specific) (c)

3.5 Road-mapping[19]

This part of the FutureFood6 project linked the current state-of-the-art thoroughly defined by the interviews and key technologies survey (see chapter 3.3) and the possible future state developed by the socio-economic scenarios and the future visions (see chapter 3.2. and 3.4). The road-mapping process defined routes towards the four visions by proposing definite measures and actions along certain driving forces and key actors. The question 'How can we get there (to a certain vision)?' was to be resolved, the barriers identified before should be overcome.

Driving forces are those socio-economic sectors in which specific actions and measures need to be undertaken in order to reach a certain future vision. In the FutureFood6 project the following driving forces could be found (differing according to the visions): market; business; policy; technology, science & education, media & promotion. Within each of these driving forces, key actors were identified, responsible for a certain action or measure. For instance, key actors within the driving force 'technology, science & education' were research institutes, universities, food safety institutions, etc. (also differing according to the visions).

In the road-mapping process, an international expert group was involved and took part in the road-mapping workshop. Before this workshop, experts had to fill in a questionnaire asking about main driving forces and key actors providing the basic facts to the workshop.

Generally, experts identified the following most important actions leading to the achievement of the visions:

- Preparation of strategic regional and national policies for food health and safety
- Public education on food quality and safety
- Development of R&D infrastructure and capacities related to food research
- Creation of national strategies for development of advanced food technologies and processes
- Indication to the European Union and national governments to introduce the appropriate concepts for financial support to achieve the identified Visions

Pathways leading to the realization all four future visions will now be highlighted, showing their short-term (from now on until 2011), medium term (until 2014) and long term developments (until 2020). Then all measures and actions will be presented in a road-mapping figure.

[19] Deliverable 16: Document on Road-mapping, TC AS CR, available on the Internet-Homepage wwwlfuturefood6.com.

Roadmap to Future Vision 1: Increased availability of high-quality region-specific and traditional food products in the region

According to the experts, the generally desired path from today to the increased availability of high-quality region-specific and traditional food (TF) products in the region in 2020 develops through several main stages: The first stage is the identification and consequent promotion of traditional food. The second phase focuses on the increased selling of traditional food. The final phase of the desired development towards the Vision is the adjustment of traditional food and its production to the emerging new life-style and social changes.

(1) Short-term: Identification and promotion

Experts assume that the first essential step towards this Vision is the identification of traditional food items and traditional food producers in CEE by policy-making institutions and business associations, which will also be responsible for defining specific requirements for products to be acknowledged as traditional. At the same time, specific requirements on traditional food to comply with EU rules should be set up by food safety institutions at regional level, so that the region would produce traditional and also safe food.

After identification, the promotion of traditional food products will follow. Agro-food businesses and/or business associations in cooperation with the media, regional authorities and tourist organisations should carry out information campaigns about the content, taste and healthiness of traditional food. For instance fairs on traditional food at 'Traditional evenings' in hotels will be organised. This sort of information will support the awareness of traditional food among the local population as well as among tourists.

As the agro-food sector is very fragmented, producer associations should be established which focus on issues related to traditional food. The associations should play a key role in promoting traditional food and local labels, in helping to finance the sector, in organizing traditional food events (e.g. fairs on traditional food, regional traditional food markets, etc.) and will also participate in the formulation of new legislative rules related to traditional food issues. These associations need to be supported both by national governments and EU Structural Funds. In addition, governments should launch new support programmes for SMEs oriented towards traditional food production, as they take a large share of the sector.

National governments also play a key role in this stage by developing the overall system and regulatory framework for the traditional food sector.

By 2011, one of the most significant measures is to further strengthen the cooperation between producers of traditional food. In the process of the development of a short-, medium- and long-term strategies concerning traditional food, business associations

should be included as well. Business associations should also mobilize the universities and research institutes to carry out research on the possible utilization of new technologies for the production of traditional food. Regional traditional food should become a priority agenda in the EU. As to the promotion activities, special sections with traditional food should be set up in the large retail chains and small shops specialised in traditional food should be opened in towns and in important tourist destinations.

(2) Medium-term: Increased sale

By 2014, the Ministries of Education should promote education on healthy ways of living and regional traditions at schools by adapting the curriculum, to 'keep the country side alive' and to avoid that specific skills and knowledge in the region die out. Also, at the regional level, strategies should be developed to prevent a regional brain-drain.

Moreover, in order to export traditional food outside the region, market studies analyzing this issue will be developed, initiated by business associations and financially supported by local authorities. Research at technical colleges and research institutes will focus on the improvement of technologies to produce traditional food products at a larger scale and more efficiently. For this reason, it is important to identify the most appropriate and efficient technologies which may influence in a positive way the production of traditional food products and the development of their market, on both national and regional (CEE countries) levels. This research will be promoted by agro-food businesses and regional governments. Together with the previous activities of bringing traditional food closer to the already aware consumers, the sale of traditional products will increase.

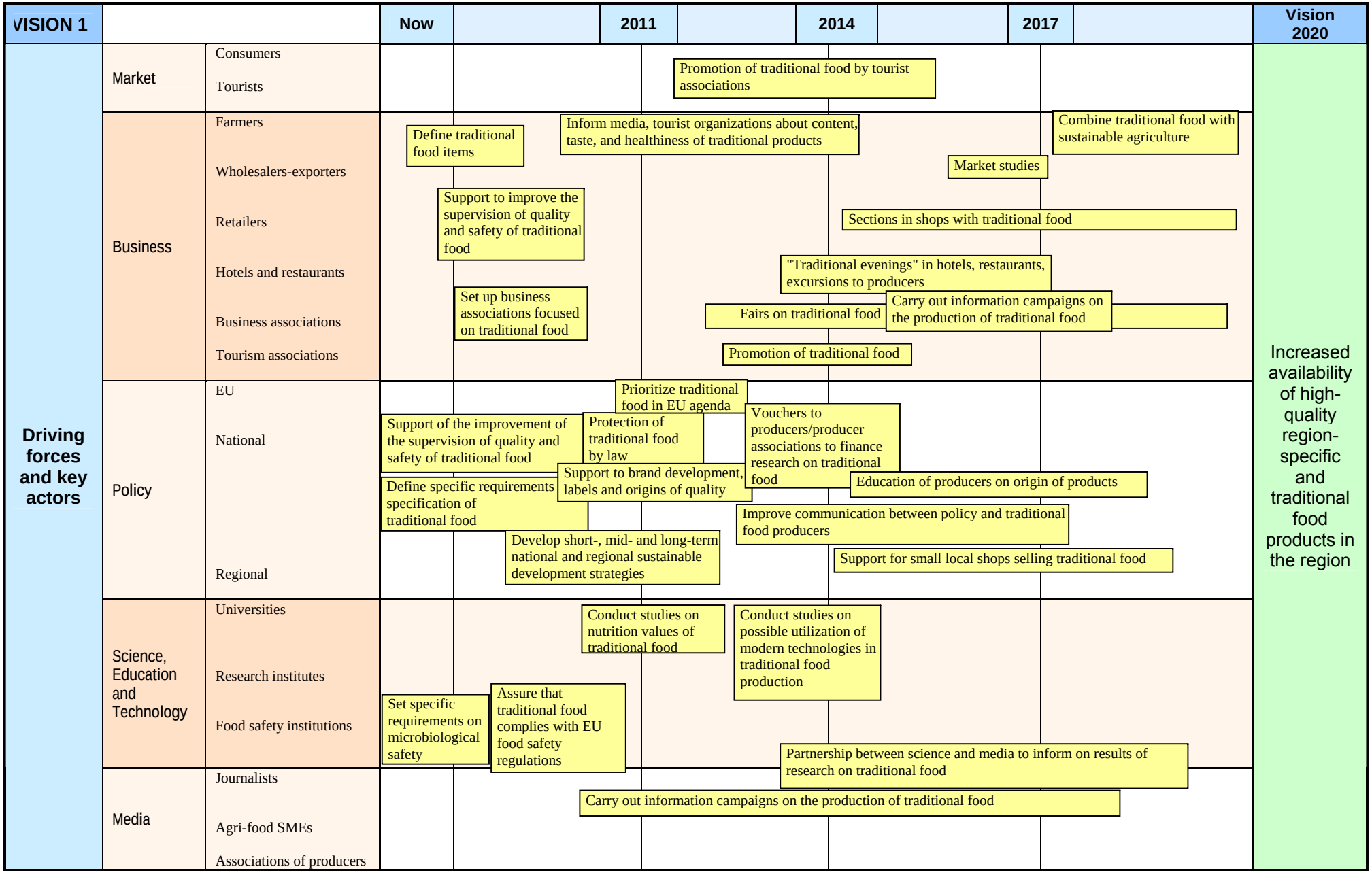
(3) Long-term: Adjustment

The adjustment phase of the development is characterized by the ongoing interplay between producers and governments, and the adjustment of traditional food and its production to changing life-styles with a focus on research and education.

At this stage, producers will combine the production of traditional food with sustainable agriculture, using modern technologies suitable for the production of traditional food, which were the subject of research in one of the previous phases of the overall development towards the Vision. To deal with the eventual problem of the lack of appropriate raw materials for traditional food, strategies for sustainable development as well as education should be implemented by national governments in order to maintain (and subsequently increase) the production of traditional food materials.

Modern research methods should adjust (or innovate) traditional recepies and technologies to changing life-styles and the preferences of a young and middle-aged generation that is not familiar with traditional food production. This issue is very closely related to commercialisation, marketing, certification, and labelling of traditional food..

Figure 14: Roadmap to Future Vision 1



Roadmap to Future Vision 2: The region will be one of the leading producers of healthy and safe food in Europe

Currently, the market of healthy and safe food is characterised by low consumer demand which leads to the unwillingness of producers to supply such kind of food. On the pathway to Vision 2, three major fields of activity were identified: to increase the awareness of consumers as well as producers, to improve production processes and to conduct specialised research and development in the field of healthy and safe food. According to the experts, governments should play a key role in all three fields and countries should take advantage as much as possible of relevant existing EU programmes.

(1) (2) Short and medium-term: improving awareness and technology

Experts thought that the primary vital condition for reaching Vision 2 is a change of the traditional and conservative way of thinking, especially among consumers. Raising their awareness and interest for healthy and safe food would increase demand for this type of food. It could be done by public information campaigns or training. Training could start from an early age onwards already, e.g. through special education programmes on healthy and safe eating habits in kindergartens, but should include adult education in training centres and expert training at universities as well. Governments should financially support these awareness and training campaigns.

But producers will also need more information regarding the proper quality of inputs and production processes, which could be provided by vocational training centres, producer associations, etc. Certification was found another important mean to improve and secure food quality. Development of new 'clusters' and support of existing ones should change the current cooperation pattern between SMEs and other stakeholders which is considered highly ineffective or lacking so far. This could help, for instance, to share the costs for product promotion. Also, targeted information events could be organised at national and regional levels using existing producer networks - for instance, to disseminate information on the possibilities to use EU programmes. Governments should support improvements of production processes and eco-innovation within agro-food manufacturing (e.g. by tax incentives). Another important role of governments is the channelling of relevant information on healthy and safe food from the European Union to all stakeholders and the implementation of EU regulations applicable to this industry. The governments should also explore the possibilities to develop targeted schemes for the transfer of good practices, knowledge and experience, which would help overcome problems of uncertainty, conservative attitude and limited experience in producing certain food products. This aim should be reached before 2010, by making use of the Operational Programme Competitiveness for member states and the pre-accession instruments for the accession countries, i.e. Croatia.

To reduce excessive fragmentation of cultivated land, governments should also provide financial support and regulatory relief in case of merging of lands and cooperative land cultivation and procession. The EU structural funds (namely Agriculture and Fisheries plan) should be used at the maximum.

Research and development institutions should take an active role in improving information on healthy and safe food. National research programmes should be launched in the fields of biotechnology and food quality and also in methods to decrease the use of herbicides and pesticides in cultivation. Identification of key technologies worth further development would be part of this task. The R&D sector should also prepare regular health risk assessments and communicate the results to both consumers and government officials. Linking the issue of a healthy population with the need of a healthy and safe diet will help to increase the level of political awareness. In order to achieve the national research programme targets, EU Framework Programmes should be utilized (e.g. Cooperation and Capacities Programmes, FP7).

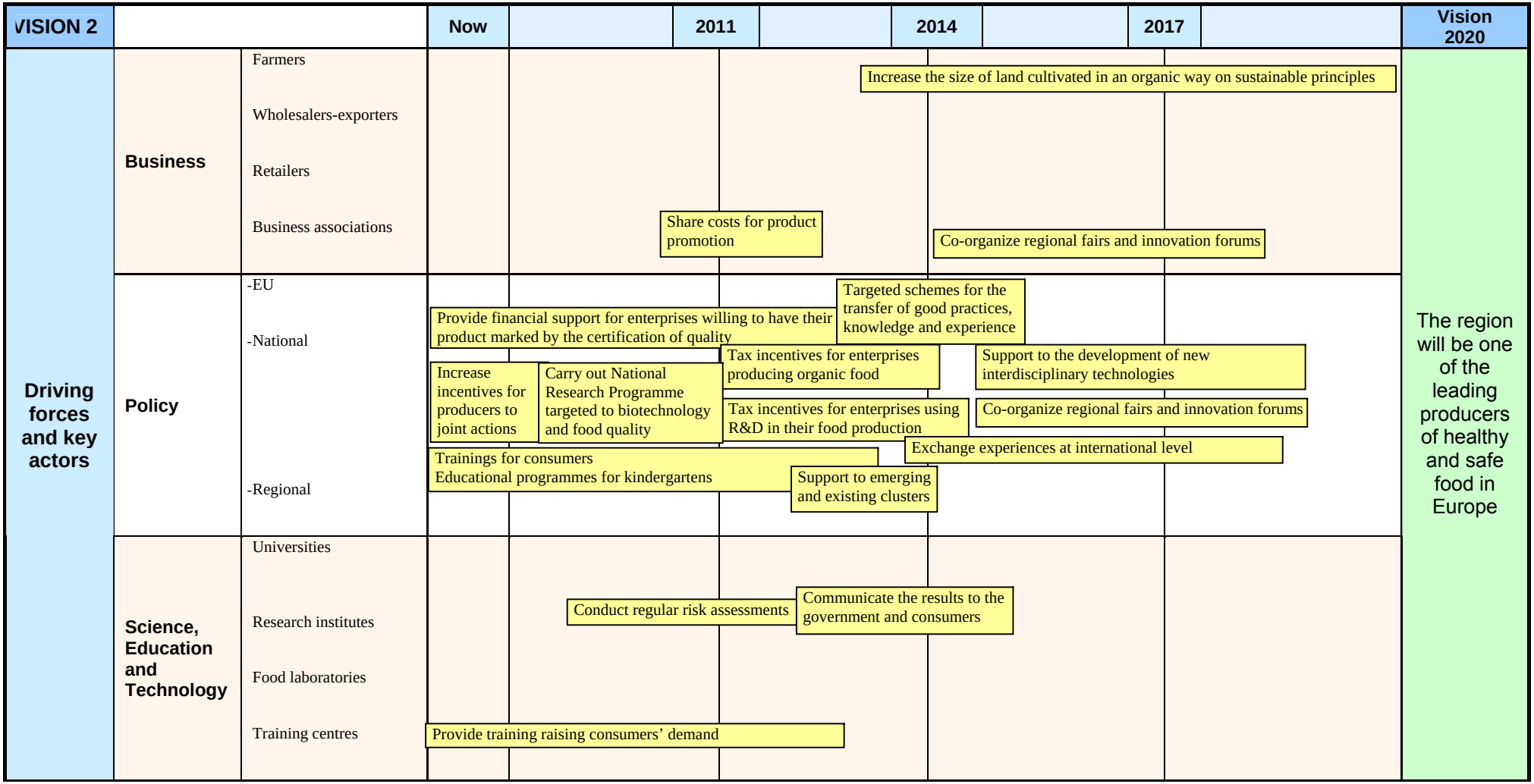
By 2013, according to the experts, each government should take corrective measures to the policy it pursues, i.e. launch a National Foresight Programme that develops future scenarios and defines the measures that need to be maintained or that have to be introduced additionally, in order to keep and further develop the competitive advantage of local producers in the field of healthy and safe food.

(3) Long-term: Maintaining the process

From 2015 till 2020, the most convenient way of maintaining the process leading to the desired Vision 2 is through the effective and responsible utilization of the Structural Funds in order to improve the overall level and quality of the infrastructure (especially ICTs). Other activities and measures should be effectively co-financed by the Operational Programme (OP) Transport, the OP Regional development and the OP Competitiveness, to improve links between producers and retailers. By this, governmental support to the various activities should decrease over time.

A new, additional measure to be taken in this period include the organisation of fairs and innovation forums for safe and healthy food, exchange of experiences at international level and support the development of new interdisciplinary technologies.

Figure 15: Roadmap to Future Vision 2



Roadmap to Future Vision 3: Research support will be a priority in national development strategies and higher cooperation levels within the food chain will be achieved (paying special attention to functional food)

This Vision contains two major goals: research support as a priority in national development strategies and achievement of higher cooperation levels within the food chain, both with regards to functional food production. In the desired development path towards these two goals national governments and their bodies were assigned the key role.

(1) Short-term: Initial measures

In the short-term development (until 2011), governments - together with the help of businesses and business associations - should first simplify regulations at the national level concerning food production. This simplification of regulations will be accompanied by developing a short- and long-term National Development Strategy for the agro-food sector, with regards to the development of basic and applied research in the food chain. In addition, in order to enhance research in the food industry, experts presumed the establishment of a well developed IPR (Intellectual Property Rights) system by governments. Banks will create special instruments providing special bridging loans for R&D organizations/companies to finance the research.

Business associations (as well as national governments) should find measures to support formal and informal cooperation in the food chain by organizing various conferences and meetings. These activities should enhance networking and cooperation among all subjects, including R&D institutes. Governments should also introduce a tax reduction for higher cooperation within the food chain.

At the same time, courses and education for all stakeholders in the field of research and management in the food chain should be organized by universities. The main issue would thus be to raise interest of the stakeholders to attend these courses.

Besides setting up the general framework for the development of the agro-food sector, governments should also make sure that functional food production meets international quality standards. Therefore, special attention and support should be paid to the network of national health and nutrition laboratories (up-to-date equipment, number of food researchers). Support should be granted to companies producing functional food, especially for SMEs.

(2) Medium-term: Consequent development

By 2014, the above-mentioned National Development Strategy in the food industry will be completed and started to be implemented. As a consequence of such a strategy, various

measures will be introduced by the governments; legislative measures to support business R&D in the industry or research grants for the development of modern technologies will be established. Support for science-industry co-operation will be provided through tax incentives. Also, intermediary agencies will be set up, supporting the cooperation between R&D and industry. Thus, the diffusion of the cutting-edge technologies in the agro-food sector would be faster and more easily incorporated by businesses.

Experts think that this development should help reach the level of 3 % of GDP spent on R&D (goals of the Lisbon strategy).

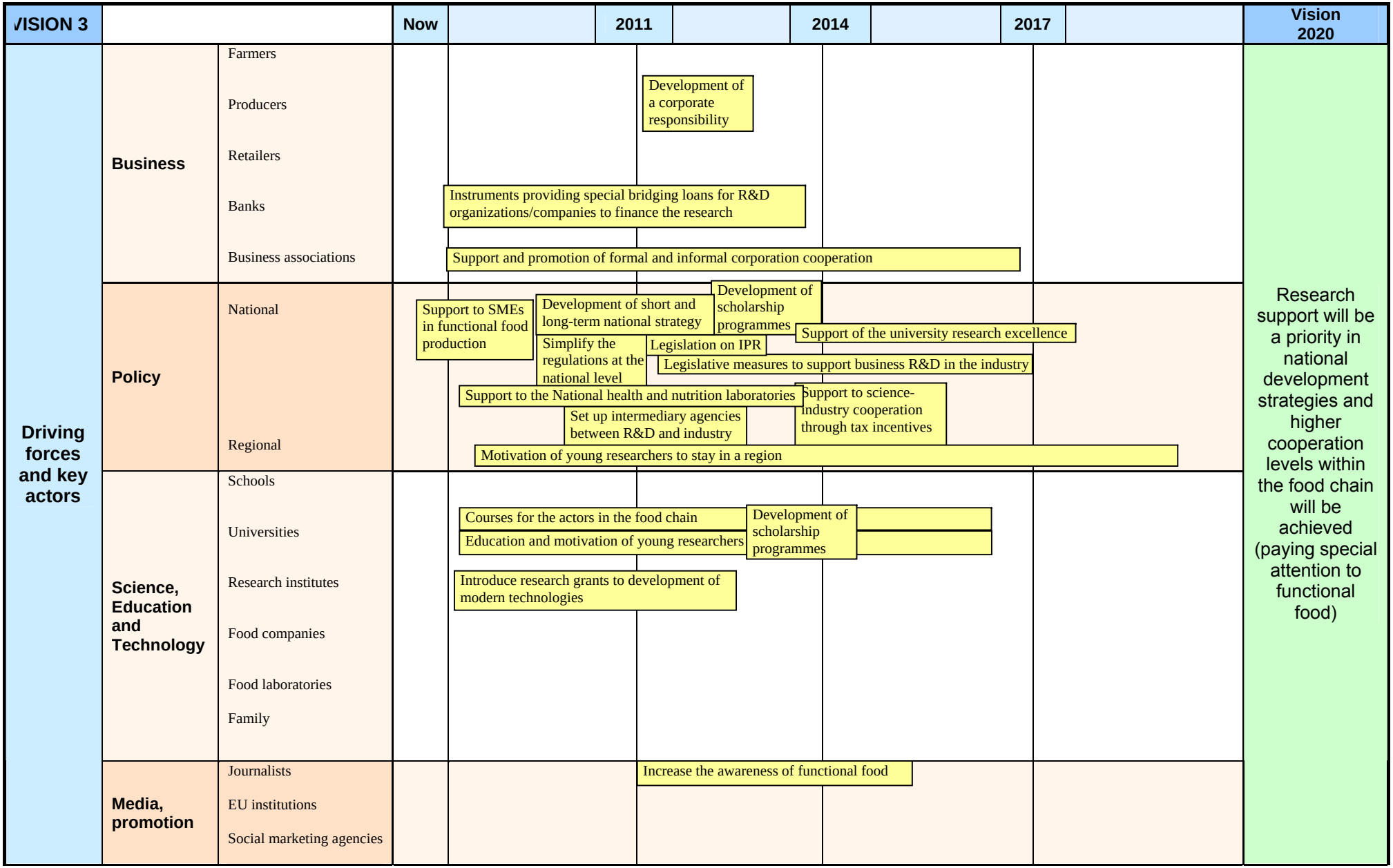
Education and motivation of the agro-food researchers is also seen as an important aspect for achieving the vision and should alleviate the shortage of human resources in the agro-food sector (brain drain). Effective measures are needed in order to motivate talented young researchers to stay in their home-regions; university and research excellence should be supported and scholarship programmes developed for this purpose.

In the mid-term, the promotion of the functional food is another very important aspect. The awareness is spread through organizing the above-mentioned conferences and meetings among the agro-food entities. To make also the public aware of the functional food, the link from the business or business associations to media is essential.

(3) Long-term: The final image

In the long-term development, the agro-food strategy is included in the more general development strategies at national level. The constant support to R&D in the food industry is no longer lacking. A satisfactory infrastructure for the knowledge-based economy and society is developed, also with the financial means of EU Structural Funds. Enhanced by governmental support in the previous phases of this development, businesses will develop corporate responsibility making investments in R&D a usual part of their business. The other side of this matter is the developed commercialization system of research at universities and research institutes. Thus, experts think that in 2020 the vision will be fulfilled.

Figure 16: Roadmap to Future Vision 3



Roadmap to Future Vision 4: Towards a knowledge-intensive agro-food sector

The following pathway can be observed for Vision 4:

(1) Short-term: Status analysis & feasibility study

Experts thought that the crucial precondition for achieving Vision 4 is the thorough analysis of the current situation of the agro-food industry in the CEE region. For that reason, experts called for a needs assessment and gap analysis through a large-scale regional survey of the agro-food industry under a common methodology to capture knowledge gaps, financial needs and needs for knowledge infrastructure in the CEE region. Business associations will initiate the survey; research institutes will carry it out in 2009. In this way, a comprehensive as well as a comparable picture of the sector will be drawn, potentials and weaknesses identified. Of course, the assessment of the food research infrastructure should be part of this analysis. This survey will serve as a basis for future measures such as initiating industrial fellowships or the conceptualization of new innovation and educational services.

In 2010, the regional survey will be followed by a feasibility study on the construction of a new knowledge infrastructure and upgrading the existing one. It will be initiated by governments and business associations. A joint approach for the whole region should be created: specialization of countries as well as coordination potentials and synergy effects in food research should be depicted in order to avoid duplications of efforts and investments among the CEE countries.

Formulation of a regional joint technology and action plan and main measures

The regional survey and feasibility study will create a knowledge basis for the formulation of the regional joint technology and action plan for the development of the infrastructure of the agro-food industry in the CEE region. By the end of 2010, some respective investment projects should already be put in place.

In 2010, new innovation and cooperation services should be launched: (1) Annual Regional Technology Forums, technology brokerage and business partnership events, organized by business associations and universities, and hosted on a rotational basis. (2) Creation of a database containing marketing and technology information on the subjects of the agro-food industry ('Market and technology watch'), managed by the business associations of the agro-food sector or some other body with a similar role. It will help identifying competitive products on the regional market.

The role of the governments for achieving the Vision is to carry out the National strategy for the development of the agro-food industry (in compliance with the above mentioned studies and the Regional technology and action plan) and to create a favourable business environment by taking the following measures: Tax incentives for companies investing in

research, innovation and technology in the agro-food sector. Tax incentives could be in the form of relief from social security payments on labour costs for research organizations.

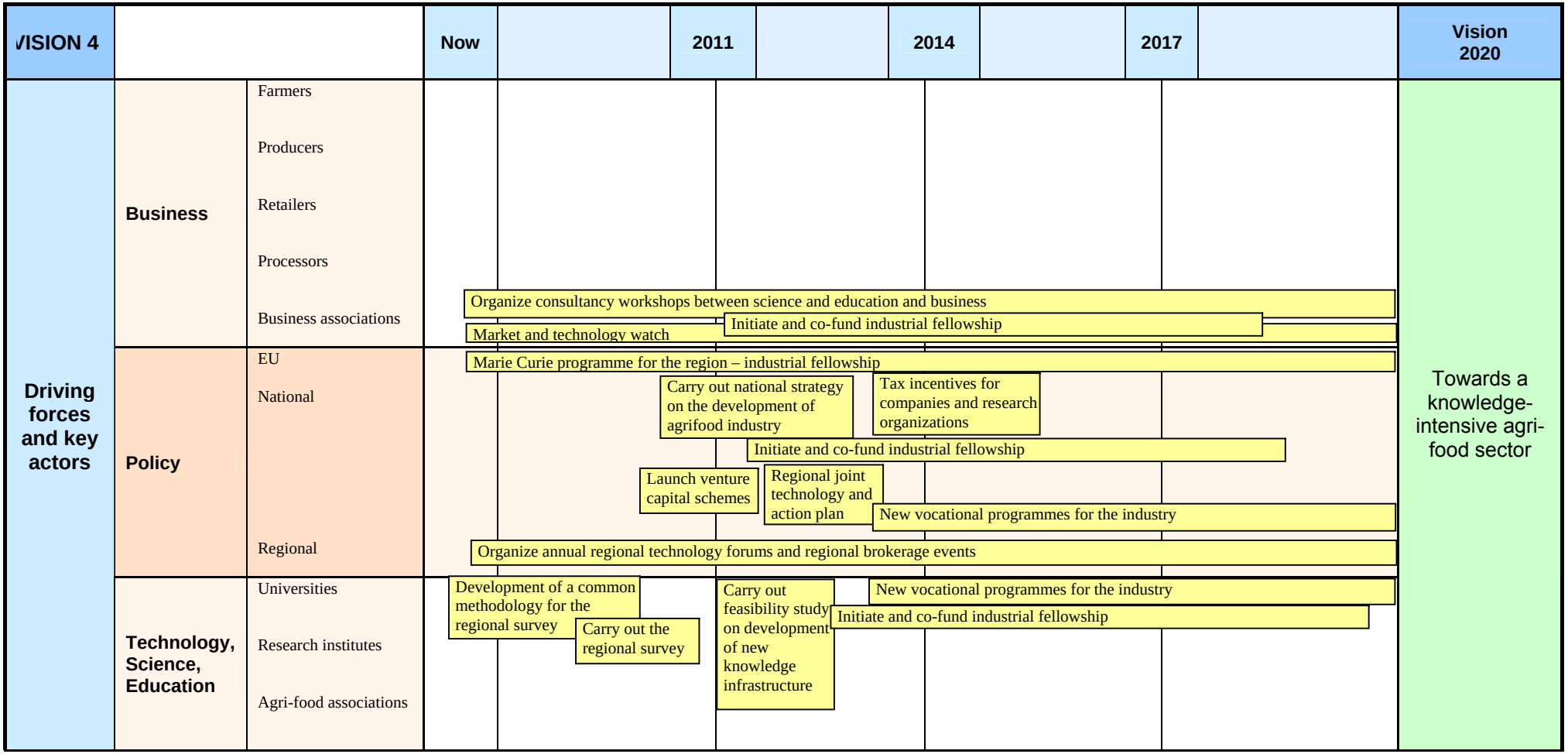
As a result, there will be an upgrade of curricula at regional universities as well as of research agendas of the research and technology organizations and new vocational training schemes for the industry will be developed. These training schemes will address specific issues within the industry, such as new technologies, emerging food safety issues, quality assurance, etc. These trainings could also take the form of e-learning or distance learning, by adopting ICTs. Besides these training courses, a more intensive cooperation between stakeholders should be elicited by tax incentives for cooperation projects between agro-food businesses and R&D institutions as well as by organizing consultancy workshops between science – education – and business.

In 2012, implementation of the regional action plan on the knowledge infrastructure is on the way. Vocational training schemes will continue. Venture capital schemes (i.e. funds made available for start-up firms and small businesses) for the whole region will be launched by the government.

(2) (3) Medium- and long-term (2013 – 2020): Maintenance
In the medium- and long-term, the main measures established in the former period will be continued, finally realizing the Vision in 2020. In some of the CEE countries, this development will be further enhanced by the new programming period of the Structural Funds.

In the CEE region, Annual Forums and brokerage events will still be organized; new vocational programmes will be adopted on a case by case basis. Successful implementation of National strategies and the Regional technology and action plan will consequently create a knowledge infrastructure which will not lack appropriate human resources. The monitoring system (‘Market and technology watch’) will also be maintained and thus create an in-depth information and knowledge basis within the region.

Figure 17: Roadmap to Vision 4



4 Policy recommendations

4.1. Preparatory remarks

The Technology Foresight approach allowed this project to identify, with regard to food health and safety, feasible long-term trends, so-called 'future scenarios', depending on the strength of various *external* influences. The logical second step was dealing with the *internal* situation of the agro-food sector, both as it is currently and as the main stakeholder would like to see it developing in the future. The project looked at the current state of the target countries' agro-food sector by using both industry statistics and by surveying the opinion of a large number of stakeholders through questionnaires and face-to-face interviews. The project has managed to stimulate a large number of stakeholders to reflect on these issues and express their views. Strengths and weaknesses, such as successful technological catching up and continued deficiencies, became obvious. Based on these results, experts from the target countries discussed in expert forums, which long-term developments they regarded as most desirable in terms of food health and safety. As they came from different disciplines, they had different views, so that the four visions they managed to formulate have followed from heated debates and well-reflected compromises.

As a final step, the experts gathered to analyse potential hindrances and those stakeholder activities, i.e. policies, which they regarded as functional for the realisation of the four visions. These activities will have to take place in a framework, which is characterized by the fact that five of the project's target countries are already EU member states and Croatia is likely to join the EU soon. At the same time, the EU is very much interested in the success of ongoing WTO negotiations, in which food health and safety is a key topic. The following item will deal briefly with the international framework. The subsequent item will summarize the experts' recommendations regarding stakeholder policies.

4.2. The international framework for recommendations

International trade with unprocessed agricultural products has played an important role for centuries. Nevertheless, in the last decades trade with food, as unprocessed agricultural products as well as processed food, has reached a new dimension. After 2005, international public awareness started focusing on the high degree that globalisation of food trade had reached, as well as on the newly emerging link between agriculture and energy generation.

Efforts to base economic relations between countries on a system of multilateral agreements started after World War II and led to the foundation of the International Monetary Fund and World Bank. The General Agreement on Tariffs and Trade (GATT), started in 1947, which in 1995 was followed by the World Trade Organization (WTO). In 1994, the Uruguay Round of GATT achieved agreements on agriculture, on technical

barriers to trade, and on the application of sanitary and phytosanitary measures. The latter agreement does not set standards, but identifies three standard-setting organisations: the International Office of Epizootics (animal health), the International Plant Protection Convention, and The Codex Alimentarius (see Box 1) dealing with food safety. The agreement on sanitary and phytosanitary measures aims at helping governments to protect consumers, but also at getting health and sanitary regulations removed, with the help of the WTO Appellate Body, if they represent disguised protectionism. In fact however, in applying the Uruguay Round of the GATT, sanitary and phytosanitary measures have often substituted the reduced tariff barriers.

Box 1: Codex Alimentarius

In 1962, the UN established the Codex Alimentarius Commission (CAC) as a trade commission. Its task was to suggest regulatory and control instruments with regard to how food and nutritional supplements are produced and sold to the consumer. The commission prepared a collection of standards, codes of practice, guidelines and other recommendations relating to foods, food production and food safety. A first version of it was published by the UN organizations FAO and WHO in 1963.

The Codex Alimentarius (CA) covers processed, semi-processed and raw food, with a special focus on foods that are marketed directly to consumers. It deals with issues such as food labelling, food hygiene, food additives and pesticide residues, and procedures for assessing the safety of foods derived from modern biotechnology. It contains guidelines for governmental import and export inspection and food certification systems. As a tool for performing sample controls, the Codex suggests the Hazard Analysis and Critical Control Point (HACCP) concept, a preventive food security approach. EU Directive 178, effective since 1 January 2006, establishes a food safety management system (FSMS, such as ISO 22000) which foresees that only food, which is in line with HACCP rules, can be imported and traded within the EU.

All 27 EU countries are member states of the Codex Alimentarius Commission, and in addition also the EU Commission became a member in 2003. The World Trade Organization recognizes the Codex as an international reference point for the resolution of disputes concerning food safety and consumer protection.

The Codex Alimentarius is going to be inaugurated on 31 December 2009. Opponents from the health freedom movement criticize the principle of everything being forbidden, which is not explicitly permitted and criticize a presumptive bias in favour of large producers of food and pharmaceuticals. For sure, CA will experience further development in the future. Its merit is that it creates the potential for trade with healthy and safe food all over the world with no or only minimal non-tariff barriers.

GATT and WTO were instrumental in backing international trade by multilateral agreements. However, still a lot has to be done to come closer to this goal. Current agreements still allow for bilateral trade agreements under certain conditions, and in many areas, multilateral regulations have not yet been achieved. Tariffs have been reduced, but not eliminated for all products, and fierce discussions are going on about non-tariff barriers – which of them represent disguised protectionism. This includes the question, in which case geographical 'brand' names should be protected.

WTO and multilateral agreements are only one stage. Another stage is grassroot initiatives, which are mushrooming all over the world. These initiatives are rather strong in the USA. Examples are Community Food Security and Food Policy Councils in all States and in major cities, or the Farm to Table initiative, which works directly with farmers, industry and government to promote innovative, environmentally sound practices and sustainable, local agriculture.

EU principles of food policy approach

The EU has a comprehensive food safety strategy: It covers not just *safe food,* but also *animal health and animal welfare, and plant health*. The strategy ensures that food is traceable as it moves from the farm through to table ('farm-to-fork-approach'), even if this means crossing internal EU borders, so that trade is not held up and choice and variety in food is achieved. The high standards apply to *food produced inside the EU and to food imports.*[20]

Due to food safety scares in the 1990s including the BSE (bovine spongiform encephalopathy) crisis, dioxin-contaminated feed and adulterated olive oil, food policy underwent reform in the early 2000s: The European Commission adopted the *White Paper on Food Safety* in the year 2000. An Action Plan consisting of 84 points was annexed to the White Paper. The main pillars of food safety contained in this White Paper are: scientific advice, data collection and analysis, regulatory and control aspects as well as consumer information.[21] The overhaul started in earnest in 2002 with the publication of the so called *General Food Law*.[22] This 'umbrella' legislation was phased in between 2002 and 2005. It includes the principles applying to food safety, introduces the concept of 'traceability', sets up the European Food Safety Authority (EFSA) and reinforces the rapid alert system.[23]

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[20] See http://europa.eu/pol/food/overview_en.htm.

[21] European Commission (2000).

[22] Regulation 178/2002 of the European Parliament and of the Council, laying down the general principles and requirements of food laws, establishing the European Food Safety Authority and laying down procedures in matters of food safety. See also Wijnands, et al (2006), p. 64.

[23] European Commission (2004), p.6.

The EU however recognises that 'safety does not mean uniformity'. The EU hence promotes diversity based on quality and protects traditional foods and products from specific regions by ensuring consumers can distinguish them from copies. It has developed the following 'quality marks': 'Protected Designation of Origin (PDO)', 'Protected Geographical Indication (PGI)', 'Traditional Speciality Guaranteed (TSG)' and 'organic farming'.[24]

Concerning the enlargement, from the outset, the EU made clear that food safety was an element of the enlargement process where no risks would be taken that might lead to lower food safety standards or to any threat to consumers. A safeguard clause could be invoked during a period of up to three years after accession, but the measures may be applied beyond the period as long as the relevant commitments have not been fulfilled.

[24] European Commission (2004), p.21.

4.3 Recommendations

As expressed in one of the visions, the CEE-6 food experts regard it as feasible that this region will become one of the leading producers of healthy and safe food in Europe. It depends on a number of factors whether the food industry will develop the ability to reach high quality standards especially in terms of food security, safety, diversity and taste. Companies will need to equip themselves with human and physical capital of adequate quality. This means *availability of advanced technology and expert knowledge*. An additional precondition is the availability of high quality supply of raw material, intermediary products and services supportive to food production.

Ability to reach highest quality standards alone is no guarantee that actual performance will always reach this level. Even in the case of the potential being in place, the food producers may or may not continuously strive for actual high quality levels. This will depend on incentives, especially those from the markets, as well as on negative consequences they have to face if missing the standards. Both incentives and negative consequences will be stronger in the case of a *highly developed control and information culture*, something the EU is heading for. The aim is making sure that a large proportion of the population, and not merely experts, will be able to assess the different aspects of food quality. Such a culture is in the best interest of the food industry, as it will strengthen its international competitiveness.

In order to reach certain visions, actions should not contradict each other and *synchronisation* is needed in a number of areas: On the policy side, a clear formulation of targets should be sought and endeavours combined into bundles. On the practical level, regulations should not be contradictory. Furthermore, linkages should be created in order to increase effectiveness and facilitate technological progress.

The policy recommendations, which the CEE-6 experts have formulated in the course of the different stages of the project, are addressing these three aspects just mentioned, as the following brief summary shows:

(1) Recommendations aimed at improving the CEE-6' capacity to produce high-quality food

- ***Increase the availability of advanced technology and expert knowledge****:* In the context of food quality in terms of food healthiness, safety, taste and diversity, it is important that food producers should have at their disposal knowledge about feasible technical solutions, which for the time being are state of the art not only in the countries under consideration, but globally. In a more advanced stage, some producers alongside the food chain may start developing solutions of their own. Technological knowledge has to be the basis for decisions about physical investment and hiring of personnel. The project's CEE-6 experts were fully aware of this fact, as is reflected both in their vision of

a knowledge-intensive agro-food sector and corresponding policy recommendations. Personnel inside the companies accumulate technical knowledge predominantly through learning on the job, which should be, as the experts suggest, facilitated. They will be more successful in doing so in the case of good educational background. At the same time, research institutes and other service providers such as laboratories also monitor what is state of the art and place effort in doing research and developing new solutions. The CEE-6 experts suggest to reform the region's systems of both education and Research and Development (R&D), to foster the integration of research institutes into EU networks and to create favourable conditions for the start of new self-financing institutes, homologation centres, tech-transfer centres, and innovation incubators.

- ***Adjust policies to the structure of the food industry:*** Countries going through a phase of technological catching-up can further develop even without doing much research and development. There is space for a take over of already existing state-of-the-art technologies, which is an important stimulus for investment and a powerful engine for productivity growth. However, the CEE-6 are characterized by a coexistence of larger domestically owned companies, which went through a process of restructuring; large companies, which at some point of time were taken over by foreign investors; small and medium-sized enterprises (SMEs); and micro companies, which frequently work at a subsistence level. Depending on this background, the companies' access to knowledge about best-practice technologies differs substantially. Foreign-owned companies have their research bases located in their home countries can easily transfer technology to the CEE-6. Small and medium-sized enterprises, especially locally owned ones, often have trouble in this respect, a fact that weakens their competitive position.
- ***Support flexibility and diversity:*** If small and medium-sized enterprises have difficulty to update their technologies, this is a problem for the food industry as a whole, as the vast majority of registered food producers belong to this category. The SME sector, within and outside the food sector, plays an important role as employer. In addition, SMEs have the potential of being flexible and innovative, even more than large companies. They can find very specific solutions, which are perfectly adapted to their production and market conditions. They can substantially improve their performance through practice-oriented close co-operation with research institutions, and this is what the CEE-6 experts suggest to strengthen. It is a way to turn a competitive disadvantage into an advantage. The precondition, however, is the high quality of the knowledge-institutes as SME partners. This category of enterprises has the potential to gain very much from improvements in the educational as well as research and development

system. Largely, the future degree of food diversity in individual countries will depend on the development of the SME sector. The SME sector is of high relevance for future increased availability of high-quality region-specific and traditional products in the CEE-6 region, as is envisaged in one of the CEE-6 experts' vision. A strong SME sector will at the same time also support the diversity of supply of functional food. A weak SME sector, on the other hand, tends to lead, as the experts stressed, to conservative behaviour, low labour force quality and lack of innovation due to low awareness of opportunities and narrow room of manoeuvre. In the CEE-6, the SME sector is still far from being in best shape.

- **Reduce obstacles for small and medium-sized enterprises:** The experts recommend removing or at least reducing a number of obstacles, which SMEs have to face. Examples are an output and revenue ceiling, which is low compared to minimum costs of e.g. information gathering; brand development, product presentation and other marketing activities; protection of intellectual property rights; product certification and other laboratory services; or breaking into new markets, especially foreign ones. Compared to larger companies, SMEs' access to loans is frequently more costly if open at all - even more so after the introduction of Basel II rules. Many of the currently effective regulations are suitable for large companies, but much less for smaller ones. The CEE-6 experts recommend efforts aimed at disenthralling the SME sector from such obstacles as far as possible, e.g. by providing information on regulations, the establishment of regional control units accessible to all producers or special local laboratories which should offer technical support at affordable prices. In their recommendations, the CEE-6 experts suggest protecting traditional region-specific food species and production techniques by law, also at the EU level. Promotion and marketing of these products in the countries will help and stimulate SMEs and several instruments have been mentioned for doing so (e.g. organization of traditional food events, special sections on traditional food set up in large retail chains, facilitation of market entry).

(2) Recommendations aimed at improving quality incentives, control and information

- ***Strengthen incentives for producing high quality:*** Markets are generating incentives to produce high quality output, and to gain a reputation as a producer of high quality food. Such incentives will be strong in the case of food quality being easily discernible for a high proportion of consumers. Many of the latter will complain about a lack of transparency, as long as the producers' and distributors' information duties are incomplete and in addition can be met by using encrypted codes. Consumers want to be sure that the product label tells the whole truth and does not conceal health-related shortcomings. Quality

standards need to be adequate to meet consumers' expectations; the probability of detection of violations of quality standards needs to be high; and the penalty severe enough to be prohibitive. These are the preconditions for a gradual rise in consumers' confidence. The CEE-6 experts strongly recommend addressing these requirements. They see much space for improvement in their countries and partly also in the EU as a whole. They stress that product labels should inform about ingredients, nutrition values, expiry dates, dietary properties, and storage conditions.

- ***Improve consumers' knowledge base:*** To be able to cope with food quality issues, consumers need to have an adequate educational background and additional access to non-biased information later on. The experts' recommendations suggest that the curricula of schools put more emphasis on nutrition-related knowledge, and point to the importance of associations and organisations that take care of consumer information, co-operation and protection. If they are strong, they will be successful in using different information channels such as media, Internet, traditional publication formats and establish contacts to opinion leaders such as physicians and dietologists.
- ***Improve the quality assessment and control system*:** There is a need for institutions, which make sure that food producers and distributors abide to currently effective quality regulations and standards. They have to be able to use state-of-the-art technology for assessing food quality in an unbiased way. This means they have to be both independent and staffed with both high-quality personnel and technical equipment. The frequency of control has to be high enough to make neglect of regulations a too risky business. In the context of EU accession, the installation of such a system was a major issue, as it is a demanding task, which needs a lot of organisational effort and considerable investment. Laboratories involved need EU accreditation, which can be withdrawn if there are serious doubts about unbiased performance. One important aspect is traceability of the origin of food ingredients, as this is the key for clarifying responsibilities. Not surprisingly, topics related to this institutional setting, which is new for the CEE-6, played an important role both in the experts' discussion and recommendations.
- **Avoid implicit protectionism:** The CEE-6 experts complained that in their countries currently the laboratories, which are tasked with controlling food quality, lack funds, qualified personnel and adequate technical equipment. Therefore, they urgently recommend steps towards a comprehensive modernisation of laboratories, which should have adequate funding e.g. thanks to public-private partnership with the help of EU funds. The experts' recommendations suggest a capacity enlargement so that controls will be more frequent and include not only a higher number of hazardous substances. In

addition, the food safety and health control system should also become capable to cope with the long-term negative impact on health as for example through mutagens and allergens. A weak control system may serve as an instrument of tacit protectionism, as it allows for the survival of low-quality production. The system needs to become fully functional; otherwise, the CEE-6 will not manage to join the club of Europe's leading food processors.

- ***Allow for intensive competition*:** Intensive competition will be crucial. Protectionism tends to support open or hidden weaknesses, which at a later point of time may surface and become irreparable. Industrial clusters have become famous for being supportive to technological catching up of companies involved. This is true, as long they act as competitors instead of forming cartels. A framework supporting direct trade between consumers and farmers that are processing their own products could serve as a tool for keeping competition vivid, for stimulating supply diversity and for fostering the evolution of new small and medium-sized enterprises. A control mechanism adjusted to the requirements of this market niche would have to be part of this framework.

(3) Recommendations aiming at better synchronisation

- ***Unify standards and norms:*** Better synchronisation should support the enforcement of the EU Acquis and lead to the abolition of exaggerated bureaucratic procedures. The experts reported problems with double standards and norms and complained about some cases of what they see as over-regulation. In other cases, they see an advantage in the unification of standards at EU level. Companies have more difficulties to become successful exporters, if they are confronted with a multitude of national regulations. It is also far from being optimal if a country's producers have to observe rules, which are not binding for imports.
- ***Increase co-operation between all main stakeholders*****:** Practically, experts from all CEE-6 see urgent needs for intensified co-operation between legislative and administrative government bodies, food producers and knowledge institutions. So far, long-term development strategies for the agro-ood sector are either missing or not in compliance with other strategies at a national or EU level. At the same time, the regulatory framework consists of many fragments, which are arranged in a confusing way. Crucial will also be the much more intensive co-operation between producers, consumers and strong knowledge institutions. It is a precondition for the realisation of the vision of research enjoying priority within national development strategies and co-operation within the food chain having been achieved, with special attention being paid to functional food.
- ***Enhance co-operation among producers:*** In the CEE-6, in the food industry the technological standards of companies differ strongly depending on the size and type of ownership. If subsidiaries of trans-national companies use state-of-the-art technologies, this may not have much spill-over effect on domestically owned large, medium-sized or small companies. The CEE-6 experts see a lack of co-operation between producers, both at different and same levels of the food chain. When purchasing input, companies frequently ignore domestic suppliers and prefer to rely on imports. The experts suggest efforts to ensure better co-operation and stronger business associations in the context of a 'farm-to-fork' approach. Co-operation is especially important for SMEs, as it may lead to more services being supplied locally and adjusted to their special needs. The implementation of high-technology solutions often requires an amount of investment, which is not affordable for individual SMEs. They can overcome this obstacle through joint investment, leasing arrangements or outsourcing. For SMEs it is a problem to observe all regulations, given that changes are frequent. The CEE-6 experts suggest establishing a guidance system adapted to the needs of small-scale producers.

4.4. Concluding remarks

When it comes to the roadmaps that are supposed to lead to the realisation of the four visions by the year 2020, strong emphasis is placed on the role of governments. Different government levels (municipalities, province and national governments, EU and other supranational institutions) are supposed to act as regulators; to install adequate institutions and take care of an adequate business and consumer environment; and to channel developments through financial support (e.g. in the sphere of education and research). Indeed, should the governments do a good job in all these fields; this will have a crucial positive effect. It will make life for consumers and producers easier. However, in the end it is up to consumers and producers, the two types of decision makers, in which direction the markets will develop. A 'the-government-should' approach is very European and could be felt in this project as well – in spite of discussions about business associations, civil society or entrepreneurial initiatives, co-operation between players and other forms of private self-organization. As a matter of fact, politicians show more willingness to initiate new arrangements as soon as they see some backing, which has to come from individuals – consumers, producers – who know what they want, and from associations of such individuals.

The CEE-6 experts mentioned 'competitiveness' much more frequently than 'competition'. For the realisation of the experts' long-term visions, it is important that the region's food industry be fully exposed to competition.

Technology Foresight is a new participatory approach using scientific tools with the aim of mobilizing both: thinking about potential long-term development paths and efforts aimed at shaping the future. The objective is opening rather than closing a process. In line with this, one of the key merits of this project is that it has opened the floor to a discussion of food safety and healthiness issues in a long-term prospective, whereby it managed to mobilize a large number of stakeholders who not only have engaged in formulating visions, but also reflected on proper ways of realisation. Both the demand and supply side of the agro-food sector can benefit a lot from absorbing the project's results and making use of the road maps that the project has developed; and also from keeping the floor open in the future, so that in the six countries a new discussion culture will take care of nutrition-related visions and their realisation.

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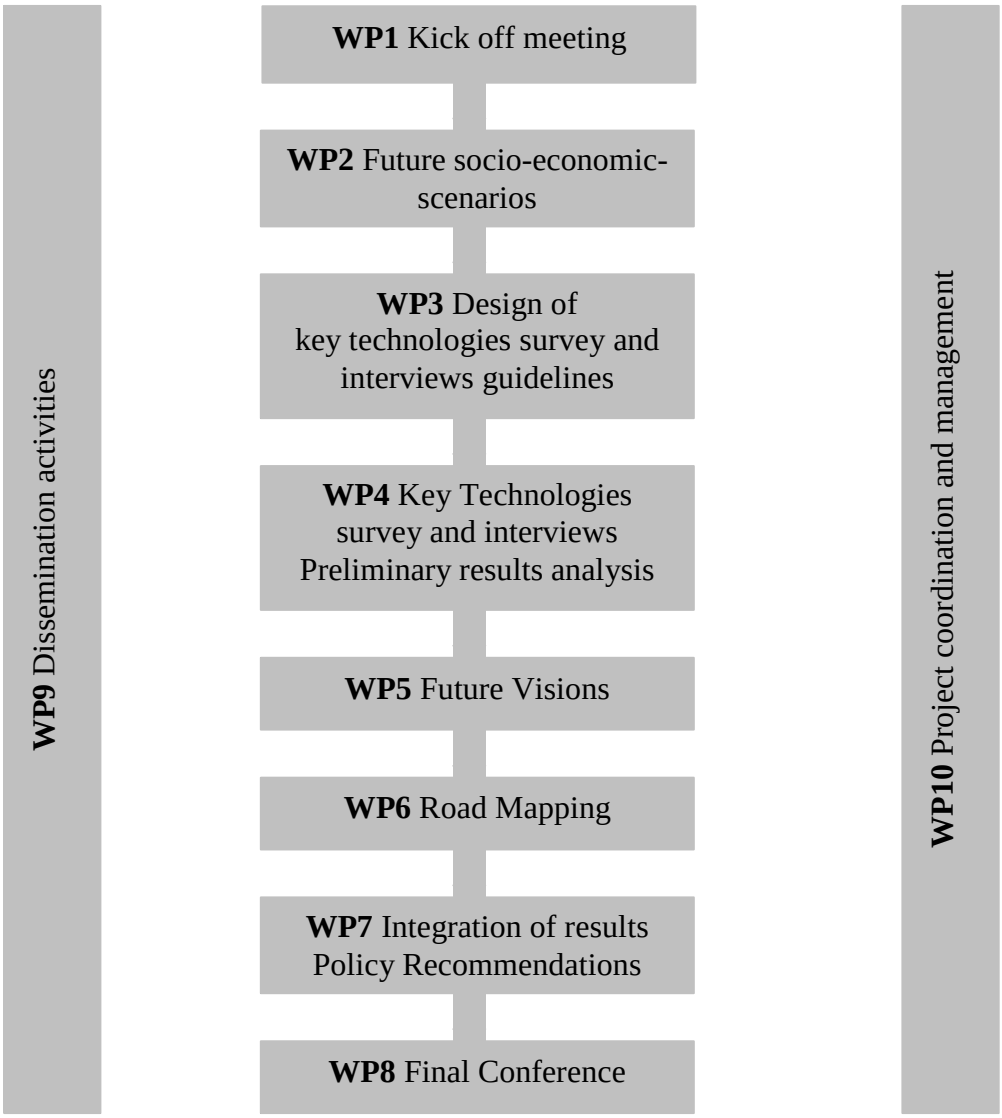
Annex

A.1 Work plan flowchart (WP= work package)



A.2. Consortium partners

United Nations Industrial Development Organization (UNIDO)
www.unido.org

The project consortium leader. Established in 1966 became a specialized agency of the United Nations in 1985. Headquartered in Vienna, UNIDO designs and implements programmes to enhance the productivity of industry in developing and transition economies. UNIDO counts among others with special services on industrial policy, traceability and the agro-industry. Activities on Technology Foresight have been part of the UNIDO technical cooperation since 1997. From 2001, UNIDO is implementing a global programme on technology foresight that draws on regional initiatives. Currently, UNIDO is carrying out initiatives in Latin America, CEE and the Newly Independent States (NIS) and in Asia. The outcomes of the initiative are policies and R&D programmes that deal with innovation, industrial growth and competitiveness. Within the FutureFood6 project, UNIDO is responsible for overall project management and coordination.

OPTI - Fundación Observatorio de Prospectiva Tecnológica Industrial
www.opti.org

The OPTI Foundation, created in 1997, is a non-profit foundation falling under the protectorate of the Spanish Ministry of Industry, Tourism and Commerce.
The OPTI Foundation is structured as a network of knowledge, gathering nine High Level Technology Centres and aiming at identifying key emerging technologies in relation to a wide range of areas, by means of Technology Foresight and Technology Watch activities. Up to now OPTI has carried out about 60 foresight studies, both at national and international level. At national level, OPTI was involved in the development of the National R&D&I Plan for 2008-2011 and also it has worked with virtually every Regional Government in Spain in setting up their Regional Technology Policies, through the application of foresight. At international level OPTI has participated in nine European projects and some others in South America. Additionally, OPTI and the National Patent Office (OEPM) have carried out Technology Watch actions since 2000.

The Vienna Institute for International Economic Studies
www.wiiw.ac.at

An independent research institute established in 1973, WIIW specializes in the analysis of economic developments in Central, East and Southeast Europe. Since the 1990s, the institute has been principally engaged in transition economics and policy advice. In research the main focus lies on the analyses and forecasting of economic developments of economies, the analysis of structural developments in the countries, the European integration process and research related to the reconstruction and stabilization in Southeast Europe. As of 2004, WIIW experts are engaged in economic policy advice to the President of the Republic of Croatia, the Government of Serbia and the President of the Republic of Macedonia. Currently, WIIW is also partner in several EU-funded research networks and research relations with organizations such as UNIDO, UNCTAD, OECD and EIB. Within the FutureFood6 project, WIIW is responsible for the integration of results derived from the activities and shaping policy recommendations.

Institute of Economics, Hungarian Academy of Sciences

(IE HAS)
www.econ.core.hu

Committed to international standards of fundamental and applied research in economics, IE HAS has focused increasingly on the analysis of the contemporary market economy and the transformation of the Hungarian economy. The Institute puts strong emphasis on promoting academic cooperation with other Hungarian and European research centers. The Institute's research fields include Macroeconomics, International Economics, Public and Institutional Economics, Economics of Innovation, Microeconomics and Sectoral Economics, Mathematical Economics, History of Economic Thoughts. IE HAS staff was involved in the first Hungarian Technology Foresight Programme as well as in EU and UNIDO foresight projects; they have been involved in various EU DG Research High-Level Experts Groups and advised a number of national foresight programmes. Within the FutureFood6 project, IE HAS is responsible for the design of the Key Technology Survey and Interview Guidelines as well as for support in performing the Survey and Interviews.

Technology Centre of the Academy of Sciences CR
www.tc.cz

Established in 1994 TC AS CR is a consortium of several institutes of the Academy of Sciences of the CR. It carries out independent analytical and strategic studies for Czech state administration particularly in area of science, technology and innovation. It plays the role of the National Information Centre for European Research and is involved in trans-national technology transfer. TC AS CR works in close cooperation with the Council for Research and Development and several Czech ministries and is involved in a number of EC projects and cooperates with UNIDO. Main activities include Strategic Studies and Projects (e.g. foresight activities, strategies for research and innovation policies), Regional Development (e.g. regional innovation strategies), National Information Centre for European Research, Technology Transfer (cooperation with enterprises in innovation issues etc.). Within the FutureFood6, TC AS CR is responsible for the Road Mapping part of the project.

BIC Group s.r.o.
www.bicgroup.sk

A private limited company established in 1993. Its activity is focused on projects dealing with innovation, regional development, technology transfer, technology foresight and others. A member of the Slovak Chamber of Commerce and Industry BIC Group has been a member of the IRC Slovakia consortium (Innovation Relay Centre) since 1997. Since 2008 BIC Group has been a member of the Enterprise Europe Network that builds upon the experiences from the Innovation Relay Centers network. The range of activities involves Support to R&D institutions (National Contact Points during FP5), SMEs support (e.g. company matching, benchmarking), Technology Foresight Exercises, Technology Transfer (e.g. inward and outward TT projects), Innovation projects, Regional Development projects (e.g. regional innovation strategies within FP6), Establishment of Clusters and Networks (FP7 project). Since 2006 BIC Group experts have been involved in a technical assistance project for the Ministry of Economy of SR designing the industry and innovation development strategy for Slovakia for 2007-2013 with an outlook to 2020. Within the FutureFood6 project, BIC Group is responsible for dissemination activities.

National Wholesale Market Company Inc.

www.veletrznica.mps.hr

National Wholesale Market Company is a joint stock (shareholding) Company founded in 1998. The founder and the only member of the Company is the Republic of Croatia. The main role of the NWMC is implementing the Croatia Wholesale Market Project. NWMC coordinates the interaction between the Government of the Republic of Croatia, the European Bank for Reconstruction and Development and Central European Initiative as the key investors, international and domestic counsellors, regional wholesale markets, and local governments as well as other subjects relevant for the realisation of the Project. Apart from the wholesale market project, the National Wholesale Market Company has been actively involved in several projects of the Ministry of Agriculture, forestry and water management.

Executive Agency for Higher Education and Research Funding (UEFICSU)
www.cncsis.ro

The National University Research Council (NURC) and its executive agency UEFISCSU are the main Romanian funding organizations for university and postgraduate research programmes. UEFISCSU represents also a center of expertise in science and technology policies and foresight, coordinating large foresight exercises in Romania, strongly connected with policy making, and being involved as a partner and coordinator in numerous FP6 and FP7 projects. Starting in 2007, UEFISCSU has coordinated two programmes of the National Research, Development and Innovation Plan, namely “Ideas” and “Human Resources”, having the total amount of 1/5th of public funds for scientific research in Romania (about Euro 1 Billion for 2008-2013). Also, since November 2008 UEFISCSU has coordinated five European Structural Funds projects. UEFISCSU has an SR EN ISO 9001:2001 certification for research programmes management, software management and data processing.

Applied Research and Communications Fund (ARC Fund)
www.arcfund.net

ARC Fund is a premier Bulgarian NGO, established in 1991, active in the field of innovation policy and knowledge-based economy. During its 17 years of experience, ARC Fund has established numerous contacts with the most relevant research organisations in Bulgaria, and has a sound network of contacts with enterprises in key areas such as: Environment, Energy, ICT, Food, Agriculture and Biotechnology, Textiles, Transport. Under FP6 ARC Fund implemented an array of projects in areas as diverse as environment (EraEnvironment), energy, agro-food (Quality-Meat, SARA, FutureFood6), ICT (EuropeanIST, ISTBonus, GET-IN), transport (TranSMEs) and in textile (ITE, Fashion to Future). Since 1991 ARC Fund initiated and coordinated the Innovation Relay Centre – Bulgaria (currently Europe Enterprise Network in Bulgaria), two Regional Innovation Strategy (RIS) actions - for the South Central and the South West Regions of Bulgaria, as well as a pilot Technology and Innovation Foresight for Bulgaria and Romania project in biotechnology and e-government. ARC Fund is the country correspondent of the ERAWATCH initiative, winning a service contract for the implementation of the “ERAWATCH Trans-national Regional Study” for 16 EU regions.

A.3. Interview Guidelines

1. Instructions

Interviewees were asked to answer the questions covering their fields of expertise (i.e. not all questions, and not necessarily all details of those questions that concern several players). All questions concern the respondents' own country, unless otherwise specified.

When asking questions concerning food safety and quality, please use the following definitions, and also share these with your interview partner.

2. Definitions

Food Safety
Involves consideration of all hazards, unintended or intended, arising along the farm-to-fork continuum, including but not limited to pathogens, toxins, chemicals, and physical objects. A product is considered to be safe, whether it is consumed orally either by a human or an animal, when it does not cause a health risk to the consumer.

Food Quality
The quality of merchandise is defined as the commodity's ability to fulfil consumer expectations, needs and wants and producers' promises.
Quality includes all attributes that influence a product's value to the consumer.

Quality Assurance and Control
The goal of quality assurance and control is to assure that all materials and products used in the manufacturing process as well as those sold onto the market, conform to given specifications. Quality assurance denotes all the relevant methods built into the whole agro-food chain, and used permanently, while quality control denotes processes and methods used ex-post.

3. Background information of interviewees

Number of respondent:
Position (without the actual name of the organisation):
Field of expertise (or field of highest level of education):
Degree of education/ science (e.g. university degree, PhD):
Age: (years)
Gender:

4. Guiding questions

Please discuss any other relevant issues with your interview partner along the broad themes and issues suggested below – but not elaborated in full detail, as country characteristics are not taken into account in this set of guiding questions.

A) Awareness of food quality and safety issues

1. What is the ***current level of awareness of food quality and safety*** issues in your country? Are there major differences among the stakeholder groups: consumers, agro-food business, policy-makers, and researchers? Are there major differences inside these groups?
2. Is the ***current level of awareness*** sufficient for being competitive in the various markets (domestic and major export markets), meeting the EU and national as well as consumer groups' requirements? If not, what steps are to be taken to raise awareness in the next 2-3 years?

B) Legal and physical infrastructure

3. Is the ***current legal infrastructure*** sufficient to deal with food quality issues and meet safety standards? What changes would be required in the legal infrastructure in order to meet the likely business, societal and regulatory challenges in the medium- and long run (2012; 2020)? Do you see a need to improve / amend the EU and national rules concerning food quality and safety? If yes, in what fields, and how?

By legal infrastructure we mean the official rules (incl. all the laws and other legally binding norms), and procedures through which the farm to fork chain is regulated, information on food quality and safety is collected, made accessible, and shared.

4. Is the ***current physical infrastructure*** sufficient to deal with food quality issues and meet safety standards? What changes would be required in the physical infrastructure in order to meet the likely business, societal and regulatory challenges in the medium- and long run (2012; 2020)? Do you see a need to improve / amend the EU and national rules concerning food quality and safety? If yes, in what fields, and how?

By physical infrastructure we mean all the equipment, instruments and other relevant hardware and software used for checking, assuring and controlling food quality and safety by any relevant private, public or 'hybrid' organisations.

C) Socio-economic factors affecting food quality and safety

5. What are the likely changes in the most important factors affecting the ***demand for food, and in particular consumers' preferences*** (functional and healthy foods, GMO food, concern for environment and sustainability, demographic changes, increase of consumer income, changing eating habits, etc.) up to 2020?

6. What are the likely developments / trends affecting the ***affordability*** of functional and healthy food for ***consumers***?
7. What are the likely changes in the most important factors (incl. scientific and technological, political, economic factors) affecting the ***behaviour (strategies) of the different players in the agro-food industry*** concerning food quality and safety up to 2020? (Please think of the producers of inputs, food processors, food retailers; please distinguish SMEs and large firms, domestic vs. foreign-owned firms, if it is relevant.)
8. What are the likely developments/ trends in the areas of ***supply chain management, in the agro-food industry*** concerning food quality and safety up to 2020?
9. What are the likely developments / trends in the areas of ***new business models, including organisational innovations, knowledge management, the agro-food industry*** concerning food quality and safety up to 2020?
10. What are the likely changes in the most important factors affecting the ***research agenda*** (main research questions / objectives and methods) ***of the various types of research organisations*** working in the fields relevant for food quality and safety up to 2020?
11. What are the likely developments / trends in the area of ***environmentally friendly farming practices,*** which would affect food quality and safety up to 2020? (As *an example*, in order to protect crops from diseases, the US took the 'biotechnological way', seen as unnatural and dangerous by many, while the EU's agriculture uses excessive amounts of chemicals, polluting the environment and leaving unhealthy residues in food products.)

D) Technological issues

12. What are the most important ***trends in test and measurement (diagnostic) technologies*** affecting food quality and safety up to 2020? How would these trends evolve in your country? Please consider human and financial resources, legal and physical infrastructures, as well as other factors fostering or hampering the diffusion / application of these new technologies. Would these trends have positive or negative impacts on food quality and safety?

Should there be *positive* impacts on safety issues, please assess their likely effects, using the following table:

	Physical hazards	Chemical hazards	Biological hazards
Prevention			
Reduction			

Key: use a 1-5 scale; in which 1 denotes minor impact; 5 denotes strong impact

13. What are the most important ***trends in packaging technologies*** (including new materials) affecting food quality and safety up to 2020? How would these trends evolve in your country? Please consider human and financial resources, legal and physical infrastructures, as well as other factors fostering or hampering the diffusion / application of these new technologies. Would these trends have positive or negative impacts on food quality and safety?

Should there be *positive* impacts on safety issues, please assess their likely effects, using the following table:

	Physical hazards	Chemical hazards	Biological hazards
Prevention			
Reduction			

Key: use a 1-5 scale; in which 1 denotes minor impact; 5 denotes strong impact

14. What are the most important ***trends in biotechnologies*** affecting food quality and safety up to 2020? How would these trends evolve in your country? Please consider human and financial resources, legal and physical infrastructures, as well as other factors fostering or hampering the diffusion / application of these new technologies. Would these trends have positive or negative impacts on food quality and safety?

Should there be *positive* impacts on safety issues, please assess their likely effects, using the following table:

	Physical hazards	Chemical hazards	Biological hazards
Prevention			
Reduction			

Key: use a 1-5 scale; in which 1 denotes minor impact; 5 denotes strong impact

15. What are the most important ***trends in ICT and automation technologies*** affecting food quality and safety up to 2020? How would these trends evolve in your country? Please consider human and financial resources, legal and physical infrastructures, as well as other factors fostering or hampering the diffusion / application of these new technologies. Would these trends have positive or negative impacts on food quality and safety?

Should there be *positive* impacts on safety issues, please assess their likely effects, using the following table:

	Physical hazards	Chemical hazards	Biological hazards
Prevention			
Reduction			

Key: use a 1-5 scale; in which 1 denotes minor impact; 5 denotes strong impact

16. What are the most important ***trends in nanotechnologies*** affecting food quality and safety up to 2020? How would these trends evolve in your country? Please consider human and financial resources, legal and physical infrastructures, as well as other factors fostering or hampering the diffusion / application of these new technologies. Would these trends have positive or negative impacts on food quality and safety?

Should there be *positive* impacts on safety issues, please assess their likely effects, using the following table:

	Physical hazards	Chemical hazards	Biological hazards
Prevention			
Reduction			

Key: use a 1-5 scale; in which 1 denotes minor impact; 5 denotes strong impact

17. What are the most important ***trends in other technologies*** (not covered above) affecting food quality and safety up to 2020? How would these trends evolve in your country? Please consider human and financial resources, legal and physical infrastructures, as well as other factors fostering or hampering the diffusion/ application of these new technologies. Would these trends have positive or negative impacts on food quality and safety?

Should there be *positive* impacts on safety issues, please assess their likely effects, using the following table:

	Physical hazards	Chemical hazards	Biological hazards
Prevention			
Reduction			

Key: use a 1-5 scale; in which 1 denotes minor impact; 5 denotes strong impact

E) Other major issues affecting food quality and safety

18. Any ***other major issue***, affecting food quality and safety in the medium- and long-term future (2013; 2020), but not covered above?

A.4. List of technologies covered in the key technologies survey

Test, measurement and diagnostics technologies (1-5)

1 New *physical methods to assess sensory attributes*; in-mouth measurement and breath analysis of flavour- and taste release from products; physical methodologies for describing and understanding the mechanics of chewing and structure degradation.

2 *New in line non-destructive methods and control systems*, integrated and pervasive sensor networks throughout factories for assessing the quality and safety and recording their fluctuations during processing.

3 *Nanotechnological sensor systems* compatible with food systems for the direct and *in situ* assessment of quality within products.

4 Improved, *non-destructive analytical and microbiological methods* for the detection and monitoring of the food safety hazards integrated into quantitative risk assessment routines.

5 New methods based on in *vitro assays and biomarkers*, which are capable to predict in vivo functionality of bioactive components specifically designed for the development of tailor-made food products.

Food packaging technologies (6-10)

6 *Active packaging* capable of changing either package permeation properties or the concentration of various volatiles and gases in the package headspace during storage, or adding small amounts of microbial, anti-oxidative or other quality improving agents via packaging material.

7 *Advanced systems providing information*, including labelling systems, traceability systems, intelligent packaging technology, anti-counterfeiting technology, or radiofrequency identification technology ('RFID').

8 *Development and application of new packaging systems* allowing the full utilization of the benefits of new food packaging technologies and better food packaging materials used in modern food processing.

9 *Edible films and coatings* made from natural ingredients able to protect coated food from spoiling, against food poisoning bacteria, or to hold vitamins and other nutrients boosting the food nutritional value.

10 New environment friendly *bio-derived, biodegradable, recyclable, and energy efficient food packaging materials*.

Biotechnology (11-15)

11 *Biochemical modification of food ingredients*, based on removing molecules causing health problems (i.e. gluten, allergens) or food modification for better consumer utilization (i.e. hydrolysed fat component).

12 *Microorganisms with specific metabolic products* enriching food with essence elements (fatty acids, amino acids and other biomolecules in the form of native or separated biological structures).

13 *Specifically bound molecules of medicines incorporated in food*, capable of using the protection function of food molecules during digestion, thus ensuring the transport of medicine into target tissue and facilitating regular and more effective distribution of medicine (especially in the case of patients with memory malfunctions).

14 *Signal bacterial molecules*, capable of regulating the micro-organism vegetation process (deceleration, acceleration), modify micro-organisms metabolic activity (to avoid generation of toxins) or modify the sporulation process (initiate or quit).

15 *Technology of food marked by biological molecules* based on a combination of specific molecules that are part of the food, facilitating the identification of food adulteration by other producers as well as find out the food identity (traceability of food) in case all other identifiers and labelling in paper or electronic form have been lost.

ICT technology (16-20)

16 *Small, economically viable and user-friendly equipment* for consumers to test food quality, located in different locations of the distribution channel.

17 *Micro sensors* integrated in food packages for detecting – alerting food quality alterations.

18 *Memory chips* integrated in the package of food products and connected to biosensors for analyzing and recording environmental conditions (temperature, humidity, etc.).

19 *ICTs*, which connect consumers' mobile devices to product information in stores and facilitate access to subjective evaluations and the synchronization of the shopping basket with dietary prescriptions.

20 Data banks on raw materials and their use as inputs for food products are linked to environmental data banks and monitoring systems; that enables the monitoring of the relationships between the environmental conditions (contamination of soil and plants) and the quality and safety of the food. This information system can be organised by the food producers in order to assure their final product quality.

Nanotechnology (21-24)

21 *Nanoscale encapsulation of food additives* (aminoacids, vitamins, peptides, proteins, antioxidants and other biologically active substances) for controlled release of their contents at targeted spots in the body.

22 *Nanomaterials tagged with fluorescent colour-coded probes* made out of synthetic tree-shaped DNA, and capable of detecting and neutralizing animal pathogens in livestock products before they reach consumers.

23 *Nano and microsensors for detection of toxins, pathogens, pesticides, contaminants and antibiotic residues* in food products throughout their production cycle and on the shelves.

24 *Nanocapsules* to develop *interactive foods* to satisfy individual preferences for taste, texture and appearance.

Other technologies (25-26)

25 *Nutrigenomics* interacting with chemicals in food, capable of turning on and off certain genes responsible for disease prevention.

26 Precision farming that uses computers, global satellite positioning systems, and remote sensing devices to measure highly localised environmental conditions, thus determining whether crops are growing at maximum efficiency or precisely identifying the nature and location of problems.

Functional food (27-28)

27 *Non-thermal processing technologies* such as High pressure treatment (HPT) or Pulsed electric field (PEF), capable of preserving biological nutrients (vitamins, minerals, omega-3 fatty acids, dietary fibre, bioactive peptides and proteins, and other health promoting compounds) in nutritionally dense food products.

28 *Encapsulation of different biological nutrients*, capable of maintaining taste, colour, texture and nutritional value of functional food.

A.5. Key technologies survey questionnaire - example

Test, measurement and diagnostics technologies

1.	**Level of expertise***	**Current level of technological development globally****					**Position of your country in developing this technology**				**Position of your country in applying this technology**			
		Emerging	Sound R&D results	Working prototype	First industrial application	Widely used	Weak	Fair	Good	Excellent	Not yet applied	Experimental use	Applied by leading actors	Widely used
New *physical methods to asses sensory attributes*; in-mouth measurement and breath analysis of flavour and taste release from products; physical methodologies for describing and understanding the mechanics of chewing and structure degradation														

* Please asses your level of expertise using the following scale: 1 – unfamiliar, 2 – casually acquainted, 3 – familiar, 4 – knowledgeable, 5 - expert.

** **Emerging**: interesting ideas, but strong scientific and practical uncertainties; **Sound R&D results**: not yet mature enough for application; **Working prototype**: the technology works in labs as a prototype, further efforts are needed for practical applications in real life conditions; **First industrial application**: applied by leading actors; **Widely used:** the technology is used by many firms and other users in real life conditions.

Potential impacts by 2020 in your country	**Significant negative impact**	**Weak negative impact**	**Neutral (no impact)**	**Weak positive impact**	**Significant positive impact**
Employment					
Economic growth					
Food safety, by types of hazards					
Biological					
Chemical					
Physical					
Health					
Food quality					