



Project no. **212117** Project acronym: **FUTUREFARM**
 Project title: **Integration of Farm Management Information Systems to support real-time management decisions and compliance of management standards**
 Instrument: **Collaborative project**
 Start date of project: **1st January 2008** Duration: **36 months**
 Thematic Priority: **THEME 2 FOOD, AGRICULTURE AND FISHERIES, AND BIOTECHNOLOGY**

Deliverable 1.1.2 Revision: Final
Analysis of external drivers

Due date of deliverable: **30/06/2008**

Actual submission date: **17/11/2008**

Work package 1: **Vision of the farm of tomorrow**

Organisation name of lead beneficiary for this deliverable:
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Accepted by Soren Pedersen, 11/3/2009

Accepted by Simon Blackmore, 11/3/2009

Project co-funded by the European Commission within the Seven Framework Programme (2007-2013)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Abstract

The purpose of this report is to analyze external drivers that could have a significant impact on knowledge management methods and on farming systems as a whole for the next 25 years.

The analysis was conducted on the basis of literature review and the personal judgment of the expert authors. For each external driver, the authors provided a description which also included recent data and a historical review of the driver. Moreover, the authors tried to identify the impact of each driver on potential yield, prices, costs, farm management, labor resources, education, environment and technical equipment development. The impacts were weighted also in terms of time (short – mid – long term impact) and in terms of geospatial influence (national, EU – wide, worldwide). The above mentioned analysis was followed by important comments for each driver that the author wished to state as well as an importance grade (from 0 to 5) which shows the extend to which the certain driver is expected to influence farming systems as a whole in the future. Finally, a SWOT analysis was conducted for each driver, on the basis of strengths, weaknesses, opportunities and threats that the influence of each driver could impose on knowledge management methods and on farming systems as they are today.

Based on the above analysis, external drivers were categorized based on their importance grade and on their influence on potential yield, prices, costs etc. Additionally, the influence of each external driver on the rest of them was identified (again based on the experience of expert authors). A dependence matrix of external drivers was created, where each driver was evaluated according to its impact on each of the rest

The external drivers analyzed are climate change, growing population, energy cost, urbanization and land abandonment, aging population and health problems, ethnical and cultural changes, knowledge based bio economy, research and development, information and communication, education and investment. These drivers had already been identified in deliverable 1.1.1 of the same European project. The same deliverable defined the above described framework and methodology of the analysis.

The results of the analysis based on the methods described depict that the most influential on the future development of agriculture drivers are the climate change, the growing population, energy cost, urbanization and land abandonment, aging population and health problems and ethnical and cultural changes. These drivers are also the most independent on other drivers, whereas, most of the rest of the drivers depend on some or all of drivers.

As far as politicians, press and international organizations are concerned, the role that they will play in the future is not easily predictable. Food quality and safety as a driver is found to be dependent on a number of other drivers. The drivers of knowledge based bio-economy, research and development, information and communication, education, investment, partnerships, cooperation, integration and voluntary agreements, development of sustainable agriculture and valuation of ecological performances should be analyzed together in the future, because of the strong interdependencies that exist among them.

Document history

Version	Status	Date	Author
0.1	Draft	20.06.2008	Karel Charvat
0.3	Draft	21.07.2008	Karel Charvat
0.4	Draft	28.08.2008	Frank Dreger
0.5	Draft	11.09.2008	Spyros Fountas
0.7	Draft	05.11.2008	Frank Dreger
1.0	Final draft	07.11.2008	Karel Charvat
1.1	Final draft	09.12.2008	Katerina Apostolidi
2.0	Reduced document	02.02.2009	Karel Charvat
2.1	Reduced document	10.02.2009	Matej Krocan
3.0	Adaption of remarks	08.03.2009	Karel Charvat

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1 Introduction

The objective of this record is to analyze the following list of external drivers and their influence on European and world wide agriculture. The drivers analyzed were identified in report D1.1.1 in a previous stage. The analysis of external drivers is the basis for a roadmap for a farm management information system, which will be defined in the next stage. The roadmap analysis will be used later in WP4 for definition of objectives for the development of a future Farm Management Information System (FMIS) which is the overall aim of the FutureFarm project.

2 Methodology

Analysis was mainly provided on the basis of existing studies. It required analyzing large number of materials related to these issues. The ‘importance’ and the ‘influence’ of the different drivers are based on the judgment of expert authors. On the basis of this analysis the most important drivers for the future roadmap are recognized.

The results of expert and literature review analysis are found in Annex 1. The analysis of literature resources was provided by Future Farm partners from Karel Charvat (WR-INFO), Frank Dreger (ZALF), Walter Mayer (PROGIS) and Spyros Fountas (CRTH). At first stage every partner analyzed a group of selected drivers and ranked these drivers. At second stage the team looked for consensus about the description and ranking of drivers.

The result of ranking was concluded into two tables:

- Summarised ranking of Future Farm experts team opinion
- Interdependencies of external drivers

These two tables were used as base for conclusion from this report. Combining of literature review expert ranking partly minimizes the subjective opinion, but generally it is not possible to eliminate subjective aspects fully. For this reason in the next stage the opinion of experts was compared with the opinion of stakeholders (D1.2.2) and all these analyses are inputs for Initial Future Farm vision (D1.2.3). This work is based on the opinion of a limited group of scientists. In second stage during Future Farm project, the vision will be discussed with the team and also with experts outside the consortium and on the base of this exercise the final Future Farm vision will be established in the end of the project.

3 Analysis of external drivers

The analysis of external drives was divided into the following sections:

- Description of external drivers
- Influence till 2012
- Influence till 2020
- Influence till 2030
- Importance of external drivers
- Influence of external drivers on yield, prices, costs, farm management, labour resources, education, environment and equipment

- SWOT analysis

For all influences the following scale is applied:

- 5 - Very high influence
- 4 – High influence
- 3 – Influence
- 2 - Low influence
- 1 - Very low influence
- 0 – No influence

The ranking and review of literature resources is part of Annex 1.

4 Analysis of importance of external drivers

The following table summarizes the importance of single external drivers and their influence on yield, prices, costs, farm management, labour resource, education, environment and equipment

Table 1 Summarised ranking of Future Farm experts team opinion about importance of external drivers (5 is maximal influence 0 no influence)

	Importance	Yield	Prices	Costs	Farm management	Labour resources	Education	Environment	Equipment
Climate change	5	5	5	5	5	3	3	5	4
Growing population	5	2	5	2	5	3	5	5	5
Energy cost	5	5	5	5	4	4	3	5	5
Urbanisation and land abandonment	3	4	4	3	3	3	4	4	3
Quality of food & safety	5	3	5	3	5	3	5	5	5
Aging population and health problems	3	2	4	4	5	3	3	2	5
Ethnic and cultural changes	3	2	3	3	4	2	2	3	2
Knowledge based bio economy	5	5	3	3	5	5	4	5	5
Regulations and standards	4	4	5	5	5	3	3	5	4
Economic instruments	5	5	5	5	5	4	4	4	4
Subsidies	5	5	5	4	5	4	4	4	5
Investments into biotechnologies and bioenergy	5	5	4	5	3	3	4	3	5
Partnerships, Cooperation and Integration and voluntary agreements	4	3	3	3	5	3	5	3	5
Research and development in Agriculture	5	5	2	5	5	3	5	5	5
Information and communications	5	3	4	3	5	4	5	4	5
Development of sustainable agriculture	5	2	3	3	5	3	4	5	4
Valuation of ecological performances	5	3	4	4	4	3	3	5	4
National strategies for rural development	3	2	2	2	2	1	4	4	2
Politicians	2	2	2	2	2	2	2	2	2
Press	4	3	2	2	2	2	2	3	2
Education	5	5	2	5	5	5	5	5	5
International organizations	5								

From the previous analysis the most important external drivers recognised are the following:

- Climate changes
- Growing population
- Energy cost
- Quality and food safety
- Knowledge based economy
- Economical instruments
- Subsidies
- Investments into biotechnologies and bio-energy
- Research and development in Agriculture
- Information and communications
- Development of sustainable agriculture
- Valuation of ecological performance
- Education
- International organisations

The drivers with the highest influence on yield were:

- Climate change
- Knowledge based bio economy
- Economic instruments
- Subsidies
- Investments into biotechnologies and bioenergy research and development
- Education

Drivers with the highest influence on prices were:

- Climate change
- Growing population
- Energy cost
- Quality of food & safety
- Knowledge based bio economy
- Regulations and standards

- Economic instruments
- Subsidies

Highest influence on costs was shown by:

- Climate change
- Energy cost
- Quality of food & safety
- Regulations and standards
- Economic instruments
- Investments into biotechnologies and bio-energy
- Research and development
- Education

Drivers with the highest influence on farm management system were:

- Climate change
- Growing population
- Quality of food & safety
- Aging population and health problems
- Knowledge based bio economy
- Regulations and standards
- Economic instruments
- Subsidies
- Partnerships, Cooperation and Integration and voluntary agreements
- Research and development
- Information and communications
- Development of sustainable agriculture Education

Highest influence on labour resource was shown by:

- Knowledge based bio economy
- Education

Drivers with highest influence on education were

- Growing population
- Quality of food & safety
- Partnerships, Cooperation and Integration and voluntary agreements Research and development
- Information and communications

Drivers with highest influence on environment were:

- Climate change
- Growing population
- Energy cost
- Quality of food & safety
- Knowledge based bio economy
- Regulations and standards
- Research and development
- Valuation of ecological performances
- Education

Drivers with highest influence on equipment and technology were:

- Growing population
- Energy cost
- Quality of food & safety
- Aging population and health problems
- Ethnical and cultural changes
- Knowledge based bio economy
- Subsidies
- Investments into biotechnologies and bio-energy
- Partnerships, Cooperation and Integration and voluntary agreements
- Research and development
- Information and communications
- Education

5 Relation among external drivers

The following cross table summarises the interdependencies among single external drivers.

Table 2 Interdependencies of external drivers

	Climate change	Growing population	Energy cost	Urbanisation and land abandonment	Quality of food & safety	Aging population and health problems	Ethical and cultural changes	Knowledge based bio economy	Regulations and standards	Economic instruments	Subsidies	Investments into biotechnologies and bioenergy	Partnerships, Cooperation and Integration	Research and development in Agriculture	Information and communications	Development of sustainable agriculture	Valuation of ecological performances	National strategies for rural development	Politicians	Press	Education	International organizations
Climate change	X	no	high	no	low	low	low	high	high	high	high	high	high	high	high	high	high	high	low	high	low	high
Growing population	probably high	X	high	high	high but could be negative	low	high	high	high	high	low	high	low	high	high	high	high but could be negative	high	low	low	low	high
Energy cost	low	low	X	low	high but could be negative	low	high	high	high	high	high	high	high	high	high	high	high but could be negative	high	medium	high	medium	high
Urbanisation and land abandonment	probably high	no	high	X	medium	no	high	medium	medium	high	medium	medium	low	medium	medium	high	high but could be negative	high	high	high	low	high
Quality of food & safety	no	no	high	no	X	no	no	high	high	high	medium	high	high	high	high	high	medium	high	medium	medium	high	medium
Aging population and health problems	no	low	low	low	high	X	high	high	high	high	medium	high	medium	high	high	high	medium	high	medium	medium	medium	medium
Ethical and cultural changes	no	no	high	medium	high	no	X	high	medium	high	medium	high	medium	high	high	high	medium	high	medium	medium	high	high
Knowledge based bio economy	probably high	no	high	no	high	no	medium	X	high	high	low	high	high	high	high	high	medium	high	medium	medium	high	high
Regulations and standards	low	no	low	no	high	no	no	medium	X	low	high	medium	high	medium	high	high	high	high	low	low	medium	low
Economic instruments	low	no	medium	no	medium	no	low	high	low	X	low	high	medium	high	high	high	high but could be negative					
Subsidies	low	no	medium	no	high	no	low	medium	low	medium	X	medium	high	medium	medium	high	high	medium	low	low	medium	low
Investments into biotechnologies and bioenergy	low	no	medium	no	high	no	medium	high	low	low	low	X	high	high	high	high	medium	low	low	medium	high	low
Partnerships, Cooperation and Integration	low	no	low	no	high	no	low	high	low	low	low	medium	X	high	high	high	high	medium	medium	medium	medium	low
Research and development in Agriculture	low	no	medium	no	high	no	low	high	medium	medium	low	high	high	X	high	high	high	medium	low	medium	high	medium
Information and communications	low	no	medium	low	medium	no	low	high	medium	medium	low	high	high	high	X	high	high	medium	medium	medium	high	medium
Development of sustainable agriculture	low	no	medium	low	medium	no	low	high	medium	medium	medium	high	high	high	high	X	high	medium	medium	medium	high	high
Valuation of ecological performances	medium	no	medium	low	medium	no	medium	high	high	medium	high	medium	high	high	medium	high	X	high	medium	medium	high	high
National strategies for rural development	medium	low	medium	low	medium	no	medium	high	high	medium	high	high	high	high	high	high	medium	X	low	medium	high	low
Politicians	low	no	medium	low	low	no	medium	high	medium	medium	medium	medium	medium	medium	medium	medium	medium	high	X	low	medium	low
Press	low	no	low	no	medium	no	medium	low	low	medium	medium	medium	medium	low	low	medium	medium	medium	high	X	medium	medium
Education	low	no	low	low	high	no	high	high	low	medium	low	high	high	high	high	high	medium	medium	medium	medium	X	medium
International organizations	medium	low	medium	low	medium	no	medium	medium	high	medium	high	medium	medium	medium	medium	medium	medium	high	medium	medium	medium	X

Based on the analysis, the following new groups of external drivers were defined:

1. **Climate changes** - Since the mid-20th century, the climate of the earth have been changing. Amongst others, this includes changes of average, maximum and minimum temperatures, average rainfall and the number of days without rain, as well as altered wind patterns. Climate change poses a serious challenge to agriculture. Climate change could bring new crop pests and diseases. Changes in seasonal temperature and rainfall patterns could result in flooding, drought and more frequent extreme weather events. Higher sea levels might hamper agriculture in lowland areas.
2. **Demographic** - demographic changes mainly include growing population, but also urbanisation and land abandonment, other important change is low interest of young people about farming
 - o **Growing population** - As the world population continues to grow geometrically, great pressure is being placed on arable land, water, energy, and biological resources to provide an adequate supply of food while maintaining the integrity of our ecosystem¹ According to the World Bank and the United Nations, between one and two billion humans are now malnourished, indicating a combination of insufficient food, low incomes, and inadequate distribution of food. This is the largest number of hungry humans ever recorded in history. Based on current rates of increase, the world population is projected to double from roughly 6 billion to more than 12 billion in less than 50 years. This problem is till now not important for Europe or in the area of Euro Atlantic civilisation, but with growing population in rest of world also Europe could be affected by growing demand on food.
 - o **Urbanisation and land abandonment** - The first cities arose 10.000 years ago in the East Asia and in the Mediterranean region. Only since the industrial revolution around 300 years ago large cities grew in Europe and the US. In 2005 around 49 % of the world's population lived in urban areas. This trend will increase and the FAO forecast for 2030 shows 4.9 billion people living in urban areas (60%). Megacities with more than 10 Mio inhabitants have increase from 3 (1975), though 18 (2000) to 20 in 2005, it is predicted that this number will reach 22 cities by 2015.. Urbanisation to such extent means that 40% of the population has to provide food as well as "environmental products" to the entire population. Cities have strong socio-cultural impacts on their surrounding rural areas. In Europe and US the people are moving from cities into surrounding villages and the countryside around large cities is so called urbanised. Large percentage of citizens is former urban citizens, bringing into

¹ IMPACT OF POPULATION GROWTH ON FOOD SUPPLIES AND ENVIRONMENT, by David Pimentel, Xuewen Huang, Ana Cordova, and Marcia Pimentel

countryside other style of live. Also there are requirements on agriculture production, mainly produce fresh products for immediate consumption.

3. **Energy cost** - During the last years energy prices have increased, especially oil prices have increased 4-5fold (USD 25 to 125/barrel), other energy costs increased too, though much less. This where followed by a drop in prices. Therefore it is also expected that the energy cost will change in the future. Energy costs will be one of the economical growth limiting factors and increased prices will lead to a general increase of prices as energy is embedded as a cost factor nearly everywhere. So with expected grow of oil prices in future, there will be probably again open question of bio energy. This theme is very complicated, there were bug enthusiasm for bio energy two years ago, nor the public opinion is mainly negative
4. **New demands on quality of food** will be done by grooving demands on quality of production, but also by aging population. Beside increased need of quality we can also expect a change in behaving patterns, more fruits and vegetables will be eaten because it is healthier.
 - **Food quality and safety** - The requirements of citizens and market on higher quality of food production. Food quality and safety will drive the production in the next decades. New approaches and more transparent systems should be employed and farmers will have to change management strategies to meet these challenges.
 - **Aging population and health problems** - The ageing of human populations has emerged as one of the most significant demographic processes in Europe of the present time - and for decades to come. In developing countries, the proportion of the population over 60, now estimated at slightly below 8 per cent, is expected to rise to 10 per cent by 2015 and to 20 per cent by 2050.² An aging population is also connected with new health problems, to which agriculture and food production have to react, the focus is more on production of fruits and vegetable.. Consumers increasingly appreciate the link between diet and disease, an aging population, rising health-care costs and advances in food technology and nutrition research.
 - **Ethnical and cultural changes** – Due the immigration of other ethnic to Europe there is growing interest for authentic ethnic products. The demand of vegetarian food is also growing worldwide. The importance of this driver will increase, but it is not expected that it will be a major driver for changes.

² www.un.org/esa/population/publications/PopAspectsMDG/04_FAO.pdf, V. POPULATION ASPECTS IN THE REDUCTION OF HUNGER, Food and Agriculture Organization of the United Nations

5. **Innovative drivers** – will have large influence on farming. They include not only direct research, but also Information and communication technologies (ICT), education and investment.
- **Knowledge based bio economy** - Knowledge-Based Bio-Economy (KBBE) can be concisely defined as “transforming life sciences knowledge into new, sustainable, eco-efficient and competitive products”. KBBE is expected to be one of the main drivers for future agri-food and non food production.
 - **Research and development in Agriculture** - Government R&D and incentives to private R&D to promote innovation towards sustainable development. R&D is the driving force for innovation in new technologies, biotechnology, new crops and varieties, new services, etc.
 - **Information and communication** -The key strategy is to provide an effective knowledge transfer to as many people as possible, through a range of services and to meet the diverse knowledge and information needs of customers and stakeholders. ICT revolution, probably the key technology of the last 25 years, has already had a considerable impact on production and processing. Adoption of ICT by agriculture and rural communities is till now not on satisfactory level, but we could expected, that it will increase.
 - **Education** -The ‘Knowledge Economy’ refers to the emphasis on investment in ‘Knowledge Capital’ as the means to meet the economies long-term rate of economic growth. In order for living standards to grow in all economies, a constant level of capital investment is required.
 - **Investments into biotechnologies and bio-energy** - establishment of undistorted, cost-reflective prices in the energy and food market and conducive investment conditions to send the right signals to private investors. Investment in bio-fuel production will strongly influence European agriculture production and will open new possibilities for the farming sector.
6. **Development of sustainable agriculture** - include long time sustainability of agriculture, soil protection, but also environment protection
- **Assessments and scenarios** – sustainability assessments which identify synergies and trade-off across the economic, environmental and social impacts. Sustainability is defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs. Regarding a sustainable development of societies usually the three "pillars" ecology, economy and sociology are considered. It is important to maintain a productive agriculture, which will be able to keep the population in rural areas with adequate

income and at the same time keep the adverse environmental effects of agriculture at acceptable levels.

- **Valuation of ecological performances** - Environment has been a free of charge product in the last centuries. Due to the high pressure on environment caused by an extremely growing population, the environment becomes a minimum factor that might limit further growth on Earth. In order to protect the environment, to enable a sustainable development and to make people aware about the importance of environment, making the environment a 'product' is a possible solution. In the past the population, the industry and the politics did a free ride on the environment with negative effects that are measurable today like emissions with their negative effects, problems like climate change etc.

7. **Policies** – policies and their changes will have a strong influence on future farming.

- **National strategies for rural development** - National strategies usually define the frames for the implementation of European Policies in single European Countries. They partly modify or adapt European policies and regulations to national conditions. National strategies will be predefined by European legislation and also by World Trade Organization (WTO) discussion.
- **Politicians** - Politicians and especially changes in leadership in single countries could change the conditions for agriculture in these countries. Usually, this influence is stronger in new member states, where the system of political parties is not so stable yet and also in countries, where government changes too often. Influence of individual politicians is currently high in single countries, but it will decrease in the future. The role of politicians will be increasingly focused on reacting to external conditions.
- **Subsidies** - Subsidies are a specific subset of economical instruments, which are not market driven. The current CAP (Common Agricultural Policy) combines a direct subsidy payment for crops and cultivated land with price support mechanisms, including guaranteed minimum prices, import tariffs and quotas on certain goods from outside the EU. Reforms of the system are currently underway reducing the import controls and transferring subsidy to land stewardship rather than specific crop production (phased from 2005 to 2012).
- **Regulations and standards** - As food distribution chains are increasingly stretched around the world, urgency has arisen for the creation of new food safety standards and stricter enforcement of existing food safety laws to ensure that food industry quality control and food processing standards provide a safe global food supply. There are various European

regulations and standards which regulate the requirements of agriculture and nature conservation and thus, similar to food safety influence European agriculture.

- **International organisation** - WTO conducts negotiations through what is called rounds. The latest is Doha Development Round commenced at Doha, Qatar in November 2001 but it was not closed till now. Its objective is to lower trade barriers around the world, permitting free trade between countries of varying prosperity. As of 2008, talks have stalled over a divide between the developed nations led by the European Union, the United States and Japan and the major developing countries (represented by the G20 developing nations), led and represented mainly by India, Brazil, China and South Africa.

8. Economy – will play very important role in globalised market

- **Economic instruments** - Economic considerations, and analysis of economic implications, are a key consideration in most decisions. Decision-making needs to go through rigorous processes of analysis and appraisal and ex-post evaluation after implementation and economists play a central role in this process, particularly with respect to the estimation of costs and benefits, including non market benefits.
- **Partnerships, Cooperation and Integration and voluntary agreements** - Farms and firms have ready access to knowledge from around the world and this, coupled with the need for cooperation on complex issues, creates the need for a more networked and interactive process, especially when clients themselves contribute knowledge to the system. New models for cooperation are introduced, such as e-collaboration services for farmers or Living Lab models together with Joint public/private programs to develop and deploy sustainable approaches with industry.

9. Public opinion – could mainly in short and middle time period influenced market and consumer behaviour

- **Press** - Press plays an increasingly important role in shaping the public opinion. It could for example promote healthy or environmentally friendly products or production of energy and it could influence the development of the agricultural sector for some time period. Press will play an important role, but it is difficult to predict in which direction.

6 Conclusion

The provided study analysed a number of external drivers and grouped them according to their importance and potential influence on the future development of agriculture. The primary group of drivers, which will be the key issues for a future roadmap, consists of the following drivers:

- Climate changes
- Demographic (Growing population, Urbanisation and land abandonment)
- Energy cost
- New demands on quality of food (Food quality and safety, Aging population and health problems and Ethnical and cultural changes)
- Innovative drivers (Knowledge based bio economy, Research and development, Information and communication, Education and Investment)
- Policies (Subsidies, Standardisation and regulation and National strategies for rural development)
- Economy (Economical instruments, Partnerships, Cooperation and Integration and voluntary agreements)
- Sustainability and environmental issue (Valuation of ecological performances, Development of sustainable agriculture)
- Public opinion (Press, International Organisation and Politicians)

These drivers have to be analysed for the future roadmap independently, because they influence each other and, in some cases, could have opposite influences on a number of factors.

7 Annex 1

Driver	Climate change
Description of driver	<p>Since the mid-20th century, the climate of the earth is changing. Amongst others, this includes changes of average, maximum and minimum temperatures, of average rainfall and of the number of days without rain, as well as altered wind patterns^{3,4}.</p> <p>Climate change poses a serious challenge to agriculture. The drive to substitute fossil fuels with renewable bio-fuels, prompted by concerns about fossil-based energy supplies, has seen food crops increasingly being replaced by energy crops.</p> <p>Climate change could bring new crop pests and diseases. Changes in seasonal temperature and rainfall patterns could result in flooding, drought and more frequent extreme weather events. Higher sea levels might hamper agriculture in lowland areas.</p>
Short time influence till 2013	<p>It cannot be expected that dramatic changes will happen in this period. However, any development and an increasing public awareness of climate change, its likely impact and actions of adaptations will have implications on agriculture.</p>
Medium time influence 2020	<p>In the medium term, climate change could benefit agriculture of higher latitudes by enabling the introduction of new crop varieties, increasing yields and expanding areas of land under cultivation.</p> <p>In certain lower altitudes, it will be probably necessary to focus on varieties that are more resistant to draught.</p>
Long time influence 2030	<p>In the long-term, however, net benefits are less certain. Particularly in lower areas, droughts and desertification will create significant social</p>

3 Teargas's Role in Transforming Ireland's Agri-Food Sector and the Wider Bioeconomy, Towards 2030 Foresight Report, May 2008

4 Bridge Over Troubled Waters: Linking Climate Change and Development, ISBN Number: 9264012753 Publication Date: 17 November 2005

	challenges in some of the world's poorest economies. Areas such as Siberia, Scandinavia and Canada ^{5,6} will profit from global warming.
Geospatial influence (world wide, Europe, selected regions)	Climate change is a major global driver, which has influence on world agriculture product market. The influence will vary in different areas. In higher altitudes this driver could have some positive influences; however in lower altitudes the influences will be mainly negative. The largest problem will probably result from extreme weather conditions and desertification.
Importance (from 0 – 5)	5 - High influence of climate change will be on new management methods, but it will also directly influence production. On the opposite side, actions will be taken in Europe to reduce the contribution of agriculture to climate change by introducing management methods that reduce greenhouse gas emissions.
Impact on potential yield	5 – Climatic changes, mainly desertification and extreme weather conditions will have a negative impact on yield production. On the opposite side, there could be a yield increase in some high altitude areas
Impact on prices	5 – climatic changes, could increase food prices if e.g. extreme weather conditions destroy or reduce the yield
Impact on costs	5 – In some areas climatic changes could significantly increase production cost (irrigation, protection against extreme weather conditions, protection against new pest and diseases)
Impact on farm management	5 – The climate changes will require adoption of farm management techniques in order to react better to new conditions and more external information will be required.
Impact on labour resources	3 – Influences on labour resources probably will be

⁵ FFRAF report: foresighting food, rural and agri-futures

⁶ Economy and Trade, Science and Technology, Rural Economy and Regional Development, Societal and Demographic Changes, Climate Change, Non-Food and Energy, Environment, Health

	neutral. In some areas more resources will be required, for example for irrigation or protection. Problem could be, if climate changes will completely stop production in some areas.
Impact on education	3 - There will mainly be requirement on education in the direction to support knowledge on how to better react to the changed situation.
Impact on environment	5 – Climate change is one of the main current environmental challenges, influencing living conditions, biodiversity, etc.
Impact on technical equipment(development)	4 – there will be probably needs for new technologies for irrigation and for usage of such technologies, to both react on climate change and to limit greenhouse gas emissions
COMMENTS	There is therefore a need to link climate change considerations with development priorities.
Strengths The importance of production in lower altitude will grow. Due to an expected global influence on agriculture and the worldwide food market agricultural production will benefit in some European regions.	Weaknesses The climate changes and warming could have negative influence on production in lower altitude areas. Generally it brings new problems such as new pests, diseases and adaptations against extreme weather conditions
Opportunities The climate changes could support production of new crops in higher altitudes. Reduction of greenhouses' gases emissions could require bigger bio energy production, which could increase profits of the farming sector.	Threats Climate change will probably have a negative influence on Mediterranean areas, where already now draught problems exist. This could lead to social problems, migration and could influence worldwide development. Possible military conflicts. Also an adoption of policies against climate changes could introduce some economical and social problems as raising food prices.

Driver	Growing population
Description of driver	<p>As the world population continues to grow geometrically, great pressure is being placed on arable land, water, energy, and biological resources to provide an adequate supply of food, maintaining at the same time the integrity of our ecosystem.⁷ According to the World Bank and the United Nations, between one and two billion humans were being malnourished at the time this report was written, indicating a combination of insufficient food, low incomes, and inadequate distribution of food. This is the largest number of hungry humans ever recorded in history. Based on current rates of increase, the world population is projected to double from roughly 6 billion to more than 12 billion in less than 50 years. As the world population expands, the food problem will become increasingly severe, conceivably with the numbers of malnourished reaching 3 billion.</p>
Short time influence till 2013	<p>The livelihoods of 75% of the world's poor will continue to depend on agriculture for the foreseeable future⁸. At the same time, rising food prices are likely to make problems of hunger and poverty worse for urban and rural populations.⁹</p>
Medium time influence 2020	<p>By 2020, current food production methods will be unable to meet the food demands of the growing world population. As high-productivity lands become scarcer and food demand increases, people will increase the cultivation of lands that were once considered too fragile for intensive use. New management methods will be required.</p>
Long time influence 2030	<p>Global food production must grow by 50 per cent by 2030 to meet the increasing demand of a growing</p>

⁷ IMPACT OF POPULATION GROWTH ON FOOD SUPPLIES AND ENVIRONMENT, by David Pimentel, Xuewen Huang, Ana Cordova, and Marcia Pimentel

⁸ IMPACT OF POPULATION GROWTH ON FOOD SUPPLIES AND ENVIRONMENT, by David Pimentel, Xuewen Huang, Ana Cordova, and Marcia Pimentel

⁹ DFID Research Strategy 2008-2013, DFID, London, UK, ISBN 1 86192 938 2, 45 pp

	<p>population. Better rain-fed agriculture and irrigation management, plus genetic engineering for higher-yielding and drought-tolerant crop varieties will be required. Currently, agriculture uses 80% of arable land in developing countries, 20% of which is irrigated. Massive efforts are required to maintain fertile cropland. Demand for animal protein may increase, triggering massive investments into genetically modified food, aquaculture, and stem cells for meat production without growing the animal. Seawater agriculture on desert coastlines could produce bio-fuels, pulp for the paper industry, and food for humans and animal bio-fuels, while absorbing carbon and reducing the drain on fresh water¹⁰.</p>
Geospatial influence (world wide, Europe, selected regions)	<p>Growing populations are a major problem of some developing countries. But due to the fact that poor economical conditions and hunger affect migration, those social problems of developing countries will influence the rest of the world and growing populations will have a worldwide impact. Alternatively, a growing number of well-off populations could stimulate the demand for food of high quality, which could increase possibilities for European farmers.</p>
Importance (from 0 – 5)	<p>5 – To guarantee food security for growing population and reduce hunger in third world countries will be among the most serious requirements to be met in the near future.</p>
Impact on potential yield	<p>2 – There will be no direct impact on potential yields. A small negative impact could occur due to potential reduction of production areas attributed to increased urbanization. Nevertheless, a growing world population will stimulate the needs for increasing yield.</p>
Impact on prices	<p>5 – Demand for both quantity and quality of food could increase food prices It happened in last years, when increase worldwide prices of such strategic crops like rice.</p>
Impact on costs	

¹⁰ IMPACT OF POPULATION GROWTH ON FOOD SUPPLIES AND ENVIRONMENT, by David Pimentel, Xuewen Huang, Ana Cordova, and Marcia Pimentel

	2 – The impact on costs will be related with new crop varieties, new fertilization methods and irrigation methods
Impact on farm management	5 – A complete change of farm management is required to guarantee worldwide food security. It will be necessary to increase production without negative effect on quality and environment. It will be not possible to reach with current methods of management.
Impact on labour resources	3 – Demand for food could in some countries result in an increase of the demand for labour resources. Probably these demands will be covered by the use of improved technologies
Impact on education	5 – New methods of farm management, new varieties, and new technologies will increase the requirements of farmer's education.
Impact on environment	5 – The need for food security could have negative influence on the environment (deforestation, over fertilization etc.). Consequently, in order to increase production, it is important to focus on such methods that will not have negative influences on the environment.
Impact on technical equipment (development)	5 – Strong research and technical development are crucial in order to increase food production about 50% till 2030
COMMENTS	Rising food prices are likely to worsen the problems of hunger and poverty for urban and rural people in developing countries. Research that leads to innovation in agriculture is therefore more important than ever for reducing poverty
Strengths The increase of the demand for food will make the market of agricultural products growth. The farm production has to increase all over the world.	Weaknesses Tackling the problem of world wide hunger will require liberalization of agriculture product market, reduction of subsidies and removal of quotas. This could introduce problems in the farming sector of the European countries.
Opportunities There will be a great opportunity to sell some specific products into countries with fast	Threats Reduction of subsidies could destroy agriculture or make it non competitive in some parts of Europe. It

economic development such as India and China, with growing food requirements. The growing demand will create new market opportunities	could also have negative influence on food safety and quality, since growing demand on food will require cheap and economically driven production.
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Driver	Energy cost
Description of driver	Year ago energy prices, especially oil prices, increased 4-5fold (USD 25 to 125/barrel).In last year again prices decrease, but with longer period, we can expected again grow of oil prices. Other energy costs have increased also but much less. Oil (gas) is (are) the driver(s).
Short time influence till 2013	Increased energy costs already led and will also in the further lead to increased food/feed prices, which in turn will lead to further intensification of agriculture and a larger focus on bio-energy production where possible. Bio-fuel production will increase in US and Europe, higher demand in countries like China will keep food and feed prices on a high level.
Medium time influence 2020	A renaissance of agriculture (and forestry) could occur worldwide due to the factor energy but also due to other factors such as population growth and climate change; this will happen only if agriculture works intensively and focused to help solving the existing problems. Strong focus to further productivity increase or to productivity growth in countries where until now productivity was low, such as countries in Africa. High energy costs might also lead to more efficient farm machinery and management. For example parallel tracking, controlled traffic, no tillage systems, variable rate technology with PF etc. can be used in order to economize on petrol and other resources. The increasing energy cost will probably reduce globalisation of food market. Local supply will become more important again.
Long time influence 2030	A long term strategy is necessary to solve the impacts of raising energy prices like increasing field areas or increasing production of bio-energy from agriculture. Together with the population increase from two billion people (1920) to 6.5 billion people (2005) to 9.5 billion people (2050) and the need to adopt methods such as carbon sequestration, there will be a competition for land. The land availability will decrease from 0.5 ha/inhabitant to 0.25 ha/inhabitant. Sustainable use of arable land along with additional

	increase of used land for producing food/feed as well as further increase of productivity will be necessary.
Geospatial influence (world wide, Europe, selected regions)	The driver will influence agricultural production worldwide. Some regions will be able to substitute expensive energy based on the use of other energy sources and on increased energy efficiency. Nevertheless energy from sources other than oil will lean to the oil price on the long run. In that case also increased productivity is necessary.
Importance (from 0 – 5)	5 Energy cost is expected to be one of the growth limiting factors and high energy prices will lead to a general price increase since energy is embedded as a cost factor nearly everywhere. Oil prices have been increasing until approximately the summer of 2008, before again dramatically falling; nevertheless increasing energy cost will be a factor that will persist for the next years.
Impact on potential yield	5 Optimized yields, management methods and energy efficiency will lower the relative energy costs.
Impact on prices	5 Energy costs are part of yield; hence energy will be generally a driving factor for prices
Impact on costs	5 Energy is an increasingly significant part of all costs. Energy costs will remain high.
Impact on farm management	4 Higher costs and augmented prices will result in additional pressure to adopt more efficient farm management strategies
Impact on labour resources	4 Incentives to work and produce in the region, not to transport goods all over the world due to higher costs of transportation.
Impact on education	3 Better education will be necessary so that existing and new technologies and techniques like bio-energy, ICT use, cooperation etc. are utilized
Impact on environment	5 Higher energy costs may lure into cost externalization while enabling new chances to use bio-energy instead of other non-sustainable energy sources.
Impact on technical	

equipment(development)	5 Energy saving techniques will have a bright future.
COMMENTS	On the short run, higher energy prices will result in higher product prices. On the other hand, they will force sustainable bio-energy to become more competitive. Higher energy costs have to be reflected in future FMIS.
<p>Strengths Increased energy prices will enhance optimized energy use; hence generally positive for the environment. Other consequences are further investment into alternative (bio)energies and increased public perception of agriculture .</p>	<p>Weaknesses Unsustainable overexploitation of agricultural fields due to high energy prices could become a danger or weakness. The structures of the typical European family farm may consist of a weakness and have to be replaced by new organisational forms, which will include increased cooperation and collective use of equipment. Small fields and non-optimized shapes will automatically result in high energy requirements combined with higher energy costs.</p>
<p>Opportunities Expensive energy could motivate the farmer(s) to become energy- independent due to in-farm bio-energy production in order to cover the farm's needs in the first stage or even be able to sell energy in a second stage. Import reductions will also be positive for local food production. High energy costs will increase the pressure for better cooperation amongst farmers and better shared use of equipment. The help of organizational structures such as cooperatives will be important.</p>	<p>Threats The farmer(s) might ignore increasing energy costs and proceed with doing business as usual. This will undermine their substance; high energy input linked with expensive energy could lead the farmer to further cost externalization to the environment.</p>

Driver	Urbanisation and land abandonment
Description of driver	<p>The first cities arose 10,000 years ago in the Far East and in the Mediterranean region. It has been only since the industrial revolution (300 years ago) that large cities grew in Europe and the US. In 2005 around 49% of the world's population lived in urban areas. This number will increase and the FAO forecast for 2030 predicts 4.9 billion people living in urban areas (60%). Mega cities with more than 10 million inhabitants were 3 in 1975, 18 in 2000, 20 in 2005 and are expected to be 22 in 2015. Such extended urbanisation means that 60% of the world population has to get food but also "environmental products" from the rural areas.</p> <p>Cities have strong socio-cultural impacts on their surrounding rural areas. Growing cities cause problems in water supply, which means less water, less land, growing costs and environmental impacts such as air pollution, water pollution and waste. The surrounding regions have limited arable land, less open space and decreased amount of inhabitants. Urban impact on neighbouring rural areas might also lead to brain drains with a negative effect to rural areas. High urbanized countries with more than 80% of the population living in cities are Brazil, Argentina, Chile, Saudi Arabia, Sweden, UK, Japan and Australia, to name the most important. Between 60-80% urbanisation is recorded from North- and the rest of South America, Europe, Turkey, Iran and Iraq as well as the CIS countries. The remaining countries have less than 60% urban population.</p> <p>Land abandonment results in giving up farming because of changing structures and environment and will have both positive and negative impact on the land itself. According to EC regulations this means no farming for at least 2 years. Hidden abandonment, meaning land that has been managed but not mainly for economic reasons, is considered to be even larger; hidden abandonment is estimated to cover 15 million hectares in Central and Eastern European Countries or even more. The actual abandonment is between 5</p>

	and 11 million hectares respectively 10-20% of 57 million hectares. ¹¹
Short time influence till 2013	For Europe, no big urbanisation impact is expected until 2013. Land abandonment will slow down because of the higher prices and the return to using land more intensively. The temporary following scheme with payment for set aside of the past will disappear.
Medium time influence 2020	In Europe similar as above. In very small structured areas in semi arid regions land degradation will increase after land abandonment; on the other hand soil properties can recover, but very slow. The vulnerability to erosion is highest during the first years of abandonment.
Long time influence 2030	Regions outside Europe that stay under abandonment will face dramatically changes in the botanical composition. In many cases, pioneer vegetations will develop with strong influences on the landscape picture. In the biggest part of Europe urbanization and land abandonment will result in more concentrated production in the urbanised areas and reduction of the production in less favourite areas.
Geospatial influence (world wide, Europe, selected regions)	The abandonment of cultivated land as a phenomenon has spread in many regions of the world. In parts of Europe, an opposite trend exists with people moving back to the countryside, but without returning to agricultural production. This is the so called urbanization of rural areas. Major drivers for land abandonment are population structure, penetration of the market economy, growth of cities, international job market, further policies regarding rights of use, taxation rules and rent. Increased environmental risk like floods, landslides etc. in many cases went parallel with land abandonment. Effective management of endangered areas is necessary in order to reduce environmental risks. Niche production might enable production under

¹¹ IMPACT OF POPULATION GROWTH ON FOOD SUPPLIES AND ENVIRONMENT, by David Pimentel, Xuewen Huang, Ana Cordova, and Marcia Pimentel

	sustainability targets. The impact of urbanisation might lead to environmental changes which can in turn affect the food systems which can evolve rapidly in an unregulated situation. Food safety and food quality in particular might be affected.
Importance (from 0 – 5)	3 The increase of the population in urban areas and also the increase of abandoned land in rural areas results in an increased portion of the population that is dependent on services from a smaller portion of the population within rural areas. This should lead to higher costs of services such as food production, bio-energy and land maintenance.
Impact on potential yield	4 Abandonment of land will initially result in decreased yields.. In later period the yield production could again increase on the base of new technologies and intensification of production.
Impact on prices	4 There will be two opposite trends; decrease prices on the base of new technologies and intensification of production as long as increasing prices due to demand on environmental friendly production.
Impact on costs	3 Costs of distribution will decrease due to high concentrated markets
Impact on farm management	3 Increasing small field plots on lease will trigger the need to have better farm management
Impact on labour resources	3 Fewer people in the labour market will increase the labour costs for qualified personnel; the use of foreign labour will increase; overall unemployment rate of rural areas might decrease due to the population decrease in these areas
Impact on education	4 – Concentration and intensification of production and also the need for environmental protection will require better educated staff.
Impact on environment	4 A shrinking group of people will need to organize food-bio-energy-environment for a growing number of people and that will lead to increased prices for the product "environment"

<p>Impact on technical equipment(development)</p>	<p>3 Concentration of production and also environmental protection will make the development of new technology inevitable.</p>
<p>COMMENTS</p>	<p>Urbanisation and abandonment could in initial stage decrease food production, but also could lead to more effective production. Optimized planning, integration of public and private needs based on a new understanding of the work of farmers/foresters within environmental caretaking, definition and also control of targets, integration of education, know how transfer and capacity building will be key task for future.</p>
<p>Strengths Today abandoned land can be used again for the fast increase of production of food or bio-energy in many cases. Agri-environmental measurements have to be designed including special treatment for land with high biodiversity value. The urbanisation leads a strong and increasing customer group in the rural areas; they are customers of food as well as “environmental” products.</p>	<p>Weaknesses Abandonment means a negative impact on the income of the rural society because of less agricultural production as well as a loss of farms through decrease of agricultural land. Urbanisation means brain drain from the surrounding rural areas.</p>
<p>Opportunities On the long term, wood production can be a source of income in abandoned land. On these areas less or no use of fertilizers leads to less environmental pressure. Further abandonment will have an important function for new habitats and will lead to higher biodiversity and can contribute to preservation of endangered/rare species. Other opportunities might be landscape, education, herb production etc. Urbanization means that the rural areas have to produce for 60% of the worldwide population food and “environmental” products like water, air, landscape but also new socio-economic and ethic products of the future like “learning by nature”. These trends could increase the income of the rural population.</p>	<p>Threats Traditional open landscapes will loose their attractiveness for locals and tourists. Urbanization has high risk for rural areas regarding waste, pollution of air and water.</p>

Driver	Quality of food & safety
Description of driver	Requirements of citizens and market on higher quality of food production
Short time influence till 2013	In the short term food safety will be increased by the wide adoption of organic farming and integrated crop management approaches.
Medium time influence 2020	The medium term influence will be to have food products with higher nutritional values, reduced chemical contamination and more advanced traceability systems.
Long time influence 2030	Long term influence will be on the intensive use of traceability systems in the food supply chain and this will be compulsory to all farmers producing food stuff and to the retailers.
Geospatial influence (world wide, Europe, selected regions)	Improving food quality and safety will be very beneficial to all societies world-wide. Areas where food products are harder to come by would highly benefit from the food safety improvements and customers will be more aware of the food quality.
Importance (from 0 – 5)	5. Food quality and safety will drive the production in the next decades. New approaches and more transparent systems should be employed and farmers will have to change management strategies to meet these challenges. If the food that the world's population consumes becomes polluted or unsafe, disasters like Foot and Mouth disease or the 2006 California Spinach E. Coli outbreak would continue around the world and in many places, the result could be very deadly.
Impact on potential yield	3. Most likely more focus on food quality and safety for specific crops will maintain the yields or even increase them as farming will become more intensive, at least for vegetable and fruits. However, with the introduction of new technologies for higher yields being put into use as well as communities and individuals becoming self-reliant, the potential yields will increase.

Impact on prices	5. Prices of quality food will increase in short term to meet the changes in the farming environment, while they will be stable or reduced in the long term when traceability and new management systems will be established.
Impact on costs	3. In the case of non subsidies production, it will increase cost of production.
Impact on farm management	5. Farm management will face new challenges because of the requirements on food quality. This would drain the soils of their nutrients and would require better management of the land and farm as a whole to reduce the amount of soil that is depleted each year, reduce waste, reduce soil erosion, and ensure that all food is handled safely. Additionally, new technologies will be introduced to meet the increased demand for quality food and to have an automated record keeping.
Impact on labour resources	3. The labour required in the agriculture field will rise for more educated and skilled people who are able to use high-tech equipment, while labour requirement will be reduced for low skilled labour. This would be very beneficial in Europe in areas of high unemployment or low income. Outside Europe, for example in Africa, it could be a problem for areas with high HIV/AIDS outbreaks where the population of adults able to work has dramatically decreased and where there is no adequate education so far.
Impact on education	5. This could be very beneficial to the agriculture programs in schools and universities. A need for well educated members of all societies in the field of agriculture will increase. On the contrary, it could pose a problem in areas with low educational standards. If higher education is not available, it would be hard to accomplish food quality and safety.

<p>Impact on environment</p>	<p>5. The impact on the environment could be detrimental, but if the improvements are handled correctly, the environment could see very little impact if any. The depletion of soil nutrients and soil erosion are going to be two main concerns for the food safety. Food quality will not have a big impact on the environment. If anything, improving food quality may call for less chemical use and could improve the condition of soils and reduce ground water contamination.</p>
<p>Impact on technical equipment (development)</p>	<p>5. The improvement of food quality and safety will definitely have an impact on the development of technical equipment. Equipment such as variable rate irrigation and fertilization will have to be put into widespread use and the development of an efficient solution to the water conservation problem will evolve.</p>
<p>COMMENTS</p>	<p>The production of high quality and healthily food is usually connected also with environmentally friendly production. In future there could be conflict with growing demand on food production and also with energy production.</p>
<p>Strengths Some of the strengths of the Food Quality and safety driver include: reducing the reliance on imported foods and food products, reduction in the overall number as well as the percentage of people malnourished each year, providing safer foods for the entire world and helping people become more self-sufficient as a whole.</p>	<p>Weaknesses Some of the weaknesses of the food quality and safety driver include: lack of resources (especially water) in many areas, lack of knowledge, lack of availability of land for agricultural use, lack of labour to produce the food products and the inability to educate many areas of the world efficiently (due to language barriers, physical barriers and medical barriers).</p>
<p>Opportunities The opportunities of the food quality and safety driver are endless. With government support and world-wide involvement, we could work together to become a very efficient planet. Malnutrition could be reduced.</p>	<p>Threats Some of the threats of the food quality and safety include increased price of products to meet food quality and safety, which in turn might add to reduced accessibility of food and malnutrition.</p>

Driver	Aging population and health problems
Description of driver	<p>The ageing of human populations has emerged as one of the most significant demographic processes in Europe of the present time - and of the decades to come.</p> <p>Also in developing countries, the proportion of the population over 60, now estimated at slightly below 8 per cent, is expected to rise to 10 per cent by 2015 and to 20 per cent by 2050.¹² An aging population leads to new health problems, to which agriculture and food production have to react. Consumers increasingly appreciate the link between diet and disease. An aging population, rising health-care costs and advances in food technology and nutrition research. Diseases such as diabetes, heart disease and some cancers can be directly linked to lifestyle and food consumption. With improved food products and improved choices made by consumers, large sums of money could be safely diverted from health care to other priority areas. New partnerships focusing on functional foods focus on nutrient quality, healthy diets and disease prevention will be required to fully take advantage of these new markets.</p> <p>Changing age structures affect food demand both directly and indirectly. One direct effect is lower food demand. With an aging population, food demand declines, as activity levels and caloric needs decline.</p>
Short time influence till 2013	<p>The importance of specific food production for aging populations with specific diet requirements will grow. There will be requirements for more fruit and vegetable production.</p>
Medium time influence 2020	<p>In this period, the average age of populations will continuously grow. This generation will be more active than previous senior generations and will require specific diets.</p>

¹² www.un.org/esa/population/publications/PopAspectsMDG/04_FAO.pdf, V. POPULATION ASPECTS IN THE REDUCTION OF HUNGER, Food and Agriculture Organization of the United Nations

Long time influence 2030	The focus on aging population and health will be a major requirement of food production. There will be important shift in composition of production in direction of vegetable, fruits, fish, chicken, etc.
Geospatial influence (world wide, Europe, selected regions)	An aging population is currently a main problem of developed countries. Together with development in Asia and other countries this problem will be extended into other parts of the world.
Importance (from 0 – 5)	3 Currently the problem is not so intense, as for example food security or energy, but its influence will grow.
Impact on potential yield	2 – The focus will mainly be on the quality of production, not a remarkable influence on yield quantity
Impact on prices	4 – The specific production will lead to increase of the price of these products
Impact on costs	4 – The specific requirements will lead to increase of the cost of these products
Impact on farm management	5 – High quality production will require new methods of management
Impact on labour resources	3 – The high quality production and production of fruits and vegetables could increase requirements on labour resources
Impact on education	3 - The high quality production and new production methods will require highly educated staff
Impact on environment	2 - The high quality production could have partly positive impacts on environment
Impact on technical equipment(development)	5 – Specific production will also have high requirements on technology and innovation
COMMENTS	The ageing of human population has emerged as one of the most significant demographic processes. The fact that the percentage of elderly people will grow in European population implies greatly changed needs

<p>Strengths A larger portion of an elderly population will increase the demand for more healthy agricultural production and for products with higher added value</p>	<p>Weaknesses The ageing population has very negative influence on the rural population. The percentage of ageing population in agriculture is very high.</p>
<p>Opportunities The demand for specific products could be a good opportunity for many agricultural producers to focus on new markets.</p>	<p>Threats The ageing population could have negative influence on production. If a low number of young farmers start agriculture, it will be difficult to introduce new methods of production.</p>

Driver	Ethnical and cultural changes
Description of driver	The recent World Food Markets (WFM) showcased the growing interest for authentic ethnic, specialty, halal, and kosher products and growing population's interest in ethnic cuisine. Also requirements on vegetarian food are growing worldwide.
Short time influence till 2013	Already in 2008 mainly Europe and US agriculture production need to respect cultural and ethnical diversity. The percentage of population, which requires specific products, is growing.
Medium time influence 2020	It is expected, that the percentage of ethnic groups in Europe and US will increase. They will have an influence on specific requirements of agriculture and food production.
Long time influence 2030	The percentage of ethnic groups will grow further. Around 2030, ethnic groups could comprise a major portion of the European population. This will influence food and agriculture production.
Geospatial influence (world wide, Europe, selected regions)	The influence will be mainly in developed countries, since migration takes mainly place from developing to developed countries. Furthermore, specific cultural requirements grow mainly in developed countries
Importance (from 0 – 5)	3 - The importance of this driver will increase, but it is not expected that it will be major driver for changes.
Impact on potential yield	2 – It will not influence the yield directly. The main influence will be on specific product. Due to growing population with specific cultural or ethnical requirements, the demand for specific products will also grow.
Impact on prices	3 –Specific products might require in some cases increased prices.
Impact on costs	3 - Specific product could partially increase cost of production

Impact on farm management	4 – New requirements will need specific evidence for production, especially traceability.
Impact on labour resources	2 – The specific production could result in increased labour costs
Impact on education	3 – High quality production will require new methods of management, which might result in the need of additional knowledge about production processes
Impact on environment	2 - Requirement for bio production could have positive influence on environment.
Impact on technical equipment(development)	3 – Specific production will derive high requirements on technology and innovation
COMMENTS	The importance of requirement for specific food items as a result of cultural and ethnical diversity will grow.
Strengths The changes in ethnical composition and cultural behaviour will increase the demand of healthier agricultural production and on the product with higher added value	Weaknesses Specific, high quality products might result in higher food prices which in turn might impede accessibility to these products for all population groups.
Opportunities The demand for specific products could be a good opportunity for many agricultural producers to focus on new markets.	Threats There are no main threats in Europe. In some developing countries orientation on production of ethnical product could have negative influence on selling their products on global market.

Driver	Knowledge based bio economy
Description of driver	Knowledge-Based Bio-Economy (KBBE) can be concisely defined as “transforming life sciences knowledge into new, sustainable, eco-efficient and competitive products”. ¹³
Short time influence till 2013	<p>The KBBE will address major challenges beyond growth and employment:¹⁴</p> <ul style="list-style-type: none"> • The growing demand for safer, healthier and higher quality food; • The increasing risk of epizootic and zoonotic diseases like avian flu, and food related disorders, such as obesity, and the need for successfully preventing these; • Threats to the sustainability and security of agricultural and fisheries production resulting in particular from climate change. • The growing demand for sustainable production and use of renewable bio-resources for eco-efficient products;
Medium time influence 2020	<p>Combined with advanced bioprocess engineering the development of high performance crop plants is the key to this vision becoming reality. Crops will serve as factories for enzymes, amino acids, pharmaceuticals, polymers and fibres, and will be used as renewable industrial feedstock to produce bio-fuels, biopolymers and chemicals. Green biotechnology will be employed since conventional or smart breeding alone will probably not be able to provide the required increase in performance. It is anticipated that already by 2020, in addition to the then mature gasification technologies, the conversion of ligno-cellulosic biomass by enzymatic hydrolysis will be standard technology opening up access to large feedstock supplies for bioprocesses and the production of transport fuels.</p>

¹³ En Route to the Knowledge-Based Bio-Economy

¹⁴ Rural development in a Knowledge-based bio-economy, Marta Iglesias, Directorate Biotechnology, Agriculture and Food European Commission – DG Research

<p>Long time influence 2030</p>	<p>Biotechnology will be an important pillar of Europe's economy by 2030, indispensable to sustainable economic growth, employment, energy supply and to maintaining the standard of living. It will be increasingly used in labour-intensive sectors, e.g. industrial processing, pharmaceuticals, agriculture and food. By 2030, the products of white biotechnology and bio-energy will have an estimated one-third share, worth € 300bn, of industrial production¹⁵.</p>
<p>Geospatial influence (world wide, Europe, selected regions)</p>	<p>In the initial phase we expect an influence of KBBE mainly in developed countries, but later their will be a world wide influence.</p>
<p>Importance (from 0 – 5)</p>	<p>5 KBBE is expected to be one of the main drivers for future agri-food and non food production</p>
<p>Impact on potential yield</p>	<p>5 - In efficient KBBE based farming systems there is little waste as residues are principally used to maintain soil fertility.¹⁶ New sorts could increase yield.</p>
<p>Impact on prices</p>	<p>3 - One efficient way of producing food is aquaculture where the ratio of mass of feed to mass of fish raised is lowest. Efficient use of agricultural waste and raw materials from forests and set-aside land to produce energy should help to save high-quality soils for food production - keeping food prices low.¹⁷ Waste and biomass utilization technologies will enhance sustainability and increase farmers' income. Biotechnology is expected to contribute to the solution to all these problems by engineering robust, high-yield, self-sustaining plants to survive on poor, arid land.</p>
<p>Impact on costs</p>	<p>3 – The KBBE could on one side increase cost of production with they focus on cleaner production, on opposite side it could guarantee for example utilization of residues.</p>

¹⁵ En Route to the Knowledge-Based Bio-Economy

¹⁶ BIO4EU report

¹⁷ En Route to the Knowledge-Based Bio-Economy

<p>Impact on farm management</p>	<p>5 Besides attractive exit options, capital investors require professional management skills and industry experience of the executives. In particular, KBBE will require investing in young companies from the white biotechnology sector where business models are often immature and so far not much value creation has been evident. Instead, financing in this sector will continue to come from the big companies of the chemical, pharmaceutical and food sectors – be it through collaborations and partnerships¹⁸.</p>
<p>Impact on labour resources</p>	<p>5 – KBBE will bring requirement on highly skilled labour resources to be able to introduce new knowledge into production.</p>
<p>Impact on education</p>	<p>4 - The number of qualified people will not keep up with demand. Measures should be taken early, e.g. by increasing the share of science courses at primary and secondary school level. In order to counter the strong international competition for talented scientists, European public research institutions need to receive adequate funding and to provide more reliable and attractive career options with competitive salaries and positions. There will be a growing need for interdisciplinary education and joint research that is closely entwined with technological development.</p>
<p>Impact on environment</p>	<p>5 - Future conflicts resulting from limited arable land for food versus non-food production need to be solved by innovation, e.g. by high tech crops, and by efficient regulation on an international level. The production of industrial crops on irrigated land should be discouraged in favour of food crops. It is not expected, that Europe will be a main producer of energy. In developing countries where the production of biomass, possibly with export potential, is expected to translate into higher income of these countries, local independence and greater political stability of developing countries, export of biomass/bio-fuels at the expense of food security and the environment must be avoided, the conservation of ecosystems, such as rainforests, being mandatory.</p>

¹⁸ En Route to the Knowledge-Based Bio-Economy

<p>Impact on technical equipment (development)</p>	<p>5 - Public-private cooperation in industrial biotechnology should also extend more downstream, in particular to validate new concepts by pilot and demonstration plants, e.g. a 'zero-waste bio-refinery'. Initial public procurement will be necessary to stimulate the development of novel technologies in Europe.</p> <p>Competitive tax incentives will be needed to attract private capital. European and national funding programmes providing seed money will be indispensable for a long time. The founders of early-stage companies should be encouraged, e.g. by means of tailored funding and by affordable access to external expertise.</p>
<p>COMMENTS</p>	<p>KBBE is a key concept for development of future European agriculture; it covers food, energy but also chemical and medical production.</p>
<p>Strengths KBBE will open new possibilities for the farming sector. The focus is on environmental friendly production of food, energy, chemicals and medicaments. The objective of KBBE is not only increase production, but also environmentally friendly production. Due to economical support it will have also positive influences on social development.</p>	<p>Weaknesses KBBE will require large investment into new technologies, but also into human resources. KBBE will require new structure of employment.</p>
<p>Opportunities KBBE will increase economical potential of rural areas and will offer new employment, and also new profit. It will also support environmental friendly production.</p>	<p>Threats Since KBBE lead to a requirement of high skilled employment, KBBE could exclude parts of rural population as well as population in developing countries, from the production processes. It could lead to a gap between developed and developing countries, if developing countries will not have access to knowledge.</p>

Driver	Regulations and standards
Description of driver	As food distribution chains are increasingly stretched around the world, urgency has arisen for the creation of new food safety standards and stricter enforcement of existing food safety laws to ensure that food industry quality control and food processing standards provide a safe global food supply. ¹⁹ There are various European regulations and standards which regulate the requirements of agriculture and nature conservation and thus, similar to food safety influence European agriculture. ²⁰
Short time influence till 2013	The year 2013 is expected to bring a CAP reform, where new regulations will be introduced. Current regulation of rural development policy for 2007 to 2013 is focused on three themes (known as "thematic axes"). These are: <ul style="list-style-type: none"> • improving the competitiveness of the agricultural and forestry sector; • improving the environment and the countryside; • improving the quality of life in rural areas and encouraging diversification of the rural economy.
Medium time influence 2020	The new standards and regulations will require strong cooperation with WTO, but also with food producers and markets. New standards will combine market requirements for food, with requirements for energy, but also environmental protection.

¹⁹ International Coordination of Food Safety Regulations

²⁰ Agriculture and the environment: Introduction, EC document

Long time influence 2030	<p>Efforts to enhance the environmental performance of agriculture will play an important role. Social and political pressures for increased environmental standards are expected. Resulting policy tools, whether positive (subsidy based) or negative (penalty based), if substantial enough, could play a major role in shaping future agriculture.</p> <p>On the other hand, the cost of dealing comprehensively with the above set of environmental issues would be many times greater than the public funds currently available through the main policy programs. It may be that public funds continue to play a marginal role in protecting or enhancing the rural environment. No dramatic increase in environmental regulation governing agriculture is expected.</p>
Geospatial influence (world wide, Europe, selected regions)	<p>The changes and unification of standards and regulation will have more and more world wide scale.</p>
Importance (from 0 – 5)	<p>4 - It is expected, that in the future economical and social influences will be of greater importance for agriculture production than regulations.</p>
Impact on potential yield	<p>4 – Deregulation of production could increase area of production and also yield. Standardization has its focus on quality of production.</p>
Impact on prices	<p>5 – Changes in regulation and standards could have large influence on prices, because it could define rules, which could increase cost of production. Decrease of subsidies could increase prices; on the other hand the deregulation of production could lead to a decline of market prices.</p>
Impact on costs	<p>5 – Level of regulation will be directly dependent on cost production.</p>
Impact on farm management	<p>5 – Regulations and standards are directly connected with requirement on management systems</p>
Impact on labour resources	<p>3 – New standards and regulations could increase the requirement of labour resources, because it could introduce methods with higher need of labour resources.</p>

Impact on education	3 – The needs to adopt new standards of production will require additional training for farmers.
Impact on environment	5 – standards and regulation are a possible instrument for environmental friendly agricultural production
Impact on technical equipment(development)	4 – implementation of new standards could require new technologies and equipment
COMMENTS	There is not clear vision about future standards and regulations, because they are related to CAP reforms and WTO negotiations.
Strengths The main strength could be the protection of the environment and food safety issues. Deregulation of agriculture market could increase possibilities for developing countries.	Weaknesses Changes in regulations and decreasing of related subsidies might result in economical problems for farmers in regions, where income depends in large parts on subsidies.
Opportunities Main opportunity is to remove barriers for world agriculture food and non food products market. It is connected with standard quality, which could be also market driven.	Threats The deregulation of agriculture production could introduce social problems in some part of Europe, but could also have a negative influence on the environment.

Driver	Economic instruments
Description of driver	<p>Economic considerations, and analysis of economic implications, are a key consideration in most decisions. Decision-making needs to go through rigorous processes of analysis and appraisal and ex-post evaluation after implementation and economists play a central role in this process, particularly with respect to the estimation of costs and benefits, including non market benefits.</p> <p>Economic instruments are capable of influencing the behaviour of consumers and manufacturers in ways that are more subtle, yet potentially more powerful, than conventional regulatory controls, and which are capable of achieving results at lower cost.</p> <p>Until now, economical instruments were mainly taxes and subsidies. In the future, economical instruments can be expected to be stronger influenced by the market and citizens requirements.</p> <p>We could expected mainly grooving requirements on quality of production, which will be guarantee by different certification systems.</p>
Short time influence till 2013	Until 2013, a revision of currently used economical instruments for managing agriculture production is expected.
Medium time influence 2020	The instruments will reflect issues such as healthy production, food safety and environment protection to greater extent that at present.
Long time influence 2030	There will be complete change of economical instruments, which will influence production. The main focus will be on removing distortion of the market but support healthy and environmental friendly production and support world wide food security. Reference???
Geospatial influence (world wide, Europe, selected regions)	The used instruments have to be unified around the world.

Importance (from 0 – 5)	5 – an agreement about economical instruments is a key issue for food safety, security and also environment protection
Impact on potential yield	5 Used economical instruments will strongly influence potential yield. The economical demands will lead to higher requirement on yield for both food and non food. Pressure to increase production can be expected.
Impact on prices	5 – Changes in used economical instruments will influence prices locally but also globally.
Impact on costs	5 – Good usage of economical instruments could lead to decreased production cost. Currently used methods don't support economically sustainable food production.
Impact on farm management	5 - Changes in used economical instruments will influence farm management methods.
Impact on labour resources	4 – The economical instruments used in the future will influence requirements on labour resources. There could be alternating influences. Instruments focused on economical production could decrease requirements on labour resources; economical support for environmentally friendly production could stimulate requirements on labour resources.
Impact on education	4 – The future used economical instruments will probably require higher educational staff.
Impact on environment	4 - There could be both positive and negative influence of the used economical instruments.
Impact on technical equipment(development)	4 – The future used economical instruments will probably require new technologies.
COMMENTS	Usage of economical instruments could strongly influence all agriculture production, but also costs and prices. (For example support for energy production could increase food prices).

<p>Strengths The usage of new economical instrument enables new possibilities for positive changes of current agriculture production.</p>	<p>Weaknesses It will be difficult to change the current status of economic incentives, because farmers profit from the current system.</p>
<p>Opportunities New effective economical instruments could enhance food safety, but also increase economical prosperity of rural regions.</p>	<p>Threats Production managed only by economical influences could lead to overproduction and negative influences on environment. Farmers in some part of the world might have problems to compete on the world market. It could also lead to fast changes in production (food, non food) in relation to market demands.</p>

Driver	Subsidies
Description of driver	<p>Subsidies are a specific subset of economical instruments, which are not market driven. The current CAP (Common Agricultural Policy) combines a direct subsidy payment for crops and cultivated land with price support mechanisms, including guaranteed minimum prices, import tariffs and quotas on certain goods from outside the EU. Reforms of the system are currently underway reducing import controls and transferring subsidy to land stewardship rather than specific crop production (phased from 2005 to 2012). Detailed implementation of the scheme varies in different member countries of the EU.</p>
Short time influence till 2013	<p>By 2013, the share of traditional CAP spending will have almost halved (32% in comparison with 62% in 92)²¹, following a decrease in real terms in the current financing period. In contrast, the amounts for the EU's Regional Policy represented 17% of the EU budget in 1988. They will more than double to reach almost 36% in 2013. The aim of the CAP is to provide farmers with a reasonable standard of living, to provide consumers with quality food at fair prices and to preserve rural heritage.</p>
Medium time influence 2020	<p>Currently it is difficult to judge, the result of the CAP reform. There is a demand, that subsidies should be made available for specific innovative investments and experiments aimed at increasing environmental performance of the farm, such as resource-saving technology (energy, water, etc.), renewable energy technologies, low emission stable systems, etc.</p>

²¹ http://ec.europa.eu/budget/reform/issues/article_5957_en.htm

Long time influence 2030	The final influence will depend on discussion of member countries. The final decision is not clear, but it is expected, that financial incentives should be available for farmers who produce according to sustainability criteria, because they bear additional costs (compared with unsustainable production) which will not directly be paid by consumers. In the transition period until 2030, the incentive should increase with the degree of implementation of such criteria.
Geospatial influence (world wide, Europe, selected regions)	The changes in subsidies will have direct affect on Europe; indirectly it will affect the entire world.
Importance (from 0 – 5)	5 – Reform of subsidies system is one of the key aspects for changing European agriculture
Impact on potential yield	5 - Changes in subsidies system will have strong influence on yield. Removing of quotas could support yield increase; on the opposite side these changes could lead to abandonment of some rural regions.
Impact on prices	5 – Changes in subsidies system, respectively decreasing of subsidies probably will increase prices of production. On the opposite, removing of quotas could reduce this effect.
Impact on costs	4 – Changes in subsidy system will only have partial influence on costs of production. It will probably lead to more effective methods of production.
Impact on farm management	5 – A decrease in subsidies will require effective farm management system to optimise costs and provide production more economical.
Impact on labour resources	4 – Reduction of subsidies will probably lead to more effective use of labour resources.
Impact on education	4 – Reduction or changes in subsidy system will require highly educated staff.

Impact on environment	4 – The changes in subsidy system will directly influence the environment. Positive effect could have a system of subsidies, which will support more environmental friendly methods of production.
Impact on technical equipment(development)	5 – reduction of subsidies or specially direct payment will require new technological solution and new technology to guarantee economical agriculture production
COMMENTS	A subsidy system is currently under discussion and a forecast of the next subsidy system is difficult. It is related with CAP reform and WTO negotiation
Strengths Changes in subsidy system could lead to more environmental friendly and safety production. Changes of subsidy system from direct payment to specific support of user friendly or eco production will have positive influences.	Weaknesses The main weakness is that changes of the subsidy system could introduce large economical, social and environmental problem into the European regions, which at current is strongly depend on subsidies, mainly in countries, dominated with small scale farms (e.g. French).
Opportunities CAP reform and changes of subsidies system will support free market and will improve chance for developing countries. Support of environmentally friendly technologies could have positive influence on environment, support for healthily production of human health.	Threats Rapid decreasing subsidies could introduce social problems in some subsidy dependent European regions.

Driver	Investments into biotechnologies and bio-energy
Description of driver	Investments – establishment of undistorted, cost-reflective prices in the energy and food market and conducive investment conditions to send the right signals to private investors
Short time influence till 2013	In the bio-fuel sector, several incentives to enhance production were given by EU and worldwide. Recent increases of food prices which threaten food security seem to cause second thoughts of EU officials and EU member state governments. But an increased energy demand by countries like China and India combined with concerns about oil reserves and exploitation will keep prices at levels that make bio-fuel production economically viable. This will maintain conducive investment conditions in the EU and worldwide in the short term and will boost investments. Investments will also increase in high-tech agriculture and in new production practices, such as hydroponics, ICM, organic farming.
Medium time influence 2020	Research breakthrough in the second generation of bio-fuels derived from lignocelluloses material will make bio-fuels production more competitive without using food material. Conducive investment conditions in the EU and worldwide will be maintained in the medium and long term. Investments in high-value crops, high quality food products and new technologies in crop production will be the case in the medium term.

<p>Long time influence 2030</p>	<p>The conditions will remain the same as the need for cheap energy, affordable prices for food with high quality and safety will be even higher with the increased population. The increasing demand of energy will keep prices high and support the demand for bio-fuels. Therefore investment interest will continue. In this period, if the oil reserves estimation is correct, it is expected that some oil reserves will be depleted and this will worsen the supply of energy. Thus energy prices will increase and investment in Renewable Energy Sources and biomass produced by the farms will be enhanced. New dimension of farms will also take place, such as pharmaceutical crops, industrial crops as well as high quality and safety food.</p>
<p>Geospatial influence (world wide, Europe, selected regions)</p>	<p>EU is an area with high dependence on imported fuels and thus will maintain a high interest for bio-fuels to cover part of the energy consumption. Also in other areas of the world increased oil prices and possible shortages of supply will keep an interest on bio-fuels and biomass investment. Influence on other crops will also take place, such as GMOs in the US and South America, pharmaceutical and industrial crops in Europe and world-wide.</p>
<p>Importance (from 0 – 5)</p>	<p>5 - Investment in bio-fuel production will strongly influence European agriculture production and will open new possibilities for farming sector. Investments in other industrial crops for the production of specialized material and pharmaceutical crops will also be important. Investments in bio-fuel production will be the driving force to put agriculture on the cutting edge of industries.</p>
<p>Impact on potential yield</p>	<p>5 - Investment in crop production and processing will enhance crop yields with the development of new varieties and new crops, e.g. tolerant to draught, salt, etc.</p>
<p>Impact on prices</p>	<p>4 - Usually, investments increase prices, but if the investments are targeted to large-scale plants and production types, then they may also generate lower prices.</p>

<p>Impact on costs</p>	<p>5 - Investments in new technologies for production and processing will help in economies of scale and reduce the costs. Especially in areas where mechanization is still not developed. On the other hand, raw material cost should be maintained at reasonable levels regardless of investments. Increasing productivity by breeding new more productive varieties or the use of new species would maintain farmer's profitability lowering production costs.</p>
<p>Impact on farm management</p>	<p>3 - The possibility of in farm production and use of energy can be an important factor to keep the raw material production cost low and avoid any energy shortage effects. New management skills will be needed to combine the new crops in the existing crop rotations and new management tolls will be needed to reduce costs and direct production to energy crops and raw material production.</p>
<p>Impact on labour resources</p>	<p>3 - Increase of employment in farming is not expected. The high labour cost would lead to either large, high power units or to more automated machinery, requiring minimum but more skilful labour.</p>
<p>Impact on education</p>	<p>4 - The introduction of new crops, as well as new technologies due to the new investments in agriculture will require new skills (better material handling systems, logistics, electronics and IT) by the farm managers and different training courses will be required.</p>
<p>Impact on environment</p>	<p>3 - Maintaining conducive investment conditions would result in increased investment in the fields of bio-energy and new technologies in agriculture. The effect on the environment will be positive in the reduction of CO₂ emissions. On the opposite side, a requirement for higher fertilization could occur. There could also be negative influences, if the area of production is increased and if there is more deforestation.</p>

<p>Impact on technical equipment(development)</p>	<p>5. New specialized equipment and high-technical oriented solutions will be developed with investments. High labour costs will enforce the need for more mechanized and highly efficient cultivation. New automated mechanisation systems will be required to keep costs at a low level. Therefore a constant demand of new equipment will be maintained.</p>
<p>COMMENTS</p>	<p>Investment in production of raw material and in processing unit is necessary if a significant part of fuel demand will be covered by bio-fuels. The high targets of EU and USA require constant investment in the next few decades. Decisions to reduce CO₂ emissions will make the use of bio-fuels necessary and maintain conducive investment conditions</p>
<p>Strengths New technologies, high-tech solutions will improve the efficiency of agriculture. Society pressures to more advanced and friendly cropping systems.</p>	<p>Weaknesses There is usually not a planning for the areas to be invested. Investors usually seek fast economic results that may not always be well tested.</p>
<p>Opportunities Research breakthrough for new technologies, equipment and services. New species and varieties would enhance yields of raw material.</p>	<p>Threats Investments will drive agriculture in areas that will have higher economic return and not always for the benefit of the human-kind.</p>

Driver	Partnerships, Cooperation and Integration and voluntary agreements
Description of driver	<p>Farms and firms have ready access to knowledge from around the world and this, coupled with the need for cooperation on complex issues, creates the need for a more networked and interactive process, especially when clients themselves contribute knowledge to the system.</p> <p>New models for cooperation are introduced, such as e-collaboration services for farmers or Living Lab models together with Joint public/private programs to develop and deploy sustainable approaches with industry</p>
Short time influence till 2013	<p>In short term, partnership agreements will start playing a vital role to meet the high demands for sustainable energy and also to secure vital production. The concepts of e-collaboration and Living lab start to be used in agriculture</p>
Medium time influence 2020	<p>Agriculture will largely adopt new collaborative models, which will support not only sharing of resources, but also of knowledge. In the medium term, partnership agreements will be more widely used and will be specialized in different sectors, such as the production of energy crops, where local industries will produce oil and bio-fuels as well as in other agricultural sectors mainly for industrial crops.</p>
Long time influence 2030	<p>In the long term, partnership agreements will be more 'mainstream', where local industries will be closely connected to the region and farmers will directly sell their products to them securing prices disposal of their production. Agricultural production will be horizontally and vertically integrated.</p>

Geospatial influence (world wide, Europe, selected regions)	The influence will be world wide. It could have higher profit for developing countries, because, collaboration could make transition easier. This will have a positive influence in the developed world with sharing of resources and viable production and also in developing countries that have a lack of agronomic and technical know-how of producing commodities needed to feed the increased number of population and also to meet the needs for energy.
Importance (from 0 – 5)	4. This will be important in the farming of the future as the farmers should work close to the industry and have agreements to secure their income. Improvement in the competitiveness of potentially viable production, including innovation, training, promotion of linkages and other support activities, in including both traditional and non traditional export sectors; development of export marketing capabilities, including market research; compliance with and adoption of quality standards relating to food production and market; Promotion of private investment and public-private partnerships in potentially viable production; building or strengthening the scientific and technical capability; and strengthening the dialogue between the industry, market experts and farmers.
Impact on potential yield	3 Potentially this will lead to increased yield, as the transfer of technical and agronomic knowledge will also help farmers using higher yielding varieties.
Impact on prices	3 Cooperation among primary producers and industry could optimise prices.
Impact on costs	3 This will reduce the cost as farmers will share specialized and expensive equipment and utilize central management and advisory systems.
Impact on farm management	5 This will change the farm management as it will not be the traditional family-oriented management but with central management and advisory guidance. The collaboration require new methods of management
Impact on labour resources	3 This will lead to a more rationalized used of labour resources.

Impact on education	5 More educated people will be needed to meet the industry requirements and to produce sustainable energy demands.
Impact on environment	3 This might have a impact on the environment due to the rationalization of resources, equipment and land use.
Impact on technical equipment(development)	5 More advanced and specialized equipment will be used which will be shared among the farmers who will work closely with the industry. Collaboration will require new technologies and communication tools
COMMENTS	Partnerships, Cooperation and Integration and voluntary agreements is a trend that has already started in many places around the world and we will see it more often in the future because both of the rationalization of resources and closer to market (industry) products. Cooperation is used in agriculture already from 20 th century. Collaboration and ICT will bring new quality.
Strengths The collaboration and integration of resources will increase productivity of the agricultural sector. It will support better utilization of technology and knowledge, viable production, dialogue with market experts, promotion of private investments and rationalization of resources.	Weaknesses The collaboration will require new investments and better education of all partners. It depends also on availability of ICT, reliance on partners and reduced flexibility on exploring new markets.
Opportunities The main opportunity is to build a knowledge network, where farmers will cooperate with researchers, education, advisory services, agro services and where all will share common knowledge.	Threats There could be problem with adoption of collaboration in some countries, where negative experiences with socialist collectivization exist and where until now farmers don't understand differences between cooperation and former collectivisation. Another potential problem is introduction of Oligopolies.

Driver	Research and development in Agriculture
Description of driver	<p>The government R&D and incentives to private R&D to promote innovation towards sustainable development.</p> <p>R&D is the driving force for innovation in new technologies, biotechnology, new crops and varieties, new services, etc.</p>
Short time influence till 2013	R&D will mainly be based on the 7 th Framework Programme within the EU, but R&D will also be important from the industry and national governments.
Medium time influence 2020	In the medium term the need for more food and for energy from crops due to the high prices of fuel will also boost R&D in Europe and worldwide.
Long time influence 2030	Research in agriculture for new and advanced agricultural commodities will be needed to keep raw material supply at low cost. The trends of the previous period will be maintained and funds will be available for research in the sector.
Geospatial influence (world wide, Europe, selected regions)	The importance of R&D will be worldwide. The western world will need to increase efficiency and develop new products for industrial, energy and other purposes on top of agriculture. Europe and the USA will be on the cutting edge on the R&D, but also developing countries will invest in R&D to tackle hunger, usually through international organizations.
Importance (from 0 – 5)	5 - R&D is the main driver to achieve any breakthrough in new product development, new services, management strategies, advancement in technologies, etc. Therefore, it is of significant importance.
Impact on potential yield	5 - R&D is expected to help farmers to increase their yields and margins. Better and more productive varieties will be combined with improved management to achieve higher quantities and high quality of raw material needed by the industry.

Impact on prices	2 - Increased demand of agricultural raw material will be tied in with new product development and this will probably generate more food stuff and energy from crops, which may avoid big price increases.
Impact on costs	5 - Improved varieties, improved management, new product development and new automation in farm machinery will permit more cost effective farming systems to be developed.
Impact on farm management	5 - R&D will permit the use of ICT in farming. New crop models and crop management will require new skills by the farmers. More precision agriculture applications and automatic data gathering will improve farm management.
Impact on labour resources	3 - R&D will reduce unskilled labour requirements but by increasing new skills, such as ICT applications, will require new skills by the farmers for successful applications.
Impact on education	5 - As new technology will be adopted new skills will be required from the farmers, the farm managers and their advisors. Training in the new technologies will be required. University education should also be directed to educate farm advisors with the necessary skills to assist farmers in the successful adoption of new technologies.
Impact on environment	5 - R&D will target important environmental problems and provide viable and sustainable solutions. E.g. R&D in renewable energy sources will reduce CO ₂ emissions, improved farm management solutions would reduce the inputs maintaining or even improving the output products that will have beneficial effects to the environment. Research on methods to maintain soil fertility and productivity (decrease erosion, increase organic matter) would also have a positive affects to the environment.

<p>Impact on technical equipment(development)</p>	<p>5 - New equipment has to be designed and developed to cover the requirements of the new crops and the new management of the farms. For example new automated systems can offer reduced labour needs. They will be introduced to reduce farm machinery, which will decrease soil compaction problems.</p>
<p>COMMENTS</p>	
<p>Strengths R&D is the basis of innovative solutions to existing problems and investments in R&D offer opportunities for future developments. Sustainable development will remain a priority and R&D funding will be of high priority. Climate change combined with high energy prices and insecure energy supply will enhance R&D funding to find new solutions to the energy problems and increase sustainability.</p>	<p>Weaknesses The results are practically applicable only after several years and this can cause short term funding cuts by governments struggling to cut spending and budget deficits. Most of R&D activities depend on public financing.</p>
<p>Opportunities R&D in agriculture might be enhanced by new challenges due to climate change, high energy costs and the necessity of sufficient food supply in both quantity and quality. The same effect will have high energy costs and the insecurity of supply. Recent food costs increases and security problems will have a similar effect.</p>	<p>Threats R&D in agriculture might be hindered by a reduction of the funds afforded by the EU and the national governments for research. Another threat is the conduction of different research projects which are not focused on the best targets. Finally, especially in the academia there is always the danger to underestimate the value of cooperation with the actual farmers.</p>

Driver	Information and communications
Description of driver	<p>The key strategy is to provide an effective knowledge transfer to as many people as possible, through a range of services and to meet the diverse knowledge and information needs of customers and stakeholders. The information and communication technologies (ICT) revolution - probably the key technology of the last 25 years, has already had a considerable impact on production and processing. It will continue to drive innovation in the period up to 2030, especially in logistics and distribution, productivity, food health and safety, traceability and services.</p> <p>ICT facilitated the development of robotics and automation now used in many industries, including the agri-food sector. New systems, such as self-milking systems for dairy cows, are being developed, as well as process automation to reduce labour and improve productivity.</p>
Short time influence till 2013	The majority of farm businesses will adopt ICT technology as tools for farm management
Medium time influence 2020	Principles of ambient mobile intelligence will be adopted by farming sector to guarantee effective management of production but also traceability.
Long time influence 2030	Agriculture will become fully knowledge driven. This will require full adoption of ICT. New sensors and nanotechnologies will become an integrated part of management.
Geospatial influence (world wide, Europe, selected regions)	The ICT will be early adopted in developed countries, but also gradually in the developing countries.
Importance (from 0 – 5)	5 - ICT will be one of the key factors of knowledge driven agriculture in the future.
Impact on potential yield	3 – Effective usage of ICT will influence quality and quantity of food production. The influence of yield will depend on selected models.

Impact on prices	3 - ICT offers better and direct marketing of products, which could influence end prices. On the opposite side, increase of prices could result from costs for traceability of products.
Impact on costs	3 - The initial investment into ICT could be compensated by optimising production processes.
Impact on farm management	5 – Future effective farm management will not be possible without adoption of ICT technologies.
Impact on labour resources	4 – Adoption of ICT will probably decrease requirements on labour resources.
Impact on education	5 – Education is key condition for ICT adoption by farmers. Future solution will require well educated staff.
Impact on environment	3 – Adoption of ICT and new knowledge management could have positive influences on environment. There are possibilities for cleaner agricultural production, with limitation of wastes.
Impact on technical equipment(development)	5 - Complete ICT adoption will also require new technologies, which will enable the utilization of new ICT solutions, like new machinery
COMMENTS	As early as 2003, ICT was recognized as a key to enabler future farming sector development.
Strengths Developing and adopting ICT improves the efficiency of knowledge transfer and innovation support services. These include technologies for automated data capture and analysis, benchmarking and modelling and forecasting for improved decision support to farmers.	Weaknesses The continuous digital gap reduces possibilities for developing of farming sector in some countries
Opportunities ICT open new opportunity for agriculture production to become fully knowledge management. Automation and robotics could open new productive and environmental friendly production.	Threats The economical and social barriers will not allow farmers in some countries to adopt new ICT technologies. This increases the gap between developed and developing countries

Driver	Development of sustainable agriculture
Description of driver	<p>Assessments and scenarios – sustainability assessments which identify synergies and trade-offs across the economic, environmental and social impacts</p> <p>Sustainability is defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs. Regarding a sustainable development of societies usually the three "pillars" ecology, economy and sociology are considered. It is important to maintain a productive agriculture, which will be able to keep the population in rural areas with adequate income and at the same time keep the adverse environmental effects of agriculture at acceptable levels. The transformation of the definition to imposing everyday applicable rules to farming and the indices to assess sustainability will play an important role in the changes of farming practices and management changes.</p>
Short time influence till 2013	<p>Climatic change, food security and safety and rural population stability are key drivers for agriculture. Farmers have to change their management practices to adapt to the requirements of sustainable agriculture and help the whole society to ease the environmental problems. Application of ICT in the agricultural sector would have a beneficial effect to the appropriate use of resources and keep a profitable agriculture. Increasing precision input applications, appropriate genetic material and automation would lead to more sustainable farming systems and permit farmers to conform to the definitions and rules of sustainability.</p>

<p>Medium time influence 2020</p>	<p>The success of all measures to reduce the environmental problems and mainly to reduce the climatic changes effects will be revealed in the short term. Any success or failure will directly affect the farming practices and management of the farms, leading to more agro-environmental measures taken by the states. By 2020 and further on, the effects on the climatic change will be clear and it is believed that more worldwide treaties will be enforced. Food security will be a problem as larger parts of the world populations will start consuming at present developed countries' levels. We can't afford unsustainable production with a growing human population.</p>
<p>Long time influence 2030</p>	<p>If the climatic change scenarios are verified, strict measures have to be adopted. This will be an important driver for farms to change practices and management into a more environmental friendly direction.</p>
<p>Geospatial influence (world wide, Europe, selected regions)</p>	<p>The important part of EU policies is to protect environment and alleviate all factors leading to the climatic change. If the climatic change scenarios will be verified a wider acceptance of the environment protection measures will be adopted worldwide. The existing situation doesn't guarantee reduction of CO₂ production in short time period. Expansions of the treaties are however already under discussion with other countries like USA to negotiate their participation. Some additional developed countries' participation will be achieved if the climatic changes scenarios will be verified in the next few years.</p>
<p>Importance (from 0 – 5)</p>	<p>5 - Environmental problems will have direct affect on the farming practices. Most of the proposed solutions to reduce CO₂ of the atmosphere involve farming practices. That will affect farming by imposing measures and new farm practices to reduce emission, but will also offer opportunities for new crops and uses of the products.</p>

<p>Impact on potential yield</p>	<p>2 - The effect on yield is not clear. One part of policies towards farming practices suggests the development of less intensively managed fields which would reduce yields, inputs and other adverse effects of agriculture (this of course threatens food security). On the other hand new technologies can offer more accurate and precise input use which would lead to increased yields and improved efficiency. The development of new varieties and new crops with increased productivity would increase yields. The trends are not clear in the short term. In the long run, a more productive agriculture should be expected to be developed.</p>
<p>Impact on prices</p>	<p>3 - Sustainability of agriculture would need several changes in farm management that have to be paid by the society either through subsidies or through increased prices or a combination of the two. But the new technologies which will be developed and adopted by the farmers will have an impact on supply and costs, however by increasing supply and reducing costs prices will stabilize in the long term.</p>
<p>Impact on costs</p>	<p>3 - The agro- environmental measures that are imposed imply increased costs at the beginning as new management skills have to be used by the farmers. The adoption of ICT will initially increase investment and costs but in the long run it will help reducing costs as a better use of inputs and labour requirements will be achieved.</p>
<p>Impact on farm management</p>	<p>5 - Farm management will be obliged to adopt new technologies and skills to achieve the expected results by the society. A lot of changes in the background to adapt to the new technologies are required and this will have a great impact to farm management.</p>
<p>Impact on labour resources</p>	<p>3 - With current labour costs, increased labour is not acceptable for the farmers. Increased automation machinery systems would result in reduced needs of unskilled workers but probably in increased employment of skilled technicians.</p>

<p>Impact on education</p>	<p>4 - Sustainability achievements are a complex process. Today's education is still putting more weight to the production part of agriculture. Education will have to change largely to achieve both targets, productive agriculture at reasonable costs and environmental protection. More emphasis should be given to the adoption of new technologies which will lead to more efficient and environmentally friendly farming systems.</p>
<p>Impact on environment</p>	<p>5 - Undoubtedly the environment will greatly benefit from the development of a sustainable agriculture. Good agricultural practices imposed by the governments will benefit environment. Use of biomass to cover part of the energy demand will have beneficial effects to the reduction of the worldwide production.</p>
<p>Impact on technical equipment(development)</p>	<p>4 – Sustainable agriculture will require suitable equipment. Thus, the development of new equipment will be enhanced and the farmers will invest to adapt to the new regulations.</p>
<p>COMMENTS</p>	<p>Regulations to improve agricultural sustainability will be necessary at the beginning, because a more sustainable agriculture requires substantial changes of farming. As the measures will be adopted, they will lead to more stable systems and help farmers in the long term to claim fees for maintaining the environment from the society.</p>
<p>Strengths Climate change will enhance rules for sustainability in agriculture. Energy costs will have similar effects. Sustainable agriculture will help farmers to claim subsidies for environmental stewardship.</p>	<p>Weaknesses Food security will oblige governments to ease agro-environmental measures to increase supply. Food costs will have similar effects.</p>
<p>Opportunities New technology is offering solutions to the development of sustainable agriculture and for better use of resources. Early adoption will help in the development of sustainable agriculture and at the same time certify the sustainability of the systems.</p>	<p>Threats Climate changes (especially in the South where desertification problems will rise) will threaten existing agricultural systems and will make any investment to new management skills and practices difficult. Reducing profits will hamper spending in new technologies, which would offer solutions to the problems.</p>

Driver	Valuation of ecological performances
Description of driver	<p>Environment has been a free of charge product in the last centuries. Due to the high pressure on environment caused by an extremely growing population, the environment becomes a minimum factor that might limit further growth on Earth. In order to protect the environment, to enable a sustainable development and to make people aware about the importance of environment, making the environment a 'product' is a possible solution. In the past the population, the industry and the politics did a free ride on the environment with negative effects that are measurable today like emissions with their negative effects, problems like climate change etc. The most discussed problems today are on a worldwide basis CO₂-sequestration, water-quality and -quantity, biodiversity and landscape aesthetics. In general we can say that farms have a production function, a buffer function for soil, water, climate, a habitat function regarding biodiversity and a socio economic function for the development of the rural area. In other words, farms have to deliver abiotic, biotic or landscape benefits.</p> <p>Beside these general targets, in detail ecological performances can be measured at: protection of erosion, burden limits on soils, N-fertilizer reduction, drinking water quality, less ammoniac gas production, reduce further climatic relevant gases, being responsible for the landscape etc.</p> <p>Within EC a consensus is reached that the farmers have to get remuneration for those activities which exceed good professional practice for a number of agro-environmental measures.</p>

Short time influence till 2013	As long as subsidies are paid in Europe, there is time to restructure the models and prepare for a period after 2013 when the chance of reduced subsidies is very high. To enable an average mid-sized European farmer to compete on the world market in a populated region with a high demand on the environment and on environmental products, these products have to be evaluated and must become part of the farmer's income.
Medium time influence 2020	The first valuation programs will start and possible failures will lead to restructuring and changes; as the environment is not a local or regional or national problem, this question has to be taken on a higher platform and must be discussed on a worldwide level.
Long time influence 2030	A worldwide valuation of ecological performances with rules has to really address, what has to be paid, who will be paid for this and whom will be paid. It taking into consideration the impact of environmental caretaking for local, regional, national, continental or worldwide influence and worldwide agreements that reflect the "village Earth" have to be signed to guarantee that not nations take a free ride on the cost of other nations.
Geospatial influence (world wide, Europe, selected regions)	As Europe at the moment takes the lead in these questions this has to be further continued. High level education programs and best practice examples have to be installed showing the local benefit for the whole population. Out of such best practice examples, further regional and national examples have to be implemented. To be able to do this, a strong political support is necessary. We have to see at the long run the different nations like neighbours that might influence each other with emissions resp. emissions, with noise, with waste etc. Today, many nations have implemented legislation that rule the living together of people. More complex is the living together of nations that influence each other. Models for the detailed valuating of ecological performances are available at a great selection.
Importance (from 0 – 5)	5 - For a long term surviving on planet Earth it will be a must to value the environment

Impact on potential yield	3 - In some cases the term "yield" will have to be newly defined - e.g. optimized yield under sustainable rules.
Impact on prices	3 - Price will increase, partly on the externalized costs.
Impact on costs	4 - Will increase as new types of costs will incur
Impact on farm management	4 - Will need to be improved to be able to calculate ecological performances.
Impact on labour resources	3 - Higher qualification - as necessary - leads to higher labour costs.
Impact on education	3 - Increased education is necessary, starting with training the trainer models.
Impact on environment	5 – Positive impact on the environmental protection and sustainability.
Impact on technical equipment(development)	4 - New measurement methods will have to be developed or integrated to enable performance valuation.
COMMENTS	<p>We will not be able to make a detailed bookkeeping nor to keep track of the good "environment" any longer - in form of forests, agriculture land, biodiversity, water resources etc.; to valuate ecological values will become a must. Instead of speaking of the state as owner of the "environment" we will have to think about private ownership with social responsibilities</p> <p>With better understanding of the environmental relations, the necessary valuation of ecological performances will become possible. Pilot projects and best practice samples will be the key to demonstrate for a wide auditorium the benefits of environmental caretaking. New model of payment of the different groups of beneficiaries have to be worked out (local, regional, national, continental and worldwide) as well as the best practice between today's "government owned" environment and tomorrows "private owned with social responsibilities" has to be worked out.</p>

<p>Strengths</p> <p>As soon as the environment becomes a product, people will also take better care of it. In the case of damages exact rules have to be defined and the costs to repair have to be carried out by the causer resp. the origin. If something has a price people will value it differently.</p>	<p>Weaknesses</p> <p>Beside all the costs we have today to arrange our lives an additional cost factor will occur, but it will be necessary to survive on the long run. Another weakness might be the complexity of the definition of environmental values and ecological performances respectively. A single factor like CO₂ impact or energy impact might help to keep it simpler.</p>
<p>Opportunities</p> <p>To value the ecological performances will give a huge impact on the further development of the world, adding a value will increase the GNP and will give labour for millions of people.</p>	<p>Threats</p> <p>The largest risk is that a country or a group of countries (EC) start a project into a direction that is not followed by other countries.</p>

Driver	National strategies for rural development
Description of driver	National strategies usually define the frames for the implementation of European Policies in single European Countries. They partly modify or adapt European policies and regulations to national conditions.
Short time influence till 2013	National strategies until 2013 are already defined and they are developed for the period from 2007 till 2013. Large changes cannot be expected.
Medium time influence 2020	With the CAP reform, national strategy will also be changed. It is expected that there will be a shift from direct payment to supporting environmentally friendly production and food safety.
Long time influence 2030	It is difficult to perceive the long time changes in the national strategies. Some countries, e.g. Ireland, have already national strategies with a strong focus on KBBE.
Geospatial influence (world wide, Europe, selected regions)	The influence of single national strategies is mainly on national level, but it could also influenced surrounding countries and in the cases of large countries also global market.
Importance (from 0 – 5)	3 – National strategies will be predefined by European legislation and also by WTO discussion.
Impact on potential yield	2 – The production will be mainly influenced by the CAP reform and eventually by a WTO agreement. National strategies will have a far less important impact on it.
Impact on prices	2 – Again, prices are expected to be influenced mainly by CAP and WTO
Impact on costs	2 – What applies for prices and potential yield, applies on costs too.

Impact on farm management	2 – National legislation will influence methods of farm management, but major influence will be global.
Impact on labour resources	1 - National legislation will influence labour management, but major influence will be global.
Impact on education	4 – Education will be strongly influenced by national strategies.
Impact on environment	3 – “Habitats directive" or the "Directive for the conservation of wild birds" is installed by the EU. They are broken down to national levels where they usually contribute to national legislation and nature protection (such as national parks, biosphere reserves etc.).
Impact on technical equipment(development)	2 – Influences on equipment will be mainly global
COMMENTS	National strategies will be predefined by European legislation and global influence.
Strengths National strategies are able to adopt European legislation for the needs of single European countries and thus respect the European diversity of landscapes, land use systems and cultural heritage.	Weaknesses National strategies could change some important aspects of reforms that the EU legislation as a whole will try to pass.
Opportunities The national strategy could have positive influence in any country if it will really address the needs of this country.	Threats National strategies could moderate the CAP reform. For example, they could try to impose a protection of the local market.

Driver	Politicians
Description of driver	Politicians and especially changes in leadership in single countries could change the conditions for agriculture in these countries. Usually, this influence is stronger in new member states, where the system of political parties is not stable yet and also in countries, where government changes too often.
Short time influence till 2013	Until 2013, the influence of politicians will be strong in single countries and changes in government could result also in changes in the national agricultural policy.
Medium time influence 2020	The influence of single politicians will probably not be too strong, the system of parties will be more stabilised and potential political changes will not have a strong influence on agriculture.
Long time influence 2030	Influence of single politicians will decrease; the situation will be more influenced by external conditions or by global drivers.
Geospatial influence (world wide, Europe, selected regions)	National
Importance (from 0 – 5)	2 – Currently mainly in the time of economical crises politicians try to influenced current situation. It could be expected, that in future the decision of politicians will be influenced mainly by external conditions. So we could expected, that decision of politicians will be given by other external drivers.
Impact on potential yield	2 – The politicians try to have influence of yield production, but their decision are mainly given by other drivers.
Impact on prices	2 – The politicians try to have influence of prices production, but their decision are mainly given by other drivers.
Impact on costs	2 – Influence of individual politicians on cost is low, main focus is on prices

Impact on farm management	2 – Influence is given mainly by decision about legislation
Impact on labour resources	2 – Influence is given mainly by decision about legislation
Impact on education	3 – There is low influence on education in sense of education about farming skills
Impact on environment	2 – Influence of individual politicians it currently high in single countries, but it will decrease in future. The role of politicians will be more and more to react to external conditions.
Impact on technical equipment(development)	2 – The influence is only non direct.
COMMENTS	The role of individual politicians will probably decrease.
Strengths Local, national and regional politicians are able to react better on local changes and are able to modify local, regional or national legislation according these changes.	Weaknesses Politicians may in many cases be more influenced by different interest groups, than by the need to solve concrete problems.
Opportunities The politicians will adopt national or regional or local legislation on the base of global conditions.	Threats Strong influence of local and national lobbies could conserve current system and later changes will be very difficult.

Driver	Press
Description of driver	Press plays an increasingly important role in shaping the public opinion. It could for example promote healthy or environmentally friendly products or production of energy and it could influence the development of the agricultural sector for some time period.
Short time influence till 2013	The press will be probably mainly focused on these aspects: <ul style="list-style-type: none"> • Food safety • Food security • Energy production • GMO
Medium time influence 2020	It is difficult to predict the influence of the press for both the middle and the long term period. The influence of press is usually visible in short term.
Long time influence 2030	As above.
Geospatial influence (world wide, Europe, selected regions)	Press currently has a worldwide influence. It depends also on freedom in single countries.
Importance (from 0 – 5)	3 - Press will play an important role, but it is difficult to predict in which direction.
Impact on potential yield	2 –Influence is difficult to be predicted.
Impact on prices	2 –Influence is difficult to be predicted.
Impact on costs	2 –Influence is difficult to be predicted.
Impact on farm management	2 –Influence is difficult to be predicted.
Impact on labour resources	2 –Influence is difficult to be predicted.
Impact on education	2 –Influence is difficult to be predicted.
Impact on environment	3 - In case the press supports an environmentally friendly agriculture, an enormous pressure will be on farmers etc.

Impact on technical equipment(development)	2 –Influence is difficult to be predicted.
COMMENTS	The press plays an important role, but it is difficult to predict in which direction.
Strengths Press will promote new methods, knowledge and innovation	Weaknesses Negative press campaigns or publishing of information without validation could negatively influence all sectors.
Opportunities Press could play the role of a facilitator for the changes to come in the agricultural sector.	Threats Publication of unreliable information could defame either new agricultural policies or new agricultural techniques or practices.

Driver	Education
Description of driver	The 'Knowledge Economy' refers to the emphasis on investment in 'Knowledge Capital' as the means to meet the economy's long-term rate of economic growth. In order for living standards to grow in all economies, a constant level of capital investment is required. Capital can take on many forms, such as, physical capital in the form of the plant and machinery; public capital in the form of infrastructure; human capital in the form of education, training and work experience embedded in a country's labour force; and 'knowledge capital', which refers to the accumulation of ideas in the form of scientific publications, patents etc. that enable new products and services to be developed or which outline new and more cost effective production systems. All forms of capital investment generate returns in terms of higher levels and rates of economic growth.
Short time influence till 2013	The key strategy will be to provide effective knowledge transfer to as many people as possible, through a range of services, and to meet the diverse knowledge and information needs of our customers and stakeholders.
Medium time influence 2020	Incorporating management practices and technologies on the home farm, supervised project work and discussion groups: linkages with higher level education institutions.
Long time influence 2030	Agriculture will require highly educated staff. There will be large shift from manual work to knowledge management.
Geospatial influence (world wide, Europe, selected regions)	This driver will play an important role on a world wide scale.
Importance (from 0 – 5)	5 Education is key factor for knowledge management in agriculture.

Impact on potential yield	5 The better management, and using of new scientific results could increase production, if it will be necessary/
Impact on prices	2 Prices will be more defined by market requirements. The main driver will be competition between food and non food market. Knowledge could partly eliminate these influences.
Impact on costs	5 – Better farm management and usage of more effective methods of production could decrease costs.
Impact on farm management	5 – Education is a necessary condition for improving farm management.
Impact on labour resources	5 – Education will decrease the requirement for manual and non educated staff, but will increase requirements on highly educated staff.
Impact on education	
Impact on environment	5 – Education is important for environmental friendly production.
Impact on technical equipment(development)	5–Highly educated staff will require new technologies.
COMMENTS	The focus on ‘Knowledge Capital’ (or the ‘Knowledge Economy’) in recent years derives from the realisation that much higher rates of return can be generated from investment in this type of capital.
Strengths Implementing the recent review of education and training service ensures that the programmes are focused on concrete groups (students, farmers, etc), based on a platform of innovation and excellence and respond to the needs of a competitive bio-economy.	Weaknesses Access to education is missing in parts of the world. This is a strong limitation for developing countries. It is a problem in Europe, that large international exchange of knowledge and educational content and best practices don’t exist.

<p>Opportunities Education will open opportunity for transformation of all agriculture sectors. It is expected that in the future farmers will become knowledge workers, which will use a large range of new technologies</p>	<p>Threats Low access to knowledge and education will be a reason for the exclusion of population in some countries from this new knowledge based agriculture. E.g. there are estimations, that 4 million people in Germany are functionally illiterate. It's a threat that employment for less educated people is getting lost.</p>
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<p>Driver</p>	<p>International organizations</p>
<p>Description of driver</p>	<p>The World Trade Organization conducts negotiations through what is called rounds. The latest is Doha Development Round commenced at Doha, Qatar in November 2001 and it continues still. Its objective is to lower trade barriers around the world, permitting free trade between countries of varying prosperity. As of 2008, talks have stalled over a divide between the developed nations led by the European Union, the United States and Japan and the major developing countries (represented by the G20 developing nations), led and represented mainly by India, Brazil, China and South Africa.</p> <p>The Doha Round began with a ministerial-level meeting in Doha, Qatar in 2001. Subsequent ministerial meetings took place in Cancún, Mexico (2003), and Hong Kong, China (2005). Related negotiations took place in Geneva, Switzerland; Paris, France; and again in Geneva.</p> <p>The focus is on more open markets which are expected to bring economic benefits to a broad range of countries over the years, including many in the developing world.</p> <p>The process in agriculture and food is mainly under umbrella of WTO, FAO and OECD.</p>
<p>Short time influence till 2013</p>	<p>The process of negotiation will be closed and there will be defined common agreement about free market with food and agriculture product and about subsidies systems.</p>

<p>Medium time influence 2020</p>	<p>The baseline is contrasted by two alternative scenarios representing two possible but extreme policy choices:</p> <ol style="list-style-type: none"> 1. The regionalisation scenario assumes that the WTO negotiations would not conclude and bilateral trade agreements would become more important. Agricultural policies would remain largely as they stand and rural development funding would be significantly increased. Consequently, total spending for the CAP would increase. For the market side again a balanced market approach had been chosen 2. The liberalisation scenario assumes a complete dismantling of the first pillar policies, i.e. agricultural markets would be completely liberalised and rural development funding substantially reduced. Environmental legislation would be partially withdrawn in order to assure competitiveness with agriculture in third countries and other sectors of the economy.
<p>Long time influence 2030</p>	<p>CAP and WTO reforms in the near future seem certain to lower the level of tax-payer and consumer support to agriculture in general; in the long-run, direct support to farm income is likely to be replaced by support for the development of the rural economy. The net effect of these policy changes and trends is that agricultural and food enterprises will be more exposed to market forces.</p> <p>This will put pressure on less competitive enterprises, but generate clearer market signals for improved decision-making and create new opportunities for innovative farmers and companies capable of adapting to the changed market needs.</p> <p>A recent EU Foresight report²² identified food and energy security as key challenges into the future and called for debate on new policies, technologies and knowledge that will enable Europe to successfully face these challenges. Innovation to improve farming and business processes will become even more critical, but higher world prices should make it easier</p>

²² EU Agri-Food Industries & Rural Economies by 2025 – Towards a Knowledge Bio-Economy – Research & Knowledge-Transfer Systems Liam Downey

	for industry to invest in the changes needed to improve productivity and competitiveness.
Geospatial influence (world wide, Europe, selected regions)	The international organizations have global influence
Importance (from 0 – 5)	5 The negotiation about world agriculture business and CAP reform will have important influence on agriculture.
Impact on potential yield	It is not possible to estimate the impact before the negotiations are closed.
Impact on prices	It is not possible to estimate the impact, before the negotiations are closed.
Impact on costs	It is not possible to estimate the impact, before the negotiations are closed.
Impact on farm management	It is not possible to estimate the impact, before the negotiations are closed.
Impact on labour resources	It is not possible to estimate the impact, before the negotiations are closed.
Impact on education	It is not possible to estimate the impact, before the negotiations are closed.
Impact on environment	It is not possible to estimate the impact, before the negotiations are closed.
Impact on technical equipment(development)	It is not possible to estimate the impact, before the negotiations are closed.
COMMENTS	Doha negotiation round is till now open and also CAP reform is not yet defined, making it very difficult to predict anything about the future.
Strengths It is not possible to estimate, before negotiations are closed. The situation with negotiation is currently not clear with current economical crises. It is not clear if negotiation will continue and will reduce barriers or it will be closed without concrete agreement and current protectionism will continue.	Weaknesses It is not possible to estimate, before negotiations are closed. The situation with negotiation is currently not clear with current economical crises. It is not clear if negotiation will continue and will reduce barriers or it will be closed without concrete agreement and current protectionism will continue.

Opportunities

It is not possible to estimate, before negotiations are closed. The situation with negotiation is currently not clear with current economical crises. It is not clear if negotiation will continue and will reduce barriers or it will be closed without concrete agreement and current protectionism will continue.

Threats

It is not possible to estimate, before negotiations are closed. The situation with negotiation is currently not clear with current economical crises. It is not clear if negotiation will continue and will reduce barriers or it will be closed without concrete agreement and current protectionism will continue.