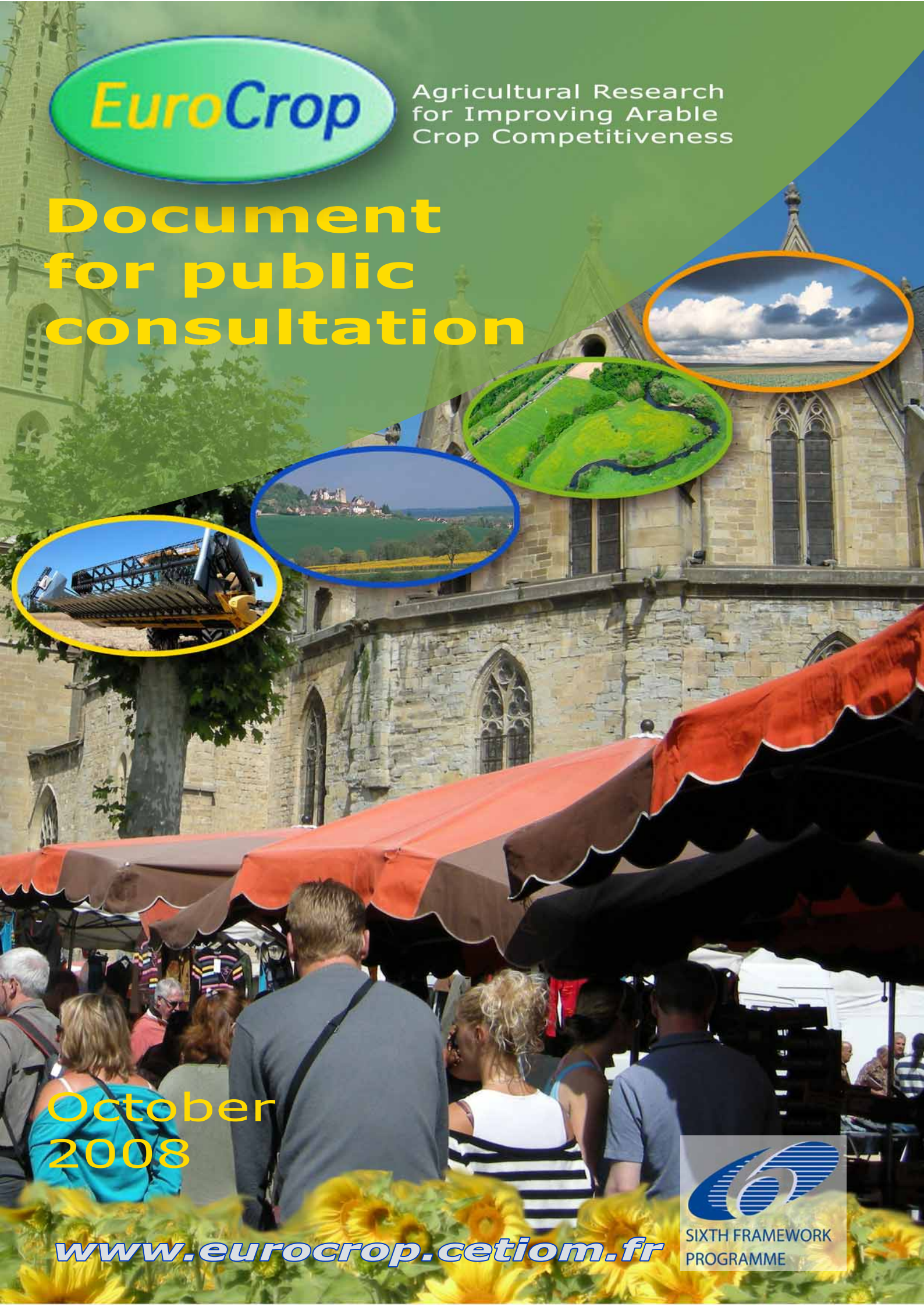
EuroCrop

Agricultural Research for Improving Arable Crop Competitiveness

Document for public consultation



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SIXTH FRAMEWORK PROGRAMME

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Foreword

The European agriculture has to maintain its competitiveness in a moving context. The CAP health check and its future evolutions, the energy crisis, the food supply gaps, the evolution of environment health, the social changes in European Rural areas, consumer's habits, climate evolutions… are among the factors which impose challenges to agriculture and its arable crops sector at 2015 horizon.

Innovation in agriculture, as key factor of "sustainable competitiveness", is supported and enhanced by coordinated research in diverse scientific disciplines, including agronomy, economy, food sciences, chemistry, environment and social sciences.

The EUROCROP project, funded under the 6th Framework Programme, aims at defining research orientations in order to improve the sustainable competitiveness of the European arable crops sector in 2015. To reach its goals, it crosses a strategic approach based on scenarios with the expertise of scientists and actors meeting in working groups focussing on crop chains priorities and on horizontal aspects.

The EUROCROP project will present its conclusions during its open conference on Friday, October 17th, 2008, in collaboration with the European Economic and Social Committee.

The European Commission wishes that EUROCROP (and especially through its final conference) offers a place for discussion to enhance the exchanges between the scientific parties and stakeholders concerning arable crops competitiveness.

The conference will invite to discussions through a round table involving external experts and stakeholders, and dialogue with the participants.

Xavier BEULIN,
Chairman of EUROCROP Committee

Executive summary

This document is the EuroCrop preliminary synthetic report for public consultation.
EuroCrop is a coordination action of the 6th Framework Programme aiming to propose relevant research orientation to maintain and develop the competitiveness of the arable crop sector in Europe.
The working process, which is briefly described in the document, crosses two levels of thinking: the development of a strategic approach using scenarios, and a scientific level aiming at identifying the research needs. Crossing these two approaches allows proposing challenge priorities.

Four scenarios have been elaborated:

- SC1: WTO agreement and expensive energy
- SC2: Europe of regions
- SC3: High environmental performance, green Europe
- SC4: challenge of global warming

These four scenarios are introduced under a summarized form, with the priorities as challenges for arable crops as seen by the EUROCROP team.

The challenges common to all or several scenarios are considered as strategic priorities, and include the following titles:

At first level of priority :

- Ensuring food safety
- Improving resource use efficiency: energy
- Improving resource use efficiency: water
- Ensure an effective crop protection in the long term (integrated crop protection)

At a second level of priority:

- Increase level and stability of yields
- Technical and economic optimisation by innovating sustainable Cropping Systems
- Adaptation of production systems and crop rotations according to changes in farming framework conditions
- Improving resource use efficiency: nutrients

And at a third level of priority:

- Managing risks for EU farmers
- Developing Non food/ non feed uses
- Maintain and improve soil quality
- Integrating different sustainability concerns in the design and implementation of innovative cropping systems
- Developing common sustainability assessment methods
- Reinforcing entrepreneurship and innovation capacity of AC systems
- Achieving a positive public perception of arable crops systems

Furthermore, 3 subsidiary challenges are a first rank priority for at least one scenario:

- Minimize greenhouse gas emissions per unit of product
- Developing strategies to face climate diversity and climate change
- Improving the integration of arable crops into rural territories and economies

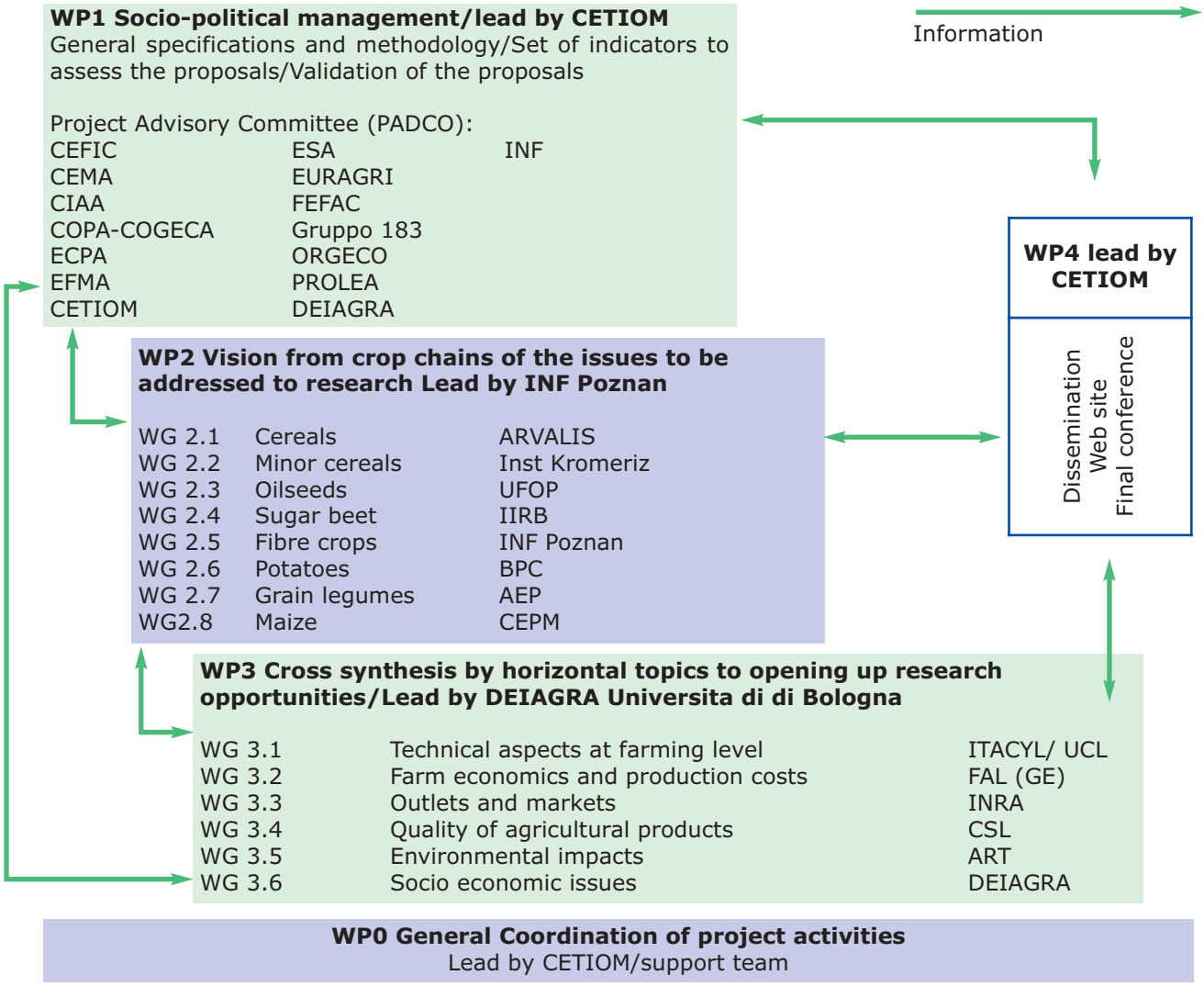
At last, a preliminary list of research topics is proposed.

Introduction: the EuroCrop working process

EuroCrop aims to define a common vision for the future of research and development related to arable crops. It brings together concerned stakeholders and actors, to reach a collective analysis of research needs and identify critical research issues, in order to improve the European arable crops competitiveness, and propose appropriate action. EuroCrop partnership includes organisations using research, including farmers' organisations, and organisations providing research, innovation and extension services. Stakeholders and representative organizations of civil society in the field of environment preservation and consumer advocate are integrated in the partnership of the project, and act especially in the Project Advisory Committee.

To meet its goals EUROCROP uses a cross-cutting approach, first by arable crop in WP2 (cereals and minor cereals, oilseeds, sugar beets, fibre crops, potatoes, grain legumes and maize, which benefited from CAP subsidies until its last reform), second by transversal elements of the competitiveness, in WP3, including technical aspects at farming level, farm economics and production costs, outlets and markets, quality of agricultural products, environmental impacts and socio-economic issues. The action is built in such a way that a crop chain approach is fully considered in WP2, in order to identify specific bottlenecks for increasing crop chains competitiveness. The role of alternative crops is taken into account in WP3.

Figure 1: EUROCROP organisation chart



These topics have been addressed by specialists and invited experts, in a series of workshops, according to a common method. The main results of this 32 months coordination action are (i) a strategic research plan and research proposals to be submitted to policy makers and planners, and widely discussed and disseminated by an open conference, and (ii) the setting-up of a European network of experts, to continue to work beyond the end of the action to set up RTD projects.

EuroCrop works on two interactive levels

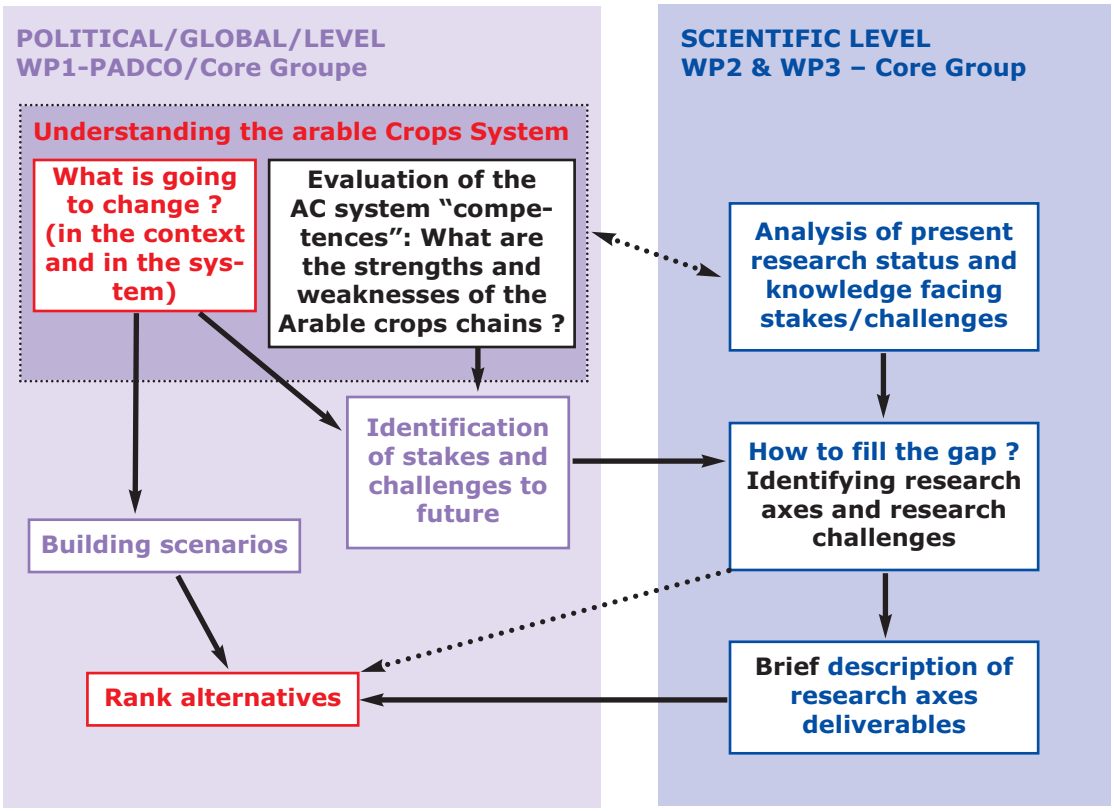
At the level of WP1/PADCO + core group, a strategic thinking has been developed, using basic retrospective and prospective approaches at 2015 horizon, in 3 steps:

- Identification of the main challenges to guarantee the AC competitiveness in 2015 future through:
  - Understanding and describing the European arable crops system (structure and dynamics),
  - Identifying potential changes and making hypotheses on the changes in the systems and in its context
  - Identifying and analysing the actual strengths and weaknesses of AC
- Building scenarios for context
- Ranking in priorities the research areas in coherence with the scenarios

At scientific level (WP2 and WP3) the identification of priority areas was carried out through:

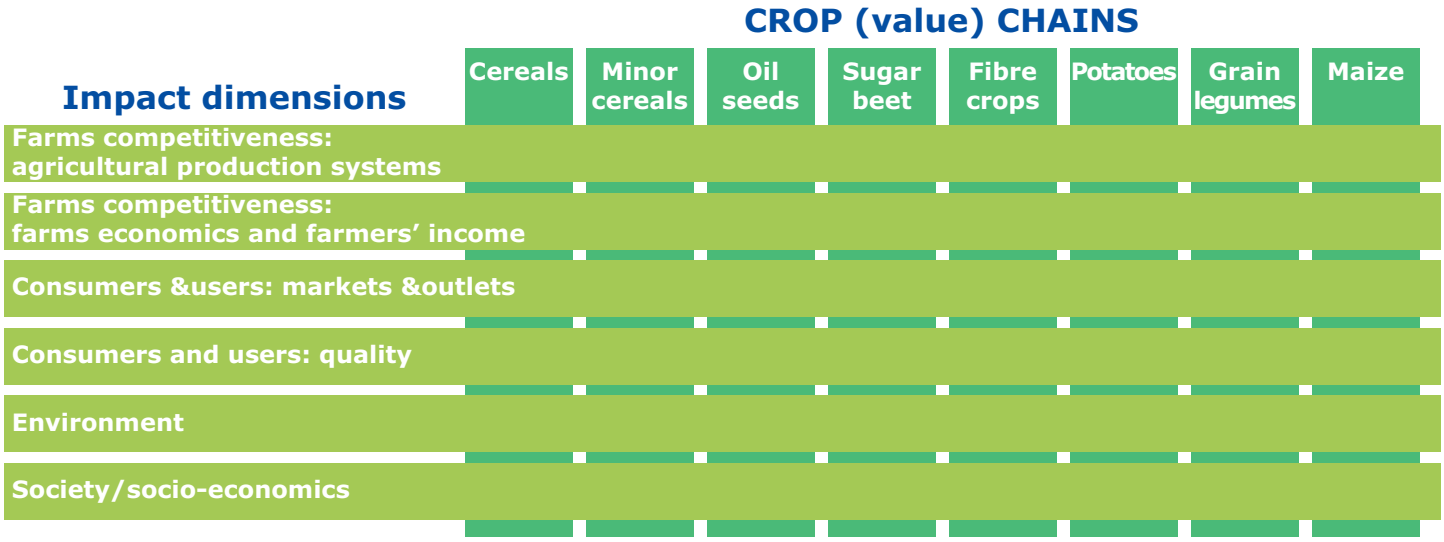
- a preparatory work on the present research status and knowledge organized to take into consideration the main challenges and the weaknesses of AC
- identifying priority research areas and research challenges to fill the gap (experts groups)
- describing briefly the topics and deliverables expected in each research area.

Figure 2: Overview of the methodology/tasks organisation



Arable crop chains competitiveness : major stakes and challenges for arable crops

What does mean "competitiveness" for EuroCrop?
EuroCrop intends to consider both the "vertical" vision of the competitiveness of a single crop and its value chain, i.e a crop chain approach, and the "horizontal" vision through transversal topics which correspond in fact to the main fields of competitiveness and public good.
Crops chains may be considered as value chains crossing fields of impacts, benefits or losses, that is to say fields of competitiveness.



The debates around competitiveness led to consider an approach with the 3 main entries:
- Markets, and economical competitiveness as key entry
- Regulations deal with social, sustainability and miscellaneous aspects. Meeting regulations has finally a cost or a value for the crop chains actors
- Sustainability or social issues, not yet transformed in regulations or immediate cost or value, require that crop chains practices are checked as cross compliant.

For its current works, EuroCrop distinguishes two levels:
"Competitiveness C1": Economical competitiveness and markets, with two sub entries:
- Economical competitiveness of Arable crops **at farm level** in EU countries (a crop versus other crops, arable crops versus other land uses): focus on yield, production costs, net income, farm economics (assuming the respect of current regulations when enforced)
- Economical competitiveness of EU arable crops **on markets**: meeting the demand of industries and consumers (quantities, quality, specifications aspects, regularity of the production, market prices…): focus on quality, cost per produced unit, access costs to markets

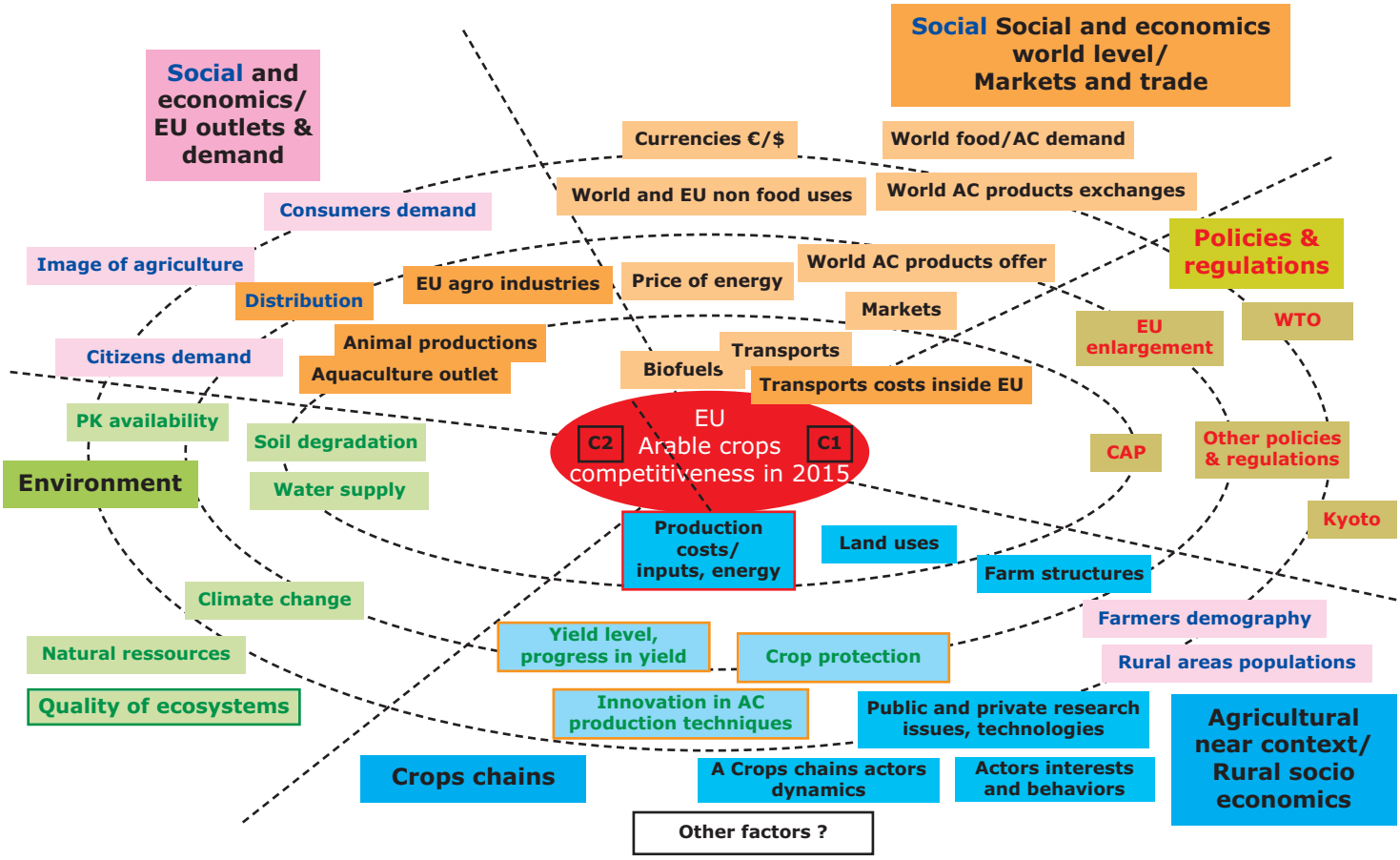
This first level is more or less a short/medium term approach.
"Competitiveness C2": Sustainability and social issues, which need assessment through indicators. EUROCROP examines the interactions of the arable crops production on "external" factors of public interest, such as environmental issues and social issues (citizen demand, employment, rural life…), in a medium term/long term approach.

The field of EUROCROP has been voluntarily limited to the AC which benefited from CAP subsidies until its last reform, i.e a limited number of field crops which constitutes the main activity of the farming systems specialized in vegetal productions, and also the central point of crop chains.

The EUROCROP thinking framework

Building a strategy needs a sufficient understanding of the context, of the functioning of the sector (the AC system) and of the interactions between the sector and its context. The reflexion on past dynamics and possible changes which might affect European arable crops competitiveness by 2015, allowed to identify the main dimensions and factors of the context. The consensus description of the arable crops system elaborated during the first year of the project could be summarized in the next figure:

Figure 4: AC CROPS SYSTEM AND ITS



This representation includes 5 external dimensions (Social and economics aspects IN EU, EU outlets and demand/World level markets and trade/Policies and regulations/Environment/agriculture near context, rural socio economics) and one internal dimension (on farm production). These dimensions were used to identify challenges and elaborate scenarios.

These considerations led the EUROCROP team to formulate 5 major stakes or dimensions for AC competitiveness:

1. TECHNICAL AND ECONOMIC EFFICIENCY OF ARABLE CROP SYSTEMS
2. MEETING DEMANDS ALONG THE VALUE CHAINS
3. NEW OUTLETS AND MARKETS
4. SUSTAINABLE PRODUCTION and ENVIRONMENT ASPECTS
5. SOCIETAL SUSTAINABILITY

The first three stakes are mostly related to the economic competitiveness (C1): The economic efficiency and the capacity of EU actors to produce standard goods at markets prices, for delivery in Europe or abroad is fundamental in a global open market. It requires the technical and economical efficacy of the crop chains at all steps, from the production of the raw products, to the different phases of transformation in agro-industries. The competition on markets plays for the same goods produced in different competitor countries or for goods equivalent for their use, i.e. substitution products.

The strengths and weaknesses of the AC chains have been considered by the expert groups, which identified

a list of challenges for the different crop chains (see annex 3). It permitted to propose a first list of 31 challenges. This list have been completed by the horizontal expert groups, and refined by the project team to reach a consensus list of 36 challenges for the AC sector.

Table 1: List of Stakes and related challenges for the Arable Crop sector

Tab1	**STAKES**/CHALLENGES FOR ARABLE CROPS
1.0	**TECHNICAL AND ECONOMIC EFFICIENCY OF ARABLE CROP SYSTEMS**
1.1	Increase level and stability of yields
1.2	Technical and economic optimisation by innovating sustainable Cropping Systems
1.3	Adaptation of production systems and crop rotations according to changes in farming framework conditions
1.4	Managing risks for EU farmers
1.5	Increasing logistics efficiency
2.0	**MEETING DEMANDS ALONG THE VALUE CHAINS**
2.1	Increase efficiency of transformation processes
2.2	Characterization of quality and standardization
2.3	Ensuring food safety
2.4	Meeting food and industrial quality standards
2.5	Maintain quality of products during storage
2.6	Increasing nutritional value
2.7	Addressing consumer demand in nutrition and dietetics
2.8	Understanding and addressing purchaser demand
2.9	Brand and quality standard protection / To ensure consumer confidence
2.10	Increasing producer share of any added value
3.0	**NEW OUTLETS AND MARKETS**
3.1	Developing New food uses
3.2	Developing New feed uses
3.3	Developing Non food/ non feed uses
4.0	**SUSTAINABLE PRODUCTION and ENVIRONMENT ASPECTS**
4.1	Improving resource use efficiency: nutrients
4.2	Improving resource use efficiency: energy
4.3	Improving resource use efficiency: water
4.4	Maintaining diversity in genetic resources of crops
4.5	Enhancing biodiversity in agro-ecosystems
4.6	Ensure an effective crop protection in the long term (integrated crop protection)
4.7	Minimize greenhouse gas emissions per unit of product
4.8	Maintain and improve soil quality
4.9	Reduce water pollution
4.10	Developping strategies to face climate diversity and climate change
4.11	Integrating different sustainability concerns in the design and implementation of innovative cropping systems
4.12	Developing common sustainability assessment methods
5.0	**SOCIETAL SUSTAINABILITY**
5.1	Improve efficiency in value chain and networking
5.2	Reinforcing entrepreneurship and innovation capacity of AC systems
5.3	Developing income with indirect relations to AC production: income from other activities
5.4	Improving the integration of arable crops into rural territories and economies
5.5	Promote a consistent regulatory and governance system to strengthen the competitiveness of AC
5.6	Achieving a positive public perception of arable crops systems

TECHNICAL AND ECONOMIC EFFICIENCY OF ARABLE CROP farming SYSTEMS

Improving the level and stability of yields is a major challenge of competitiveness at the primary production scale: at crop level, in many situations, the actual crop yields are still far from the genetic potential of the species and of the agronomical potentials of the fields, and their regularity from a year to another is a major subject of uncertainty. Progress at crop stage is still possible through genetic improvement and breeding and at a lesser extent through crop management practices. A major field of progress and capacity of adaptation lies in the innovation in management practices and organization at cropping system and farming systems scales, which is still a promising field for research in agronomy, organization and economy. At the scale of farms, collectors and production basins, logistics are a source of progress in competitiveness, particularly regarding energy expenses and raw product quality management. Managing the risks for farmers (markets prices and yields variations) has also to be considered as a source of competitiveness on medium term and of stability of the EU production. Main beneficiaries: all crop chains actors, then consumers

MEETING DEMANDS ALONG THE VALUE CHAINS

On existing markets, the global competitiveness of a crop chain includes its capacity of "vertical development", i.e. to maximize the added value between the resources and the final product, and also share added value and risks.

Meeting demand is the basis of any future development of EU crops chains. This stake recovers the continuous adaptation to the consumers' needs and demands, including innovation on current markets, accompaniment of consumers' preferences and way of life evolutions, products quality, health (dietetics, nutritional value) and sanitary aspects. The final indicator is the preference of the consumer to buy a European product, and, in the best cases, his acceptation to pay a quality premium. The related global benefits for the European society lay in a positive commercial balance on agri-products, a convenient part of self sufficiency for food, a significant employment in agriculture and agro-industries, the disposal of quality and nutritional value products.

Main beneficiaries: consumers

NEW OUTLETS AND MARKETS

In a competing market, innovation offers a strategic advantage. The horizontal expansion of crop chains depends on both new products and new markets. Opening new outlets for the arable crop products (through the identification of new needs or more suitable ways to answer old needs, and through innovative research) is a way to develop the demand of arable crops products and so sustain prices, and to develop economic activity in EU.

Main beneficiaries: consumers and social actors, crop chains actors

SUSTAINABLE PRODUCTION and ENVIRONMENT ASPECTS

Sustainable production is both a question of long term survival and societal acceptance. This stakes covers the necessity for the crop chains to limit the negative impacts on environment and to prevent the degradation of the renewable resources status (qualities and quantities) and of biodiversity. On the long run, arable crop chains have also to seek for a decreasing dependency on non-renewable resources (nutrients, energy, water, genetic resources, soils…), i.e. to offer a "zero" balance regarding these non-renewable resources (or even positive regarding energy aspects, due to the harnessing of solar energy). Reaching sustainable production is a field of progress in technical efficiency, taking into account long term considerations and compatibility with economy.

Sustainable production issues have to be considered under three main aspects:

- The dependency of AC to vital resources and capacities, whose availability is not secured on the long term: energy, water, fertilizers, crop protection facilities facing the crops enemies' evolutions. The matter is here to decrease this dependency. This aspect is a basis for "competitiveness" on markets in the long term.
- The impacts of the AC on environment and on public resources and common heritage. This aspect is directly connected to societal acceptance: harmonious relations of AC to environment.
- The impacts of environmental evolutions, notably climate change, on the crops and cropping systems.

One integrative major challenge is the development of recognized sustainability assessment methods.

Main beneficiaries: farmers and citizens

SOCIETAL SUSTAINABILITY

The transformation of agriculture on one side and the growing urbanization of the populations in a context of abundance in economically developed countries led to chaotic and sometimes conflict relations between agriculture and society. Societal acceptance became a real stake for agriculture in general and arable crops in particular. To renew the social acceptance bases, and the confidence of social actors, crops chains must not only answer the societal concern about environment, but also renew the insertion of agriculture in the territories and its role in rural development

Securing a significant part of their supply chain with local sources, required quality and services is a key advantage for agro industries, which lays on the activity of skilled farmers. Keeping the production sector attractive for professional farmers need to ensure farmers a favourable environment which includes networks, training and actions to reinforce entrepreneurship and innovation capacity, and also incomes ensuring common standards of living to the farmers. This stake recovers aspects related to economics, social, crop chains actors' dynamics, policies and their consequences.
Main beneficiaries: crops chains actors and citizens.

Challenges and research goals

Focussing to research, the experts groups had to translate their analysis of challenges into questions for research. The exchanges between the EUROCROP WP and WG leaders permitted to organise a synthetic list of 105 related research goals, which is given in table 2.
This list constitute the basis of the Strategic Research Agenda.
This hierarchical approach is suitable to ensure the consistency of the proposed goals with the strategic orientations, but poorly adapted to present research proposals, since a single research action may contribute, and often do, to several challenges. A matrix approach, showing these cross contributions is then needed. The elaboration of consistent research topics is a specific task of EUROCROP whose first results are given in the last chapter "The EUROCROP research proposals".

Tab2	STAKES/CHALLENGES/research GOALS FOR ARABLE CROPS
1.0	**TECHNICAL AND ECONOMIC EFFICIENCY OF ARABLE CROP SYSTEMS**
1.1	Increase level and stability of yields
1.1.1	Increasing yield potential of varieties by breeding
1.1.2	Increasing yield potential of varieties by management practices
1.1.3	Increasing yield stability through varieties and crops physiological plasticity
1.2	Technical and economic optimisation by innovating sustainable Cropping Systems
1.2.1	Measuring economic performance of cropping systems
1.2.2	Developing alternative crop management
1.2.3	Developing precision farming SYSTEMS
1.2.4	Optimising cropping systems with reduced or no tillage
1.2.5	Optimising investments and work organization
1.2.6	Optimization and management of crop rotations
1.2.7	Developing more effective support for farmers: extension and services
1.3	Adaptation of production systems and crop rotations according to changes in farming framework conditions
1.3.1	Setting up of tools and strategies to support adaptation to change
1.3.2	Analysis of specific regional actions to adapt to change
1.4	Managing risks for EU farmers
1.4.1	Find strategies to manage risks factors
1.5	Increasing logitics efficiency
1.5.1	Predicting harvest and quantities
1.5.2	Improving storage efficacy
1.5.3	Improving batching and marketing
2.0	**MEETING DEMANDS ALONG THE VALUE CHAINS**
2.1	increase efficiency of transformation processes
2.1.1	Increasing efficiency of processing and opportunities for wider exploitation of crops products and by products
2.2	Characterization of quality and standardization
2.2.1	Harmonization of sampling and test methods to guarantee quality
2.2.2	Developing more efficient / rapid AC products characterization methods (analyses)
2.2.3	Promoting the elaboration of EU and international standards for AC products
2.2.4	Developing certifications for AC production methods/ Standardising assessments between Member States
2.2.5	Developing information networks
2.3	Ensuring food safety
2.3.1	Preventing contamination
2.3.2	Monitoring and ensuring food safety along the crop chains

Tab2	STAKES/CHALLENGES/research GOALS FOR ARABLE CROPS
2.0	MEETING DEMANDS ALONG THE VALUE CHAINS
2.4	Meeting food and industrial quality standards
2.4.1	Understanding and managing the determinants of quality along the crop chain
2.4.2	Delivering quality/Better matching of market demand and delivery by crops: master crop management impacts on quality efficiently
2.4.3	Maintain confidence of consumers that any quality specification is effective (including GM free segregation method)
2.4.4	Breeding for quality
2.5	Maintain quality of products during storage
2.5.1	Controlling ingress to grain/seed batches of different cultivars with different quality parameters/Contamination with lower, or different quality seed/grain
2.5.2	Prevent loss of quality and increased risk of deterioration in store as a result of reducing chemical armoury to control pest and disease/
2.6	Increasing nutritional value
2.6.1	Characterizing and improving the nutritional properties of AC raw products
2.6.2	Reduce unfavorable impacts of processing on nutrition
2.6.3	Preserve and develop nutritional properties
2.7	Addressing consumer demand in nutrition and dietetics
2.7.1	Developing the role of AC products in health troubles prevention: elaborating balanced diets
2.7.2	Enhancing the role of AC products for health: identifying essential elements and understanding their roles and benefits
2.8	Understanding and addressing purchaser demand
2.8.1	Understanding the needs and procedures of industrial purchasers
2.8.2	Understanding the consumers' preferences and needs
2.8.3	Meeting consummers' expectations
2.9	Brand and quality standard protection/To ensure consumer confidence
2.10	Increasing producer share of any added value
3.0	NEW OUTLETS AND MARKETS
3.1	Developing New food uses
3.11	Identifying components of interest, properties and potential uses
3.1.2	Setting new processes for new products
3.1.3	Enabling benefits and risks assessments for new products
3.1.4	Adapting species to new needs: breeding and genetics
3.2	Developing New feed uses
3.2.1	Identifying components of interest, properties and potential uses
3.2.2	Setting new processes for new products
3.2.3	Enabling benefits and risks assessments for new products
3.2.4	Adapting species to new needs: breeding and genetics
3.3	Developing Non food/non feed uses
3.3.1	Identifying components of interest, properties and potential uses
3.3.2	Setting new processes for new products
3.3.3	Enabling benefits and risks assessments for new products
3.3.4	Adapting species and crops to new needs: breeding, genetics, new crops management
4.0	SUSTAINABLE PRODUCTION and ENVIRONMENT ASPECTS
4.1	Improving resource use efficiency: nutrients
4.1.1	Understanding crop species nitrogen use physiology
4.1.2	Improve nitrogen fertilization practices on crops
4.1.3	Breeding for crops species with improved N uptake and nitrogen efficiency
4.1.4	Developing N fixating organisms for non legume crops
4.1.5	Nitrogen optimization at cropping system scale/developing reduced nitrogen input and productive cropping systems/
4.1.6	Improving resource use efficiency: PK & other nutrients
4.1.7	Efficient use of slurry and manure in cropping systems
4.1.8	Integrate livestock and arable farming

Tab2	STAKES/CHALLENGES/research GOALS FOR ARABLE CROPS
4.0	**SUSTAINABLE PRODUCTION and ENVIRONMENT ASPECTS**
4.2	**Improving resource use efficiency: energy**
4.2.1	Assessing energy use in crop chains and at farming level
4.2.2	Innovating for high energy efficiency of cropping systems
4.2.3	Innovating for high energy efficiency in transformation processes
4.2.4	Improve energy efficiency of agricultural input production
4.2.5	Efficient use of agricultural equipment
4.2.6	Use of agro-fuels in the crop chains
4.2.7	Develop competitive cropping systems for agro-fuels
4.3	**Improving resource use efficiency: water**
4.3.1	Breeding for high water use efficiency
4.3.2	Improving water management in cropping practices
4.3.3	Improving irrigation water at farm level
4.3.4	Improving irrigation water at irrigated bassin level
4.4	**Maintaining diversity in genetic resources of crops**
4.4.1	More systematic use of wild relatives in crop breeding programs (disease and drought tolerance)
4.4.2	Conserving genetic resources of cultivated crops (e.g. gene banks)
4.5	**Enhancing biodiversity in agro-ecosystems**
4.5.1	Understand biodiversity
4.5.2	Measure biodiversity: indicators
4.5.3	Efficient biodiversity enhancement
4.5.4	Assess risks of GM crops
4.6	**Ensure an effective crop protection in the long term (integrated crop protection)**
4.6.1	Understanding the genetics of resistances
4.6.2	Understanding and forecasting crop antagonist interaction (biology, attacks and wastes)
4.6.3	Innovating in plant protection products
4.6.4	Integrated crop protection at cropping system level
4.6.5	Deal with new and evolving plants pathogen problems
4.7	**Minimize greenhouse gas emissions per unit of product**
4.7.1	Manage the carbon cycle
4.7.2	Minimize N2O emissions
4.8	**Maintain and improve soil quality**
4.8.1	Maintain and improve soil physical properties
4.8.2	Maintain and improve soil chemical properties
4.8.3	Maintain and improve soil biological properties
4.9	**Reduce water pollution**
4.9.1	Minimize runoff
4.9.2	Minimize nitrate leaching
4.9.3	Minimize phosphorus losses
4.9.4	Minimize leaching of agrochemicals
4.9.5	Minimize long term impact of agrochemicals
4.10	**Developping strategies to face climate diversity and climate change**
4.10.1	Improving crop plasticity to face climate diversity and global change
4.10.2	Anticipating / forecasting the changes of climatic conditions and their effects on crops
4.10.3	Developing climate change strategies in the agricultural sector
4.11	**Integrating different sustainability concerns in the design and implementation of innovative cropping systems**
4.11.1	Design innovative and sustainable production systems which take account of the diversity of evaluation criteria concerning sustainability
4.12	**Developing common sustainability assessment methods**
4.12.1	Developing sustainability assessment methods for arable cropping systems and farms
4.12.2	Developing sustainability assessment methods for crop chains
4.12.3	Development of specific European experimentation networks

Tab2	STAKES/CHALLENGES/research GOALS FOR ARABLE CROPS
5.0	**SOCIETAL SUSTAINABILITY**
5.1	**Improve efficiency in value chain and networking**
5.1.1	Promote cooperation along the chain to facilitate joint strategies
5.1.2	Developing new tools to share information
5.2	**Reinforcing entrepreneurship and innovation capacity of AC systems**
5.2.1	Promote awareness of market trends in AC chains (clearly identify arable crops market trends)
5.2.2	Develop service and institution to stimulate enterpreneurship in AC chain
5.3	**Developing income with indirect relations to AC production: income from other activities**
5.3.1	Managing multifunctional and pluriactivity farming
5.4	**Improving the integration of arable crops into rural territories and economies**
5.4.1	Defining contribution of AC to societal needs (Gaining a proactive role in supporting rural sustainability)
5.4.2	New approaches to improve integration of AC in rural economy (Innovation in land use/Support and manage the process of adoption of innovation to improve the competitiveness of AC systems)
5.5	**Promote a consistent regulatory and governance system to strengthen the competitiveness of AC**
5.5.1	Identifying coherent policy framework for AC system
5.6	**Achieving a positive public perception of arable crops systems**
5.6.1	Developing a positive image of arable crops chains and crops products
5.6.2	Developing a positive image of AC production systems

The EUROCROP scenarios for 2015

A technical and scientific thinking permitted to the EUROCROP group to propose a full list of stakes, challenges and research goals, but making priorities in this long list needs a consensus vision of future It may be attempted through forecasts, generally based on the continuation of tendencies, but this approach reveals insufficient in most cases, since it is unable to take into account unexpected events or ruptures. For this reason, building strategies on forecasts may be risky. Furthermore, important factors for the future of AC are numerous and making hypotheses on the future behaviour of individual factors soon lead to consider high number of combinations. It is the reason why the project team chose to elaborate scenarios, based on sets of hypotheses which are coherent, relevant for the AC, and plausible. Scenarios are not intended to forecast future, but to provide a frame for strategic thinking.

Using its AC system representation and the morphological analysis methodology, the EUROCROP team considered 5 main drivers (with no order of priority):

- the WTO negotiations success (or not) and world economic growth
- the price of energy
- the EU policies orientations
- the Environment and health concern
- the global warming threat

and elaborated a set of 4 scenarios, making hypotheses on these 5 drivers (see table 3) :

- **SC1: WTO agreement and expensive energy**
- **SC2: Europe of regions**
- **SC3: High environmental performance, green Europe**
- **SC4: challenge of global warming**

Table 3: scenarios main characterictics.

	SC1	SC2	SC3	SC4
TITLE	WTO agreement and expensive energy	Europe of regions	High environmental performance, green Europe	Challenge of global warming
MAIN DRIVER	WTO agreement is reached on bases similar to EU proposal and CAP is reduced, orientations are kept	WTO agreement is not reached, lower economic growth, energy prices constant	A growing concern about health and environment in opinion becomes a major driver of public poli	Global warming becomes sensible and leads the policies. CAP is reoriented
SECONDARY DRIVER	Sustained economic growth and	CAP is reduced and decentralized to "regions" of Europe, on increased subsidiarity bases	WTO agreement is not reached, lower economic growth, energy prices constant	WTO agreement is reached on bases similar to EU proposal

Then, the 4 scenarios have been described as written stories, including hypotheses on the secondary factors. Some major hypotheses have been considered as constant whatever the scenario and at the timescale of EUROCROP (2015):

At world level:

- Climate change: the existence of the climate change is the object of a consensus, on the basis of the IPCC works, which become the reference.
- World food demand will grow similarly to past decades, with a tendency to higher demand and consumption of meat at world level
- Energy: the cost of energy is much higher than in the end of the 20th century, from “high” to “very high”.
- Water problem is more and more pregnant (quantity and quality)

At EU level:

- EU ageing population influences consumers behaviours and rural dynamics
- EU agro-industry: goes on performing in all scenarios, with a higher added value in agro and food exports from EU. Factories for EU market still located in EU
- Reinforcement of environmental regulations (level depending on scenarios)
- Water supply: the costs of water increases, and payments for irrigation becomes the normal situation.

The scenarios may be used in two ways:

- to imagine research strategies answering to each scenario: what is the proper strategy if the scenario happens ? But this option is rather theoretical, since the probability of a given scenario always remains quite low, even if the scenario is plausible.
- To identify the research actions which appear to be necessary whatever the considered scenario, and may be considered as major priorities. This second option keeps the favour of the project.

Using scoring methods, the EUROCROP group elaborated research priorities for each scenario:

Scenario 1: WTO agreement and expensive energy

Leading logic

- Going on with the liberal world market logics, a WTO agreement is reached, consistent with the EU proposals. The world growth remains high (around 5-6% in Asia and stagnating around 2% in EU). The tension on the AC products markets is due to the growth of the economic activity and to higher demands (food for developing countries, meat, biofuels…) and results in high prices of food, energy, commodities in general. World agricultural production increases at a bit lower pace than in the previous decade, mainly due to progress in productivity.
- On the climate side, global warming is a concern and a subject of negotiations, but the situation is not so alarming that the leader States, including China and India, accept to reach a global agreement on climate and trade. The subject is still a concern in international conferences but the policies of leader nations remain rather insubstantial at world scale. Impacts on the global economy and organization of societies do not reveal before 2015. The EU is obliged to combine its own policies to adapt to climate change with a necessity of competitiveness.
- The necessities of the markets dominate, and the dominant agricultural model is clearly competitive, productive business agriculture. The CAP is maintained but supports become more and more limited.
- The public opinion movements influence only partially, hardly progress and only maintain their positions on "old subjects": GMO, regulations on inputs … In fact, the majority of the opinion is focussed to purchasing power aspects, as a result of high energy prices and menacing inflation. There is no major change in the system, whatever the territorial scale: the "non productive areas" remain relatively neglected, as well as the roles of agriculture in non commodities production aspects.
- In rural areas, the positive demographic balances of some regions are due mainly to residential relocation, that is to say a phenomenon with no or few connection to agriculture and rural activity, at least in its initiation.

Hit points

- sustainability criteria are not or poorly taken into account by governments and international institutions, and do not influence commercial exchanges
- High or medium growth rate and expensive energy (around 180$/barel); the increase of transport costs has effects on raw products trade, agricultural international trade more and more deals with transformed products (notably after first transformation).
- Due to the price of energy, Biofuels develop rapidly with 1st and 2nd generation technologies. The 2nd generation becomes significant in 2015
- The increased demand and the impact of energy in production costs lead to high crop and food prices. Markets are more tense and fluctuating.
- The CAP subsists, but direct payments are gradually reduced, and completely decoupled from production. The production is mainly led by markets. The CAP budget is 60% of its 2006 value, including supports linked to environmental sustainability (including climate change mitigation) and rural life.
- No adoption of GM technologies for cropping in Europe
- Europe of the crop chains: priority in agriculture to economic performance and production. Agriculture is strongly integrated in industrial food and bioenergies system, standards command the producers, production under contracts.
- Raise of crop protection problems, due to a growing intensification of crops and the enhancement of international exchanges.
- In animal husbandry, the industrial model is dominant. It is more independent from AC agricultural systems. Globally, "industrial" animal productions (pork, poultry, dairy cows) maintain or slightly decrease. Meat beef production decreases and imports increase.
- Rapid development of aquaculture to compensate sea fish resources depletion

- Global EU AC production slightly increasing due to progress in yield, moderate in Western Europe, high in Eastern Europe,
- Consumers are receptive to functional foods, pay low attention to social standards, production standards, fair trade, and more attention to origins,
- Organic products reach a ceiling below 10% of the market
- Rural areas: migration to rural areas is limited to residential relocation of urban people with generally higher income,
- Land abandonment of non cost effective lands ("limited" to 7%)
- Bigger farm structures, decreasing in number

Table 4: Priority challenges in Scenario 1

	Priority challenges in Sc. 1: WTO agreement and expensive energy	Rank of priority (over 36 chal.)
1.1	**Increase level and stability of yields**	1,0
1.2	**Technical and economic optimisation by innovating sustainable Cropping Systems**	8,0
1.3	Adaptation of production systems and crop rotations according to changes in farming framework conditions	16,0
1.4	Managing risks for EU farmers	18,0
1.5	**Increasing logistics efficiency**	5,0
2.1	**Increase efficiency of transformation processes**	6,0
2.2	Characterization of quality and standardization	13,0
2.3	**Ensuring food safety**	7,0
2.5	Maintain quality of products during storage	15,0
2.9	Brand and quality standard protection/To ensure consumer confidence	10,0
3.3	Developing Non food/non feed uses	12,0
4.1	**Improving resource use efficiency: nutrients**	4,0
4.2	**Improving resource use efficiency: energy**	2,0
4.3	**Improving resource use efficiency: water**	3,0
4.6	Ensure an effective crop protection in the long term (integrated crop protection)	17,0
5.1	Improve efficiency in value chain and networking	10,0
5.2	Reinforcing entrepreneurship and innovation capacity of AC systems	8,0
5.5	Promote a consistent regulatory and governance system to strengthen the competitiveness of AC	14,0

Comments: in this scenario, the main challenge for agriculture and arable crops is obviously economic competitiveness on global market. Yield level and stability appear as the first priority in European conditions to answer growing needs (food, energy) in a competitive market. Production costs must be reduced (technical and economic optimisation of cropping systems). If markets are deregulated, economic studies giving a capacity of anticipation, and action to manage market risks for farmers are a necessity. Concerning processing, increasing the efficiency of transformation processes, especially concerning energy consumption, is the main priority. For quality aspects, the attention is focussed on standards, quality and safety of standardized production, and consumers' confidence into commercial brands. Most of the challenges chosen as priority in chapter 4 (environment) present a common interest to environment and economic competitiveness on medium term. Crop protection remains a major factor of economic competitiveness (yields) in a context of enhanced exchanges, with a needed evolution to integrated protection and environmental compliance. In the field of social sciences, the priority is clearly to the development of added value through entrepreneurship, innovation capacity and networking.

Subsidiary questions could be raised for this scenario:

- How to increase added value on exported products (high transport costs)
- How to optimize and develop the quality of AC products and by-products for animal feed, in intensive animal production systems (energy content, digestibility, micronutrients…) and aquaculture?
- What use for low productivity areas: land maintenance?
- attention to landscape quality: impact of urban immigrant to rural areas
- Work and equipment optimisation for large size farms.

Scenario 2: Europe of regions

Leading logic

- There is no WTO agreement, but the dominant logic remains a liberal one which reveals a double regionalisation, in bilateral agreements between countries and in an increased autonomy of EU regions in the implementation of EU policies, with a competition between EU regions and on internal EU market.
- On the climate side, global warming is a concern and a subject of negotiations, but the situation is not so alarming that the leader States, including China and India, accept to reach a global agreement on climate and trade. The subject is still a concern in international conferences but the policies of leader nations remain rather insubstantial at world scale. Impacts on the global economy and organization of societies do not reveal significantly by 2015.
- The economic growth remains moderate and so the price of energy (100-130$), also influenced by efforts on alternative energies. Prices of food are high due to higher demands (food for developing countries, meat, alternative energies…), and a stagnating world production (partially due to a decreasing EU production), maintained mainly due to progress in productivity in other regions of the world.
- In EU the main logic is Subsidiarity: the CAP is maintained until 2013 as a transition period, with a budget of 60% of its 2006 value, reoriented towards regional development, and with supports totally decoupled from production. Then it turns to procedural frameworks: following the logic of Subsidiarity, the limited budget is mainly used as financial levers to support rural territories development through regional/territorial projects. The environmental regulations are not reinforced at EU level, but may be at regional or national level. Regulations on inputs are nevertheless managed and reinforced at EU level (authorization of active components). Environment and rural policies play through funding to regional projects.
- After 2013, the agricultural policies are de facto in the hands of the regions which favour their local economy. Their policies are in direct relation to the local social interest of the agricultural and agro-industrial activity: employment, environmental quality, local economic growth... Not production for itself.
- Many agricultural models emerge from territorial projects, and integrate more or less environmental considerations depending on the results of the negotiations between local stakeholders and actors. This principle leads to contrasted situations between regions: agricultural models led by environment, leisure and tourism, local agro-industries, energy production… coexist, with variations between two main models led by production for regional industries on one side and landscape and environment on the other side.
- Consumers behaviours do not evolve significantly.
- In rural areas, the positive demographic balances of some regions are not due only to residential relocation, but also to new local activities, in many cases not directly related to agriculture. But the situations may be contrasting between regions.

Hit points

- sustainability criteria are partially taken into account by OECD members governments and international institutions, limited to social aspects, but not really influence commercial exchanges.
- Alternative energies develop, mainly on local bases, notably with biogas. The 1st generation biofuels large industries stagnate or disappear. The 2nd generation is not significant before 2020.
- High crop prices due to an increasing demand and to world production stagnation; more fluctuating markets.
- No adoption of GM technologies in Europe, specific markets for GMO free products.
- In the regions keeping a production priority, crop protection problems occur, in a regulatory context leading to a limited innovation capacity.
- Major food industries secure their supply through diversifying their sources, including from imports. In some regions, small food industries also develop, and short marketing chains from farm to local market.
- In animal husbandry, the modes of production depend on the options of territorial projects, but most regional policies lead to a predominance of extensive models integrated in rural landscape and to a decrease of intensive pork and poultry productions: only the most competitive units survive when well integrated to local industries. No new units (regions generally consider they are prejudicial for their image). Extensive beef (pasture) is maintained with regional subsidies. Meat beef and dairy are maintained, but poultry and pork productions decrease, with increasing imports for white meats. Some exigent regional projects are implemented, leading to reinforce the links betweens AC and animal productions.

- Aquaculture knows a moderate development.
- Global EU agricultural production decreasing by 15%.
- Consumers are receptive to functional foods, but pay low attention to social standards, production standards and fair trade, and more attention to origins.
- Organic products reach a ceiling below 20% of the market.
- Abandonment of low productivity lands ("limited" to 4%).
- Bigger farm structures: the diversity of regional policies and territorial projects lead to the co-existence of large industrial farms units with traditional small scale family farms as part time activity.

Table 5: Priority challenges in Scenario 2

	Priority challenges in Sc. 2: WTO agreement and expensive energy	Rank of priority (over 36 chal.)
1.1	**Increase level and stability of yields**	4,0
1.2	**Technical and economic optimisation by innovating sustainable Cropping Systems**	6,0
1.3	Adaptation of production systems and crop rotations according to changes in farming framework conditions	15,0
1.4	Managing risks for EU farmers	12,0
2.3	**Ensuring food safety**	3,0
2.7	**Addressing consumer demand in nutrition and dietetics**	6,0
2.8	Understanding and addressing purchaser demand	17,0
2.9	**Brand and quality standard protection/To ensure consumer confidence**	10,0
2.10	Increasing producer share of any added value	17,0
4.2	Improving resource use efficiency: energy	10,0
4.3	Improving resource use efficiency: water	16,0
4.6	**Ensure an effective crop protection in the long term (integrated crop protection)**	2,0
4.8	Maintain and improve soil quality	17,0
4.11	Integrating different sustainability concerns in the design and implementation of innovative cropping systems	12,0
5.2	**Reinforcing entrepreneurship and innovation capacity of AC systems**	8,0
5.3	**Developing income with indirect relations to AC production: income from other activities**	5,0
5.4	**Improving the integration of arable crops into rural territories and economies**	1,0
5.5	Promote a consistent regulatory and governance system to strengthen the competitiveness of AC	12,0
5.6	**Achieving a positive public perception of arable crops systems**	8,0

Comments: in this scenario, the main challenge becomes the insertion of arable crops activity in the regional economy and in territories, which needs a strong mobilisation of social sciences. It means developing added value at regional level with local market and/or local extension of crops chains (transformation), crop chains structuring and investments at regional level, diversification of arable farms activity in relation to the local context. The public perception of AC sector, including at local stage, becomes determining for the regional orientations concerning agriculture, and the contents of the territorial projects.
The importance given to integrated crop protection is justified, considering the public perception of pesticides uses and the possible supplementary regional constraints.
Increasing yield level and stability, and the performances of cropping systems as well, must be achieved under increased environmental and social constraints. Concerning quality, the ensuring/maintaining food safety grows in importance under the assumption that local and smaller scale food transformation industries grow in importance. Understanding the purchasers' demand reveals more important with a more diversified demand.

Subsidiary questions in this scenario:
- Local production of energy (projects driven by regional policies).
- Evolution of production systems towards a higher integration of animal and vegetal productions a regional scale.
- Studies to support arable crops in organic farming conditions.

Scenario 3: High environmental performance, green Europe

Leading logic

- In this scenario, the major driver is the pregnant concern of public opinion about health and environment as a result of successive and repeated crises on several aspects: pollutions scandals, health studies underlining the effects of agrochemical on cancer diseases on farmers populations, scientific comparative studies results on effects of intensive agriculture on wild fauna, and on the accumulation of organic molecules in food chains, effects on mammals fertility… economic studies on the external costs of agriculture...
- Agriculture comes back to the centre of the political agenda and a public debate leads to new orientations to agriculture, environment and rural development policies. The revised objective of agriculture is to produce safe food and develop environmental quality. For a large majority of public opinion, the organic agriculture becomes the most advanced model of environmentally friendly agriculture. In this context, public debate leads to the emergence of the "Health and Environment Performing agriculture". Environment and health become fundamental economic criteria and a priority, a compromise approach is not accepted anymore.
- Consumers attitudes evolve.
- The failure of WTO negotiations offers to Europe a favourable context to a relative environmental protectionism and a self centred policy, fitting with the public opinion of the time.
- The economic growth remains moderate and so, relatively, the price of energy (100-130$),
- On the climate side, the situation is not so alarming that the leader States, including China and India, accept to reach a global agreement on climate and trade. Global warming is still a concern in international conferences but the policies of leader nations remain rather insubstantial at world scale. Impacts on the global economy and organization of societies do not reveal until 2015. In EU, the opinion is much aware of climate change, which is taken into account in policies, notably in agricultural policies. The EU takes a set of voluntary measures to decrease its CO2 emissions.
- Agriculture being back at the centre of the political agenda in Europe, CAP budgets are maintained, and a new HEP CAP is implemented from 2014. The budget is reoriented to support the "Health & Environment Performing agriculture" (HEP) model (75%), and to rural development (25%). The HEP agriculture standard practices compel heavy restrictions on inputs, at first pesticides, and more generally environmental compliance. Supports are coupled again to a production activity but ar totally linked to HEP production conditions and cross compliance (decreased production level prevents Europe to export de facto). Environmental regulations are reinforced.
- Efforts on alternative energies
- Prices of food are very high, specially in EU, due to higher demands (food for developing countries, meat… and decreasing EU production. The world agricultural production slightly decreases; the decrease of European production being partially compensated by new productions in South America (especially Brazil) and Eastern Europe (Ukraine), enhanced by the very high food prices.

Hit points

- Sustainability criteria are fully taken into account by Europe. The market in Europe in fact includes two kinds of products: high sustainability standard, with high price, and medium/low sustainability standard, cheaper but supporting taxation. Europe implements a taxation on imports of low sustainability products, which allows supports to high sustainability products (notably food), and develops labels and certifications. European internal regulations make obligatory to give indications on sustainability status of commercialised products.
- Limited increase of transport costs.
- Rapid development of all alternative energies (including nuclear, solar, eolian, biofuels…) and important efforts in the reduction of energy consumption.
- Alternative energies are developed on the basis of biogas and biomass with second generation technologies hich will reach significant levels by 2020. The 1st generation biofuels dies in Europe, because of food needs, and too high prices of foodstuffs. The 1st generation Biofuels knows a limited development at world level, kept under controle by the governments (food and social impacts).
- No adoption of GM technologies in Europe. The opinion pressure on GMO imports leads to the emergence of a specific GMO free food market.
- Severe regulations on inputs: pesticides severely restricted, fertilizers under drastic quotas.
- Important crop protection problems with significant effects on production à GMO come back in the

debates on how to solve crop protection problems.

- The Major food industries secure their supply through diversifying their sources, including from imports.
- The Animal husbandry sector knows a complete revolution to cope with the new standards on effluents, feed, limited numbers of heads per ha and animal welfare. All EU meats production are reduced by -30%. Late intensive production regions know restructuring problems.
- Moderate development of aquaculture.
- The global EU production drop by 30% for meat and 25% for vegetal productions. Arable crops production is focussed to food. EU does not significantly export agricultural commodities anymore, but still exports high quality processed products in limited quantities.
- Consumers better accept innovation when benefits to quality, health and environment are apparent. They present a low receptiveness to functional foods, but pay attention to nature and production standards, and to ethical concern. A major point is a decrease in meat consumption by 20%.
- Organic products are considered as a reference for health and environment and reach more than 30% of the market.
- Rural areas: HEP agriculture requires a higher working force in quantitative and qualitative terms: agriculture looks for labour. Some new farmers and farms employees join rural areas.
- Land abandonment is very limited because of the several needs: agriculture, animal husbandry and biomass + preservation areas.
- farm structures: the growth in size is limited.

Comments: in this scenario, the main challenges for agriculture and arable crops are environmental **compliance and food safety**
Regarding environmental compliance, which is imposed, the use of pesticides is strictly limited, and the development of a more efficient integrated crop protection become the major priority for arable crops sustainability. The, the attention is focused to the limitation of arable crop farming impacts on resources quantities (saving nutrients, energy and water through an enhanced efficiency of these resources) and quality (soils degradation and water pollution).
Concerning quality aspect, the priority is given to food safety, based on the assumption of a more fragile situation of crops health (higher importance of fungus and mycotoxins).
The development of recognized sustainability assessment methods (environmental indicators, life cycle assessment of products) is a necessity for the efficient conception of coherent policies and actions.

Subsidiary questions:

- Improving CO2 balance of arable crops and farming activity?
- Production of renewable energy at farm or local scale

Table 6: Priority challenges in Scenario 3

	Priority challenges in Sc. 3: High environmental performance, green Europe	Rank of priority (over 36 chal.)
1.1	Increase level and stability of yields	18,0
1.2	Technical and economic optimisation by innovating sustainable Cropping Systems	11,0
1.3	Adaptation of production systems and crop rotations according to changes in farming framework conditions	17,0
2.3	**Ensuring food safety**	5,0
2.4	Meeting food and industrial quality standards	18,0
3.3	Developing Non food/ non feed uses	14,0
4.1	**Improving resource use efficiency: nutrients**	2,0
4.2	**Improving resource use efficiency: energy**	2,0
4.3	**Improving resource use efficiency: water**	4,0
4.4	Maintaining diversity in genetic resources of crops	13,0
4.5	Enhancing biodiversity in agro-ecosystems	10,0
4.6	**Ensure an effective crop protection in the long term (integrated crop protection)**	1,0
4.7	**Minimize greenhouse gas emissions per unit of product**	9,0
4.8	**Maintain and improve soil quality**	6,0
4.9	**Reduce water pollution**	7,0
4.10	Developing strategies to face climate diversity and climate change	15,0
4.11	Integrating different sustainability concerns in the design and implementation of innovative cropping systems	11,0
4.12	**Developing common sustainability assessment methods**	8,0
5.6	Achieving a positive public perception of arable crops systems	16,0

- Development of genetic resistances to crop species enemies. Use of biotechnologies for plant breeding GMO?
- Higher integration of animal husbandry systems with vegetal productions systems.
- Development of added value in high quality transformed products.
- Development of vegetal proteins production and transformation.
- Nutritional studies.
- Development of agro-materials for construction.

Scenario 4: challenge of global warming

Leading logic

- Global warming becomes sensible, but the climate perturbations remain moderate : no direct physiological effect of temperature on yields is observed yet, except in Southern regions, but:
  - Observed at regional level the pests and diseases pattern evolves.
  - Irregularity in water balances affect yields in non irrigated areas
  - Localisation of productions slowly evolving.
  - Extreme weather events seem to be more frequent. Severe drought events are more frequent, unpredictable and affect major producers competitors of EU too.
- Global warming is now a major driver for policies and international negotiations. Many subjects are on the spot: assessment and reduction of CO2 emissions, exchanges of clean technologies, consideration of CO2 content of goods in international trade…
- On the economic side, a WTO agreement has been reached in 2010 removing all trade disturbing supports by 2013 and giving a substantial market access to a limited number of products. Price of energy is high and arable crops products too.
- The world agricultural production is hardly maintained due to erratic climate events (droughts, storms…) and water problems. New agricultural acreage is limited as international negotiations resulted in compensating governments efforts to avoid deforestation (Brazil).
- European Union takes a set of voluntary measures to decrease its CO2 emissions, leading to reinforce common policies regarding agriculture, considered as a major actor for limiting and adapting to the climate change, through the enhancement of agro-resources and the management of nature.
- The public opinion becomes more conscious of the real value of food (on quantity, quality and safety aspects) and energy, and the key role of agriculture to ensure security in these aspects is recognized, as the result of a debate on costs and benefits. Agriculture is again a public concern, as a contributor to public good.
- Its missions are revised to meet the triple necessity to "feed the world", produce energy and manage natural resources/ preserve environment. It leads to a model of dual agriculture with a politically driven environmental partition and separation between productive agriculture and agriculture generating positive environmental impacts but a limited amount of food. Agriculture is always double purpose (production and environmental benefits), but with a clear dominant priority depending on the agronomical potentialities of the milieu.
- The CAP budget is maintained but reoriented to the meet the double "food and climate challenge": supports remain partially coupled to production (25%), and linked to compliance with a multicriteria evaluation based on a farm activity efficiency and benefits for the public good: carbon balance, energy balance, food and energy production, local environment impacts. In a dynamic of progress, the new target of farmers is to find the best optimisation between these criteria in their farming conditions, and with their own benefits.
- Consumers behaviours slowly progress

Hit points

- Sustainability criteria are taken into account in Europe: obligation of labels indicating CO2 content on commercialized products, taxes and tariffs on all products (EU origin or imports) proportional to their CO2 content (transportation costs included).
- Medium growth rate and expensive energy: 180$
- Rapid development of all alternative energies (including nuclear, solar, eolian, biofuels…) and efforts

in the reduction of energy consumption. Strong researches and development of 2nd generation biofuels (significant level before 2020). The 1st generation biofuels is maintained as market regulators and for the possibility it gives to shift from biofuels to food uses with very limited delays.

- High crop and food prices
- Some GM products approved for cropping in EU, for specific use and for their benefits to environmental issues
- Environmental regulations are reinforced. Heavier regulations on inputs: in environmental zones, pesticides and fertilizers are forbidden. In "productive zones" pesticides uses are controlled and nitrogen are limited to quotas per farms on the basis of best management practices.
- Evolution of pests and diseases patterns; insufficient innovation in pesticides in a regulatory context leading to a limited innovation capacity
- Food industries: to rely on quantities and qualities, evolution towards more integration with a growing part of the production under contract.
- Animal husbandry: the industrial model (pork, poultry and dairy) is dominant in productive regions, with more independence from AC agricultural systems. Globally, animal productions maintain. Beef meat production maintains only in low potential environmental regions (pasture), and beef meat becomes a luxury product.
- Rapid development of aquaculture to compensate the diminution of sea fish resources
- EU agricultural production is maintained. Yields hardly progress in Western Europe due to investments on efficiency (environment constraints and heavier constraints on farming conditions). Still consequent yield progress in Eastern EU. Agricultural efficiency progresses in all EU countries. Co-existence of intensive models in the best conditions and extensive models on less productive areas for crops. Higher integration of animal husbandry and vegetal productions at regional scale.
- Consumers show a better acceptability of innovation when benefits to quality, health and environment are proved, They are poorly receptive to functional foods, pay attention to production standards on production systems (integrated farming being the reference), and demand for guarantees, traceability, transparency.
- Organic products reach a ceiling at around 15% of the market.
- Land abandonment is very limited, due to the competitions between uses. Set aside has been cancelled.
- farm structures: in productive areas,. In agri-environmental zones, coexistence of a model of small farming as part time activity, and larger units devoted to "agri-environmental management" emerged with public subsidies. In the most productive areas, the number of farmers goes on reducing (larger units).

Comments: in this scenario, the double challenge for AC is recognized by opinion and politics: production:

Table 7: Priority challenges in Scenario 4

	Priority challenges in Sc.4: challenge of global warming	Rank of priority (over 36 chal.)
1.1	Increase level and stability of yields	11,0
1.2	**Technical and economic optimisation by innovating sustainable Cropping Systems**	6,0
1.3	Adaptation of production systems and crop rotations according to changes in farming framework conditions	14,0
1.4	Managing risks for EU farmers	15,0
2.3	**Ensuring food safety**	12,0
3.3	Developing Non food/ non feed uses	13,0
4.1	**Improving resource use efficiency: nutrients**	8,0
4.2	**Improving resource use efficiency: energy**	4,0
4.3	**Improving resource use efficiency: water**	3,0
4.4	Maintaining diversity in genetic resources of crops	16,0
4.6	**Ensure an effective crop protection in the long term (integrated crop protection)**	5,0
4.7	**Minimize greenhouse gas emissions per unit of product**	2,0
4.8	Maintain and improve soil quality	10,0
4.9	Reduce water pollution	16,0
4.10	**Developing strategies to face climate diversity and climate change**	1,0
4.11	**Integrating different sustainability concerns in the design and implementation of innovative cropping systems**	9,0
4.12	**Developing common sustainability assessment methods**	6,0
5.6	Achieving a positive public perception of arable crops systems	18,0

food security and energy + environmental compliance.
Developing strategies to face climate change is the first – integrating – challenge. Then the key idea lies in innovating cropping and farming systems with an enhanced efficiency regarding energy, CO2, water, fertilizers… Yield remains a priority, but the integrating challenge is to minimize the greenhouse gas emissions per unit of product. It needs to develop (multicriteria) sustainability assessment methods, CO2 content assessment (life cycle assessment of products), models and decision support systems… The implementation of a flexible integrated crop protection, including innovation and optimisation of pesticides, is a priority to face the evolutions of crop enemies in a climate changing context.
The valorisation of by products and unexploited biomass grows in importance in this scenario.

Subsidiary questions:

- Monitoring of new emerging pest and diseases
- Crops tolerance to drought. Irrigation optimisation
- Environmentally friendly production in low agronomic potential areas
- Develop of cultivars with improved characteristics regarding environment impacts and use of resources: resistance to drought, nutrients use efficiency… Including GMO
- Standards, production under contracts: link between cropping practices and products quality
- Develop quality of AC products and by-products for animal feed, in intensive animal production systems (energy content, digestibility, micronutrients…)
- Develop synergies between animal (including aquaculture) and AC production systems at regional scale
- Development of agro-materials for construction

Towards research strategies: the priorities common to all scenarios

Using the set of 4 contrasted scenarios to test the robustness of strategic options, we consider that a challenge which is a priority in several scenarios correspond to a main strategic priority. We know that none of these scenarios will occur, but probably some intermediate story.

We distinguish 3 levels to characterize their importance (see table 7):

- level 1 (red colour): the challenge has a score in the 25% best scores for 3 scenarios, and in the 50% best for the remaining scenario
- level 2 (dark purple colour): the challenge has a score in the 25% best scores for 3 scenarios at least, or in the 50% best at least for the 4 scenarios
- level 3 (pink colour): the challenge has a score in the 25% best scores for 2 scenarios at least, or in the 50% best at least for the 3 scenarios
- specific joker (bright blue): the challenge is scored in 1st, 2nd or 3rd position in one of the scenario (ie not considering this challenge could be a fatal mistake if the considered scenario happens)

Proceeding in this way, we make the assumption that our set of 4 scenarios covers the possibilities for future in a satisfying manner. In fact, a quick test with a supplementary scenario did not make appear different priorities.

The results emerging from the project activities are summarized in table 7 and include the 50% higher priority challenges (18 over 36 challenges)
4 challenges appear as first level priorities for AC systems sustainable competitiveness:
- the food safety, which is a basis need of populations
- the maintenance of an efficient crop protection, as major guarantee for food security
- the improvement of resources use efficiency,: energy and water, of both short term economic interest and fundamental issue for long term sustainability.

The 2nd level includes 4 supplementary challenges where economic competitiveness is predominant, dealing with yield level and stability improvement, optimisation of cropping systems and adaptation of production systems, nutrients use efficiency (long term sustainability issue)

Then 3rd level priorities represent could be considered as secondary levers of competitiveness:
- managing risks for farmers (risks related to markets, climate variations…)
- developing non food-non feed uses
- developing entrepreneurship and innovation capacity
- developing a positive public perception of AC

Developing sustainability assessment methods is a basic need for both the ex-ante and ex-post evaluation of actions on AC systems.
At last, the issue of soil quality, often neglected when dealing with competitiveness, is a growing preoccupation.

Specific jokers concern:

- the integration of arable crops in rural territories, which are essential in the context of scenario 2. It appears as a clear priority in scenario 2, where competitiveness is determined at regional level, but it should be considered that meeting this challenge could contribute to other political objectives, rural development being the first one.
- The 2 other joker challenges are key issues for scenario 4, related to climate change: to mitigate its effects and minimize a further degradation of the situation (minimize GHG emissions per unit of product)

Table 8: common challenges in all scenarios

		Sc. 1	Sc. 2	Sc. 3	Sc. 4	Common
	CHALLENGES FOR ARABLE CROPS	Rank of priority (over 36 chal.)				
1.1	Increase level and stability of yields	1,0	4,0	18,0	11,0	
1.2	Technical and economic optimisation by innovating sustainable Cropping Systems	8,0	6,0	11,0	6,0	
1.3	Adaptation of production systems and crop rotations according to changes in farming framework conditions	16,0	15,0	17,0	14,0	
1.4	Managing risks for EU farmers	18,0	12,0	29,0	15,0	
2.3	**Ensuring food safety**	7,0	3,0	5,0	12,0	
3.3	Developing Non food/non feed uses	12,0	23,0	14,0	13,0	
4.1	Improving resource use efficiency: nutrients	4,0	25,0	2,0	8,0	
4.2	**Improving resource use efficiency: energy**	2,0	10,0	2,0	4,0	
4.3	**Improving resource use efficiency: water**	3,0	16,0	4,0	3,0	
4.6	**Ensure an effective crop protection in the long term (integrated crop protection)**	17,0	2,0	1,0	5,0	
4.7	Minimize greenhouse gas emissions per unit of product	33,0	33,0	9,0	2,0	
4.8	Maintain and improve soil quality	29,0	17,0	6,0	10,0	
4.10	Developing strategies to face climate diversity and climate change	36,0	35,0	15,0	1,0	
4.11	Integrating different sustainability concerns in the design and implementation of innovative cropping systems	28,0	12,0	11,0	9,0	
4.12	Developing common sustainability assessment methods	35,0	24,0	8,0	6,0	
5.2	Reinforcing entrepreneurship and innovation capacity of AC systems	8,0	8,0	29,0	22,0	
5.4	Improving the integration of arable crops into rural territories and economies	19,0	1,0	21,0	33,0	
5.6	Achieving a positive public perception of arable crops systems	23,0	8,0	16,0	18,0	

The EuroCrop research proposals

The EuroCrop core team identified research goal and actions intended to make the AC sector able to meet its challenges. The result of this work is a hierarchical list, structured according following STAKES/CHALLENGES/ RESEARCH GOALS/RESEARCH GAPS. This approach is suitable to identify actions, and check their consistency with the strategic orientations, but poorly adapted to present research proposals, since a single research action may contribute, and generally do, to several challenges. A matrix approach is then needed, and the elaboration of consistent research topics.
The result of this work is a preliminary list of 66 research topics. This list will be completed and the topics described in contents.

Table 9: preliminary list of research topics and related challenges

Related Challenge	RESEARCH TOPICS
1.1	1.1A Increasing yield potential of varieties by breeding: abiotic tolerance
1.1	1.1.B Increasing yield potential of varieties by breeding: biotic tolerance
1.1	1.3 Increasing yield stability through genetic resistances to crops enemies (weeds, pests and diseases)/breeding/network ICP
1.1	1.4 Better effects of crop rotations on Weed/Pest/Diseases/alternative crops and cropping systems
1.1	1.5 Tolerant varieties (drought, N deficiency, Weed, Pest and Disease)/understanding crops reactions to stress. Knowledge, orientations, tools for breeding
1.2/1.4	1.15/2.8 Risk management of arable farming under price volatility and climate change (+ Decision support system for a rapid adaptation to economic context)
1.2/4.11	5-1.2 Use of new technologies/methods to increase the efficiency of crop management
1.2	1.16 Optimizing crop rotations in reduced or no tillage conditions
1.2	1.17 Management of crop rotations/Prevent and control weed infestation, disease and pest infection
1.3	2.1 production systems and rotations: impact of increasing commodity and inputs prices on production systems
1.3	2.2 Economics of farm size: economies of farm size under changing market and political conditions with focus to new member states
1.4	see 1.2
2.1	4.4 Better understanding of the interaction between crop quality characters and processing – to identify areas for improvement and development
2.1	4.5 Development of pest and disease control measures to protect/enhance product quality
2.1	4.8 Development of information transfer programme to increase production and use of EU-derived plant proteins
2.3	3.3 preventing safety risks in AC
2.4	4.9 Development of early warning systems to predict incidence of specific disease problems that may have an influence on crop quality
2.4	4.3 Development of co-existence strategies for EU arable crops with GM and non-food crops.
2.4	4.1 Better understanding of the genetic determinants of quality traits to help develop better cultivars capable of delivering required quality in the face of abiotic stress
2.6	4.10 Optimise the digestibility of plant proteins fed in animal diets
2.6	3.2 Optimizing AC for optimal utilization of nutrients in human and animal nutrition and/or utilization of components of AC or by products of food processing for non-food applications
2.6	4.2 Better understanding of the interaction between processing methods and nutritional quality of produce – to optimise bio-availability
2.7/3.2	3.7 Science based integration of feed crops and related animal products in consumers' health concerns
2.8	3.8 Understanding the industrial needs and involving the industry in exploiting crops potential for bio based products
2.8	4.7 Better understanding of public concerns associated with GM technologies to help shape communication strategies
2.8	4.6 Develop and improve carbon footprints for EU produce and develop agreed standard methods for their determination across Europe
3.0	3.4 Whole crop utilization
3.0	3.10 Whole crop utilization for Non feed/non food, food and feed, and synergies between different outlets
3.0	3.11 Land use in agro-industrial parks:optimizing synergies between agricultural production and industries in a territory, considering energy and mass flows
3.0/1.5	3.6 Improvement of competitiveness of crop production on the global feed and related markets: strategies for competitive EU feed production
3.1	3.1 Optimizing AC for new healthy products

Related Challenge	RESEARCH TOPICS
3.2	3.5 Strategies to enhance nutritional quality and processability of crop products and by-products fom food industry, bioenergy or biorefinery to secure supply to the European feed sector
3.3	3.9 Land use optimisation for Food, feed and NonFood/Nonfeed, and synergies between production and services/ how to optimize land use and synergies at different scales
3.3	3.12 Ecocertification
4.1	1.21 Breeding for crops species with improved N uptake and nitrogen efficiency
4.1	1.22 Developing reduced nitrogen input and productive cropping systems/nitrogen optimization at cropping system scale/Optimize legumes in Cropping systems
4.1	5-2.2 Global assessment of N emissions of cropping systems
4.1	1.23 Better use of manures: treatment , application, timing
4.1	5- (2.4 + 1.3) Integrated assessment of the exchange of organic fertilisers from region with high livestock densities to arable region/Integration of arable and livestock farming
4.2	1.20 Understanding and calculating energy costs in crop chains and at farm level / New methods and references for energy balance of cropping systems
4.2	1.19 Innovating for high energy balance of cropping systems
4.2	2.7 Establish competitive crops rotations for bioenergy: Analyse the contribution of different crops and crop rotations to bioenergy yields and their economical and ecological impacts in selected regions of Europe
4.2	2.8 Economics of straw remove: identify different local consitions for straw removal in Europe and analyse their impact on supply costs
4.2	1.8 Improving crops water USE efficiency:Varietal evaluation & breeding
4.3	1.9 Water efficient cropping systems
4.3	5-2.1 Designing and testing water efficient cropping systems in a multi-scale approach
4.3	1.10 Sustainable irrigation in relation to water and soil (drainage, Salinisation).
4.4	
4.5	5-3.1 Efficient biodiversity enhancement
4.6	1.13 Forecasting of pests and diseases taking into account cropping and management system and crop canopy sensibility
4.6	1.14 Preserving the durability of crop protection tools
4.6	5-3.2 Effective crop protection strategies
4.6	5-3.3 Deal with new and emerging pathogens (pests, diseases, weeds)
4.7	2.5 Measurement of carbon realease/Establishment of a common methodology for measurement of carbon release and to use this methodology to compare production systems for selected crops in selected regions of Europe
4.7	1.11 Reducing greenhouse gas emissions of cropping systems
4.8	5-1.4 Integrated soil protection (physical, chemical and biological aspects)/ tasks: 1/ Avoid compaction, Reducing soil erosion 2/ Improve soil Chemical properties (OM, salinisation…) 3/ Improve soil biological properties by adequate cropping systems
4.10	1.18 Anticipating/forecasting the changes of climatic conditions and their effects on crops
4.10	2.4 Economics of adaptation to climate change
4.10	5-2.3 Integrated assessment of management strategies for different climatic scenarios.
4.11	1.12 Evaluation of different farm types concerning the sustainability of their cropping systems
4.11	5-1.1 Environmental and economic optimisation of (low-input) cropping systems
4.12	5-3.4 Scaling issues: find sustainable solutions on different scales
4.12	5-3.5 Evaluate best region for crop production.
5.1	6.5 Comparative analysis and identification of the innovation opportunities to increase efficiency in the arable crops chain and networks.
5.1	6.10 Value chain and networking/ Analyze trust along the network
5.1	6.11 Value chain and networking: Analyze value chain and market power.
5.2	6.8 Analysis of farmer awareness of market trends and identification of knowledge gaps
5.2	6.9 Analysis the factor of entrepreneurship at EU level
5.3	2.9 Researching new activities and possibilities to the farmers in the new market situation, new tools for the rural development.
5.4	6.3 Deprivation in the quality of rural life: provision of public and social goods and services.
5.4	6.4 Connection between land consolidation and arable crops.
5.4	6.6 Structure and interaction between arable crops and urban planning.
5.4	6.7 Open innovation
5.5	2.3 adopting consistent policies: designing improved contractual options to allow flexible access to land for farming in the new Member States
5.5	6.1 Definition of services for improving farmers' orientation, sensitiveness and adaptability to the market.
5.5	6.2 Designing EU policy for improving arable crops competitiveness in consideration of globalization process and the three main uses of crops: food, feed, energy.
5.6	

CONCLUSIONS

At the end of EUROCROP, several main issues have been underlined and recognized as priorities for the future of AC, in a perspective of sustainable competitiveness.
At first, the competitiveness of a sector may not be considered anymore according to its only economic results. The externalities of agricultural activity regarding environment and social aspects became a full part of its competitiveness.
The question of political choices, for example those of free trade (scenario 1) versus a certain environmental protectionism (imagined in scenario 3, and at a lesser extent in 4, which would protect a European agriculture fitting environmental and social standards through taxes on imported products out of these standards) is not in the scope of the project, but it clearly appears that it cannot be sufficient to suppress the negative externalities in Europe, soon becoming the object of regulations, but that it is necessary to do it and develop at the same time the quantities of produced positive wealth and public good: the AC sector, and the agriculture sector in general, first contributes to "public good" through the production of food, in quantity and quality, and even of energy, the quality of landscapes and life context, employment, etc…
In addition, the recent revolutions in commodities markets seem to induce a new consciousness of the scarcity and true value of these resources, which need to be preserved and used in proper ways.
These considerations explain the importance given by EUROCROP to the development of the efficiency of the sector, as a major way of progress and competitiveness: as much or even more produced wealth for less consumed resources (energy, water, nutrients…) and negative impacts. The matter is to reach a multicriteria performance.
In this regard, innovation has a fundamental role to play.
Innovation may be based partially on the use of old knowledge and techniques reassembled in new practices. This way of progress must not be neglected, and even developed, but major breakthroughs will probably require the mobilisation of the newest technologies with specific developments for agriculture: we may recall remote sensors and images analysis, satellites images, biotechnologies, not excluding GMO applications...
It must be stressed that the technological innovation, often considered for several decades as a source of danger and uncertainty, could contribute considerably to give answers to a number of sustainability challenges.
Research developments are necessary at many scales, going from fundamental or analytic approaches on the cultivated species (genetics and breeding – what about GMO?), plants physiology or crops enemies biology, to systemic approaches at different levels: cropping systems, production systems, crop chains, territories, environmental impacts, social networks… and involving multiple scientific disciplines. In many cases multidisciplinary works are indispensable to progress significantly.
At last, beyond the technical aspects of the agricultural efficiency and of the environment, the activity of a sector is strongly dependant on the quality and dynamism of its actors, and on their insertion in the economic and social networks, and in territories. The organisation of crop chains, the repartition of the added value within these crop chains, are also determining for their attractiveness. Several challenges in these fields involving research in social sciences and economy have been judged as priorities.

Annex 1: Glossary and Abbreviations

LIST OF ACRONYMS

AC: Arable Crops
ETP: European Technology Platform
GHG: Green house Gas
SRA: Strategic Research Agenda
WG: Working Group
WP: Working Package

DEFINITIONS

Cropping system: the set of technical practices operated on fields managed in the same way, defined by the nature of the crops, crop rotation, and crop management techniques applied to these crops.

Farming system: includes the cropping systems present on a farm and their connections with other activities in the farm, eg animal husbandry.

Agricultural/production system: "the system of production used by a farmer as specified by the technology used, resources available, preferences held and goals pursued within a given agro-ecological and socio-economic environment (production system: Dillon and Hardaker (1993), with the productive aspect and the commercialisation of the products obtained (agricultural system: Libeau-Dulos and Rodriguez Cerezo (2004)).

Annex 2: Crop chains specificities: expression of challenges by crop chain

Major cereals/wheat:

1. Increase production level.
2. Manage environmental impact of crop system.
3. Decrease production costs.
4. Improve inputs efficiency.
5. Assess climate changes impacts
6. Obtain and maintain good sanitary and technologically quality.

Minor cereals

1. Stabilizing (increasing) yields.
2. Reduction of the impact of abiotic stresses (drought, low temperatures, etc.).
3. Decreasing of production costs.
4. Additional quality requirements for new markets (achieving).
5. Diversification of use.
6. Determination of quality of production.
7. Improvement of crop management practices (for two stakes: Harvested product quality and progress in quality at farm level and Quality of processed/marketed products).
8. Breeding for quality.
9. Diversification of quality demands, consideration of regional quality demands.
10. Prevention of contamination of products by mycotoxins (biotoxins).
11. Pesticide residue reduction (for two stakes: Production sanitary safety and Impact of crops on environment).
12. Increasing of intraspecies diversity.
13. Suitable cropping systems for "minor cereals".

Oilseeds crops

1. Increase production level and decrease the production costs.
2. Improve the crop chain organization.
3. Improve the quality for existing and new outlets.
4. Sustainable products competitive on EU and non EU market.

Sugar beet

1. Maintain the efficient crop protection.
2. Increase water use efficiency.
3. Facing climate changes.
4. Improve sugar beet production efficiency.
5. Producing renewable energy.
6. Improving impacts of sugar beet on the environment.
7. Energy and emissions balance in sugar beet production.
8. Predictability of consumers demand and behavior.
9. Safety of chain process.

Fibre crops

1. Yield level and quality differences between regions.
2. Quality of the first processor products (including fibre homogeneity).
3. Managing abiotic and biotic stress.
4. Reduction of costs with no negative effect on quality and natural environment.
5. New outlets for fibrous plants.
6. Competition of cheaper fibres from non-European markets and man-maid fibres.
7. Introduction of EU subsidies threading the quality and quantity of yields (cotton).
8. Labor consumption in primary processing and production industries. Low spinning efficiency in relation to cotton and man-made fibre spinning techniques.
9. Difficulty in blending bast fibres with cotton and man-made fibres (quality reduction

and processing efficiency).
10. Lack of strong marketing focused on consumer.
11. Association of hemp with marihuana and resulting negative perception of the crop.
12. Lack of objective and unified methods for fibre (quality and quantity) evaluation.
13. Environmental impact of plant protection treatments.
14. Role of flax and hemp in crop rotation and environmental protection.

Potatoes

1. To produce new varieties with improved pest & disease resistance.
2. Improved resource use efficiency.
3. Evolutionary potential of pests & pathogen populations.
4. To develop a robust tool to measure and compare "sustainability".
5. Improve utilisation of potato in processed products.
6. To address consumer demands for healthy food.
7. To produce new varieties with improved taste & texture characteristics for processed market.
8. Utilisation for GM potatoes for the production of molecules for medicinal & industrial use ("molecular farming").

Grain legumes

1. Reinforce chain organization to reach self-sufficient stage of development (information, references, partnerships, policies and market rules).
2. Exploit the legume crops benefits in the arable agricultural systems.
3. Enhance level and/or stability of yields for legume crops; and
4. Answer the new demands and develop new outlets.
5. Enhance energy efficiency of farm systems and the sustainability of agriculture
6. Enhance crop competitiveness for scenario of free market system

Maize

1. Increase the yield level and yield stability.
2. Costs optimisation and technical efficiency.
3. Reduce corn vulnerability to water deficiency stress.
4. Maintaining the quality following the establishment of "food" regulations in 2007.
5. Geographical spread of corn "bio aggressors".
6. Secure the present and future outlets

Annex 3: Synoptic table of priority challenges in the different scenarios

	CHALLENGES FOR ARABLE CROPS	Sc. 1	Sc. 2	Sc. 3	Sc. 4	Common
		Rank of priority (over 36 chal.)				
1.1	**Increase level and stability of yields**	1,0	4,0	18,0	11,0	
1.2	**Technical and economic optimisation by innovating sustainable Cropping Systems**	8,0	6,0	11,0	6,0	
1.3	**Adaptation of production systems and crop rotations according to changes in farming framework conditions**	16,0	15,0	17,0	14,0	
1.4	**Managing risks for EU farmers**	18,0	12,0	29,0	15,0	
1.5	Increasing logistics efficiency	5,0	27,0	34,0	25,0	
2.1	Increase efficiency of transformation processes	6,0	32,0	35,0	31,0	
2.2	Characterization of quality and standardization	13,0	29,0	25,0	27,0	
2.3	**Ensuring food safety**	7,0	3,0	5,0	12,0	
2.4	Meeting food and industrial quality standards	22,0	25,0	18,0	23,0	
2.5	Maintain quality of products during storage	15,0	27,0	28,0	28,0	
2.6	Increasing nutritional value	34,0	36,0	20,0	35,0	
2.7	Addressing consumer demand in nutrition and dietetics	31,0	6,0	26,0	35,0	
2.8	Understanding and addressing purchaser demand	20,0	17,0	32,0	33,0	
2.9	**Brand and quality standard protection/To ensure consumer confidence**	10,0	10,0	21,0	29,0	
2.10	Increasing producer share of any added value	23,0	17,0	32,0	32,0	
3.1	Developing New food uses	25,0	30,0	24,0	23,0	
3.2	Developing New feed uses	21,0	33,0	36,0	20,0	
3.3	**Developing Non food/non feed uses**	12,0	23,0	14,0	13,0	
4.1	**Improving resource use efficiency: nutrients**	4,0	25,0	2,0	8,0	
4.2	**Improving resource use efficiency: energy**	2,0	10,0	2,0	4,0	
4.3	**Improving resource use efficiency: water**	3,0	16,0	4,0	3,0	
4.4	Maintaining diversity in genetic resources of crops	27,0	21,0	13,0	16,0	
4.5	Enhancing biodiversity in agro-ecosystems	32,0	21,0	10,0	19,0	
4.6	**Ensure an effective crop protection in the long term (integrated crop protection)**	17,0	2,0	1,0	5,0	
4.7	**Minimize greenhouse gas emissions per unit of product**	33,0	33,0	9,0	2,0	
4.8	**Maintain and improve soil quality**	29,0	17,0	6,0	10,0	
4.9	**Reduce water pollution**	30,0	31,0	7,0	16,0	
4.10	**Developing strategies to face climate diversity and climate change**	36,0	35,0	15,0	1,0	
4.11	**Integrating different sustainability concerns in the design and implementation of innovative cropping systems**	28,0	12,0	11,0	9,0	
4.12	**Developing common sustainability assessment methods**	35,0	24,0	8,0	6,0	
5.1	Improve efficiency in value chain and networking	10,0	20,0	29,0	29,0	
5.2	**Reinforcing entrepreneurship and innovation capacity of AC systems**	8,0	8,0	29,0	22,0	
5.3	Developing income with indirect relations to AC production: income from other activities	25,0	5,0	26,0	25,0	
5.4	**Improving the integration of arable crops into rural territories and economies**	19,0	1,0	21,0	33,0	
5.5	Promote a consistent regulatory and governance system to strengthen the competitiveness of AC	14,0	12,0	21,0	21,0	
5.6	**Achieving a positive public perception of arable crops systems**	23,0	8,0	16,0	18,0	

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WG3.2 farm economics and production costs: Tanjia Moellman, Yelto Zimmer, FAL: Bundesforschungsanstalt für Landwirtschaft Braunschweig Völkenrode, Braunschweig, Germany
WG3.3 Outlets and markets
WG3.4 Quality of agricultural products: David Turley, CSL:Central Science Laboratory, Sand Hutton, York, UK
WG3.5 Environmental impacts: Thomas Nemecek, ART Agroscope Reckenholz-Tänikon Research Station, Zurich, Switzerland
WG3.6 Socio-economic issues: Rino Ghelfi, DEIAGRA: Università di Bologna, Dipartimento di Economia e Ingegneria Agrarie, Bologna, Italy

The EuroCrop partners

Project core group

Project Advisory committee

The EuroCrop final conference is organised in collaboration with the European Economic and Social Commitee

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