System for Environmental and Agricultural Modelling; Linking European Science and Society

Documentation of baseline and policy scenarios to be assessed with Prototypes 2 and 3

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Table of contents

General information

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Executive summary

This deliverable describes the construction of baseline and policy scenarios in Test Case 1 and 2 for the second and third prototypes of SEAMLESS-IF. It provides details of the methodology used in SEAMLESS-IP to build scenarios, and the data and parameters needed for the implementation of these scenarios in SEAMLESS-IF. These scenarios will be used to test the second and third prototypes of the integrated framework and its individual tools, especially the two backbone model chains: Data-base-APES-FSSIM-Indicators and Data-bases-APES-FSSIM-EXPAMOD-CAPRI-Indicators.

The report is divided in two parts. The first part gives an overview of what we, in the SEAMLESS integrated project, define as a scenario. It also identifies the main elements for defining scenarios in agreement with the literature. After this overview, the steps defining scenarios in SEAMLESS-IF are identified and explained. The last section of the first part applies this approach to four typical user's problems that SEAMLESS-IF is designed to address: i) Green intensification at regional scale in animal-based farming systems (Auvergne), ii) Nitrate Directive at regional scale in crop based farming systems (Midi-Pyrenees), iii) Trade liberalisation at EU scale and iv) WTO and cotton policies in a LDC country (Sikasso and Koutiala regions of Mali).

The second part of the report details the scenarios used in SEAMLESS-IF for Test Case 1 and 2 at EU and regional scales. The scenarios that can be developed depend on the availability of data as well as the model chain used for assessing the impact of the different EU policies and technological innovations. It proposes a template for the baseline and the policy scenarios compatible with the SEAMLESS-IF structure. More details on the parameters (premiums and constraints) of scenarios to be implemented by WP6 with prototype 2 and 3 are given in three sets of annexes:

- Annex 1: Concrete description of a SEAMLESS-IF project for four examples using the concepts highlighted in the document "Explanation of the project definition V0.7": EU, Midi-Pyrennes, Auvergne and Mali.
- Annex 2: Scenarios to be carried out throughout EU regions with the third prototype.
- Annex 3: Scenarios to be carried out throughout some detailed regions for Prototype 2 and 3: Midi-Pyrenees (France), Auvergne (France), Zachodniopomorskie (Poland) and Koutiala.

Specific part

1 Introduction

1.1 Proposal of a "SEAMLESS scenario" definition

In the SEAMLESS project the scenario concept is defined as "a consistent framework of exogenous assumption and endogenous-related variables describing the possible future of systems" (https://portal.wur.nl/sites/seamless/WP1). This definition is very broad and need a deep clarification to be used as a reference to build concrete scenarios related to an assessment of a future policy in general and the development of Test Case 1 (TC1) and Test Case 2 (TC2) in particular. Several efforts have been made within the project trying to define this concept (Therond et al., 2007; Janssen et al., 2007a, Ewert et al., 2005; Ewert et al., 2006). The following section tries first to review the rich literature on scenario and scenario development, and second to give a proposal of "SEAMLESS-IF scenario" definition using the concepts selected in SEAMLESS-IP.

1.1.1 What are the elements for the scenario definition?

Literature provides a wide range of scenario definitions (see review in Therond et al., 2007) and there is probably not any definition comprehensive enough to cover the diversity of conceptions used in the various scenario-oriented studies (Van Ittersum *et al.*, 1998, Börjeson *et al.*, 2006). It is therefore difficult to identify a common understanding of the typical features of a scenario and how it can be developed as well as the definition of a relevant and generic terminology (Van Notten et al., 2003). However in their review on European scenario studies, Greeuw et al., (2000) proposed to keep the Kahn and Wiener (1967) definition: "*Scenarios are hypothetical sequences of events constructed for the purpose of focusing attention on causal processes and decision points*".

Rotmans et al. (2000) show that, despite the wide diversity of objectives and methods, all scenarios share the following features (for more details see Therond et al., 2007): *i) they represent sequences of events over a certain period of time, ii) they are hypothetical, describing possible future pathways, iii) they contain elements that are judged with respect to importance, desirability, and/or probability*. Based on this statement, Alcamo (2001) resumes the 5 elements that structure scenarios used in environmental and socio-economic studies:

1- Description of step-wise changes: this part identifies the main step-wise changes of the future state of the behaviour of the agricultural systems. These changes can be expressed in the form of diagram, table, or written phrases. For example, scenarios derived from Water Framework Directive cover the changes in the future water situation by for example testing the extending of the amount of irrigated land or by developing new rotations/crops for a better water use efficency over time and space (Cosgrove and Rijsberman, 2001).

2- Driving forces: The driving forces are the main factors or determinants that influence the step-wise changes described in a scenario. As an example, some of the driving forces of greenhouse gas emission scenarios are assumed to be population growth, economic growth, and the rate at which energy use becomes more efficient (Alcamo et al., 1995; Nakicenovic et al., 2000). On the environmental side, most of the European land studies only looked at environmental consequences of different long-term baseline scenarios with exogenous driving forces which are mainly related to the population, economic growth, and agricultural food supply (Rounsevell et al., 2006) without any assumption on the changes of the European land use (Eickhot et al., 2007). Some studies touched upon the consequences of land and water shortage for the amount of food demand, but only used one reference scenario without implementing specific changes in the agricultural trade regime (Bruinsma, 2003). Moreover, a few studies touched upon issues like agricultural intensification due to increased pressures on arable land and their consequences on the nitrogen cycle (Cassman et al., 2003).

Parameter values of these driving forces must be assumed by the scenarios developers, or taken from other studies (Alcamo et al., 2001).

3- Base year: The base year is the beginning year of the scenario. For quantitative scenarios, the base year is usually the most recent year in which adequate data are available to describe the starting point of the scenarios (EEA, 2001).

4- Time horizon and time steps: The time horizon describes the most distant future year covered by a scenario (Alcamo et al., 2001). The selection of an appropriate time horizon for a scenario depends very much on the objectives of the scenarios (Bruinsma, 2003). If it aims to describe the steps in the EU plan to reduce air pollution or the impact of the CAP reforms on the agricultural sustainability, then the appropriate time horizon is in the range of 10 to 20 years (Bertrand et al., 1999; Van Meijl and Van Tongeren, 2002). If they aim to describe the longer-term effects of climate change then an appropriate time horizon could be 100 years or more (Alcamo and Kreileman, 1996; Nakicenovic et al., 2000). The number of time steps between the base year and time horizon of the scenarios are usually kept to a minimum because of the large analytical effort needed to describe each year. Cosgrove and Rijsberman (2000) retained for example only two time steps between 1995 and 2025 to assess the impact of world water vision scenarios, However, Nakicenovic et al (2000) chose time steps of 10 years to analyze scenarios of the impacts of Global greenhouse gas emission.

5- Storyline: A storyline is a narrative description of a scenario, which highlights its main features and the relationships between the scenarios driving forces and its main features. These storylines can be newly constructed for each scenario development (Stigliani et al., 1989) or taken from previous scenario exercises (Eickhout at al., 2007).

1.1.2 The SEAMLESS scenario components

Considering the specific objectives of SEAMLESS-IF and the concept used within SEAMLESS-IP until now, Therond *et al.* (2007) propose that the main components of a SEAMLESS scenario are:

1- ***Driving forces*** for the future that affect agriculture in a given area. They may be either external or internal *i.e.* endogenous and exogenous factors for agricultural systems.

> ***External forces*** (called hereafter “outlooks”) are hypothetical changes in the general conditions surrounding agriculture, which cannot be controlled by farmers and agricultural or environmental policy makers (climate, population growth, inflation, GDP growth...).
>
> ***Internal forces*** include:
>
> > • **The resources and strategies of farmers** which determine the available technology at the farm gate.
> >
> > • **The main policies** that govern the interactions among farmers and between farmers and their socio-economic environment.

2- ***Base year***: for the duration of the SEAMLESS project (2005-2008) the climate and agricultural contexts in years 2001 are considered as the base year (for more details see Louhichi et al., 2006). It is envisaged that this base year will be updated during and after the project.

3- ***Time horizon***: As the CAP reform and EU environmental policies are the major driving forces to be assessed in SEAMLESS-IF scenarios, the appropriate time horizon selected to analyse the impact of scenarios on the system behaviour is between 10 and 20 years (one generation).

In addition to these three components Therond *et al.* (2007) propose to add a fourth element:

4- ***Spatial extent***: in SEAMLESS-IF a large range of spatial scales are considered, from field (AenZ) to EU and global levels.

This SEAMLESS definition of a scenario differs from the one of Alcamo (2001) since:

- the "step-wise changes" of a scenario (section 1.1.1), *i.e.* changes of the future state of the agricultural system is not part of a SEAMLESS scenario, because it gives the possible impacts of the scenario on the investigated systems which are in SEAMLESS-IF an output of the model chain. A SEAMLESS-IF scenario is therefore defined only by the external and the internal forces of the agricultural systems and contains no hypothesis on the system reactions to these forces.

- the Storyline, called "narrative scenario" by Therond et al (2007), is used to enable the users, i.e. Policy Experts and Integrative Modellers, to describe their hypothesis on the system's responses and impacts due to the application of the driving forces described in each scenario. A narrative scenario provides a qualitative assessment of impacts of a policy scenario compared to the baseline. Table 3 shows the SEAMLESS guidelines of how the hypothetical behaviour of the system's (field, farm, territory, market), in response to the implementation of the selected policy and technological innovations, can be described against the baseline scenario both for the agricultural systems and for their environmental, economic and societal impacts (Therond et al., 2007).

Table 3. Example of narrative scenario (Therond et al., 2007)

Policy options	Market/organization	Territory	Farm	Field
New Agri-Environmental Scheme.	Shift in productions? Shift in nature and balance in inputs.	↑ Water quality ↓ Water withdrawals. ↑ Biodiversity. ↓ Erosion.	Farmers contract AEM for: diversification, ↓ pesticides, ↓ tillage, ↑ catch crops, SAF, …	New cropping systems based on conservation agric., integrated production, SAF, intercropping, long rotations…

In conclusion, SEAMLESS scenarios will be composed of the four above-mentioned elements previously translated in model parameters. These scenarios will be developed in an iterative way trough a specific procedure allowing a balance between policy experts' expectations and SEAMLESS-IF capabilities (Therond et al., 2007).

1.1.3 Types of scenarios

In the literature several types of scenarios are used: quantitative, qualitative, baseline, anticipatory etc. Table 1 summarizes the main types of scenarios with their definition, the advantages and limits of each type and some examples extracted from the literature. However, this table is not an exhaustive review of the rich literature on scenarios and definitions of scenarios types, but it focuses only on the types of scenarios, which are relevant for a model-based framework such as SEAMLESS-IF.

Two types of scenarios are compared in this table[1]: Quantitative vs. qualitative and exploratory vs. anticipatory[2]. The third types, e.g. baseline vs. policy scenarios the type of scenario that will be used by SEAMLESS are developed in the next section:

- Baseline scenarios: In the context of environmental studies, the baseline scenarios are also known as ‘reference’ or ‘benchmark’ or ‘non-intervention’ scenarios (EEA, 2001). They can be used for the following purposes (Almaco, 2001):

1- to assess the consequences of current policies or to provide a reference case for new policy interventions. For example, what would be the impact of the CAP policy on agricultural sustainability up to 2020 assuming that no modification will be applied to the current one?

2- To take into account the uncertainty of the driving forces. For example, what would be the expected trends in soil organic matter up to 2020 if the current CAP is maintained?

3- To take into account the uncertainty of environmental conditions. For example, what is the expected water use or nitrogen leaching up to 2020 in different part of Europe a) under average climate conditions? b) if a drought occurs over much of central Europe?

The definition of baseline scenarios is not an easy task because for one problem to be analyzed, several baseline scenarios can be considered. The main reason is that driving forces of environmental problems can take many different directions (Bertrand, 1999). For example, the CAP reform as a baseline scenario after 2013 provides a wide range of projections for the future implementation depending on intra and extra EU negotiations. Accordingly, rather than developing a single baseline, it is often better to develop multiple baselines that reflect different trends, some of which have a lower probability, and some higher. The selection of one of these baselines will be needed but the choice may be easier on the basis of this panel.

- Policy scenarios: describes a ‘default’ view of the future.

In environmental studies, policy scenario depicts the future effects of environmental protection policies. Policy scenarios are also sometimes known as ‘pollution control’, ‘mitigation’ or ‘intervention’ scenarios (EEA, 2001). Some of the purposes of policy scenarios are to (Alcamo, 2001):

1. identify policies that attain specific environmental goals or norms. For example, what will happen if the Nitrate Directive is implemented in all EU regions?

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[1] This comparison is the same one retained by the EEA and developed by Alcamo (2001).

[2] In the literature in addition to exploratory and participatory scenarios, Börjeson *et al.* (2006) distinguished also the predictive scenario, which traduces an exploration of probable future.

2. examine the social, economic and environmental impacts of specific environmental policies. For example, what would be the expected trends in soil organic matter accumulation if a completely eco-conditional CAP reform is implemented between 2013 and 2020?

3. take into account the uncertainty of future environmental conditions and societal driving forces. For example, i) if the Nitrate Directive is implemented in whole of the Midi-Pyrenees region; what would then be the maximum nitrogen leaching under average wet conditions (more and less the current conditions) versus dry years whose frequency is likely to increase in the next 30 years? ii) what would be the evolution of the employment in the agricultural sector if the general economic and employment development of the region continues versus if there is a radical shift towards more negative economic trends.

Table 1- The major types of scenarios: quantitative vs. qualitative and exploratory vs. anticipatory. For each type of scenario the table gives a brief definition, the advantages, limits and references.

Types of scenarios	**Quantitative**	**Qualitative**
Definition	Describe possible futures with needed numerical information in the form of tables and graphs. Usually based on available data, past trends and/or mathematical models.	Describe possible futures in the form of words or visual symbols. They take shape mostly by narrative text or "storylines"
Advantages	Usually represent complex scenarios with several possible combinations of measures, e.g. CAP reform and air pollution policy.	Represent the views of several different stakeholders and experts at the same time. The qualitative nature implies an easier interpretation of results with simple graphs.
Limits	The risk is high that users take the numbers as a sign that we know more about the future than we actually do. Information on uncertainty of results is therefore essential.	No numerical information rather than numerical trends, which can constitute a big limitation when decisions relative to externalities (nitrogen leaching…) are to be taken. In addition, no complex scenarios with interactions of drivers of very different nature can be developed and analyzed.
References	Van Meijl et al., 2002; Eickhout et al., 2007; Anderson, 1999; François et al., 2005.	Nakicenovic et al., 2000 ; Alcamo et al., 1995; Leggett et al., 1992.
Types of scenarios	**Exploratory "known also as descriptive"**	**Anticipatory or backcasting "known also as prospective or normative scenarios"**
Definition	Scenarios that begin in the present and explore trends into the future.	Start with a prescribed vision of future, either optimistic, pessimistic, or neutral, and then work backwards in time to visualize how this future could emerge.
Advantages	More common in environmental studies to assess the impact of policies at long and short term.	Allow building predictive tools such as models to be used afterwards for analyzing policy impact assessment. This approach is more used in medicines and architecture than for environmental or agri-environmental policy impact assessment.
Limits	No possible validation on the quality of the trends and numerical results.	Difficult to visualize with complex scenarios how the future could emerge.

References	Schmid et al., 2007; Belhouchette et al., 2005; Oñate et al., 2006; Matthews et al., 2006.	Stigliani et al, 1989; Alcamo et al., 2001.

1.1.4 The SEAMLESS scenarios domain

SEAMLESS scenarios will be tools to identify and explore a range of possible futures of agricultural systems. In the field of policy impact assessment the main objective of these scenarios is to support public decision by providing coherent tools to analyze trade-offs between social, economical, environmental and institutional determinants and impacts at a relevant range of spatial hierarchical scales (Therond *et al.* 2007). These scenarios should provide a framework to integrate both data and model-produced output in combination with qualitative knowledge.

The very large variation in the scenario conceptions and use makes it difficult to establish a clear presentation of the generic specificities, objectives and boundaries of scenarios that can be assessed within S-IF (Therond, et al. 2007, van Notten et al., 2003, Börjeson et al. 2006).

However van Notten et al. (2003) in order "to analyse and compare scenarios in a credible and consistent manner" proposed a scenario typology to enable a shared understanding of the typical features of contemporary scenarios. This typology is based on identification of the strong link between objectives, methods and scenario conception in scenarios studies. It allow to classify scenarios according to fourteen discriminating characteristics distributed into three “overarching themes”: (1) the “project goal” of the scenario study, (2) the methodological design used (“process design”) and (3) the “scenario content” (see figure 1).. The "'project goals" influences the process design that in turn influences the scenario content. If the scenarios study is an ongoing cyclical process the scenario content can also influence the project goal.

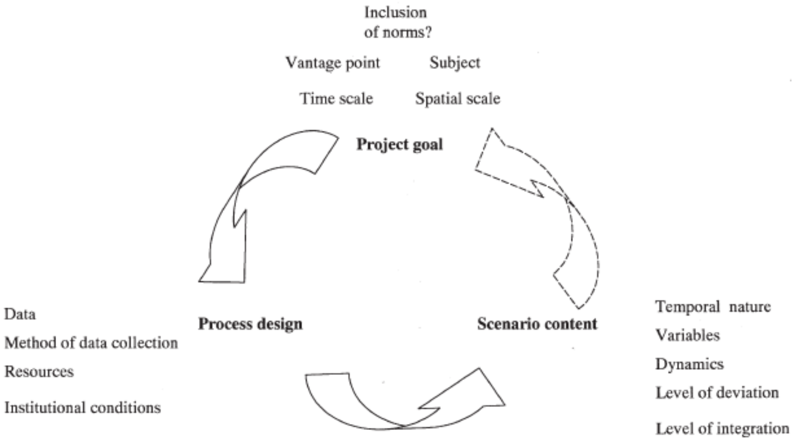

Figure 1: Simplified representation of the criteria of the scenario typology (Van Notten *et al.* 2003)

Van Notten et al. (2003) explain that their scenario typology has a retrospective as well as a prospective function: it can be used to compare and learn from past scenarios studies and also to help to characterize a given new type of scenarios. Consequently this scenario typology offers a structured and adapted framework to position within the space of possible scenario conceptions the scenarios that can be assessed within SEAMLESS-IF and to specify their specific characteristics and boundaries. Using the Van Notten et al. (2003) typology the Table 2 gives a WP6 proposal to clarify and to specify the nature and the boundaries of scenarios that SEAMLESS-IF should be able to assess.

Table 2: Description of SEAMLESS scenarios characteristics using the typology criteria of Van Notten *et al.* (2003).

Overarching themes	**Characteristics of scenarios**	**Characteristics of SEAMLESS scenarios.**
SEAMLESS scenarios goal	I- Inclusion of norms ?: descriptive *vs.* normative	SEAMLESS scenarios are as well as: * **"Descriptive" scenarios** (which describe possible futures) when SEAMLESS-IF is used to assess impact of scenario trends as baseline scenarios or non intervention scenarios. * **"Normative" scenario** (which describe probable or preferable futures) when SEAMLESS-IF is used by policy expert as a tool for: - **policy options assessment** (*i.e.* policy alternatives). In this case SEAMLESS scenarios will answer to the question: "What will happen if such a policy is implemented?" This type of scenario should be build to address "policy option assessment" question. - **policy design** to explore the feasibility and implications of achieving certain specific targeted objectives of the future policy. In this case SEAMLESS scenarios will answer to the question "How can the objectives of policy (framework) be reached?" This type of scenario should be build to address the "policy framework design" question.
	II- Vantage point: forecasting *vs.* backcasting	SEAMLESS scenarios can be composed of: * **Forecasting scenarios** which takes the present as their starting point and are exploratory rather than decision-support exercises. They can take the shape of baseline scenarios. * **Backcasting scenarios** which reason from a specific future situation and explore the paths those need to be taken to arrive at desirable future. They are normative scenarios by definition.
	III- Subject: issue based, area based, institution based	SEAMLESS scenarios address the future of agriculture ("institution-based") and of agricultural area ("area based") and will also deal with the future of agrosystems ("issue based").
	IV- Time scale: long term *vs* short term	Similar to the majority of policy impact assessment scenario, SEAMLESS scenarios are short term scenarios (less than 20 years, one generation).
	V- Spatial scale: global *vs* local	SEAMLESS scenarios address a large range of spatial scales from the field type (AEnZ) to Europe and Global levels.

SEAMLESS scenario process design (general design adopted for the scenario elaboration)	VI- Data: qualitative *vs* quantitative	SEAMLESS scenarios can be composed of both qualitative and quantitative information. As Van Notten (2003), Greeuw *et al.* (2000) state this combination is favoured to make more consistent scenarios since a quantitative scenario can be enriched and its communicability enhanced with the help of qualitative information.
	VII- Method of data collection: participatory vs desk research	Data collection for SEAMLESS scenarios is and will be mainly based on desk research and expert participatory research. In some cases according to policy expert's expectations and for specific impacts assessment the data collection could be also based on stakeholder participatory research.
	VIII- Resources: extensive *vs* limited	Financial, human and time resources for SEAMLESS scenario construction, assessment and analysis will depend on the expectations of, constraints defined by and resources provided by the policy experts who want to use SEAMLESS-IF to perform a policy impact assessment or a policy design.
	IX- Institutional conditions: open *vs* limited	In the same way as resource allocation institutional conditions (constraints) to the elaboration of scenarios will depend on policy experts who will define the "room for manoeuvre" of the scenario project. For example political sensibility to a scenario project determines the institutional conditions.
SEAMLESS scenario content (variety into composition of scenarios)	X- Temporal nature: claim *vs* snapshot	SEAMLESS scenarios will address time by describing the time horizon-state of agricultural systems without describing the temporal causality chain describing the path of development from the base year to the time horizon.
	XI- Variables: heterogeneous *vs* homogeneous	SEAMLESS scenarios can consider a broad variety of exogenous and endogenous (to agricultural systems) driving forces and associated variables**.** This high potential set of scenario variables is qualified here as "heterogeneous" in opposition to a limited and "homogeneous" set of scenarios variables. The following sections of this article provide a general description of the main driving forces taken into account by SEAMLESS-IF.
	XII- Dynamics: peripheral *vs* trend	SEAMLESS scenarios should be either trends scenarios or peripheral scenarios. The former extrapolate from existing trends whereas the latter called also contrast scenario describe a discontinuous path to the future and include unlikely and extreme events.
	XIII- Level of deviation: alternative *vs* conventional	SEAMLESS scenarios can **cover a large range of deviation** and can take the shape of conventional as well as of alternative scenarios (the latter addressing futures that differ significantly from the previous).

	XIV- Level of integration: high *vs* low	SEAMLESS scenarios will present a high level of integration *i.e.* all components relevant to investigate images of future of agricultural systems are incorporated and brought together to form a whole. They will provide an assessment of impacts of the studied change factors on the agricultural systems sustainability and their contribution to sustainable development throughout a key set of environmental, economical, social and institutional indicators.

1.2 Definition of the SEAMLESS scenarios based on the project definition in SEAMLESS-IF

1.2.1 The SEAMLESS-IF procedure to define SEAMLESS scenarios

Therond *et al.* (2007) proposed to define the SEAMLESS-IF procedure of scenario definition and assessment as a three phases process (figure 2):

1- **Phase 1: the pre-modelling phase, "From the user's problem to the definition of the scenario parameters"**:

During this phase multiple interactions between "Policy experts and SEAMLESS experts will allow the definition of a scenario that could involve policy changes and/or technological innovation compatible with the functionalities of SeamFrame. The Policy and the SEAMLESS experts will describe narrative scenarios for each policy option to be assessed with SEAMLESS-IF. By using the outcomes of these interactions, the SEAMLESS experts will determine quantitative scenario parameters, which are consistent with the user's expectations and with the functionalities of SeamFrame, its databases and model chains. Finally Policy experts will select indicators and will describe their expectations in term of precision of indicators.

2- Phase 2: the modelling phase, "From scenario parameters to indicators values":

This phase is conducted entirely by Integrative Modellers (also called SEAMLESS experts) with interactions with users restricted to clarifications. This phase corresponds to the implementation of the scenario parameters in a SeamFrame project. The run of this computerized project will provide indicator values for each scenario defined during the first phase using a set of pre-existing SEAMLESS models and other components (database, typologies, indicator calculator) parameterised and linked by the SEAMLESS experts in the SeamFrame environment.

3- Phase 3: the post modelling phase, "From indicators values to quantitative and qualitative impacts":

During this phase iterative interactions between Policy experts and SEAMLESS experts will allow to review and assess scenarios with Seam:PRES. Feedback workshops with the users, the experts and if necessary stakeholders groups can be held to improve the analysis of quantitative impacts in reference to the expected impacts. Based on the outcomes of these meetings small adjustments in the specification of scenarios, model chains and indicators can be made and new model simulations can be carried out by the SEAMLESS experts without going back to Phase 1. Lastly final lists of impacts by scenario are selected in order to address the user's question and requirements in term of policy assessment. These lists are composed of a combination of qualitative (from additional expertise) and of quantitative impacts (from simulation) for each scenario.

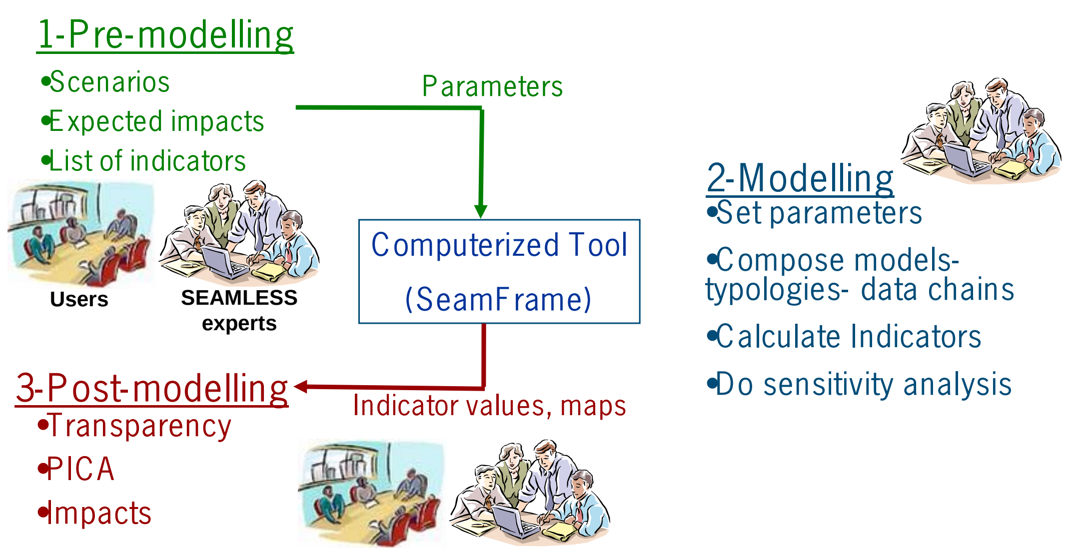

Figure 2: an overview of three phases of the SEAMLESS-IF procedure (redrawn from Therond *et al.* 2007).

1.2.2 Translation of a scenario in SEAMLESS-IF parameters

During the pre-modelling phase of the SEAMLESS-IF procedure for policy impacts assessment shortly described above, Policy experts with the help of SEAMLESS experts will have to describe their general problem and to translate it into a set of parameters for a set of scenarios (or experiments). This rephrasing of the user problem corresponds to the translation of quantitative and in some case qualitative statements into parameters required for quantitative modelling. This "translation" will be performed through a specific guideline based on the project description methodology of Janssen *et al.* (2007a and 2007b), which will ensure the compatibility of the outcomes of the pre-modelling phase of SEAMLESS-IF procedure and the requirements and constraints of SeamFrame. Following this methodology, policy expert will have to translate their question into:

• **A problem (or Policy case)** which corresponds to the description of the general policy problem that the policy experts want to test (*e.g.:* impact assessment of the interaction between the nitrate directive and the CAP in 2012), its **time horizon** (short term currently but may be enlarged in the future versions) and its **spatial scale** (*e.g.*: EU level with a NUTS2 grid).

• **A set of Policy options**, which corresponds to the description of the internal driving forces derived from the agricultural and environmental policy options of interest for the users, and their translation into parameters. One policy option refers to one alternative of an investigated policy (e.g.: a given European Directive alternative, for more examples see D6.2.1.2). Several policy options can be associated with a Policy case. Each policy option has its specific policy parameters (or setting) which correspond to the precise changes in the policy(ies) that are envisaged (e.g.: the implementation measures of a Nitrate Directive option). Policy experts can define one or several policy options to address a problem with SEAMLESS-IF. For the

Prototype 2 of SEAMLESS-IF, if the model chain used to handle the policy expert's problem does not integrate a market model[3], the exogenous source of prices (from previous prospective studies) will be defined as specific (price) policy option(s).

• **A set** of **Outlook (*i.e.* external driving forces) parameters** that will be implemented in SeamFrame (*e.g.:* growth of GDP per capita, demographic changes). For one Problem the users can select several outlooks in order to investigate impacts of these external driving forces (*e.g.:* several hypotheses on the climate change). For one scenario only one outlook is selected (see bellow the definition of scenarios).

• **A set of** b**iophysical, agro-management and farm contexts** which describes the boundaries to the biophysical and farm systems (*e.g.*: list of crops, selection of farm types). They describe also the technological context through the description of current and innovative agro-ecological technologies available at the farm gate for each scenario *i.e.* the internal driving forces corresponding to the technological innovations of each scenario. For one scenario this context is composed of one or several "biophysical, agro-management and farm context" options. A first technological context corresponds to the baseline context. It describes the current technological context projected at the time horizon. The other "technological contexts" are defined in order to enlarge the space of possibilities of agricultural activities when they are part of the problem the users want to address. For example if the users want to assess the impact of policies which promote conservation agriculture, this type of option will be added in the technological context of the FSSIM model. However, if the users would like to reduce the space of possibilities for some experiments, to a set of alternative activities the baseline technological context can be removed. For one Problem the users can select one or several context options.

• **A set of baseline and policy and technical innovation scenarios** (called also experiments within SEAMLESS-IF**)**. As SEAMLESS scenarios correspond to a combination of internal and external driving forces they will be defined trough the selection of a combination of one or several policy option(s), one outlook and one or several biophysical and agro-management contexts (see figure 3). Several scenarios (at least one baseline and one policy scenario) are required for a specific Impact Assessment. The baseline scenario is the reference situation. It is estimated from past trends and predicted changes in economic, agricultural and environmental policies and their extrapolation into the future by the model chains.

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[3] For example if the problem assessment scale correspond to the Midi-Pyrenees region and the adapted chain to handle this problem is APES-FSSIM there is no market model to determine market prices and so they have to be determined from exogenous sources (e.g.: other prospective studies) and implemented in SEAMLESS-IF database.

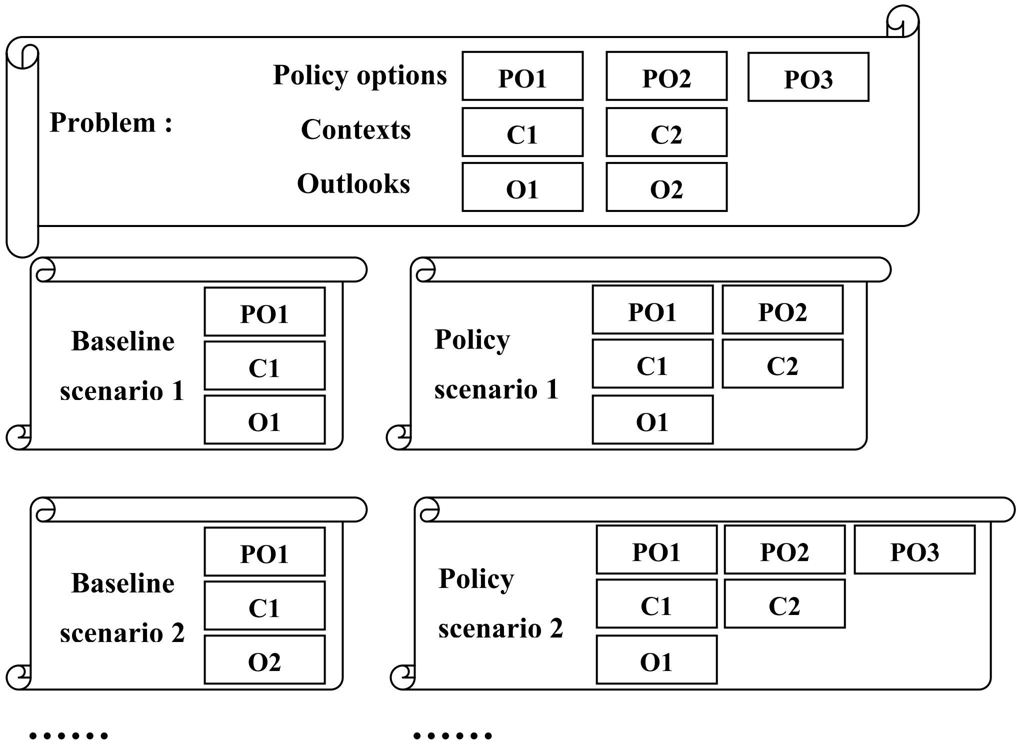

Figure 3: Overview of link between problem, policy options, contexts, outlooks and baseline and policy scenarios.

This specific structure of the description of the user's problem will allow SEAMLESS experts to pass to the modelling phase (*i.e.* to implement scenario parameters and to run the adapted model chain) in order to assess policy and technological innovation scenarios.

Four examples of translation of typical user's problems that SEAMLESS-IF can address are presented in table 4 and described *in-extenso* in annexes 1, 2, 3 and 4.

These examples cover a large range of possible scenarios (relative to the future of agricultural systems) in terms of:

- driving forces (internal and/or external, political and/or technological, economical and/or environmental)
- time horizon (2013, 2020)
- spatial scale of the scenario assessment (farm, region, EU, global)
- model chain used to handle the problem (APES-FSSIM, APES-FSSIM-EXPAMOD-SEAMCAP, SEAMCAP-GTAP,CGE-FSSIM Mali-APES-FSSIM Mali)
- activities taken into account (current and/or alternative)
- management of market prices (endogenous vs. exogenous)
- number and type of experiments (i.e. scenario) created and managed with SEAMLESS-IF for a given problem.
- Indicators calculated to assess the selected scenarios.

The complete descriptions of these examples (see annex 1) are presented from a modelling-phase perspective *i.e.* through the description of the outcomes of the pre-modelling phase and their translation into parameters compatible with SeamFrame and its model chains.

The framework used to present *in-extenso* these four user's problems is an adaptation of the one described in the beginning of this section since it integrates some improvements proposed by WP6 while developing these examples:

- **Context is split up in fixed context and technological context**. The fixed context is not experiment dependent. It corresponds to the definition of the agricultural systems to be investigated in term of representative farms and crops and their spatial and temporal scales. Technological context options are experiment dependent and describe only the technologies taken into account in the scenarios.
- **The condition of management of prices is described in one or several "Price contexts"** that are experiment dependent. For one experiment it is made up by one or several "price context" options.
- **An experimental plan** describes the needed comparisons between results of a set of experiments, in order to analyse the impacts of interest for the users. Indeed for a given problem the quantification of all the differences corresponding to the comparisons of each indicator value between all the scenarios does not make sense for the policy experts. To identify the relevant comparisons policy experts, with the assistance of SEAMLESS experts, have to build an experimental plan during the pre-modelling phase. This experimental plan presents the combinations of experiments that policy experts want to analyse.

Table 4: A summary of four examples translating four potential user's problems that SEAMLESS-IF can handle: Green intensification at regional scale (Auvergne), Nitrate Directive at regional scale (Midi-Pyrenees), Trade liberalisation at EU scale and WTO and cotton agreement for 2 Malian regions.

Scenario characteristics	*Test case 2* *Green intensification* *in the Auvergne region*	*Test case 2* *Nitrate Directive and Conservation agriculture* *in the Midi-Pyrenees region*	*Test case 1* *Trade Liberalisation, the G20 proposal applied* *in Europe*	*Test case 1+ 2* *WTO and cotton agreements* *in Mali*
Problem	Impact of milk and meat production prices increase (+2%/year) and AEM to respect environment (water quality and biodiversity) are intensified. Evaluated the level of environmental subsidy, necessary to maintain the current water quality and biodiversity.	Integrated assessment of implementation of the CAP 2003 reform and the implementation of the current Nitrate Directive. Will the implementation of the Nitrate directive or a subsidy favour Conservation Agriculture?	Integrated assessment of trade liberalisation in order to evaluate possible outcomes of the next WTO (sensitivity analyses of the so called "G20 proposal on market access")	Impact of the cotton agreements on the Malian cotton producers of (i) a WTO agreement (including cotton) and (ii) a multilateral agreement on cotton (domestic support removal in developed countries) without other changes in trade policies
Time horizon	2020	2020 (to take into account long term evolution of some environmental soil state variables)	2013	2013
Problem assessment spatial scale	• Extent: Auvergne • Résolution: Field	• Extent: Midi-Pyrenees • Résolution: Field	• Extent: EU • Résolution: NUTS2	• Extent: World • Resolution: Malian AenZ
Model chain	APES-FSSIM	APES-FSSIM	APES-FSSIM-EXPAMOD-SEAMCAP	SEAMCAP-GTAP-CGE-FSSIM-APES
Policy options (policy driving forces)	• CAP2003, • AEM* "Green intensification" (100 €/ha for agriculture area with nitrogen balance <30 kg/ha/year).	• CAP2003, • Nitrate Directive • AEM* for conservation agriculture	• CAP2003 • Current WTO agreement • G20 proposal • G20 proposal lower tariff cut • G20 proposal higher tariff cut	• CAP2003 • Current WTO agreement • G20 proposal • Cotton agreement
Outlooks (exogenous driving forces)	• 'business-as-usual'	• 'business-as-usual'	• 'business-as-usual'	• 'business-as-usual' • China (GDP growth)
Context (technological driving forces)	• Current activities	• Current activities • Alternative activities: * Nitrate Directive activities * Conservation Agriculture	• Current activities • Alternative activities: * Conservation Agriculture	• Current activities • Alternative activities: * Organic cotton + Genetically modified cotton

	Green intensification *in the Auvergne region*	*Nitrate Directive and Conservation agriculture* *in theMidi-Pyrénées region*	*Trade Liberalisation, the G20 proposal applied* *in Europe*	*WTO and cotton agreements* *in Mali*
Source of alternative activity coefficients	No alternative activities	PEG-PTG-TCG-APES and specifics surveys	PEG-PTG-TCG-APES	APSIM and specific surveys
Prices	Prices are exogenous from previous prospective studies or adapted run of S-IF at European level. Two price contexts are defined.	Prices are exogenous from previous prospective studies or adapted run of S-IF at European level.	Prices are endogenous from SEAMCAP.	Prices are endogenous from SEAMCAP, GTAP and CGE.
Experiments (i.e. policy options + one outlook + one context)	3 experiments to assess impacts of increase of milk and meat prices and increase of premium as an AEM* for limitation of farm nitrogen balance.	6 experiments to assess impacts of Nitrate Directive, Conservation Agriculture development and AEM for Conservation Agriculture	7 experiments to assess impacts of different G20 proposals and Conservation Agriculture	10 experiments to assess impacts of WTO and cotton agreements and of outlooks and of alternative cotton technologies.
Selected indicators	• Income per farm • Nitrate leaching per farm and per NVZ • Crop diversity per region • Specialisation per region • Agriculture income per region • Employment in agriculture per region • Percentage of subsidies per farm • Farm density per region	• Cropping pattern per region • Farmer income per far • Soil organic matter(%) per type of soil • Nitrate leaching per part of Farm type in Vulnerable zone • Area of Mustard and Clover per region • % of area with no-ploughing and tillage per region	• Total agricultural income per region and EU • Money Metric (Consumer surplus) per region and EU • Tariff revenues per region and EU • Total Welfare per region and EU	• Global Cotton price • National GDP • National Trade balance • Farmer income per farm • Cropping pattern per farm • Soil organic matter(%) per types of soil • Nitrogen balance per types of soil • Regional Area of Cotton

2. Definition of Baseline and Policy scenarios

2.1 Baseline scenarios

2.2.1 General overview

The Baseline scenario in Prototype 1 of SEAMLESS-IF examined the consequence of continuing to implement the current European Common Agricultural Policy until 2012 (Perez et al, 2006). This baseline scenario is in principal still valid for Prototypes 2 and 3 with the small difference that the time horizon is now 2013.

This baseline scenario includes the current situation in terms of implementation of EU environmental policies and the cross compliance conditions, as well as other future changes already foreseen in the current legislation (e.g. sugar market reform) (Louhichi et al., 2006).

In practice this means that, the baseline scenario that was adopted in 2006 will be implemented until 2013, taking into account several exogenous assumptions mainly on prices and technological progress. In the second prototype of SEAMLESS-IF an important improvement, compared to the first one, will be the capability of FSSIM to select and implement technological innovations in the farming system, as a response to policy changes. The description of agricultural activities, are performed trough current activities (Louhichi et al., 2006) that reflect the actual situation concerning adoption of technology, and alternative activities (Janssen et al., 2006), that reflect both activities not applied at the moment, but using already known technologies (on the-shelf) and activities using technologies that are not yet fully developed (in the pipeline) (Louhichi et al., 2006). In these alternative activities we can identify two types of information:

- the technological progress induced by the genetic improvement or new equipments for crop management. The impact of this technological improvement on crop yield and environmental externalities should be simulated by the APES model for the period 2006-2013 and implemented for both the baseline and the policy scenarios.

- the test of agro-management innovations. These innovations will be implemented only for the policy scenarios. In Test case 2 we have selected a list of agro-ecological innovations aimed at reducing the environmental impacts of agriculture on soil, water and biodiversity and for which recent research efforts in FP5 and FP6 projects have provided sufficient information for the parametrization of APES and FSSIM (Belhouchette et al., 2006). This selection was discussed with a large audience of scientists during a specific symposium at the bi-annual congress of the European Society for Agronomy in September 2006.

For CAPRI, Prototype 2 also features a baseline for 2020 using the same assumptions as for the 2013 baseline but reflecting that all exogenous drivers and trends apply for another 7 years. A description of the main baseline assumption in the context of TC1 is given in D6.2.3.2.

Main scenario variables

This section presents briefly the major agricultural policy variables (ie. scenario elements), which will be considered in the second prototype of SEAMLESS-IF.

The reform implies the decoupling of most direct aid payments from production. This new agricultural policy is expected to reduce many of the incentives to intensive production that have increased environmental risks. Cross-compliance and modulation have become compulsory; with the latter increasing further the budget available to finance social and environmental measures under the second pillar. Compulsory cross-compliance refers to statutory EU standards in the field of environment, food safety, animal health and welfare at farm level. Beneficiaries of direct payments will also be obliged to maintain all agricultural land in good agricultural and environmental conditions (OECD, 2004).

- Single farm payment scheme

The single farm payment (SFP) will replace most of the existing premium under different common market organizations. For some countries, such as France, farmers will be allotted payment entitlements based on historical reference amounts received during the period 2000-02 (Louhichi et al., 2006).

For the baseline scenario the SFP will be calculated at farm level based on the average of previous payments from 2000-2002, referred to as the “historical payment”. The direct payments included in the single payment are: (i) Premiums for cereals, oilseeds, protein crops and energy crops, (ii) traditional and established durum wheat premiums, (iii) direct income support for dairy cows, (iv) direct payments to sheep and goat, (v) national envelopes for dairy cows, sheep & goat and bovine meat cattle, (vi) slaughter premiums for adult cattle and claves, and (vii) national premiums to dairy cows in northern Sweden and Finland.

- Introduction of dynamic modulation
In order to finance the Rural Development Regulation (RDR) measures, direct payments for farms with more than 5 000€ direct payment per year will be reduced by 4% in 2006 and 5% from 2007 onward. This 5% reduction will result in additional RDR funds of EUR 1.2 billion per year.

- Compulsory cross-compliances
This conditionality implies regulatory requirements, which farmers have to comply with to fully receive the European income support that is applied for. The set of conditions that apply are based on 18 EU directives and regulations with standards on public health, animal and plant health, the environment and animal welfare. Additionally farmers have to comply with national fixed regulations and conditions on maintaining their farmland in good agricultural and environmental conditions. National governments are also obliged to preserve the area with permanent grassland (EC, 2004).

As an example we give below the two conditions a farmer of the French Midi-Pyrenees region has to fulfill to receive the European income support:

(i) *diversification of crop pattern:* the crop pattern should contains (i) at least two different crop families (cereals, oilseeds ...), each having more than 5% of total available land, or (ii) at least three different crops (wheat, barley, canola…), each having more than 5% of total available land.

(ii) *environmental set-aside:* farmer has to keep, at least 3% of its COP (area grown with cereal, oil and protein crops) + fallow, hemp and flax area as environmental set-aside.

Several cross-conditionality rules have also been imposed in the Midi-Pyrenees region (e.g. the conditions for land application of fertilizer near the rivers and the establishment of fertilizer plans on a farm-by-farm basis and the keeping of records on fertilizer use), but they will not be implemented with TC2 in the second prototype because the territorial model will not be operational in the model chain.

- Agri-environment schemes “AES”
EU applies agri-environmental measures, which support specific farming practices design for environment and landscape preservation. The environmental target of these AES is rather broad, concerned with environmental protection, nature conservation, and landscape management and enhancement. Also the preservation of rare breeds and the promotion of organic farming method, public access and training of farmers are mentioned in the list of

possible activities to be supported (Primdahl et al., 2003). Within the EU, Each Member State, and frequently each region, has chosen their own method of implementation of the AES measures. This high diversity will make it difficult to fully implement these AES at EU scale in a scenario but typical examples of AES will be applied on the sample regions selected for prototype 2.

2.2 Policy scenarios in Test Case 1 (TC1)

2.2.1 Objective of TC1

The general layout of TC1 has already been described in D6.2.3.2. We briefly repeat here only the main objectives and what has been changed after D6.2.3.2.
In TC1 the effect of agricultural policies on agricultural markets is analysed. This includes basically the effects that price changes exert on production of agricultural commodities at different levels (from farm type to global markets) and the changes in welfare suffered by consumers and producers as well as environmental effects. The focus of the analysis is therefore the ‘market level’.

For the purpose of this analysis, in TC1 a baseline and policy scenarios are constructed an implemented in SEAMCAP. The former one did not change compared to Prototype 1 apart from shifting the simulation year from 2012 to 2013, while the latter has experienced some changes relevant for Prototype 2. In the following section those changes are described.

2.2.2 Policy scenarios in line with this objective

a) Reduction in import tariffs

In Prototype I, TC1 was based on a proposal on the reduction of trade-distorting instruments by the EU which was the latest available proposal at that time. In the meantime the G20 states[4] came up with a different proposal. The “G20 Proposal” proposes a world wide cut in tariffs according to the following key:

	Developed countries		*Developing countries*	
Thresholds	*Thresholds (in AVEs)*	*Linear Cuts*	*Thresholds (in AVEs)*	*Linear Cuts*
	0≤20	45%	0≤30	25%
	> 20≤50	55%	>30≤80	30%
	>50≤75	65%	>80≤130	35%
	>75	75%	>130	40%
High tariffs & Cap	cap:100%		cap: 150%	

AVEs = ad valorem equivalents

[4] The G20 (Group of 20, also variously G21, G22 and G20+) is a block of developing nations established on 20 August 2003. The group emerged at the 5th Ministerial WTO conference, held in Cancún, Mexico from 10 September to 14 September 2003.

According to this formula, tariffs lying within certain thresholds are cut differently. Furthermore a maximum ad valorem tariff of 100% for developed countries and 150% for developing countries is recommended. The proposal maintains that overall proportionality of commitments between developed and developing countries should be achieved through lower tariff reductions and higher thresholds for the bands. Developing country Members will cut less than 2/3 of the cut to be undertaken by developed country Members. The political variables within the proposal that might be changed are the different thresholds and the corresponding tariff cuts as well as a cap for tariffs, which gives the maximum of tariffs allowed.

For certain, so-called “sensitive products” exemptions for these tariff cuts are discussed. But currently the product list is not settled so that TC1 does not include any sensitive products.

b) Export subsidies
The assumptions on a reduction of export subsidies are the same as described in D6.2.3.2. That means export subsidies are completely eliminated in TC1.

c) Tariff rate quotas
In TC1 of Prototype 1 we assumed an expansion of tariff rate quotas (TRQs) according to the proposal of the former WTO chairman Harbinson. In the current proposal TRQs are not tackled so that we do not change them in TC1 for Prototype 2.

2.3 Policy scenarios in Test Case 2 (TC2)

2.3.1 Objective of TC2

The aim of the second test case is to analyse how the SEAMLESS-IF platform can be used to assess the interaction between the EU environmental policies including technological innovations and their impact on the sustainability of farming systems, and their contribution to sustainable development from farm to EU levels.

2.3.2 How to build a policy scenario for TC2

There are mainly two scales to be considered when analysing the impact of the implementation of an EU directives including technological innovations, the EU level and the regional level. Because of the lack of pan European database, on regional adaptation of directives, on crop characteristics, and crop management (timing of management) two assessments with a varying degree of detail will be carried out in this Test Case:

1. A simplified assessment will be developed at EU level.
2. A detailed assessment will be made in five selected regions, Midi-Pyrenees (for arable farms), Auvergne (for Livestock farms), Zachodniopomorskie (for mixed farms) and the two Malian regions, e.g. Sikasso and Koutiala (for mixed farms).

1. A simplified assessment to be carried out throughout the EU.

It is well known that the purpose of the Nitrate Directive is to give guidelines and it is up to each member state to interpret the guidelines and implement measures and construct an action plan that is able to improve the situation in line with the directions of the guidelines. This means that the member states are in practice implementing the directive with different levels of ambitions. Because of this, we propose to assess the effects of a high ambition and one low ambition application of the Nitrate directive at the regional level throughout Europe. Taking into account the diversity of the adaptation of the measures by each country, measures in four regions through the simple sample regions are selected to represent all EU regions, using the typology developed by Hengsdijk et al., for creating alternative activities):

North: Scandinavian countries will be represented by the Nitrate directive as it is implemented in Finland.

West: UK, Netherlands, Belgium, West Germany, North-West of France will be represented by the Nitrate Directive as it is implemented in Flevoland (Netherlands).

East: Central and Eastern Europe (e.g. East Germany, Austria, Poland, Hungary) will be represented by the Nitrate Directive as it is implemented in Zachodniopomorskie (Poland).

South: Mediterranean countries (e.g. Greece, Italy, Spain, Southern France) will be represented by the Nitrate Directive as it is implemented in the Midi-Pyrenees region.

This approach assumes that there are some relationships between geographical locations (climate) and the rotation and crops constraints. This assumption is crucial because the assessment of the two main measures from the nitrate directive, e.g. calendar of fertilisation with a restricted periods of application and the calculation of the crop nitrogen requirement are completely climate and agro-management dependent.

- In the **"low ambition"** application of the nitrate directive the SEAMLESS-IF will simulate the current level of ambition as already implemented in some EU regions. The three measures that should be implemented at this scale (for more detailed see annex 2) are:

  a- A better management of nitrogen mineral and organic fertilization

  b- Contribution of nitrogen from animals' wastes limited to 170kg N/ha/year.

  c- Respect the restricted period to apply manure or fertilizing nitrogen (according to the type of fertilization and land use).

- In the **"high ambition"** application of the nitrate directive SEAMLESS-IF will simulate the implementation of these directives with higher environmental ambitions and generally more complex, costly and/or risky farming techniques applied by farmers.

  In addition to the first two measures mentioned above (low ambition application) the following measure should be considered (see also annex 1):

  d- Respect the restricted period to apply manure or fertilizing nitrogen (according to the type of fertilization and land use).

2. A detailed assessment to be carried out in the detailed regions

To respect the new CAP-reform and the Nitrate Directive there is a general consensus that agro-ecological cropping systems could play a significant role in the reduction of water use and water pollution while keeping the agronomic performances (yield and quality of product) of the crop at a competitive level (Belhouchette et al., 2006). For this reason a more detailed scenario with a concrete implementation of Nitrate Directive and new technological innovations in specific EU regions (Midi-Pyrenees+ Auvergne+ Zachodniopomorskie) have been developed. The concept has been extended to the 2 Malian regions (Sikasso and Koutiala) where the Nitrate Directive is not relevant but where the development of agro-ecology is also a target. In these regions the SEAMLESS researchers have been working with national and regional decision makers and stakeholders in order to collect information to capture the complexity of constraints and incentives for farmers. This information will be used to define realistic scenarios at the regional level based on simultaneous implementation of EU environmental directives, technological innovation, cross compliance rules from the CAP reform and specific regional agro-environmental schemes.

The selected policy options including technological innovations to be tested in the detailed EU regions (arable farms) are (for details see annexes 3.1 and 3.2):

a. Implementation of the Nitrate Directive as currently adopted by the farmers in the selected regions.

b. Implementation of the nitrate directive as currently adopted by the farmers in the selected regions + adoption of the main agri-environmental measures (AES).

c. Implementation of the Nitrate Directive as currently adopted by the farmers in the vulnerable zones of the region + Implementation of nitrogen fertilization requirement per crop as is defined by the nitrate directive in the whole region

d. Implementation of the nitrate directive as currently adopted by the farmers in the vulnerable zones + incentive measures to reduce soil tillage in the whole region

e. Implementation of the nitrate directive as currently adopted by the farmers in the vulnerable zones of the region + incentive measures to promote ecological farming (organic farming).

In the Auvergne region, in addition to the nitrate directive, specific scenarios related to the livestock are developed (for more details see annex 3.3):

a. Extensification of pasture: the purpose of this scenario is to increase the biodiversity and to decrease the hay storage volume in the mountainous areas where meadows could be very hilly and winters could present long snowy periods.

b. Green intensification: this scenario suggests possibilities to intensify breeding with respect of the environment by implementing a specific premium allowing to reduce the nitrogen balance and the consumption of unsustainable energy.

c. Crops Straws instead of meadows: the focus of this scenario is to increase the cultivated area reserved for straw production in order to change the breeding system in the mountains regions from stanchion stable to free-stall housing, which requires an important production of straw.

d. No silage in dairy and mixed farms: the objective of this scenario is to improve the quality of milk for cheese making by forbidding the use of silage in dairy or mixed farms, with a limitation of the amount of concentrate in the diet, and by increasing the number of pasture days.

In the Malian regions three main scenarios are selected to test the model chain APES-FSSIM-Indicators and the link between GTAP and the regional Mali model. The test of the models will involve simultaneous changes of products and inputs prices and the implementation of technological innovations as alternative activities. Thus, the scenarios, which are developed for Mali, are a mixture of TC1 and TC2 (for more details see annex 3.4):

(i) *Modification of the cotton price*: the scenarios to be tested will be based on a 15% reduction of the price payed to the farmer compared to 2001/02, which corresponds to the current situation in 2006. In this case three assumptions (scenarios) will be tested:

1- the current situation of relatively low price will be continued over 2006.

2- the current decrease of the price trend (15% between 2001 and 2006), will amplify to reach 30% of the 2001/02 average price. This assumption is based on the observed pessimism that dominates the actual international cotton market.

3- a 15% increase above the 2000/02 average price. This assumption is based on the opinion of some economists who think that the price of cotton is able to increase to the level of previous years after the current price drop.

ii) *Modification of the cotton supply chain organisation*: in cotton areas, until this day, the supply of inputs for the cotton crop is made by the CMDT (Company for the Development of textile Industry), which centralizes rural demand, signs the international contracts, and distribute fertilizers to the farmers organizations through a credit system (through financial systems decentralized or banks, but guaranteed on cotton). This system has been efficient in terms of producer purchase price because CMDT has not applied important commercial margins on this activity. Recently, within the framework of the reorganization of the sub sector, the provisioning of inputs for the other productions (inputs for cereals and the inputs for animal husbandry called «non strategic» for the CMDT) was privatised and transferred to the four major farmers organizations. This «privatization» (however partial, because it is always the cotton collected by CMDT that guarantees credit on these inputs) showed serious limits with problems of delivery in the villages for lack of professionalism. However, the privatisation program aims at the transfer of the inputs distribution to the farmers' organizations (federations and unions of cooperatives of cotton producers). For a better evaluation of the impact of privatisation on the inputs prices and the credit system of the cotton sub sector as well as on the volatility of the cotton price, two contrasted scenarios have been developed:

1- the first scenario is favorable to the cotton agricultural production by decreasing the price of inputs in comparison to 2000/02, linked to the abolition of taxes.

2- the second scenario is unfavorable to the cotton agricultural production by increasing considerably the prices of inputs in comparison with 2000/02, and the rate of interest for the credits of campaign.

iii) *Introduction of technological innovations (as alternative activities in FSSIM)*: three alternative technologies will be tested or combined in different scenarios:

1- Genetically modified cotton (GMC): The progressive introduction of cottons genetically modified in the middle of the nineties allowed a significant rise of the average world yield. Among the introduced genes two are more important. First the production of the Bacilius Thurengis by the cotton plant improves it resistance to some insects such as the bolls borer (mainly Helicoverpa armigera in Mali). Second the introduction of a gene of resistance to glyphosate, which facilitates chemical weeding.

Experiments have already taken place in Burkina Faso. The above-mentioned genes are in the process of being introduced in African varieties. Genetically modified varieties will probably be available in the short term in Mali. 2- Mulch-based and no till system, also called locally sowing under vegetal cover (SCV): SCV were introduced recently in Mali under an experimental framework. The principle of the technique is to suppress tillage such as ploughing, as much as possible, to produce aerial biomass and roots, to recycle the nutritive elements and to protect the soils against the aggressions (intense rains, extreme dryness during the dry season). These technologies are known to have high costs of establishment (lower yields during the first 2-3 years) and to interact with the management of the residues (with competition with animal feeding) and therefore with the organic matter management.

3- Organic cotton: the Swiss NGO, Helvetas, introduced Organic cotton in Mali. It is cultivated on few hundred of hectares. To benefit from the label, a farm should be completely converted to organic farming. As the organic grain sector is not developed yet, cereals are not grown in rotation or association with cotton and farmers have to leave a plot into fallow for a minimum of three years before growing certified organic cotton.

3 Conclusion

This report gives the structure and the details of the baseline and the policy scenarios to be implemented in TC1 and TC2, in order to test the capability of Prototype 2, and later on Prototype 3, of SEAMLESS-IF to analyse the effect of agricultural polices on agricultural market (TC1) and the interaction between EU environmental directives including the adoption of agro-ecological technologies (TC2).

In the first part of this deliverable we propose a definition and structure of a scenario compatible with SEAMLESS-IF objectives and structure. The concrete illustration of the scenarios definition was given in the format of a SEAMLESS-IF "project definition", with four examples covering different types of impact assessment problems:

1) Analysis of trade liberalisation options at EU level,
2) Integrated assessment of the cross impacts of the CAP 2003 reform and Nitrate Directive in the Midi-Pyrenees region,
3) Analysis of the impact of an hypothetical policy supporting a 'green intensification' process in the mountainous areas of Auvergne,
4) Assessment of the impact of a WTO agreement on Malian cotton producers.

For the assessment of the effects of Nitrate directive at the EU scale, two types of scenarios, "low" and "high" with respect to environmental ambitions, have been proposed and examples have been presented.

Detailed descriptions of the Test case 2 policy scenarios at EU level are given in the annexes of this deliverable. Specific scenarios related to the Nitrate Directive including technological innovations have been developed for the Test case regions Midi-Pyrennes, Zachodniopomorskie and Auvergne. In Auvergne it is related to livestock. In the Test case applied to the Malian regions of Sikasso and Koutialla hybrid scenario between TC1 and TC2 have been developed for testing SeamFrame and its tools.

Other types of scenarios based on EU directives and technological innovations will be defined and developed in interaction with users while testing the second prototype of SEAMLESS-IF. These scenarios will however not be implemented by SeamFrame during this project but will serve as the basis for future research projects and to define guidelines for improvement of Prototype 3 and the final version of SEAMLESS-IF. Examples of such scenarios could be to run an assessment of the implementation of The Water Framework looking for a spatially adapted and economically efficient (from a national and EU perspective) use of agri-environmental measures. It could also be an assessment of different policy options related to pesticides regulations. Another option could also be to make an assessment of the Biofuel directive under different world market price of biofuels and oil prices and with different types of cropping systems.

References

Alcamo, J., 2001. Scenarios as tools for international assessments, 24. European Environmental Agency (Eds.), Office for Official Publications of the European Communities, 31 p.

Alcamo, J., and Kreileman, C.J.J., 1996. Emission scenarios and global climate protection. Global Environmental change. 6(4) :305-334.

Alcamo, J., Bouwman, A., Edmonds, J., Grübler, A., Morita, T., Sugandhy, A., 1995. An evalution of the IPCC IS92 emission scenarios. In: IPCC, Climate change 1994. Cambridge University Press. 251-304.

Belhouchette, H., Wery, J., Thérond, O., Duru, M., Bigot, G., Was, A., Kloczko-Gajewska, A., Leenhardr, D., Majewski, E., Josien, E., Bergez, J-E., Henning, J., Thenard, V., 2005. Report on the major characteristics of environmental policies and agro-ecological technologies to be studied in test case 2. Seamless project, report N° 11, PD 6.1.2. 87pp.

Bertrand, G., Michalski, A. and Pench, L., 1999. Scenario Europe 2010: five possible futures for Europe. Working paper, European Commission Forward Studies Unit, http://europa.eu.int/comm/cdp/scenario/resume/index_en.htl.

Börjeson, L., M. Höjer, K. H. Dreborg, T. Ekvall, and G. Finnveden., 2006. Scenario types and techniques: Towards a user's guide. Futures 38, 723-739.

Bruinsma, M., 2003. Effectiveness of Higher Education Factors that determine outcomes of university education. Groningen, GION/COWOG.

Cassman, K.G, Dobermann, A., Walters, D.T. and Yang, H.S., 2003. Meeting cereal demand while protecting natural resources and improving environmental quality. Annual Review of Environment and Resources 28, 315-358.

Cosgrove, W.J. and Rijsberman, F., 2001. The making of the world water vision exercice. *In*: Rijsberman, F. (ed.) World water scenarios: Analysis. Earthscan, London.

Cosgrove, W.J. and Rijsberman, F.R. 2000. World Water Vision: Making
EC, 2004.. www.europa.eu.int.

EEA., 2001. Scenarios as tools for internal environmental assessments. Report 24. 31pp.

Eickhout, B., van Meijl, H., Tabeau, A. and van Rheenen, T. 2007. Economic and ecological consequences of four European land use scenarios. Land Use Policy, Volume 24, Issue 3, July 2007, Pages 562-575.

Ewert F., van Ittersum M., Bezlepkina I., Oude Lansink A., Andersen E., Bäcklund A.-K., Brouwer F., Flichman G., Heckelei T., Olsson J., Olsson L., Rizzoli A., Theesfeld I., Wery J., Wien J. E., Elbersen B., Donatelli M., Martinson L., Perez I., Svensson M., van Diepen K., Development of a conceptual framework for integrated analysis and assessment of agricultural systems in SEAMLESS-IF, PD 1.2.1, SEAMLESS integrated project, EU 6th Framework Programme, contract no. 010036-2, www.SEAMLESS-IP.org, 55 pp.

Francois, J.F., van Meijl, H., and van Tongeren, F. 2005. Trade Liberalization and Developing Countries Under the Doha Round, Economic Policy, 20 (42), 349.

Greeuw, S. C. H., van Asselt, M. B. A., Grosskurth, J., Storms, C. A. M. H., Rijkens-Klomp, N., Rothman, D. S., and Rotmans, J. 2000. Cloudy crystal balls: an assessment of recent European and global scenario studies and models. European Environment Agency, Copenhagen, Denmark, 96 p.

Janssen S., Hongtao, L., Athanasiadi,s I., and David, H., 2007b. Explanation of the Project Definition", SEAMLESS Working paper of the Dot.Force.

Janssen, S., Hengsdijk, H., and van Ittersum, M., 2007. Alternative Activities for Prototype 2 of FSSIM: ambitions and proposal for further development. SEAMLESS working paper.
Janssen, S., Therond, O, Belhouchette, H, Bezlepkina, I. and Wery, J., 2007. Concrete description of a SEAMLESS project for regional analysis, Working paper of the WP1-6.

Janssen, S., Therond, O, Belhouchette, H, Bezlepkina, I. and Wery, J., 2007a. Concrete description of a SEAMLESS project for regional analysis, Working paper of the WP1-6.

Leggett, K.D., and Paulus, P.B. 2005. Cognitive and social comparison processes in brainstorming Journal of Experimental Social Psychology, Volume 41, Issue 3, May 2005, Pages 313-320.

Louhichi, K., Janssen, S., Li, H., Zander, P., Stokstad, G., Kanellopoulos, A., Van Ittersum, M., Van Der Maden, E., Hengsdijk, H., Flichman, G., Blanco, M., Rizzoli, A-E., Athanasiadis, I., Huber, D., Sattler, C., Hecker, M., Karstens, N., 2006. D3.3.6: A first version of FSSIM for the arable farming sector to be used within Prototype 1 of SEAMLESS-IF. Seamless Project, 118pp.

Matthews, K.B., Wright, I.A., Buchan, K. Davies, D.A. and Schwarz, G. 2006. Assessing the options for upland livestock systems under CAP reform: Developing and applying a livestock systems model within whole-farm systems analysis. Agricultural Systems, Volume 90, Issues 1-3, October 2006, Pages 32-61.

Metzger, M. J., Bunce, R. G. H., Jongman, R. H. G., Mücher, C. A. and Watkins, J. W., 2005. A climatic stratification of the environment of Europe. Global Ecology and Biogeography, (Global Ecol. Biogeogr.) (2005) 14, 549–563.

Nakicenovic, N.(ed), 2000. Greenhouse gas emission. Technological Forecasting ad Social Change, 65 (3).

Nakicenovic, N., J. Alcamo, G. Davis, B. de Vries, J. Fenhann, S. Gaffin, K. Gregory, A. Grübler, T. Y. Jung, T. Kram, E. L. La Rovere, L. Michaelis, S. Mori, T. Morita, W. Pepper, H. Pitcher, L. Price, K. Raihi, A. Roehrl, H-H. Rogner, A. Sankovski, M.

OECD, 2004. Analysis of the 2003 CAP Reform. 53pp.

Perez, I., Bigot, G., Bousset, J.P. Josien, E., Majewski, E., Rapidel, B., Thénard, V., Thérond, O., 2006. Development of Scenarios for Test case 1. Seamless Project, Deliverable D6.2.5.

Primdahl, J., Peco, B., Schramek, J., Andersen, E., Oñate, J.J., 2003. Environmental effects of agri-environmental schemes in Western Europe. Journal of Environmental Management. 67, 129-138.

Rounsevell, M.D.A., Reginster, I., Araújo, M.B., Carter, T.R., Dendoncker, N., Ewert, F. House, J.I.., Kankaanpää, S. R. Leemans, M.J. Metzger, *et al.* A coherent set of future land use change scenarios for Europe. Agriculture, Ecosystems & Environment, Volume 114, Issue 1, May 2006, Pages 57-68.

Schlesinger, P. Shukla, S. Smith, R. Swart, S. van Rooijen, N. Victor, Z. Dadi, 2000: Emissions Scenarios, A Special Report of Working Group III of theIntergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 599 pp.

Schmid, E., Sinabell, F., and Hofreither, M. F. 2007. Phasing out of environmentally harmful subsidies: Consequences of the 2003 CAP reform. Ecological Economics, Volume 60, Issue 3, 15 January 2007, Pages 596-604.

Stigliani, W.M., Brouwer, F.M., Munn, R.E.,Shaw, R.W. and Antonowsky, M. 1989. Future Environments for Europe: Some implications of alternative development paths. The science of the Total Environment. 80:1-12.

Therond, O., Taverne, M., Wery, J., Josien, E. Belhouchette, H., et al., 2007. Proposals from WP6 for revision of SEAMLESS-IF procedure in Prototype 2, D6.5.4.2, SEAMLESS integrated project, EU 6th Framework Programme, contract no. 010036-2, www.SEAMLESS-IP.org, 47 pp.

van der Wal T., Wolf J., 2006. Methodological concepts for integrated assessment of agricultural and environmental policies in SEAMLESS-IF., PD1.3.8. SEAMLESS integrated project, EU 6th Framework Programme, contract no. 010036-2, www.SEAMLESS-IP.org, 49 pp.

Van Ittersum, M.K., Rabbinge, R., and Van Latesteijn, H. C., 1998. Exploratory land use studies and their role in strategic policy making. Agricultural Systems 58, 309-330.

van Meijl, H., and van Tongeren, F., 2002. The Agenda 2000 CAP reform, world prices and GATT--WTO export constraints, European Review of Agricultural Economics, Oxford University Press for European Association of Agricultural Economists, vol. 29(4), pages 445-470, December.

Van Notten, P. W. F., Rotmans, J., van Asselt, M. B. A. and Rothman, D. S., 2003. An updated scenario typology. Futures 35, 423-443.

Younie, D., Watson, C.A., 1992. Soil nitrate-N levels in organically and intensively managed grassland systems. Aspects Appl. Biol. 30, 235–238.

Annexes

Annex 1: Detailed description of a SEAMLESS project Impact Assessment at EU level, based on TC1.

By Marcel Adenäuer,

Based on the document of Sander Janssen et al. "**Concrete description of a SEAMLESS project for a regional analysis" and on the example for a regional analysis** from Olivier Therond

This note concentrates on the modelling Phase, but shows the link to the policy expert's problem defined in the Pre-Modelling Phase in each step.

****

Modelling phase

This phase of the SEAMLESS-IF procedure is aimed at implementation in SeamFrame of the pre-modeling phase's outcomes and run of experiments.

Steps of this phase:

Step 1) Project - Problem description

Step 2) Policy options

Step 3) Outlooks

Step 4) Fixed and technological contexts

Step 5) Price context

Step 6) Implementation of Experiments and of the experimental plan

Step 7) Implementation of expected impacts

Step 1) Project - Problem description

Outcomes of the pre-modelling phase used in this step:

The EU Commission asks for an analysis of trade liberalisation options in order to evaluate possible outcomes of the next WTO round. They want to find out what the impacts of reductions in border protection are on European agriculture, consumers of agricultural goods and the income from tariffs. They are particularly interested in sensitivity analyses of the so called "G20 proposal on market access" which provides a certain formula for the reduction in border protection depending on the initial level of protection and the developing status of a nation (http://www.g-20.mre.gov.br/conteudo/proposals_marketaccess.pdf)

Translation into SEAMLESS-IF:

Start SEAMLESS-IF and create a new project with its properties:

- *ProjectTitle: Trade Liberalisation, G20 proposal*
- *Owner(s):*
    - *Integrated Modelers: Marcel Adenäuer (email: marcel.adenaeuer@ilr.uni-bonn.de institute: ILR, Uni Bonn). (access to the whole project)*

   - *Policy experts from EU Comission (email: mrX@ec.europa.eu. ('view' access to the project).*

- *Problem Description: Assessment of impacts of trade liberalisation based on the G20 proposal on European agriculture.*
- *Temporal Scale[5]:*
   - *Extent: 2013*
- *Spatial scale[6]:*
   - *Extent: EU27 and world wide*
   - *Resolution: NUTS2 regions of EU27*

Outcomes of the pre-modeling phase used in this step:
The "G20 Proposal" proposes a world wide cut in tariffs according to the following key:

	Developed countries		*Developing countries*	
Thresholds	*Thresholds (in AVEs)*	*Linear Cuts*	*Thresholds (in AVEs)*	*Linear Cuts*
	0≤20	45%	0≤30	25%
	> 20≤50	55%	>30≤80	30%
	>50≤75	65%	>80≤130	35%
	>75	75%	>130	40%
High tariffs & Cap	cap:100%		cap: 150%	

AVEs = ad valorem equivalents

According to this formula, tariffs lying within certain thresholds are cut differently. Furthermore a maximum ad valorem tariff of 100% for developed countries and 150% for developing countries is recommended.
In this table there are two "political variables": Thresholds and linear cuts. In this example the policy expert identifies the linear cuts as the variable for which a sensitivity analysis should be carried out. He wants to compare three options: The first is defined by the above table, the second one assumes that each cut is 10 percent points lower than in the first option and the third one assumes that they are 10 percents point higher.
I addition to these tariff changes the EU eliminates all export subsidies.

Step 2) Policy options

In SEAMLESS-IF:

Add the policy options as discussed with Policy expert by pressing on the "create policy options for seamcap" button[7]:

- *Policy Option 1: CAP2003*

[5] Scale, its attributes and its links to other concepts requires clarification on a very short term.

[6] Idem.

[7] The policy editor for SEAMCAP is not yet available, so buttons and views of the editor referred to here are still suggestions

- *Constraints in FSSIM-MP: introduce 'income support' calculation and according to decoupling rules adapt 'production subsidies'-calculation for each Member State*
    - *'Income-support'- constraints requires the following parameters to be set:*
        - *Reference yield per region: tonnes/ha/country MS*
        - *Level of decoupling per crop: for all eligible crops per MS*

- *Policy Option 2: Current trade policy*
    - *No modification in the trade policy register card*
- *Policy Option 3: G20 proposal*
    - *Select the trade policy register card and the G20 button*
    - *Insert the linear percentages cuts associated with each threshold indicated in the above table.*
    - *Select the Export subsidies button and set all expenditures to zero*
- *Policy Option 4: G20 proposal lower tariff cut*
    - *Select the trade policy register card and the G20 button*
    - *Insert the linear percentage cuts associated with each threshold 10 percent points lower than given in the above table.*
    - *Select the Export subsidies button and set all expenditures to zero*
- *Policy Option 5: G20 proposal higher tariff cut*
    - *Select the trade policy register card and the G20 button*
    - *Insert the linear percentage cuts associated with each threshold 10 percent point higher than given in the above table.*
    - *Select the Export subsidies button and set all expenditures to zero*

Step 3) Outlook as trend and trend deviations exogenous to SEAMLESS

Outcomes of the pre-modeling phase used in this step:

Policy experts asked only for one outlook, which is the standard outlook of DG-AGRI implemented in the standard SEAMCAP baseline, the so called "business as usual" outlook

In Seamless-IF:

- *Currently SEAMCAP features only one set of outlooks (Baseline). This may change in future versions. Actually the standard baseline is chosen automatically*

Step 4) Fixed and technological contexts[8]

Outcomes of the pre-modelling phase used in this step:

Discussions have shown that two technology experiments should be taken into account. One using the standard technology and one using Conservation Agriculture activities (no plowing and

In the FSSIM part of Seamless-IF:

The fixed context is created by the 'create fixed context' button:

- *Fixed context:*
  - *Representative Farms: all representative farms defined throughout the standard SEAMLESS farm typology*
  - *Crops: no modification in the regional predefined list*

Then two "Technological contexts" are created by the corresponding button.

- *Technological context 1: current activities (baseline technological context)*
  - *Crops: no addition to the regional predefined list*
  - *Production Orientation: conventional - no technological innovation.*
    - *Min rotation length: 1 year*
    - *Max. rotation length: 4 year*
- *Technological context 2: conservation agriculture*
  - *Crops: mustard and clover*
  - *Production Orientation: conservation oriented (technological innovation)*
    - *Conservation Options*
      - *No plow tillage for crops: winterbarley, winterwheat, soybean and grass*
      - *Intercrops: mustard and clover before sunflower and maize.*

After the specification of these contexts, the user can click the 'run biophysical models '-button, so that the SEAMLESS-IF starts running the biophysical models (FSSIM-AM and APES) to determine the sets of input-output coefficients for FSSIM-MP, e.g. the solution space within which FSSIM-MP can find a solution.

Step 5) Price context

Outcomes of the pre-modeling phase used in this step:

Policy experts want interactions between the regional production and prices market to be reflected. Prices should therefore be the result of market equilibrium.

In Seamless-IF:

  - *By choosing SEAMCAP as the main model component, endogenous prices are automatically reflected*

[8] The boundaries (called "context") of the biophysical and farm systems of the selected problem have to be set in order to create the solution space in which possible impacts can be simulated. These contexts integrate also technological innovations as some driving forces of the problem.

Step 6) Implementation of Experiments and of the experimental Plan[9]

Outcomes of the pre-modeling phase used in this step:

During the pre-modeling phase problem description has been translated into 7 experiments. These experiments have been used to build an experimental plan which describes the needed comparisons between results of experiments in order to address impacts of change factors described in the problem definition (for an example see below).

[9] The experiments thus define the changes or driving forces compared to the reference situation, by capturing the changes in policy options, context, and outlook, either as changes in isolation (only one policy option/outlook/context-change) or simultaneously (more than one policy option/outlook/ context-change). For each experiment, the model chain has to quantify indicator values.

In SEAMLESS-IF:

Enter the selected experiments described through various combinations of policy options, experiment dependent contexts and outlook by using the 'create experiment' option:

Experiments			Policy options	Outlook	Technological context	Prices context
N°	*Name*	*Short description*	*Name*	*Name*	*Name*	*Name*
1	*Baseline*	*Standard outlook on exogenous drivers and policy variables*	*CAP2003+ Current trade policy*	*Business as Usual*	*Current activities*	*endogenous*
1.1	*G20 proposal Conventional agriculture*	*Baseline + implementation of the G20 proposal on trade liberalisation. Supply response based on Conventional agriculture.*	*CAP2003+ G20 proposal*	*Business as Usual*	*Current activities*	*endogenous*
1.2	*G20 proposal -10% Conventional agriculture*	*Baseline + implementation of the G20 proposal on trade liberalisation. With lower tariff cuts than in 1.2. Supply response based on Conventional agriculture.*	*CAP2003+ G20 proposal -10%*	*Business as Usual*	*Current activities*	*endogenous*
1.3	*G20 proposal +10% Conventional agriculture*	*Baseline + implementation of the G20 proposal on trade liberalisation. With higher tariff cuts than in 1.2. Supply response based on Conventional agriculture.*	*CAP2003+ G20 proposal +10%*	*Business as Usual*	*Current activities*	*endogenous*
2.1	*G20 proposal Conservation agriculture*	*Baseline + implementation of the G20 proposal on trade liberalisation. Supply response based on Conservation agriculture.*	*CAP2003+ G20 proposal*	*Business as Usual*	*Conservation agriculture*	*endogenous*
2.2	*G20 proposal -10% Conservation agriculture*	*Baseline + implementation of the G20 proposal on trade liberalisation. With lower tariff cuts than in 1.2. Supply response based on Conservation agriculture.*	*CAP2003+ G20 proposal -10%*	*Business as Usual*	*Conservation agriculture*	*endogenous*
2.3	*G20 proposal +10% Conservation agriculture*	*Baseline + implementation of the G20 proposal on trade liberalisation. With higher tariff cuts than in 1.2. Supply response based on Conservation agriculture.*	*CAP2003+ G20 proposal +10%*	*Business as Usual*	*Conservation agriculture*	*endogenous*

Then the experimental plan (description of comparisons of experiments needed to explore impacts of changes of user interest) is built, using the 'create experimental plan' functionality:

(example of reading: indicators values from experiment 1.1 run has to be compared to indicators values from experiment 1 run in order to assess impacts of the G20 proposal against the baseline situation)

Experiments	*1(Baseline)*	*1.1*	*1.2*	*1.3*
1				
1.1	*G20 proposal Conventional agriculture*			
1.2	*G20 proposal -10% Conventional agriculture*			
1.3	*G20 proposal +10% Conventional agriculture*			
2.1		*G20 proposal Conservation agriculture*		
2.2			*G20 proposal -10% Conservation agriculture*	
2.3				*G20 proposal +10% Conservation agriculture*

Now that the experiments and the experimental plan have been defined, the user can click the 'Run Economic Models'-button to start the quantification of experiments one by one with the previously generated results of the biophysical models. The model chain in this case has to be APES-FSSIM-EXPAMOD-SEAMCAP.

Step 7) Implementation of expected impacts

Outcomes of the pre-modeling phase used in this step:

During the pre-modeling Policy- and SEAMLESS experts described their hypothesis on the changes expected between experiments and baseline (*i.e.* experiment n°1). For each of the experiments and for each indicator they defined an expected impact as either positive (+ or ++ or +++) or negative (- or -- or ---) or as a relative change (+ or – percentage) or an absolute change (+ or – an absolute amount) or as no change (=) or as a description.

In SEAMLESS-IF (the indicators selection-edition of the modeling phase is performed with SeamFrame GUI)

Using i) the description of expected changes and ii) the SeamFrame GUI for the selection of indicators Policy experts selected in the library the following indicators:

- *Total agricultural income Indicator Scale: Regional and EU WP2 green list*
- *Money Metric (Consumer surplus) Indicator Scale: Regional and EU WP2 green list*
- *Tariff revenues Indicator Scale: Regional and EU WP2 green list*
- *Total Welfare Indicator Scale: Regional and EU WP2 green list*

In SEAMLESS-IF:

Use the 'Define Expected Impacts'- button. These expected impacts do not change the configuration of the model chain as done in step 1-6, but they capture expert knowledge that *can be used later on to identify discrepancies between what experts expect and what the model chain calculates.*

Table 1 expected impacts of experiments on different indicator values

Experiments	**Expected Impacts** :Expected changes in values of indicators relative to the reference			
	Total agricultural income	*Money Metric*	*Tariff revenues*	*Total Welfare*
Baseline				
G20 proposal *Conventional agriculture*	--	++	--	++
G20 proposal -10% *Conventional agriculture*	-	+	-	+
G20 proposal +10% *Conventional agriculture*	---	+++	---	+++

Experiments 2.1, 2.2, and 2.3 have the same expected impacts as those using conventional agriculture. Nonetheless the impact of using conservation agriculture on those indicators cannot be assed beforehand.

After a long time, the SEAMLESS-IF has finished it runs for the 6 experiments. One can see the results in terms of indicator values for the different experiments and sensitivity runs and they compare these carefully with the expected impacts to highlight the differences between expected impacts and calculated impacts to the policy expert.

Annex 2: Concrete description of a SEAMLESS project for the Midi-Pyrenees regional analysis based on TC2.

By Olivier Therond, Hatem Belhouchette, Etienne Josien, Jacques Wery, Marie Taverne, Jean Paul Bousset, Geneviève Bigot,

based on the document of Sander Janssen et al. "**Concrete description of a SEAMLESS project for a regional analysis"** and on the **conclusions of a dedicated WP6 web meeting (30/03/07).**

Objective of this note: to provide **a simplified but detailed example of definition and implementation of a project in SeamFrame at Midi-Pyrenees region level**. **This example focus on the description of the modelling phase of the SEAMLESS-IF procedure** for a policy impact assessment (described in the D6542). In this example interaction between SEAMLESS experts (Jacques, Hatem and Olivier) and policy experts (Mrs X and MrY) occurred during the pre-modelling and will occur during the post modelling phases of the S-IF procedure (these two phases are not described in detail in this document).

****

Pre-modelling phase[10]

Interactions of the pre-modelling phase enabled:

- throughout specific guidelines, PICA and an "Initial consistency control" **to translate the policy expert's problem in parameters of policy options, outlooks, fixed and technological and prices contexts** (that SEAMLESS-IF can handle).
- **to define experiments and an associated experimental plan (**which describe which change factors users want to investigate by the comparison of indicator values between experiments),
- **to describe the user's hypothesis on impacts** (called hereafter **expected impacts**) of each experiment against the baseline,
- **to select a list of indicators**. **This selection has been carried out with the GUI** which allowed to select indicators in the SEAMLESS library (i.e. already implemented in SeamFrame) and to create new indicators with the indicator editor (to define with the users the new algorithms corresponding to the new indicators). **In order to maintain consistency with the S-IF procedure the selection of indicators is described as a step of the pre-modelling phase**.

Outcomes of this phase are implemented in SEAMLESS-IF by experts during the second phase of S-IF procedure. To have an easier reading, origin and type of these outcomes are quickly described in introduction of each step of the modeling phase.

****

Modeling phase

This phase of the SEAMLESS-IF procedure is aimed at implementation in SeamFrame of the pre-modeling phase's outcomes and run of experiments.

[10] For the Prototype 2 except for the selection of indicators this pre-modeling phase will be mainly led out of the GUI throughout specific guidelines.

Steps of this phase:

Step 1) Project - Problem description

Step 2) Policy options

Step 3) Outlooks

Step 4) Fixed and technological contexts

Step 5) Price context

Step 6) Implementation of Experiments and of the experimental plan

Step 7) Implementation of expected impacts

Step 1) Project - Problem description

Outcomes of the pre-modeling phase used in this step:

Mrs X and Mr. Y of the Regional Agricultural State Services (in French DRAF) of Midi-Pyrenees expressed their objective to perform an integrated assessment of the cross impacts of the CAP 2003 reform and Nitrate Directive in the Midi-Pyrenees region. They also want to evaluate if this policy framework will favour Conservation Agriculture (CA) and they are interested to know if a subsidy on Conservation Agriculture would increase its uptake. Furthermore in order **to take into account long term evolution of some environmental soil state variables (e.g.: organic matter of soil) and associated indicators they decided to select 2020 at time horizon of simulation**. This choice of time horizon is also consistent with available previous European and regional prospective studies which can be used to determine some experiment's parameters. Even if the time horizon is fixed to 2020 and the CAP2003 have to be reformed in 2012 users and experts assumed that the selected policies will continue until 2020.

  - *Integrated Modelers: Olivier Therond (email: Olivier.Therond@toulouse.inra.fr, institute: INRA), Hatem Belhouchette (email: belhouch@ensam.inra.fr; institute: INRA), Jacques Wery (email: wery@ensam.inra.fr; institute: INRA). All three have 'write' access to the project.*
  - *Policy experts: Mrs. X and Mr Y of the Midi-Pyrenees DRAF (email mr.X@draf.mp and mr.Y@draf.mp; institute: Midi-Pyrenees DRAF). These two have 'view' access to the project.*

- *Problem Description: Assessment of cross impacts of CAP2003 reform-Nitrate directive and of the introduction of Conservation Agriculture on agricultural incomes, nitrate leaching in Vulnerable Zones and sustainability of agriculture in the Midi-Pyrenees region in France.*
- *Temporal Scale[11]:*
  - *Extent: 2006-2020*
- *Spatial scale[12]:*
  - *Extent: Midi-Pyrenees (Regional)*
  - *Resolution: Agri-environmental zones*

[11] Scales, its attributes and its links to other concepts require clarification on a very short term.

[12] Idem.

Step 2) Policy options

Outcomes of the pre-modelling phase used in this step:

Policy experts identified three quite different policies to implement in SEAMLESS-IF: **The CAP2003, the Nitrate Directive** (*i.e.* specific nitrogen fertilization regulations within the Vulnerable zones) and **the conservation agriculture** (an agro-environmental measure targeted at soil conservation). The CAP2003 and Nitrate Directive are already existing policy, while the subsidies for conservation agriculture have been defined by policy experts. For this latter Policy experts initially planned to test a 100 euros subsidy per hectare associated with specific practices (e.g.: no-ploughing). But interactions with SEAMLESS experts led to realize that the numbers of 100 is a bit arbitrary, so they decided to carry out some sensitivity runs for 50, 100, 150 and 350 euros of the subsidy.

In SEAMLESS-IF:

Through the 'create policy option'-button in the SEAMLESS-IF, Olivier adds the policy options as discussed with Policy experts:

- *Policy Option 1: CAP2003 Reform*
  - *Constraints in FSSIM-MP: introduce 'income support' calculation and according to French decoupling rules adapt 'production subsidies'-calculation*
    - *'Income-support'- constraints requires the following parameters to be set:*
      - *Reference yield per region: 6 tonnes/ha*
      - *Level of decoupling per crop:75% for all eligible crops*[13]
- *Policy Option 3: Nitrate Directive*
  - *Constraints in FSSIM-MP: introduce new constraints to translate regulations on nitrogen fertilisation:*
      - *Specific compulsory activities in Vulnerable Zone (designed during the step 4 "context")*
      - *Penalties if regulations are not respected: 3% reduction of all the PAC subsidies*
- *Policy Option 3: introduce subsidies for conservation agriculture (see step " technological contexts" for more information on the distinction of subsidy targets)*
  - *.A subsidy of 150 euros per hectares is attached to crops clover and mustard and to the 'no-ploughing' tillage option and the sensitivity experiment runs of 50, 100, 150 and 350 are defined*

Step 3) Outlook as trend and trend deviations exogenous to SEAMLESS

Outcomes of the pre-modelling phase used in this step:

Interactions between policy experts and Olivier, Hatem and Jacques led to select **only one outlook:** 'business-as-usual' in which there are no trend deviations *i.e.* the current situation is prolonged and the results of other prospective studies will be used to quantify parameters of this outlook. This choice is linked to the type of changes of user's interest (no changes link to the outlook parameters)

In Seamless-IF:

Jacques enters one outlook to the project in SEAMLESS-IF by the 'add Outlook' button:

- *Outlook 1*
    - *Name: Business as Usual*
    - *atmospheric CO_2-concentration: 0.038%* [14]
    - *unemployment in Midi-Pyrenees region: 6%*
    - *GDP-growth: 2.5%*
    - *Petrol price: 1.25 euro/liter*

Step 4) Fixed and technological contexts[15]

Outcomes of the pre-modeling phase used in this step:

Ms. X and Mr. Y in interaction with Olivier, Hatem and Jacques selected the fixed context (no modification in the regional standard parameters) and three "technological contexts". One technological context is targeted at the assessment of CAP 2003 reform. It is the baseline technological context. Another describes activities compatible with the regional Nitrate Directive regulations. The last technological context describes conservation agriculture activities.

Design of new activities of technological context

Two technological contexts lead to the creation of alternative activities not already implemented in the SEAMLESS database:

- ***For the Nitrate Directive context an adapted parameterization of the chain PEG-PTG-APES** is sufficient to create activities which respect regional nitrogen fertilization regulations of the Nitrate Directive (for more details see bellow technological context 2).*

***For the conservation agriculture technological context a specific regional consultation of regional experts is necessary and has been led by** Olivier and Hatem during the modelling phase period. This survey allowed to identify two types of technological innovation options related to conservation agriculture and to collect all the data (description of new activities and specific parameters of FSSIM-AM) necessary to design the new conservation agriculture activities. First type is to not to use a plough when tilling the soil and the second is to use catch crops between the harvest of one winter crop and the sowing of the next spring crop.*

In Seamless-IF:

The fixed context is created by the 'create fixed context' button:

- *Fixed context:*
    - *Representative Farms: all representative farms defined throughout the standard SEAMLESS farm typology*
    - *Crops: no modification in the regional predefined list*

Then Three "Technological contexts" are created by the corresponding button.

[14] Atmospheric CO_2-concentration in January 2007 (in volume)

[15] The boundaries (called "context") of the biophysical and farm systems of the selected problem have to be set in order to create the solution space in which possible impacts can be simulated. These contexts integrate also technological innovations as some driving forces of the problem.

- *Technological context 1: Current activities (baseline technological context)*
    - *Crops: no addition to the regional predefined list*
    - *Production Orientation: conventional - no technological innovation.*
        - *Min rotation length: 1 year*
        - *Max. rotation length: 4 year*
- *Technological context 2: Nitrate Directive activities*
    - *Crops: no addition to the regional predefined list*
    - *Production Orientation: Nitrate Directive activities*
        - *Nitrate Directive Options:*
            - *Nitrogen fertilization according to the crop target yield and the soil provision of nitrogen*
            - *Limit contribution of nitrogen contained in the animals effluents to 170kg N/ha/an*
            - *Respect the restricted period to apply manure or fertilizing nitrogen*
- *Technological context 3: Conservation Agriculture*
    - *Crops: mustard and clover*
    - *Production Orientation: conservation oriented (technological innovation)*
        - *Conservation Options*
            - *No plow tillage for crops: winterbarley, winterwheat, soybean and grass*
            - *Intercrops: mustard and clover before sunflower and maize.*

After the specification of these contexts, the user can click the 'run biophysical models '-button, so that the SEAMLESS-IF starts running the biophysical models (FSSIM-AM and APES) to determine the sets of input-output coefficients for FSSIM-MP, e.g. the solution space within which FSSIM-MP can find a solution. While the SEAMLESS-IF is running these biophysical models, the user can continue with the other steps, or wait till his is notified by an email that the 'server' has finished calculating.

Step 5) Price context

Outcomes of the pre-modelling phase used in this step:

During the pre-modelling phase **Olivier, Hatem and Jacques decided that it will be necessary to used the APES-FSSIM chain of models (without CAPSEAM). This choice led Mrs X and Mr Y and the SEAMLESS experts to decide to use prices of previous European and regional prospective studies. They assumed that there is no interaction between the regional production and prices market. For this reason they decided to define only one price context.**

In Seamless-IF:

Jacques enters one price context to the project in SEAMLESS-IF by the 'add price context' button:

- *Economical context 1: regional prospective 2020*
    - *Introduce prices of the previous studies*

Step 6) Implementation of Experiments and of the experimental Plan[16]

Outcomes of the pre-modelling phase used in this step:

During the pre-modelling phase **Ms. X and Mr. Y, Olivier, Hatem and Jacques translated the problem description in four main experiments and 3 additional experiments to test impacts of the amount of the conservation agriculture subsidy**. These experiments have been used to build an experimental plan which describes the needed comparisons between results of experiments in order to address impacts of change factors described in the problem definition (see bellow).

[16] The experiments thus define the changes or driving forces as compared to the reference situation, by capturing the changes in policy options, context, and outlook, either as changes in isolation (only one policy option/outlook/context-change) or simultaneously (more than one policy option/outlook/ context-change). For each experiment, the model chain has to quantify indicator values.

In SEAMLESS-IF:

Olivier goes back to the SEAMLESS-IF and enters the selected experiments described through various combinations of policy options, experiment dependent contexts and outlook. For this Olivier uses the 'create experiment' option:

Experiments			Policy options	Outlook	Technological context	Prices context
N°	Name	Short description	Name	Name	Name	Name
1	Baseline (CAP 2003 reform)	Only CAP 2003 reform takes place	CAP Reform	Business as Usual	Current activities	regional prospective 2020
2	CAP2003 + Nitrate Directive	CAP 2003 and Nitrate Directive takes place and the farmers don't have options for conservation agriculture.	CAP2003 + Nitrate Directive	Business as Usual	Current activities + Nitrate Directive activities	regional prospective 2020
3	CAP2003 + Nitrate Directive+ Conservation agriculture	CAP 2003 and Nitrate Directive takes place and there is no support for conservation agriculture through subsidies, but farmers can choose conservation agriculture on their farms.	CAP2003 + Nitrate Directive	Business as Usual	Current activities + Nitrate Directive activities + Conservation agriculture	regional prospective 2020
4.1	CAP2003 + Nitrate Directive+ subsidies for Conservation agriculture	CAP 2003 and Nitrate Directive takes place and there is support for conservation agriculture through subsidies	CAP2003 + Nitrate Directive + Conser. Agriculture with 50€/ha	Business as Usual	Current activities + Nitrate Directive activities + Conservation agriculture	regional prospective 2020
4.2	CAP2003 + Nitrate Directive+ subsidies for Conservation agriculture	CAP 2003 and Nitrate Directive takes place and there is support for conservation agriculture through subsidies	CAP2003 + Nitrate Directive + Conser. Agriculture with 100€/ha	Business as Usual	Current activities + Nitrate Directive activities + Conservation agriculture	regional prospective 2020
4.3	CAP2003 + Nitrate Directive + subsidies for Conservation agriculture	CAP 2003 and Nitrate Directive takes place and there is support for conservation agriculture through subsidies	CAP2003 + Nitrate Directive + Conser. Agriculture with 150€/ha	Business as Usual	Current activities + Nitrate Directive activities + Conservation agriculture	regional prospective 2020
4.4	CAP2003 + Nitrate Directive + subsidies for Conservation agriculture	CAP 2003 and Nitrate Directive takes place and there is support for conservation agriculture through subsidies	CAP2003 + Nitrate Directive + Conser. Agriculture with 350€/ha	Business as Usual	Current activities + Nitrate Directive activities + Conservation agriculture	regional prospective 2020

Then Olivier enters the experimental plan (description of comparisons of experiments needed to explore impacts of changes of user interest). For this Olivier uses the 'create experimental plan' functionality:

(example of reading: indicators values from experiment 2 run has to be compared to indicators values from experiment 1 run in order to assess impacts of Nitrate Directive against the baseline situation i.e. CAP2003 without Nitrate Directive)

	Experiment 1 (Baseline)	*Experiment 2*	*Experiment 3*	*Experiment 4*
Experiment 1				
Experiment 2	*Impacts of Nitrate Directive*			
Experiment 3		*Impacts of ND and conservation agriculture*		
Experiment 4.1			*Impacts of ND and subsidies for conservation agriculture*	
Experiment 4.2				*Impacts of the modification of the subsidy*
Experiment 4.3				*Impacts of the modification of the subsidy*
Experiment 4.4				*Impacts of the modification of the subsidy*

Now that the Experiments and the experimental plan have been defined, the user can click the 'Run Economic Models'-button to start quantification of experiments one by one with the previously generated results of the biophysical models. The comparison of results between experiments (according to the experimental plan) will be investigated with SeamFrame in the post-modelling phase.

Step 7) Implementation of expected impacts

Outcomes of the pre-modeling phase used in this step:

During the pre-modelling phase Ms. X and Mr. Y and SEAMLESS experts described their hypothesis on the changes expected between experiments and baseline (*i.e.* experiment n°1). For each of the experiments and for each indicator they defined an expected impact as either positive (+ or ++ or +++) or negative (- or -- or ---) or a relative change (+ or – percentage) or an absolute change (+ or – an absolute amount) or no change (=) or as a description.

In SEAMLESS-IF (the indicators selection-edition of the modelling phase is performed with SeamFrame GUI)

Using i) the description of expected changes and ii) the SeamFrame GUI for the selection of indicators Policy experts selected in the library the following indicators:

- *Cropping pattern Indicator Scale: Regional WP2 blue list #6*
- *Farmer income Indicator Scale: Representative farm WP2 blue list #1*
- *Soil organic matter(%) Indicator Scale: types of soil WP2 blue list #14*
- *Nitrate leaching Indicator scale: part of Representative Farm in Vulnerable zone WP2 blue list #2*

During the discussion Hatem noticed that two indicators expected by the Policy experts "area of intercrops" and "% of area with no-ploughing tillage" does not exist in the indicator library, so he opened the indicator editor and created a new indicator:

- *Indicator: Area of Mustard and Clover Indicator Scale: Regional*
    - *Sum of all representative farms (Weight Factor *(Sum of area of mustard and clover per representative farm).*

In SEAMLESS-IF:

Hatem have now to implement the expected impacts in the SEAMLESS-IF by the 'Define Expected Impacts'- button. These expected impacts do not change the configuration of the model chain as done in steps 1-6, but they capture expert knowledge that can be used to later on identify discrepancies between what experts expect and what the model chain calculates.

Table 2 expected impacts of experiments on different indicator values

	Expected Impacts :Expected changes in values of indicators relative to the reference					
Experiments	*Cropping pattern*	*Farmer income*	*Soil organic matter(%)*	*% of no-ploughing tillage*	*Nitrate leaching*	*Area of Mustard and Clover*
Agenda 2000	*0*	*0*	*0*	*0*	*0*	*0*
CAP 2003	*Increase in wheat*	-	=	=	=	=
CAP2003 + Nitrate Directive	*Increase in wheat*	-	=	=	-	+
CAP2003 + Nitrate Directive+ Conservation agriculture	*High increase in cereals*	-	+	++	-	++
CAP2003 + Nitrate Directive+ subsidies for Conservation agriculture	*High increase in cereals*	-	++	++	--	+++

After a long time, the SEAMLESS-IF has finished it runs for the five experiments and Olivier, Jacques and Hatem can see the results in terms of indicator values for the different experiments and sensitivity runs and they compare these carefully with the expected impacts to highlight the differences between expected impacts and calculated impacts to Ms. X and Mr. Y.

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Post-Modeling phase

Interactions of the post-modeling phase will enable:

- **to ensure the transparency of the results**
- **to review quantitative impacts throughout Seam:PRES** (differences of indicator values between scenarios) and the uncertainty associated with these results.
- **to perform the PICA**

Questions highlighted by this example:

- **How to specify scales** (of problem and fixed context) in order to be consistent with the vision of the user and the requirements of the tools?
  - Do the three items (extent, resolution, grain) have to be defined for spatial and temporal scales of problem and fixed context?
  - How to make the link with the spatial (and temporal) scales of indicators
- **How to implement in SeamFrame experts indicators** (i.e. indicators of prime interest for the Policy Experts but that can not be quantified by S-IF and should be assessed throughout experts consultations)?
- **How to handle the evolution of policy framework between the base year and the time horizon** (e.g.: CAP2003 from the base year to 2012 then first pillar removal)? Is it for the development of SEAMLESS-IF beyond 2008?
- **How for a given problem to analysis and present the cross results of sensitivity analysis several parameters?** It seems very difficult to handle and to present such cross results.
- **What are the attributes of the economical contexts?** The functionalities of SeamFrame should allow to implement external database of prices.
- **What are the attributes of the fixed context?** In the contexts what is problem dependent and what is experiment dependent?
- **In order to be efficient and to pool activities relative to indicators and impacts how to move the step 7 in the pre-modeling phase**? That seems difficult as the implementation of the expected impacts necessitate the implementation of experiments performed in the modelling phase.

Annex 3: Concrete description of a SEAMLESS project for the Auvergne regional analysis.

By G Bigot, J.P. Bousset, E. Josien.

Objective of this note: to provide **a simplified but detailed example of definition and implementation of a project in SeamFrame at Auvergne region level. This example focus on the description of the modeling phase of the SEAMLESS-IF procedure** for a policy impact assessment (described in the D6542). In this example, interactions between Mrs Sim, a SEAMLESS modeller and Mr Pol, a regional policy expert, occurred during the pre-modeling and will occur during the post-modeling phases of the S-IF procedure (these two phases are not described in detail in this document).

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Pre-modeling phase[17]

Interactions of the pre-modeling phase enabled:

- throughout specific guidelines, PICA and an "Initial consistency control" **to translate the policy expert's problem in parameters of policy options, outlooks, biophysical and agro-management contexts** (that SEAMLESS-IF can handle).
- **to define experiments**,
- **to describe the user's hypothesis on impacts** of studied changes (exogenous, policies and technological innovations),
- **to select a list of indicators. In order to maintain consistency with the S-IF procedure the selection of indicators is described as a step of the pre-modelling phase**.

Outcomes of this phase are implemented in SEAMLESS-IF by the modeller Mrs Sim during the second phase of S-IF procedure. To have an easier reading origin and kind of these outcomes are quickly described in introduction of each step of the modelling phase.

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Modeling phase[18]

Steps of this phase:

Step 1) Project - Problem description

Step 2) Policy options

Step 3) Outlooks

Step 4) Fixed and technological Context

[17] For the Prototype 2 except for the selection of indicators this pre-modelling phase will be mainly led out of the GUI throughout specific guidelines.

[18] Implementation in SeamFrame of the pre-modelling phase's outcomes and run of experiments.

Step 5) Price context

Step 6) Implementation of Experiments and of the experimental plan

Step 7) Implementation of expected Impacts

Step 1) Project - Problem description

Outcomes of the pre-modeling phase used in this step:

During their meeting, Mr Pol expressed to Mrs Sim he would like to perform an integrated assessment of an hypothetical policy supporting a 'green intensification' process in the mountainous areas of Auvergne, arguing that the growing of the needs for green energy, the increase of the world population and agricultural products demand, associated to the liberalisation of prices might incite farmers in flat areas to reduce significantly milk and meat productions to develop green energy, cereal and proteinous products and thus give farmers in mountainous areas the opportunity to develop milk and meat productions according to a regularly increase of 2% per year of their prices. Policy-makers want to avoid environmental damages, mainly on biodiversity and water quality, due to intensification of livestock farming in mountainous areas of Auvergne. So, they want to study with SEAMLESS-IF what could be the potential effect on biodiversity and water quality of a premium supporting farmers to limit nitrogen inputs in the farm. The impact of the price evolutions will be forecasted by the year 2020 considering that the CAP 2003 is still applied until this date.

In SEAMLESS-IF:

Coming back her office, Mrs Sim starts the SEAMLESS-IF and creates a new project with these properties:

- *Project Title : Green intensification in Auvergne*
- *Owner(s):*
    - *Integrated Modelers : Mrs Sim (email: mrs.sim@seam.less,*

      (to have a 'write' access to the project).
    - *Policy experts: Mr Pol (email mr.pol@auvergne.fr).*

      (just to have a 'view' access to the project).
- *Problem Description: Impact of a new policy to improve green intensification for breeding and mixed farms in Auvergne region in addition to CAP 2003.*
- *Temporal Scale[19]:*
    - *Extent: 2006-2020*
- *Spatial scale[20]:*
    - *Extent: Auvergne Region*

[19] Scales, its attributes and its links to other concepts require clarification on a very short term.

[20] Idem.

- *Resolution: farm types*

Step 2) Policy options

Outcomes of the pre-modeling phase used in this step:

According to Mr Pol's objectives, Mrs Sim decides to evaluate different sets of policy options: first the Policy option 1 which corresponds to the CAP 2003, with a set of measures related to income support for farmers, as partial decoupling, milk quota and subsidies for animals productions. The Policy option 2 is the conditions measure so called "green intensification option", which is defined by subsidies per hectare of agriculture area to farms where nitrogen balance is less than 30 kg N/ha/year. Mr Pol asked that SEAMLESS models determine premium for each farm type to optimize their income.

In SEAMLESS-IF:

Through the 'create policy option' button in the SEAMLESS-IF, Mrs Sim adds the policy options as discussed with Mr Pol:

- *Policy Option 1: CAP 2003*
  - *Constraints in FSSIM-MP: already implemented*
  - *Details of Auvergne subsidies for animal productions and for agroenvironmental measures in D6232*
- *Policy Option 2 : Green intensification*
  - *Constraints in FSSIM-MP: to calculate a subsidy per farmtype on conditions that the nitrogen balance stays inferior to 30 kgN/ha on the all agricultural area with an optimized income.*

Step 3) Outlook as trend and trend deviations exogenous to SEAMLESS

Outcomes of the pre-modeling phase used in this step:
During their meeting, the policy expert and the Seamless expert decided that the previous options were most influenced by the local context than by the outlook so they only retain the 'business-as-usual'-outlook in which there are no trend deviations in climate, and in global context.

In Seamless-IF:

Mrs Sim enters these outlook of the project in SEAMLESS-IF by the 'add Outlook' button:

- *Outlook 1: "Business as Usual"*
  - *atmospheric CO_2-concentration: 0.038%* [21]
  - *unemployment in Auvergne region: 6%*
  - *GDP growth equal to 2.5%*

Step 4) Fixed and technological Contexts[22]

Outcomes of the pre-modelling phase used in this step:

[21] Atmospheric CO_2-concentration in January 2007 (in volume)

[22] The boundaries (called "context") of the biophysical and farm systems of the selected problem have to be set in order to create the solution space in which possible impacts can be simulated. These contexts integrate also technological innovations as some driving forces of the problem.

Mr. Pol and Mrs Sim agreed to test the different policy options in the current context of Auvergne and particularly with the current breeding and crops activities. At this stage, new technologies are not envisaged.

In Seamless-IF:

Only one fixed context is determined by the ‘create fixed context’ button. According to the ‘Spatial scale’ parameter of the project, different fields will show that allow entering different information:

- *Fixed Context 1: current context*
    - *Representative Farms : all representative farms defined throughout the standard SEAMLESS farm typology*
    - *Crops : no modifications in the regional predefined list*
    - *Breeding productions : no modifications in the regional predefined list*

And the current technological context is confirmed by the corresponding button :

- *Technological Context 1: conventional agriculture (baseline technological context)*
    - *Crops: No new productions*
    - *Breeding productions: No new productions*
    - *Production Orientation: conventional - no technological innovation.*
        - *Min rotation length : 1 year*
        - *Max. rotation length : 4 year*

After the specification of these contexts, the user can click the ‘run biophysical models ’-button, so that the SEAMLESS-IF starts running the biophysical models (FSSIM-AM and APES) to determine the sets of input-output coefficients for FSSIM-MP, e.g. the solution space within which FSSIM-MP can find a solution. While the SEAMLESS-IF is running these biophysical models, the user can continue with the other steps, or wait till his is notified by an email that the ‘server’ has finished calculating.

Step 5) Prices context

Outcomes of the pre-modelling phase used in this step:

As exposed in the problem definition, Mr Pol would like to test the impact of a regular increase of prices (about 2% per year) on animal products in mountain region owing to a new orientation of agricultural productions in the flat regions. Consequently two contexts of prices have to be defined: with and without additional increase of prices on animal products

In Seamless-IF:

Mrs Sim presses the ‘price context’ button to define the two possibilities:

Price context 1: regional prospective 2020

Current Prices projected at the time horizon.

Price context 2: increase of 2% per year of animal products

Current Prices projected with an additional increase of 2% per year of animal products.

Step 6) Implementation of Experiments and of the experimental plan

Outcomes of the pre-modelling phase used in this step:

According to their discussions, Mr Pol and Mrs Sim decided to define three experiments described in the table bellow. A comparison between E2 and E1 gives elements about the impact of an increase of milk and meat prices on incomes of the different farm types and consequently impact on environmental parameters. The comparisons between the E3 and E1 and E3 and E2 give elements on the possible impacts of agro-environmental measures to limit the effect of intensification of animal productions regarding the two different context prices.

In SEAMLESS-IF:

Mrs Sim goes back to the SEAMLESS-IF and enters the selected experiments described through various combinations of policy options, context and outlook. For this, she uses the 'create experiment' option:

Experiments			*Policy options*	*Outlook*	*Fixed and technological context*	*Prices context*
N°	*Name*	*Short description*	*Name*	*Name*	*Name*	*Name*
E1	*Base line*	*Only CAP 2003*	*CAP 2003*	*Business as Usual*	*Current activities*	*Current prices*
E2	*CAP 2003 + prices increase of animal products*	*CAP 2003 and an increase of 2% per year of milk and meat prices*	*CAP 2003*	*Business as Usual*	*Current activities*	*Increase of 2% per year of milk and meat prices*
E3	*CAP 2003 + prices increase of animal products +* *calculated agro environmental subsidies*	*CAP 2003 and an increase of 2% per year of milk and meat prices + a calculated subsidy per farm type if the nitrogen balance <30kgN/ha/year on the whole agricultural area*	*CAP 2003 + optimizedAEM*	*Business as Usual*	*Current activities*	*Increase of 2% per year of milk and meat prices*

Then, Mrs Sim enters the experimental plan (description of comparisons of experiments needed to explore impacts of changes of user interest). For this, she uses the 'create experimental plan' functionality:

Experiments	E1	E2
E2	Impacts of a price increase of animal products	
E3	Impacts of a combined effect of a price increase and an agro-environmental measure	Impacts of agro-environmental measure

Now that the Experiments have been defined, the user can click the 'Run Economic Models'-button to start quantification of experiments one by one with the previously generated results of the biophysical models.

Step 7) Implementation of Expected Impacts

Outcomes of the pre-modeling phase used in this step

During the pre-modelling phase, Mr Pol and Mrs Sim also described their hypothesis on the changes expected between experiments and reference (table 1), related to indicators. For each of the experiments and for each indicator they defined an expected change as either positive (+ or ++ or +++) or negative (- or -- or ---) or an undefined change (+ /–) or no change at all (=) in reference to the baseline. They expected the prices increase favours the farm income, the agriculture income and the employment, decreasing the importance of subsidies. They don't know the impact of this price context on the specialisation and the crop diversity but they fear the increase of nitrogen leaching. So the agro-environmental measure is proposed to compensate the impact of intensification with no worsening of economical parameters.

In Seamless IF: using i) the description of expected changes and ii) the SeamFrame GUI for the selection of indicators the Policy expert selected in the library the following indicators:

- *Farm income Indicator Scale: Representative farm WP2 blue list #1*
- *Nitrate leaching Indicator scale: part of Representative WP2 blue list #2*
- *Crop diversity Indicator Scale: Regional WP2 blue list #6*
- *Specialisation Indicator Scale: Regional WP2 blue list*

In SEAMLESS-IF:

Mrs Sim has now to implement the expected impacts in the SEAMLESS-IF by the 'Define Expected Impacts'- button. These expected impacts do not change the configuration of the model chain as done in steps 1-6, but they capture expert knowledge that can be used to later on identify discrepancies between what experts expect and what the model chain calculates.

Table 3 expected impacts of experiments on different indicator values

Experiment	*1* *farm income*	*2* *NO3 leaching*	*6* *crop diversity*	*7* *specialisation*	*9* *agriculture income*	*10* *employment in agriculture*	*11* *% of subsidies*
Base line or CAP 2003 reform	*0*	*0*	*0*	*0*	*0*	*0*	*0*
CAP 2003 + prices increase of animal products	++	++	+/ -	+/-	++	++	-
CAP 2003 + prices increase of animal products + calculated agro environmental subsidies	=	- - -	+ +	+	=	=	++

After a certain time, the SEAMLESS-IF finishes it runs for the six experiments and Mrs Sim can see the results in terms of indicator values for the different experiments and compares carefully with the expected impacts in view to present the results to Mr Pol.

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Post-Modeling phase

Interactions of the post-modeling phase will enable:

- **to ensure the transparency of the results**
- **to review quantitative impacts throughout Seam:PRES** (differences of indicator values between scenarios) and the uncertainty associated with these results.
- **to lead PICA**

Questions highlighted by this example

- How to specify scales (of problem, policy options an context) in order to be consistent with the vision of the user and the requirements of the tools?
- What are the limits of the tools: can FSSIM calculate an optimized premium according to different value of parameters?
- How to deal with the hypothesis of prices evolutions in Seamless-IF (in this example, an hypothesis of increase of prices of inputs (nitrogen for example) should be interesting.

Annex 4: Concrete description of a SEAMLESS project for a EU-LDC analysis applied to Mali.

By Marijke Kuiper and Bruno Rapidel,

based on the example for the Midi-Pyrenees (V02) from Olivier Therond

Objective of this note: to provide **a simplified but detailed example of definition and implementation of a project in SeamFrame for a EU-developing country analysis**. **This example focus on the description of the modeling phase of the SEAMLESS-IF procedure** for a policy impact assessment (described in D6542). In this example interaction between SEAMLESS experts (Marijke and Bruno) and policy experts (Mrs X and Mr Y) occurred during the pre-modeling and will occur during the post modeling phases of the S-IF procedure (these two phases are not described in detail in this document).

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Pre-modeling phase[23]

Interactions of the pre-modeling phase enabled:

- throughout specific guidelines, PICA and an “Initial consistency control” **to translate the policy expert’s problem in parameters of policy options, outlooks, fixed and technological and prices contexts** (that SEAMLESS-IF can handle).
- **to define experiments and an associated experimental plan (**which describe which change factors users want to investigate by the comparison of indicator values between experiments),
- **to describe the user’s hypothesis on impacts** (called hereafter **expected impacts**) of each experiment against the baseline,
- **to select a list of indicators**. **This selection has been carried out with the GUI** which allowed to select indicators in the SEAMLESS library (i.e. already implemented in SeamFrame) and to create new indicators with the indicator editor (to define with the users the new algorithms corresponding to the new indicators).

In order to maintain consistency with the S-IF procedure the selection of indicators is described as a step of the pre-modeling phase. In this case of the Malian case study, some specific indicators were added to the list contained in the GUI.

Outcomes of this phase are implemented in SEAMLESS-IF by experts during the second phase of S-IF procedure. To have an easier reading, origin and specifications of these outcomes are quickly described in introduction of each step of the modelling phase.

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Modelling phase

This phase of the SEAMLESS-IF procedure is aimed at implementation in SeamFrame of the pre-modeling phase’s outcomes and run of experiments.

Steps of this phase:

[23] For the Prototype 2 except for the selection of indicators this pre-modeling phase will be mainly led out of the GUI throughout specific guidelines.

Step 1) Project - Problem description

Step 2) Policy options

Step 3) Outlooks

Step 4) Fixed and technological contexts

Step 5) Price context

Step 6) Implementation of Experiments and of the experimental plan

Step 7) Implementation of expected impacts

Step 1) Project - Problem description

Outcomes of the pre-modeling phase used in this step:

Mrs X and Mr. Y of the Malian Ministry of Agriculture are interested in assessing the impact of a WTO agreement on Malian cotton producers. Given the lack of progress in the WTO negotiations they are also interested in the impact of a cotton agreement, i.e. what the impact would be of eliminating domestic support for cotton producers in developed countries (mainly the US). In terms of time-horizon 2013 appears a useful benchmark since this year has been circulating in the WTO negotiations as the year in which EU export subsidies would be eliminated. Although the US is required (based on a WTO ruling) to eliminate its support program immediately this has not yet occurred. Given this reluctance, using 2013 as the time-horizon appears realistic.

In SEAMLESS-IF:

Marijke and Bruno are in their office, start SEAMLESS-IF and create a new project with the following properties:

- *Project Title: WTO Cotton, Impact of WTO and a cotton agreement on cotton producers in Mali*
- *Owner(s):*
    - *Integrated Modelers: Marijke Kuiper (email: marijke.kuiper@wur.nl), institute: LEI) and Bruno Rapidel (email bruno.rapidel@cirad.fr; institute: CIRAD). Both have 'write' access to the project.*
    - *Policy experts: Mrs. X and Mr Y of the Malian Ministry of Agriculture. Both have 'view' access to the project.*
- *Problem Description: Assessment of impact of a WTO agreement and of a cotton agreement without further trade liberalization on the farm income of cotton producers in Mali.*
- *Temporal Scale[24]:*
    - *Extent: 2013*
- *Spatial scale[25]:*
    - *Extent: world (Global)*

[24] Scales, its attributes and its links to other concepts require clarification on a very short term.

[25] Idem.

    - *Resolution: Malian AenZ.*

Step 2) Policy options

Outcomes of the pre-modeling phase used in this step:

Policy experts identified two different policies to implement in SEAMLESS-IF: **a WTO agreement in the current Doha-round** and **an agreement to only eliminate the support for cotton producers in developed countries (especially the US). The baseline policy is the status-quo on negotiations on reducing support to EU and US cotton producers: changes in EU domestic support are as foreseen in the CAP Decoupling (included in the baseline scenario). US supports remain at the current state, i.e. there is no change in US domestic support in the baseline.**

WTO agreement

Given the state-of-play in the ongoing WTO negotiations a likely outcome would be in line with the current G20 proposal for agricultural productions (4 tiers with fixed cuts in each tier). Tariffs on manufactured goods are expected to be cut according to a Swiss formula. Given the proposal of the EU to eliminate export subsidies by 2013, all export subsidies are assumed to be eliminated. Circulated proposals for reducing domestic support will not effectively change current levels of domestic support. Therefore there will be no reduction in domestic support.

Cotton agreement

According to the WTO-ruling the US needs to eliminate its support for cotton. Taking a multilateral perspective the cotton agreement is assumed to eliminate all domestic support for cotton production in developed countries.

In SEAMLESS-IF:

Through the 'create policy option'-button in the SEAMLESS-IF, Marijke adds the policy options as discussed with Policy experts:

- *Policy Option 0 (baseline):*
    - *Europe: standard baseline that accounts for the 2003 CAP reform through proper changes in the European FSSIM-MP, CAPRI and GTAP (for a discussion see PD… describing the baseline scenario).*
    - *Mali: baseline to incorporate expected changes in Mali policies in the period 20011-2013:*
        - *Malian FSSIM-MP: [describe policy setttings]*
        - *CGE for Mali: [describe policy settings]*
- *Policy Option 1: WTO agreement*
    - *CAPRI:*
        - *Set tariffs according to G20 proposal for agriculture*
        - *Eliminate export subsidies*
    - *GTAP:*
        - *Define shocks to agricultural tariffs according to G20 proposal*
        - *Define shocks to non-agricultural tariffs according to Swiss formula*
        - *100% shock to export subsidies*

- *Policy Option 2: cotton agreement*
    - *CAPRI does not include cotton so the cotton agreement is modelled through GTAP only (which may affect CAPRI if cotton producers change production)*
    - *GTAP:*
        - *100% shock to domestic support on "plant-based fibres" in all GTAP countries or regions*

Note: the national CGE for Mali and FSSIM for Mali will also be run. But since the policy changes do not occur in Mali there us no need to create policy scenarios for the CGE or FSSIM.

Step 3) Outlook as trend and trend deviations exogenous to SEAMLESS

Outcomes of the pre-modeling phase used in this step:

Interactions with policy experts have identified the importance of developments in China for the global trade in cotton. Therefore two outlooks are selected: (1) 'business-as –usual' in which there are no trend deviations, i.e. the current situation is prolonged and the results of other prospective studies will be used to quantify parameters of this outlook. (2) 'China' outlook where the economic growth in China is expected to increase even stronger (the GDP growth rates for China are increased by 50 percent).

In Seamless-IF:

Bruno enters the two outlooks to the project in SEAMLESS-IF by the 'add Outlook' button:

- *Outlook 1*
    - *Name: Business as Usual*
    - *Atmospheric CO_2-concentration: 0.038%* [26]
    - *GDP-growth in each country/country aggregate as derived from prospective studies*
    - *Population growth in each country/country aggregate as derived from prospective studies*
    - *The privatisation of the CMDT continues as foreseen (done in 2008) without major changes in the commodity chain (credit will be available, prices established before the cropping season).*
    - *The mechanism for price negotiation in Mali is clearer and the share is as follows: 60% for farmers, 40% for processing industry.*
- *Outlook 2*
    - *Name: China*
    - *Atmospheric CO_2-concentration: 0.04%* [27]
    - *GDP-growth in China: 10.5%*

[26] Atmospheric CO_2-concentration in January 2007 (in volume)

[27] Atmospheric CO_2-concentration in January 2007 (in volume)

- *GDP-growth in other countries/country aggregates as derived from prospective studies*
- *Population growth in each country/country aggregate as derived from prospective studies*
- *The privatisation of the CMDT continues as foreseen (done in 2008) without major changes in the commodity chain (credit will be available, prices established before the cropping season).*
- *The mechanism for price negotiation in Mali is clearer and the share is as follows: 60% for farmers, 40% for processing industry.*

Step 4) Fixed and technological contexts[28]

The fixed context is not experiment dependent. It corresponds to the definition of space of investigation in term of representative farms and crops[29] (FFSIM), or countries/country aggregates and sectors/sector aggregates in CAPRI and GTAP. These specify the details at country level and of economic sectors included in the model. Given the linking between CAPRI and GTAP it is expected the number of countries and sectors will be fixed. If so then the fixed context cannot be changed for CAPRI and GTAP and is thus truly fixed.

CAPRI, GTAP and the CGE model introduce technology changes differently than FSSIM namely by shifting production functions instead of introducing new technologies in the system. We need to consider if we treat these as changes in the technological context (they do not affect the configuration of the models, they only change the value of some parameters) or as part of the policies.

Outcomes of the pre-modelling phase used in this step:

Ms. X and Mr. Y want to explore whether changes in cotton production technology affect the impact of the trade agreements. In addition to currently used technologies they would like to explore the impact of organic cotton and of genetically modified cotton.

In Seamless-IF:

The fixed context is created by the 'create fixed context' button:

- *For CAPRI, GTAP and CGE model there is no need to change the standard contexts*
- *FSSIM Fixed context:*
    - *Representative Farms: all representative farms defined throughout the standard SEAMLESS farm typology for the cotton areas in Mali*
    - *Crops: no modification in the regional predefined list*

- *Technological context 1: Current activities (baseline technological context)*

[28] The boundaries (called "context") of the biophysical and farm systems of the selected problem have to be set in order to create the solution space in which possible impacts can be simulated. These contexts integrate also technological innovations as some driving forces of the problem.

[29] Attributes of the fixed context remain to define.

    - *Crops: no addition to the regional predefined list*
    - *Production Orientation: conventional - no technological innovation.*
        - *Min rotation length: 1 year*
        - *Max. rotation length: 4 year*
- *Technological context 2: alternative cotton technologies (alternative technological context)*
    - *Crops: no addition to the regional predefined list*
    - *Production Orientation: alternative cotton technologies*
        - *Organic cotton*
        - *Genetically modified cotton*

Step 5) Price context

Price context: prices are endogenous in CAPRI, GTAP and the CGE and therefore there is no point in defining a context for them. FSSIM in Mali will use the prices coming out of the Mali CGE model as input so there is no need to define a price context.

Step 6) Implementation of Experiments and of the experimental Plan[30]

Outcomes of the pre-modeling phase used in this step:

During the pre-modeling phase **Ms. X and Mr. Y, Marijke and Bruno translated the problem description in 2 main experiments with 2 different outlooks and 2 different technological contexts.** Given that we compare with the business as usual as a reference point we end up with 10 experiments of which the outcomes will be compared.

In SEAMLESS-IF:

Marijke goes back to the SEAMLESS-IF and enters the selected experiments described through various combinations of policy options, experiment dependent contexts and outlook. For this Marijke uses the 'create experiment' option:

[30] The experiments thus define the changes or driving forces as compared to the reference situation, by capturing the changes in policy options, context, and outlook, either as changes in isolation (only one policy option/outlook/context-change) or simultaneously (more than one policy option/outlook/ context-change). For each experiment, the model chain has to quantify indicator values.

Experiments N°	Name	Short description	Policy options Name	Outlook Name	Context Name
1	Baseline (CAP reform)	Business-as-usual scenario	CAP2003	Business as Usual	Current activities
2	Baseline + China outlook	Business-as-usual scenario and higher growth in China	CAP2003	China	Current activities
1.1	Baseline + WTO	Impact of WTO agreement	CAP2003 + WTO agreement	Business as Usual	Current activities
1.2	Baseline + cotton	Impact of cotton agreement	CAP2003 + cotton agreement	Business as Usual	Current activities
1.3	Baseline + technology +WTO	Impact of WTO agreement with new technologies	CAP2003 + WTO agreement	Business as Usual	alternative cotton technologies
1.4	Baseline + technology + cotton	Impact of cotton agreement with new technologies	CAP2003 + cotton agreement	Business as Usual	alternative cotton technologies
2.1	Baseline + China +WTO	Impact of WTO agreement	CAP2003 + WTO agreement	China	Current activities
2.2	Baseline + China + cotton	Impact of cotton agreement	CAP2003 + cotton agreement	China	Current activities
2.3	Baseline + China + technology +WTO	Impact of WTO agreement with new technologies	CAP2003 + WTO agreement	China	alternative cotton technologies
2.4	Baseline + China + technology + cotton	Impact of cotton agreement with new technologies	CAP2003 + cotton agreement	China	alternative cotton technologies

Then Marijke enters the experimental plan (description of comparisons of experiments needed to explore impacts of changes of user interest). For this Marijke uses the 'create experimental plan' functionality:

Experiments	*Compared with*	*2*
1		
1.1	*WTO (comparison of 1.1 with1)*	
1.2	*Cotton (comparison of 1.2 with 1)*	
1.3	*WTO + alternative technologies (comparison of 1.3 with 1)*	
1.4	*Cotton + alternative technologies (comparison of 1.4 with 1)*	
2	*impact of China outlook (comparison of 2 with 1)*	
2.1		*WTO (comparison of 2.1 with 2)*
2.2		*Cotton (comparison of 2.2 with 2)*
2.3		*WTO + alternative technologies (comparison of 2.3 with 2)*
2.4		*Cotton + alternative technologies (comparison of 2.4 with 2)*

Now that the Experiments and the experimental plan have been defined, the user can click the 'Run Economic Models'-button to start quantification of experiments one by one with the previously generated results of the biophysical models. The comparison of results between experiments (according to the experimental plan) will be investigated with SeamFrame during the pre-modelling phase.

Step 7) Implementation of expected impacts

Outcomes of the pre-modelling phase used in this step:

During the pre-modelling phase Ms. X and Mr. Y and SEAMLESS experts described their hypothesis on the changes expected between experiments and baseline (*i.e.* experiment n°1). For each of the experiments and for each indicator they defined an expected impact as either positive (+ or ++ or +++) or negative (- or -- or ---) or a relative change (+ or – percentage) or an absolute change (+ or – an absolute amount) or no change (=) or as a description.

In SEAMLESS IF (the indicators selection edition of the modeling phase is performed with

In SEAMLESS-IF:

Bruno now has to implement the expected impacts in the SEAMLESS-IF by the 'Define Expected Impacts'- button. These expected impacts do not change the configuration of the model chain as done in steps 1-6, but they capture expert knowledge that can be used to later on identify discrepancies between what experts expect and what the model chain calculates.

Table 4 expected impacts of experiments on different indicator values

	Expected Impacts :Expected changes in values of indicators relative to the reference						
Experiments	*Cotton price*	*GDP*	*Trade balance*	*Farmer income*	*Cropping pattern*	*SOM*	*Nitrogen*
1 Baseline	*0*	*0*	*0*	*0*	*0*	*0*	*0*
1.1 WTO	++	++	-	-	+	-	-
1.2 Cotton	+	+	+	++	++	--	--
1.3 WTO +technology	++	++	-	*0*	+	-	-
1.4 Cotton +technology	+	+	+	+++	++	--	--
2 China outlook	+	+	+	++	+	-	-
2.1 WTO	+++	+++	*0*	+	+	-	-
2.2 Cotton	++	++	*0*	++	++	--	--
2.3 WTO +technology	+++	+++	*0*	++	+	-	-
2.4 Cotton +technology	++	++	*0*	+++	++	--	--

After a long time, the SEAMLESS-IF has finished it runs for the experiments and Bruno and Marijke can see the results in terms of indicator values for the different experiments and sensitivity runs and they compare these carefully with the expected impacts to highlight the differences between expected impacts and calculated impacts to Ms. X and Mr. Y.

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Post-Modeling phase

Interactions of the post-modeling phase will enable:

- **to ensure the transparency of the results**
- **to review quantitative impacts throughout Seam:PRES** (differences of indicator values between scenarios) and the uncertainty associated with these results.
- **to lead the second phase of PICA**

<u>Questions highlighted by this example:</u>

- *Spatial scale[1]: Grain:*

  Resolution depends on part of model chain; cannot have farm household level for all countries so which level to define as the grain*?*

- *Technological context:*

  CAPRI, GTAP and the CGE model introduce technology changes differently than FSSIM namely by shifting production functions instead of introducing new technologies in the system. We need to consider if we treat these as changes in the technological context (they do not affect the configuration of the models, they only change the value of some parameters) or as part of the policies.

- *Baseline*:

  Are we going to provide standard baselines with the system? (like the 2013 and 2020 baselines used in the test cases)

- *Create experimental plan*

  I couldn’t get my head around the way in which the experimental table was set-up.

Annex 5: Scenarios to be carried out throughout EU regions for Prototype 3

By H. Belhouchette and O. Therond.

M1: A better management of nitrogen mineral and organic fertilization.

Measures	Modelling
M1.1: Creation of alternative activities based on current crops but with better management and yield	- PEG and PTG create: generate alternative activities (AA) - Handbook: identify N use and potential yield associated to AA (data are available for the 3 regions) - APES: quantify externality associated to AA - TCG: quantify others inputs (costs…)
M1.2: Cross-compliance linking these alternative activities to EU premium: if these activities are not selected, premium will be cut	- FSSIM-MP: constraint in the system linking AA, cross-compliance, and EU premium.

M2: Limit contribution of nitrogen contained in the animals' effluents to European norm 170kg N/ha/an.

Measures	Modelling
M2.1: Cross-compliance linking manure N use to EU premium: if the applied nitrogen per year and ha exceeds the norm premium will be cut	FSSIM-MP: constraint in the system linking N use, cross-compliance, and EU premium.

M3: Respect the restricted period to apply manure or fertilizing nitrogen (according to the type of fertilization and land use).

The same thing then the first measure but instead of using handbook to identify N use and potential yield associated to the alternatives activities we use APES taking into account period to apply manure or fertilizing nitrogen

Measures	Modelling
M3.1: Creation of alternative activities based on current with taking into account the restricted period to apply manure or fertilizing nitrogen	- PEG and PTG create: generate alternative activities (AA) - Expert: identify period to apply manure or fertilizing nitrogen for each AA (data are available for the 3 regions) - APES: quantify potential yield and externality associated to AA - TCG: quantify others inputs (costs…)
M3.1: Cross-compliance	- FSSIM-MP: constraint in the system linking AA, cross-

linking these alternative activities to EU premium: if these activities are not selected, premium will be cut	compliance, and EU premium.

Annex 6: Scenarios to be implemented in some of the detailed regions for Prototypes 2 and 3.

By H. Belhouchette and O. Therond.

6.1 Scenarios to be tested in the Midi-Pyrenees region

i- Scenario 1: implementation of the Nitrate Directive as currently adopted by the farmers in the Midi-Pyrenees region (table 1).

Table 1: scenario 1: Measures from the nitrate directive.

Measures	Description	AA	Model	scale	Farm type	penalty
M1	A better management of nitrogen fertilisation	CA with new nitrogen management	APES	VZ	% of VZ within each farm type	1.5%
M2	Limit contribution of nitrogen contained in the animals effluents to 170kg N/ha/an.	CA with new nitrogen management	APES+FSSIM	VZ	% of VZ within each farm type	0.25%
M3	restricted period to apply fertilizer	CA with new fertilization plan	APES	VZ	% of VZ within each farm type	0.25%
M4	restrictions fertilization near surface waters	grassland	APES	VZ	% of VZ within each farm type	0.5%
M5	minimum quantity of vegetation during rainy periods	Catch crop	PEG-PTG-APES-TCG-FSSIM	VZ	% of VZ within each farm type	0.5%

Measure 1- A better management of nitrogen mineral and organic fertilization (Annexe 1): to reach this objective, farmers have to keep records on fertilizer use and to fertilize according to the crop requirement and the soil provision of nitrogen.

The formula below represents the recommended methodology in the Midi-Pyrenees region that farmer should follow to calculate in a concrete way the real crop nitrogen requirement:

Crop growth nitrogen fertilization requirement= the amount of nitrogen from mineral fertilization + the amount of nitrogen from livestock manure.

i- the amount of nitrogen from mineral fertilization

In the Midi-Pyrenees region, to calculate the amount of nitrogen fertilization requirement by crop the following two criteria should be considered:

- **reasonable yield prevision**: in this study the average yield reported in the survey for current activity (from 1998 to 2002) will be considered as a potential yield (table 2).

Table 2 – Potential yield (tn/ha) by soil type in the Midi-Pyrenees region (survey, 2006)

Crops	**Soil**			
	Boulbène		**Terrefort**	
	rainfed	**irrigated**	**rainfed**	**irrigated**
Soft wheat	5.5	-	7	-
Durum wheat	-	-	5.5	-
Sunflower	-	-	2.2	-
Barley	7	-	5	-
Maize grain	6.5	9.5	9.5	11
Rape	1.9	-	2.5	-
Soya	2	3.3	2	3.3
Peas	3.5	4.5	3.5	4.5
Oats	3.6	-	3.6	-
Fallow	-	-	-	-
Maize fodder	-	11	11	-

- **soil nitrogen pool** which depends on the nature of soil, the type of previous crops and the annual rainfall variability.

Thus, the amount of nitrogen needed by crop will be calculated in three steps:

1- Nitrogen required according to the yield prevision = the amount of N required to produce a unit of yield (table 3)* potential yield (table 2).

Table 3- Nitrogen required (kg/ha) to produce 1t/ha of yield or biomass (for forage crop) (refernce).

Oats/barley	Durum wheat	Soft Wheat	Rye	Colza	Grain maize	Silage maize	Sorghum grain/	Sorghum/ silage	sunflower
3.1	45	40	37	87	30	17.8	35	16.2	56

2- Soil nitrogen pool = soil N residue from the previous crop (table 4, 5, 6) + mineralization rate (table 7) + grassland effect (table 8).

Table 4- Soil nitrogen stock identified by crop, previous crop and soil type (boulbène, terrefort) in the Midi-Pyrenees region for the autumn crops: soft and durum wheat, barley, oats, and colza.

Characteristics of previous crops			**Soil**	
Previous crops	Yield (t/ha)	Amount of nitrogen (kg/ha)	Terrefort	Boulbene
Sunflower	2.3	0-40	15-40	10-30
Maize	9.0	140-200	20-60	5-15
Maize	11	160-220	5-30	5-10
Sorghum	8.0	130-180	5-25	5-20
Rape	2.5	120-160	60-85	45-65
Soya	*	0	60	50
Peas	*	0	70	55
Soft wheat	5.5	120-180	15-60	10-45
Durum Wheat	5.5	160-230	50-95	40-70
Barley	7.0	120-180	15-60	10-45
Oats	3.6	120-180	15-60	10-45

Table 5- Soil nitrogen stock identified by crop, previous crop and soil type (boulbène, terrefort) in the Midi-Pyrenees region for the spring crops: maize, sorghum and sunflower.

Characteristics of previous crops			**Soil**	
Previous crops	Yield (t/ha)	Amount of nitrogen (kg/ha)	Terrefort	Boulbene
Sunflower	2.3	0-40	5-25	5-10
Maize	9.0	140-200	10-35	5-15
Maize	11	160-220	5-20	5-10
Sorghum	8.0	130-180	5-15	5-10
Rape	2.5	120-160	30-50	15-25
Soya	*	0	40	25
Peas	*	0	45	25
Soft wheat	5.5	120-180	10-45	5-20
Durum Wheat	5.5	160-230	30-50	15-25
Barley	7.0	120-180	10-45	5-20
Oats	3.6	120-180	10-45	5-20

Table 6- Soil nitrogen stock identified by crop, previous crop and soil type (boulbène, terrefort) in the Midi-Pyrenees region for grassland (kg/ha)

	Type of grassland		
	Pasture	Ensilage	Pasture+ensilage
Soil without vegetation cover	0		
Fallow	10-20		
Temporary grassland	50	20	35
Permanent grassland	150	60	105

Table 7- Grassland effect kgN/ha (Plaquette, 2002)

	Pasture	Cut	Pasture and cut
≤ 2 years	50	20	35
2 to 6 years	150	60	105
> 6 years	200	80	140

Table 8- Mineralization by soil type (kg/ha).

	Irrigated crop	Dry crop
Boulbene	120	80
Terrefort	90	60

3- the amount of nitrogen from N mineral fertilization = Nitrogen required according to the potential yield – Soil nitrogen pool

ii- the amount of nitrogen from livestock manure fetilization

the amount of Nitrogen from manure fertilization = amount of nitrate in the manure* equivalent coefficient of available nitrate* amount of manure.

Measure 2- Limit contribution of nitrogen contained in the animals effluents to 170kg N/ha/an. This limit will be considered as a parameter in the FFSIM-MP model.

Measure 3- respect the restricted period to apply manure or fertilizing nitrogen (according to the type of fertilization and land use): the calendar below (table 9) presents the period in which the use of mineral and organic nitrogen fertilizers during the rainfall period is forbidden in the Midi-Pyrenees region (Prefecture du GERS, 2006). The implementation of this constraint can influence considerably the quantity of nitrogen leached during winter. From this calendar, an interdict period will be associated to each activity and the nitrate leached will be simulated using the APES model.

Table 9- calendar for restrict period to apply manure in the Midi-Pyrenees region.

Land use	Type of N fertilizer	Restricted period
Arable crops sowed in winter	Solid manure	No restriction
	Liquid manure	Restriction from 01/10 to 15/01
	Mineral	Restriction from 01/09 to 15/01
Arable crops sowed in spring	Solid manure	Restriction from 01/07 to 01/09
	Liquid manure	Restriction from 01/07 to 15/01
	Mineral	Restriction from 01/07 to 15/02
Grassland	Solid manure	No restriction
	Liquid manure	Restriction from 01/11 to 15/01
	Mineral	Restriction from 15/10 to 15/02

Measure 4- respect the restrictions for manuring near surface waters (2 m for fertilizing mineral and 35 m for the others), on ground in strong hillside (> in 7 %), on flooded, ice-cold or covered with snow grounds: the implementation of this measure implies the identification for each farm type the percentage of the area nearest a surface waters. In the reality, farmer used those surfaces to implement grassed strips in order to respect the cross compliance condition (implementation of 3% of the SCOPE area along the rivers). So, we can assume that this measure is already respected by farmer and consequently will be withdrawn from the nitrate directive.

Measure 5- maintain a minimum quantity of vegetation cover during (rainy) periods that will take up the nitrogen from the soil that could otherwise cause nitrate pollution of water: the implementation of catch crop within a rotation is not yet completely integrated by farmers. Moreover, farmers in the Midi-Pyrenees region consider the economic and the environmental efficiency of this measure are not completely proved.

The implementation of the catch crop means:

- identify and select by interacting with local experts the list of catch crops that can be tested in the Midi-Pyrenees region.
- generate and simulate by integrating the selected catch crops new activities and their itineraries, externalities, yields and costs by using the model chain: PEG-PTG-APES and TCG or expert knowledge.

In the Midi-Pyrenees region this measure was reserved only for the ZAC regions (zone of complementary actions) which are generally located near rivers-Basin, but not yet completely spatially mapped. To avoid this problem, we will assume that this measure will be implemented in the whole of vulnerable zone. Table 10 gives the most used catch crops in France. From this table and after interaction with local experts, two or three catch crops will be selected and new rotations, yield and externalities will be simulated using the model chain PEG-PTG an APES. Additionally, the cost of installation and harvesting of the selected catch crops will be evaluated and calculated.

Table 10 - The most used Nitrate catch crops in France

Crops	Sowing	Harvest	Advantages	Limits	Seed cost (€/ha (average 2000-2002)
Crucifer					
White mustard	September, 15	Graining stage	- speed growth -Destructed early	-reduced biomass	15
Fodder radish	August, 15	Graining stage	- more tolerant to water stress - recommended for earlier sowing	- speed vegetative growth. - Difficult to destruct	20
Graminaceous					
Rye-grass	September, 15	March	- resisting freezing - high tillering	- misadvised after cereal. - vegetation growth very slow	40
Oats	September, 15	March	- chemical destruction - Speed growth	- low tillering	28
Leguminous					
White clover	September, 15	March	- good for improvement soil structure. - ideal after cereal	- low rate of Emergence	35

Percentage of penalties:

The implementation of Nitrate Directive in the Midi-Pyrenees region implies that several cross-conditionality rules have to be imposed and respected by farmers. Table 11 resumes the percentage of penalty relative to each Nitrate Directive measure. As it is shown in this table the maximum reduction of premium can attain 3% of the total premium. Of course, the percentage of the penalty will yearly increases and can exceed 3% if farmer does not respect those measures. The evolution of penalties across the years will be not integrated and simulated in this study.

Table 11- percentage of premium reduction in the Midi-Pyrenees region (Prefecture du Gers, 2006)

Measures	**Penalties: % of premium reduction**
1- A better management of nitrogen mineral and organic fertilisation	1.5%
2- Limit contribution of nitrogen contained in the animals effluents to 170kg N/ha/an	0.5%
3- respect the restricted period to apply manure or fertilizing nitrogen (according to the type	Considered in cross-compliance conditions

of fertilization and land use	
4- respect the restrictions for manuring near surface waters (2 m for fertilizing mineral and 35 m for the others)	0.5%
5- maintain a minimum quantity of vegetation cover during (rainy) periods	0.5%

ii- Scenario 2: implementation of the nitrate directive as is adopted now by the farmer in the Midi-Pyrenees region + low ambition Agri-environmental measures[31] (table 12)

Table 12: scenario 2: Measures from nitrate directive + low ambition AEM.

Measures	Description	AA	Model	scale	Farm type	Premium
Nitrate Directive as is described in annexe 1.						
Low ambition AEM: rotational constraint						
M1	the number of crops more than 4. the area reserved for the	No AA	Represented in FFSIM as constraints	Whole region	% of VZ within each	Established by crop and farm type: arable (rainfed and irrigated)+mixed.
M2	number of crops present by field for a period of 5 years more than 3.					
M3	eligible area covers more than 70% of the total area					
M4	main crop should covers less than 55% of the eligible area.					

[31] Agri-environment schemes (AEM) were introduced into EU agricultural policy during the late 1980s as an instrument to support specific farming practices that help to protect the environment and maintain the countryside. With the CAP reform in 1992, the implementation of agri-environment programmes became compulsory for Member States in the framework of their rural development plans. The 2003 CAP reform maintains the nature of the agri-environment schemes as being obligatory for Member States, whereas they remain optional for farmers. In addition, the maximum EU co-financing rate has increased to 85% in Objective 1 areas and to 60% in other areas.
Farmers who commit themselves, for a five-year minimum period, to adopt environmentally-friendly farming techniques that go beyond usual good farming practice, receive in return payments that compensate for additional costs and loss of income that arise as a result of altered farming practices. Examples of commitments covered by national/regional agri-environmental schemes are (EC, 2005):

- Environmentally favourable extensification of farming;
- management of low-intensity pasture systems;
- integrated farm management and organic agriculture;
- preservation of landscape and historical features such as hedgerows, ditches and woods;
- conservation of high-value habitats and their associated biodiversity.

M5	total of the area covered by three main crops less than 95% of the eligible area.					

In France, there is a large consensus that some AEM, which the achievement is already proved, should be now generalized for all France regions. In the crops area of Midi-Pyrenees the most famous measure recommended is the “rotational measure”. In the Midi-Pyrenees region this measure imply that (table 13):

- the number of crops per farm should be upper to 4.

- the number of crops cultivated per field for a period of 5 years should be upper to 3.

-: the eligible area “area under contract” should cover more than 70% of the farm area.

- the area devoted for the main crops should cover less than 55% of the eligible area.

- the total area devoted for the three main crops should cover less than 95% of the eligible area.

Table 13- Details of constraints and premium for the “rotational measure”.

	Dry	Irrigated	Mixed
Premium (ha/year)	44.17	54.17	75
Area under contract	> 70% of eligible area*		> 70% of eligible area reserved for mixed crops.
Number of crops	minimum 4		
Number of crops present by field for a period of 5 years	minimum 3		
Area reserved for the main crops	< 55% of eligible area		
Total area covered by three main crops	< 95% of eligible area		
Additional constraints	- no successively more than 2 cereal crops - no monoculture	- no successively more than 2 cereal crops - no monoculture except for maize.	(AMEC*)/(AMEC +SCOPE))> 40% of eligible area

- Eligible area = UUA – (area “grassland” + area “permanent crop”+ area “tobacco” + area “vegetable”)
- AMEC: area for the main fodder crops.

iii- Scenario 3- implementation of the nitrate directive as is adopted now by the farmer in the vulnerable zones + Agri-environmental measures (rotational) in the whole region+ Implementation of nitrogen fertilization requirement by crop as is calculated in the nitrate directive in the whole region (Table 14):

14: scenario 3- Measures from nitrate directive + low ambition AEM+ a better management of fertilizer.

Measures	Description	AA	Model	scale	Farm type	penalty
Nitrate Directive as is described in annexe 1.						
Low ambition AEM as is described in annexe						
Implementation of nitrogen fertilisation requirement by crop as is calculated in the nitrate directive						
M1	A better management of nitrogen fertilisation	CA with new nitrogen management	APES	Whole region	% of VZ within each farm type	1.5%

Penalties: 1.5 % of premium reduction if the farmer doesn't respect this rule.

iv- Scenario 4 a- implementation of the nitrate directive as is adopted now by the farmer in the vulnerable zones + incentive measures to reduce soil tillage[32] in the whole region (table 15):

Table 15: scenario 4a.:Measures from nitrate directive + incentive measures to reduce soil tillage

Measures	Description	AA	Model	scale	Farm type	Premium
Nitrate Directive as is described in annexe 1.						
incentive measures to reduce soil tillage						
M1	No-soil tillage	CA activities with: -no soil tillage+ new sows rate+ treatments…	APES+FSSIM (costs)	Whole region	% of VZ within each farm type	35€/ha

Several definitions are given to the conservation agriculture. In the Midi-Pyrenees region, the conservation agriculture is generally associated to the soil tillage without entirely turned over the soil. This technique can be sub-divided into four categories (figure 2):

Non-inversion

Reduced tillage — Deep ploughing

Direct sowing — Shallow tillage — Shallow ploughing — Sub-soiling ploughing

- <u>Direct sowing</u>: the soil preparation and sowing are done in the same operation. The soil tillage is simplified and limited for the soil seed bed (5cm).

This technical is reserved mainly for the cereal winter crop, rape and peas.

- <u>Shallow tillage</u> : the farmer makes one or several superficial soil tillage just to prepare the seed bed without depletion at the deeper horizon (5 to 10 cm).

This technique is reserved mainly for the cereal winter crop, rape and peas.

32

- **Shallow ploughing**: the farmer makes at least one ploughing in the first 20 cm.

This technique is reserved mainly for the spring crops.

- **Subsoil ploughing**: the farmer makes at least one deep ploughing for the first 50 cm without entirely turned over the soil.

This technique is reserved mainly for the spring crops.

In these scenario settings, alternative activities will be created by associating alternative soil tillage operations according to the information given above (table 16). The impact of those alternative activities (no-soil tillage) on nitrogen leaching and yield will be simulated using the APES model. The additional costs associated for those alternative activities will be established by using experts knowledge and the database of KASA project.

Table 16- Comparison between soil tillage for current and alternative activities identified by crops in the Midi-Pyrenees region.

Crops	Current activities			Alternative activities		
	Sowing	Shallow tillage	Deep ploughing	Direct sowing	Shallow tillage	Shallow plough
Soft wheat	*	*	*	*		
Durum wheat	*	*	*	*		
Barley	*	*	*	*		
Oats	*	*	*	*		
Soya	*	*	*		*	
Rape	*	*	*	*		
Maize	*	*	*			*
Sorghum	*	*	*			*
Sunflower	*	*	*		*	
Peas	*	*	*	*		

In the Midi-Pyrenees region two main additional operations have to be considered when conservation agriculture is implemented in comparison with the conventional agricultural (table 17 and 18):

- **sowing rate:** in general conservation agriculture induces a reduction in the contact between seeds and soil reducing the germination rate. Usually, no-tillage system induced a loss of 10% of germination rate (Midi-Pyrenees study, 2005). Thus, it is recommended in the conservation agriculture, compared to the conventional option, to increase the sowing rate at least by 5%.

- Weeds control: in conservation agriculture, the lack of deep tillage may result in more fluctuations in weeds pressure than observed in conventional tillage. If a significant number of weeds are allowed to go to seed, weed seed numbers in the top of the soil will begin to increase and weed problems can intensify. To control weeds and slug, in the Midi-Pyrenees region farmers are usually obliged to increase the number of treatment of herbicide (Midi-Pyrenees study, 2005).

Table 17: sowing rate and number of treatment for conventional (current) and conservation agriculture (alternative).

	Current		Alternative	
	Density of sowing (kg/ha)	Treatments*	Density of sowing	Treatments*
Soft wheat	120	3	138.0	4
Durum wheat	150	3	172.5	4
Barley	110	3	126.5	3
Oats	100	3	115.0	3
Soya	80	2	92.0	2
Rape	5	3	6.0	3
Maize	30	2	34.5	3
Sorghum	7.5	3	8.5	3
Sunflower	5	2	5.75	2
Peas	180	3	207.0	3

* Treatments for pesticide and slugs.

Table 18: additional costs for conservation agriculture (alternative activities) compared to the conventional agriculture (current activities).

		Time (h/ha)	**Cost (€/h)**	**Cost (€/ha)**
Current activity	Deep ploughing	2	40	80
	Shallow tillage	2	33	66
	Sowing	2.30	43	107.5
Alternative activity	Direct sowing	1.30	48	73
	Shallow tillage	2	33	66
	Additional weeding	0.30	36	18
	Anti-slug	- tractor : 0.75	18	13.5

		- product	-	35
	Yield lost	**To be calculated by APES**		

Premium

In the Midi-Pyrenees region, the adoption of conservation agriculture by farmer implies a premium of 30.5 €/ha/year (Midi-Pyrenees study, 2005).

v- Scenario 4b- implementation of the nitrate directive as is adopted now by the farmer in the vulnerable zones + incentive measures to promote ecological farming[33] (organic farming) (Table 19).

Table 19: scenario 4b.:Measures from nitrate directive + incentive measures to promote ecological farming.

Measures	Description	AA	Model	scale	Farm type	Premium
Nitrate Directive as is described in annexe 1.						
incentive measures to promote ecological farmin						
M1	New rotations	New rotations with new N management	APES (yield+ N leaching)+FSSIM (constraints + costs)	Whole region	% of VZ within each farm type	Progressive premium

Since several years, the Midi-Pyrenees region has been the 6th French region in term of organic production area and it is in the firsts in organic cereal production. In 2004, more than 13 400 organic hectares (i.e 2.7% of the UAA in the Midi-Pyrenees and 1.9% in France) were cultivated for 254 producers in the Midi-Pyrenees region. The major cultivated crops were cereals (38%), oleaginous and high-protein plants (35 %) and forage (15%) (Agence française pour le développement et la Promotion de l'Agriculture Biologique, 2005). With the implementation of the CTE between 1999 and 2002, number of farms converted to organic agriculture doubled. However, since 2003 with the CTE loss, the important annual increase of number of organic farmers and hectare stopped. In the Midi-Pyrenees region, this trend is

[33] The first regulation on organic farming (EEC, 1991) [Regulation EEC N° 2092/91] was drawn up in 1991 and, since its implementation in 1992, many farms across the EU have converted to organic production methods. The conversion period is a minimum of two years before sowing annual crops and three years in the option of perennials. In August 1999 rules on production, labelling and inspection of the most relevant animal species (i.e. cattle, sheep, goats, horses and poultry) were also agreed (EC, 1999) [Regulation EC N° 1804/1999]. This agreement covers such issues as foodstuffs, disease prevention and veterinary treatments, animal welfare, husbandry practices and the management of manure. Genetically modified organisms (GMOs) and products derived from GMOs are explicitly excluded from organic production methods.

Cropping activities in organic farms are defined by EU regulations N°. 2092/91 and in part by N° 1804/99 (EC, 1999). They are characterised by

i) Abandonment of mineral N-fertiliser compensated by higher input of manures and wider crop rotations with cultivation of legumes, green manures, etc. or higher stocking density

ii) Abandonment of synthetic pesticides compensated e.g. by selection of appropriate species, natural enemies, mechanical weed control, etc.

iii) Livestock reared preferably by feed from the unit, resulting in a higher requirement of arable forage, grassland or a reduced stocking density.

confirmed by the strong decrease of hectare actually in conversion. Despite everything, contrary to France, the Midi-Pyrenees region presents always a little annual increase of its organic hectares in 2004.

- Criteria to build rotations in the Midi-Pyrenees region.

In the Midi-Pyrenees region, several economic and agronomic criteria should be considered by the farmer when the conversion from conventional agriculture to the organic form was decided:

i- nitrogen management: biological nitrogen fixation is the main source of nitrogen in crops organic farming systems. For this reason and to improve the organic soil matter the rotation should start in:

- rainfed system by cultivating an annual or perennial leguminous crops for fodder grain production or fallow.
- irrigated system by cultivating a Soya for the first two successive years. This crop is also retained for its economic profitability.

Thus, in clay calcareous soil (“terrefort”) the typical rotation in the Midi-Pyrenees region is:

- year 1: leguminous for grain production (field bean, lupin, and pea)

- year 2: Cereal (durum and soft wheat, maize)

- year 3- sunflowers

- year 4- fallows for annual land use or for a short period.

- year 5- Green manure as an intercrop (berseem clover sowed in Jun, red clover sowed in April).

In clay loam soil (“boulbène”), some additional cereals which require less nitrogen fertilization compared to the wheat and maize such as barley, oats and triticale can follow wheat and sunflower.

ii- adventitious management: For this purpose, the alternation of cereal/oleo-protein crops or leguminous should be harmonized with the alternation of crops in each season: fall/spring, fall/summer or spring/summer to stopped the growth of adventitious.

iii- feasibility: for climate, soil or technicality reasons:

- the sowing of some spring crops e.g. barley, oats, lupin, lentils and chick-pea are delayed or cancelled when March (February) is particularly rainy.
- The cultivation of lentils, chick-pea and lupin are not recommended in a hydromorphic soil.
- The timing and the use of some materials specific to organic farming requires specific technicalities e.g. combined system, materials for hoeing, and so a specific formation to control those materials is required.

iv- economic profitability: in organic farming the economic profitability is considered by evaluating the ratio yield/price of the principal crops in the rotation and the specific premium accorded for organic farming:

- In rainfed system the soft wheat is considered as a principal crop in the rotation and the rest of crops will serve only to provide nitrogen and to clean the soil from adventitious (table 20)
- In irrigated system the soya is the main profitable crop (table 21).

Table 20: example of ecological farming rotation in rainfed system

Soil	Clay calcareous (terrefort)	Clay loam (boulbène)
Duration of rotation	4-6 years	5-7 years
Example of rotation	- leguminous for fodder (1 to 3 years) or fallow [(Vicia sativa+ berseem or Fenugreek) or red clover] - soft wheat+ green manure (berseem) - spring barley - field bean.	- soya or leguminous for fodder (1 to 3 years) or fallow [(Vicia sativa+ berseem or Fenugreek) or red clover] - soft wheat + green manure (berseem or red cover) - soya - sunflower - field bean

Table 21: example of ecological farming rotation in irrigated system

Soil	Clay calcareous (terrefort)	Clay loam (boulbène)
Duration of rotation	7 years	6-7 years
Example of rotation	- irrigated soya - irrigated soya - soft wheat + green manure - irrigated filed bean - maize+ green manure - fallow (Vicia sativa)+ berseem - soft wheat.	- irrigated soya - irrigated soya - soft wheat + green manure - irrigated filed bean - maize or sunflower+ green manure - fallow (Vicia sativa)+ berseem - soft wheat.

Tables 22 and 23 give respectively information on yield and price for organic farming compared to conventional agricultural and costs and gross margin in both agricultural.

Table 22: comparison between yield and price in organic framing and conventional agriculture. Average yield from 1992 to 2002 and price for 2002 (Guide pratique agribio 12/10/2004).

Crops	Conventional agriculture		Organic farming	
	Yield (tn/ha)	Price (tn/ha)	yied (€/tn)	price (tn/ha)
Durum wheat	4.0	122.0	2.0	227.0
Soft wheat	5.5	99.1	3.0	269.0
Spring barley-oats	5.0	99.1	2.5	226.0
Triticale	4.5	99.1	3.0	227.0
sunflower	2.3	221.0	1.6	342.0
Rainfed soya	2.0	190.5	1.3	460.0
Irrigated soya	2.8	190.5	2.0	460.0
Alfalfa	8.0	76.2	8.0	150.0
Irrigated maize	10.0	106.7	4.5	185.0
Rainfed field bean	2.0	122.0	1.6	257.3
Irrigated filed bean	2.5	122.0	1.8	257.3
Irrigated lupin	2.2	152.4	1.8	262.5
Rainfed peas	3.0	137.2	1.8	245.0

Table 23: comparison between costs and gross margin in organic framing and conventional agriculture (Guide pratique agribio 12/10/2004).

Crops	Conventional agriculture		Organic farming	
	Costs (€/ha)	Gross margin (€/ha)	Costs (€/ha)	Gross margin (€/ha)
Rainfed field bean	131	472	130	641
Rainfed soya	188	504	137	772
Triticale	229	528	208	784
Soft wheat	302	554	249	869
Rainfed peas	179	592	177	623
sunflower	224	595	91	767
Spring barley-oats	183	624	200	676
Durum wheat	335	687	248	740
Irrigated lupin	200	696	200	834
Irrigated field bean	166	700	164	860
Irrigated alfalfa	212	709	240	1271
Irrigated soya	207	813	204	1203
Irrigated maize	498	1056	562	758

- From conventional agriculture to organic farming: steps and premium

The conversion from conventional agriculture to the ecological farming in the Midi-Pyrenees region request a minimum period of 24 months. EU commission has created a specific subvention which serves to compensate the yield decrease during the conversion period and to support the acquisition of new materials.

In the Midi-Pyrenees region, subsides is versed during five years (conversion period for annual and grassland crops), with modulation processes to take into account the progressive adaptation and the stabilization of yield. Table 24 resumes in the Midi-Pyrenees region the premium level and the modulation rate according to type of production.

Table 24: conversion premium from conventional agriculture to organic farming in the Midi-Pyrenees region (htt://www.agritarn.com/bio/bio_tarn.htm)

Crops	Period	Premium value (€/ha/year)	Contract period (years)
Leguminous	years 1 and 2 years 3 and 4 year 5	457 229 152	5
Annuals crops (mainly cereals)	years 1 and 2 years 3 and 4 year 5	366 183 122	5
Grasslands	years 1 and 2 years 3 and 4 year 5	160 80 53	5
Olives and vineyard	years 1, 2 and 3 year 4 year 5	572 343 229	5

Orchards	years 1, 2 and 3 year 4 year 5	877 526 351	5

6.2 Scenarios to be tested in the Zachodniopomorskie region

By E. Majewski, B. Nawrot, S. Straszewski and A. Wąs.

The objective of this part is to develop from the policy option based on the implementation of the Nitrate Directive policy settings to be tested in the Zachodniopomorskie region. The description of the policy settings (correspondent to the policy option to assess) will allow to identify with details the parameters and the constraints to be considered in the FFSIM-MP and AM model.

The Nitrate Directive is implemented only in the vulnerable zones, so in each farm type the percentage of vulnerable zone should be calculated and added.

To resume:

- Region NUTS 2: Zachodniopomorskie, Poland.

- Policy options: Nitrate Directive (DN) +/- AEM +/- technological innovation

- Policy scenarios: four policy scenarios are proposed as presented in table 2 to be assessed in the Zachodniopomorskie region.

Table 25. Policy scenarios for the Zachodniopomorskie region.

Scenarios	**Description**	**Scale**
1- Scenario 1	Nitrate directive (ND)	Vulnerable Zone (VZ)
2- Scenario 2	ND+ low ambition AEM (catch crops)	VZ In the whole region
3- Scenario 3	ND+ low ambition AEM (catch crops) + technological innovation (no tillage system for combinable crops[34]; deep ploughing)	VZ In the whole region
4- Scenario 4	ND+ low ambition AEM (catch crops) + Integrated Farming System	VZ In the whole region

The assessment of these scenarios can imply the creation of new activities (alternative activities).

<u>i- Scenario 1: implementation of the Nitrate Directive as currently adopted by the farmers in the Zachodniopomorskie region.</u>

In Zachodniopomorskie the Nitrate Directive regulation lay down that every farmer in Vulnerable Zone (V.Z), which covers more than 10% of this region, has to:

1- draw up an annual fertilization plan, keep record of an annual nitrogen balance and purchase and use of fertilizers,

[34] Cereals, Oil seed rape

2- manage in a better way the nitrogen mineral and organic fertilisation with reasonable yield prevision, taking into account the crop growth nitrogen requirement, crop rotation and soil type and limit contribution of nitrogen contained in the animals effluents to 170kg N/ha/an,

3- limit a maximum single dose of liquid manure to 50m^3/ha,

4- respect the restricted period to apply manure or fertilizing nitrogen (according to the type of fertilization and land use),

5- refrain from applying liquid manure on areas where ground water level is equal or less than 1,2m from the surface level,

6- ensure the storage of solid and liquid manure and waste in safe and leakproof containers or on plates ;

Measure 1- Keeping record of annual nitrogen balance, together with annual fertilization plan: to reach this objective farmers have to keep records of fertilizer purchase and use and to fertilize according to the crop requirements and the soil provision of nitrogen.

The annual fertilizing plan provides information on proper use of organic and mineral fertilizers for the particular crops in rotation, taking into consideration the crop N, P, K needs and the soil provision of these macronutrients.

As nitrogen is the most important macronutrient, it has to be balanced and therefore annual nitrogen balance must be prepared.

The formula below represents the recommended methodology in the Zachodniopomorskie region that farmer should follow to calculate in a concrete way the real crop nitrogen requirement:

Crop growth nitrogen fertilization requirement= the amount of nitrogen from mineral fertilization + the amount of nitrogen from livestock manure.

i- the amount of nitrogen from mineral fertilization

In the Zachodniopomorskie region, to calculate the amount of nitrogen fertilization requirement by crop the following two criteria should be considered:

- **reasonable yield prevision**: in this study the average yield reported in the survey for current activity (from 1998 to 2002) will be considered as a potential yield.

- **soil nitrogen pool** which depends on the nature of soil, the type of previous crops and the annual rainfall variability.

Thus, the amount of nitrogen needed by crop will be calculated in three steps:

1- Nitrogen required according to the yield prevision = the amount of N required to produce a unit of yield (table 26)* potential yield.

Table 26. Nitrogen required (kg/ha) to produce 1t/ha of yield or biomas (forage crop) (reference).

Previous crops	kg/t/ha
Winter wheat	26,50

Spring wheat	28,00
Rye	24,40
Spring barley	23,00
Oats	21,50
Winter Triticale	25,00
Spring triticale	23,00
Spring cereal mix	22,00
Legumes	57,00
Potatoes	5,00
Sugar beets	5,30
Winter canola	65,00
Spring canola	70,00
Maize for silage	4,50

2- Soil nitrogen pool = soil N residue from the previous crop (27, table 28) + mineralization rate (annex 29) + grassland effect (annex 30).

Table 27. Soil nitrogen stock identified by crop, previous crop and soil type for various autumn crops on different soil types.

Soil nitrogen stock identified by crop, previous crop and soil type for the autumn crops: winter wheat, winter canola (A soil)					
Previous crops	Yield (t/ha)	Amount of nitrogen (kg/ha)		Soil nitrogen stock (kg/ha)	
		min	max	min	max
Winter wheat	6,6	170	210	30	50
Spring wheat	6,1	100	200	45	60
Spring barley	5,4	60	110	80	100
Sugar beets	58,0	140	180	120	140
Winter canola	4,2	160	190	50	70
Soil nitrogen stock identified by crop, previous crop and soil type for the autumn crops: winter wheat, winter canola (B soil)					
Previous crops	Yield (t/ha)	Amount of nitrogen (kg/ha)		Soil nitrogen stock (kg/ha)	
		min	max	min	max
Winter wheat	5,5	100	140	20	30
Spring wheat	5,0	80	130	30	50
Rye	4,0	70	90	10	20

Spring barley	4,5	40	70	30	60
Oats	4,0	70	90	20	30
Winter Triticale	5,7	100	120	10	20
Spring triticale	4,2	70	80	20	30
Spring cereal mix	5,2	60	80	10	15
Legumes	3,0	30	50	70	90
Potatoes	28,0	60	70	60	80
Sugar beets	47,0	120	140	90	110
Winter canola	32,0	130	150	40	50
Spring canola	18,0	100	130	40	60
Maize for silage	45,0	130	160	80	90

Soil nitrogen stock identified by crop, previous crop and soil type for the autumn crops: winter triticale, winter rye (C soil)

Previous crops	Yield (t/ha)	Amount of nitrogen (kg/ha)		Soil nitrogen stock (kg/ha)	
		min	max	min	max
Rye	3,5	60	70	5	10
Spring barley	3,0	40	70	20	30
Oats	3,2	50	70	15	20
Winter Triticale	4,0	80	100	10	20
Spring triticale	3,0	60	70	15	25
Spring cereal mix	4,2	50	70	10	15
Legumes	2,0	10	30	60	70
Potatoes	22,0	30	60	50	70
Maize for silage	38,0	100	120	60	80

Table 28. Soil nitrogen stock identified by crop, previous crop and soil type for various spring crops on different soil types.

Soil nitrogen stock identified by crop, previous crop and soil type for the spring crops: wheat, barley (A soil)					
Previous crops	Yield (t/ha)	Amount of nitrogen (kg/ha)		Soil nitrogen stock (kg/ha)	
		min	max	min	max
Winter wheat	6,6	170	210	15	25
Spring wheat	6,1	100	200	25	45
Spring barley	5,4	60	110	40	60
Sugar beets	58,0	140	180	70	90
Winter canola	4,2	160	190	40	50
Soil nitrogen stock identified by crop, previous crop and soil type for the spring crops: wheat, barley (B soil)					
Previous crops	Yield (t/ha)	Amount of nitrogen (kg/ha)		Soil nitrogen stock (kg/ha)	
		min	max	min	max
Winter wheat	5,5	100	140	10	20
Spring wheat	5,0	80	130	20	30
Rye	4,0	70	90	5	15
Spring barley	4,5	40	70	20	40
Oats	4,0	70	90	10	20
Winter Triticale	5,7	100	120	5	15
Spring triticale	4,2	70	80	10	20
Spring cereal mix	5,2	60	80	5	15
Legumes	3,0	30	50	40	50
Potatoes	28,0	60	70	40	60
Sugar beets	47,0	120	140	60	70
Winter canola	32,0	130	150	20	30
Spring canola	18,0	100	130	20	30
Maize for silage	45,0	130	160	50	70
Soil nitrogen stock identified by crop, previous crop and soil type for the spring crops: barley, cereal mix (C soil)					
Previous crops	Yield (t/ha)	Amount of nitrogen (kg/ha)		Soil nitrogen stock (kg/ha)	
		min	max	min	max
Rye	3,5	60	70	5	10
Spring barley	3,0	40	70	10	20
Oats	3,2	50	70	10	20

Winter Triticale	4,0	80	100	5	10
Spring triticale	3,0	60	70	10	15
Spring cereal mix	4,2	50	70	5	15
Legumes	2,0	10	30	30	40
Potatoes	22,0	30	60	30	50
Maize for silage	38,0	100	120	40	60

Table 29. Mineralisation by soil (kg/ha)

A	15
B	30
C	45

Table 30. Soil nitrogen stock identified by crop, previous crop and soil type for the grassland.

Previous crops	Type of grassland		
	Pasture	Ensilage	Pasture + ensilage
Soil without vegetation cover	10,0	20,0	15,0
Fallow	15,0	30,0	30,0
Temporary grassland	40,0	50,0	45,0
Permanet grassland	30,0	40,0	35,0

3- the amount of nitrogen from N mineral fertilization = Nitrogen required according to the potential yield – Soil nitrogen pool

ii- the amount of nitrogen from livestock manure fetilization

the amount of Nitrogen from manure fertilization = amount of nitrate in the manure* equivalent coefficient of available nitrate* amount of manure.

Measure 2- Limit contribution of nitrogen contained in the animals effluents to 170kg N/ha/an. This limit will be considered as a parameter in the FFSIM-MP model.

Measure 3- respect the restricted period to apply manure or fertilizing nitrogen (according to the type of fertilization and land use)

Table 31. Calendar for restrict period to apply manure in the Zachodniopomorskie region.

Land use	**Type of N fertilizer**	**Restricted period**
Arable crops sowed in winter	Solid manure	After sowing
	Liquid manure	After sowing
	Mineral	20 June – harvest (approx. 20 August)
Arable crops sowed in spring	Solid manure	After sowing
	Liquid manure	After sowing
	Mineral	20 June – harvest (approx. 10 September)
Grassland	Solid manure	1 XII - 28 II 1 IV – last crop (approx. 30 September)
	Liquid manure	1 XII - 28 II 1 VII – last crop (approx. 30 September)
	Mineral	1 I - 28 II 15 VII – 31 XII

Measure 4- respect the restrictions for manuring near surface waters, on ground in strong hillside (> in 10%), on flooded, ice-cold or covered with snow grounds.

ii- Scenario 2: implementation of the Nitrate Directive as currently adopted by the farmers in the Zachodniopomorskie region together with the use of catch crops in rotation

As far as catch crops are concerned, there are two plant species that can be cultivated in rotation : white mustard (the most commonly used) and oil seed rape. Both might be cultivated without any exceptions after cereals, but in case of cultivating white mustard after oil seed rape only a selected variety of white mustard lethal to Heterodera Schachtii might be used. Therefore, the rotations possible in Zachodniopomorskie region are:

a) cereal - catch crop (white mustard or oil seed rape) – spring crop;

b) oil seed rape – white mustard lethal to Heterodera Schachtii – spring crop.

Moreover, in Zachodniopomorskie region as well as in the rest of Poland, catch crops cannot be cultivated prior to any winter crops.

iii- Scenario 3: implementation of the Nitrate Directive as currently adopted by the farmers in the Zachodniopomorskie region together with the use of catch crops in rotation and technological innovation (no tillage system for combinable crops; deep ploughing)

This scenario suggests some changes in farming technologies on top of implementation of Nitrate Directive and the use of catch crops. Table 32 summarises the possibilities of using two different technologies, their advantages and disadvantages.

As Zachodniopomorskie region consists both of small and large farms, an assumption has to be made that no tillage system will be applied mainly in the large farms. The smaller farms should rather apply deep ploughing every 4-5 years in rotation, except for poor quality soils where this system is inappropriate.

Table 32. Comparison of two different cultivation methods.

	NO TILLAGE	**DEEP PLOUGHING**
Type of crop	Cereals, legumes, oil plants, catch crops	Root crops, oil seed rape
Advantages	• Decreased sowing rate • Protection of soil bacteria and microorganisms • Reduced energy use per hectare • Higher efficiency of machines and human labour	• Destruction of plough pan • Higher yield within the entire rotation
Disadvantages	• Increased need for herbicides use • Lower yield (up to 30% in the first 3 years)	• Higher energy demand

As far as rotations are concerned, deep ploughing is applied in two part rotations (e.g. Wheat-oil seed rape) every third time before sowing oil seed rape, which equals every six years. In three part rotations (e.g. wheat-oil seed rape- barley) deep ploughing is applied every second time before sowing oil seed rape, so again every six years.

iv- Scenario 4: implementation of the Nitrate Directive as currently adopted by the farmers in the Zachodniopomorskie region together with the use of catch crops in rotation and Integrated Farming System.

Scenario 4 developed for Zachodniopomorskie region suggests implementation of Integrated Farming System as an innovation. IFS seems to be more probable to be accepted on larger scale within the region, contrary to Ecological Farming, mainly because of good quality of soils. The other reason is that in Poland there is very low demand for ecological products and no increasing tendency is observed. As for environmental benefit, IFS has much to offer, comparably with the organic production systems. Moreover, it does not restrict in any terms the scale of production and farm profit.

There are several rules of implementation of Integrated Farming System to be obeyed by farmers:

- The percentage of cereals (5 basic cereals, mixture of cereals or mixture of cereals and legumes) in cropping structure cannot exceed 66% of the total area of arable land;
- Cropping structure has to contain at least 3 groups of plants from the following: cereals, legumes, root crops, oil plants, grass on arable land (together with their mixtures with legumes);
- Maximum share of the following crops in the sowing structure on arable land according to the proper agrotechnology is: Beet root - 25%, Oil seed rape – 25%,

beetroot and oil seed rape together – no more than 40%, potatoes – 25%, wheat – 50%, other – 50%;

- The farmer has to prepare a fertilizing plan according to a seasonal chemical analysis of soil (once every 5 years) together with estimation of a nutrient (N,P,K) balance and liming needs;
- Livestock density should not exceed 1,8 livestock unit per hectare;
- Cultivation of catch crops in rotation at the area not smaller than 50% of spring crops in rotations: cereals – spring crops (table 33);
- Farmer has to apply standard rules of Good Agricultural Practice.

The payments that are assigned to farmers implementing Agri-environemental Measures level at 330 PLN/ha (82,5€ / ha) plus additional payment for having at least 3% of ecological infrastructure amounting to 30 PLN/ha (7,5€ / ha).

Table 33. The most widely used catch crops for under ploughing.

Crops	Sowing	Under ploughing	Advantages	Limits	Seed cost (€/ha 2007)
Crucifer					
White mustard	August, 15	After March 1	- speed growth - high amount of biomass - good biological sorption of Nitrogen	- proper selection of varieties	17,5
Rape	August, 15	After March 1	- good biological sorption of Nitrogen	- may attract insects - difficult to destruct	5

6.3 Scenarios to be tested in the Auvergne region

By G. Bigot, E. Josien, N. Turpin and J.P. Bousset.

The agriculture in Auvergne concerns especially crops production (mainly wheat, corn, and barley) and cattle breeding for milk and meat productions So the main policies to test are about regional implementation of Nitrate Directive and technical innovations about crops and animal breeding. The main scenarios proposed for Midi-Pyrénées are retained about crops and new propositions are specified for cattle productions (table 34).

Table 34- Policy scenarios in Auvergne region.

scenarios	description	scales
1- Scenario 1a	Nitrate directive (ND)	a- Vulnerable Zone (VZ)
2- Scenario 1 b	Nitrate directive (ND)	b- In the whole region
3- Scenario 2	Nitrate directive + rotational measure	Vulnerable Zone In the whole region
4- Scenario 3	Nitrate directive + rotational measure + nitrogen fertilization according to the Nitrate Directive	Vulnerable Zone In the whole region In the whole region
5- Scenario 4a	Nitrate Directive + no- tillage	Vulnerable Zone In the whole region
6- Scenario 5	Extensification	In the whole region
7- Scenario 6 a	Green intensification (+10% price)	In the whole region
8- Scenario 6 b	Green intensification (+20% price)	In the whole region
9- Scenario 7	Crops instead of meadows	In the whole region
10- Scenario 8	No silage	In the whole region

scenario 5 – extensification of pasture

a- specification of the baseline

Most of the Auvergne breeding farms are located in mountainous zones classified as less-favoured areas. So most of these farms receive *a compensatory allowance fo rnatural handicaps* as described in D6.2.3.2 §2.7. This premium is equal to 130 € /ha with a maximum of 50 ha allocated per farm. To receive this premium, farmers must maintain an average stocking rate between 0.7 LU /ha and 1.6 LU/ha. If this stocking rate exceeds these limits and stays between 0.25 and 2.0 LU/ha, the premium is reduced about 10 %. Beyond these limits, the premium is not allocated.

The stocking rate is calculated with all the Livestock Units present in the farm (cattle, ewe and other herbivores as equins, cervids, …) and the total areas of permanent and temporary grasslands, forage crops, subsistence cereals and collective summer grass.

Furthermore, most of these farms receive a specific *agro-environmental premium for grassland* equal to 76 € per ha of meadow to maintain pasture with an average stocking rate (calculated as above) inferior to 1.8 LU/ha. The nitrogen fertilization must be inferior to 130 uN/ha with less than 60 mineral uN . This premium is allocated to a maximum of 100 ha per farm.

b- new policy

In mountainous areas where meadows could be very hilly and winters could present long snowy periods, stocking then spreading manure in good conditions is often a problem. This relief imposes also a great diversity in managing meadows: some plots could be highly intensified while others are slightly used. So to contribute to the development of the biodiversity and to decrease storage volume of manure, this scenario suggests limiting the stocking rate to 1.2 LU/ha and organic and mineral nitrogen fertilizations to 80 kg/ha to get the agro- environmental premium for grassland (table 35).

Table 35 : scenario 5 in Auvergne: extensification

Measures	Description	AA	Model	scale	Farm type	Premium
M1	< 1,2LU/ha + N < 80 kg/ha	No AA	APES + FSSIM	Whole region	All Breeding farms	The current agro-environmental premium

In this event, breeding and mixed farms could react differently according to their structure:

- 1° They want to keep these two premiums, so they have to maintain or decrease their stocking rate inferior to 1.2 LU/ha, with a stability or a reduction of the cattle on the same agricultural area.
- 2° They could respect the stocking rate inferior to 1.6 LU/ha with no (or slight) changes in their management and receive only the compensatory allowance for natural handicaps.
- 3° They could maintain the stocking rate superior to 1.6 LU/ha and decrease or maintain their income with equal or higher receipts and the only premiums linked to the production with no expectation of any agro-environmental premium: neither compensatory allowance for natural handicaps, nor agro-environmental premium for grassland.

- 4° The last solution could appear for farmers not located in less-favoured area and who wants to keep the benefits of the agro-environmental premium for grassland. So they could have to decrease the stocking rate with a reduction of the cattle as in case 1.

scenario 6 – Green intensification

The price liberalization of agricultural products could favour breeding in mountainous regions particularly if the flat regions specialize in green energy productions.

This scenario suggests possibilities to intensify breeding with respect of the environment. The milk quota disappears, and the prices of milk and meat increase about 10% (scenario 6 a) or even 20% (scenario 6 b). So to protect the environment, a premium per hectare is brought to limit the nitrogen balance to 30 kg/ha/an and the consumption of unrenewable energy to 500 literoil per hectare calculated as proposed by the 'planete' method. All the others premium for milk or meat productions are maintained (tables 36, 37).

Table 36: scenario 6a in Auvergne : green intensification

Measures	Description	AA	Model	scale	Farm type	Premium
M1	No milk quota + 10% on milk and meat prices	No AA	FSSIM	Whole region	All breeding farms	No specification
M2	N balance < 30 kg/ha + Unrewable Energy consumption <500l gasoil + maintain total UAA	No AA	APES + FSSIM	Whole region	All breeding farms	Calculated premium

Table 37: scenario 6b in Auvergne : green intensification

Measures	Description	AA	Model	scale	Farm type	Premium
M1	No milk quota +20% on milk and meat prices	No AA	FSSIM	Whole region	All breeding farms	No specification
M2	N balance < 30 kg/ha + Unrewable Energy consumption	No AA	APES + FSSIM	Whole region	All breeding farms	Calculated premium

	<500l gasoil + maintain total UAA					

The economical equilibrium must be attained by the increase of the production and the market prices, if not, a premium is allocated and FFSIM proposes the minimum premium per farm-type.

scenario 7 – straw crops instead of meadows

In mountainous zones, far from the crops area, a cattle is bred in stanchion stable system with a production of liquid manure. This system requires an important storage volum just to spread liquid manure during the appropriated periods and on the suitable surfaces. The change to a free-stall housing requires straw supplies about 10 kg/ animal/ day. So to develop the production of straw crops in pasture zones, a premium of 175 €/ha is proposed to plough the meadows at the surface just necessary for the farm requirements of straw. To receive this premium, farmers must buy no straw outside and they have to compost the manure to facilitate its decomposition.
The implementation of this scenario in FSSIM (table 38) needs the specific calculations:

Table 38: scenario 7 in Auvergne : straw crops instead of meadows

Measures	Description	AA	Model	scale	Farm type	Premium
M1	+X ha with cereals instead of X ha of meadows + Compost of the manure + No straw purchase	No AA	APES + FSSIM	Whole region	All Breeding farms	175 €/ha + current premium

1° the quantity of straw required for the litter according to the livestock.

2° the verification of no straw purchases. If so, to add this quantity to the precedent.

3° to calculate the crops area necessary to produce the total tonnage with an average yield of straw collected per ha about 5 t.

4° to calculate the weight of the yearly manure and consequently the cost of the composting on the base of 1,52 €/t

5° the possibilities for each breeding farm to produce its own straw according to the conditions of their current activities in crops

6° to calculate the economic balance with an additionnal premium of 175 €/ha.

scenario 8– no silage in dairy and mixed farms

To improve the quality of milk for cheese making, the purpose is to forbid silage in dairy or mixed farms, with a limitation of 30% maximum of concentrate in the diet, and a minimum of 140 days in pasture (ie 38 % of the annual consumption of forage provided by fresh grass). In this case, the price of milk is 15% higher than the market price according to a better average quality of milk.

The implementation of this scenario needs APES and FSSIM (table 39).
In APES, the management of grassland differ with the way of forage collecting (hay instead of silage), specially on dates and quantity collected. Then in FSSIM, the feeding value of hay is highly dependent on the weather at the cutting period.

The calculation of the average diet for the dairy cows needs the control of the percentage of concentrate and fresh grass.

With no silage, the forage production on the same grassland risks to be inferior and if the production is not enough, hay purchases are necessary.

The economical balance must be satisfied by the increase of 15% of the milk price.

Table 39 : scenario 8 in Auvergne : no silage in dairy and mixed farms

Measures	Description	AA	Model	scale	Farm type	Premium
M1	No silage on total UAA + 15% for milk price + concentrate = 30% max + pasture during minimum of 140 days	No AA	APES + FSSIM	Whole region	Dairy and mixed farms	No specification

6.4 Scenarios to be tested in the two Malian regions

By A. Samake, J.F. Bélières, B. Rapidel, H. Belhouchette, B. Barbier, T. Diarisso, B. Sidi Traore.

Within the framework of the previous Seamless activity, three scenarios were selected for Mali: (i) cotton price variation (ii) technical innovations, and (iii) institutional, technical or economic changes in the cotton sector. The reasons behind these choices are directly linked to ongoing changes in the cotton producing area of Mali.

✓ Disengagement of the state and reorganization of the cotton sub sector

Policies of rural development in the Southern regions of Mali were targeted towards cotton production and implemented principally across a para-state company: the Malian Company for the Development of Textile Industry (CMDT). The Malian State still owns 60 % and the French company of Development of Textile industries, now called Dagris 40 %. The company manages almost the whole cotton sector and implements extensive programs of rural development in the area. Since 2001, the Malian State entered in a process of progressive disengagement which must be completed by 2008 with the privatization of the cotton company

Even today CMDT is in charge of organizing the production and the marketing of cotton. It has a monopoly position on almost all the Malian territory. It guarantees the purchase of cotton at a price fixed before the campaign. It ensures to producers the provision of the necessary inputs for cotton (fertilizers, seeds, pesticides). The company owns several ginning factories for the production of the fiber which it sells on the international market. It sells cotton seeds to other companies for the manufacture of oil for humans and oil cakes for animal feed. The company is heavily involved in the financial scheme since it is the cotton production that guarantees the input loans to farmers. The company pays to farmers the remaining balance after the loan is being reimbursed to the bank.

The reorganization of the sub sector towards greater liberalization and disengagement of the State was decided after the crisis of 2001 when the production fell, creating a huge deficit. This is done under the pressure of donor institutions (in particular the World Bank which has promoted for several years the privatization of the sub sector). This crisis also originated from a fall of the world price, and a strike by most of the producers through their trade-union claims and following a fall of the price to the producer at the end of the campaign, the bad management of the cotton company, with very high costs of operation and no reserve funds (whereas the system envisaged the constitution of guarantee funds).

The official agenda of privatization is presented in the revised chronogram adopted in the Council of Ministers on February 9, 2005. A detailed plan introducing some gaps is under examination. The significant steps in the perspective of the creation of the Funds of maintenance prices, are summarized in table 40.

Table 40: Timetable of the privatization of the cotton sub-sector in Mali.

Measurements	Chronogram adopted in February 2005	Plan detailed in examination
Adoption of the strategy of privatization	**June, 2005**	**December, 2005**
Elaboration of the schema of privatization	**May, 2006**	**April, 2006**
Installation of the Stock Market of Cotton	**December, 2005**	**September, 2006**
Installation of OCC	**June, 2006**	**September, 2006**
Opening of the capital CMDT to the producers	**November, 2005**	**November, 2006**
Decentralized management CMDT or Creation of subsidiaries	**November, 2006**	**June, 2007**
Privatization of CMDT	**October, 2008**	**August, 2008**

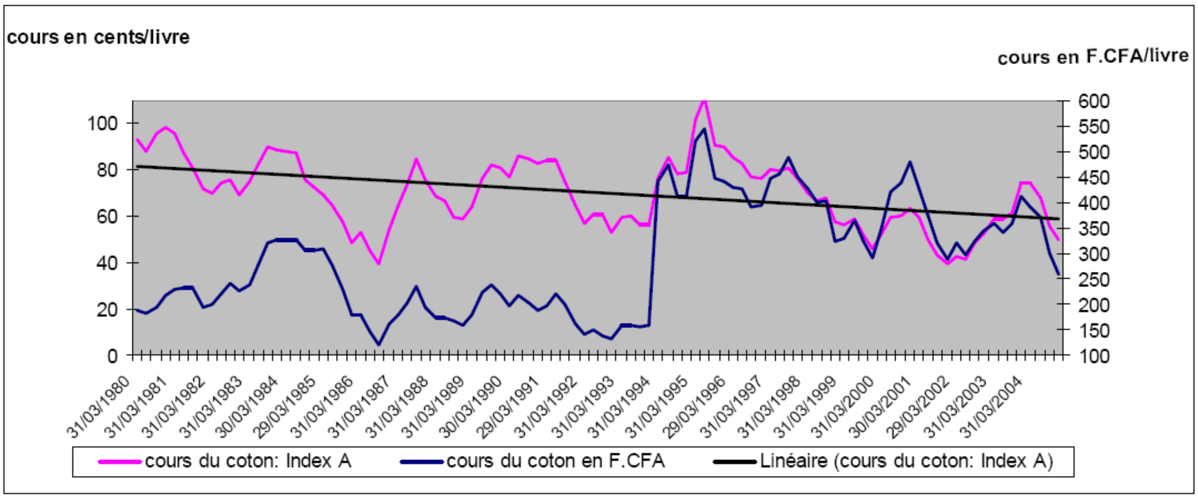
The adoption of the strategy of privatization by which will be defined the number of lots as well as the elaboration of the schema of privatization which will specify their geographical limits, will allow to make progress the installation of cooperative structures beyond of communal level. The principle of price uniformity on the whole of Mali of the purchase prices of seed cotton and of that of inputs seems accepted, what allows to envisage the chase of the Fund of unique support after the privatization of CMDT.

Several policy scenarios are to be envisaged for the continuation of the sub sector cotton.

✓ Evolutions of the world prices of cotton

The international prices of cotton fell notably, especially when expressed in Fcfa. After an auspicious period from 1995 to 98, prices fell several times. To face the strong fall of year 2000, CMDT, financially weakened by a deficient management, had lowered the purchase price to the producer during the campaign (150 Fcfa by kilogram instead of 185 Fcfa announced) which angered producers. Trade unions launched **a strike** which was largely followed and in 2000, the areas sown in cotton were halved. In 2001 (at the time of marketing of the cotton fiber of 2000) world prices increased. Since then prices have fluctuated. They are low at the beginning of 2007.

Figure 1 : Evolution of world prices of cotton (Indice Cotlook A, trimestriel).



Source : (Perrin 2005).

What will be the evolutions of the world price of cotton? The ongoing international negotiations on trade largely relate to cotton with special focus on subsidies granted by some countries. United States, Europe and China have a cotton sub sector which depresses the international prices. According to some analysts, « despite distortions generated by subsidies on the world market, the price strives towards the level of the production costs of the most competitive producers, which are less than 55 hundred dollars the pound. Consequently, the average international price of cotton will remain distinctly lower in the average of 70 hundred Fcfa per pound over the last thirty campaigns, online with the production costs of the majority of the producers, except climatic disaster in China or in the United States » MRSC, 2005}.

The price of cotton in Mali is also linked to the euro (on which CFA franc is pegged) and that of the US dollar. It seems therefore very difficult to make predictions on the evolution of the prices of cotton at medium and long term. Predictions exist (notably those of the World Bank) but are not accessible for us.

Moreover, between the world cotton fiber and the price of seed cotton to the producer, there is all the part of the value chain, which goes from primary trading to the Fob export.

In Mali, within the framework of negotiation between producers and CMDT to define a mechanism of fixing price (Nubukpo and Keita, 2005), it had been decided that the share of the final price of cotton (and more particularly the quotation Cotlook) was the following: 60 % for the producers (price of seed cotton) and 40 % for CMDT.

1. Scenarios to be tested

1.1 Modification of the price of cotton

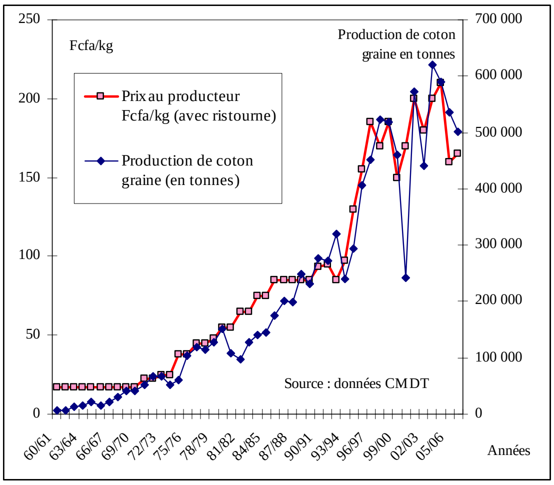
The evolution of the international price of cotton is difficult to predict. The estimate of the levels of production and therefore supplies, net import from China and, in a lesser extend, consumption seems delicate in the long term, which induces a strong uncertainty in the forecasts of price beyond six months" (Perrin, 2005). The removal of state subsidies by the United States should help increase the cotton price. Some analysts consider that impact would be limited. In Europe, cotton remains marginal and subsidies granted to the producers have little weight on the world market. « The fact that the European Union is a marginal cotton producer implies that the impact of the cotton production of the European Union on the evolution of prices on the world market is negligible. In addition, for this sector, the European Union does not grant subsidies for exportation and allows a postpaid access right[35]».

We will not be able to test the impact of prices given by the CAPRI model of SEAMLESS-IF with a scenario of reform of the European subsidies, since this reform should not weigh significantly on the world market.

✓ Settings

Base years for SEAMLESS-IF are 2001 and 2002. However at this period the prices to the producer were high: 200 Fcfa / kg in 2001 and 180 Fcfa / kg in 2002.

Figure 2 : Evolution of seed cotton production in Mali and of the purchase price to the producer



The current situation with prices about 160 Fcfa / kg in 2005 and 165 Fcfa / kg in 2006, already corresponds to a fall of 14 %.

As retained at the time of the 2006 December workshop 2006 in Montpellier, the scenarios to be tested will be based on a fall of the prices to the producer compared to 2001/02 (average of 190 Fcfa/kg) of 15%, which corresponds to the current situation. This situation of relatively low price will be continued over the period concerned.

Two other levels will be tested: one amplifying the price reduction to 30 % from the average price of 2001/02 (that is a fall to 133 Fcfa per kilogram) and the other one testing an increase of 15 % above average price 2000/02 which is 218,5 Fcfa / kg above the best levels of the previous years.

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[35] Communication of the Commission to the Council and the European Parliament entitled «To reach a sustainable agricultural model for Europe by the reformed CAP - sectors of the tobacco, the olive oil, cotton and sugar. Brussels, 23.9.2003 N° COM (2003) 554 final.

These scenarios will assume that the principle of uniformity of the purchase prices of seed cotton and of that of inputs is maintained on the whole Mali and that prices are guaranteed (mechanism of fixing of price and fund of support) avoiding therefore price fluctuations (very low volatility, while a stronger volatility will be simulated with the scenario of privatization).

Since FSSIM is a farm level model, there will be no specific data for the whole sub sector and the rest of the economy. In scenario prices evolution (noted S1Prix) three sub- scenarios are selected:

- S1Prix_1: fall of 15 % of the prices compared to 2000/02: from 190 Fcfa/kg to 161,5 Fcfa/kg,
- S1Prix_2: fall of 30 % compared to 2000/02: from 190Fcfa/kg to 133 Fcfa/kg.
- S1Prix_3: increase of 15 % compared to 2000/02: from 190 Fcfa/kg to 218,5 Fcfa/kg.

✓ **Expected effects**

The effects of the fall of the prices of cotton seed, *ceteris paribus*, are difficult to predict. In 2005 and 2006 the cotton area did not decrease much while the fall of prices was important, from 210 Fcfa / kg in 2004 to 160 Fcfa / kg in 2005. The high production of 2003/04 (620 000 tones with a price of 200 Fcfa / kg) was followed by a fall of about 20 %. This fall was due to the fall of yields, since the cultivated areas was almost the same as in 2006/07 (about 550 000 hectares on average from 2003-2005 compared to 470 000 hectares in 2006). To explain this fall of area, the cotton sub-sector recalls more problems of climatic conditions during sowing dates than lower prices.

Indeed producers are integrated in a “captive” system which almost forces them to grow cotton. Cotton production opens the access to inputs and credits for crops. Producers do not have short term real alternative: (i) the grain crops for commercial purpose are more risky owing to the very high price volatitly. Grains are also more sensitive to climatic hazards than cotton; (ii) other crops (peanut, cowpea, sesame, potato, etc) have narrow and unstable markets owing to restricted opportunity and the lack of organization of the sub sector. There are no real fast substitution possibilities.

With the levels of actual prices, economic margins per hectare (before remuneration of family labor) are low but remain positive for most of the cotton area and for the great majority of farmers. The producers see their income diminishing. The least performing should rather abandon cotton production; the others will indeed make it in a progressive way. There will be perhaps a fall of intensification in cropping systems, cotton could be replaced by maize, millet or sorghum in a traditional way with little use of inputs. The farming system is in crisis. There are more seasonal migrations and definitive departures to find supplementary activities.

Expected effects for each of the above scenarios could be the following:

- S1Prix_1: with the level of actual prices, the profitability of cotton production strongly decreased, but net margins (before remuneration of family labor) remain positive for a majority of the producers. It can thertefore be hypothetized that production is going to decrease and then become stable. The least competitive producers are going to reduce their cotton area or to abandon the cotton crop (notably the smallest producers, less implicated, with low productivity). Two hypothesis can be formulated: (i) farmers (especially those specialized on cotton and particularly big farms) will be encouraged to intensify their cotton production. With the abandonment of the least competitive areas average yield will finally increase; (ii) with a cotton system still bringing input and credit, producers (at least a part of them) could try to save inputs on cotton and so to maintain cotton production at a low profitability (with low yields) to use the inputs saved on cotton for other crops, especially on cereals. But the farms which are going out of cotton production are likely to adopt extensive practices, with reduction of the corn area to the benefit of less demanding crops (millet and sorghum). The consequence will be a general reduction of the amount of cereal produced in the region. This sub-scenario should result in a strong differentiation between farms: the smallest farms should be found in very precarious situations (food insecurity, very weak agricultural incomes, decapitalization), which should accelerate the rural migration.

- S1Prix_2: the emphasis of the fall of prices until 133 Fcfa by kg is going to be translated by a serious deterioration of the cotton crop profitability. For a significant part of the farms gross margins will become negative. For other farms, margins will be low and the crop will not allow to remunerate family work at an «acceptable» level to ensure proper functioning of the family. A lot of farms (practically all the small, very important part of averages, but also some big farms) will suppress cotton crop to the benefit of subsistence crops (cereal principally). The corn production is going to go down to the benefit of other less productive but also less demanding and overall the cereal production could drop, notably the part commercialized by farms. The possibilities of diversification (sesame, peanut, sweet pea, etc) being weak, because of the weakness of markets and the lack of organization of the sub sector, agriculture will be strongly depressed. The financing system should collapse quickly. The selling of production means will then be the only solution for numerous farms but the markets of the animals and the farm equipment may collapse too with prices very low because of an important offer. The managers will develop strategies of survivals with a very strong exodus, actives members of the family being sent in search of other opportunities, with whole families leaving the fields to live in the city.

- S1Prix_3: The increase in the price of cotton should be translated in the opposite by an increase in the cotton area and an emphasis of the specialization of farms. The actual system should continue with cotton cropping on marginal lands leading to a stagnation of average cotton yield. The increase in cotton area is going to be associated with an increase of corn area and a reduction of other grain crops (especially sorghum). However the general situation of farms is not going to improve a lot because the increase of gross margins will remain rather limited (no progress of the average yield). This may lead to blasting of families with youngers looking for autonomy to pick up monetary income from cotton. On average poverty will slightly decrease, except for small farms because they do not have the producing factors required to benefit from opportunities offered by the rise of the cotton price.

Table 41: Evolution of some indicators under the three scenarios

Criteria	S1Prix_1	S1Prix_2	S1Prix_3

Price of cotton seed in comparison with 2000/02 (190 Fcfa/kg)	↘ (161,5 Fcfa/kg)	↘ (133 Fcfa/kg)	↗ (218,5 Fcfa/kg)
Cotton area (part of cotton in rotations)	(-)	(---)	(+)
Corn area	(-)	(---)	(+)
Areas in other cereals	(+)	(+++)	(-)
Cotton production	(-)	(---)	(++)
Production of cereal by worker	(+)	(++)	= ou (-)
Practices of intensification of cropping systems	(+)	(+)	(---)
Consumption of pesticides and of mineral fertilizer	(-)	(---)	(+)
NO3 Leaching kg / hectare / year	(-)	(---)	(+)
N balance	(-)	(---)	(+)
Evolution of Soil Organic Matter	=	(-)	(+)
Farm income	(-)	(---)	(+)
Capitalization (+) / Décapitalisation (-)	=	(---)	(++)
Poverty	(++)	(+++)	=
Difference between poorest and richest farms	(++)	(+++)	(+)
Number of not worked hours	(+)	(++)	(-)
Exodus / departures of assets	(+)	(+++)	=

(=) No change, (-) Moderate fall (---) Very strong fall
(+) Light increase; (++) Average increase (+++) Very strong increase

1.2 Scenarios of modification of sub sectors

These scenarios are linked to the measures of economic policy taken with the privatization of CMDT and the reorganization of the sub sector as indicated in the first part. Two sub scenarios are to be tested: one favorable to the cotton production (S2_MFil_1) and an unfavorable one (S2_MFil_2). Scenarios are contrasted to better evaluate the effect of privatization on the price of the inputs and the system of credit of the cotton sub sector as well as on the volatility of the cotton price.

- ✓ **Taxes**

Agricultural inputs were tax free before 2000 but since UEMOA has implemented the Common External Tariff (TEC). inorganic fertilizers (urea, etc) and pesticides are subject to a 7,5 % tax (5 % customs duties, statistical charge (1 %) Community levy of solidarity (1 %) and Community levy (0,5 %)). TVA does not apply, for the time being, to agricultural inputs, but the General Direction of levies plans to apply it soon (Gagnon, 2005). Machineries and imported vehicles, pay 10 % customs duties and are subjected to VAT, for a complete tax pressure of 26,58 %. In a favorable hypothesis, the taxes which apply on the inputs could be raised and in the unfavorable scenario the TVA of 18% could be applied to the inputs. There will be therefore, for the same product a difference between the two scenarios.

- ✓ **Organization of sub sector**

In cotton areas, until this day, the supply in inputs for the cotton crop is ensured by CMDT which centralizes rural demand, sign international contracts, convey products to the villages and transfer the inputs to the farmers organizations through a credit system (through financial systems decentralized or banks, but guaranteed on cotton). This system has been efficient in terms of producer purchase price because CMDT never applied important commercial margins on this activity.

Within the framework of the reorganization of the sub sector, the provisioning of inputs for the other productions (inputs for cereals and the inputs for animal husbandry called «non strategic» for the CMDT) was privatized and transferred to the four major farmers organizations .

This «privatization» (however partial, because it is always the cotton collected by CMDT that guarantees credit on these inputs) showed serious limits with problems of delivery in the villages for lack of professionalism and not obscure management. However the programmed evolutions aim at the transfer of the inputs distribution to the farmers' organizations during the ongoing restructuring (federations and unions of cooperatives of cotton producers).

The effects of this reorganization of inputs sector are:

- knowing what occurred for the inputs for the other productions than cotton, it can disorganize the sector with important problems for the producers (rupture of provisioning at the right time, fall in cotton quality, lack of credit, etc). These failures should result in an increase in the costs of the inputs for the producers and/or a fall of the yield, but also a fluctuation in prices of the inputs;
- The privatization and the implication of the producers in the companies can improve the effectiveness and a redistribution of the margins through the basic organizations with a fall on the final cost of the inputs and perhaps also an improvement of the system of credit, being translated by a fall of the financial expenses and the facilitation to buy the inputs.

✓ System of credit and price stability

As stated before, the financing of agricultural activities is based on cotton crop. CMDT has the monopoly and the obligation of purchase of cotton seed, which has no other markets (except for the craft traditional extrusion which remains very marginal). With cotton the farmer gets credits of campaign guaranteed by the cotton production to come. The cotton price being known at the beginning of the season, the modalities of attribution are easy to determine and risks for the organisms of financing are small. With this system, the credits of campaign are granted for a term of 10 months with a 12 % rate of interest a year (that is 10 % on the borrowed capital).

More over, there is a mechanism of fixing of the price of seed cotton which allows the producers to know before seeding, the price at which they will sell their production (Nubukpo and KEITA, 2005). With the obligation of purchase for CMDT and the price fixed beforehand, risks for the producer are very weak, except from climatic uncertainty.

The effects of the reorganization of the sub sector can differ:

- In relation to credit, the private cotton societies could distance themselves from the actual system (risks of skid in the attribution being translated by unpaid debts impossible to recover on cotton production) and to limit at the farthest guarantees which they will bring in the organisms of financing. These will meet then with more well brought up risks and augment their rates of interest. Today the rates of interests fluently played for rural activities go from 18 % to 24 % by year (loans of equipment, of soldering, of marketing of cereal, of consumption). The access to credit will be more difficult for the small farms because they will have of difficulties in finding guarantees.

- In the opposite, we can assume that the involvement of the farmers in the system of inputs supply will allow them to reinforce their relationships with the financing companies. It will also make easier, by a system of guarantees, the access to inputs for cotton in the smallest farms and to enlarge the system to inputs for other crops. In that case, rates of interest could go down (up to 10 % year) especially for other productions and for inputs for animal husbandry.
- With regards to the price of cotton, we assume that the actual system will continue allowing the price stability of cotton and a price guaranteed at the beginning of campaign.

But if private cotton societies succeed in dismantling the mechanisms of price guaranteed at the beginning of campaign, the price of cotton will fluctuate with variations translated by a mean price and a standard deviation.

✓ Settings

Data to be used to work out these scenarios concern the price of inputs, the rates of interest of the credits of campaign, the variation of cotton price and the conditions of access on credit, especially for other crops than cotton.

For favorable scenario (S2_MFil_1):

- The prices of inputs would follow a 10 % reduction in comparison with 2000/02 owing to the abolition of taxes in import (5 %) and the improvement of the system of supply via the cooperatives of producers;
- The interest rate for the input credits would increase by 8 % annually (6,7% on 10 months) with possibilities of easing credit access for cotton (possibility of having up to 80 % of inputs on credit) and for the grain crops (up to 60 % of inputs on credit for other activities) ; this will lead to a net increase of cash availability for farms.
- The price of cotton is not volatile.

For disadvantageous scenario (S2_MFil_1):

- The prices of inputs would follow a 23 % increase in comparison with 2000/02 owing to subjugation in TVA (18 %) and in the deterioration of the system of supply via the cooperatives of producers (5 %)
- rates of interest for the credits of campaign would go to 24 % by year (20 % on 10 months) with a restriction of the access to the credits of campaign for cotton (possibility of borrowing only 50 % of necessary inputs) and for other activities (possibilities of having only 30 % of inputs necessary for credit).
- The price of cotton present a certain changeability (coefficient of variation: 30 %).

✓ **Expected effects**

The expected effects, rather largely join those of the scenarios on the price evolutions.

The unfavourable scenario will result in a fall of the agricultural productions. Farms will reduce cotton and corn areas and will increase millet and sorghum areas and probably in legumes. They will tend to limit the agricultural activities to the basic needs of the family (self-sufficiency) and reduce the commercialization. They will search for complementary incomes and migrate out of the area. The favorable scenario should allow to increase the cotton and grains production. Farms will sell more products and incomes will increase

Table 42: Evolution of some indicators for the scenarios of modification of sub sector

Criteria	S2_MFil_1	S2_MFil_2
Cotton area (part of cotton in rotations)	(++)	(-)
Corn area	(++)	(-)
Areas in other cereals	(-)	(+++)
Cotton production	(+++)	(--)
Production of cereal by worker	=	(++)
Practices of intensification of cropping systems	(++)	(--)
Consumption of pesticides and of mineral fertilizer	(++)	(--)
NO3 Leaching kg / hectare / year	(++)	(--)
N balance	(++)	(--)
Evolution of Soil Organic Matter	(+)	(-)
Farm income	(++)	(-)
Capitalization (+) / Decapitalization (-)	(+)	(-)
Poverty	=	(++)
Difference between poorest and richest farms	(++)	(-)
Number of not worked hours	(-)	(+)
Exodus / departures of assets	(-)	(+++)

(=) No change, (-) Moderate fall (---) Very strong fall

(+) moderate increase; (++) strong Increase (+++) Very strong increase

1.3 Scenarios with innovations

1.3.1 Rationale behind innovation selection

Three alternative technologies will be tested or combined in different scenarios:

- Varieties of genetically modified cotton (CGM): cotton LT, cotton Round Up Ready (S3_Inno_1)
- Productivity increase with non GMO varieties and technique of sawing under vegetal cover (SCV) (S3_Inno_2)
- Organic and fair trade cotton. S3_Inno_3

The simulation of the effect of innovations on the farming system have been considered in SEAMLESS-IP within the framework of Test case 2. This Test case had not been considered for Mali in the initial DOW. However, we decided to test these innovations, because the

FSSIM and APES versions developed for LDC countries should be able to test these changes. Moreover, these innovations make debate in Mali, and its therefore a good opportunity to demonstrate the capabilities of SEAMLESS-IF.

a- Genetically modified cotton GMC

GMC is now common around the world. In 2004 it represents 25 % of the world cotton area and 35 % of the world cotton production (Estur, 2007). The progressive introduction of cottons genetically modified in the middle of the nineties allowed a significant rise of the average world yield. Among the introduced genes two are more important. First the production of the Bacilius Thurengiensis by the cotton plant improves it resistance to some insects such as the boll borer (mainly *Helicoverpa armigera* in Mali). Second the introduction of a gene of resistance to the glyphosate facilitates the chemical weeding . The introduction of these technologies to Mali is the debate object intense but low in objective technical elements.

Experiments have already taken place in Burkina Faso. The above metionned genes are in process of introgression in African varieties. Genetically changed varieties will. Genetically modified varieties will probably be available in the short term in Mali.

b- Other innovations

Innovations linked to the agronomical crop management can also be compared with CGM options. Three innovations can be tested. Aprototype of cropping system of the cotton plant of water strain, sowings on vegetal cover and the introduction of leguminous into the rotation

The prototypes in situation of water stress (called *prototype cotton*) have been tested in experimental station and in farmers fields (Lançon and Al, 2007; Rapidel and Al, 2005; Turini, 2005). The prototypes in hydrous situation of constraint (prototype cotton). From denser sowings of more compact varieties and use of growth regulators, one can significantly reduce the period of fructification of the cotton plant. Its cycle is then better adapted to one chronically excessive rainy season. The packing of plantation generates more working times, in particular with sowing, but also with the decrease of sawing and weeding.

Sowings on vegetal cover (SCV) were introduced recently in Mali under an experimental framework. The principle of the technique is to tillage such as ploughing, as much as possible to produce aerial biomass and roots, to recycle the nutritive elements and to protect the soils against the aggressions (intense rains, extreme dryness during the dry season). These technologies are known to have high costs of installation (lower yields during the first 2-3 years) and to interact with the management of the residues and therefore with the organic matter management.

The introduction of a legume in the rotation is not a recent innovation. It aims to solve the problems of soil fertility, which in turn improve food and feed production during the long dry season (Enyong and Al., 1999). This innovation was never adopted widely despite many studies on the factor of adoption (Pannell and Al., 2006). The low opportunity cost of land is one of the major explanation (Buckles and Triomphe, 1999).

c- Organic Cotton Bio, fair trade Cotton

The international market for cotton suffers from major market failures due to excessive subsidies from riche countries and China. It is typically in a state of overproduction. The development of niches of commercialization such as organic cotton and fair trade can be a partial resolution to assure the sale of Africain cotton. Two initiatives are ongoing in the region. :

Organic cotton was introduced in Mali by the Swiss ONG, Helvetas. It is cultivated on some hundred of hectares. Few dependable technical elements are available, due to the lack of capitalization of the technical monitoring accomplished by this ONG. To benefit from the label, a farm should be converted completely to organic farming. ,

as courses of study biological grain, who could allow this restructuring, is not developed yet, it is supposed that a plot of fallow of more than 3 years cultivated cotton bio can be immediately labelled. The technical organic way on cotton is strict. No artificial pesticides, no inorganic fertilizers, herbicides. As expenses are restricted, outputs is low.

The organic grain sector is not developed yet. To get the label one has to leave a plot into fallow and cultive 3 years of organic cotton. The organic cropping pattern is strict: no artificial pesticides, no of inorganic fertilisers, not herbicides. The costs are limited, but yields are also lower than under conventional agriculture.

The sub sector fair trade cotton is promoted by the French firm DAGRIS in Mali, in Senegal, in Cameroon and in Burkina Faso, in collaboration with the NGO Max Havelaar, specialized in fair trade. Standards for the certification are those of the FLO organization and concerns principally democracy, management of the Rural Organization, as well as of social and environmental criteria. Generally, FLO's conditions are respected in the case of sub sector cotton in Mali. Besides, to reassure markets permanently, the participants (producers and CMDT) wrote a charter to answer the criticisms of the gining factories. It is about a charter by objectives where each actor promises to set up a certain number of actions aiming at reducing pollution, sticky cotton, to check *micronaire* and homogeneous lots.

- Settings

To make these innovations, it is enough to create new activities and to add them in possible rotations in the FSSIM data base. The various parameters of these new activities must reflect their characteristics.

a- Genetically modified cotton

No experimentation on genetically modified cotton took place in Mali. The Burkinabè experiments are not considered very reliable, and their results are not yet available. We therefore used the figures available for South Africa, where studies were undertaken by CIRAD to compare, under conditions similar to those of Mali, the effectiveness of Bt (Hofs and Al, 2006a ; Hofs and Al, 2006b). The modifications of cropping patterns of the cotton plant are thus the following ones:

Coton Bt

- Additional Price linked to the seed technology: 20€/ha (Monsanto price for South Africa adapted to low expectation of yield and profit)
- Modification of the plant health treatments: no more pyrethrinoides. As the current treatments mix organophosphorus and pyrethrinoides, it will be necessary to check the reduction in cost linked to cancellation of the pyrethrinoides.

- yield increase: + 5% (no optimal condition of production, but intermediate conditions between the situations described by Hofs and Al (2006a; 2006b)).
- Modification of earliness: the bolls in low position are better protected, flowering is therefore slightly earlier, which decreases slightly the yield variability (- 10% applied to the coefficient of variation).

Cotton resistant to glyphosate

- We supposed that the price of this technology would be the same one as for Bt. On the other hand, the variability of the yield would not be modified.
- It will be possible to remove weeding (labour saving in peak period).
- It will be necessary to apply at least twice a total herbicide, which will have a lower cost than the traditional pesticide currently applied on cotton fields (6 €/ha/spraying).
- The best control of weeds will have an effect on yields, estimated at +5%.

Cotton incorporating the two genes

- Addition of the advantages of the two genes.
- yield increase of 10%.
- Price technology of 30 €/ha.

b- Innovations without CGM

Prototypes

Experiments under farmers’ conditions led to differentiate several prototypes (Lançon et al., 2007), according to restrictions and opportunities for the producers. For simplicity, we present only one of these prototypes, the most contrasted to the conventional cropping pattern

- Additional cost of seed, linked to an increase of the necessary dose
- application of total erbicide
- Faster ploughing (-66 %) and more precocious (but it is not simulated in FSSIM)
- Increase sowing time (+50 %) because of higher density
- Longer thinning linked to the strongest specific gravity (+100 %)
- The single hoeing, during the peak labor period, more labor intensive than a normal hoeing (+50 %)
- Longer (+40 %)
- Reduced pesticides treatments (-1 treatment), the same level of fertilization
- Improved yields, +25 %
- The same yield variability

Sowing under Vegetal cover (SCV)

SCV experiments are ongoing. Modifications do not concern the cropping system of the cotton plant, since the yields of other crops can change. Animals feeding will also be changed. This innovation requires social modifications, such as the management of herds and the access to crop residues, and the pastures. Since FSSIM is a farm level model, we ignore this restriction in the scenarios.

Technical options for cotton

- No tillage
- Same dates of sowing
- Herbicide
- Two reduced hoeings (manual picking):-75 % in time
- 50 kg of urea on during sowing
- Same pest protection
- No ridges
- Improved output (estimated in + 5 %)
- Lower yield variability

New cropping system with

- The same modification (less soil management, more herbicide, improved yield and less yield variability).

Animal feed and organic fertilization

- No work for organic fertilizer
- No work for residue recollection
- No animals feed on the plots

Legumes

Introducing peanuts in rotations and its effect on the following crop were already taken into account in the previous version of the test of FSSIM in Mali (Simien, on 2006).

c- Organic Cotton, fair trade Cotton

In the previous FSSIM version, organic cotton had been introduced but it was not found cost effective. Coefficients, particularly those who concern working time, will be revised with the Helvetas advisors. On the other hand, fair trade cotton had not been tested.

- The participants do not try to change the cropping system proposed by CMDT, but rather conform to it in a more faithful way . The cropping system will therefore be the one recommended by CMDT.
- Average yields are slightly better.
- Paid prices are also better, but they split into two categories: price paid to the producer is 238 FCFA (that is 44 % above the price of 165 FCFA / kg of seed cotton paid for the rest of thee sub sector, yield in identical ginning). A bonus is paid to the local unions and to the producers' group to finance social investments and activities. Producer price was taken into account in settings for FSSIM.

- Expected effects

As much as the introduction of innovations is proposed at a local level, the effect in the upper ladder depends upon their adoption by farmers. We offer therefore evolutions itemized in table 43 by assuming a real adoption of innovations. We assume that evolution of agricultural income is always positive (otherwise, innovation will not be adopted).

Table 43: The evolution of some indicators for scenarios of introduction of innovations

Criteria	S3_Inno_1	S3_Inno_2	S3_Inno_3
Cotton area (part of cotton in rotations)	(+)	(+)	=
Corn area	(-)	(-)	=
Areas in other cereals	(+)	=	=
Cotton production	(+ +)	(+ +)	(-)
Production of cereal by worker	=	(-)	=
Practices of intensification of cropping systems	(+)	(+)	=
Consumption of pesticides and of mineral fertilizer	(-)	(+)	(- - -)
NO3 Leaching kg / hectare / year	(+)	(-)	(- -)
N balance	(+)	(+)	(- - -)
Evolution of Soil Organic Matter	(+)	(++)	(-)
Farm income	(+)	(+)	(+)
Capitalization (+) / Decapitalization (-)	(+)	(+)	=
Poverty	=	(-)	=
Difference between poorest and richest farms	(+ +)	(+ +)	(-)
Number of not worked hours	(-)	(-)	(-)
Exodus / departures of assets	=	(-)	(-)

(=) No change, (-) Moderate fall (---) Very strong fall

(+) Light increase ; (++) Average increase (+++) Very strong increase