



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

Identification of indicators for Test case 1

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General information

Task(s) and Activity code(s):	Task 6.2, Activity 6.2.3
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Executive summary

This deliverable identifies and defines a selected list of model outputs and potential indicators to be used in the analysis of test case 1 of the 18th month prototype (18MPROTO). The selection is based on the models and model links included in SEAMFRAME in month 12. In its construction the main leaders of Work Package 2, 3 and 6 have been consulted.

This deliverable and PD6.2.3 have to be interpreted as a glance in the 'real' application of SEAMLESS tools in an early phase of the project, in this case the definition of indicators. This work is based on a selected list of consolidated economic indicators calculated by the CAPRI model (central modelling component for test case 1) and environmental indicators calculated by FSSIM/APES. It serves as a starting point for future prototypes and extensions to test case 2. However, it is important to note that further interaction will be needed with WP2 and the modelling responsables of WP3 to further specify the single indicators.

Specific part

1 Introduction

1.1 Objectives of the deliverable

This deliverable identifies and defines a short list of model outputs to be used in the calculation of indicators for test case 1 in the 18th month prototype. The selection is based on models and model links included in SEAMFRAME in month 12. In its construction the main leaders of Work Package 2, 3 and 6 have been consulted.

Based on this 'pragmatic view' of model outputs to be delivered in month 18 and the needs of the project, WP2 is expected to make a final decision on indicators to be selected in the 18MPROTO. Further details on indicators not assessed via models or based on post-model analysis (e.g. institutional constraints) will be addressed in a future revised version of the deliverable, based on the recent 'consultation on institutional indicators' released by WP2.

1.2 Spatial scaling of indicators

Different spatial scales are distinguished in SEAMLESS:

- (i) *Global level.* Different countries or groups of countries in the World considered.
- (ii) *European level.* Several aggregates considered: EU25, EU15, EU10, Bulgaria and Rumania.
- (iii) *Member State level*
- (iv) *Regional level.* Nuts 2 regions (EUROSTAT nomenclature)
- (v) *Farm type level.* Differentiation between a consistent mapping of farm types across Europe or a selection of farm types (sample farm types → WP3 and test case farm types → WP6)
- (vi) *Homogeneous regional units.* These are classified according to soil type and climate class. Not decision is taken on the scale, which will depend on the number of explanatory variables assumed as relevant in the distribution algorithm.
- (vii) *Grid level.* The mapping dimension will be 1x1 km².

Whereas at month 18 CAPRI is foreseen to consistently work at a global, Member State (EU25 countries), regional (Nuts 2 regions) and farm type level, FSSIM/APES will first only produce indicators at farm type level for the 'sample regions' and 'test regions'. GTAP will cover a wide list of countries and sectors (not only agriculture) in the world.

At further stages of the project, developing country models (Mali test case region) and territorial models (based on homogeneous regional units) will also be used to assess test case 1. Whereas the first type of models should be coupled through a social accounting matrix to GTAP, the second one will be embedded in CAPRI and linked to FSSIM.

2 Classification of indicators

As reflected by WP2 in PD2.2.1, an indicator list regroups a set of indicators measured in units appropriate to the considered phenomena. These lists are generally ordered in themes and sub-themes, so as to enhance legibility of the performance of a nation or a region in the different dimensions of sustainable development. In the first consultation on indicators three lists of sustainable development indicators (SDI) were defined: economic, environmental and social. The first three ones are addressed by test case 1 in the first prototype, as following.

2.1 Economic indicators

2.1.1 Definition of economic indicators

An economic indicator (or business indicator) is a statistic about the economy. Economic indicators allow analysis of economic performance and predictions of future performance. In SEAMLESS, economic indicators can be understood as statistics that measure changes in the economic conditions of a certain agro-environmental system represented by a specific economic agent (farm, region, country).

2.1.2 Selected list of potential economic indicators for TC1

This following classification is made according to the model outputs and indicators provided by the different SEAMLESS models (see table 1). All indicators described are calculated per year:

- a) *Share of agriculture in the whole economy* (GTAP).
- b) *Total factor productivity indices* (GTAP).
- c) *Net value of capital*.
- d) *Activity level, production level and yields* (CAPRI, FSSIM/APES). The activity level corresponds to the number of hectares or heads of an agricultural activity. The production level to the number of tonnes of litters of a certain product. Yield is, logically, linked to these two previous variables.
- e) *Human consumption, processing and feed demand* (CAPRI). These are the main uses (demand types) of agricultural products.
- f) *Trade volume* (CAPRI). Corresponds to the number of tonnes of a product traded, either between two countries or as aggregated number (total imports/exports coming in/going out for a country or trade block).
- g) *Labour and land factor prices* (GTAP).
- h) *Producer and consumer prices* (CAPRI). These are respectively the prices received by the producers (model agents: farm, region, ...) and suffered by the taxpayers or consumers (society).
- i) *Agricultural income* (CAPRI). It is calculated according to the gross value added concept of the EAA. Costs for crop, animal, and other variable inputs, as reflected in the EAA, are deducted from the income of agricultural producers (agricultural gross value added at market prices). Income from premiums in a respective region is added to the producers' market income.
- j) *Profits from the processing industry* (CAPRI). Production of processed products in the dairy and oilseed industry is evaluated with the derivative of the normalised

quadratic profit function. As an exception, production of milled rice is calculated through fixed processing factors.

- k) *Budgetary expenditure* (CAPRI). It comprises all direct payments for agricultural commodities (premiums included in the first pillar of the CAP), export subsidies, costs for intervention purchases, and processing, feed industry, and consumption aid. This corresponds to the FEOGA budgetary costs included in the first pillar for each of the supported production programs.
- l) *Tariff revenues* (CAPRI). They result from the application of import tariffs. They are calculated by multiplying tariffs with valued import flows, and summing over all product lines. The administrative costs of the tariff system (including TRQs) are not considered in the analysis.
- m) *Money metric utility measure* (CAPRI). The money metric measure is the minimal expenditure needed for consumers to reach the utility level of the simulation scenario at prices of the reference scenario (Varian 1992, p. 110).
- n) *Welfare* (CAPRI). The welfare measure in CAPRI is based on production and consumption shifts of agricultural primary goods due to endogenous prices. An aggregate of 'all other goods' is additionally included in order to close the demand balance. Changes in welfare are endogenously driven by price changes. Following a standard welfare analysis, total welfare is decomposed into the sum of *agricultural income* (welfare gain of producers), *money metric* (welfare gain of consumers), *profits by processing activities* (welfare gain of the agro-industry), and *tariff revenues* (welfare gain of the public sector), minus *budgetary expenditure* (welfare loss from taxpayers):

Table 1. Model output for economic indicators

Outputs for economic indicators	Model	Data	Unit	Scale / Level							Grid	Comments
	Name	Name of data bases involved		Global (main trade blocks)	EU	MS	Nuts 2	Sample/ test case regions	Farm Type	HRU		
Share of agriculture in the global economy	GTAP	GTAP	Share	x	x	x						
Total factor productivity indices	GTAP	GTAP	index or % change	x	x	x						
Net value of capital	GTAP	GTAP	% change	x	x	x						
Activity level of agricultural activities	CAPRI	CAPREG	Hectares/heads		x	x	x	x	x	x	x	
	FSSIM	FADN	Hectares/heads					x	x			Only sample regions, only crop products (18MPROTO)
Yields for agricultural activities	CAPRI	CAPREG	Tonnes/ha or head		x	x	x	x	X	x	x	
	FSSIM	FADN+APES output	Tonnes/ha					X	x			Only sample regions, only crop products (18MPROTO)
Production of agricultural products	CAPRI	CAPREG	Tonnes	x	x	x	x	x	x	x	x	
	FSSIM	FADN-FSSIM_DB	Tonnes					x	x			Only for current activities FADN is a reference for calibration
Production variability	APES-FSSIM		t/ha						x			
Human consumption of main agricultural products	CAPRI	CAPREG	Tonnes	x	x							
Processing of sugar, rice, oils and dairy products	CAPRI	CAPREG	Tonnes	x	x							
Feed demand	CAPRI	CAPREG	Tonnes	x	x							
Trade flows of main	CAPRI	CAPREG	Tonnes	x	x							

Outputs for economic indicators	Model	Data	Unit	Scale / Level							HRU	Grid	Comments
	Name	Name of data bases involved		Global (main trade blocks)	EU	MS	Nuts 2	Sample/ test case regions	Farm Type				
agricultural products													
Trade volume (M,X) of main agricultural products	CAPRI	CAPREG	Tonnes	x	x								
	GTAP	GTAP	% change or US\$ or EURO	x	x	x							
Producer and consumer prices of main agricultural products	CAPRI	CAPREG	Euro per tonne	x	x	x							
Labour factor price	GTAP	GTAP	% change	x	x	x							
Land factor price	GTAP	GTAP	% change	x	x	x							
Import and export prices	CAPRI	CAPREG	Euro per tonne	x	x								
Money metric (=consumer surplus)	CAPRI	CAPREG	Euro	x	x	x							
Agricultural income (=value added)	CAPRI	CAPREG	Euro	x	x	x	x	x	X				
	FSSIM	FADN-FSSIM_DB	Euro						x	X			Only sample regions, only crop products (18MPROTO)
. Total revenues	CAPRI	CAPREG	Euro and Euro/ha or head	x	x	x	x	x	X				
	FSSIM	FADN-FSSIM_DB	Euro and Euro/ha						x	X			Only sample regions, only crop products (18MPROTO)
. Total costs	CAPRI	CAPREG	Euro and Euro/ha or head	x	x	x	x	x	X				
	FSSIM	FADN-FSSIM_DB	Euro and Euro/ha						x	X			Only sample regions, only crop products (18MPROTO)
. Gross margins	CAPRI	CAPREG	Euro and Euro/ha or	x	x	x	x	x	X				

	Model	Data	Unit	Scale / Level							HRU	Grid	Comments
	Name	Name of data bases involved		Global (main trade blocks)	EU	MS	Nuts 2	Sample/ test case regions	Farm Type				
Outputs for economic indicators			head										
	FSSIM	FADN-FSSIM_DB	Euro and Euro/ha					x	X			Only sample regions, only crop products (18MPROTO)	
Outlays on domestic support	CAPRI	OECD	Euro	x	x								
Outlays on CAP premiums (direct payments)	CAPRI	CAPREG	Euro and Euro/ha or head		x	x	x	x	x				
	FSSIM	FADN-FSSIM_DB	Euro and Euro/ha					x	x				
Profits of the processing industry (sugar, rice, oils) and dairy industry	CAPRI	CAPREG	Euro	x	x	x							
Tariff revenues	CAPRI	AMAD	Euro	x	x	x							
Budgetary outlays (first pillar of the CAP)	CAPRI	CAPREG	Euro		x	x							
. Export subsidies outlays	CAPRI	DG-AGRI, WTO	Euro		x	x							
. Intervention stocks costs	CAPRI	DG-AGRI	Euro		x	x							
Total welfare	CAPRI	(composite indicator)	Euro	x	x	x							

2.2 Environmental indicators

2.2.1 Definition of environmental indicators

According to the European Environmental Agency's glossary, an environmental indicator is a parameter or a value derived from parameters that has been specified to describe a change in the bio-physical environment that is of concern to ecosystems, material and human development'

2.2.2 Towards test case 2

Environmental indicators will become a very important issue in test case 2, which deals with the application of different management technologies in agriculture and the responses of the sector to the main environmental directives in a more developed stage of SEAMFRAME. In the 18MPROTO, therefore, only a limited amount of model output related to environmental indicators will be available (see table 2), mainly relating to passive indicators calculated based on information handled internally by economic models. These indicators are, however, of high relevance, since they address from an aggregated perspective an environmental externality in agriculture.

2.2.3 Selected list of potential environmental indicators for TC1

The potential environmental indicators for test case 1 are mainly calculated by CAPRI (for the whole Europe) and APES/FSSIM (for the sample regions).

Table 2. Model output for environmental indicators

Environmental Indicators	Model Name	Data Name of data base	Unit	Scale / Level							Grid	Comments
				Global (main trade blocks)	EU	MS	Nuts 2	Sample regions	Farm Type	HRU		
NPK balance	CAPRI	(composite indicator)	Tonnes and t/ha		x	x	x	x	x	x		
. N fixation	CAPRI	CAPREG	Tonnes and t/ha		x	x	x	x	x	x		
. NPK import in atmospheric deposition	CAPRI	CAPREG	Tonnes and t/ha		x	x	x	x	x	x		
. NPK import in mineral fertiliser	CAPRI	CAPREG	Tonnes and t/ha		x	x	x	x	x	x		
. NPK import in organic fertiliser	CAPRI	CAPREG	Tonnes and t/ha		x	x	x	x	x	x		
. NPK export in crop harvesting	CAPRI	CAPREG	Tonnes and t/ha		x	x	x	x	x	x		
. N export in ammonia losses	CAPRI	CAPREG	Tonnes and t/ha		x	x	x	x	x	x		
. NPK export in crop harvesting	CAPRI	CAPREG	Tonnes and t/ha		x	x	x	x	x	x		
Methane emissions	CAPRI	CAPREG	Tonnes and t/ha		x	x	x	x	x	x		Based on IPCC rules
. Methane emissions from rice fields	CAPRI	CAPREG	Tonnes and t/ha		x	x	x	x	x	x		Based on IPCC rules
. Methane emissions from animal production	CAPRI	CAPREG	Tonnes and t/head		x	x	x	x	x	x		Based on IPCC rules
Nitrous oxide emissions	CAPRI, FSSIM/APES	CAPREG	Tonnes and t/ha		x	x	x	x	x	x		Based on IPCC rules
. Nitrous oxide emissions from manure handling	CAPRI	CAPREG	Tonnes and t/ha		x	x	x		x	x		Based on IPCC rules
. Nitrous oxide emissions from soils	CAPRI	CAPREG	Tonnes and t/ha		x	x	x		x	x		Based on IPCC rules
Global warming potential	CAPRI	CAPREG	CO2 equivalents		x	x	x		x	x		Based on IPCC rules
Soil eroded (yearly	APES-FSSIM		t/ha						x			outputs are a

Environmental Indicators	Model	Data	Unit	Scale / Level							Grid	Comments
	Name	Name of data base		Global (main trade blocks)	EU	MS	Nuts 2	Sample regions	Farm Type	HRU		
cumulated)												Calculated at field level, The upscaling to regions requires the development of modelling procedures.
Soil eroded (peak)	APES-FSSIM		t/ha						x			
N leaching (yearly cumulated)	APES-FSSIM		kg/ha						x			
N leaching (variability)	APES-FSSIM		kg/ha						x			
Soil Organic Matter trend	APES-FSSIM		t/ha*year						x			
Ammonia volatilization (yearly cumulated)	APES-FSSIM		kg/ha						x			
GHG emissions (yearly cumulated)	APES-FSSIM		kg/ha						x			
Water drainage (yearly cumulated)	APES-FSSIM		m3/ha						x			
Water drainage (variability)	APES-FSSIM		m3/ha						x			
Water surface runoff (yearly cumulated)	APES-FSSIM		m3/ha						x			
Chemicals leaching (yearly cumulated)	APES-FSSIM		kg/ha						x			
Chemicals leaching (variability)	APES-FSSIM		kg/ha						x			
Water use (yearly cumulated, mean across PE)	APES-FSSIM		m3/ha						x			
Water use (yearly variability, mean across PE)	APES-FSSIM		m3/ha						x			
Landscape attributes	APES-FSSIM (via post-model analysis T3.7)							x				
Biodiversity attributes	APES-FSSIM (via post-model analysis T3.7)							x				

2.3 Social indicators

2.3.1 Definition of social indicators

Social indicators of development are statistics for assessing human welfare to provide a picture of the social effects of economic development (World Bank, 1995). Social indicators are an important tool for evaluating a country's level of social development and for assessing the impact of policy. Such indicators are already in use in investigating poverty and social exclusion in several European countries and have begun to play a significant role in advancing the social dimension of the EU as a whole (Atkinson et al., 2002)

2.3.2 Towards future prototypes

In SEAMLESS the analysis of several social and institutional indicators is foreseen. Ambitions for this in the first prototype are limited, as only a limited amount of model outputs from aggregated models are included (the basis of these indicators) and the FSSIM models will not be still fully developed. The estimation of social indicators in SEAMLESS is mainly based on econometric approaches (e.g. cohort analysis for employment and gender indicators). For the TC1/18MPROTO, therefore, only some scattered indicators will be calculated, as confirmed by the several modelling leaders. This is presented in table 3.

2.3.3 Selected list of potential social indicators for TC1

Since CAPRI does not endogenously cover social indicators, GTAP and FSSIM are left with the task of coming up with reliable social indicators. Nevertheless, in task 3.9 several econometric approaches for the calculation of labour and gender indicators will be developed and coupled to CAPRI results. This is an important part of sustainability and will have to be reinforced in the future prototypes of the project.

Table 3. Model output for social indicators

Social Indicators	Name	Name of data base	Unit	Global (main trade blocks)	EU	MS	Nuts 2	Sample regions	Farm Type	HRU	Grid	Comments
Food availability	GTAP	GTAP		x								For developing countries
Food access (food purchasing power)	GTAP	GTAP		x								For developing countries
Labour	APES-FSSIM (via post-processing)		months/man						x			

3 Concluding remarks

This deliverable identifies and defines a selected list of model outputs to be used in the calculation of indicators for test case 1 in the 18th month prototype. The selection is based on the models and model links included in SEAMFRAME in month 12 (see PD6.2.3). In its construction the main leaders of Work Package 2, 3 and 6 have been consulted. Nevertheless, there is still some uncertainty about the model outcomes in month 18 and further consultation with the rest of modelling leaders will be needed.

This deliverable has to be interpreted as a look in the 'real' application of SEAMLESS tools in an early phase of the project (with all sort of problems attached to it), in this case the definition of indicators. This work is based on a selected list of consolidated economic indicators calculated by the CAPRI model (central modelling component for test case 1) and environmental indicators calculated by FSSIM/APES. It serves as a starting point for future prototypes and extensions to test case 2.

Note: a more detailed specification of the listed indicators according to definition, coverage, collection, calculation and source is proposed for a revised version of PD621 in month 14. For this task, however, detailed information from the partners will be needed.

Glossary

<i>Indicator</i>	number or ratio (a value on a scale of measurement) derived from a series of observed facts; can reveal relative changes as a function of time
<i>Spatial dimension</i>	the magnitude of something in terms of surface (applied to the regional definition of the models)
<i>Money metric</i>	minimal expenditure needed for consumers to reach the utility level of the simulation scenario at prices of the reference scenario

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