Prototypical Policy Impacts on Multifunctional Activities in rural municipalities

A collaborative project under the EU Seventh Framework Programme

KEY ECONOMIC AND DEMOGRAPHIC FACTORS AT EUROPEAN AND GLOBAL LEVEL DRIVING LAND USE PATTERNS AT A RANGE OF SCALES

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COOPERATION

PRIMA aims to develop a method for scaling down the analysis of policy impacts on multifunctional land uses and on the economic activities. The scoped policies will include the cohesion policy (ERDF, ESF, CF), the enlargement process (IPA) & the rural development policy (EAFRD) of the European Commission, with a special focus on agriculture, forestry, tourism, and ecosystem services. The approach will: rely on micro-simulation and multi-agents models, designed and validated at municipality level, using input from stakeholders; address the structural evolution of the populations (appearance, disappearance and change of agents) depending on the local conditions for applying the structural policies on a set of municipality case studies. Involving eleven partners, the project is coordinated by *Cemagref*.

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EXECUTIVE SUMMARY

This report contains a description of a baseline scenario that may be used as background for the simulation experiments in the PRIMA project. At this moment it is not useful to define different scenarios, because in the case studies the stakeholders don't reflect explicitly on different scenarios. As a consequence, the roughly expected development is the best point of reference for these case studies. One baseline is also sufficient to develop the whole PRIMA system. This system consists on the one hand of a worldwide simulation with LEITAP/IMAGE, and a downscaling method of the LEITAP results from national to NUTS2 level. On the other hand the PRIMA system has agent based modelling at a local scale, partly based on stakeholder interviews, and an upscaling method to NUTS2 level.

The baseline takes the USDA projections of population and GDP as a starting point. Crude oil production projections are based on IEA projections, while land productivity projections are based indirectly on FAO projections. The distribution of technological change is based on a historical study about differences in productivity growth between different sectors. The paper shows the general tendencies in agriculture, forestry, and services as projected by the LEITAP model, based on the assumptions described above, and discusses some ideas for improvement of this modelling exercise. Finally, it summarizes shortly the main variables that have to be downscaled in deliverable 5.3.

1 INTRODUCTION

1.1 Objective

This document describes the assumptions for the macroeconomic baseline that is used in the PRIMA project for downscaling. The purpose of the baseline is to have a plausible development of the world population and economy. The assumptions are defined at the level of the LEITAP/IMAGE model as used in this project, where the economic developments of most EU-countries are modelled explicitly and the rest of the world is divided into regions that contain groups of countries. The main drivers are population, technological change, and the depletion of some important natural resources like crude oil. The available physical area is also included explicitly in the model. All other factors are determined by mechanisms in the model, where the model guarantees consistency across sectors and countries. For the baseline we assume a minimum number of changes.

The purpose of the baseline is to provide an indication of the future development of the European economy. Such a baseline should be roughly consistent with expectations of the stakeholders in the interviews for WP2, so should not be very extreme. Because it is too complicated to ask stakeholders for different scenarios, and it is almost impossible to translate different developments in a simple way to local level conditions, certainly as long as no downscaling method is available, it is not useful to have more than one scenario. Creating consistency between the different case studies is approximated because all are living in the same Europe at the moment. Most stakeholders don't anticipate a lot of changes except for tendencies that are already on their way. For this reason, a baseline with minor policy changes is the best point of reference, both for downscaling macroeconomic predictions to a NUTS2 regional level and upscaling story lines and its outcomes at a local level to the NUTS2 regional level.

For developing and testing the modelling approach in PRIMA the one simple baseline approach seems to be best. When the whole system is available, it may be useful to develop different macro-scenarios in order to investigate how different international developments and policies influence local scenarios and possible policies.

In this document we first describe the source of the data (chapter 2) after which we give a glimpse of the content of these assumptions and its consequences through the LEITAP model (chapter 3). Then we discuss shortly some improvement of the LEITAP model that will be further developed in deliverable 5.2.

2 THE SOURCES OF THE BASELINE

The baseline discussed in this document is a point of reference for is implicit in the case studies. The factors that influence trends and driving forces are a

starting point for this baseline. The baseline shows the consequences as generated by the LEITAP model. When policy experiments will be accomplished, this will have effects compared with the baseline.

2.1 The base year database

The current projections are based on the 2001 GTAP database, where some information about current land use is added, based on FAO-data. At this moment there is a 2004 database available, but the first version didn't have the required quality for agricultural analysis. We will investigate to what extend the recent release of an improved version of the 2004 database is sufficient for our purposes.

For the simulations we will use 2010 as a base year. This implies that the database of 2001 or 2004 has to be updated. In any case, we update GDP, population, and crude oil production with their most recent available estimates. Also ethanol and biodiesel production is updated till this year. We extend the EU with the new member states, adjusting import and export tariffs as well as agricultural factor subsidies consistently. We adjust for EU-policy changes in the period between the base year and 2010. This includes decoupling and the dairy, cattle and sugar reforms.

2.2 USDA Population and GDP projections

The USDA publishes population and GPD projections till 2030 (http://www.ers.usda.gov/Data/Macroeconomics/#BaselineMacroTables). Their population projections are based on detailed international projections from the US Census Bureau (Census Bureau International Population Database, to be found in http://www.census.gov/ipc/www/idb/estandproj.php). The GDP series starts with the 2005 U.S. dollar GDP series derived from the latest edition of the World Bank's *World Development Indicators* and is filled in using other data sources such as Oxford Economic Forecasting, Global Insight, Project Link, and the International Monetary Fund's *International Financial Statistics*. Conversion to dollars is based on a fixed 2005 exchange rate.

The advantage of using the USDA series is that they are available at a low aggregation level, i.e. 190 countries and 34 regions of the world, are consistent and easily accessible.

Based on the USDA population projections and the GDP projections it is assumed that labour supply follows population and capital growth equals GDP growth. This last assumption is consistent with the stylized facts of economic growth, one of which is that the capital-output ratio is roughly constant over time. For natural resource growth it is assumed that it is 25% of GDP growth. Available land is based on information from the IMAGE model that is derived from FAO statistics.

Based on the GDP projections, technology in the model is calibrated by swapping technology with GDP in the first model run. This calibrated technology is used in all simulations. In the calibration procedure it is assumed that productivity growth is generated by different speeds of technology growth in dif-

ferent sectors. The relative sectoral growth rates are based on Kets and Lejour (2003) who have examined the historical developments in sectoral total factor productivity in OECD countries between 1970 and 1990. This implies that primary agriculture has a much faster growth rate than services and even than a lot of industrial sectors. Next to the decisions of the distribution of technology over sectors, also decisions had to be made about the distribution of this productivity over different production factors. We assume that changes in productivity are mainly in labour saving technology. Also intermediate goods and to a less extend also in intermediate inputs and natural resource saving technology. It is a stylized fact of economic growth history that capital intensity does not change, which implies a zero increase in capital productivity. Improvements in capital goods generate savings in the other production factors.

2.3 IEA Crude oil production projections

In the World Energy Outlook 2009 the IEA suggests that crude oil prices will rise to 120 dollars per barrel. For the moment we don't follow this projection directly, but use the IEA projections of crude oil production and make the projections of energy prices based on the structure of the LEITAP model. As far as these are different from IEA, it may be worthwhile to investigate the reasons for their difference.

2.4 FAO/PBL land productivity projections

Land productivity projections are based on FAO projections till 2030 as used in the study World Agriculture: Towards 2015/2030 - An FAO Perspective (Bruinsma, 2003). These projections are made consistent with the IMAGE land use database, and include adjustments for the quality of land that is used consistent with the IMAGE land allocation and climate model.

2.5 Policy assumptions

For the baseline we implement only currently planned policies. We assume that the nominal EU budget remains constant with 2% inflation. So, the real budget is reduced with 2% a year. We implemented a cattle market reform in the period 2001-2004, a milk reform in the period 2004-2007, and a sugar reform in the period 2007-2010. In the period 2001-2004 the EU is extended till 25 EU-members, and in the period 2004-2007 with two other EU-member (Bulgaria and Rumania). In the period 2004-2007 a type of decoupling is modelled, implemented as allocation of first pillar subsidies to land and equalizing the subsidy rate on land rates over sectors.

During the simulation milk and sugar quota in the EU are modelled, but during the simulation period, milk quota in the EU are abolished. This is done by increasing the quota by 6% in the period 2007-2010, and abolishing them completely afterwards.

For the Netherlands the sector "oap", i.e. pork and chicken, is made exogenous because the size of the sector is determined by the manure policy.

3 A SHORT CHARACTERIZATION OF THE BASELINE

For the macroeconomic simulations we use an aggregation with maximum consistency between the IMAGE model and LEITAP. Most countries of the EU27 are separated out. Only Bulgaria-Rumania, Belgium-Luxemburg, Cyprus-Malta and the Baltic countries are taken together. The rest of the world is divided in 23 regions, where large countries like the US, Canada, Japan, Brazil, China and India are separated out.

In the sketch below, we will aggregate information to the world, the EU15 (EU member states in 2000) and the EU12 (new EU member states) , High Income countries (USA, Canada, Australia, New Zealand), Central and South America, Asia, Africa and the Rest of the World (Russia, Turkey, and the rest of Europe).

3.1 GDP and population

Tables 1 and 2 show the assumptions about population and welfare growth between 2001 and 2030, according to the USDA database. We see in general a decrease in population growth rate, where population is decreasing in the EU12 and after 2020 also in the EU15. Population growth in Africa remains very high, but decreases gradually. Income per capita is growing fastest in the new EU member states, and also Africa is catching up a little bit, especially after 2020. The same assumption is made for Russia and Turkey (the rest of the world).

Table 1 | Yearly percentage population growth in the baseline

	World	EU15	EU12	HighInc	C&SAmer	Asia	Africa	ROW
2001-2004	1.21	0.27	-0.17	0.97	1.37	1.20	2.21	0.06
2004-2007	1.19	0.23	-0.16	0.95	1.33	1.18	2.15	0.08
2007-2010	1.17	0.19	-0.16	0.92	1.26	1.16	2.11	0.06
2010-2013	1.14	0.14	-0.18	0.89	1.20	1.13	2.06	0.03
2013-2020	1.05	0.07	-0.26	0.85	1.08	1.01	1.94	-0.04
2020-2030	0.87	-0.04	-0.43	0.80	0.88	0.79	1.75	-0.16
2001-2030	1.04	0.09	-0.28	0.87	1.10	1.00	1.96	-0.04

Source: LEITAP, based on USDA.

Table 2 | Yearly percentage growth of GDP per capita in the baseline

	World	EU15	EU12	HighInc	C&SAmer	Asia	Africa	ROW
2001-2004	1.55	1.18	4.27	1.64	1.18	2.74	2.17	4.06
2004-2007	2.44	2.18	5.88	1.71	3.63	4.07	3.32	5.12
2007-2010	0.57	0.23	4.42	-0.37	2.10	2.15	3.49	2.82
2010-2013	2.29	1.95	4.30	2.10	2.81	3.48	3.19	3.51
2013-2020	2.33	1.90	3.69	2.03	2.93	3.53	2.76	3.67
2020-2030	2.70	1.95	3.62	1.99	3.04	4.17	2.74	3.90
2001-2030	2.20	1.70	4.09	1.70	2.76	3.57	2.87	3.83

Source: LEITAP, based on USDA.

With respect to GDP per capita (table 2) it is assumed that high income countries show less growth than low income countries, where Africa is catching up much less than Asia because of its faster population growth and political instability. The new EU members are able to catch up from about 25% towards almost 50% of EU15 purchasing power corrected GDP per capita.

3.2 Agricultural production

Table 3 | Yearly growth of arable production per capita in the baseline

	World	EU15	EU12	HighInc	C&SAmer	Asia	Africa	ROW
2001-2004	1.64	1.18	1.91	1.80	0.70	1.90	1.31	4.86
2004-2007	1.52	1.37	1.68	0.62	2.84	1.55	1.71	4.04
2007-2010	0.12	-1.07	0.84	-1.75	1.14	0.34	2.03	1.40
2010-2013	0.75	0.33	0.81	1.43	1.34	0.60	1.53	2.16
2013-2020	0.46	0.14	0.63	0.87	1.00	0.35	0.98	1.88
2020-2030	0.61	-0.07	0.92	1.48	1.13	0.44	1.14	1.67
2001-2030	0.74	0.19	1.01	0.93	1.25	0.69	1.31	2.31

Source: LEITAP.

Agricultural production is determined by the LEITAP model. The location of production is determined by a combination of demand and supply factors. In general, arable production is growing less than GDP, because agricultural consumption is not very income elastic. For some commodities, like rice and wheat, the income elasticity of consumption is even negative. Because of differences in consumption growth, land availability and differences in the development of labour and capital cost (where the assumption that productivity growth is faster in agriculture than in the average economy is important) arable production is mainly taking place outside Western Europe.

The consequence of this distribution of production, land use growth is also distributed unequally over the world. We see a decline in land use in the EU15 (5% in 30 years), and a fast increase in land use in the rest of the world outside Asia.

Table 4 | Percentage growth of arable land in the baseline

	World	EU15	EU12	HighInc	C&SAmer	Asia	Africa	ROW
2001-2004	7.28	6.70	10.51	8.63	4.87	6.02	6.07	13.15
2004-2007	5.41	-7.64	4.35	3.27	10.19	4.60	8.36	10.22
2007-2010	1.68	-1.69	0.44	-5.01	5.07	2.42	8.26	-0.08
2010-2013	3.61	-0.74	0.23	5.69	4.74	1.50	7.80	3.16
2013-2020	5.93	-1.88	-1.45	9.02	8.03	1.68	14.08	5.95
2020-2030	12.99	-2.45	-1.57	27.57	14.30	5.33	22.35	6.73
2001-2030	42.59	-7.97	12.60	56.63	57.01	23.47	87.22	45.37

Source: LEITAP.

Table 5 | Percentage growth of agricultural land in the baseline

	World	EU15	EU12	HighInc	C&SAmer	Asia	Africa	ROW
2001-2004	2.21	0.88	14.20	2.63	0.87	2.33	0.53	7.44
2004-2007	2.90	-0.65	2.05	0.91	5.86	1.73	3.76	7.67
2007-2010	0.01	-1.13	0.30	-3.60	1.70	-0.14	3.23	-1.18
2010-2013	1.88	-0.44	0.08	2.33	2.07	0.11	5.10	1.51
2013-2020	2.33	-1.41	-1.04	2.41	2.45	-1.02	8.79	2.34
2020-2030	5.03	-2.13	-2.29	8.58	2.54	-0.37	14.79	1.76
2001-2030	15.19	-4.80	13.12	13.59	16.45	2.62	41.32	20.85

Source: LEITAP.

An important background of the land productivity growth is the growth in production per hectare. This production per hectare is especially fast in the livestock sectors, showing intensification of production. This intensification in livestock also explains partly why more arable land is needed for production. The projection of productivity growth of arable land is a little bit less than 40% in 30 years., where land productivity increases more in especially Africa.

Table 6 | Percentage growth of exogenous land productivity in livestock in the baseline

	World	EU15	EU12	HighInc	C&SAmer	Asia	Africa	ROW
2001-2004	10.29	0.51	0.58	7.75	9.14	9.49	16.67	8.61
2004-2007	10.52	0.51	0.58	7.90	9.16	9.56	16.91	8.66
2007-2010	10.75	0.51	0.58	8.05	9.19	9.63	17.15	8.71
2010-2013	7.79	0.15	1.42	5.90	6.86	7.69	10.81	6.86
2013-2020	19.46	0.36	3.37	14.55	16.79	19.01	27.27	16.85
2020-2030	21.43	-1.00	12.85	17.44	21.63	23.08	22.66	23.77
2001-2030	111.09	1.03	20.37	78.96	97.47	107.42	176.42	98.26

Source: LEITAP.

Table 7 | Percentage growth of exogenous land productivity of arable land in the baseline

	World	EU15	EU12	HighInc	C&SAmer	Asia	Africa	ROW
2001-2004	3.42	1.53	1.14	3.30	2.78	3.46	4.71	3.86
2004-2007	3.44	1.55	1.15	3.33	2.80	3.48	4.72	3.90
2007-2010	3.47	1.57	1.15	3.37	2.81	3.51	4.73	3.94

2010-2013	3.37	1.81	1.85	3.40	2.96	3.76	4.26	2.16
2013-2020	8.13	4.31	4.39	8.20	7.09	9.09	10.26	5.14
2020-2030	11.77	5.21	8.76	12.17	10.84	12.83	14.34	7.88
2001-2030	38.30	17.01	19.65	38.47	32.76	41.52	50.95	29.97

Source: LEITAP.

3.3 Forestry

The forestry sector is not well developed in the LEITAP model. It is assumed that natural resource increase and productivity increases. As a consequence, even in the EU15 a slight increase in forestry is possible. In the current baseline, the forestry sector develops especially in the rest of the world (Russia), Africa, the EU12 and some parts of Asia.

Table 8 | Yearly percentage growth of production in the forestry sector in the baseline

	World	EU15	EU12	HighInc	C&SAmer	Asia	Africa	ROW
2001-2004	0.99	0.25	1.26	0.26	0.23	2.15	1.45	1.55
2004-2007	1.63	0.45	2.97	-0.07	0.88	2.94	3.25	2.71
2007-2010	1.14	0.05	1.96	-0.51	0.34	2.16	3.34	1.87
2010-2013	1.53	0.27	1.90	0.29	0.76	2.45	3.15	2.09
2013-2020	1.57	0.23	1.58	0.30	1.08	2.51	2.29	2.44
2020-2030	1.97	0.44	1.96	0.43	1.54	3.04	1.54	3.18
2001-2030	1.61	0.31	1.89	0.22	1.02	2.66	2.24	2.53

Source: LEITAP.

3.4 Services

The service sector is not a growing sector in the sense of real value added, but because of its relatively slow increase in labour productivity, the service sector becomes more and more important sector in terms of employment. An important question is to what extend this employment in the service sector may generate employment in rural areas. To find this out is one of the challenges of the downscaling exercise.

Table 9 | Yearly percentage growth of employment in the service sector in the baseline

	World	EU15	EU12	HighInc	C&SAmer	Asia	Africa	ROW
2001-2004	0.93	0.57	0.55	1.12	1.50	0.72	2.42	0.85
2004-2007	1.01	0.65	0.63	1.19	1.71	0.79	2.35	0.78
2007-2010	0.77	0.44	0.33	0.99	1.53	0.45	1.97	0.49
2010-2013	0.91	0.58	0.46	1.14	1.53	0.57	2.10	0.69
2013-2020	0.85	0.55	0.38	1.10	1.42	0.44	1.99	0.61
2020-2030	0.79	0.52	0.27	1.08	1.22	0.26	1.76	0.44
2001-2030	0.85	0.54	0.39	1.10	1.41	0.46	2.00	0.59

Source: LEITAP.

4 LEITAP WISHLIST

The baseline results discussed in chapter 3 are a good starting point for the downscaling exercise. But at this moment it is not clear yet what exactly is coming out of the agent-based models. As a consequence, it is not wise to start with too much detail now. But there are already some elements in the modelling structure that would be nice if they could be improved. In the context of the PRIMA project, the focus is on downscaling and therefore not on improvement of the macroeconomic modelling structure. So, the discussion below provides some idea about possibilities and limitations of the LEITAP model. Some improvements, for example about forestry, may be implemented in an elementary way.

4.1 Tourism

Although it is planned that only the service sector is modeled at the LEITAP level, tourism seems an important sector at the level of the agent-based models. Regretfully, there is no tourism sector in the GTAP database, where even hotels and restaurants are not split out as a sector. Hotels and restaurants are part of the GTAP sector Trade, that mainly includes sectors that have nothing to do with tourism:

Table 10| Sectors included in the sector Trade (trd) of the GTAP database.

Sales, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
Wholesale trade and commission trade, except of motor vehicles and motorcycles
Non-specialized retail trade in stores
Retail sale of food, beverages and tobacco in specialized stores
Other retail trade of new goods in specialized stores
Retail sale of second-hand goods in stores
Retail trade not in stores
Repair of personal and household goods
Hotels and restaurants

Another sector that could be related with tourism is the sector Recreational, cultural and sporting activities. But also this sector includes a very diverse mix of sectors.

Table 11| Sectors included in the sector Recreational, cultural and sporting activities (ros) of the GTAP database.

Recreational, cultural and sporting activities
Other service activities
Private households with employed persons

Based on these problems, we may conclude that it is almost impossible to split out tourism in a reasonable manner. We have to find out if tourism can be included in some way in the downscaling method. The extend to which this is useful depends also on how much attention is paid to recreation in the case studies.

4.2 Forestry

Forestry is seen as an important sector in the PRIMA project. It is included explicitly in the GTAP database, but has no explicit land included in the GTAP database. But there seem to be opportunities to include land more explicitly into the database, as has been done by Purdue University. At this moment research is going on to what extend it is possible to implement forestry as a land using sector in the PRIMA project.

Forestry is a very general sector in the GTAP database. It consists of Forestry: forestry, logging and related service activities. Its main customer is the lumber industry, producing wood and products of wood and cork, except furniture; articles of straw and plaiting materials. Also the paper industry and chemical industry are important customers. At this moment all these industries are included in one large industry sector. When relevant, lumber, paper and chemical industry may be split out. This has to be determined if in the case studies these industries seem to be relevant.

4.3 Land use

The substitution between different land uses in LEITAP is based on the assumption that there is an average land prices for the average type of land, and that these land prices may differ between different uses of land. It is assumed that the land price of extra land for a specific crop increases the land price for this crop, while a reduction of land use for a crop reduces the land price. This is a very rough assumption. When in the case studies or the agent-based modeling exercise some useful information becomes available to improve on this assumption, this may help to improve the reliability of the LEITAP predictions.

5 VARIABLES FOR DOWNSCALING

The LEITAP model generates the following variables that may be important to downscale to a NUTS2 level:

- population
- GDP per capita
- Production per sector
- Land use per agricultural sector and when implemented also land use in forestry. Nature has to be derived indirectly during the down-scaling method.
- Land use intensity and land productivity. This is essential information to calculate information in
- Farm income and farm income per worker
- Employment per sector

Because there is an interdependency of different activities, it is important to do the downscaling for the whole economy, i.e. all sectors should be included in the downscaling method.

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