VOLANTE

VISIONS OF LAND USE TRANSITIONS IN EUROPE

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Description of a coupled macroeconomic, multi-sector analysis at global scale with first simulation results

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COOPERATION

Contents

Chapter 1: Introduction

This deliverable describes results for 4 marker scenarios from the global models in the top-down analysis in WP7, which provide the boundary conditions for in-depth analysis at the level of EU-27, individual member countries as well as sub-national levels. The 4 marker scenarios will also provide a starting point for a larger number of policy scenarios to be analysed in the next steps of the VOLANTE project.

The VOLANTE top-down modelling framework has been developed to serve the stakeholder discussions and roadmapping in module Visions by adequate information that can fuel discussions and provide quantitative assessments to support the final roadmapping exercise. Selected scenario results have already been used in 4 visions workshops which have been conducted by Module Visions in June and September 2012.

The objectives of WP7 are to enable integrative land system change assessment by integrating land use models across different sectors and spatial scales (from global to sub-national); to integrate impacts of policy parameters such as taxes, land use regulations and international trade policies on land system change; to understand and explore the interactions between land-use relevant sectors; and to integrate land management information in spatial land allocation models for Europe.

The overall concept of the modelling approach has been described in detail in Deliverable D5.1. Here we will only focus on necessary updates compared to the initial modelling and scenario approach. Detailed descriptions of the involved models and a list of potential outputs are also provided in D5.1. Here we will focus on exemplary results which are relevant for further steps in VOLANTE, especially more detailed analyses in the full top-down modelling chain, which will be provided in Deliverable 7.2.

The coupled macroeconomic, multi-sector analysis at global scale combines the macroeconomic growth model ReMIND, combined with the global land use model MAgPIE; the global Computable General Equilibrium Model LEITAP/MAGNET; the global forestry model EFI-GTM; and a global assessment of expansion of urban areas by JRC.

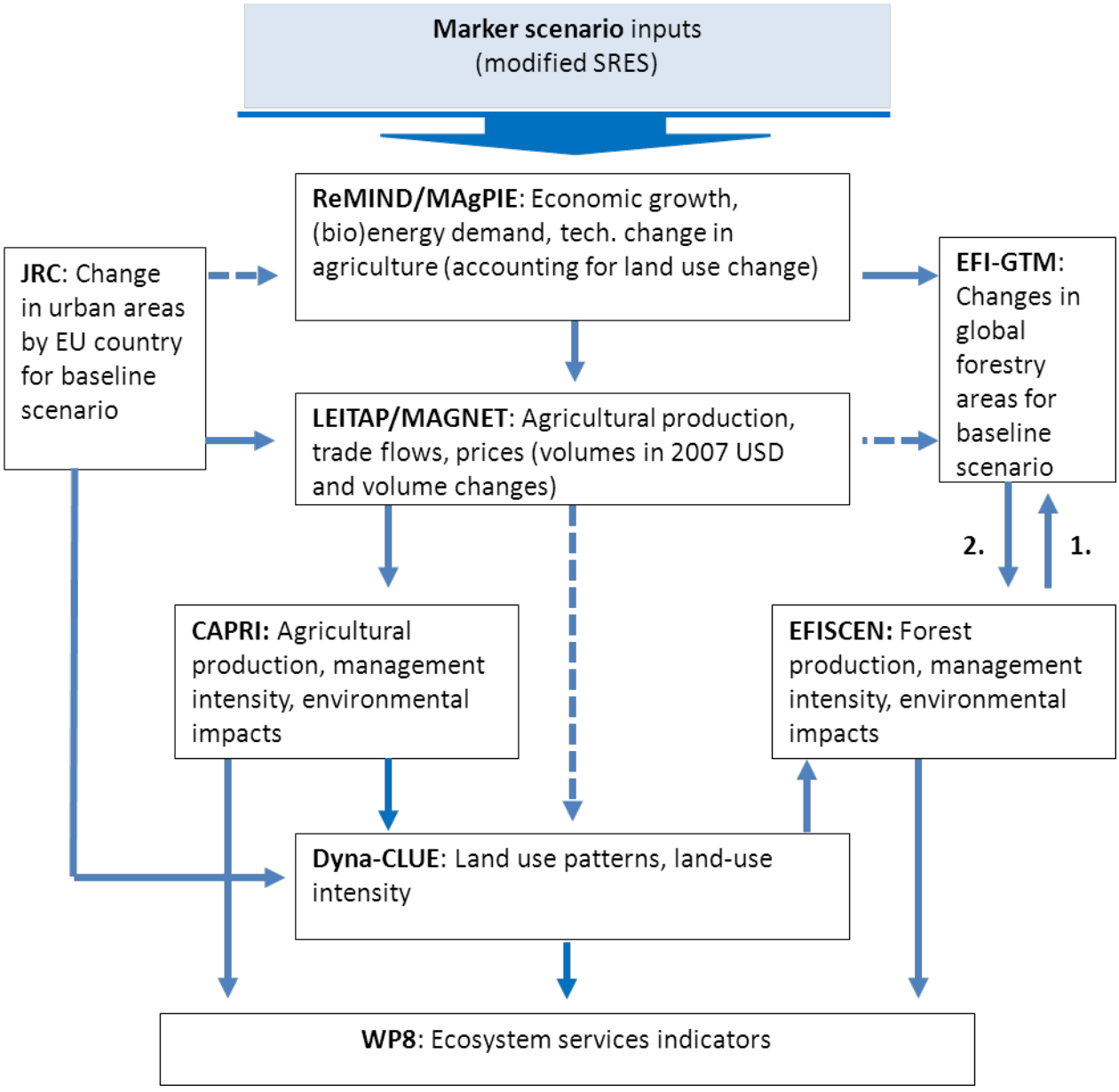
Chapter 2: Update on the joint modelling approach and data flow

Compared to D5.1 there have been minor updates to the data flow in the top-down modeling chain, as described in Fig. 1. Based on a number of general assumptions, according to the storylines of 4 modified SRES marker scenarios (see Chapter 3), the modeling chain starts with the combined ReMIND/MAgPIE models. They use exogenous inputs on population growth as well as assumptions on international trade (liberalized vs. regulated), food demand patterns (high vs. low meat consumption), land use regulation (strong vs. weak forest protection in tropical areas), and bioenergy demand (depending on climate mitigation targets). The ReMIND model then generates GDP growth rates for 10 world regions, which takes feedbacks from land-use constraints in the MAgPIE model into account. Due to time constraints and the sequence of model outputs, the change in urban areas for non-European regions, based on JRC calculations, could not be taken into account for the four marker scenarios at this stage. For the marker scenarios it has been assumed that the feedback of urban land expansion on GDP growth is minor in the ReMIND model. The sensitivity of this assumption will be tested later in the project, as part of the policy scenario analysis.

Population numbers, GDP growth rates, dietary patterns, and required areas for second-generation bioenergy crops have then been delivered to the LEITAP/MAGNET model and to the EFI-GTM model. Changes in urban areas have been provided by JRC. These are used as an input by LEITAP/MAGNET, which then calculates changes in worldwide land use, changes in agricultural production and consumption, changes in bilateral trade flows by sub-sector and region, and changes in agricultural prices for key commodities. With regard to changes in agricultural productivity, LEITAP/MAGNET makes assumptions on exogenous yield trends, which are combined with endogenous processes of factor substitution.

Based on changes in GDP and population, the EFI-GTM model provides future trends in forest production by sub-sector, forest product trade by sub-sector, and forest product prices.

Figure 1: Data flow and top-down modeling chain
(Status: October 2012)



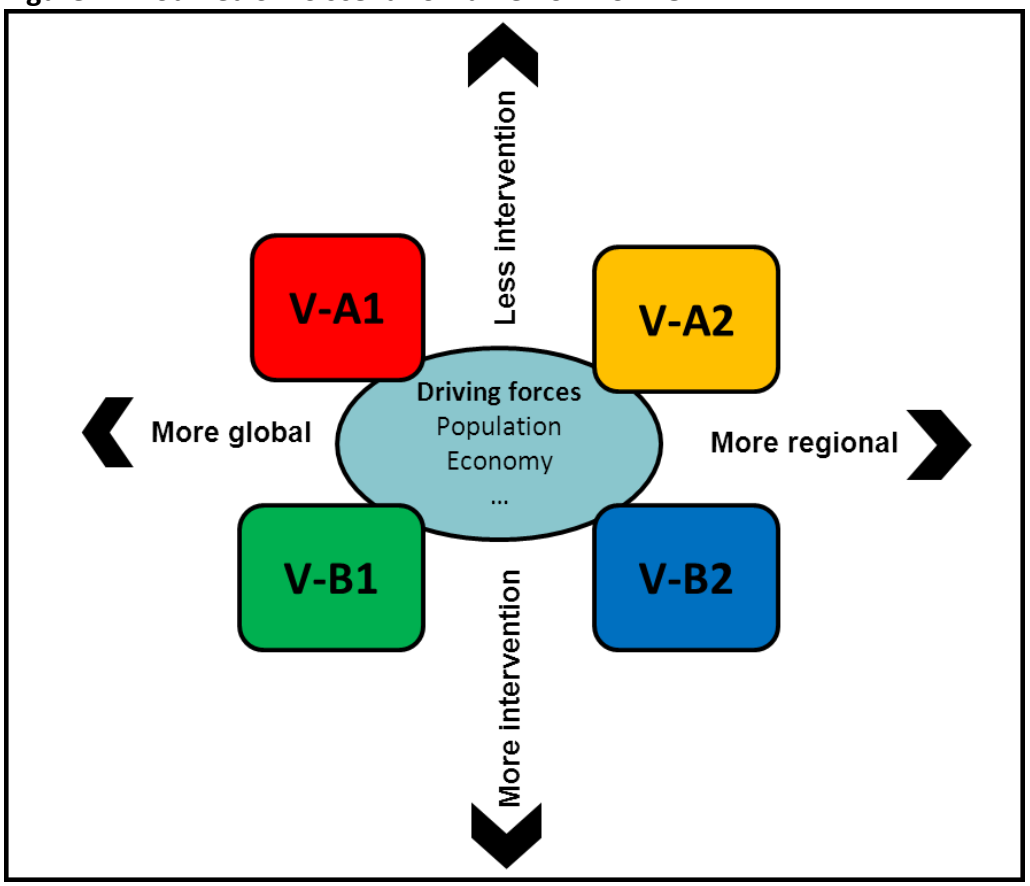
Chapter 3: Marker scenario specification for model implementation

Four VOLANTE marker scenarios have to be jointly developed by Module Assessment (WP7) and Module Visions (WP9), in order to assure a pragmatic approach for the model applications. Basic settings for the SRES scenarios have been modified according to specific VOLANTE requirements.

Compared to the original SRES scenarios, the axis "regional vs. global development" has been kept, whereas the axis "economic vs. environmental priority" has been replaced by "less intervention vs. more intervention" (s. Figure 2). This assures a better representation of

(i) land-use relevant aspects
(ii) the fact that more environmental does not necessarily mean less economic (as assumed in SRES)
(iii) endogenous representation of GDP in the VOLANTE WP7 modeling approach.

Figure 2: Modified SRES scenario framework for VOLANTE



The brief narratives for these marker scenarios are as follows:

V-A1 represents a globalised world with strong economic growth, high growth of food and feed demand, weak regulation on land use change, declining tropical forest areas, a fully liberalized CAP, and phased-out bioenergy mandates.

V-A2 represents a fragmented world with modest economic growth, high population growth, high growth of food and feed demand, weak regulation on land use change, declining tropical forest areas, no change in the CAP, and phased-out bioenergy mandates.

V-B1 represents a sustainable world with modest economic growth, slow growth of food and feed demand, strong regulation on land use change, protected tropical forest areas, a liberalized CAP, and modest bioenergy demand.

V-B2 represents a fragmented world with modest economic growth, modest growth of food and feed demand, some regulation on land use change, some protection of tropical forest areas, no change in the CAP, and modest bioenergy demand.

Table 1 provides an updated overview specification of four marker scenarios, appropriate for global model implementation in WP7. A more detailed table on specific model parameters and settings at different scales is provided in the Annex and in the attached Excel file. Later in the project, the four marker scenarios will be further disaggregated into a larger number of policy scenarios on specific land use aspects.

Table 1: Updated marker scenario specification for global modeling in VOLANTE (modified SRES scenarios)

	V-A1	V-A2	V-B1	V-B2
Population	8.5 billion people in 2040	10.3 billion people in 2040	8.5 billion people in 2040	8.9 billion people in 2040
Trade	Stepwise trade liberalization	No trade liberalization	Stepwise trade liberalization	Higher import tariffs
Food Demand	Increasing demand per capita for calories & livestock products (linked to income growth)	Increasing demand per capita for calories & livestock products (linked to income growth)	Equal per capita consumption around the world, sustainable diet ("contraction and convergence")	Increasing demand per capita for calories & livestock products (related to income growth)
Land-Use	Weak regulation, e.g. declining forest area	Weak regulation, e.g. declining forest area	Global land use regulation for climate mitigation, forest protection & biodiversity conservation (constant forest area)	Regionally specific land use regulation for climate mitigation, forest protection & biodiversity conservation (constant/declining forest area)
Bioenergy	Bioenergy (global supply) for baseline use [no global agreement on CC mitigation]; biofuel targets phased out	Bioenergy (regional supply) for baseline use [no global agreement on CC mitigation]; biofuel targets phased out	Bioenergy (global supply) for CC mitigation [global agreement on CC mitigation]; medium bioenergy shares	Bioenergy (regional supply) for baseline [regional agreements on CC mitigation]; medium bioenergy shares
Climate Change	Medium level of emissions (CC: ca. +3C in 2100); medium climate impacts	High level of emissions (CC: GMT ca. +4C in 2100); medium climate impacts	Low Level of Emisions (CC: ca. +2C in 2100); medium climate impacts	Not represented in AR4 Assumed low to medium level of emissions; medium climate impacts
CAP reform (until 2020 plus extrapolation)	Fully liberalized: full abolition of Pillar 1 and 2 . CAP budget will be zero.	No change. CAP budget constant.	Fully liberalized: full abolition of Pillar 1 and 2 . CAP budget will be zero.	No change. CAP budget constant.

Chapter 4: Marker scenario results from global models

In this chapter a selection of global model outputs will be presented, based on the four marker scenarios as described above. Results in this report will be presented mainly in the form of graphs. Detailed model results and outputs on a large number of indicators are available on the WP7 FTP site, as described in D5.1.

This overview of results demonstrates that the global modeling chain is operational. A number of useful results have been generated for the four marker scenarios, which can be used for the conceptual development of the pathway and trade-off analyses in module Visions.

Table 2 provides figures on population for 10 world regions, based on the original SRES scenarios, for the A1 and B2 scenarios.

Table 2. Population (in million)

A1	AFR	CPA	EUR	FSU	LAM	MEA	NAM	PAO	PAS	SAS	World
2005	776	1440	598	289	557	368	319	154	460	1515	6476
2010	878	1473	596	293	593	412	332	157	487	1631	6852
2015	983	1504	603	297	628	458	345	158	513	1741	7229
2020	1087	1527	608	299	659	503	359	159	538	1843	7582
2025	1184	1538	613	301	687	547	372	160	559	1932	7893
2030	1268	1536	616	303	710	588	385	160	578	2006	8150
2035	1333	1524	619	304	728	624	397	160	593	2061	8343
2040	1398	1502	618	304	742	658	407	160	605	2107	8501
B2	**AFR**	**CPA**	**EUR**	**FSU**	**LAM**	**MEA**	**NAM**	**PAO**	**PAS**	**SAS**	**World**
2005	790	1417	590	285	548	370	319	152	481	1548	6500
2010	899	1469	585	287	585	412	331	153	507	1666	6894
2015	1017	1522	587	289	621	454	345	153	532	1772	7291
2020	1142	1571	587	289	654	494	358	152	555	1876	7678
2025	1268	1611	587	289	685	533	369	151	578	1976	8047
2030	1391	1638	584	289	715	571	375	149	601	2068	8380
2035	1509	1656	579	288	742	607	379	146	621	2152	8679
2040	1614	1670	573	287	766	640	381	145	637	2226	8939

Note: AFR: Sub-Saharan Africa; CPA: Centrally-planned Asia (incl. China); EUR: Europe (incl. Turkey); FSU: Former Soviet Union; LAM: Latin America; MEA: Middle East and North Africa; NAM: North America; PAO: Pacific OECD (Japan/Australia/New Zealand); PAS: Pacific Asia; SAS: South Asia (incl. India)

Table 3 provides figures on GDP per capita for 10 world regions and world averages from the ReMIND/MAgPIE models, for the A1 and B2 scenarios.

Table 3: GDP per capita (measured in constant 2005 US$)

A1	AFR	CPA	EUR	FSU	LAM	MEA	NAM	PAO	PAS	SAS	World
2005	1054	1504	25271	4126	6148	4052	40119	36187	4030	704	7026
2010	1286	2220	27975	5596	8154	5146	43286	38826	5386	929	7920
2015	1629	3563	31302	7949	11445	6848	46866	41987	7614	1300	9336
2020	1908	4879	34599	10319	14455	8241	50134	45260	9650	1635	10646
2025	2431	7941	39093	14754	20456	10948	54291	49210	13720	2314	13143
2030	2905	11053	43591	19233	26159	13307	58273	53146	17561	2957	15554
2035	5521	14852	49170	25768	31364	17926	63206	57541	23360	3943	19003
2040	7901	18847	54923	32507	36505	22062	68071	62207	29027	4901	22389
B2	**AFR**	**CPA**	**EUR**	**FSU**	**LAM**	**MEA**	**NAM**	**PAO**	**PAS**	**SAS**	**World**
2005	865	2163	26117	3647	5371	3251	43214	37739	5678	510	7286
2010	908	3303	29171	4068	5832	3394	47271	40538	7335	583	8014
2015	1011	4440	31206	4928	6723	3630	49070	42556	9133	735	8629
2020	1135	5992	33480	5996	7803	3918	51084	44898	11438	931	9421
2025	1387	7457	35338	7714	9401	4496	52161	46608	13441	1237	10199
2030	1713	9361	37558	9937	11365	5192	54194	48690	15805	1656	11223
2035	2226	10940	39686	12808	13635	6301	56808	50300	17709	2195	12291
2040	2932	12819	42186	16533	16447	7711	59728	51911	19963	2926	13658

Note: AFR: Sub-Saharan Africa; CPA: Centrally-planned Asia (incl. China); EUR: Europe (incl. Turkey); FSU: Former Soviet Union; LAM: Latin America; MEA: Middle East and North Africa; NAM: North America; PAO: Pacific OECD (Japan/Australia/New Zealand); PAS: Pacific Asia; SAS: South Asia (incl. India)

Figure 3 shows aggregate changes in agricultural production in 10 world regions from the LEITAP/MAGNET model. Production is expanded most strongly in Sub-Saharan Africa and Southeast Asia. In Europe, agricultural production does not change much, except in the A2 scenario.

Figure 3: Changes in agricultural production (2010-2040, in %)

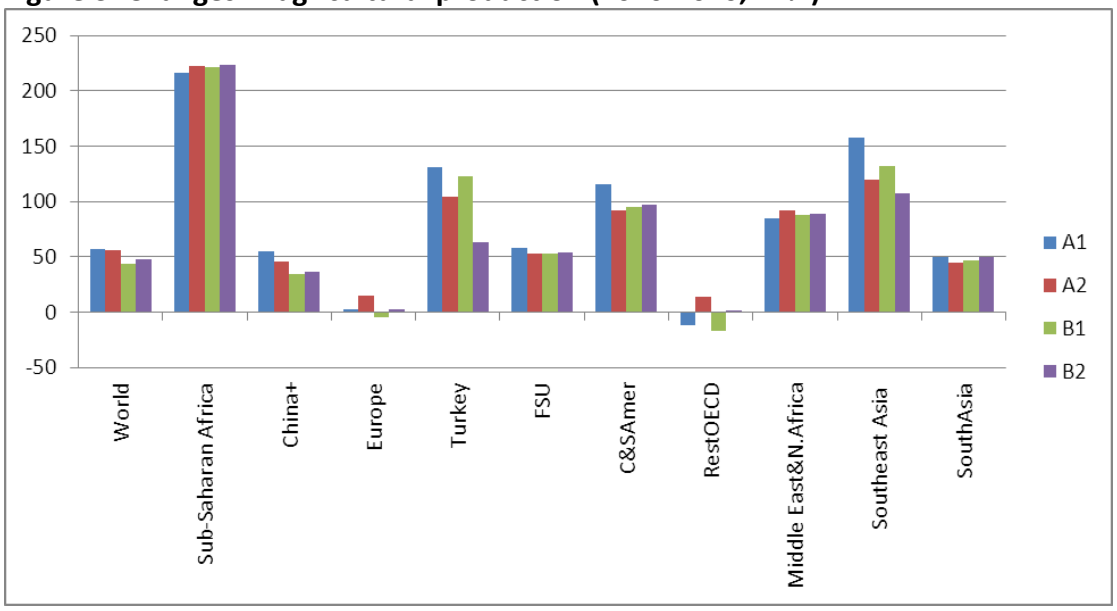


Figure 4 shows changes in agricultural land use (cropland plus grassland) in 10 world regions, from the LEITAP/MAGNET model. In Europe, agricultural land use is reduced by about 15% in the globalized scenarios A1 and B1. In Sub-Saharan Africa, Latin America, and Southeast Asia, which are all three forest-rich areas, agricultural land is strongly expanding. Here, scenario A1 has the strongest impact.

Figure 4: Changes in agricultural land use (2010-2040, in %)

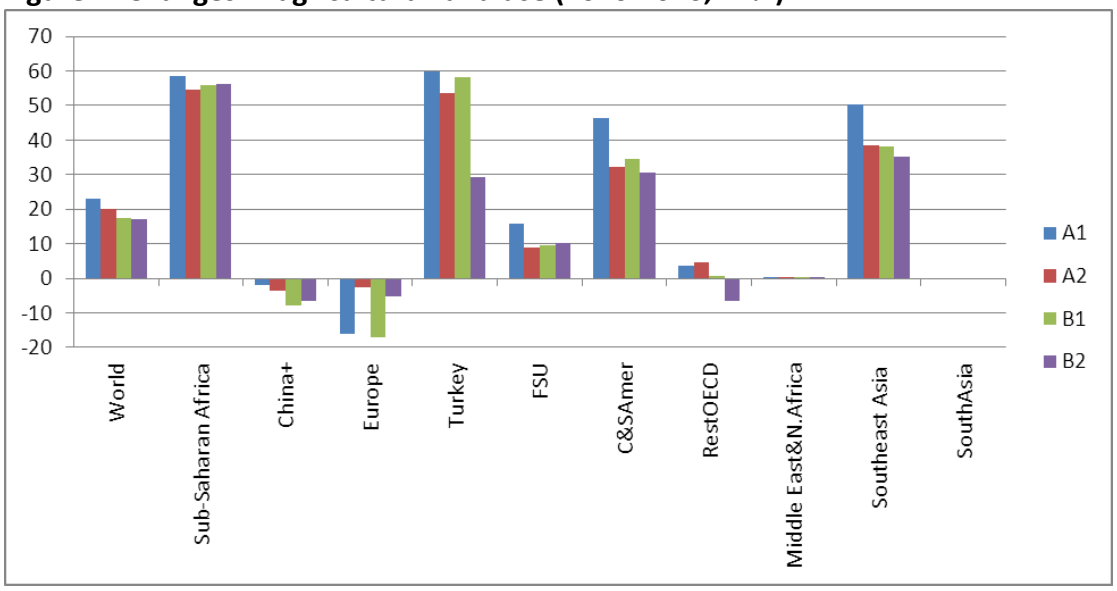
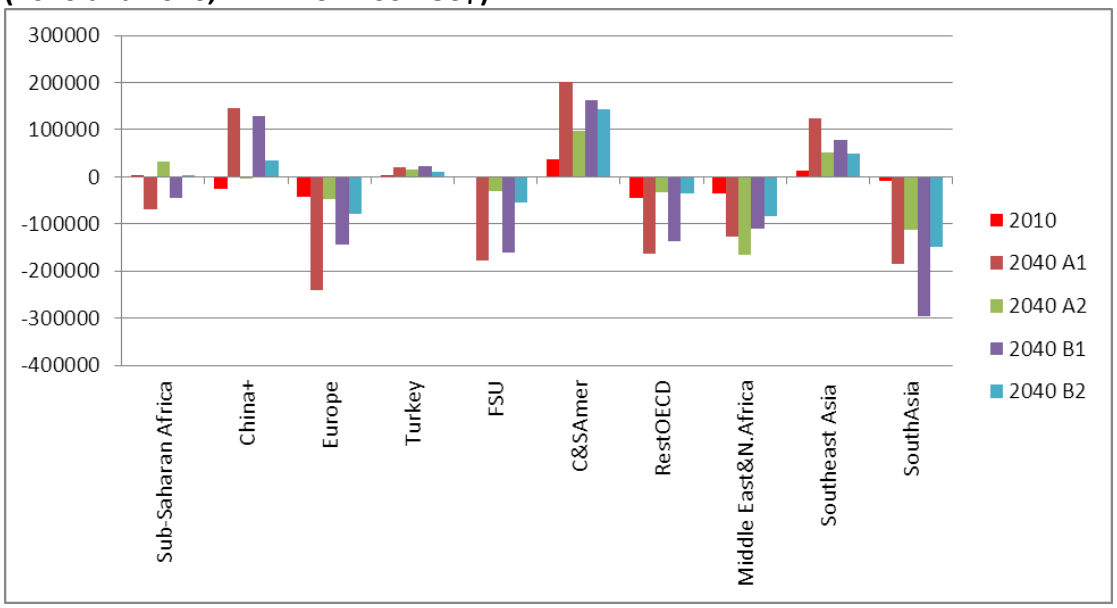


Figure 5 shows related net exports in agri-food products. Especially in the globalized scenarios, Europe's net exports are falling strongly, while net exports in Latin America and Southeast Asia are expanding.

Figure 5: Regional net exports (including intraregional trade) (2010 and 2040, in million 2001 US$)



Assumptions on technological change in agriculture, combined with endogenous adjustment processes lead in the LEITAP/MAGNET model to falling world market prices for agri-food commodities in all four marker scenarios. While price levels decrease by about 10% in 2040 in the A2 scenario, they fall even further, by about 20% in the A1 scenario. This means that increasing food demand from higher population and income can be compensated by increased agricultural productivity in combination with expansion of agricultural land use (see also Fig. 4).

Figure 6: Development of real world market prices of agri-food commodities (2010=1)

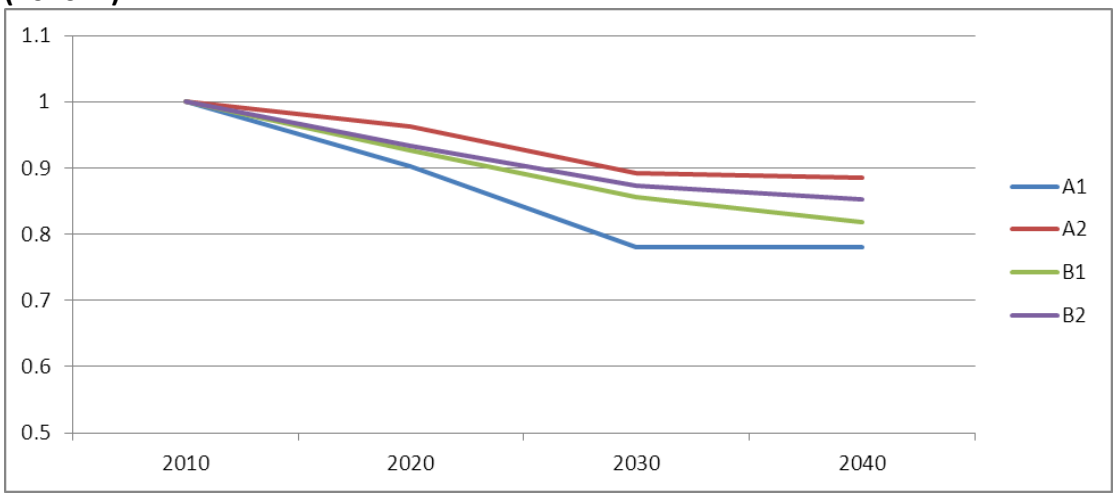
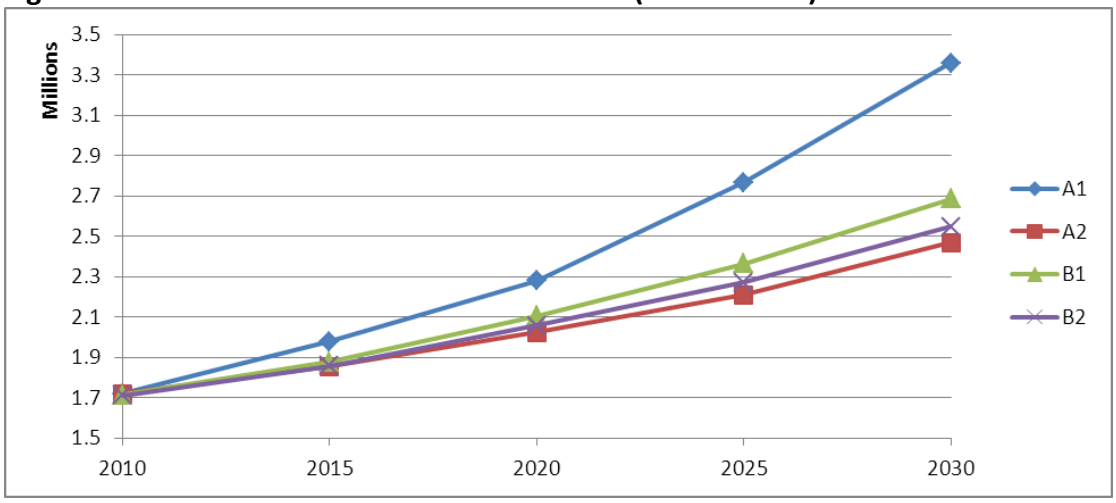


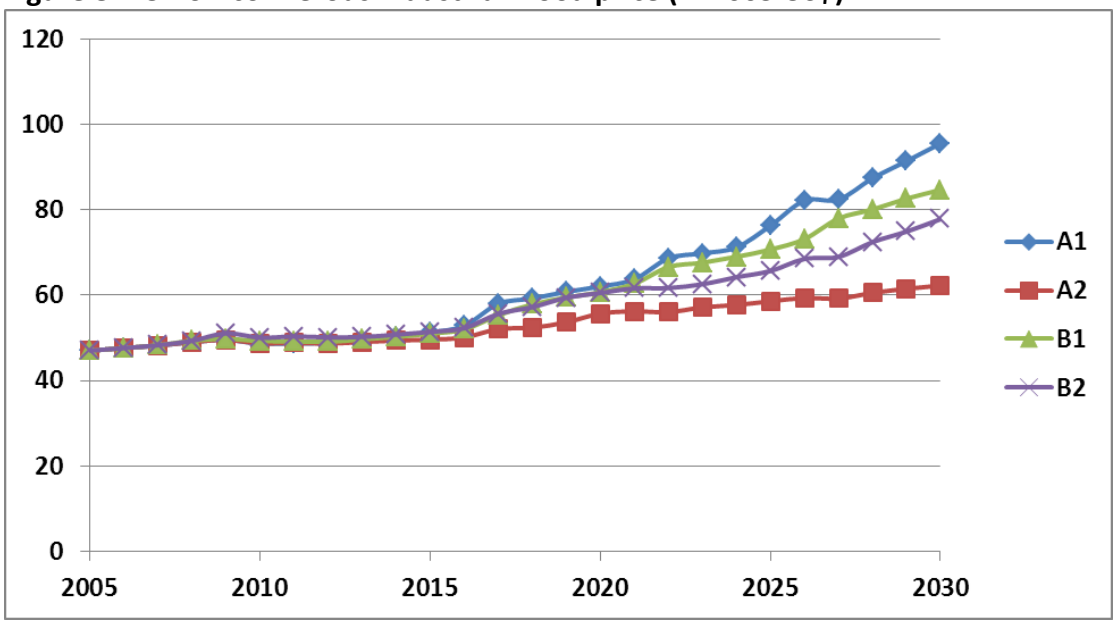
Figure 7 shows world industrial round wood harvest from the EFI-GTM global forest sector model, which reflects rising demand from population and GDP scenarios. Wood harvest volumes are especially high in the A1 scenario.

Figure 7: World industrial round wood harvest (in billion m3)



As a response to higher global demand, industrial wood prices in the EU rise especially strongly in scenario A1, while changes are rather modest in A2.

Figure 8: EU non-coniferous industrial wood price (in 2005 US$)



Annex: Detailed marker scenario specifications

(This will also be provided as a separate Excel document, together with this deliverable)

Item	Sub-Item	Spatial level	Model	V-A1			V-A2			V-B1			V-B2		
				2020	2030	2040	2020	2030	2040	2020	2030	2040	2020	2030	2040
Demography (Population)		Global	ReMIND/MAgPIE	7.6 billion	8.1 billion	8.5 billion	8.2 billion	9.2 billion	10.3 billion	7.6 billion	8.1 billion	8.5 billion	7.7 billion	8.4 billion	8.9 billion
		Country/ NUTS2	CAPRI	Baseline (7.6 billion)	Baseline (8.1 billion)	Baseline (8.5 billion)	Baseline plus difference with V-A1-2020 from LEITAP/MAGNET	Baseline plus difference with V-A1-2030 from LEITAP/MAGNET	Baseline plus difference with V-A1-2040 from LEITAP/MAGNET	Baseline plus difference with V-A1-2020 from LEITAP/MAGNET	Baseline plus difference with V-A1-2030 from LEITAP/MAGNET	Baseline plus difference with V-A1-2040 from LEITAP/MAGNET	Baseline plus difference with V-A1-2020 from LEITAP/MAGNET	Baseline plus difference with V-A1-2030 from LEITAP/MAGNET	Baseline plus difference with V-A1-2040 from LEITAP/MAGNET
Economic growth (GDP)		Global	ReMIND/MAgPIE (endogenous)	10646 US$ per capita (global average)	15554 US$ per capita (global average)	22389 US$ per capita (global average)	7248 US$ per capita (global average)	8302 US$ per capita (global average)	9376 US$ per capita (global average)	9975 US$ per capita (global average)	12957 US$ per capita (global average)	17172 US$ per capita (global average)	9421 US$ per capita (global average)	11223 US$ per capita (global average)	13658 US$ per capita (global average)
		EU-27/ Country	LEITAP/MAGNET	2.2% growth rate (EU-27)	2.3% growth rate (EU-27)	2.2% growth rate (EU-27)	1.5% growth rate (EU-27)	1.5% growth rate (EU-27)	1.3% growth rate (EU-27)	2.2% growth rate (EU-27)	1.9% growth rate (EU-27)	1.8% growth rate (EU-27)	1.3% growth rate (EU-27)	1.2% growth rate (EU-27)	1.2% growth rate (EU-27)
Trade		Global	ReMIND/MAgPIE	Trade liberalisation	Trade liberalisation	Trade liberalisation	Continuous trade patterns	Continuous trade patterns	Continuous trade patterns	Trade liberalisation	Trade liberalisation	Trade liberalisation	Highly regionally self-sufficient	Highly regionally self-sufficient	Highly regionally self-sufficient
		Global/ EU-27/ Country/ NUTS	LEITAP/MAGNET/ CAPRI	stepwise trade liberalization: 50% import tariff and export subsidies reduction for all commodities	stepwise trade liberalization: 50% of remaining import tariff and export subsidies reductionfor all commodities	stepwise trade liberalization: abolition of remaining import tariff and export subsidies reduction for all commodities	no trade liberalization shocks	no trade liberalization shocks	no trade liberalization shocks	stepwise trade liberalization: 50% import tariff and export subsidies reduction for all commodities	stepwise trade liberalization: 50% of remaining import tariff and export subsidies reductionfor all commodities	stepwise trade liberalization: abolition of remaining import tariff and export subsidies reduction for all commodities	20% import tariff increase and 20% export subsidies decrease for all commodities to stimulate regional self-sufficiency	none	none
			EFI-GTM	no tariff change assumption	no tariff change assumption	no tariff change assumption	no tariff change assumption	no tariff change assumption	no tariff change assumption	no tariff change assumption	no tariff change assumption	no tariff change assumption	tariff for trade into EU	tariff for trade into EU	tariff for trade into EU
Agricultural productivity		Global	ReMIND/MAgPIE	endogenous	endogenous	endogenous	endogenous	endogenous	endogenous	endogenous	endogenous	endogenous	endogenous	endogenous	endogenous
		Global/ EU-27/ Country	LEITAP/MAGNET	the same for all scenarios exogenous crop, region and period specific productivity shocks	the same for all scenarios exogenous crop, region and period specific productivity shocks	the same for all scenarios exogenous crop, region and period specific productivity shocks	the same for all scenarios exogenous crop, region and period specific productivity shocks	the same for all scenarios exogenous crop, region and period specific productivity shocks	the same for all scenarios exogenous crop, region and period specific productivity shocks	the same for all scenarios exogenous crop, region and period specific productivity shocks	the same for all scenarios exogenous crop, region and period specific productivity shocks	the same for all scenarios exogenous crop, region and period specific productivity shocks	the same for all scenarios exogenous crop, region and period specific productivity shocks	the same for all scenarios exogenous crop, region and period specific productivity shocks	the same for all scenarios exogenous crop, region and period specific productivity shocks
		Country/ NUTS2	CAPRI	Baseline	Baseline	Baseline	Baseline plus shift in crop supply curve in EU driven by difference with V-A1-2020 from LEITAP/MAGNET	Baseline plus shift in crop supply curve in EU driven by difference with V-A1-2030 from LEITAP/MAGNET	Baseline plus shift in crop supply curve in EU driven by difference with V-A1-2040 from LEITAP/MAGNET	Baseline plus shift in crop supply curve in EU driven by difference with V-A1-2020 from LEITAP/MAGNET	Baseline plus shift in crop supply curve in EU driven by difference with V-A1-2030 from LEITAP/MAGNET	Baseline plus shift in crop supply curve in EU driven by difference with V-A1-2040 from LEITAP/MAGNET	Baseline plus shift in crop supply curve in EU driven by difference with V-A1-2020 from LEITAP/MAGNET	Baseline plus shift in crop supply curve in EU driven by difference with V-A1-2030 from LEITAP/MAGNET	Baseline plus shift in crop supply curve in EU driven by difference with V-A1-2040 from LEITAP/MAGNET
Consumer behaviour and food demand	Calorie share of animal products	Global	ReMIND/MAgPIE	Increasing demand per capita for calories & livestock products (linked to income growth)	Increasing demand per capita for calories & livestock products (linked to income growth)	Increasing demand per capita for calories & livestock products (linked to income growth)	Increasing demand per capita for calories & livestock products (linked to income growth)	Increasing demand per capita for calories & livestock products (linked to income growth)	Increasing demand per capita for calories & livestock products (linked to income growth)	Equal per capita consumption around the world, sustainable diet ("contraction and convergence"); Regional animal share +7% to -20% compared to A1/A2/B2	Equal per capita consumption around the world, sustainable diet ("contraction and convergence"); Regional animal share +7% to -20% compared to A1/A2/B2	Equal per capita consumption around the world, sustainable diet ("contraction and convergence"); Regional animal share +11% to -33% compared to A1/A2/B2	Increasing demand per capita for calories & livestock products (linked to income growth)	Increasing demand per capita for calories & livestock products (linked to income growth)	Increasing demand per capita for calories & livestock products (linked to income growth)
	Demand for animal products	Global	LEITAP/MAGNET	linked to income growth via demand function: no shocks	linked to income growth via demand function: no shocks	linked to income growth via demand function: no shocks	linked to income growth via demand function: no shocks	linked to income growth via demand function: no shocks	linked to income growth via demand function: no shocks	reduced compared with standard model outcomes according to numbers from ReMIND/MAgPIE	reduced compared with standard model outcomes according to numbers from ReMIND/MAgPIE	reduced compared with standard model outcomes according to numbers from ReMIND/MAgPIE	linked to income growth via demand function: no shocks	linked to income growth via demand function: no shocks	linked to income growth via demand function: no shocks
	Demand for animal products	Country/ NUTS2	CAPRI	Baseline (linked to income growth)	Baseline (linked to income growth)	Baseline (linked to income growth)	Baseline plus shift in demand curve driven by consumption quantity difference with V-A1-2020 from LEITAP/MAGNET	Baseline plus shift in demand curve driven by consumption quantity difference with V-A1-2030 from LEITAP/MAGNET	Baseline plus shift in demand curve driven by consumption quantity difference with V-A1-2040 from LEITAP/MAGNET	Baseline plus shift in demand curve driven by consumption quantity difference with V-A1-2020 from LEITAP/MAGNET	Baseline plus shift in demand curve driven by consumption quantity difference with V-A1-2030 from LEITAP/MAGNET	Baseline plus shift in demand curve driven by consumption quantity difference with V-A1-2040 from LEITAP/MAGNET	Baseline plus shift in demand curve driven by consumption quantity difference with V-A1-2020 from LEITAP/MAGNET	Baseline plus shift in demand curve driven by consumption quantity difference with V-A1-2030 from LEITAP/MAGNET	Baseline plus shift in demand curve driven by consumption quantity difference with V-A1-2040 from LEITAP/MAGNET
Producer behaviour and food supply	Food supply countries outside EU	Country/ NUTS2	CAPRI	Baseline	Baseline	Baseline	Baseline plus shift in supply curve driven by production quantity difference with V-A1-2020 from LEITAP/MAGNET for countries outside EU	Baseline plus shift in supply curve driven by production quantity difference with V-A1-2030 from LEITAP/MAGNET for countries outside EU	Baseline plus shift in supply curve driven by production quantity difference with V-A1-2040 from LEITAP/MAGNET for countries outside EU	Baseline plus shift in supply curve driven by production quantity difference with V-A1-2020 from LEITAP/MAGNET for countries outside EU	Baseline plus shift in supply curve driven by production quantity difference with V-A1-2030 from LEITAP/MAGNET for countries outside EU	Baseline plus shift in supply curve driven by production quantity difference with V-A1-2040 from LEITAP/MAGNET for countries outside EU	Baseline plus shift in supply curve driven by production quantity difference with V-A1-2020 from LEITAP/MAGNET for countries outside EU	Baseline plus shift in supply curve driven by production quantity difference with V-A1-2030 from LEITAP/MAGNET for countries outside EU	Baseline plus shift in supply curve driven by production quantity difference with V-A1-2040 from LEITAP/MAGNET for countries outside EU

Item	Sub-Item	Spatial level	Model	V-A1			V-A2			V-B1			V-B2		
				2020	2030	2040	2020	2030	2040	2020	2030	2040	2020	2030	2040
Climate Change	Climate impacts on crop yields and forest NPP	Global/ EU-27/ Country	ReMIND/MAgPIE/ LPJmL	Medium level of emissions (CC: ca. +3C in 2100); medium climate impacts	Medium level of emissions (CC: ca. +3C in 2100); medium climate impacts	Medium level of emissions (CC: ca. +3C in 2100); medium climate impacts	High level of emissions (CC: GMT ca. +4C in 2100); medium climate impacts	High level of emissions (CC: GMT ca. +4C in 2100); medium climate impacts	High level of emissions (CC: GMT ca. +4C in 2100); medium climate impacts	Low Level of Emissions (CC: ca. +2C in 2100); medium climate impacts	Low Level of Emisions (CC: ca. +2C in 2100); medium climate impacts	Low Level of Emisions (CC: ca. +2C in 2100); medium climate impacts	Not represented in AR4 Assumed low to medium level of emissions; medium climate impacts	Not represented in AR4 Assumed low to medium level of emissions; medium climate impacts	Not represented in AR4 Assumed low to medium level of emissions; medium climate impacts
		EU-27/ Country/ NUTS2	EFISCEN	Growth change based on LPJmL projections											
Bioenergy	Area demand for second generation bioenergy	Global	ReMIND/MAgPIE	52 million ha globally	83 million ha globally	137 million ha globally	52 million ha globally	83 million ha globally	137 million ha globally	52 million ha globally	83 million ha globally	137 million ha globally	52 million ha globally	83 million ha globally	137 million ha globally
	Area demand for second generation bioenergy	Country/NUTS2	CAPRI	Baseline	Baseline plus increase of second generation bioenergy consistent with ReMIND/MAgPIE	Baseline plus increase of second generation bioenergy consistent with ReMIND/MAgPIE	Baseline	Baseline plus increase of second generation bioenergy consistent with ReMIND/MAgPIE	Baseline plus increase of second generation bioenergy consistent with ReMIND/MAgPIE	Baseline	Baseline plus increase of second generation bioenergy consistent with ReMIND/MAgPIE	Baseline plus increase of second generation bioenergy consistent with ReMIND/MAgPIE	Baseline	Baseline plus increase of second generation bioenergy consistent with ReMIND/MAgPIE	Baseline plus increase of second generation bioenergy consistent with ReMIND/MAgPIE
	First generation biofuel mandates	Global/ EU-27/ Country/ NUTS2	LEITAP/MAGNET/ CAPRI	EU27: 10%, USA: 4%, Canada: 3%, Brazil 25%, Rest of South America 10%, India 15%, South East Asia %, Indonesia: 12%	no mandatory biofuel targets, biofuels subsidies abolished, biofuels production market driven	no mandatory biofuel targets, biofuels subsidies abolished, biofuels production market driven	EU27: 10%, USA: 4%, Canada: 3%, Brazil 25%, Rest of South America 10%, India 15%, South East Asia %, Indonesia: 12%	no mandatory biofuel targets, biofuels subsidies abolished, biofuels production market driven	no mandatory biofuel targets, biofuels subsidies abolished, biofuels production market driven	EU27: 10%, USA: 4%, Canada: 3%, Brazil 25%, Rest of South America 10%, India 15%, South East Asia %, Indonesia: 12%	no mandatory biofuel targets, biofuels subsidies frozen at 2020 level, biofuels production market driven	no mandatory biofuel targets, biofuels subsidies frozen at 2020 level, biofuels production market driven	EU27: 10%, USA: 4%, Canada: 3%, Brazil 25%, Rest of South America 10%, India 15%, South East Asia %, Indonesia: 12%	no mandatory biofuel targets, biofuels subsidies frozen at 2020 level, biofuels production market driven	no mandatory biofuel targets, biofuels subsidies frozen at 2020 level, biofuels production market driven
	Trade restrictions on biofuels	Global/ EU-27/ Country	LEITAP/MAGNET	non	non	non	non	non	non	non	non	non	non	non	non
	Demand for bioenergy from wood products/ residues	Global	EFI-GTM	volume of wood biomass for bioenergy is fixed by MAgPIE (FAOSTAT fuelwood)	volume of wood biomass for bioenergy is fixed by MAgPIE (FAOSTAT fuelwood)	volume of wood biomass for bioenergy is fixed by MAgPIE (FAOSTAT fuelwood)	volume of wood biomass for bioenergy is fixed by MAgPIE (FAOSTAT fuelwood)	volume of wood biomass for bioenergy is fixed by MAgPIE (FAOSTAT fuelwood)	volume of wood biomass for bioenergy is fixed by MAgPIE (FAOSTAT fuelwood)	volume of wood biomass for bioenergy is fixed by MAgPIE (FAOSTAT fuelwood)	volume of wood biomass for bioenergy is fixed by MAgPIE (FAOSTAT fuelwood)	volume of wood biomass for bioenergy is fixed by MAgPIE (FAOSTAT fuelwood)	volume of wood biomass for bioenergy is fixed by MAgPIE (FAOSTAT fuelwood)	volume of wood biomass for bioenergy is fixed by MAgPIE (FAOSTAT fuelwood)	volume of wood biomass for bioenergy is fixed by MAgPIE (FAOSTAT fuelwood)
	Trade restrictions on biofuels	Country/NUTS2	CAPRI	stepwise trade liberalization: 50% import tariff and export subsidies reduction for all commodities	stepwise trade liberalization: 50% of remaining import tariff and export subsidies reductionfor all commodities	stepwise trade liberalization: abolition of remaining import tariff and export subsidies reduction for all commodities	no trade liberalization shocks	no trade liberalization shocks	no trade liberalization shocks	stepwise trade liberalization: 50% import tariff and export subsidies reduction for all commodities	stepwise trade liberalization: 50% of remaining import tariff and export subsidies reductionfor all commodities	stepwise trade liberalization: abolition of remaining import tariff and export subsidies reduction for all commodities	20% import tariff increase and 20% export subsidies decrease for all commodities to stimulate regional self-sufficiency	none	none
	% land used for Biofuel cultivation	EU-27	Dyna-CLUE	15%	18%	20%	15%	18%	20%	15%	18%	20%	15%	18%	20%
		EU-27/ Country/ Nuts	EFISCEN	Demand based on EFI-GTM projections	Demand based on EFI-GTM projections	Demand based on EFI-GTM projections	Demand based on EFI-GTM projections	Demand based on EFI-GTM projections	Demand based on EFI-GTM projections	Demand based on EFI-GTM projections	Demand based on EFI-GTM projections	Demand based on EFI-GTM projections	Demand based on EFI-GTM projections	Demand based on EFI-GTM projections	Demand based on EFI-GTM projections
CAP reform (until 2020 plus extrapolation)	General	Global/ EU-27/ Country/ NUTS2	LEITAP/MAGNET/ CAPRI	fully liberalized: full abolition of Pillar 1 and 2. CAP budget will be zero.	no shock	no shock	no change: CAP budget constant.	no change: CAP budget constant.	no change: CAP budget constant.	fully liberalized: full abolition of Pillar 1 and 2. CAP budget will be zero.	no shock	no shock	no change: CAP budget constant.	no change: CAP budget constant.	no change: CAP budget constant.
	Production quotas	Global/ EU-27/ Country/ NUTS2	LEITAP/MAGNET/ CAPRI	milk quota abolition, sugar quota in place	milk quota abolished, sugar quota in place	milk quota abolished, sugar quota in place	milk quota abolition, sugar quota in place	milk quota abolished, sugar quota in place	milk quota abolished, sugar quota in place	milk quota abolition, sugar quota in place	milk quota abolished, sugar quota in place	milk quota abolished, sugar quota in place	milk quota abolition, sugar quota in place	milk quota abolished, sugar quota in place	milk quota abolished, sugar quota in place
	Coupled payments	Global/ EU-27/ Country/ NUTS2	LEITAP/MAGNET/ CAPRI	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled
	Decoupled payments	Global/ EU-27/ Country/ NUTS2	LEITAP/MAGNET/ CAPRI	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled	no shock: payments already decoupled

Item	Sub-Item	Spatial level	Model	V-A1			V-A2			V-B1			V-B2		
				2020	2030	2040	2020	2030	2040	2020	2030	2040	2020	2030	2040
	Set-aside		Dyna-CLUE	Abolished in EU15 from current level to 0% between 2008 and 2012 (equal change per year) 50% of area in set-aside is released as available area for arable land. Never introduced in EU10	Abolished	Abolished	Never introduced in EU10; gradually abolished in EU15 from current level to 0% between 2018 and 2022 (equal change per year); 50% of area in set-aside is released as available area for arable land.	Same as 2020	Same as 2020	Never introduced in EU10; gradually abolished in EU15 from current level to 0% between 2018 and 2022 (equal change per year); 50% of area in set-aside is released as available area for arable land.	Same as 2020	Same as 2020	Continued in EU15; introduced in EU10 between 2008 and 2013 at a rate of 1% per year up to 5% in total; 50% of the newly set-aside area is assumed to be already in the land use data as 'unproductive land'; the other 50% will increase the area needed for arable	Same as 2020	Same as 2020
Land-Use	Reduced availability of cropland due to forest protection	Global	ReMIND/MAgPIE	No forest protection	No forest protection	No forest protection	No forest protection	No forest protection	No forest protection	-78 million ha	-100 million ha	-120 million ha	-78 million ha	-100 million ha	-120 million ha
	Urban expansion	Global /EU-27/ Country	MOLAND	Urban expansion depending on GDP	Urban expansion depending on GDP	Urban expansion depending on GDP	Urban expansion depending on GDP	Urban expansion depending on GDP	Urban expansion depending on GDP	Urban expansion depending on GDP	Urban expansion depending on GDP	Urban expansion depending on GDP	Urban expansion depending on GDP	Urban expansion depending on GDP	Urban expansion depending on GDP
	Availability of agricultural land	Global/ EU-27/ Country	LEITAP/MAGNET	shifting world land supply by 0.6%, EU by 1.1%	shifting world land supply by 0.9%, EU by 1.7%	shifting world land supply by 1.5%, EU by 2.0%	shifting world land supply by 0.6%, EU by 1.1%	shifting world land supply by 0.9%, EU by 1.7%	shifting world land supply by 1.5%, EU by 2.0%	shifting world land supply by 1.4%, EU by 1.1%	shifting world land supply by 1.9%, EU by 1.7%	shifting world land supply by 2.8%, EU by 2.0%	shifting world land supply by 1.4%, EU by 1.1%	shifting world land supply by 1.9%, EU by 1.7%	shifting world land supply by 2.8%, EU by 2.0%
		Country/NUTS2	CAPRI	Change in availability of agricultural land due to urban expansion from MOLAND	Change in availability of agricultural land due to urban expansion from MOLAND	Change in availability of agricultural land due to urban expansion from MOLAND	Change in availability of agricultural land due to urban expansion from MOLAND	Change in availability of agricultural land due to urban expansion from MOLAND	Change in availability of agricultural land due to urban expansion from MOLAND	Change in availability of agricultural land due to urban expansion from MOLAND	Change in availability of agricultural land due to urban expansion from MOLAND	Change in availability of agricultural land due to urban expansion from MOLAND	Change in availability of agricultural land due to urban expansion from MOLAND	Change in availability of agricultural land due to urban expansion from MOLAND	Change in availability of agricultural land due to urban expansion from MOLAND
	Change in forestry area	Global	EFI-GTM	No forest area change, part of the forest area in developing Asia and Latin America is shifted to itensive plantation management according to high plantation scenario (FAO, 2000)	No forest area change, part of the forest area in developing Asia and Latin America is shifted to itensive plantation management according to high plantation scenario (FAO, 2000)	No forest area change, part of the forest area in developing Asia and Latin America is shifted to itensive plantation management according to high plantation scenario (FAO, 2000)	No forest area change, part of the forest area in developing Asia and Latin America is shifted to itensive plantation management according to high plantation scenario (FAO, 2000)	No forest area change, part of the forest area in developing Asia and Latin America is shifted to itensive plantation management according to high plantation scenario (FAO, 2000)	No forest area change, part of the forest area in developing Asia and Latin America is shifted to itensive plantation management according to high plantation scenario (FAO, 2000)	Forest area stay unchanged, shifting forest area to more intesive plantations compensates reduction of supply from natural forests due to forest conservation	Forest area stay unchanged, shifting forest area to more intesive plantations compensates reduction of supply from natural forests due to forest conservation	Forest area stay unchanged, shifting forest area to more intesive plantations compensates reduction of supply from natural forests due to forest conservation	Forest area stay unchanged, shifting forest area to more intesive plantations compensates reduction of supply from natural forests due to forest conservation	Forest area stay unchanged, shifting forest area to more intesive plantations compensates reduction of supply from natural forests due to forest conservation	Forest area stay unchanged, shifting forest area to more intesive plantations compensates reduction of supply from natural forests due to forest conservation
	Change in forestry area	EU-27/ Country/Nuts	EFISCEN	Area changes based on Dyna-CLUE projections	Area changes based on Dyna-CLUE projections	Area changes based on Dyna-CLUE projections	Area changes based on Dyna-CLUE projections	Area changes based on Dyna-CLUE projections	Area changes based on Dyna-CLUE projections	Area changes based on Dyna-CLUE projections	Area changes based on Dyna-CLUE projections	Area changes based on Dyna-CLUE projections	Area changes based on Dyna-CLUE projections	Area changes based on Dyna-CLUE projections	Area changes based on Dyna-CLUE projections
	Willingness of private owners to harvest their forest	EU-27/ Country/Nuts	EFISCEN		Low willingness			Medium willingness			Medium willingness			High willingness	
	Change in agricultural area		Dyna-CLUE	From CAPRI	From CAPRI	From CAPRI	From CAPRI	From CAPRI	From CAPRI	From CAPRI	From CAPRI	From CAPRI	From CAPRI	From CAPRI	From CAPRI

Item	Sub-Item	Spatial level	Model	V-A1			V-A2			V-B1			V-B2		
				2020	2030	2040	2020	2030	2040	2020	2030	2040	2020	2030	2040
	Protected areas		Dyna-CLUE	Forest & semi-natural & recently abandoned >agriculture not allowed in Natura2000 locations; all other conversions allowed in Natura 2000 locations, including urbanization/abandonment	Same as in 2020	Same as in 2020	Forest & semi-natural & recently abandoned >agriculture not allowed in Natura2000 locations; all other conversions allowed in Natura 2000 locations, including urbanization/abandonment	Same as in 2020	Same as in 2020	Forest, semi-natural, recently abandoned > all other uses not allowed in Natura 2000 locations (except succession); Other restrictions in Natura 2000 areas:Agricultural uses > urban: not allowed;Arable > grass: allowed;Grass > arable: not allowed;Arable & grass > permanent not allowed;Permanent > grass & arable: not allowed;Agriculture > recently abandoned: allowed,but incentives to prevent this by	Same as 2020	Same as 2020	Forest, semi-natural, recently abandoned > all other uses not allowed in Natura 2000 locations (except succession);Other restrictions in Natura 2000 areas:Agricultural uses > urban: not allowed;Arable > grass: allowed;Grass > arable: not allowed;Arable & grass > permanent not allowed;Permanent > grass & arable: not allowed;Agriculture > recently abandoned:allowed, but incentives to prev	Same as 2020	Same as 2020
	Policy measures to control fragmentation		Dyna-CLUE	Incentives aimed at limiting fragmentation of natural areas leading to stronger separation of land use functions	Same as 2020	Same as 2020	No specific incentives	Same as in 2020	Same as in 2020	Incentives aimed at limiting fragmentation of natural areas. Semi-natural and forest have a positive neighbourhood relation with all natural land use types (neighbourhood setting for nature is 0.2 to limit fragmentation).	Same as 2020	Same as 2020	Incentives aimed at limiting fragmentation of natural areas	Same as 2020	Same as 2020
	Agro-biodiversity		Dyna-CLUE	No specific arrangements; agriculture within Natura2000 may be abandoned.	Same as 2020	Same as 2020	Agricultural areas within Natura2000 network either remain under extensive agriculture or are abandoned	No further arrangements	No further arrangements	Agricultural areas within Natura2000 network either remain under extensive agriculture or are used for nature development. The main grassland areas in LFA's are incorporated in Natura2000 network (extensive pastures)	Same as 2020	Same as 2020	No arrangements	No arrangements	No arrangements
	Local patches of (semi-)natural areas		Dyna-CLUE	No specific efforts	Same as 2020	Same as 2020	No specific efforts	Same as 2020	Same as 2020	Strong protection of local patches; but in case of strong competition and in main agricultural regions some patches may dissapear.	Same as 2020	Same as 2020	Very strong protection of local patches; but in case of strong competition and in main agricultural regions some patches may disappear	Same as 2020	Same as 2020
	Less favoured areas		Dyna-CLUE	LFA concept completely abolished	None	None	LFA maintained at current level	Same as 2020	Same as 2020	LFA maintained at current level, except for arable agriculture in locations with high erosion risk.	None	None	LFA maintained at current level, except for arable agriculture in locations with high erosion risk.	None	None
	Incentives/ compensation for farmers		Dyna-CLUE	Compensation for farmers abolished	Same as 2020	Same as 2020	Compensation for farmers abolished	Same as 2020	Same as 2020	Compensation for farmers abolished	Same as 2020	Same as 2020	Compensation for farmers abolished	Same as 2020	Same as 2020

Item	Sub-Item	Spatial level	Model	V-A1			V-A2			V-B1			V-B2		
				2020	2030	2040	2020	2030	2040	2020	2030	2040	2020	2030	2040
	Shifts in permanent pastures areas		Dyna-CLUE	Fully allowed, dynamic land allocation possible. Tendency to concentrate pasture preferably in most productive areas	Same as 2020	Same as 2020	Fully allowed, dynamic land allocation possible	Same as in 2020	Same as in 2020	Incentives to prevent the conversion of permanent pasture to arable land. Implemented through a decrease in suitability for arable land on land currently assigned to pasture.	Same as 2020	Same as 2020	Incentives to prevent the conversion of permanent pasture to arable land. Implemented through a decrease in suitability for arable land on land currently assigned to pasture	Same as 2020	Same as 2020
	Shifts in arable cropping patterns		Dyna-CLUE	Tendency to concentrate pasture/arable crops preferably in most productive areas	Same as 2020	Same as 2020	No change from current location preferences for arable crops	Same as in 2020	Same as in 2020	Tendency to concentrate pasture/arable crops preferably in most productive areas.	Same as 2020	Same as 2020	No change from current location preferences for arable crops	Same as 2020	Same as 2020
	Effect of population on succession		Dyna-CLUE	High pressure in densely populated areas due to recreational uses/hobby farming etc. Conversion of recently abandoned to seminatural takes longer (years added to 'natural'succession time per population pressure, class 1: 100 years (no succession); 2: 30 years; 3: 25 years;4: 5 years;5: 0 years. Due to grazing it is assumed that succession is retarded by 5 to 10 years depending on livestock density in neighborhood. If the mean density of land-based	Same as 2020	Same as 2020	High pressure in densely populated areas due to recreational uses/hobby farming etc. Conversion of recently abandoned to seminatural takes longer (years added to 'natural'succession time per population pressure class 1: 100 years (no succession);2: 25 years;3: 15 years;4: 2 years;5: 0 years.Due to grazing it is assumed that succession is retarded by 5 to 10 years depending on livestock density in neighborhood. If the mean density of land-based	Same as in 2020	Same as in 2020	areas due to recreational uses/hobby farming etc. Conversion of recently abandoned to seminatural takes longer (years added to 'natural'succession time per population pressure class 1: 100 years (no succession);2: 20 years;3: 10 years;4: 2 years;5: 0 years. Due to grazing it is assumed that succession is retarded by 5 to 10 years depending on livestock density in neighborhood. If the mean density of land-based systems in the neighborhood (circle radius 3 km)	Same as 2020	Same as 2020	Low pressure in densely populated areas due to recreational uses/hobby farming etc. Conversion of recently abandoned to seminatural takes longer (years added to 'natural' succession time per population pressure class 1: 100 years (no succession); 2: 15 years ; 3: 8 years; 4: 0 years; 5: 0 years. Due to grazing it is assumed that succession is retarded by 5 to 10 years depending on livestock density in neighborhood. If the mean density of landbased systems	Same as 2020	Same as 2020
	Effects of active nature restoration on succession		Dyna-CLUE	No	No	No	No	No	No	Within NATURA2000 sites is, due to favourable management/reforestation the succession time of recently abandonment ->seminat & semi-nat->forest is reduced by 4 years			Within NATURA2000 sites is, due to favourable management/reforestation the succession time of recently abandonment ->seminat & semi-nat->forest is reduced by 4 years	Same as 2020	Same as 2020
	Erosion risk		Dyna-CLUE	No specific measures	No specific measures	No specific measures	No specific measures	No specific measures	No specific measures	Conversion to arable land is not allowed in erosion sensitive areas; incentives are provided to abandon arable land in erosion sensitive areas or convert to grassland/permanent crops.	Same as 2020	Same as 2020	Conversion to arable land is not allowed in erosion sensitive areas; incentives are provided to abandon arable land in erosion sensitive areas or convert to grassland/permanent crops.	Same as 2020	Same as 2020

with first simulation results

Item	Sub-Item	Spatial level	Model	V-A1			V-A2			V-B1			V-B2		
				2020	2030	2040	2020	2030	2040	2020	2030	2040	2020	2030	2040
	Land conversion policies (large cities, towns, villages, focus of growth, nature and urbanization)	Large cities	Dyna-CLUE	No restrictions; in practice, growth of urban centres is faboured in this scenario	Same as 2020	Same as 2020	No restrictions; in practice, growth of urban centres is favoured in this scenario	Same as 2020	Same as 2020	Growth restricted to designated areas	Same as 2020	Same as 2020	Restrictions on growth	Same as 2020	Same as 2020
		Provincial towns	Dyna-CLUE	No incentives or restrictions	Same as 2020	Same as 2020	No incentives or restrictions	Same as 2020	Same as 2020	Designated areas adapted to demand	Same as 2020	Same as 2020	Incentives for growth	Same as 2020	Same as 2020
		Small Villages	Dyna-CLUE	No particular incentives or restrictions; loose regulations combined with high incomes may lead to proliferation of second houses	Same as 2020	Same as 2020	no incentives or restrictions; in practice, rural population will tend to decrease in regions with land abandonment	Same as 2020	Same as 2020	Growth (if any) restricted to designated areas	Same as 2020	Same as 2020	Targetted to maintain existing size and structure	Same as 2020	Same as 2020
		Focus of growth	Dyna-CLUE	No restrictions/spatial urban planning. Autonomous focus of growth of urban centres. High incomes combined with loose regulations may lead to proliferation of second houses in green areas or sprawled growth.	Same as 2020	Same as 2020	No restrictions/spatial urban planning. Autonomous focus of growth of urban centres; Sprawled growth	Same as 2020	Same as 2020	Restrictions in urban spatial planning resulting in compact urban growth; growth both in large cities and provincial towns	Same as 2020	Same as 2020	Restrictions in urban spatial planning resulting in compact urban growth with a focus/incentives for growth of provincial towns. Small villages are targeted to maintain existing size and structure	Same as 2020	Same as 2020
		Nature & urbanization	Dyna-CLUE	No restrictions for conversions into residential areas	Same as 2020	Same as 2020	No restrictions for conversions into residential	Same as 2020	Same as 2020	Semi-natural and forest may not change into residential uses	Same as 2020	Same as 2020	Semi-natural and forest may not change into residential uses	Same as 2020	Same as 2020
	Change of built-up area per person per year		Dyna-CLUE	Add 3 m^2 per person per year (approx. double the average value of trend during 1990-2000 over all EU countries)	Same as 2020	Same as 2020	Add 1.18 m^2 per person per year (approx. average value of trend during 1990-2000 over all EU countries)	Same as 2020	Same as 2020	Add 0.5 m^2 per person per year due to the effect of strong economic growth but restrictive spatial planning policies (compact urbanization; about half of the average value of the trend during 1990-2000 over all EU countries)	Same as 2020	Same as 2020	Minus 0.1 m^2 per person per year as result of lower economic growth and strong restrictive spatial planning policies (compact urbanization)	Same as 2020	Same as 2020
	Distribution of population in NUTS2 regions (average of circle with radius 3km; increase/decrease). Dense: > 500 inh/km2; intermediate: 60-500 inh/km2; thin: <60 inh/km2.		Dyna-CLUE	Increase in population is concentrated in the most densely populated areas of both the dense and intermediately populated areas. Decreases in population take place in the thinly populated areas	Same as 2020	Same as 2020	Increase in population is spread in both the dense and intermediately populated areas. Decreases in population take place in the thinly populated areas.	Same as 2020	Same as 2020	Increase in population is spread in both the dense and intermediately populated areas. Decreases in population take place in the thinly populated areas.	Same as 2020	Same as 2020	Increase in population is concentrated in depending on the current spread of population, also small growth in the thinly populated areas (villages etc.). Decreases in population take place in the thinly populated areas.	Same as 2020	Same as 2020