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This brief series was developed in preparation for the Foresight Breakout Session of the Global Conference on Agricultural Research for Development (GCARD 2012) and the Global Foresight Hub[1]. The briefs were written to communicate to a wider audience, such as policy makers, civil society organizations, researchers, and funders. The briefs were classified into three categories: Future Studies, Regional Update, and Visioning.

The future of rural Europe: Lessons from a multi-scale modeling approaches

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Based on: Rienks W.A. (ed.), 2008. The future of rural Europe – An anthology based on the results of the EURURALIS 2.0 scenario study. Wageningen, The Netherlands. http://www.eururalis.eu/background.htm

How can we keep the European rural areas viable? Where can land abandonment occur? Can Europe remain self-sufficient for food? What will be the trade-offs for the implementation of a biofuel policy? These questions are easy to ask, but difficult to answer.

Let's discuss the future of rural Europe

The main goal of the EURURALIS projects was to develop a tool that can support the discussion about the future of rural Europe. The project was first commissioned by the Dutch Ministry of Agriculture in the preparation phase for the Dutch EU-presidency (July – December 2004). To this end a number of scientific models were selected and combined that could simulate future dynamics in agricultural land use in all EU countries. The models needed to be implemented in a user-friendly software system, to select relevant scenarios and policy measures, and to visualize results for policy makers.

A scientific advisory group and a policy advisory group were formed to guard the development process. These stakeholder groups were comprised of participants from science (mostly international researchers) and policy advisory organizations (mostly from the Dutch Ministry of Agriculture). They were involved in three stages: identifying information needs in advance of the project, determining scenario options, and evaluating draft scenario results. The role of stakeholders was mostly reactive: they were presented with results and requested to provide feedback.

EURURALIS: from global to local

Land-use changes in different scenarios were simulated using a quantitative, model-based approach. For this EURURALIS models drivers from global to the local scales that together shape European land-use patterns. The suite of models in EURURALIS includes LEITAP, IMAGE, CLUE and a number of spatial indicator models, as shown in Figure 1. Combining models has several advantages over stand-alone applications. For example, the combination of IMAGE and LEITAP can calculate the ecological consequences of agricultural production, trade and consumption, while the impact indicator models use the land-use maps generated by CLUE to show the location specific impact of future land-use developments.

The link between global and local models allows top-down and bottom-up processes to be incorporated in one system. Top-down here refers to the influence of global developments, such as the world market and demographic changes in local land use. Bottom-up processes refer to developments that are primarily driven by local processes, such as the conversion of abandoned farmland to scrublands and forests. In addition, the explicit allocation of land uses on a grid allows spatially explicit indicators to be calculated, such as connectedness of natural areas or erosion risk.

[1]http://www.egfar.org/our-work/shaping-future-together/global-foresight-hub

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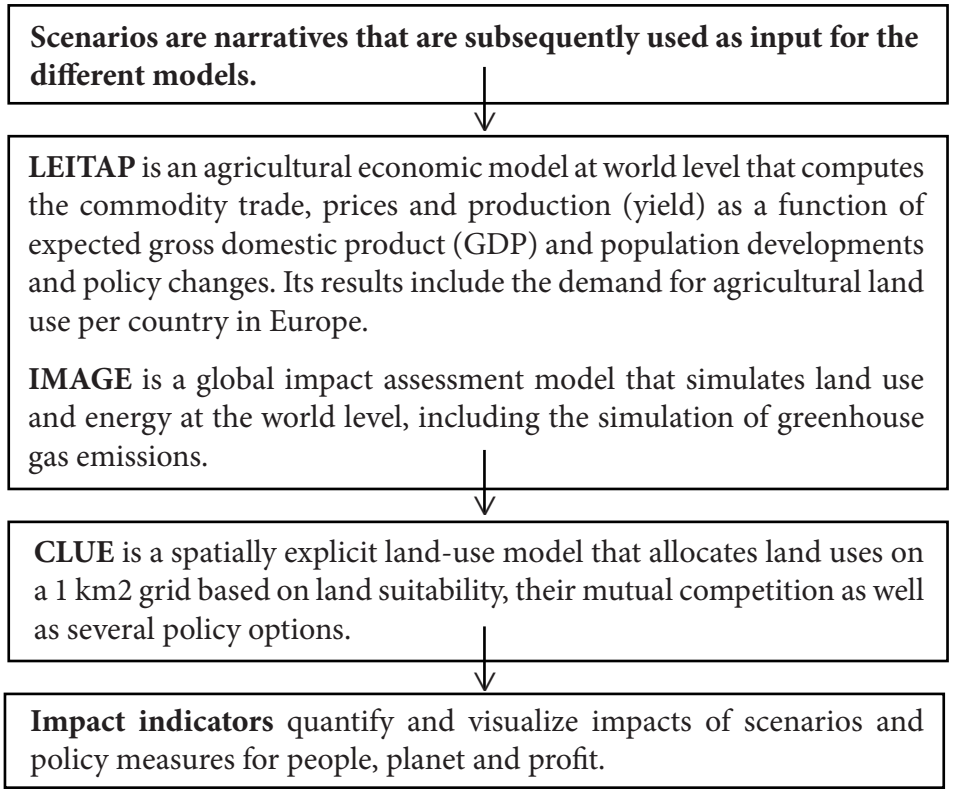

Figure 1: Overview of the EURURALIS modeling approach

Four alternative scenarios

To fuel the discussion, EURURALIS adopted four alternative but consistent scenarios, each having their own benefits and drawbacks. These scenarios were loosely based on the special report on emission scenarios[2], and defined around two contradicting axes: One axis represents global integration versus a more regionalized development; the other presents a low-regulated (market-oriented) against a high-regulated world. Scenarios were defined in terms of population growth, GDP developments, as well as a number of trade- and agriculture-related issues. The combination of both axes yields the following four scenarios:

- The world in **Global Economy** has few borders, limited intervention from governments and a reduction of trade barriers. Technological development is strong and many people, but not all, will benefit from this world. Nature and the environment are not seen as a priority area.
- **Continental Markets** divides the world into regional blocks, each striving for self-sufficiency. Therefore agricultural trade barriers and support mechanisms continue to exist, although government intervention is generally decreased.
- **Global Coordination** envisages a successful world of cooperation, aiming to reduce poverty and environmental problems. Governments have a strong role, but trade barriers are removed.
- **Regional Communities** adopt locally grown food and regional self-sufficiency. The world is strongly regulated, including measures to sustain small-scale agriculture.

Four alternative scenarios

Results for all four scenarios indicate that the importance of agriculture for the European economy will remain small for the EU15 (those member states, mainly from western Europe, that entered the EU before 2003) and continue to decrease towards that same level for the EU12 (those countries, mainly from eastern Europe, that entered the EU after 2003) in all four scenarios.

[2]Nakicenovic et al. (2000). IPCC special report on emissions scenarios. Intergovernmental Panel on Climate Change (IPCC).

Moreover, all scenarios except the Continental Market show a significant trend of land abandonment, as shown in Figure 2. The market-oriented (low regulation) scenarios in particular show a continuation of current trends in which marginal areas in Europe face a large decrease in agricultural land. Consequently, employment in agriculture will continue to decrease. In spite of the large decreases in agricultural area in the more marginal areas of Europe still a large proportion of the EU territory will remain covered by agricultural use.

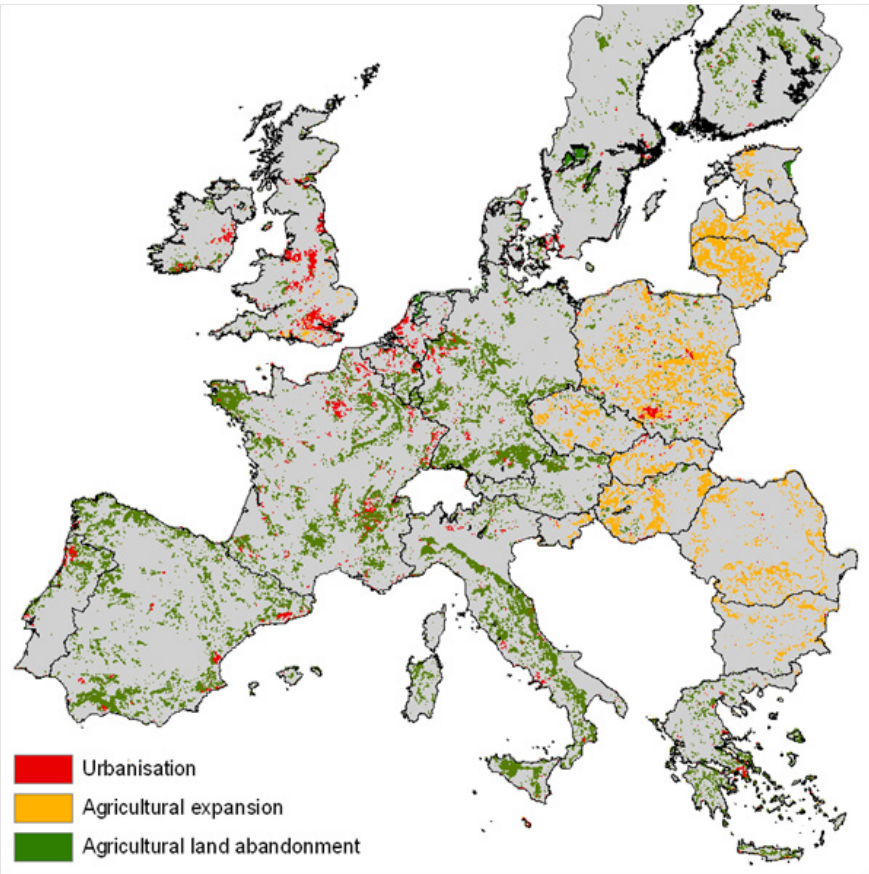

Figure 2: Visualization of expansion and abandonment of agricultural lands in Europe for a scenario without biofuel policy

The four scenarios also revealed some differences between the alternative possible futures. These differences do not allow scenarios to be ranked in terms of good and bad, but instead they show that future developments will most likely be a trade-off between people, planet and profits. The Global Economy scenario yields the highest employment and GDP of all scenarios. Land abandonment can create opportunities for carbon sequestration and biodiversity, but at the same time the real farm income and agricultural employment are the lowest. The Continental Markets scenario yields the highest real farm income, but has a downside on the environmental impacts as more land is needed for agricultural production. The Global Cooperation scenario shows only medium economic growth for Europe, while it is more favorable for other world regions. Moreover this scenario assumes more successful climate mitigation measures and the implementation of biodiversity policies. The Regional Communities scenario yields the highest agricultural employment in Europe, as the role of farmers also includes the protection of the environment, and rural development.

The four scenarios are used to assess the effects of two important policies: the 2003 Common Agricultural Policy (CAP) reform and the implementation of a biofuel policy in Europe. The change of CAP policies from market price support to income support will most likely yield little changes in agricultural production, but considerable changes in farm incomes owing to a reduction in CAP subsidies will decrease farm income. The EU biofuel policy, which aims for a 5.75 percent fuel consumption target, will have a large influence on land use in the EU. While the employment in agriculture and its contribution to the GDP will only increase slightly, it will require about 8 percent of the agricultural land to grow first-generation biofuel crops, with negative consequences in terms of erosion, carbon sequestration and biodiversity. At the same time, this policy will also lead to an increase in biofuel production outside Europe, especially in the liberalized scenarios. This leads to higher farm incomes in Brazil but also a loss of biodiversity in that region.

Global drivers, such as population increase, GDP developments and technology change remain the main drivers for expected land-use changes. However, European policy options like the CAP reform and the biofuel policy will affect some of their impacts, especially for issues like farm income and land abandonment.

Location matters!

The innovative aspect of the multi-scale, multi-model approach adopted in EURURALIS is the link between processes at the global or continental scale (such as demand on the world market and the CAP) to their actual constitution at the local scale. The local aspect is especially important as there is a variation in locations in terms of both physical properties (such as soil quality, elevation or rainfall) and socio-economic properties (including cultural heritage and existing farming practices). This causes the land use response to global or European drivers to be context specific. Moreover, from simulated land-use patterns EURURALIS calculates other spatial effects, such as connectedness of natural areas, urban sprawl, carbon sequestration, or the risk of erosion. These impact indicators require spatially explicit information; hence location matters – the influence of these variations can only be included when the local scale is represented explicitly.

The link between global and local scales revealed that relatively small net changes might have a great impact locally as an increase in agriculture land use in one location can be compensated with a decrease in another location. Hence future developments are not only a trade-off between different preferences, but also between different locations. What might be beneficial in one location might have undesired effects on another location. A special case of this effect is telecoupling: the influence of changes in one location on the land use in another, remote, location. An important example is forests that are cleared for biofuel production in Brazil as a consequence of the European biofuel policy. Such dynamics are not visible when land use change is assessed on a world scale only and require an assessment of both local and global processes.

Although this suite of models was originally developed for the EURURALIS project, it proved to be a fruitful combination, as it has been applied in several other land-use outlooks. These include the SCENAR 2020[3] and Land use modeling – Implementation[4] projects, both commissioned by the European Commission. As the models are flexible in their application, they can be updated when new data and information become available. In addition, it is possible with relatively little work to apply the presented combination of models to other regions in the world, provided that data are available. Obviously, such an endeavor would again require a close collaboration between stakeholders as scenario definition and policy options are typically region-specific and only meaningful when designed in a collaborative process.

[3]Nowicki, P, et al. 2006. SCENAR 2020 – Scenario study on Agricultural and the rural world. Contract No. 30-CE-0040087/00-08 Final report for the European Commission.

[4]Pérez-Soba, M., Verburg, P.H., Koomen, E., Hilferink, M.H.A., Benito, P., Lesschen, J.P., Banse, M., Woltjer, G., Eickhout, B., Prins, A-G. and Staritsky, I. 2010. Land use modelling - Implementation. Preserving and enhancing the environmental benefits of "land-use services. Final report to the European Commission, DG Environment. Alterra Wageningen UR, VU University Amsterdam Geodan, Object Vision, BIOS, LEI and PBL

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