Report to the GTAP Advisory Board 2013

The Agricultural Economic Research Institute (LEI) has been a member of the GTAP consortium since November 1996. We use GTAP for a variety of research activities related to international trade in agri-food products. The following presents a summary of our activities over 2012/2013.

People

In 2012 Heleen Bartelings joined the team, resulting in 12 researchers involved in CGE-related work: Michiel van Dijk, Aikaterini Kavallari, Marijke Kuiper, Myrna van Leeuwen, Hans van Meijl, Jeff Powell, Martine Rutten, Edward Smeets, Lindsay Shutes, Andrzej Tabeau and Geert Woltjer. Aikaterini attended the USAGE training course on dynamic CGE in Washington DC in December 2012 given by Peter Dixon and Maureen Rimmer. In addition John Doornbos and Barbara van Hout continued develop dedicated software tools for MAGNET. The annex contains an overview of the team with their main interests.

MAGNET consortium

The group of developers and users of MAGNET has been extended beyond LEI and includes also researchers from TI and IPTS. A MAGNET consortium has been created which regularly meets to discuss areas where the different member institutes can join forces in developing parts of the model.

Strategy – MAGNET production version

The sizeable group of researchers involved with GTAP work makes it worthwhile to exploit potential economies of scale, overcoming limits posed by project-driven research as done at LEI. Significant investments continued in 2012/2013 to convert the LEITAP model in a modular CGE model called MAGNET: Modular Applied GeNeral Equilibrium Tool. MAGNET has the standard GTAP model at its core with all extensions added in a modular fashion. It allows the user to select which additional modules he/she wishes to include by adjusting the model settings and by including the relevant data.

To consolidate and develop MAGNET we meet once per week for quick updates and we organize longer meetings to address specific issues in depth. In 2012 a meeting was again organized with Peter Dixon and Maureen Rimmer (visiting LEI for the fifth time) to work on long term projections, a historical closure and miscellaneous modeling issues.

During the first two months of 2013 the LEI-team jointly focused on releasing a production version of MAGNET. On March 1st MAGNET 2.0 was released to our partners at IPTS and TI with full documentation.

Current efforts are aimed at testing a production version set-up. The enormous flexibility of MAGNET has great advantages in tailoring the model to a specific research question. The drawback of this flexibility is that there is a potential danger to use settings which make less economic or empirical sense (for example production trees and implied elasticities). Furthermore it is very helpful to have a benchmark at the start of a project, since many project entail comparable baseline scenarios and so on. Building on a tested and documented set-up can greatly reduce the work efforts. Hence we are currently testing a model version that offers users a predefined set-up of the whole system from which to start a project.

CGE-related research in 2012/2013

Model development
(the general procedures are described in the 2012 report)

- *Library of procedures for adjusting a GTAP based SAM when splitting regions and commodities, further developments*

  - Development of procedures to create new sectors by using a mapping towards a common commodity set at a lower aggregation level than the GTAP commodities
  - Development of procedures to aggregate data from different data bases to the same regional and commodity level by splitting them to a detailed level and then aggregating them back.
  - *Splitting crude vegetable oil and oilcake from vegetable oil sector*
  - *Splitting animal feed from ofd*
  - *Splitting fertilizer from crp*
  - General procedure to create new (biofuel) sector where inputs are taken from a set of other sectors
  - Procedure to digest tariff data
- *Land supply*
  - Alternative specification of the land supply function developed jointly with Peter Dixon and Maureen Rimmer to improve performance when the land asymptote is shocked. Methodology applied for REDD criteria related to biofuel directives (RED).
  - Specification of land supply and land use based on land transition matrix as alternative for the standard land supply-CET function.
  - Included AEZ's in land allocation system
  - Included forestry as a separate type of land use where a split is made between the decision to harvest forests and to change land use for forestry.
  - Sources for update of exogenous land productivity used in projections are exploited including the OECD-FAO agricultural outlook for the medium-term and FAO's work on long term projections
- *Including biofuel sectors into the database*.
  - IEA data are used to introduce ethanol and biodiesel data in the version 8 database
  - Biofuels trade data, also based on IEA sources, are incorporated into MAGNET
  - FAO volume data are used to create consistency in energy content
  - Subsidies for biofuel use are based on a comparison between gasoline price and cost price of biofuels
  - DDGS as a byproduct of maize ethanol.
  - Biodiesel is made of crude vegetable oil instead of oilseed, where the byproduct oilcake is generated with vegetable oil production
  - Molasses as byproduct of sugar is introduced
- *Dynamic international investment and income flows improved*
  - The function that adjusts international investment is made quadratically dependent on the rate of return on investment in order to get faster adjustment.
- Depreciation is set on 6% of the value of capital, instead of 4%. In order to solve the problem of negative savings, savings are shocked in the direction of zero savings in the baseline projections if savings are negative. Improved fix to make investment more consistent with growth in capital stock in static model, in cooperation with Peter Dixon and Maureen Rimmer.
- *Factor markets*
  - Introduction of upwards-sloping labor supply curves (currently for EU countries) to offer an intermediate labor market specification between flexible employment with fixed wages and full employment with flexible wages.
- *Household modeling*
  - Building on the MyGTAP code generously shared by Terrie Walmsley and Peter Minor we developed a module offering the possibility for one or more regions to replace the regional household by a separate government and one or more households.
  - Model runs, efforts now focus on building a household database to use in the module.
- *Fertilizer modeling*
  - Literature research on modeling approaches of fertilizers and fertilizer policies
  - Splitting up the GTAP p_c sector to fertilizers and rest of p_c
  - The database on fertilizers is gradually enhanced with data on fertilizer use per crop and per country
  - Production trees of the production version have been modified so as to capture substitution between land and fertilizer use for crop production accounting hence for intensification vs. extensification of agricultural production systems
  - Sensitivity analysis of substitution elasticity
- *Tariffs*
  - Tariff shocks are handled at 6 digit level instead of the GTAP aggregation, applying shocks on bound tariffs instead of applied tariffs when necessary.

- Ongoing research on exploiting possibilities to model separately ad-valorem and specific tariffs instead of ad-valorem equivalent tariffs
- Ongoing efforts involve updating the GTAP tariffs with more recent information derived from TRAINS
- External databases used are TRAINS and UN COMTRADE which are available to MAGNET via LEI's METABASE handling system

- *Multi-technology production*
  - Created possibility to run GTAP with sectors that have no trade, i.e. sectors are not anymore a subset of commodities.
- *Integration national and international CGE (i.e. MAGNET and ORANGE)*
  - Created possibility to run GTAP at two aggregation levels, one for most regions of the world, another for the regions where more sector and commodity detail is required. This uses the new GTREE possibility to substitute variables.
  - Development of procedures to transform a national SAM in a different format towards GTAP format; in this case the SAM for ORANGE is integrated into the MAGNET database.

Data and model management software

- *DSS (Dynamic Steering System)*
  - Created possibility to add endowments to database
- *GTREE*
  - *Created possibility to substitute strings in order to be able to use subroutines where some sets, coefficients or variables are substituted with a different name.*

Linking of models and long term scenario development

- *VOLANTE*
  - A roadmap for future land resource management in Europe a number of long term development scenarios is analyzed. They vary by macroeconomic and policy assumptions and are examined by linked system of models including LEITAP, ReMIND/MAgPIE, MOLAND, EFI-GTM, CAPRI, EFISCEN and CLUE.
- *AgMIP Comparison of alternative approaches for long-term scenarios for agricultural markets and trade*
  - In the project, long term projection for agricultural markets and trade made by LEITAP, IMPACT, ENVISAGE, GLOBIOM, IMAGE and 6 other global models, Projections are based on the same set of assumptions and are developed by LEI, IFPRI, IIASA and World Bank. In debt projections comparison is done to improve the global models and learn from each other.
- *BE-BASIC*
  - In collaboration with colleagues from Utrecht University we develop a scenario linkage path in order to analyse the impacts of biofuel policies on land use changes in Brazil; MAGNET is soft-linked to a spatial allocation model PLUC, which is applied in this exercise for Brazil and uses land demand changes derived from MAGNET
  - Land use data for Brazil are taken from national sources and are harmonized between MAGNET and PLUC (both regarding land demand per crop and on potentially available agricultural land)

Bioenergy

- The chemical sector in ORANGE has been split into a 'chemical-fossil based' industry and a 'chemical-biobased' industry.
- In the Dutch Bebasic and knowledge infrastructure Biobased economy projects the economic MAGNET model will be linked to bottom up analyses of Copernicus institute and to environmental models.
- "Land use change effects of biofuel use in the EU 27" - contributions of LEI to the project: concerning 'Opportunities and threats of the biobased economy for sustainable development' of the Netherlands Environmental Assessment Agency (PBL). Project evaluate direct and indirect land use change effects of the 10% biofuel target of the Renewable Energy Directive (RED) in the year 2020"Impact analysis of a bioeconomy in the EU" contributions of LEI to the project: concerning 'Opportunities and threats of the biobased economy for sustainable development' of the Netherlands Environmental Assessment Agency (PBL). The focus of this study is on the macro-economic impacts in the EU of emerging biobased sectors, i.e. the use of biomass for the production of second generation biofuels, electricity and chemicals. Results are expressed in terms of im-pact on Gross Domestic Product (GDP), trade balance and employment for the

year 2030. Also the impact of the use of residues on the agricultural sector and on agri-cultural land use is evaluated.

- The research on an impact of the rebound effect of first generation biofuels on greenhouse gas emissions in the EU. The MAGNET model is used to evaluate the rebound effect of biofuel use in the EU. A sensitivity analysis is carried out based on the range of model parameter values identified when reviewing literature. The impact of the rebound effect of biofuel use in the EU on GHG emissions was estimated.
- An economy-wide assessment of the food security impacts of changes in bioenergy use in a framework of Global-Bio-Pact FP7 project. The illustrative MAGNET application that quantifies the impact of increased biofuel production on food prices and macroeconomic indicators in Argentina, Indonesia and Brazil. Furthermore, it studies the implications for food security in these regions and, via food prices, on selected African regions.

Global household database

- Using funding from various projects work has started on developing a household database to for the new household module. With the usual limits of funds and time we start focusing on a limited number of countries, one of which is Ghana (the focus of a USAID project).
- Our ambition is one of broad but global coverage, i.e. we aim for a global database compatible with any GTAP version, constructed from public data sources. Our intention is to make the source data and procedures we use publicly available to solicit feedback on our approach and invite others to contribute data.

LEITAP/MAGNET – 2012/2013 related publications

Boulanger, P., Kavallari, A., Rau, M.L. and Rutten, M. (2013). **Trade Openness and Investment in North Africa. A CGE application to deep and comprehensive free trade areas (DCFTAs) between the EU and respectively Egypt, Morocco and Tunisia**. Paper for the **IATRC Symposium "Productivity and Its Impact on Global Trade", June 2-4, Seville.**

Dixon, P. B., Meijl, H. van, Rimmer, M. T., Shutes, L. & Tabeau, A (2013). RED vs. REDD: Biofuel policy vs. forest conservation. Paper submitted to the Journal of Environmental and Resource Economics. A working paper version is available at http://www.factormarkets.eu/working-papers?page=3

Kavallari, A., Smeets, E. and Tabeau, A. (2013). Land Use Changes of Biofuel Use in the EU: An Uncertainty Analysis. Contributed paper at the 133rd EAAE Seminar, June 14-16, Chania.

Rutten, M. and A. Kavallari (2013), Can reductions in agricultural food losses avoid some of the trade-offs involved when safeguarding domestic food security? A case study of the Middle East and North Africa. Paper for the 16th Annual Conference on Global Economic Analysis " New Challenges for Global Trade in a Rapidly Changing World", June 12-14 2013, Shanghai, China

Rutten, M., P. Nowicki, M-J Bogaardt and L. Amaryan (2013), Reducing food waste by households and in retail in the EU: A prioritisation using economic, land use and food security impacts. LEI report (forthcoming) commissioned by BIO-IS as part of the project 'Modelling Milestones for achieving Resource Efficiency' (a project under framework contract Env.G.4/FRA/2008/0112 for DG Environment).

Rutten, M., L. Shutes and G. Meijerink (2013), Sit Down at the Ballgame: How Trade Barriers Make the World Less Food Secure, Food Policy, 38: 1–10. Earlier versions appeared as SSRN Working Paper and GTAP Conference Paper (GTAP resource nr. 3507), 2011. Underlying project report: Sit Down at the Ballgame: How Export Barriers Make the World Less Food Secure, Report 2011-047, LEI-Wageningen UR.

Tabeau, A. and H. van Meijl (2012). The Impact of Intermediate Technology Change on Global Land Use in 2050. Contributed paper at the Conference "Planet Under Pressure 2012", March 26 -29, London.

Woltjer, G.B. (2013), Modellering van verandering van grondgebruik en bosbouw in een algemeen evenwichtsmodel, WOt-paper 21, Wageningen : Wettelijke Onderzoekstaken Natuur & Milieu.

Woltjer, G.B. (2013), Modellering van vleesconsumptie en productie in een algemeen evenwichtsmodel, WOt-paper 22, Wageningen : Wettelijke Onderzoekstaken Natuur & Milieu.

Woltjer, G.B. (2013), Forestry in MAGNET : a new approach for land use and forestry modelling, WOt-werkdocument 320, Wageningen : Wettelijke Onderzoekstaken Natuur & Milieu.

Stehfest, Elke, Maurits van den Berg, Geert Woltjer, Siwa Msangi, Henk Westhoek (2013), Options to reduce the environmental effects of livestock production – Comparison of two economic models, Agricultural Systems 114, 38–53.

Achterbosch T., Woltjer G., van Meijl H., Tabeau A., Bartelings H., van Berkum S. 2013, An economy-wide assessment of the food security impacts of changes in bioenergy use LEI, part of Wageningen UR, The Netherlands, Report of the FP7 Global-Bio-Pact Project (FP7-245085)

Andrzej Tabeau, Hans van Meijl, Koen P. Overmars, Elke Stehfest, 2013, REDD policy impacts on agri-food sector and food security: scenario analysis with a CGE model", paper for 133rd EAAE Seminar on "Developing Integrated and Reliable Modeling Tools for Agricultural and Environmental Policy Analysis",

Aikaterini Kavallari, Edward Smeets, Andrzej Tabeau, 2013, Land Use Changes of Biofuel Use in the EU: an Uncertainty Analysis, paper for 133rd EAAE Seminar on "Developing Integrated and Reliable Modeling Tools for Agricultural and Environmental Policy Analysis".

Edward Smeets, Jamil Moorad, Andrzej Tabeau, Siemen van Berkum, Geert Woltjer, Hans van Meijl, 2013, The impact of the rebound effect of first generation biofuels on greenhouse gas emissions in the EU, paper for the 17th ICABR Conference, June 18-21, 2013 in Ravello, ItalyChristoph Schmitzat al. (Andrzej Tabeau and Hans van Meijl co-authors), 2013, An agro-economic model comparison of cropland change until 2050, p*aper for 16th Annual Conference on Global Economic Analysis*

Geert Woltjer, Hans van Meijl, Andrzej Tabeau, Heleen Bartelings and Thom Achterbosch, 2013, A quantitative analysis on the macroeconomic and food security impact of biofuel target policies, p*aper for 16th Annual Conference on Global Economic Analysis*

7 coauthored articles submitted to Agricultural Economics and one in PNAS resulting from AgMIP(Hans van Meijl, Andrzej Tabeau and Aikaterini Kavallari co-authors, see below)

Ahammad, H., Sands, R.D., Fujimori, Sh., Hasegawa, T., Havlik, P., Kyle, P., Mason d'Croz, D., Popp, A., Tabeau, A., Valin, H., van der Mensbrugghe, D., van Meijl, H., von Lampe, M. (2013). International trade under a changing climate: a comparison of results from selected global economic models, Agricultural Economics, Special Issue on Global Model Intercomparison (forthcoming)

von Lampe, Martin, D. Willenbockel, K. Calvin, S. Fujimori, T. Hasegawa, P. Havlik, P. Kyle, H. Lotze-Campen, D. Mason d'Croz, G. Nelson, R. Sands, C. Schmitz, A. Tabeau, H. Valin, D. van der Mensbrugghe, H. van Meijl (2013). Why Do Global Long-term Scenarios for Agriculture Differ? An overview of the AgMIP Global Economic Model Intercomparison, Agricultural Economics, Special Issue on Global Model Intercomparison (forthcoming)

Lotze-Campen, H., von Lampe, M., Kyle, P., Fujimori, Sh., Hasegawa, T., Havlik, P., Kavallari, A., Mason d'Croz, D., Nelson, G., Popp, A., Tabeau, A., van der Mensbrugghe, D., van Meijl, H., Valin, H., Willenbockel, D., Wise, M. (2013): Impacts of increased bioenergy demand on global food markets: a model intercomparison, Agricultural Economics, Special Issue on Global Model Intercomparison (forthcoming)

Nelson, G.C., van der Mensbrugghe, D., Blanc, E., Calvin, K., Hasegawa, T., Havlik, P., Kyle, P., Lotze-Campen, H., von Lampe, M., Mason d'Croz, D., van Meijl, H., Müller, Chr., Reilly, J., Robertson, R., Sands, R.D., Schmitz, Chr., Tabeau, A., Takahashi, K., Valin, H. (2013). Agriculture and Climate Change in Global Scenarios: Why Don't the Models Agree, Agricultural Economics, Special Issue on Global Model Intercomparison (forthcoming)

Nelson, G., H. Ahammad, D. Deryng, J. Elliott, S. Fujimori, P. Havlik, E. Heyhoe, P. Kyle, M. von Lampe, H. Lotze-Campen, D. Mason d'Croz, H. van Meijl, D. van der Mensbrugghe, C. Müller, R. Robertson, R. D. Sands, E. Schmid, C. Schmitz, A. Tabeau, H. Valin, D. Willenbockel, Assessing uncertainty along the climate-crop-economy modeling chain, PNAS (forthcoming)

Robinson, Sh., van Meijl, H., Willenbockel, D., Calvin, K., Dietrich, J., Fujimori, Sh., Havlik, P., Mason d'Croz, D., Masui, T., Sands, R.D., Schmitz, Chr., Tabeau, A., Valin, H., van der Mensbrugge, D., von Lampe, M., Wise, M. (2013). Different Supply-Side Specifications in Models of the Global Food System, Agricultural Economics, Special Issue on Global Model Intercomparison (forthcoming)

Schmitz, Chr., van Meijl, H., Kyle, P., H., Fujimori, Sh., Gurgel, A., Havlik, P., Mason d'Croz, D., Popp, A., Sands, R.D., Tabeau, A., van der Mensbrugghe, D., von Lampe, M., Wise, M., Blanc,

E., Hasegawa, T., Valin, H., (2013): How much cropland is needed? – Insights from a global agro-economic model comparison, Agricultural Economics, Special Issue on Global Model Intercomparison (forthcoming)

Valin, H., Sands, R.D. van der Mensbrugghe, D. Sands, R.D., Bodirsky, B., Fuimori, Sh., Hasegawa, T., Havlik, P., Kyle, P., Mason d'Croz, D., Rolinski, S., Tabeau, A., van Meijl, H., von Lampe, M. (2013): Global Food Demand towards 2050: Drivers, Modeling Approaches and Results Comparison, Agricultural Economics, Special Issue on Global Model Intercomparison (forthcoming)

Annex – the MAGNET team at LEI

Hans van Meijl

Hans.vanMeijl@wur.nl

- Team leader
- CAP
- Bio-based economy

Geert Woltjer

Geert.Woltjer@wur.nl

- Developer
- Land use
- Biofuels

Marijke Kuiper

Marijke.Kuiper@wur.nl

- Developer
- Trade
- Poverty

Lindsay Shutes

Lindsay.Shutes@wur.nl

- Food security
- Factor markets
- Poverty

Andrzej Tabeau

Andrzej.Tabeau@wur.nl

- Baseline
- CAP

Martine Rutten

Martine.Rutten@wur.nl

- Food security, food waste and resource scarcity
- Trade
- Diets, nutrition and health

Aikaterini Kavallari

Aikaterini.Kavallari@wur.nl

- Linking PE-CGE
- CAP
- Medium term market outlook projections
- Biofuels

Michiel van Dijk

Michiel.Vandijk@wur.nl

- Technical change
- Land use change
- Developing countries

Edward Smeets

Edward.Smeets@wur.nl

- Biofuels and biobased materials
- Land use change
- GHG emissions

-

Jeff Powell

Jeff.Powell@wur.nl

- Biofuels
- Econometric parameter estimation

Myrna van Leeuwen

Myrna.vanLeeuwen@wur.nl

- Single country CGE (ORANGE)
- Agricultural policy

Heleen Bartelings

Heleen.Bartelings@wur.nl

- [add interest]

John Doornbos

John.Doornbos@wur.nl

-
- Software development

Barbara van der Hout

Barbara.vanderHout@wur.nl

- Software development

Annex: overview of the structure of the MAGNET model