Integrated assessment of agricultural systems at the European level

This Policy Brief presents the outcomes of a workshop (Brussels, 17-2-2016) with policy-makers from the European Commission (EC) and researchers from the Joint research Centre (JRC) and various European research institutions. The objective was to formulate future needs for research in the field of integrated assessment of agricultural systems, based on a joint reflection on efforts in the past with regard to the key elements in fig. 1.

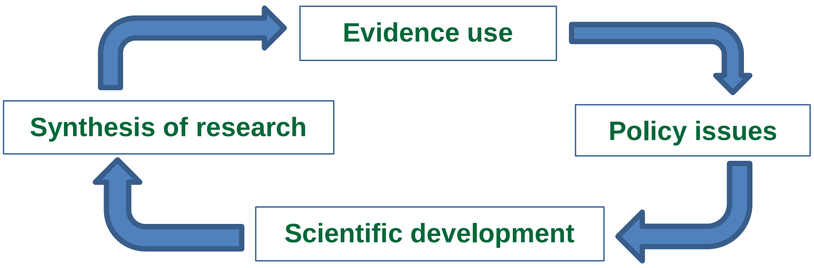

Figure 1. General framework for the reflection

Currently, developments in the policy and science side are to some extent happening in parallel. At the policy side agricultural and environmental challenges (e.g. environmental degradation, biodiversity loss, rural population decline, climate change) have resulted in responses and strategies in terms of climate smart agriculture, bio-based and circular economy, resource efficiency and socially acceptable farming. At the science side, research made numerous efforts to respond to these challenges with integrated research, covering the economic, environmental and social dimensions of sustainable development.

The main outcome of the workshop are shared views on the need to synthesize research evidence based on inputs from the science as-well-as the policy side.

Key elements in developing this synergy are:

1. **Systematic synthesis of evidence as an institutional element in the existing science-policy-interfaces for agricultural systems**. An end-user driven identification of policy relevant indicators and linked analytical questions should support the process of convergence of evidence: a systematic and transparent exploration of the available evidence in the existing knowledge reservoir combined with the distillation of robust messages for policy-makers (e.g. like in the Intergovernmental Panel on Climate Change).
2. **Contextualization of scientific tools precedes use**. Impact assessment of policy options as an instrument for enhanced policy guidance requires context specific analysis with respect to agriculture, the most important agricultural policies and local conditions. Therefore contextualization is a key feature for any scientific tool to be used for integrated assessment.
3. **Tackling the subject of data as limiting factor.** A lack of data is more limiting scientific progress than a lack of models. The need for new typologies of agricultural systems at various spatial/temporal scales requires a European database with (new types of) farm management information and the capacity to capture heterogeneity in space and time.

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Key findings

Evidence use

The period 2003-2013 shows an increased mentioning of quantitative models and scientific evidence in 805 Impact Assessment (IA) reports produced by the EC. This in particular applies to economic and environmental impacts. Models are less frequently used in assessing social impacts (with few exceptions as employment effects and labor markets) and in truly integrated assessments. Actual model use is even higher since part of it is not visible for readers of IA reports. Several policy units (e.g. DG AGRI) tend to use models mainly in the early (pre-assessment) stages of the policy process. Despite the positive trend, the available scientific evidence in the existing knowledge reservoir is strongly under-utilized in actual policy-making. This is due to the existing abundance and diversity of available models; the lack of transparency whether differences are directly policy relevant, or merely reflect differences in underlying scientific approaches; the lack of a clear genealogy (identical models appear under different names) and the fact that external parties do not have access to the MIDAS-platform of the JRC which gives an overview of the in-house modelling capacities of the EC.

Policy issues

Impact assessment of policy options as an instrument for enhanced policy guidance requires context specific analysis. Therefore contextualization is a key feature for any model to be used for integrated assessment. Other generic model features are transparency and the capacity to address trade-offs, as-well-as risks and uncertainties. The focus on market models during the early stages of the Common Agricultural Policy (CAP) broadened towards models that also could integrate environmental and ecological topics. Various developments resulted in a growing need for farm models: 1) Structural changes in the agricultural sector in combination with changing positions/behavior of the actors in the agri-food supply chain; 2) The changes of the CAP from compliance to performance requires insights in the responses at farm level and their impacts at landscape level; 3) The strive towards a circular economy and delivery of ecosystem services; and 4) The growing need for maintaining consistency between EC regulations and local realities, which is a consequence of the increased freedom for Member States to implement the CAP at national and landscape levels. Many farm models have been used to assess the impact of the CAP reform (including policy topics like decoupling, modulation and redistribution of payments, greening and ageing; see Background).

Scientific developments

Here the key issues are ‘data’, ‘integration’ and the ‘foresight analysis’ which should steer the research agenda setting for the first two topics. Generally a lack of data (e.g. to develop typologies of agricultural systems and to assess agricultural management at sufficient temporal and spatial resolution) is more limiting scientific progress than a lack of models. There is a strong need for a European database with (new types of) farm management information and the capacity to capture heterogeneity in space and time. Regarding integration key topics are: an integrated approach of micro/macro interactions at farm and landscape level; combined use of models including the question of weak/strong couplings; modelling of farmers behavior with agent-based or bio-economic models at global/regional/household levels; risks/uncertainties and their propagation in model chains; agri-food supply chain modelling; the need for process based summary models and the communication of model limitations. The following knowledge gaps as identified by the JRC are obstacles in the process of linking policy measures to insights in responsiveness, farm practices and environmental impacts: 1) Geo-referenced farm data: limited access to farm micro-data, to local agronomic data and to administrative data; 2) Pan-European environmental monitoring data (e.g. on biodiversity) / lack of harmonization and access to data of Member States; 3) Farmers responsiveness to policy change (e.g. for assessing options for greenhouse gas mitigation in agriculture); and 4) Linking Ecosystem Services Accounting with agro-economic analysis/valuation of the environment, including aggregation/disaggregation at the required scales.

Synthesis of research evidence

This field emerged as the most important result of the workshop, both from a researchers' and a policy-makers' perspective. The workshop resulted in shared views on the gaps in available data and knowledge, as-well-as the lessons learned on how to tackle them. Closing these gaps from a science oriented perspective requires primarily and end-user driven definition of policy relevant indicators and linked analytical questions that contribute to addressing the future challenges for the CAP. This requires new data as indicated in the previous section and new insights in the following topics:

- Avoiding environmentally harmful activities and providing ecosystem services and other environmental public goods and revealing conflicts or trade-offs between different objectives and between different levels, e.g. demand for food/feed/bio-based material/bio-energy.
- Options for implementation of the CAP at national/regional/landscape levels.
- Risks and uncertainties in the evaluation of policy options, including model assumptions and the propagation of uncertainties in model chains.
- Consequences of new (farming) technologies and changes in the position/behavior of farmers and other actors in the agro-food supply chain.

Closing these gaps from a process oriented perspective requires:

- Improved organization of the process of 'convergence of evidence': a systematic and transparent exploration of the available evidence in the existing knowledge reservoir and the distillation of robust messages from the existing variety of models (e.g. like in the Intergovernmental Panel on Climate Change).
- Interaction in the science-policy-interface targeted at jointly developing a research agenda based on foresight analysis of both scientific developments and upcoming policy issues.
- Mobilising the potential for synergy between JRC and the wider European research community by opening the MIDAS platform for external researchers. Expected result: a more systematic and transparent exploration of the existing knowledge reservoir (in the pre-assessment phase of a policy) and the distillation of robust messages from the existing variety of models.
- Funding mechanisms that support integration, continuity, shared learning and permanent innovation. Currently it is much easier to obtain funding for developing a completely new model than for testing and improving existing models based on feedback from actual application in policy processes. Besides funding, this also requires a strong commitment from the stakeholders in the policy domain to participate in user and stakeholder groups of scientific projects.

Many participants pointed at the fact that often a model implicitly reflects an underlying view on society. It is important to understand and make explicit how model outcomes can depend on these underlying views and to develop modelling approaches that can deal with the existing diversity of underlying views on society.

Background

Workshop: programme and participants

The workshop (17th February 2016, Radisson Blu Royal Hotel, Brussels) was organised by Wageningen UR as a joint reflection on "Knowledge gaps in integrated assessment of agricultural systems at the European level" with policy makers and with researchers from the FP6 Integrated project SEAMLESS and the FP7 Network of Excellence LIAISE.

Session 1: Use of evidence in impacts assessment of agricultural systems

1. Use of models in Impact Assessment - Anna Lena Guske (FUB)
2. Application of farm level models in impact assessment and scientific developments - Pytrik Reidsma (Wageningen UR)
3. Reflections from relevant policy perspectives: Koen Dillen (DG-AGRI), Szvetlana Acs (JRC), Jasper Dalhuizen (Ministry of Economic Affairs, The Netherlands)
4. Reflection on session 1:
   - State of science in integrated assessment of agricultural systems: Martin van Ittersum (Wageningen UR).
   - Challenges from "Towards a New Generation of Agricultural Systems": Sander Janssen (Wageningen UR).

Session 2: Science-readiness for impact assessment of agricultural systems: state-of-the-art & challenges

1. JRC on economic and environmental modelling capabilities: Stefan Niemeyer & Jean-Michel Terres (JRC-IES) and Robert M'barek (JRC-IPTS).
2. Role and form of farm-field models in supporting strategic thinking and scenario analysis with stakeholders and policy makers: Jacques Wery (Montpellier SupAgro)
3. Representing actor behaviour in integrated assessment models: Thomas Berger (Hohenheim University)
4. The landscape level in integrated assessment of agricultural systems - Erling Andersen (University of Copenhagen)
5. Reflections on session 2:
   - Argyris Kanellopoulos (Wageningen UR)
   - Francesco Galioto (Uni. Bologna)

Drawing up the research agenda: group reflection on challenges

Other participants (in addition to those mentioned in the programme): Jacques Jansen (Wageningen UR), Martin Köchy (Thünen Institute), Evangelia Kougioumoutzi (Global Food Security) and Erwin Schmid (BOKU).

Analysis of evidence use in IA reports[1]

Analysis of 805 IA reports (published by COM http://ec.europa.eu/governance/impact/ on the use of evidence from 2003-2014 and on the use of models from 2003 - Sep 1, 2013 (excl. ongoing IAs). Conclusions regarding the use of evidence (see also Figure 2):

- Models and scientific evidence are increasingly being used in IAs; referencing is not always clear. Also the description of JRC models in JRC reports often lacks references to peer reviewed publications.

[1] Sources: presentations by Anna-Lena Guske and Pytrik Reidsma

- Model use increased over the examined period and policy learning takes place. However, still a large number of IA reports, do not mention the use of models
- Some areas are traditionally weak with regard to the use of quantitative models: Social impacts (with few exceptions as employment effects and labor markets)
- There are only very few truly integrated assessments (most are disciplinary)
- The availability of farm models >> the actual use in IAs.

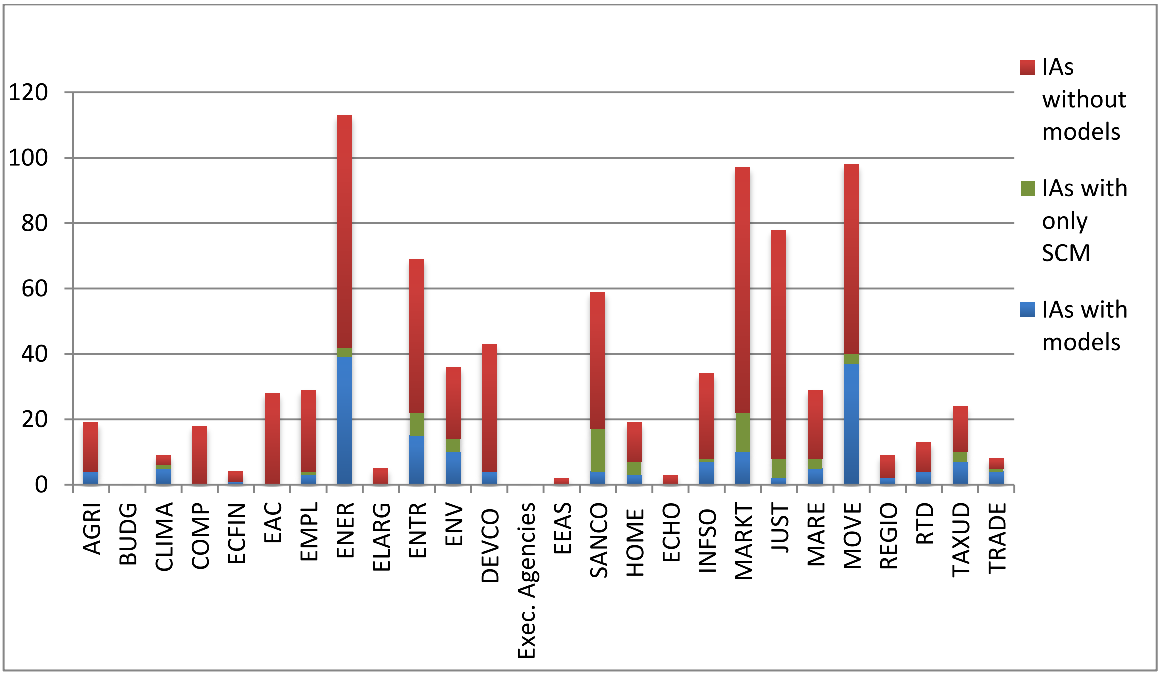

Fig. 2: Policy DGs and model use in IAs 2003 – Sep 2013 (SCM = Standard Cost Model)

The total number of models used in the IA reports was 144; most models were used only once (125). The most frequently used models were: PRIMES (simulates the European energy system and markets, used in 33 IA reports) and TREMOVE (impacts of different transport and environment policies on the emissions of the transport sector, used in 20 IA reports). Other more frequently used models were: GEM-E3 (13 IAs), POLES (13 IAs), QUEST (11 IAs), GAINS (11 IAs) and ASTRA (6 IAs).

Table 1: Models used in IA reports for the policy area Agriculture and Rural Development

Models used	**Policy topics**	**Scientific articles**
Standard Cost Model	CAP direct payments; organic production; school aid fruit, veg. & milk	26
CAPRI model	CAP direct payments; indication place of origin	25
OECD PEM model	CAP direct payments	0
AGLINK model	CAP direct payments; health check CAP	4
PESERA model	CAP direct payments	20
AIDS7K model	CAP direct payments	0
FADN model	CAP direct payments	0
CEN model	Agricultural product quality	0
SPS model	Health check CAP	0
ESIM model	Health check CAP	0
GAINS model	Health check CAP	11
OECD/AGLINK model	Health check CAP	0
Aids4k model	Health check CAP	0
QUEST model	Biofuels communication	0
LEADER model	Support for rural development	0

For the policy area Agriculture and Rural Development 24 IA reports were produced; of which 9 used a model. Table 1 gives an overview of the models used. The IA reports don't make any references to scientific articles and – with the exception of SCM, CAPRI, PESERA and GAINS – there is very little peer reviewed literature available for these models. In only one IA report a farm model was used (CAPRI with farm type extension).

Integrated assessment of agricultural systems[2]

A SCOPUS search for the period 2007-20015 on the keywords farm models, policy and EU resulted in 179 articles which covered the types of farm models in Figure. 3.

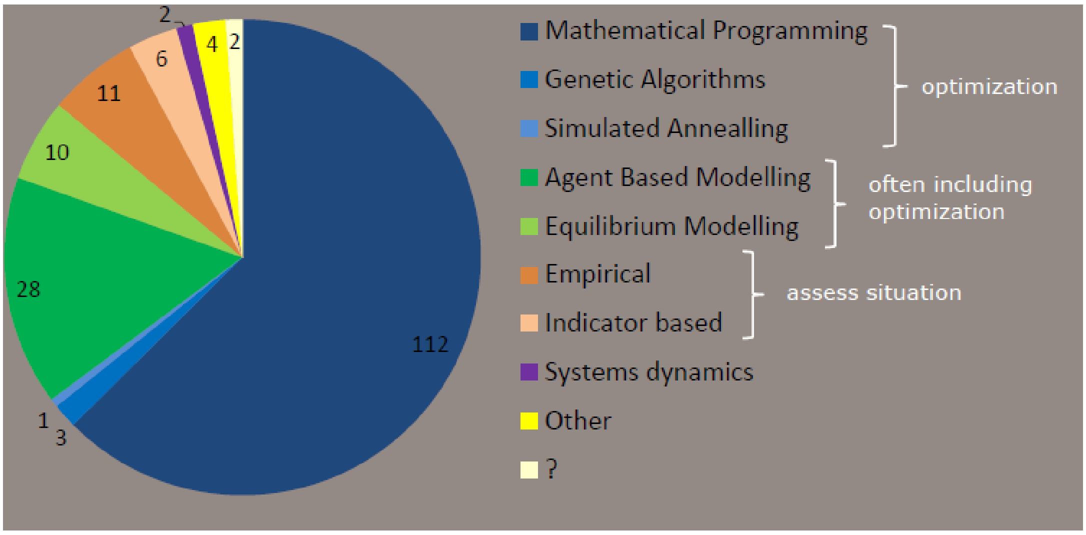

Fig.3: Types of farm models used in the 179 articles

A selection of these articles for the period 2013-2015 (42 in total) were examined in more detail. The following policy issues were addressed: CAP - decoupling and greening (43%); CAP - quota abolishment (7%); CAP - climate change mitigation (12%); CAP – ageing (2%); Water use (12%); Pesticide use (2%); Ozone (2%); Risk (5%); Other e.g. review (14%). Of these 42 studies two-thirds were used to assess and inform policies; the remaining one-third was almost equally distributed across the identification of policy needs, use as a decision support tool, or for other purposes (e.g. review). Of these studies 38% addressed multiple sectors; 79% addressed farm diversity (specialization, size, intensity) and 10% addressed spatial diversity.

Agricultural systems are complex systems and the complexity can be captured with the concepts of Figure 4. In applying these concepts in IAAS (Integrated Assessment of Agricultural Systems) the questions arises how far we should go into agricultural systems realism? Many problems become apparent at higher scale levels (e.g. climate, food system, biodiversity), while the solutions require insights in the diversities at farm and field scale. In practice models are often more boundary objects than expert systems and therefore it is important to share the concepts behind the models:

- Among disciplines (e.g. economy, agronomy, ecology, hydrology) → from concepts to processes and emerging properties
- With owners of data and knowledge → data quality and completeness
- With stakeholders → credibility of the simulated system
- With users → relevance of scenarios and credibility of results

[2] Sources: presentations by Pytrik Reidsma, Jacques Wery and Thomas Berger

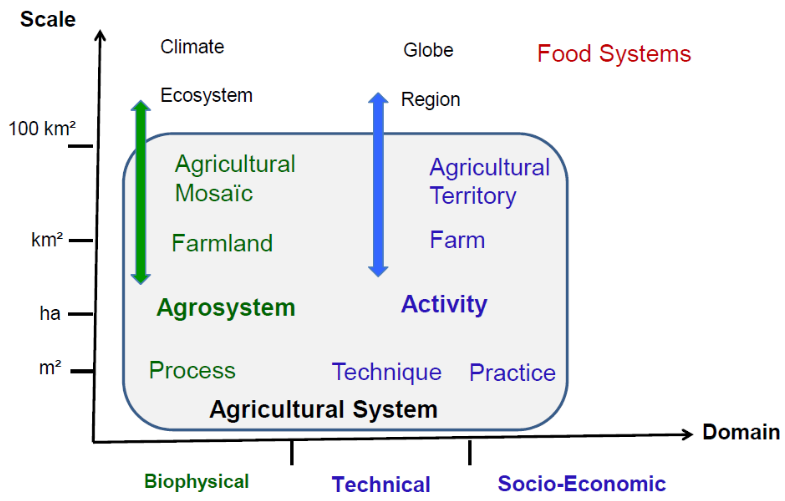

Fig. 4: Concepts for capturing agricultural systems

Most farm models in Figure 3 are Mathematical Programming models without considering interactions between farms. Farm behavior and interaction can be better represented in Agent-Based Models, also called Multi-Agent Systems (MAS). A recursive micro-simulation approach of actor behavior allows a detailed analysis of elements like: structural change, disaggregation, learning, risk and individual strategies. MAS provides information which can complement the output of other types of models. Figure 5 gives an outlook on a future model portfolio for integrated assessment of agricultural systems.

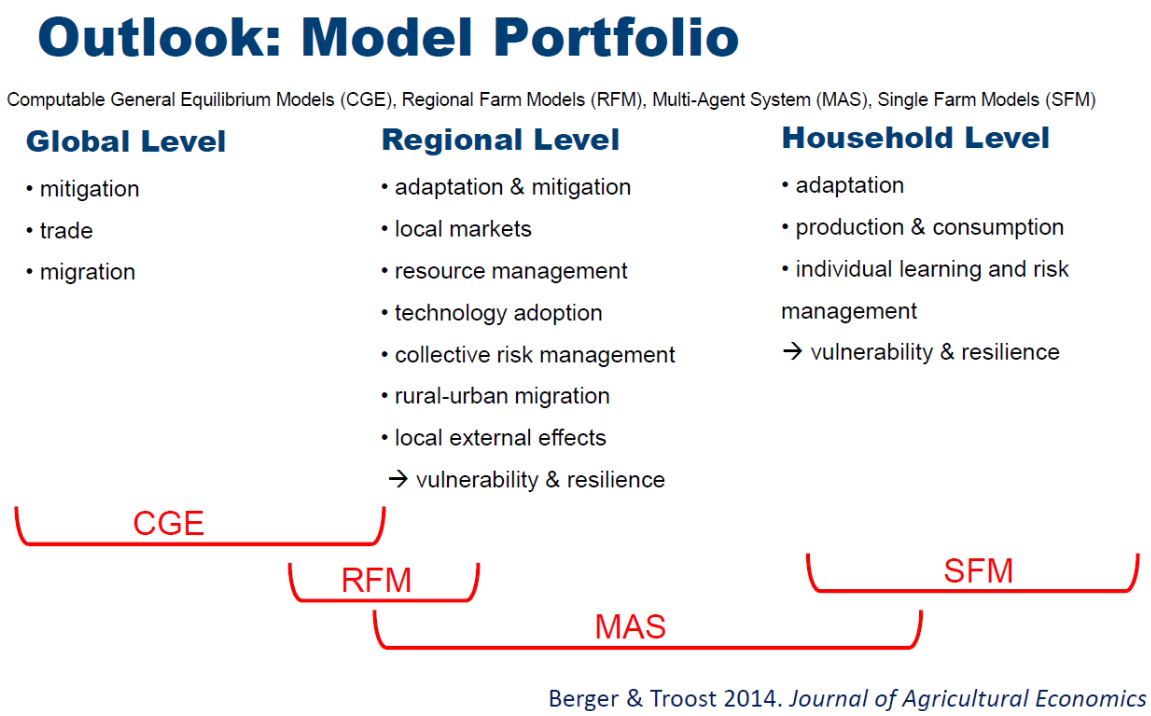

Fig. 5: Model portfolio for integrated assessment of agricultural systems

http://www.seamlessassociation.org/

http://www.liaise-kit.eu/