Guidelines for the evaluation of decentralized policies: Challenges, evaluation techniques and impacts. Public Deliverable D6.5, PRIMA collaborative project, EU 7th Framework Programme, contract no. 212345

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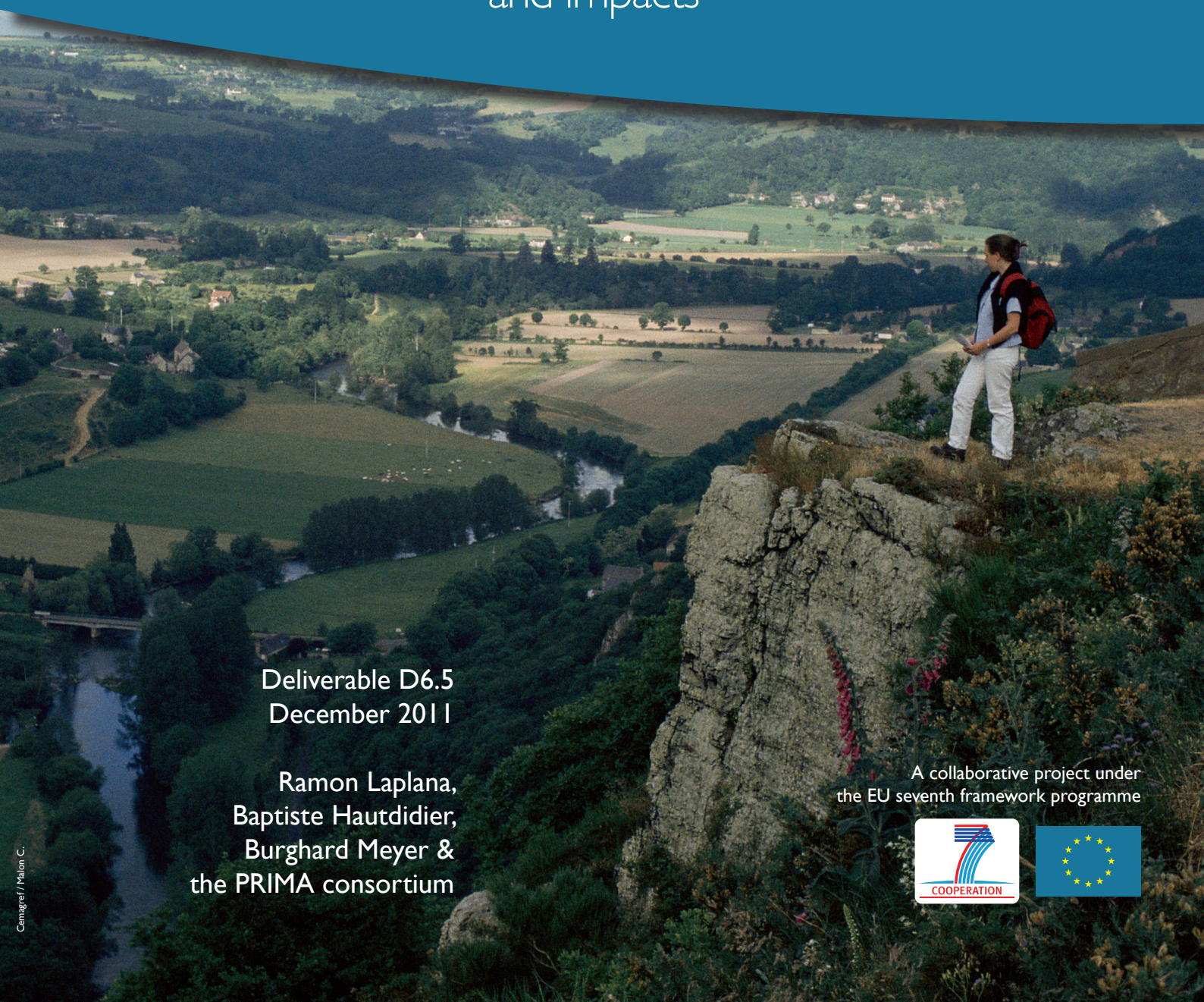
Prototypical Policy Impacts on Multifunctional Activities in rural municipalities

Guidelines for the evaluation of decentralized policies: Challenges, evaluation techniques and impacts



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COOPERATION

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1. Introduction

Facing structural change, European rural areas still fulfil multiple social, economic and ecological functions. Because of scale interplays and sustainability trade-offs, their future dynamics are yet particularly difficult to ascertain. The research project PRIMA, backed by the European Commission's Seventh framework programme, aimed to develop methods for scaling down the assessment of policy impacts on multifunctional land-use and economic activities. The analysis covered the cohesion policies (ERDF, ESF, CF), the enlargement process (IPA) and the rural development policy (EAFRD), with a focus on agriculture, forestry, tourism, and ecosystem services. Special attention has been paid to the structural effects of the policies and on their impact on the environmental quality in the regions.

1.1 Objectives of the guidelines

This report, based on materials provides a short synthesis of the methodological outputs of PRIMA that are most relevant for the downscaling of population parameters and indicators for the analysis of local policy impacts in any *ex ante* Impact Assessment Tool. The aimed added value is to enhance major existing Impact Assessment procedures (EIA, SEA, SIA) by models that consider individual stakeholders-and interactions between them and the environment-in addition to already used aggregate model approaches at coarser scale. In this way, more environmentally impact assessment procedures will be enhanced by social and economic considerations.

1.2 Practical results

Rural sustainable development, viewed through the lenses of multifunctionality, diversity of activities, and ecosystem services, is a major challenge for the cohesion policy. Taking an European perspective, PRIMA helps demonstrate how sustainable development can be triggered by problem-solving oriented research. By prioritizing local scales, PRIMA has developed innovative integrated assessment tools for rural development, taking into account site-specific potentials and perspectives of local stakeholders.

1.3 Summary of the method

The approach was structured in five steps:

- A review of structural policies, drawing on six regional case studies (United Kingdom, France, Germany, Czech Republic, Croatia and Bulgaria), identified driving forces, local constraints and baselines for the design of national and regional scenarios for multifunctional land use and economic activities.

- The involvement of local stakeholders (*e.g.* farmers, forest industries, local consumers, tourism actors) was implemented during the whole exercise, through the design of scenarios, the formulation of agent decision rules, the assessment of models' design and outputs.

- The design and development of micro-simulation and agent-based models was grounded on local dynamics and simulated the impact of EU policies on multifunctional land uses and ecosystems at the municipality level.

- A mapping between available municipal-level data and prototypical, contrasted model outputs, allowed scaling up the results to the regional scale, for comparison with integrated models.

- The potential of the approach was investigated to enhance screening and scoping steps of existing impact assessment methods.

2. Definitions, concepts and methods

2.1 Rural areas, rural municipalities

Source: Happe & al. (2009)

The most common description of rural areas is given by the OECD (1994), that identifies areas as rural on the sole basis of population density (150 inh./km²) (DG AGRI 2008). JONARD *et al.* (2007) added two additional aspects to the OECD indicator: "peripherality" (by using distances and accessibility, with travel time thresholds of 30 to 60 minutes to large city centres) and "naturality" (when the land cover is at least 90 % of the LAU2 is covered by forest, agricultural and natural areas, as measured on the basis of Corine Land Cover 2000). For the analysis and the measurement of the population density, different databases can be used, *e.g.* the population census per commune 2001 (SIRE database; without Bulgaria) at LAU2 level, EUROSTAT or ESPON datasets for the NUTS2 and NUTS3 level.

Municipalities in rural areas are the smallest units of local self-government, comprising actors from different sectors (farming, forestry, tourism, local governments and administration, local economy, consumers). Municipalities are a vital factor in regional development (CoR 2007). According to the European Charter of Local Self-Government drafted in 1985, local authorities should be able, "*...within the limits of the law, to regulate and manage a substantial share of public affairs under their own responsibility in the interests of the local population.*" A fine-grained level of analysis such as the municipality may not yield for each case a high diversity of rural uses. But they remain relevant, insofar as this is a level where most actors interact and many policies and government measures start. EU policies are increasingly tailored to the public's real interests, giving greater consideration to local authorities (CoR 2007).


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2.2 Structural fundings and European policies

Source: Kopeva & al. (2010)

The EU Cohesion Policy aims to reduce the gap in the different regions' levels of development, in order to strengthen economic and social cohesion. It has three objectives:

- *Convergence*. This objective "shall be aimed at speeding up the convergence of the least-developed Member States and regions by improving conditions for growth and employment through the increasing and improvement of the quality of investment in physical and human capital, the development of innovation and of the knowledge society, adaptability to economic and social changes, the protection and improvement of the environment, and administrative efficiency." (EC 2006) This objective is financed by the ERDF, the ESF and the Cohesion Fund.

- *Regional Competitiveness and Employment*. This objective "shall, outside the least-developed regions, be aimed at strengthening regions' competitiveness and attractiveness as well as employment by anticipating economic and social changes, including those linked to the opening of trade, through the increasing and improvement of the quality of investment in human capital, innovation and the promotion of the knowledge society, entrepreneurship, the protection and improvement of the environment, and the improvement of accessibility, adaptability of workers and businesses as well as the development of inclusive job markets." (EC 2006) It is financed by the ERDF and the ESF.

- *European territorial cooperation* objective "shall be aimed at strengthening cross-border cooperation through joint local and regional initiatives, strengthening transnational cooperation by means of actions conducive to integrated territorial development linked to the Community priorities, and strengthening interregional cooperation and exchange of experience at the appropriate territorial level." (EC 2006) This objective is financed by the ERDF.

Community financial instruments for achieving these objectives are European Regional Development Fund (ERDF), European Social Fund (ESF), Cohesion Fund (CF). As illustrated by figure 1, the cohesion policy has been allocated a budget of €347bn for the period 2007–13, which is more than a third of the whole of the European budget.

On 20 February 2006, the Agriculture Council adopted EU strategic guidelines for rural development, five months after the adoption of the Council Regulation on support for rural development by the new European Agricultural Fund for Rural Development (EAFRD). These guidelines set out a strategic approach and a range of options which Member States could use in their national strategy plans and Rural Development programmes. Since the reform of the Common Agricultural Policy, Rural Development is playing an increasingly important role in helping rural areas to meet the economic, social and environmental challenges of the 21st century. Rural areas make up 90 % of the territory of the enlarged EU and the new legal framework points more clearly to the direction of boosting growth and creating jobs in rural areas – in line with the Lisbon Strategy – and improving sustainability - in line with the Göteborg sustainability goals.

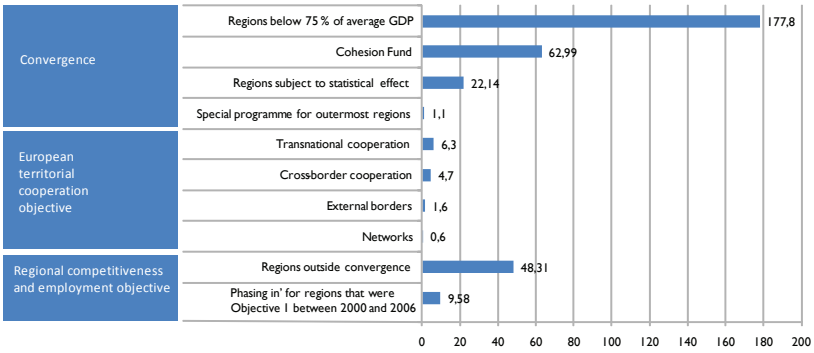

Fig. 1 | EU cohesion policy, budget broken down by objectioves

The Rural Development policy 2007-2013 focuses on three areas in line with the three thematic axes laid down in the new rural development regulation: improving competitiveness for farming and forestry; environment and countryside; improving quality of life and diversification of the rural economy. The fourth axis, called LEADER, introduces possibilities for locally based bottom-up approaches to rural development. This programming period provided a unique opportunity to refocus support from the new rural development fund on growth, jobs and sustainability.

The European legal framework being established, Member States can now elaborate their national strategy plans and rural development programmes before submitting them to the European Commission. For each set of priorities, the EU strategic guidelines are suggesting key actions. Member States shall prepare their national rural development strategies on the basis of six community strategic guidelines, which will help to identify the areas where the use of EU support for rural development creates the most value added at EU level; make the link with the main EU priorities (Lisbon, Göteborg); ensure consistency with other EU policies, in particular cohesion and environment; accompany the implementation of the new market orientated CAP - and the necessary restructuring it will entail in the old and new Member States. The six strategic guidelines are:

- Improving the competitiveness of the agricultural and forestry sectors
- Improving the environment and the countryside
- Improving the quality of life in rural areas and encouraging diversification
- Building local capacity for employment and diversification
- Translating priorities into programmes
- Complementarity between community instruments

Pre-accession assistance helps the countries that are candidates for membership of the European Union to satisfy the accession conditions (the Copenhagen criteria). Considerable investment is required if the candidate countries are to adapt their institutions and standards in order to comply with the Community acquis and to be able to meet their obligations as Member States. Pre-accession assistance to the candidate countries is a key factor in the Union's pre-accession strategy and is determined by the accession partnerships. For the period 2007-2013, the Instrument for Pre-accession Assistance (IPA) is the sole funding vehicle, replacing the other pre-accession instruments. Once they join the Union, the new Member States, which are no longer entitled to pre-accession assistance, receive temporary financial assistance, the Transitional Facility, provided for by the treaty of accession.

2.3 Multifunctionality

Source: Kopeva & al. (2010)

The concept of multifunctionality has been discussed for the last two decades among academic circles, international organizations and institutions. The literature review reveals different viewpoints and evolution of the concept. Currently two broad acceptions of multifunctionality can be identified:

- As an analytical or activity-oriented concept: it describes the characteristics of farm production, the outcomes from land uses and the joint-production, focusing on these relationships.

- As a normative or policy-oriented concept: it is considered as a policy instrument of rural development.

The broader definition considers and emphasizes the generation of noncommodity outputs that relate multifunctionality not only with the environment (narrow definition) but with the safety of food production, rural viability and quality of life in rural areas. The holistic or 'joined-up' approach analyses all market and non-market production relationships by examining the input and output ends of the production and household livelihood processes, as well as the positive and negative non-market outputs and inputs involved.
An operational definition of multifunctionality, such as the one retained in PRIMA, can be the following: assessed at the scale of land cells or landscape, multifunctionality is the ability of this piece of land/landscape to provide multiple benefits both to human and non-human systems. At the land cell level, analysis and modeling can focus on the multifunctional land use by farms, firms in forestry and tourism. At the landscape level, modeling will be on municipality and regional level.

2.4 Impact Assessment, procedures and tools

Source: Meyer & al. (2012)

Environmental assessment is a procedure that ensures that the environmental implications of decisions are taken into account before the decisions are made. The process involves an analysis of the likely effects on the environment, recording those effects in a report, undertaking a public consultation exercise on the report, taking into account the comments and the report when making the final decision and informing the public about that decision afterwards.

In principle, environmental assessment can be undertaken for individual projects such as a dam, motorway, airport or factory (*Environmental Impact Assessment* or EIA) or for plans, programmes and policies (*Strategic Environmental Assessment* or SEA).

The purpose of a SEA is to ensure that environmental consequences of certain plans and programmes are identified and assessed during their prepa-

ration and before their adoption. The public and environmental authorities can give their opinion and all results are integrated and taken into account in the course of the planning procedure. After the adoption of the plan or programme, the public is informed about the decision and the way in which it was made.

Sustainability Impact Assessment (SIA) is a process undertaken before and during a trade negotiation which seeks to identify economic, social and environmental impacts of a trade agreement. The purpose of a SIA is to integrate sustainability into trade policy by informing negotiators of the possible social, environmental and economic consequences of a trade agreement. A SIA should also provide guidelines for the design of possible accompanying policy measures. Such measures may go beyond the field of trade as such, and may have implications for internal policy, capacity building or international regulation. Accompanying measures are intended to maximise the positive impacts of the trade negotiations in question, and to reduce any negative impacts. In 2002, the approach was extended to the other DGs, resulting in a new form of IA often called 'Commission-wide IA' (Ruddy *et al.* 2008) .

Specific tools (the SIATs, for *Sustainability Impact assessment tools*) have been designed to fill this dual purpose, by delivering analyses that should be both thorough (with a need for balance and insight) and easily tractable to political decision-making. Adapted at first from the realms of economics and "decision support", adhoc tools have been recently developed, often based on a sophisticated chain of models. The EU demand on SIATs has shifted since then from an overt optimism (as the tools were expected to build a virtuous circle between top-down data-driven assessments and value-driven regional feedbacks) to stances that are more reflexive and critical (where IA tools, with their limitations, are expected to help not only to answer focussed questions but to frame issues).

Box 1 | Modelling approaches

Micro-simulation

Micro-simulation describes economic and social events by modelling the behaviour of individual agents (e.g. persons, households, firms). It is also possible to create spatial micro-simulation models by adding geographical information to micro-level data, allowing for a small-area approach to policy analysis.

Cellular automata

Cellular automata are dynamic spatial systems in which the state of each cell, at a determinate time, is determined from the previous states of the cells within a neighbourhood according to a set of transition rules. They are very efficient computationally and this fact allows analyses at a very high resolution level. Moreover these models are particularly easy to interface with data exported from maps and from other geographic description tools. On the other side, they are not well suited to incorporate complex social factors and human decisions.

Agent Based Models

Agent-based modelling and simulation is a tool that offers a perspective on simulating human behaviour in complex environments. It has been proven a suitable tool to experiment with the management of complex environmental resources. Agent-based simulation allows for experimenting with the complexities at individual, social, and environmental levels by formalizing populations of artificial humans, called "agents" in an artificial world. Agent-based simulation allows for the modelling of interactions between individuals assuming that social interaction causes information and norms to spread, the accumulation of these interactions can be studied on a population scale. Agent-based simulation allows for experimenting with policy measures without harming people and the environment. Via simulations, the mid-term and long-term effects of policy measures can be studied in scenarios.

General Equilibrium Models

Computable general equilibrium models such as GTAP are among the most widely used models in SIA tools and can typically cover the whole economy, including factor market. The standard model is characterized by an input-output structure (based on input-output tables of nations and groups of nations) that explicitly links industries in a value added chain from primary goods, over continuously higher stages of intermediate processing, to the final assembling of goods and services for consumption. An important stake for such models, regardless of their scope, is how to interact in a relevant manner with regional outputs and processes.

Sources: Happe et al. 2009, Woltjer et al. 2011

2.5 Downscaling and upscaling

Source: Woltjer & al. (2011)

There is a strong need for accurate and spatially referenced information regarding policy making that has been expressed by land users, and policy and decision makers in the context of Impact Assessments, but this need are no longer done at a single level of analysis. Following Ewert *et al.* (2011), Integrated Assessment and Modelling (IAM) can be considered as an attempt to capture complex multi-scale problems, which is achieved by applying models at different scales and linking these in addressing the same issue. Different methods have been employed in natural sciences to estimate system responses across scales or levels. Cantelaube *et al.* (2012) consider that changing the spatial distribution of data provided by a model from one geographical scale to another is faster than building a new model working at this new spatial unit. This approach is faster because it does not need to calibrate and to validate new models; it is also more effective, regarding amount and quality of data called for a new model based on new spatial units and scale. Considering the scope of a project such as prima, tools available to assess the effects of structural policies on the multifunctional character of the rural areas essentially present as limits to be either: (i) approaches covering a large range of spatial scales but mono-sectoral, or (ii) approaches covering one spatial scale, the region, but mono-sectoral, or finally (iii) integrated approaches, pluri-sectoral but informing as well as possible of the consequences of the policies only on one regional level.

2.6 Stakeholders

Source: Raley & Bousset (2009)

A vast litterature has been developed around the concept of stakeholder. In the frame of prima, stakeholders were equated with actors within rural areas, as well as policymakers at different levels.

Actors are those whose (hypothetical) actions are the target of the policies chosen for investigation and it is their behaviour which can be the focus of an *ex-ante* agent based modelling. In some contexts, policymakers will be seen as actors since they represent the interests of civil society and (in theory at least) will develop policies in pursuit of society's best interests.

The role of stakeholder can also be to provide expert knowledge, as was the case in prima. Thus a definition modified from (Freeman 1984) can be used, where stakeholders are "*any group or individual who can affect or is affected by the achievement of the objectives of a given policy programme*".

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Box 2 | Potential impacts considered in PRIMA

Economic domain
Diversity of products
Contribution to income from agriculture
Quality of products
Development of non agricultural activities
Processing of dairy or meat products
Services
Contribution to income from forestry
Utilization of timber and non-timber forest resources
Contribution to the income generation from tourism
Farm size
Land use
Modernisation of farms

3 From policies objectives to scenarios

3.1 The use of impact matrices

Source: Kopeva & al. (2010a)

In support for the elaboration of scenarios, the following method can be used for an analysis on the potential effects of the policies on the multifunctional character of the activities. The applied approach for analysis is based on the idea that multifunctionality, as a policy concept, fulfils three specific functions: economic, environment and social, and is a prerequisite and precondition for sustainable rural development. Therefore, the proposed matrix consists of policy measures and domains of impact.

Step 1. Identification of areas of potential impact in each domain/area.
Three domains of impact are defined – economic, social and environment. These impact areas correspond to the functions that multifunctionality exercises. Actually, potential impact in economic functions is expected in production of commodities; provision of monetary income and access to consumer markets; food safety (quality and maintaining productive potential); diversification or rural activities (through development of new activities related to farming). Potential impact in social functions is expected in establishment and maintenance of social ties; keeping young generations in rural areas; decreasing the migration to urban areas; improving age structure of farmers; preserving and maintaining cultural capital; preservation of rural communities and the status of each individual within those communities. Potential impact in environmental function is expected in environmental protection; organic farming; afforestation of rural areas; preservation of biodiversity; preservation of natural resources.

Step 2. Assessment of potential impact of EU policies on multifunctionality.
Assessment is based on evaluation lead by experts, bearing on the different available competences. Three possible values are determined: positive, negative, neutral. The evaluation must be based on existing policy and strategic documents on national and regional level. The expert's assessment is qualitative.

Step 3. Calculation the potential impact and ranking the policy measures/ submeasures by ABC method
The ABC method categorizes policy measures in terms of their importance, placing more emphasis on higher impact measures (A) than on lesser impact measures (B and C). The procedure is as follows: (1) Separate measures and submeasures into types; (2) Calculate the potential impact for each measure/submeasure on the basis of experts evaluations – scoring, without any weight (3) Rank each measure from highest to lowest, based on total score. (4) Classify the measures as A-the top 20% (of the total score); B-the next 30%; and C-the last 50%.

Social domain
Contribution to employment
Contribution to rural viability
Animal welfare cultural heritage
Provision of recreational areas
Decreased/stopped migration outflow
Migration inflow to rural areas
Job opportunities
Contribution to income
Improved age structure

Environmental domain
Provision of recreational areas
Water conservation
Soil conservation
Improvement of Agricultural Landscapes
Contribution to air quality
Use of renewable resources
Supply of renewable energies
Energy use reduction in horticulture, manure processing
Reduction of ammonia emission in intensive livestock production
Biodiversity
Diversification of activities towards ecological production

Prioritization of submeasures of the Instrument for Pre-Accession (IPA) Fund is given below. 50% of measures are estimated by experts to have notable (ie. with scores over 80%) positive impacts on economic domain of multifunctionality. The outputs of their implementation will contribute to multifunctional land use and multifunctional landscape. Other 37% have positive impact (between 59 and 80%. Thus the IPA measures, despite their diversity and focus, are expected to have positive impact on multifunctionality.

The highest impact IPA measures have on the contribution to rural viability (83%), followed by contribution to income and job opportunities (70%). Critical analysis and assessment of EU policy on multifunctional land use activities on national and regional level. Interesting are the facts that employment is unlikely to affect multifunctional land use, while migration into rural areas is denoted in a neutral position .

Fig. 2 | Potential impact of different measures of IPA on the economic domain of multifunctionality

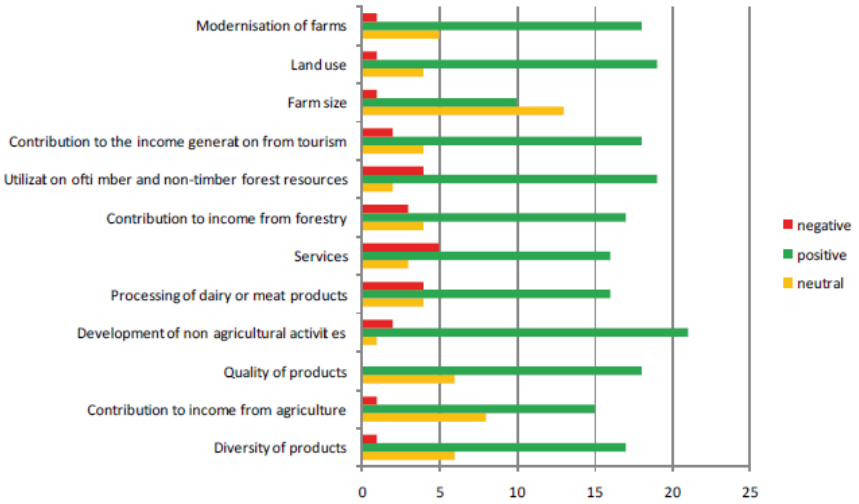


Fig. 3 | Ranking of IPA submeasures according to their positive potential impact on the economic domain of multifunctionality

A >80 %	1.3. Developing capacities of NGOs for monitoring the harmonisation with the AC in the field of natural resource management and regional sustainable development
	2.1.1. Tourism and rural development measures
	2.1.2. Development of enterpreneurship
	2.2.1. Environmental protection measures
	3.1.1. Investments in business infrastructure
	3.2.1. Improving the investment opportunities
	3.2.2. Transfer of technology and incentives for new enterprises
	4.3.1. Further development of Croatian Qualification Framework
	4.3.3. Strengthening institutions in vocational education and education of adults
	5.2.2. Preparation and implementation of local rural development strategies
	5.3.1. Improvement of rural infrastructure
	5.3.2. Diversification and development of rural activities
B 50 - 80 %	2.2.2. Preservation of protected areas
	3.3.1. Strengthening the institutional capacities
	3.3.2. Development of sectoral studies, action plans and project proposals
	4.1.1. Improving the access to employment and labour market
	4.2.1. Support to groups with dissabilities regarding education
	4.3.2. Strengthening the system of education for adults
	5.1.1. Investments in farms (restructuring and reaching the Community standards)
	5.1.2. Investments in processing and marketing of agricultural and fishery products
	5.2.1. Activities for improvement environment and landscape
C <50 %	1.1. Enforcing the role of NGOs in monitoring harmonisation with the *Acquis Communautaire* (AC)
	1.2. Enforcing the capacity of NGOs in monitoring the anti-discrimination strategies
	2.1.3. Cultural and social co-operation

3.2 Towards scenario planning

Source: Kopeva & al. (2010b)

On the basis of the analysis of current EU policies and forces driving future change (trends), alternative scenarios can be developed. They have to focus on policy changes and possible results/outputs of EU policy implementation on regional and local (LAU) level, with the idea that they can be modelled in terms of impacts by micro simulation and aggregated approaches.

Two groups of driving forces are defined with impact on the sustainability– external and internal. Internal driving forces can be grouped in five groups:

Political – EU literacy, regional policies focused on multifunctionality
Economic – investments, business climate/environment, economy of scale (of individual beneficiaries - companies, firms, farms, etc.), prices, gross value added
Technological – innovations and IT
Social – migration, dependency ratio, age structure, implementation of participatory approach
Environment – status quo of air, water, soil & biodiversity quality

External driving forces can be grouped in four groups:

Political – EU policy, national policy (priorities) in agriculture, forestry, tourism and environment, governance
Economic - possibilities for non-farm economic activities, macroeconomic stability, infrastructure, bank system network
Social - urban/rural population ratio, programs for business start-up for unemployed
Environment - shift to alternative energy sources, climate change

Box 3 | Scenario planning steps

The process of scenario planning goes through the following steps:

1. Gather background information

2. Determine key driving forces
o High level of uncertainty
o High level of influence

3. Identify a small number of scenarios
o Inductive – emblematic events and the official future
o Deductive – building a scenario matrix

4. Develop scenarios (beyond the two most important driving forces)
o Include other driving forces
o Systems thinking
o Narrative development
o Characters, catchy names, etc.

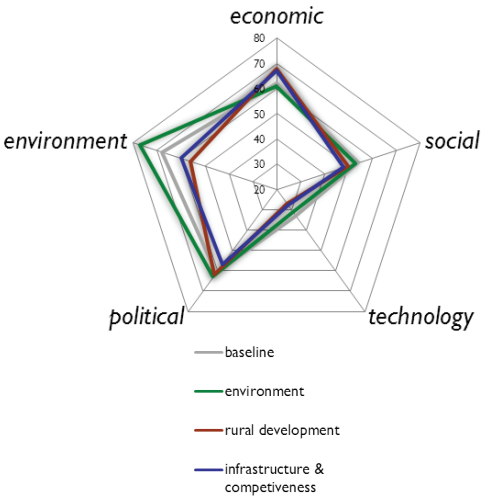


Fig. 5 | Combined impacts of selected driving forces for the four scenarios

Source: Raley XXXXXXX

Box 4 | Scenarios developed by PRIMA

'Baseline'
The 'baseline' scenario is defined to analyse a base situation without additional intervention and different alternative options for intervention, i.e. the introduction of new measures in agriculture, forestry, tourism, and environment. The baseline scenario is a 'business as usual' projection, including the existing framework in terms of agricultural and environmental policies, technological and market conditions, and the projection of technological trends and of decided policy changes to be implemented until the target year 2013.

'Environment'
This scenario is built on the assumption that measures for landscape, natural and cultural heritage preservation will be leading. Having in mind importance of environment issue in global aspect, it is assumed that environment policy will be more closely linked to rural development and more specifically to multifunctional land use activities. Thus, changes in the policy priorities on EU level are expected.

'Rural development'
Rural Development Policy will have a leading role in the next planning period (2014-2020). Sustainable rural development will be achieved through: increasing competitiveness of agriculture and forestry; improving land management; implementing complex measures for environment protection and preservation, wider rural economy through new agricultural and non-agricultural activities; increasing the role of local initiative groups in regional and local decision making process.

'Infrastructure & Competitiveness'
This scenario assumes widened and enriched policy measures in Cohesion Policy. This scenario is developed on the assumption that Cohesion policy will have leading role on national and regional level. New objectives and measures will be elaborated aiming increasing of competitiveness of SMEs, development of favourable business conditions, improving quality of human resources, increasing capacity of local/regional branch organizations, construction of relevant new infrastructure and restoration of the existing.

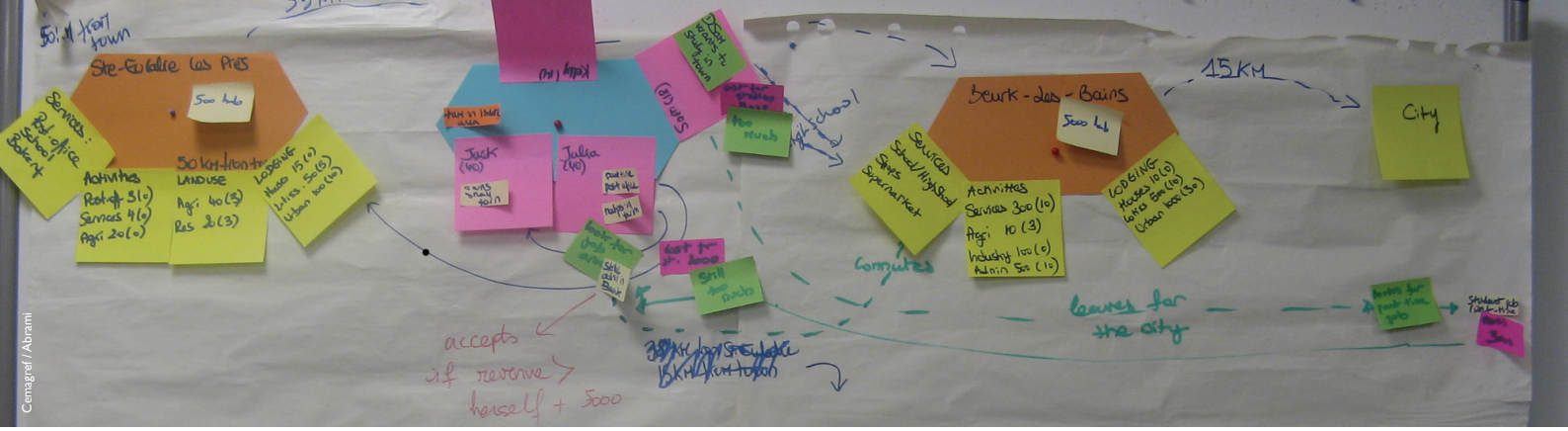
4. Stakeholders' involvement

The questions to be tackled revolve here around the identification of relevant stakeholders, as well as the nature of their engagement: before, during and after the development of models.

4.1 Five archetypical roles

Role 1: scenario design
The objective for stakeholders here is to help design policy scenarios on which agent-based and micro-simulation models can be tested. Stakeholders are selected from those who, with respect to the relevant policies and geographical area, have expertise in policy-making, implementation or analysis. Two types of scenario can be used for the modelling process: *past* scenarios, as events that happened in the past which caused a change in some of the model components (*e.g.* employment); *future* scenarios, as hypothetical events which might happen in future.

Stakeholders can also engage in scenario design in a workshop with an demonstrator of the micro-simulation or agent-based models. After receiving an explanation of the model's function, stakeholders can debate the policy interventions which it can capture, before starting to develop specific scenarios.



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Role 2: formulating agent decision rules
The objective here is to provide information to enable behaviour rules for the main actors in rural areas (at local level) to be drawn up. Inputs from stakeholders can be sought concerning their perceptions of the main behavioural drivers and decision-making of actors, together with any significant between-actor influences in the case-study areas.

Stakeholders may be the actual agents, who will report on their own likely actions when confronted with a particular policy scenario. However others, such as lay actors and decentralised authorities might report on agent behaviour. Of particular value are likely to be the mediating agents, consisting of people whose specialist knowledge equips them to anticipate agent reactions to a policy *e.g.* farm advisors, tourism project officers, and animators.

Although anticipated as pre-model engagement with stakeholders, for greater efficiency this activity can be conducted as soon as an initial model has been developed. Within the model's structure, gaps in the knowledge of actors' behaviour can be identified. In a workshop setting, information to develop decision rules can be elicited, for example, through role-playing games. Alternatively, a questionnaire survey of relevant actors can obtain useful behavioural information.

Role 3: Model development
To assist model development, inputs from policy stakeholders (who may be actors or policymakers) can be used to improve the prototype micro-simulation and agent-based models. At a stakeholder workshop, information can be obtained to elicit whether the model accurately captures the dynamics underlying socio-economic activity of a municipality. This interaction will establish the legitimacy of the model to represent future scenarios. Possible future scenarios for implementation in the model can be discussed (measures and events) prior to further development after the workshop.

Role 4: Validation
Post-model engagement is required for policy makers to validate models and their outputs. The validation criteria is the pertinence, coherence and consistency of the model outputs and mappings with regards to the stakeholders' knowledge and expertise.

Ideally a further workshop will be conducted to allow detailed discussion of model outputs. However, alternatives such as an application of the DELPHI technique using a questionnaire survey might be considered, especially if resources are constrained or if stakeholders are unable to agree to an additional meeting.

Role 5: Awareness-raising
Policymakers as potential end-users, and post-model engagement is anticipated to allow an increased awareness of the potential gains of model-based approaches to be gained by them. In addition, the presentation of models in stakeholder workshops and the discussion of their capabilities will also raise awareness.

4.2 A general procedure for the identification of stakeholders

- Define the specific issue(s) for interactions with the stakeholders
- Identify the specific policymakers, and develop a policymaker's map in relation to the selected policy area.
- Prepare a chart of the specific stakeholders who are the policy targets or who affect or are affected by the policy programme.
- Identify the strength of the stake of stakeholders for the issues to be addressed by the policy
- Prepare a degree of influence (power) versus degree of stake grid

4.3 A few lessons on stakeholders' engagement

Source: Barreteau et al. (2011)

Issues of scale and granularity may commonly arise, as the interactions with stakeholders dynamics usually begs for a higher model precision. An efficient way would thus be to start with a realistic simulation, in order to be able to identify gaps with reality but also to expect better fit with stakeholders' perceptions on local nuances.

The gaps with model's dynamics should be assessed by defining contrasted situations and by trying to explore the validity and generality of stakeholders' perceptions, bearing in mind that singular events could be overweighted.

Such a process requires that the model brokers should be even clearer on what could be expected from model and requirements from the modelling activity. An 'interpretation buffer stage' is thus needed, as well as a clarification of the various roles of the modelling setting: modellers, brokers, model users, field scientists, model administrators.

Attention should be paid in particular to the composition of stakeholder groups, as a high diversity of users can entail a high diversity of views -and power relations- that may be uneasily tractable. Accordingly, the interaction process bears its own contingency, requiring the modelling team to interpret throughly the outcomes, but also to use windows of opportunity in the best way.

5. The PRIMA micro-simulation model of municipality networks

To model the evolution of rural municipalities in terms of population structure, employment, housing and services under different policies, PRIMA proposes a microsimulation approach that considers individuals, each interacting with the others and with her environment. The model implements virtual individuals, members of households located in municipalities and their state transitions corresponding to demographic and changing activity events: birth, finding a partner, moving, changing job, quitting their partner, retiring, dying... The virtual municipalities offer jobs and dwellings which constrain the possible state transitions.

The purpose of the model is to study how the population of rural municipalities evolves. This evolution is assumed to depend, on one hand on the spatial interactions between municipalities through commuting flows and service, and on the other hand on the number of jobs in various activity sectors (supposed exogenously defined by scenarios) and on the jobs in proximity services (supposed dependent on the size of the local population).

The model represents a network of municipalities and their population. The distances between municipalities are used to determine the flows of commuting individuals (for job or services). Each municipality comprises a list of households, each one defined as a list of individuals. The municipalities also include the offers of jobs, of residences and their spatial coordinates. See box 5 for the exhaustive list of the main model entities with their main attributes and dynamics.

As a first step, a scenario object has to be defined contains all the exogenous changes to apply to the objects of the model at a given date. They can be a change in job offer for a municipality or a change of a parameter value defined at the municipality-Set level, such as the average fertility level for example.

Being strongly data-driven, this type of model is generally dedicated to a particular case study. The PRIMA project had the initial objective to model six different European rural regions. They differ a lot in their culture, their regulations and the available data. Thus, as a modelling approach, PRIMA adopts a compromise between abstract modelling and totally data-driven modelling, demonstrating the interest of adding dynamic microsimulation with demographic transitions, coupling agent-based and microsimulation approaches and using stochastic behavioural models.

Source: Baqueiro, Deffuant, Jager (2011)

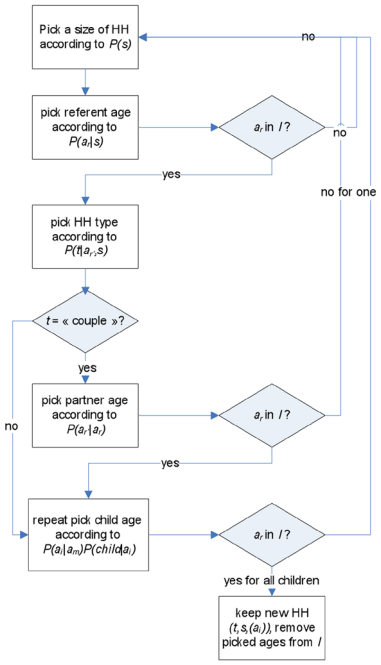
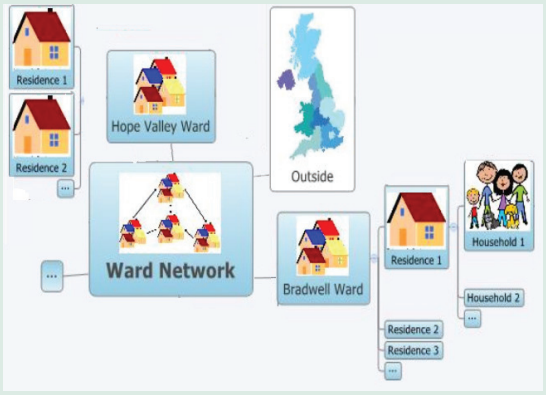


Fig. 6 | Flowchart for the generation of an artificial population

source: Gargiulo et al. (2010)
doi:10.1371/journal.pone.0008828.g008

Box 5 | Components of the microsimulation model

Main components and structure of the model (example of a UK region)



source: Baqueiro et al. (2011)

List of modelled individual dynamics

Name of Dynamic	What does the rule determine?
Aging	When the individual age increases in 1 year.
Dying	The age at which the individual will die
Become student	The age at which the individual will become a student
Enter job Market	The age at which the individual will enter the job market
First Assigned SPC	The SPC that a person who just stopped being a student will look for
Look for a job when Unemployed	The type of job (SPC) that an unemployed individual will look for
Look for a Job when Employed	The type of job (SPC) an Employed individual will look for. Includes probability of whether an employed individual looks for a job.
Become Unemployed if Employed	Whether an individual will become unemployed in this year
Become Inactive if Employed	Whether an individual will become Inactive if currently employed
Become Inactive if Unemployed	Whether an individual will become inactive if currently unemployed
Remain Inactive if Inactive	Whether an individual will stay Inactive if currently Inactive
Become Retired	Whether an individual will become retired
Set Own Household	An individual creates a new household
Change Residence	An individual moves to another residence
Join Partner	An individual joins a new partner
Split from Partner	An individual splits from a "couple" household
Emigrate	An individual changes residence to another municipality
Immigrate	An individual changes residence to another municipality

source: Baqueiro et al. (2011)

PRIMA developed a graphical user interface for defining the parameter values and visualising the evolution of chosen indicators. The user can choose these indicators through an XML interface. It is possible to ask for a large number of indicators at the same time.

6. Two examples of model adaptations

6.1 'United Kingdom' case study: an agent-based model for inter-ward migrations

An agent-based model simulation applied to Derbyshire & Nottinghamshire in the UK was developed to study migration dynamics. The model is capable of simulating a population with agents that make a decision to migrate or not. Economic, social and environmental satisfaction are the key drivers of migration. Jobs deliver economic satisfaction, the number of friends living close determines social satisfaction, and the quality of the environment determines environmental satisfaction. Agents are connected in a similarity based network, and can share information.

The experiments demonstrate that social needs in particular may have a strong impact on population dynamics. In the context of a declining population, the presence of a social need causes the population to initially decrease at a slower rate because of their social satisfaction (stabilizing effect). However, if a critical population size is reached, the social satisfaction decreases, and causes more people to move, resulting in a self-amplifying dynamical process.

The question thus is how to anticipate such a sudden population decline and how to prevent it, if possible and desired. The empirically parameterized model developed in PRIMA allows having a deeper look at the attributes of the agents that are moving away. This makes it possible to make more fine-grained projections of what type of people are more likely to move away, and for what reasons. The model allows for exploring how creating jobs in different socio professional categories and sectors of activity may match with the qualification of the agents that are prone to move. It would also be possible to explore if the qualifications of workers would match with an increased demand for services of the retirees that move to the ward.

Obviously the precise strategies cannot be derived from the simulation model, but this downscaling of population dynamics using an agent-based model illustrates the possibilities of identifying the possible developments in the system at a detailed level, which in turn is helping to focus the policy making effort at potential effective policies at the specific ward level.

This level also fits well with the scale of EU community funding policies aimed at supporting the viability of mainly depopulating agricultural areas in Europe. Having a simulation tool that is capable of exploring the population dynamics at the same level as the policies that are implemented opens a perspective on developing more effective policies, and possibly on testing policies using the same simulation tool.

In further developments the model could test how the creation of particular types of jobs, or the development of environmental quality and possibly associated tourist business might have an impact on the viability of a community. Moreover it would be possible to get insights on how such policies were implemented in a wider geographical area. This allows testing different scenarios of for example using the same policies in all the communities in an area, or focusing on different developments in different communities. The simulation model might give indications if a homogeneous or heterogeneous development is preferred for a region as a whole.

Source: Zhang & Jager (2011)

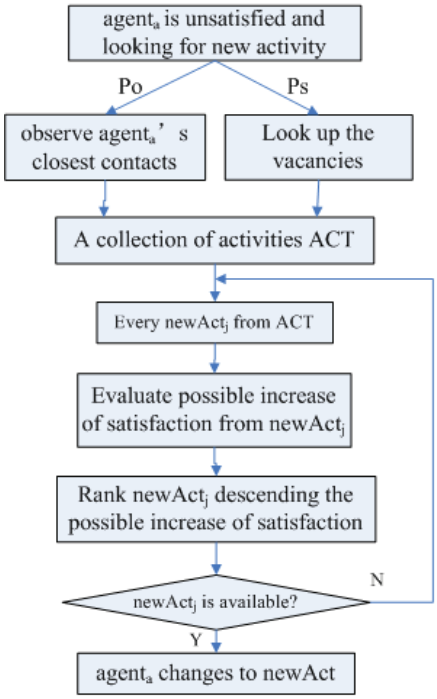


Fig. 7 | Agent-based model: flowchart of an individual's decision making process

6.2 German case study: deriving dynamics from the Labour Force Survey

Because each of the transitions are driven by probabilistic decisions, adapting the model to a particular region requires the specification of each probability value (either a distribution or a single value) relevant to the adapted region.

Adapting the PRIMA model to a particular region involved three main steps: first, the specification of input parameters defining the initial state of the simulations; second, defining the probability distributions that drive the dynamics during the simulation; lastly, including any additional perturbation that would be considered during the simulation time excluded from the model dynamics. In addition to the transitions in economic status (fig. 8), supplementary probability distributions must be specified for a complete definition of the model dynamics. The majority of these distributions were derived from the EU Labour Force Survey. As illustrated by fig. 9, a transition from unemployment can for example be inferred for Germany by socio-professional categories, age, year, and urban/rural context.

To evaluate the validity of the model, preliminary simulations were run after calibration. Preliminary simulations results show an adequate model fit to statistical data obtained from regional offices. Nevertheless, some of the selected indicators shed light to assumptions that need to be changed or improved for the different regions. With the help of expert regional stakeholders, a set of plausible explanations for the simulations' disparities were elucidated. As a result, a list of refinements was proposed to improve the model adaptations to better represent each region. Additional insight was gained when comparing the simulation results with real data for the post 2007-crisis years. It was shown that even though the simulation was able to correctly replicate past trends before the crisis, it was impossible to reproduce postcrisis trends given that the dynamics were strongly affected by external factors not considered in the model. Such an impact should serve as a reminder of the limitation of these types of models.

Source: Baqueiro et al. (2011)

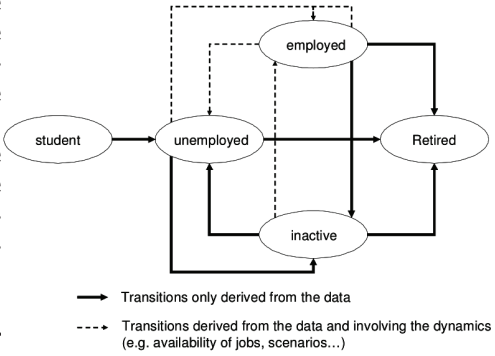


Fig. 8 | Individual transitions among economic status

source: Huet & Deffuant (2011)

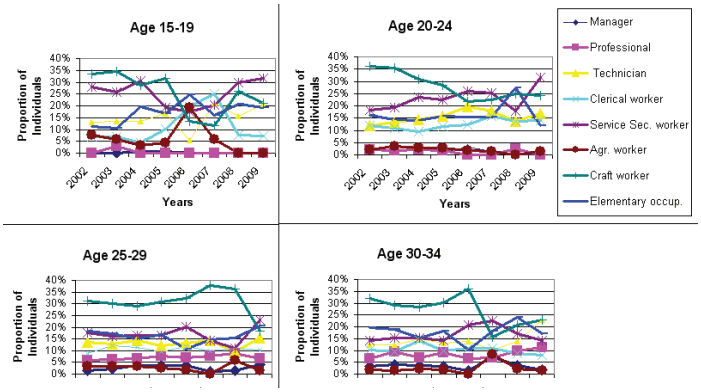


Fig. 9| Proportion of unemployed people finding a job by Socio-Professional Categories (SPC) in Germany, from 2002 to 2009, Age 15-34

source: Baqueiro et al. (2011), based on Eurostat LFS

Box 6 | The consequences of using microdata: the Eurostat LFS

The EU LFS is a large household sample survey which provides quarterly and yearly results on labour participation of people aged 15 and over as well as on persons outside the labour force. As a data source, the LFS offers a homogenized dataset that can be used to derive properties of the changes in the population features between a range of dates. Although the depth of the LFS covers several aspects relevant for the PRIMA models, the data available for scientific use (provided as aononymised datasets) contains a subset of the whole LFS.

The anonymised dataset lacks some variables (such as income related variables), some countries are unavailable for scientific use (such as data related to Croatia), and some years are also not included in the data (e.g. Germany datasets before 2002). These limitations were handled by the use of other data source available on each country, or using alternative variables as proxies for the required data. For the reliability of data, Eurostat ensures a process is followed by each of the LFS participating countries.

A part of the result of this process is a set of guidelines to ensure the reliability of statistics derived from the LFS data. These guidelines define the limit of records needed to ensure the reliability of statistical analysis. It is thus assumed that by following those guidelines, the obtained data observes a high level of reliability.

7. Downscaling the integrated modelling: from national to regional workable models

Source: Woltjer et al. (2011)

For a meaningful interaction with microsimulation and agent-based models, important methodological gaps of existing integrated models have to be addressed. PRIMA provides a tool where policies and scenarios on a world, European and country level modelled by the general equilibrium model MAGNET (formerly LEITAP) can be downscaled towards NUTS2 level for European countries. The system is integrated with the MAGNET modelling system, implying that downscaling can be accomplished as long as the data in the base year on a regional level are available, and can handle various levels of sector aggregation at regional scale. The model first assumes that regional percentage growth equals national percentage growth and adds regarding explanatory variables, making population age specific and dynamic, and including migration, labour and land markets to the model. A land supply module is added to the system, and the simulation tool is managed through a graphical user interface able to display various visualizations of model outputs.

The output of MAGNET that may be downscaled to the regional level consist of population, GDP (*i.e.* value added per sector), production per sector, land use per sector, as far as land use is relevant (*i.e.* for agriculture, forestry), land cover for all categories of land, income per worker, employment per sector.

The first downscaling step assumes that the regional percentage change in variables like value added, employment, land use are the same as the national ones. An additional constraint is introduced to ensure consistency between employment and population, namely that population grows with employment. This implies that population grows with the same percentage as employment corrected for the national tendency in the employment/population ratio. Implicitly it is assumed that migration adjusts to the labour market, and that other migration (elderly people, children) follow also the employees with whom they are related. The second step concerns the adding of a region specific component which guarantee that the sum of all regional value added changes equal the national value added change.

Population dynamic can be considered by using a cohort approach, creating an endogenous population dynamics. Migration, more complex but essential to include a functioning labour market, could be determined in the same way as proposed with value added. First, assume simply that each age class in each region as a fixed net immigration probability. Net migration as fraction of population in age class a in region is a fixed regional component (perhaps determined by average net migration in the past), and some components that are determined by the development of wages and unemployment rate. The shift component will make the sum of all regional migrations equal to the national net migration rate.

The labour force is determined by the regional population in working age. Unemployment can be determined easily by including calculating difference between labour force and employment in all sectors together. In this way, we not only added population dynamics, but also implemented a labour market, where unemployment in regions is generated and wages and unemployment cause changes in migration and therefore labour supply, as well as changes in output prices and therefore labour demand.

Box 7 | Data availability, sector aggregations

A specific issue concerns the adjustment of the procedures to data availability. Normally, regional sector and commodity aggregations are not the same as those used in the national model. For this reason, a mapping between the two aggregations is made, where the national development at the regional sector aggregation is a weighted average of the developments in the national sectors in the case the regional aggregation is more aggregated. This procedure can be applied to generate national developments at the regional sector aggregation for all variables that should be downscaled. It creates also a flexibility. For example, the available downscaling module uses value added towards a 3, 6 and 12 sector aggregation at a regional scale, and downscale production value in agriculture with a one-to-one mapping from the regional to the national sector aggregation.

The different levels of aggregation where regional total developments are determined by development of the sectors of which the regional economy consists poses a consistency problem. In general if regional development of total value added is seen as the sum of 3 aggregate sectors the result will be different than when a 6-sector aggregation is used. For this reason, we have also developed formulas that aggregate one sector aggregation to another. In this way it is possible to compare a 6-sector aggregation with a 3-sector or a 12-sector aggregation, and see what the consequences of these different decompositions are on regional developments. This enables research in the importance of shift share analysis in explaining regional growth.

The whole land supply curve in the national model was replaced by a land cover approach. The fundamental idea in this approach is the theory of land rent, *i.e.* that the price of normal quality agricultural land is determined by the productivity of the least productive land. The ease in which different land types can be transferred into agricultural land depends on the type of land cover. For this reason, for each non-agricultural land cover type, a reaction curve is built depending on the price of land, and agricultural land cover is defined as the difference. In this way the available land for agriculture depends on the price of agricultural land, where this price influences agricultural output and therefore demand for agricultural land through the output price. The land price may also influence land use intensities, but this requires that also other inputs are changed depending on land price.

The comparison of such model outputs with microsimulation and agent-based models should be undertaken with caution, as their purpose and scope remain arguably distinct. It seems relevant to relate the two approaches in different ways. For example, downscaled results can be used as a scenario environment for local modelling and stakeholder analyses. On the other hand, detailed local studies can be useful to analyse how policies really work out in practice. An abstraction of this information can be used as input for modelling the effects of different policies on regional or national levels.

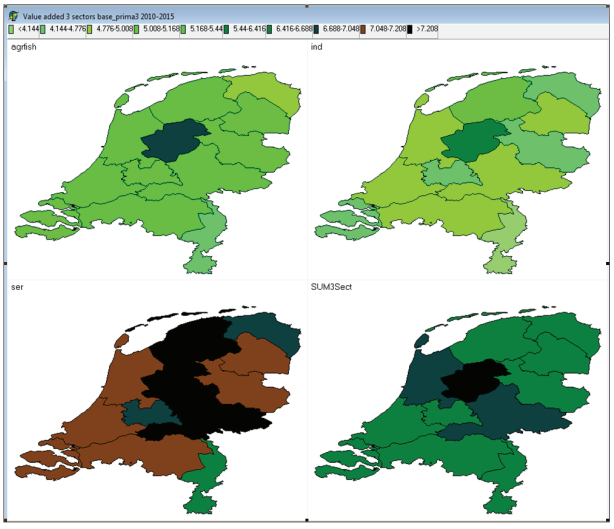


Fig. 9 | An example of graphical output: expected percentage change of GVA between 2010 and 2015 for the regions in the Netherlands, accross the three sectors

7. From modelled outputs to impact assessment practice

Source: Meyer et al. (2011), Meyer (2010)

The transformation of any SIA to regional and local level requires the widening of the current approaches of the assessment of policies (Figure 10). The missing links with SIA, and the stakes of a downscaling to the local and regional scale level can be seen in the clarification of the policies' impacts from a general change to the formulation of programmes or plans of investments on the regional level. The application should be carried out by the competent authorities responsible for the projects funding or related specialised consulting companies. The application should include stakeholders and should also include the local key actors.

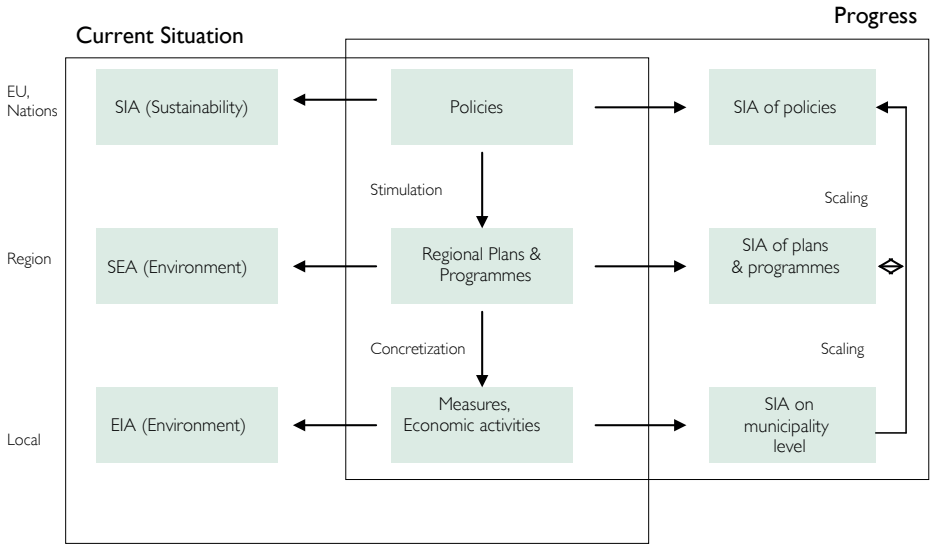


Fig. 10 | Workflow and methodological steps for the translation of model outputs to SIA

When the SIA shall be applied during the policy formulation process, a wide set of potential regional plans and programmes will be focused as scenario by including a set of potential projects with impacts on the economic, social and environmental dimension of sustainability and with land use impacts. A feedback loop is essential by scaling up and summarising the impacts to the policy formulation level.

As an example of an implementation approach, the method developed in the course of PRIMA entails: (i) a comparison of model outputs with available indicators (as part of the *Common Monitoring and Evaluation Framework*, Cf. fig. 11) through the use of transition matrices ; (ii) the definition of thresholds application if available; (iii) a reliance on assessment methods and tools by using additional spatial information if available.

The research achieved in PRIMA has demonstrated further enhancements of screening, scoping and assessment methodology, by exploring the multifunctionality of rural areas and ecosystem functionalities, the economic activities of agriculture, forestry and tourism.

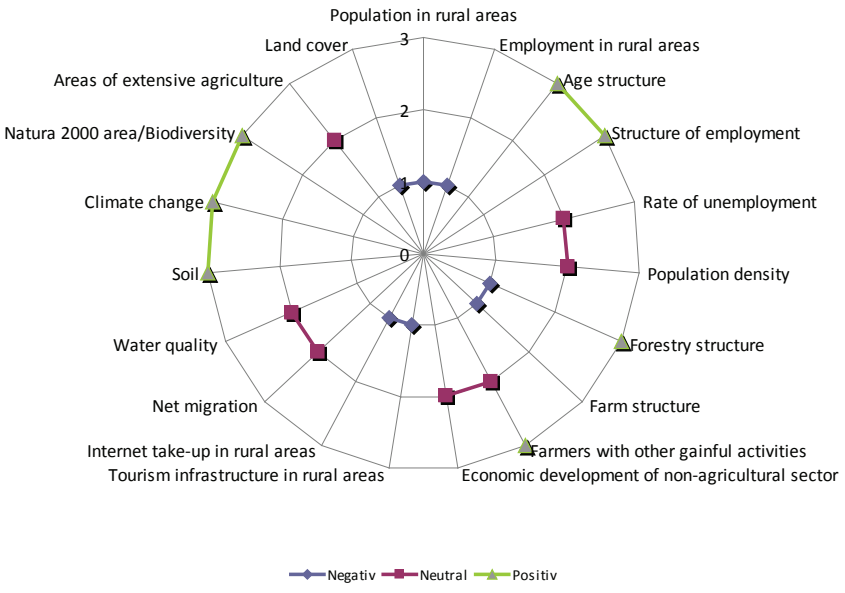
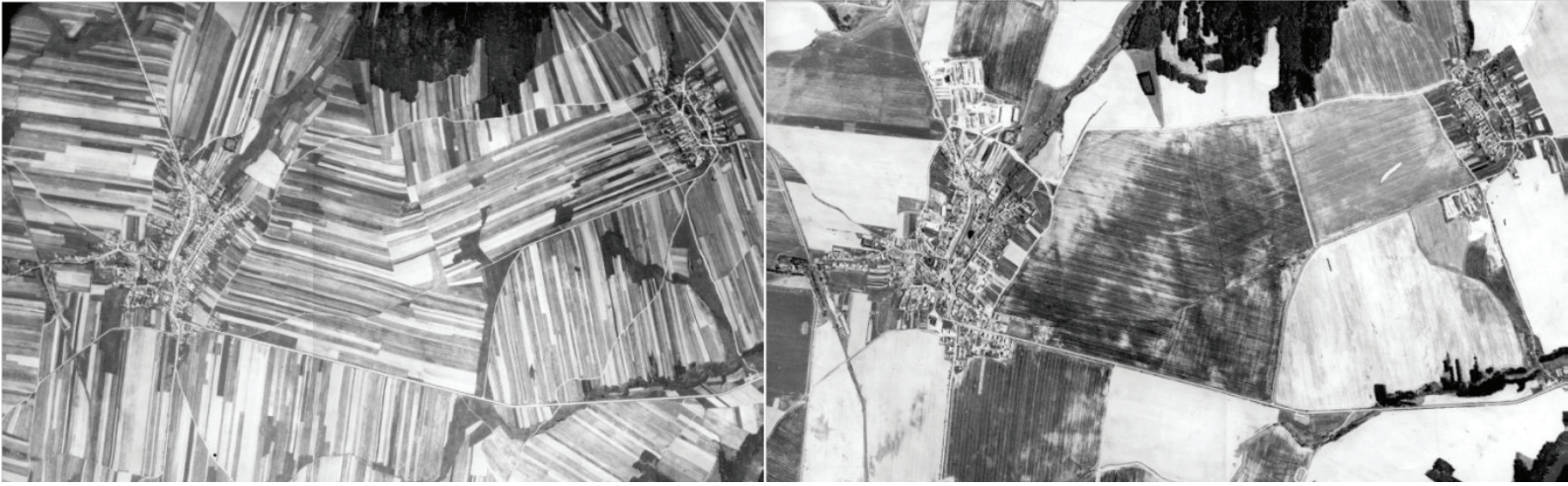


Fig. 11 | Generalised spidergram for the demonstration and assessment of changes induced by policy impacts for the selected PRIMA indicators



Aerial photographs of the south Moravian region (Czech Republic), 1957 and 1990: dramatic landuse/landcover transition, revealed by long-term and landscape-level perspectives

source: Jelinek (UZEI)

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Methodologies for scaling down to the regional and local level the analysis of policy impacts on multifunctional land uses and the economic activity

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