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Bridging Scientific Knowledge and Stakeholders' Visions for Agri-Environmental Assessment: Editorial

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In this fourth issue of the new series of the Italian Journal of Agronomy we have collected a selection of papers dealing with agri-environmental issues.

We have organised this issue as a sort of methodological path departing from the core of agri-environmental research (in particular those studies focusing on modelling and indicators) and taking the reader towards a new frontier of agricultural research, where agronomy and ecology meet sociology.

Intermediate steps are studies bridging agri-environmental approaches with operation research in order to provide an interface between scientific knowledge and policy/decision-making.

What do all these studies have in common?

The adoption of modelling – in a broad sense – as the inspiring methodological approach.

Traditionally, modelling is seen as an applied method aimed at integrating the various components of a system and their interactions from a wide range of disciplinary perspectives, such as hydrological, economic, agronomic and ecological. There is therefore an implicit reference to a mathematical formalisation of reality which relates models mostly to physical and ecological processes, such as nutrient balance, sediment transportation, etc. Models are thus understood as computer tools, in which systems of differential equations are used mainly for research purposes, or for management issues and, sometimes, for forecasting or exploring different future scenarios. Such tools traditionally lack the integration of socio-economic aspects, and this tends to limit the potentials of modelling outside the academia.

Recently, the scientific community is reconsidering both the meaning of modelling and its role in the civil society and the interest has thus shifted towards the processes involved in model conceptualisation, development and use. Experts and practitioners are now intending the word in a broader sense, not limited to physical, mathematical representations of reality, but encompassing additional components such as mental models, subjective visions, cognitive maps, thus including the psychological and social dimensions.

We can intend mental models as the "internal", subjective representations of reality and its dynamics, hold by all the people having a certain degree of knowledge about a specific issue. In order to become part of a shared knowledge and later on, when possible, becoming also simulation tools, mental tools should be communicated to the others. Techniques like cognitive mapping can provide methodologically robust approaches for "external" representations of mental models, as means to share the subjective views of reality. External representations of mental maps can then be formalised and transferred to computer tools as a way of representing and organising knowledge about the systems, or of supporting communication among the individuals involved.

In the agri-enviromental context this new emphasis on the exploitation of internal mental models is promising for at least two reasons: (i) first of all because agricultural systems are socio-ecosystems characterised by the highest complexity, whose simulation with a holistic approach is very unlikely to happen within mechanistic models; (ii) secondly, because the current culture of environmental policy and management is increasingly inspired by the principles of public participation, in which decisions should be taken with the participation of all the actors (so-called stakeholders), i.e. those who have interests in a particular decision, either as individuals or as representatives of a group.

It follows that the broadening of the perspectives considered in agri-environmental

modelling seems very promising in order to provide a robust methodological background for (i) integrating the part of knowledge already implemented within operational mechanistic models and that part which is still embedded in empiric subjective forms, and (ii) fostering the exchange of knowledge and visions among the experts and stakeholders involved in a common decision process, deliberation, etc.

In practice this new challenge consists in developing new approaches in agri-environmental management, aimed at "opening" the black boxes in which simulation models are often closed and at providing robust scientific approaches for developing and sharing mental models. The models later become mathematical formalisations and computer tools in participatory modelling processes, which allow for the effective impact of simulation models in agri-environmental policy and management.

The papers included in this issue offer the reader a view along one of the two perspectives mentioned above and in particular the second one, which focuses on bridging physical modelling and social sciences.

The first paper by Giupponi and Carpani provides a survey of the recent agri-environmental literature and, in particular, of those references presenting the use of models and indicators for the assessment of agricultural systems and their effects on environmental compartments (water, soil, air). It proposes a classification approach which helps to understand the potentials of the various approaches for developing, implementing, and assessing, agri-environmental policies.

The second paper, by Bechini and Castoldi, deals with Agro-ecological indicators (AEIs) of crop management and focuses on the soil surface balance of nitrogen as an indicator contributing to the sustainability assessment of the farms of a protected area, in an agricultural park.

In the third paper, Basso, Ritchie and Sartori illustrate the Salus model focusing on the effects of tillage methods and residue management practices on field infiltration, and indirectly on other variables, which are very relevant for assessing the relationships between agricultural activities and the environment: soil organic carbon, bulk density, drainage, soil evaporation and surface runoff.

Sacco, Zavattaro and Grignani return to the use of the nitrogen balance, but broadening the view, from the single farm, to the whole territory, thus integrating field scale modelling (using the Cropsyst model) and geographical information systems. A new component appears here, namely a metamodel, i.e. a computer-statistical procedure that helps to explore the relationships between agricultural practices and the environment in the various areas of the study.

In the fifth paper, Bona and Riello narrow down the analysis to farms cultivating sunflower, on the one hand, while broadening the approach to explore a global vision of the production system, on the other, by experimenting the use of the Life Cycle Assessment. This approach *from cradle to grave* is adopted to provide "a systematic analysis of the flows of matter and energy during the life of a product - from the extraction of the raw materials, through production, its use, until the product is disposed of". While the third and fourth papers focused in particular on agricultural negative externalities in terms of potential water pollution from nutrients of agricultural origin, this paper provides a view on the potential positive externalities in terms of contribution to substituting fossil fuels with renewable energy coming from biofuels. The use of questionnaires appears here as a means for collecting information from farmers in order to integrate data commonly available from official statistics.

In the work by Giupponi, Stanica, Féas and Furlan, the agri-environmental issue is brought to the field of decision-making for irrigation planning. Here expert'opinions are the basis for developing a decision model framed within a specific type of computer tool: a decision support system. The emphasis shifts from the simulation of agricultural systems to the integration of multi-disciplinary contributions, all together with the opinions of the farmers involved. In this paper modelling also involves the social dimension and is used as a means to analyse and process the opinions and preferences of different interest groups.

Roggero, Seddaiu and Toderi in the seventh paper move even further in the social dimension by focusing on stakeholders' involvement in a project dealing again with water pollution of agricultural origin: the same topic of Bechini and Castoldi and Sacco et al., but with a quite

differentiated approach. They attempted to bridge scientific knowledge, as discussed previously, with stakeholders' visions. The participatory approach proposed allowed to highlight the scientific weaknesses of the assumptions embedded in some agri-environmental measures, thus contributing to the identification of priorities for both scientific research and agro-environment policies.

The last paper goes deeply into the details of social analysis, which provided also the methodological background for the work by Giupponi et al. The analysis was structured in five steps: stakeholder identification; data collection; data treatment; network visualisation; and local network analysis. A factorial analysis of multiple correspondences and a cluster analysis were applied to provide a statistically robust basis for analysing the local network of stakeholders and their interactions. This paper thus provides sufficient methodological insight for non sociologists to understand the potentials of the Social Network Analysis for – agri-environmental – studies in the rural areas.