Integrated Spatial Assessment: a Multidimensional Approach for Sustainable Planning

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Abstract: *The paper presents the different steps of a multidimensional methodological approach for supporting the construction of planning choices, starting from the concept of "integrated assessment". The integration among Problem Structuring Methods, Public Participation, GIS, Multicriteria and Multigroups Decision Support Systems and Geographic Information Systems identifies a decision-making process explored for the transformation strategies definition in the spatial planning field according to sustainable and complex values.*

Keywords: Complex social values; Integrated assessment; Strategic environmental assessment; Decision Support System

1. From Integrated Assessment to Integrated Spatial Assessment

Planning and strategic evaluation imply the need to operate in the framework of 'integrated assessment' conceived as a procedure to arrive at an informed judgment to different courses of action with regards to environmental, social and economic problems. At the same time, the integrated assessment implies the need of constructing a balanced vision between conservation and progress, and requires the application of complementary approaches, which can utilize combinatorial assessment methodologies. These methodologies can be seen as flexible tools able to overcome the limits of each single method and strengthen the validity of the evaluation process to improve the coherence and internal consistency of the evaluation itself. In this perspective, a variety of territorial information (social, economic and environmental) may be combined and correlated to the characteristics of the different options of territorial use, facilitating the construction of appropriate indicators and favouring the forecasting of the impacts, leading up to the preparation of a preference priority list of the various options. The integrated assessment may be defined as an interdisciplinary process of combining, interpreting and communicating knowledge from diverse scientific disciplines in such a way that insights are made available to decision makers and that the entire cause-effect chain of a problem can be evaluated from a synoptic perspective with two characteristics (van Asselt and Rotmans, 1996):

1. it should add value compared to assessment based on a single disciplinary;
2. it should provide useful information to decision makers.

This approach was applied initially to problems of the environmental type but subsequently was considered viable for addressing complex issues of urban planning in which economic, social and environmental questions are closely interrelated.

The integrated assessment constitutes an ongoing process, both iterative and interactive, able to stimulate dialogue between expert and common knowledge, starting from recognition of the relevance of two fundamental questions: 'technical indeterminacy' and 'value multiplicity' (Ravetz, 2000). It emerges that recognition of the complex values at play is the base of the identification, integration and/or ideation of methods and tools for policies, plans and projects evaluation. The collective choices of our time are marked by uncertain facts, values in dispute, high stakes and urgent decisions (Funtowitz and Ravetz, 1991), which require the adoption of evaluation tools, rigorous from the scientific point of view, transparent in reference to the decision-making process

as well as of participatory type, like in 'social multi-criteria evaluations' proposed by Munda (2004). These evaluation methodologies extend the field of social cost-benefit analysis to incorporate different aspects referring both to impact assessment and to local communities participation in the decision-making process, while integrating subjective and objective components, tangible and intangible values.
In order to support the construction of choices in planning, different steps of a multidimensional methodological approach were identified starting from the concept of 'integrated assessment' while taking into account the experiences made in some case-studies of local planning. In particular, it was structured an articulated evaluation process defined 'Integrated Spatial Assessment' (ISA) (Fusco Girard et al., 2005; Fusco Girard et al., 2006), aimed at integrating multidimensional aspects within the elaboration of strategies and choices in planning, while recognizing the important role of environmental, social, and economic effects within the decision-making process and the selection of alternative options. In this perspective, the use of combined approaches and tools has a privileged role in the decision-making process.

2. The Methodological Approach

The integration between Multi-Criteria and Multi-Groups Analysis and Geographical Information Systems is remarkably fruitful in land management where the role of local players, their relations and objectives may be considered a structuring element for the process of information construction in a spatial and dynamic evaluative model (Joerin et al., 2001). Compared to traditional forms of GIS utilization, it should be possible to evaluate data covering not only the current situation but also:
1. the spatial characteristics of options proposed;
2. the temporal modification of data following the options implementation;
3. the expressed preferences of local players;
4. the conflicts analysis between the various stakeholders;
5. the evaluation of various options in order to obtain a preference priority list.

Taking into account the previous steps, we defined a methodological process that combines the contribution of different methods and tools.
In particular, starting from the identification of the complex social values for sustainable planning, the first methodological step that we propose is the application of Problem Structuring Methods (PSMs) combined with Public Participation Geographic Information Systems (PPGIS) for the construction of a shared knowledge framework.
The PSMs are methods providing a useful support to information structuring within Decision Support Systems, able to deal with a variety of not structured problems and situations, overcoming traditional approaches and espousing communicative conceptions of planning (Rosenhead and Mingers, 2001). In particular, not structured problems are characterised by multiplicity of actors; multiplicity of points of view; incommensurable interests and/or in dispute; important intangible values; and uncertainty. In these situations, through PSMs it is possible to visualize a problem so that participants can clear their positions and converge to one or more potential issues aimed at building consensus. Through PSMs it is possible to represent graphically the complexity of the issues under exam, explore the solutions' space, compare discrete alternatives, face uncertainty in terms of 'possibilities' and 'scenarios' rather than in terms of probability and prediction. PSMs are based on explicit modelling of cause-effect relations, and their technical simplicity allows them to be used in 'facilitated groups' and workshops.
At the same time, the PPGIS is defined by Sieber (2006) as the use of Geographic Information Systems to broaden public involvement in policymaking as well as the value of GIS to promote the goals of nongovernmental organizations, grassroots groups and community based organizations. PPGIS is meant to bring the academic practices of GIS and mapping to the local level in order to promote knowledge production. The idea behind PPGIS is empowerment and inclusion of marginalized populations, who have little voice in the public arena, through geographical

technology education and participation. PPGIS uses and produces digital maps, satellite imagery, sketch maps, and many other spatial and visual tools, to change geographical involvement and awareness on a local level. The local participatory management of urban neighborhoods usually derives from 'claiming the territory', and has to be made compatible with national or local authority regulations on administering, managing and planning urban territory (McCall, 2003).
The second methodological step combines Multi-Criteria and Multi-Groups Decision Support Systems with Geographic Information Systems (GIS) in order to overcome the limitations of specific techniques through the application of different methods, which derive from different fields of discipline and define a more complete and integrated framework of analysis and evaluation.
Many experiences of integration between Multi-Criteria and Multi-Groups Analysis and GIS have been developed with reference to different sectors and using different evaluation methods. This type of integration gives rise to a 'spatial multicriteria and multigroups analysis'. Spatial multicriteria decision problems typically involve a set of geographically-defined alternatives from which a choice of one or more alternatives is made with respect to a given set of evaluation criteria (Jankowski, 1995; Malczewski, 1999). Spatial multicriteria analysis is widely different from conventional multicriteria techniques due to inclusion of an explicit geographic component. It requires information on criterion values and the geographical locations of alternatives in addition to the decision makers' preferences with respect to a set of evaluation criteria. This means that analysis results depend not only on the geographical distribution of attributes, but also on the value judgments involved in the decision-making process. Therefore, two considerations are of fundamental importance for spatial multicriteria analysis: the GIS component (i.e., data acquisition, storage, etc.); and the multicriteria analysis component (i.e., aggregation of spatial data and decision makers' preferences into discrete decision alternatives) (Al-Shalabi et al., 2006).
Spatial analysis combined with multicriteria methods have been used in recent years to support evaluation, especially in the field of land-use planning. For example, GIS technology was used to assess the criteria requested by suitability of land for housing. Because the required criteria were heterogeneous and measured on various scales, GIS was integrated with an outranking multicriteria method called ELECTRE-TRI (Joerin et al., 2001). Integration between GIS and multicriteria analysis using Analytical Hierarchy Process (AHP) was used in selecting the location for housing sites in a complex process, involving not only technical requirement, but also physical, economical, social, environmental and political requirements (Al-Shalabi et al., 2006). GIS and multicriteria analysis provided also a better insight into the consequences of alternative water regimes on the performance of the wetland functions, supporting stakeholders participation. In particular, multicriteria analysis was performed using the software package DEFINITE (Janssen et al., 2005).
In general, in the last decade a wide range of applications was experimented for decision-making, linking multicriteria assessment and GIS, considering both different methods and different fields: urban and territorial planning, nature conservation, risk management, etc. (Chen et al., 2001; Geneletti, 2004; Malczewski, 2004). We propose to extend this integration in the perspective of 'integrated assessments' in order to consider not only the technical aspect of the decision-making problem but also the involvement and participation of local community to choices in planning.
The integration among Problem Structuring Methods, Public Participation GIS, Multi-Criteria and Multi-Groups Decision Support Systems and Geographic Information Systems identifies a decision-making process that allows to analyse the complexity of human decisions for a flexible environment in which the individual learning assumes a significant role in decisional process, and to explore the transformation strategies definition in the spatial planning field according to sustainable and complex values.

3. Concluding remarks

From the above perspective, Integrated Spatial Assessment can be seen as a preventive 'check of sustainability', becoming relevant in the decision-making process for collective choices, trying to define possible actions – and limits and conditions – of development and enhancement of territory

within urban and spatial planning. Some selected case-studies, experimented in Campania region, offer the opportunity to explore the potentials of this methodological approach and to verify its applicability.

References

Al-Shalabi M.A., Bin Mansor S., Bin Ahmed N., Shiriff R. (2006), "GIS Based Multicriteria Approaches to Housing Site Suitability Assessment", Paper presented to the XXIII FIG Congress, Shaping the Change, Munich, Germany, October 8-13.

Chen K., Blong R., Jacobson C. (2001), "MCE-RISK: Integrating Multicriteria Evaluation and GIS for Risk Decision-Making in Natural Hazards", *Environmental Modelling and Software*, 16: 387-397.

Funtowicz S.O., Ravetz J.R. (1991), "A New Scientific Methodology for Global Environmental Issues", in Costanza R. (ed.), *Ecological Economics*, Columbia, New York, 137-152.

Fusco Girard L., Cerreta M., De Toro P. (2005), "Integrated Spatial Analysis: Approaches and Instruments", paper presented to the Second Meeting of INU Campania, Vision of Territory: From Utopias to Scenarios, Naples, 14 November 2005.

Fusco Girard L., Cerreta,M., De Toro P. (2006), "Integrated Spatial Analysis: A Decision Support System for Territorial Planning", paper presented to the International Meeting MTSID '06, Methods, Models and Information Technologies for Decision Support, Procida, 28-30 September 2006.

Geneletti D. (2004), "A GIS-Based Decision Support System to Identify Nature Conservation Priorities in an Alpine Valley", *Land Use Policy*, 21: 149-160.

Jankowski P. (1995), "Integrating Geographical Information Systems and Multiple Criteria Decision Making Methods", *International Journal of Geographical Information Systems*, 9: 251-273.

Janssen R., Goosen H., Verhoeven M.L., Verhoeven J.T.A., Omtzigt A.Q.A., Maltby E. (2005), "Decision Support for Integrated Wetland Management", *Environmental Modelling and Software*, 20: 215-229.

Joerin F., Theriault F., Musy A. (2001), "Using GIS and Outranking Multicriteria Analysis for Land-Use Suitability Assessment", *International Journal of Geographical Information Science*, 15: 153-174.

Malczewski J. (1999), *GIS and Multicriteria Decision Analysis*, JohnWiley and Sons, New York.

Malczewski J. (2004), "GIS-Based Land-Use Suitability Analysis: A Critical Overview", *Progr. Plann.*, 62: 3-65.

McCall M. K. (2003), Seeking Good Governance in Participatory-GIS: A review of Processes and Governance Dimensions in Applying GIS to Participatory Spatial Planning, *Habitat International*, 27: 549–73.

Munda G., 2004, "Social Multi-Criteria Evaluation: Methodological Foundations and Operational Consequences", *European Journal of Operational Research*, 158: 662-677.

Ravetz J.R. (2000), "Integrated Assessment for Sustainability Appraisal in Cities and Regions", *Environmental Impact Assessment Review*, 20: 31-64.

Rosenhead J., Mingers J. (2001), *Rational Analysis for a Problematic World Revisited: Problem Structuring Methods for Complexity, Uncertainty and Conflict*, Wiley, Chichester.

Sieber R. (2006), "Public Participation and Geographic Information Systems: A Literature Review and Framework", *Annals of the American Association of Geographers*, 96/3: 491-507.

van Asselt M.B.A., Rotmans J. (1996), "Uncertainty in Perspective", *Global Environmental Change*, 6(2): 121-57.

