Integrating the concept of ecosystem services and values in Land use planning

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Abstract. Many high-profile efforts conducted recently have proposed integrating ecosystem service values in the decisions made about land usage; however, there are not many evidences of using such approach in practice. The objective of the present study is to give an overview of the obstacles in the way of using ecosystem service assessment and valuation in managing the environment. In addition, a few solutions to achieve a comprehensive and practical framework are proposed. When it comes to land planning, the results should be comprehensive to facilitate comparison with other alternatives. One approach to this end is to aggregate the results to a manageable set through weighting methods. Here, the way of utilizing weighting method in making decisions about land usage is examined and potential areas of development are proposed. Moreover, the differences in the available patterns of use are examined, the cause and consequences of the differences are discussed, and necessity of the found differences is investigated.

1. Introduction

Adding environmental aspects to planning, policymaking, and programming activities had drawn an increasing attention from decision-makers in the both public and private sectors [1]. To realize this goal several analysts and practitioners had demanded an improved and more systematic use of analytical tools to comprehend and evaluate economic, technological, and environmental systems in an attempt to add pertinent and structured knowledge to decision-making processes [2], [3]. In fact, there are some analyzing tools for land use/landscape planning for different systems available that are widely used. The farmers have been challenged by citizens and firms to add more functions along with food production to land/landscape use. This means that the landscape needs to carry out several functions simultaneously. The objective is to achieve landscape performance in the context of sustainable development; that is, utilizing the natural resources based on a comprehensive consideration of all ecological, social, and economic functions while preserving the potentials for providing goods and services to future generations [4]-[6]. In the case that these concerns are realized for landscape/land development purposes, the decisions about modifying landscapes need to be made after taking into account the economic, social, and ecological functions and values. Under sustainable landscape development, man changes the landscape only to improve its performance and achieve extra value. Thereby, science needs to link the physical structure and function of the landscape to the economic, sociocultural, and ecological values needed by the users [7]. Since scientific knowledge influences landscape-development processes, the desired landscape values, at first, should be linked to the intended changes in the structure and functioning of the physical landscape [8].
The top challenge as to biomass-landscape is to make decision about the optimal allocation and management of a large number of land use options. Landscape functions and services represent a key concept in policy making given that decision-makers need to handle a clear demand for landscape services by a wide range of stakeholders [9]-[12].

Given the above introduction, the present study is an attempt to offer an overview of the challenges in the way of using ecosystem service assessment and valuation for environmental management and introduce a number solutions to achieve a comprehensive and practical framework.

2. Land use planning

A systematic assessment of land and water potential is called land-use planning, which examines different options for land use based on economic and social conditions to find the best possible land-use option. The objective is to choose and actualize the land use policies that will realize the needs of the public in the best possible manner, while the resources are preserved for the future. What powers the attempt for planning is the need for change, the need for better management, or the need for a completely different pattern of land use that is demanded by changes in the circumstances.

All types of rural land use are under consideration: agriculture, pastoralism, forestry, wildlife conservation, and tourism. In addition, planning guides us in the face of conflict between rural and urban or industrial expansion through determining which regions are the most suitable for rural use [13].

One probable mistake in the early stages of land-use planning is to focus only on land resources and neglecting the way they can be used. Decisions for land use are not only based on land suitability and the demand for products and criticality of using the land for a specific purpose is also taken into account. Information about suitability of the land, the demands for alternative products or uses and chances to fulfill the demands for the available land now and in the future need to be taken into account [13]. There is no two land use planning projects completely similar as the local circumstances and objectives can be varied notably and each project demands a different treatment. Still, we can introduce ten steps as a guide (Figure 1) [13].

![Figure 1. Steps in land-use planning](image)

Each step needs a specific activity or a set of activities and the information generated in the past step is used in the next step.
By adopting a broader point view, the steps can be categorized into the following logical sequence [13]:

- Identifying the problems (Steps 1-3)
- Determining what are the alternative solutions (steps 4-6)
- Deciding about the best alternative and develop a plan (steps 7, 8)
- Implementing the plan and finding how it functions and learning from the experience (steps 9, 10)

3. Weighting methods

The environmental systems analysis tools discussed in this paper have their roots in different scientific disciplines. The proposed set of weighting methods adopted as the tools are different and regardless of their large overlapping, the categorizations adopted here are based on different logics and none cover all types of methods.

3.1. Monetary methods

3.1.1. Different types of economic values. Environmental economists distinguish different types of economic values [14]. The first recognized difference is between use and non-use value of environmental goods and services. Furthermore, use values are categorized into direct (e.g. the timber value of a forest) and indirect use values (e.g. the value of carbon fixation of a forest). A non-use value refers to the value that people attach to an amenity without taking into account if they use it or not [15].

3.1.2. Market prices. A marginal valuation of goods and services at the available level of supply and demand is provided by market prices. The market value is used for computing damage costs, loss of production, and loss of capital. Still, it is notable that the market values only cover the direct use values, and they are not a reliable measure of the total economic value [15].

3.1.3. Revealed willingness to pay. Relying on the information about people’s expenditures on the related market goods, under the revealed preference method, the analyst tries to find the value of non-marketed goods [16]. The value of lost property and the value of production losses both are taken into account in the market-related damage. The willingness to pay (WTP) for environmental quality, in travel cost study, is determined based on differences in expenditures for visiting recreational sites with different quality. The value of commodity such as landed property, under hedonic pricing method, is determined as a set of characteristics and one or more of them can be environmental [16]. The key problems in these methods are limited applications and difficulties to link the market data to the environmental amenities.

3.1.4. Stated willingness to pay. Estimates of the value a person perceives for environmental quality, under stated preference methods, are explained by surveying where they are asked to express their preferences. Among the available methods are contingent valuation and choosing the modeling. Given that the approach covers both use and non-use values, it is considered as the most comprehensive one. The mentioned preference method might be influenced by a variety of biases such as link to the survey design, the interview situation, information given to respondents, and strategic behavior [17].

3.1.5. Imputed willingness to pay. Imputed WTP covers many cost methods including damage cost avoided, replacement cost, and substitute cost method [18]. These methods assume that if people incur costs to avoid damages caused by lost ecosystem services or to replace the services of ecosystems, then, such service needs to be worth at least what is paid to replace them. However, there are problems in using cost approaches as costs are not linked to the extent of the damage and they are not pertinent to the felt severity of the problem. One may say that they are the lower limit to the benefits when only economic issues are under consideration. They are the best options when avoidance measures are determined; that is, there is a clear will to pay the costs [19].
3.1.6. Political willingness to pay. Finnveden et al. (2002) argued that societal value might be different from the sum of individual values and given that, it may sound reasonable to deduce values from the behavior of government [20]. The costs for achieving established target can be construed as society’s WTP with political process as the mediator. Determining a target for pollution level or the protection of an ecosystem demands an implicit valuation as the decision highlights the decision-makers’ willingness to pay the value for reaching the target. In a similar manner, taxes are the tools to internalize the externalities created by consumption or production. Payable taxes of emission can be explained as a political valuation of the created externalities.

3.1.7. Avoidance costs. Valuation based on avoidance costs refers to the estimation of the cost of imposing limitation on, for instance, emissions [21]. The difference between this method and costs-to-reach target estimates lies with the fact that the adopted limits are not decided by the actors but rather by analysts so that it represent no one’s WTP and indicates a hypothetical situation. This can be used in greened economy GDP computations [21].

3.2. Non-monetary methods

3.2.1. Proxy methods. The easiest way to weigh different types of environmental impacts and compare them are proxy methods. These methods rely on countable quantitative measures that are assumed to represent the total environmental impacts [22].

3.2.2. Distance-to-target methods. Different categories of environmental impact based on the distance between current level of environmental pollution and future environmental target value are measured by these methods [23]. There will be no necessity for equally important targets when the targets are determined. Thereby, a sort of weighting between the impacts should be performed. Still, in many cases, the targets are considered to be of the same weight so that there is no inter-effect weighting [20].

3.2.3. Revealed willingness to pay. Discussing preferences in a panel to make judgement can be carried out in different ways. Experts, stakeholders, or lay people can participant in the panel and the process of discussing the issue can be classified into different ways[24]. Multi-criteria analysis is a group of methods designed to deal with the problems featured with several goals [15].

4. Integrating economic aspects in land use planning

Adopting a proper usage for an area of land is one of the most challenging part of land programing. At the decision making point, the planners and decision-makers need to interact with each other. At the point of decision, the roles of the planner and the decision-maker must interact. Priority determining methods are either qualitative or quantitative and regardless of that, the proposed method can be categorized as follows[25]:

- a. Comparative qualitative or quantitative methods.
- b. Quality or quantitative methods to determine capacity of the area of land.
- c. Quantitative methods of mathematical programming.

Through the simplest planning situation –i.e. new land settlement- it is possible to allocate land units to specific usages. Afterward, the settlers are brought in and they, at least at the beginning, need to practice the planned usages. In most of the cases however, the land is already occupied by settlers and used for cultivating, grazing, etc. purposes. Is such case, the objective of planning is to solve the current problems in the land-use systems; in addition, the land use cannot be allocated easily. It is possible to offer new land-use types for specific areas, which is done through developing services and providing inputs and services. In some cases, the options can be set out in a goal achievement matrix and ranked based on the chosen criteria.

The idea proposed here is to use analysis of environmental economy results as a weight in the seventh stage of land planning. Knowing that there is no consensus about these values in the society, it cannot be expected to have a generally accepted single valuation or weighting methodology. Still, it is
imperative to utilize multiple methods in parallel to show how the different values might influence the results of study.

5. Results and discussion
As shown by the review, there was a wide range of choices in land use and weighting methods for different environmental systems analysis tools. On the other hand, the way that the methods are used is different. It appears that these differences have to do with traditions and views about environmental economic valuation and weighting rather than applications. Nowadays, the lack of consistent environmental economic weighting/valuation sets is quite clear. To improve the quality and usefulness of these sets, more studies and development are needed. The results showed that the following points can be of interest for the future studies:
   a. To compare land usages based on different methods of usage planning and comparing the results;
   b. To use land planning methods featured with economic evaluation and comparing them with physical methods of land planning along with weighting based on environment economy;
   c. To develop a new consistent environment economic valuation weighting/valuation sets; that is, using the same valuation method for all types of land uses;
   d. To evaluate the employed methods and the resulted sets as to scientific quality, consistency, and data gaps and to test them in case studies to ensure reasonableness of the results;
   e. To develop several sets of value obtained from a large number of methods, using taxes, avoidance cost, cost-to-reach targets.

6. References
[1] Lenschow A, Environmental policy integration: Greening sectoral policies in Europe. 2002: Routledge.
[2] Thissen W A and Twaalfhoven P G, Towards a conceptual structure for evaluating policy analytic activities. European Journal of Operational Research, 2001. 129(3): p. 627-649.
[3] Nilsson M, et al., The use and non-use of policy appraisal tools in public policy making: an analysis of three European countries and the European Union. Policy Sciences, 2008. 41(4): p. 335-355.
[4] Brundtland G H, World commission on environment and development (1987): Our common future. World Commission for Environment and Development, 1987.
[5] IUCN, Rio declaration on environment and development, 1992, WWF: Switzerland.
[6] Linehan J R and Gross M, Back to the future, back to basics: the social ecology of landscapes and the future of landscape planning. Landscape and Urban Planning, 1998. 42(2): p. 207-223.
[7] Haines-Young R, Sustainable development and sustainable landscapes: Defining a new paradigm for landscape ecology. Fennia, 2000. 178(1): p. 7-14.
[8] Termorshuizen J W and Opdam P, Landscape services as a bridge between landscape ecology and sustainable development. Landscape ecology, 2009. 24(8): p. 1037-1052.
[9] FAO, Cultivation our futures, in FAO/Netherlands Conference on the Multifunctional Character of Agriculture and Land. 1999, FAO/LNV,: The Netherlands.
[10] OECD, Multifunctionality: towards an analytical framework. 2001, Paris,: Organization for Economic.
[11] Bills N and Gross D, Sustaining multifunctional agricultural landscapes: comparing stakeholder perspectives in New York (US) and England (UK). Land Use Policy, 2005. 22(4): p. 313-321.
[12] De Groot R S, et al., Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecological complexity, 2010. 7(3): p. 260-272.
[13] Agriculture Organization of the United Nations. Interdepartmental Working Group on Land Use Planning, Guidelines for land-use planning. Vol. 1. 1993: Food & Agriculture Org.
[14] Turner R K, Pearce D, and Bateman I, Environmental economics: an elementary introduction. 1994: Harvester Wheatsheaf.
[15] Ahlroth S, et al., Weighting and valuation in selected environmental systems analysis tools—suggestions for further developments. Journal of Cleaner Production, 2011. 19(2): p. 145-156.
[16] Hanley N S and JF White B, Environmental economics in theory and practice. 2002: Palgrave macmillan.
[17] Carson R T, Flores N E, and Meade N F, Contingent valuation: controversies and evidence. Environmental and resource economics, 2001. 19(2): p. 173-210.
[18] Mishra S, Valuation of environmental goods and services. , in In: Singh, O.P. (Ed.), Environment and Natural Resources: Ecological and Economic Perspectives. 2010, Regency Publications: New Delhi. p. pp. 34e54.
[19] Kopp R J, Krupnick A J, and Toman M A, Cost-benefit analysis and regulatory reform: An assessment of the science and the art. 1997.
[20] Finnvveden G, et al., Normalization, grouping and weighting in life cycle impact assessment. Life cycle impact assessment: striving towards best practice. Society of Environmental Toxicology and Chemistry (SETAC), Pensacola, 2002.
[21] UN, Integrated environmental and economic accounting, 2003, European Commission, IMF, OECD and World Bank: New York, United Nations. p. 100-118.
[22] Huijbregts M A, et al., Is cumulative fossil energy demand a useful indicator for the environmental performance of products?, 2006, ACS Publications.
[23] Weiss M, et al., Applying distance-to-target weighing methodology to evaluate the environmental performance of bio-based energy, fuels, and materials. Resources, Conservation and Recycling, 2007. 50(3): p. 260-281.
[24] Seppälä J, Decision analysis as a tool for life cycle impact assessment. 1999: Eco-Informa Press Bayreuth.
[25] Cocks K and Ive J, Rural land use planning techniques. In Micro computer for lacal goverment planning and management. 1986, Sydney: Hargreen Pub. 112-122.