Final Progress Report
Sustainability Science Program, Harvard University
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Name: Davide Geneletti

Your field(s):
environmental sciences, land use planning, spatial analysis

Faculty host(s) at Harvard name and department:
William Clark, Belfer Center for Science and International Affairs, Center for International Development
Noel Michele Holbroook, Dept. of Organismic and Evolutionary Biology
Merilee Grindle, David Rockefeller Center for Latin American Studies, Center for International Development

Description of SSP-related research activity:

Title: Integrating ecosystem services in land use planning

Abstract: Research on ecosystem services has been defined as a cornerstone of sustainability science, but, despite the attention that it has attracted in recent years, its use in supporting decision-making is still very limited. This applies in particular to the planning level of decision-making, whereas more studies are found at the policy level. This research aimed at contributing to the advancement of sustainability science by developing an analytical framework to predict and represent the effects of planning choices on a range of ecosystem services, and eventually on the wellbeing of different social groups. This was performed by addressing three specific issues related to the incorporation of ecosystem services in planning, such as: the issue of scale, which arises when ecosystem-service benefits accrue at one spatial scale, but costs are borne at another; the issue trade-offs, which arises when plans' policies change the relative mix of ecosystem services and their spatial pattern of provision and fruition; the issue of identifying a reasonable set of indicators to generate information that decision makers and stakeholders will be able to understand and use effectively.

Identification of the problem you address:
The publication of the Millennium Ecosystem Assessment fuelled a number of studies aimed at analyzing and quantifying the importance of ecosystems for human well-being to eventually make better decisions regarding the sustainable use of Earth's resources. However, only a fraction of these studies are actually designed to support on-the-ground land use planning . Land use planning results in direct drivers and indirect drivers that affect the distribution and quality of virtually all ecosystem services within a region. If this is disregarded, the plan might be poorly effective, and impact negatively on human well-being. Hence, it is crucial to identify and assess the spatial patterns of both the provision and fruition of ecosystem services, and to use this information to support the planning process.

Key question asked about the problem:
The core research question of this project is: what spatial policies produce a sustainable landscape, defined as one in which "the output of services is maintained and the capacity to deliver benefits for future generations is not undermined" (Potschin and Haines-Young, 2006)? This question was broken down in three more specific questions:
1. What are the effects of different spatial policies on the production of services through time?
2. How changes in the production affect the actual benefits, hence human wellbeing?
3. What are the tradeoffs between different ecosystem services and wellbeing constituents, and how are they affected by the spatial scale of analysis?

The methods by which you answered that question:

A case-study approach was undertaken by focusing on land use planning in The Araucanía (southern Chile), a region rich in natural resources, but affected by poverty and relatively low performance in development indicators. The methodology was based on the generation of land use scenarios that simulate the implementation of different spatial policies through time. For each scenario, the production of key ecosystem services (e.g., water filtration, soil retention) is modeled and compared (Q1). The effects on the constituents of wellbeing (adequate livelihoods, health, etc) are then assessed by looking at spatially-resolved socioeconomic variables that estimate the appropriation of services by different groups of beneficiaries (Q2). Finally, the geographical and temporal patterns of tradeoffs are studied by disaggregating the results at different levels (from regional to sub-municipal) (Q3).

Principle literature upon which the research drew:

The research drew on three main streams of scientific literature:
-       Literature on coupled human-environmental systems
-       Literature on spatial modeling of ecosystem services
-       Literature on theory and methods to assess the environmental effects of projects, plans and policies (environmental impact assessment, strategic environmental assessment, sustainability assessment).

Empirical data acquisition description:

The research made use of baseline data and knowledge acquired during previous studies conducted in the Araucanía region. This data set was integrated with additional information available from Chilean research institutes and governmental agencies. The data set included:
-       Surveys conducted in the last decade on basic needs and poverty;
-       Census surveys;
-       Agricultural and forest cadastre;
-       GIS baseline data (biophysical and socioeconomic information);
-       Time series of land cover and land use maps (last 20 years);
-       Land use plans and other planning tools at different planning tiers;
-       Sector studies and report on agriculture, forestry, aquaculture, tourism, urban development, native people, livelihoods, etc.

Geographical region studied:

The Araucanía (southern Chile)

Recommendations that might be relevant for your problem:

1.   The results illustrated the importance of taking into account the spatial arrangement of land uses produced by different policies.
2.   This study generated a representation of the trade-offs between provisioning and regulating services, and between regulating services that occur at different spatial scales. This information provides valuable support to planning, by narrowing the scope of potential decisions.
3.   The combined use of different metrics to represent the effects on the ecosystem services provides a better understanding of the performance of alternative spatial policies.

A description of the final product(s) you have/are aiming to produce:

I'm aiming at three manuscripts to be published in international journals. Two have been already submitted (to Land Use Policy and to the Journal of Biodiversity Science, Ecosystem Services and Management , respectively). The third one is expected to be submitted in September 2011. I also aim at writing a short policy-relevant report that summarizes the findings of the papers and that will be translated in Spanish and distributed to policy makers in the study region.

Description of major other intellectual or professional advancement activity(ies) over the past academic year:

Bossi, Andrea, Robert Howard, Davide Geneletti, and Simone Ferrari. 2012. UK and Italian EIA systems: A comparative study on management practice and performance in the construction industry, *Environmental Impact Assessment Review* 34: 1–11.

Geneletti, Davide. 2012. Reasons and options for integrating ecosystem services in strategic environmental assessment of spatial planning. *International Journal of Biodiversity Science, Ecosystem Services and Management* (available on line), DOI:10.1080/21513732.2011.617711.

Bagli, Stefano, Davide Geneletti Francesco Orsi. 2011. Routeing of power lines through least-cost path analysis and multicriteria evaluation to minimise environmental impacts. *Environmental Impact Assessment Review* 31: 234–239.

Diamantini, Corrado, Davide Geneletti and Roberta Nicchia. 2011. Promoting urban cohesion through town planning: The case of Caia, Mozambique. *International Development Planning Review* 33(2):169-186.

Geneletti, Davide. 2011. Environmental assessment of spatial plan policies through land use scenarios: A study in a fast-developing town in rural Mozambique. *Environmental Impact Assessment Review* 32(1): 1-10.

Orsi, Francesco, Richard Church, and Davide Geneletti. 2011. Restoring forest landscapes for biodiversity conservation and rural livelihoods: A spatial optimisation model. *Environmental Modelling and Software* 26(12): 1622-1638.

Scolozzi, Rocco and Davide Geneletti. 2011. Spatial rule-based assessment of habitat potential to predict impact of land use change on biodiversity at municipal scale. *Environmental Management* 47(3): 368-383.

Vettorato, Daniele, Davide Geneletti, and Pietro Zambelli. 2011. Spatial comparison of renewable energy supply and energy demand for low-carbon settlements. Cities 28(6):557-566.

Please list citations for reports, papers, publications and presentations that built on your fellowship research:

Paper presentation at the International Conference: Impact Assessment and Responsible Development for Infrastructure, Business and Industry, Puebla 28 May – 4 June 2011
(http://www.iaia.org/conferences/iaia11/)
Paper title: Integrating ecosystem services in land use plans
Abstract: This paper aims at contributing to the theory and practice of integrating ecosystem services in land use planning, and Strategic Environmental Assessment (SEA). The research developed an analytical framework to predict and represent the effects of planning choices on a range of ecosystem services, and eventually on the wellbeing of different social groups.

Principal collaborators outside Harvard (list name and institution):
Fernando Peña (Laboratorio de Planificación Territorial, Universidad Católica de Temuco)
Fernando Burrow (Pontificia Universidad Catolica de Chile)
Corrado Diamantini and Francesco Orsi (Dept. of Civil and Environmental Engineering, University of Trento)

List any awards or grants that you have received this year for the current or coming year.
NA

If you are moving to a new position, please list your contact information there:
University of Trento, Department of Civil and Environmental Engineering