Negotiation-support toolkit for learning landscapes

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33 | Polyscape

Fergus Sinclair and Timothy Pagella

Polyscape is a GIS framework designed to explore spatially explicit synergies and trade-offs amongst ecosystem services to support landscape management (from individual fields through to local landscapes of 1000 km^2 scale). Polyscape currently maps the impacts of land-cover change on surface runoff, habitat connectivity, erosion, carbon sequestration and agricultural productivity. The tool also incorporates trade-off algorithms that allow visualisation of the impact of different land management decisions and, thus, can be useful for land-use planning at local landscape scales.

Introduction

Bagstad et al (2013) recently reviewed 17 ecosystem services' tools against eight evaluative criteria that gauged their readiness for widespread application in public- and private-sector decision making. There is scope for further exchange of concepts and algorithms between these models, while there is a clear need for greater user-friendliness and options for exchange between models based on common definitions and concepts. Most of the models are currently framed as 'decision support', aiming for a best-current-science representation of the likely consequences of actions. As discussed before in many of the tools herein, it is relevant to complement such models with approaches that are more directly cognizant of the negotiation context, where knowledge, aspirations and skills are not (yet) shared between the various stakeholders.

The Polyscape approach provides a spatially explicit framework for different stakeholders to explore impacts of land-use options for a range of ecosystem services and to identify synergies and trade-offs amongst them. Negotiation of ecosystem services is likely to involve interaction at the plot, farm and local landscape scale and the tool was designed to work at these scales (typically 10 to 1000 km^2). Stakeholders are engaged from the outset, with the representation of ecosystem services' maps iteratively developed and drawing heavily on local and expert stakeholders' knowledge and feedback. This ensures local legitimacy of outputs. This participatory mechanism facilitates in the negotiation of land-use options and in the evaluation of their impact on the provision of ecosystem services. The core of the Polyscape approach is a GIS toolkit that uses generally available data to map:

1. where interventions are most and least desirable with respect to single ecosystem services (currently, agricultural production, water flow, sediment flow, biodiversity conservation and carbon storage; these layers would need to be customised for each landscape);
2. trade-offs and synergies amongst impacts of land-use change on a range of ecosystem services, pinpointing win-win options and areas where incentives may be required to manage trade-offs; and
3. how changes in landscape structure have an impact on the provision of ecosystem services.

Given the emphasis on participation and the difficulties of operating in data sparse environments, the process of developing the maps is likely to be more important than the final maps.

Objective

The objective of Polyscape is to represent the basic physical structure of a landscape along with the key spatial processes that influence ecosystem functions and create spatial dependencies between cause and effect. This is to be done in a way that is intuitive and communicates well with local stakeholders. The tool captures additional information and insights into the current situation before exploring future changes.

Steps

1. Obtain a working version of the model and the software needed to run it. Polyscape is in the proof-of-concept phase. Initial development used Python scripts that were hardwired into the tools. Polyscape runs in ESRI™ ArcMap™ 9.2 (or 9.3) with Spatial Analyst™ and Arc-Hydro extension. The tool is currently being ported to QGIS.
2. Develop specifications for the ecosystem services being considered (see Figure 33.1)
   Parameterize the model with existing spatial information.
3. Present the initial model version to a group of stakeholders, obtain their suggestions for refinement and improvement and observations on how realistic the model is; adjust to the degree possible.
4. Bring the adjusted model to further meetings of landscape actors (including farmers) and explore with them how a wide range of alternative future configurations would affect the performance measures in agronomic, economic and environmental perspectives.
5. Capture the main contrasts, trade-offs and choices that emerge from the 'what if' scenarios of local stakeholders, and bring them into local negotiations.
6. Validation with local stakeholders and experts.

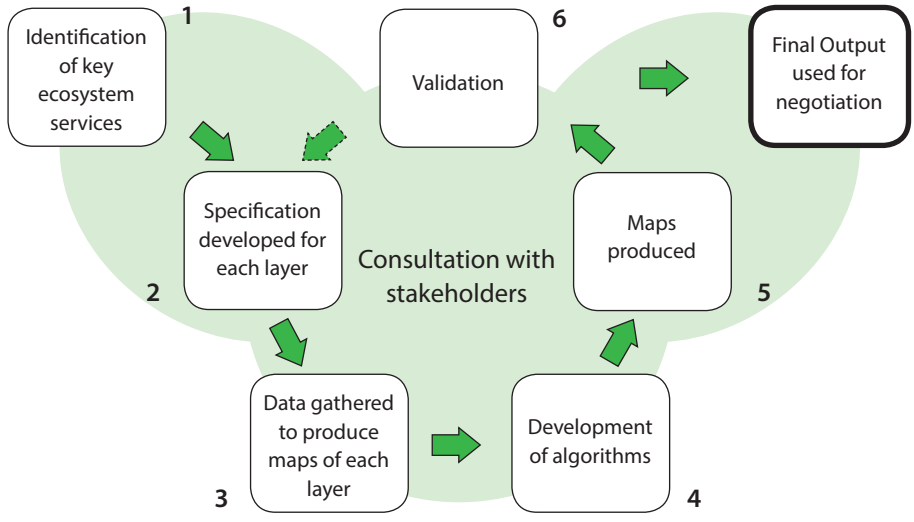

Figure 33.1. Iterative cycle of map development for Polyscape

Example of application

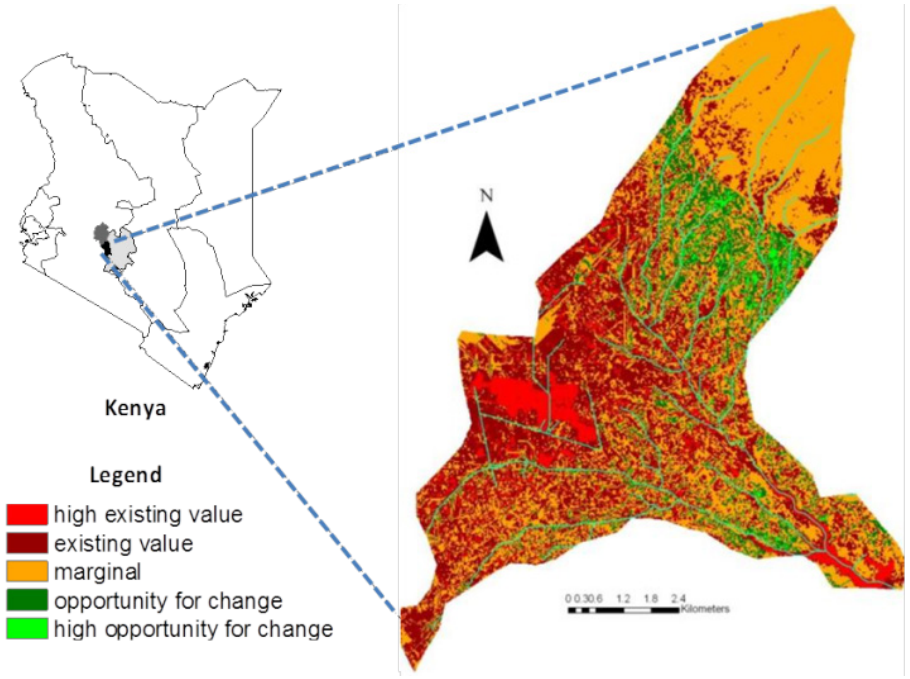

Figure 33.2. Example of Polyscape output for the Sasumua watershed in Kenya, trading-off flood mitigation and agricultural productivity services

Polyscape produces spatially explicit outputs in the form of maps showing areas where different ecosystem services either show a trade-off or have synergies at landscape scale. Polyscape was applied in the Sasumua watershed in upland Kenya. The trade-offs shown explore interactions between two separate ecosystem services (flood mitigation and farm productivity). The research interest here was to explore where best to place trees in the landscape (Figure 33.2). Areas where tree planting did not interfere with agricultural production but would intercept surface runoff are shown as light green; areas where a single ecosystem service is good and another ecosystem service is neutral are shown as dark green. The areas coloured red or maroon show where there was a trade-off between agricultural production and hydrological regulation, possibly requiring incentives to promote tree planting.

Key references

Jackson B, Pagella T, Sinclair F, Orellana B, Henshaw A, Reynolds B, McIntyre N, Wheater H, Eycott A. 2013. Polyscape: a GIS mapping framework providing efficient and spatially explicit landscape-scale valuation of multiple ecosystem services. *Landscape and Urban Planning* 112:74–88.

The landscape scale is a meeting point for bottom–up local initiatives to secure and improve livelihoods from agriculture, agroforestry and forest management, and top–down concerns and incentives related to planetary boundaries to human resource use.

Sustainable development goals require a substantial change of direction from the past when economic growth was usually accompanied by environmental degradation, with the increase of atmospheric greenhouse gasses as a symptom, but also as an issue that needs to be managed as such.

In landscapes around the world, active learning takes place with experiments that involve changes in technology, farming systems, value chains, livelihoods' strategies and institutions. An overarching hypothesis that is being tested is:

> Investment in institutionalising rewards for the environmental services that are provided by multifunctional landscapes with trees is a cost-effective and fair way to reduce vulnerability of rural livelihoods to climate change and to avoid larger costs of specific 'adaptation' while enhancing carbon stocks in the landscape.

Such changes can't come overnight. A complex process of negotiations among stakeholders is usually needed. The divergence of knowledge and claims to knowledge is a major hurdle in the negotiation process.

The collection of tools—methods, approaches and computer models—presented here was shaped by over a decade of involvement in supporting such negotiations in landscapes where a lot is at stake. The tools are meant to support further learning and effectively sharing experience towards smarter landscape management.

World Agroforestry Centre
ASB Partnership for the Tropical Forest Margins
AARD
Federal Ministry for Economic Cooperation and Development
Norad
IFAD Enabling poor rural people to overcome poverty
CGIAR Research Program on Forests, Trees, and Agroforestry