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# Assessing community values to support mapping of ecosystem services in the Koshi river basin, Nepal

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ABSTRACT

Human activities and climate change are key factors impacting ecosystem functions and its goods and services, which are important to the livelihoods of mountain communities. In Nepal, community based ecosystem management has been widely adopted as a way to secure local management and empowerment, but local knowledge, perceptions and values of ecosystem change and services are often ignored, and perhaps inadequately understood, in decision-making processes at district or national level. Our objective therefore was to develop a multi-method approach to support mapping of ecosystem services and assessing their local values. Local perceptions of ecosystem use, change and values were identified using participatory mapping, key informant and focus group discussions, and an extensive household survey carried out in the upstream Koshi River basin. Results were cross-validated with scientific literature, statistics and remote sensing data. Key ecosystem services identified are water, agricultural produce, and various forest products, most of which show a declining trend. We demonstrate that the use of different methods and levels of input results in different and complementary types of insights and detail needed for balanced and informed decision-making regarding sustainable management of ESs to secure current and future livelihoods and ecosystem functioning.



## 1. Introduction

Ecosystems provide goods and services to society on many levels, which have different values for society – the most basic contribute to income, food, water and shelter (Marc et al., 2005). Ecosystem values are determined on different scales, from local scale to regional and national scale to the international and global scale, depending on their use and context (Paavola and Hubacek, 2013). Locally, ecosystems may provide resources for food, drinking and irrigation water, and firewood, while part of these resources are enjoyed and shared at the regional scale if there is a sufficient supply of these (water, agricultural produce) or even the global scale in case of some specialty items shared on the global market. Ecosystems may also provide global services such as climate regulation and biodiversity protection, or provide a cultural function such as recreation and tourism (MEA, 2005). This paper concentrates mainly on local and regional values of those ecosystem goods and services identified by local users themselves as the most important to their livelihoods.

Qualifying and quantifying ecosystem goods and services, and integrating their local value with their market-, national- and global value helps both local users and national decision makers to make balanced and sustainable management choices considering the equality principle (e.g. Crossman et al., 2013; Paavola and Hubacek, 2013). Many developing countries including Nepal regulate much of their forestry and land management via a community based approach such

*Abbreviations:* ES(s), Ecosystem service(s); HH, Household; FGD, Focus group discussion; CFUGs, Community Forest User Groups; VDCs, Village development committees

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as Community Forest User Groups (CFUGs), a system designed to open for active local participation, management, empowerment and mobilisation (Kanel and Kandel, 2004). Although this approach has improved forest management in general, the community based system provides challenges of linking community forestry with livelihood promotion, good governance, and sustainable forest management (Kanel and Kandel, 2004). Also, most of the costs of local management are borne by the CFUGs themselves and received minimal government support, while many forest users are living in poverty. While community forests are managed according to operational plans prepared by CFUGs, and CFUGs can act as self-governing entities to generate, utilise and sell forest products, plans have to be approved by the District Forest Office and management regulations have to be followed. This can limit or constrain complete self-governance of these local decision-making bodies, and community perceived values of ecosystem services (ESs) may not be streamlined into district or national level management or development plans.

ES mapping and valuation is of great importance especially for conservation purposes and for local development planning including sustainable ES dependent livelihoods (Willemen et al., 2013). These two goals however may conflict at times, and the same authors highlight the need for spatial methods to assess ES trade-offs, as well as the main challenges for conservation measures to contribute to both livelihood improvement and conservation gains. While ES maps can play a crucial role in understanding and managing the trade-offs in ecosystem service flows resulting from conservation strategies, the validation of such mapping is crucial. Many studies use secondary data to map ES or their values, and to avoid bad decision making based on oversimplified maps or lack of validated data; there is an urgent need to combine and verify data collected at different scales and from different sources (Crossman et al., 2013; Martínez-Harms and Balvanera, 2012).

The objective of this paper is to design a holistic approach for the identification of ESs and their local values and distribution, with a special interest in their relevance for livelihoods and consequences of changing conditions. We address this objective through a detailed case study using multiple ES mapping, identification and valuation approaches, combining and validating information obtained at different scales: (1) managers and local decision makers' knowledge and perceptions from key informants (CFUG members and managers at district level), (2) local knowledge and perceptions collected through focus group discussions (FGDs), participatory mapping and ecosystem status and use of calendar creation, and an extensive household (HH) survey, and (3) scientific knowledge such as satellite data and literature analysis. The use of multiple approaches allows for integration of complementary information and/or for verification of information across methods. Our method does not intend to give greater geographic detail of ESs, which can be derived from available satellite data on land cover and is also addressed by others in this special issue. Instead it aims to combine and verify data ( Crossman et al., 2013; Martínez-Harms and Balvanera, 2012) and to give greater contextual detail to support informed decision making at every level regarding ES use, management, as a basis for adaptation and mitigation plans and as potential for e.g. Payment for Ecosystem Services schemes.

## 2. Material and methods

Setting for our case study is the Jhiggu Khola watershed in the Central Region of Nepal (Fig. 1). The watershed, with population of around 63,000 and approximately 14,000 HHs (CBS Nepal, 2012), is mostly rural and its land cover is made up mainly of forest and crop-land.

The importance and local valuation of ES was analysed using a combination of different levels of input (local and management level, scientific and district statistical information and data analysis), types of information (primary and secondary data) and tools (Fig. 2). The main aim and advantage of such multilevel input is the ability to cross validate information on ES use and highlight their spatiotemporal distribution. Cross-validation of different approaches is important as it may reveal (1) differences in perception of ES use and valuation across scales, (2) misconceptions of issues both at the local or management and decision-making level, which could misinform decision-making, and (3) generalisation of multifaceted problems at the scientific level, thus identifying the complexity of problems to be dealt with.

There is great variety in use of ES typologies in the literature, with services, goods and benefits being defined differently and listed in different categories. While there may be a need for consistency and universally accepted typologies (see also discussion of this in Haines-Young and Potschin, 2009), we argue that typologies may differ per intended use in any given context. The use of ES typology per se however is considered advantageous as it points to the interdependencies between human well-being (livelihoods, development) and ecosystems (conservation and management), suggesting win–win solutions when sustainably managed, which resonate with policy makers, local users, and wider society. As this study is part of a larger project taking primarily a livelihood perspective, at each scale we document user and stakeholder defined ES and changes only. This has the advantage that we focus only on ES perceived as valuable and important at each level, but the disadvantage of missing out on services that are not directly obvious or of direct local importance.

Key informant discussions with district level authorities, using open ended questions, formed the basis of the locally perceived state and importance of ESs, and the degree of incorporation of community knowledge and perceived values in local development planning. The study included 7 key informants; the local development officer, presently acting as chief of the district government, the district soil conservation-, agriculture- and forest- officers, a former member of parliament, and a former village chairperson. FGDs followed the same set-up, with open ended questions regarding ES use, perceived status and importance and related issues in the local context, using participatory mapping techniques to guide these discussions. Open ended questions were tailored to the stakeholders, and did for example not directly ask for “which ecosystem services do you identify and use?” but rather “what things in nature and the land around are important for you, for example for your livelihood, economy, health, or quality of life, and why?”

Many recent studies show the potential use of participatory mapping techniques for ES assessment (e.g. Raymond et al., 2009; Klain and Chan, 2012; Brown, 2013; Baral et al., 2014). Participatory mapping however is not geographically correct, and this technique was used primarily to provide context for discussion and visualise linkages between upstream and downstream locations and drivers of change. In the current case, detailed maps of forest and land-use areas already exist, and e.g. can indicate the detailed location of a forest, but the crux is that this forest does not necessarily provide all ES. Participatory mapping thus ensures that existing maps are cross-checked for their factual local ES function, and these participatory exercises also included the creation of calendars mapping the annual variations in availability and use of specific ESs, climate variables, and variations in HH size to cover the temporal aspects of variations. Finally, participatory mapping also played a role in including all FGD participants in the discussion, ensuring that the results reflect the perceptions of many and not of one spokesman only. Local perceptions were further quantified through a survey in 600 HH, covering the watershed's 13 village development committees (VDCs) and its one municipality. The survey, developed in a multidisciplinary team, covered questions regarding HH, income sources, the importance of ES for livelihoods, their perceived change, drivers and management, in order to capture not only ES values but also their context. Covering 600 households across the watershed ensures representativeness of

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