



Enhancing feasibility: Incorporating a socio-ecological systems framework into restoration planning



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ABSTRACT

Forest restoration is the counterforce to deforestation. In many parts of the world it mitigates forest loss and degradation, but success rates vary. Socio-political variables are important predictors of effectiveness of restoration activities, indicating that restoration strategies need to be locally adapted. Yet, contextual assessments of the biophysical, social and political characteristics of forest restoration are rare. Here, we integrate a social-ecological systems framework with systematic decision-making to inform forest restoration planning. We illustrate this approach through a prioritization analysis in a community-based forest restoration context in Paser District, East Kalimantan, Indonesia. We compare the solutions of our integrated framework with those identified on the basis of biophysical criteria alone. We discover that incorporating a socio-political context alters the selection of priority areas. While the social feasibility and political permissibility can be enhanced, ecological benefits are likely to be reduced and/or opportunity costs of alternative land uses are to be increased. Our conceptual framework allows the appraisal of potential trade-offs between social and ecological outcomes of alternative options, and has the potential to evaluate the efficiency of existing policies. Empirical testing in a range of contexts is required to ensure broad applicability and transferability of our conceptual framework.

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1. Introduction

Tropical deforestation has been the primary contributor to forest loss globally over the last decade (Hansen et al., 2013). An estimated 500–600 million hectares (or 30–40%) of tropical forest is considered to be in a degraded state (Blaser et al., 2011). In South East Asia, primary forest represents a small proportion of total forest cover, with most forests having experienced some form of logging or extraction (Sodhi et al., 2009). As such, the goods and services provided by forests, such as timber and non-timber forest products, habitat for biodiversity and water regulation, have deteriorated, often with severe consequences for forest-dependent communities (Lamb et al., 2005; Wells et al., 2013; Abram et al.,

2014). Forest restoration to mitigate forest loss and/or degradation has had variable success, with performance strongly moderated by country-specific socio-ecological and political contexts (Lamb et al., 2005; Lamb, 2010; FAO, 2011; Meyfroidt and Lambin, 2011).

When implementing forest restoration, either through afforestation or reforestation, context is especially important in countries such as Indonesia that are ecologically and socio-culturally heterogeneous (Fearon, 2003; Nagendra, 2007; Lamb, 2010; Ostrom and Cox, 2010). For example, the Government of Indonesia has implemented a variety of forest restoration programmes since the 1950s, mainly using a top-down approach (Murniati et al., 2007). While most restoration programmes are considered unsuccessful (Murniati et al., 2007), remarkable success has been achieved in central Java through reforestation using teak (*Tectona grandis*) on severely degraded lands on drought-prone limestone soils (Nawir et al., 2007b). This achievement is largely due to familiarity with teak planting (with the practice dating back to the 1800s), highly motivated communities seeking to enhance the

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provision of water, and compatibility of the programme with the capacity of local communities (e.g. the communities have other sources of income while the planted trees reach a harvestable size). Conversely, a lack of fit toward prescribed species (including teak) with local experiences and resource needs contributes to limited success of reforestation programmes in other regions such as in Sumatra and Kalimantan (Indonesian Borneo), along with other factors including unclear tenure and complicated funding mechanisms (Nawir et al., 2007a).

The methods available for planning restoration activities are increasingly sophisticated, accounting for both spatial and temporal heterogeneity (e.g. Birch et al., 2010; Budiharta et al., 2014). Most of restoration design studies have focused on ecological criteria with few analyses incorporating social elements (e.g. Orsi and Geneletti, 2010; Jellinek et al., 2014). Furthermore, spatial heterogeneity in the social context of where restoration will be undertaken has not been captured. Instead, the social or political feasibility of restoration is assumed to be homogenous across large geographic extents, even including entire nations or continents, ignoring the local context of the planning region (e.g. Egoh et al., 2014; Carwardine et al., 2015). While contextual assessments that account for both the socio-political and ecological characteristics of a region are becomingly available in the environmental management literature (e.g. Basurto et al., 2013 in fisheries; Baur, 2013 in pasture; Cox, 2014 in irrigation systems), similar analyses for planning forest restoration activities are lacking.

The social-ecological systems (SES) framework proposed by Elinor Ostrom (Ostrom, 2009; Ostrom and Cox, 2010) has potential utility for diagnosing the local nuances of natural resource management and informing restoration projects. In this framework, the motivations for restoration are seen as being locally

unique, analogous to the unique symptoms associated with a patient in medical practice. While individuals may exhibit similar symptoms, the treatments prescribed by a medical practitioner vary depending on the individual physiological attributes of the patient, such as age and blood pressure. Similarly, restoration activities are more likely to be effective if the planning process is based on a diagnostic style of investigation. This approach would seek to characterise the socio-political and ecological context and provide insight into the opportunities and constraints that could influence the effectiveness of restoration activities.

Here we develop an analytical framework for operationalising a contextual and systematic approach to restoration planning that employs Ostrom's SES framework in conjunction with methods for systematic decision-making (Fig. 1). This approach enables priority areas for restoration to be identified by integrating information on ecological suitability, social feasibility and political permissibility. We illustrate our analytical framework into developing forest restoration plan in Paser District in the province of East Kalimantan, Indonesia, where a recently developed community forestry programme aims to achieve both ecological recovery and improved livelihoods provision through increased benefits from forests (Sardjono et al., 2013).

2. Methods

2.1. Case study

Paser District has a total extent of 1.16 million hectares (Fig. 2; Paser Statistics Service, 2014a). In 2013, approximately 256,000 people inhabited 144 villages within 10 sub-districts (Paser Statistics Service, 2014a). The population is represented by numerous ethnic groups including Paser indigenous people (Dayak

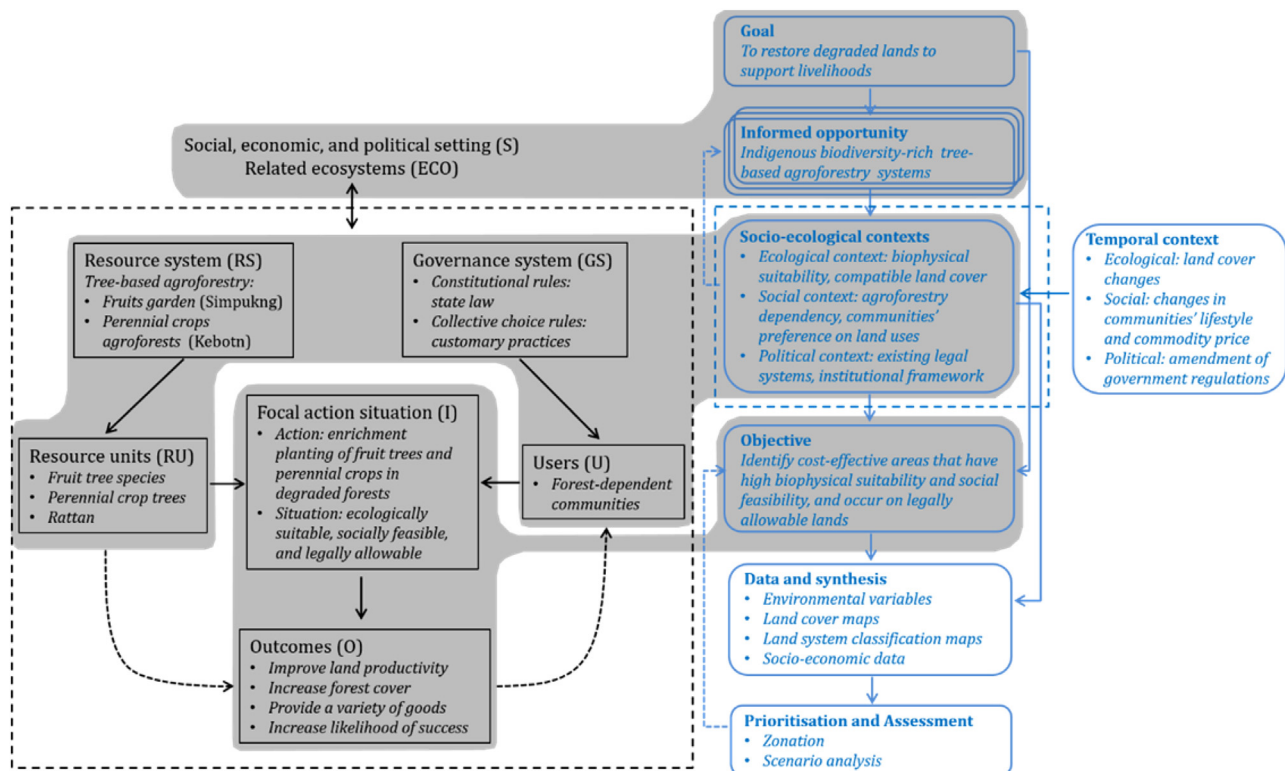


Fig. 1. Analytical framework for operationalising social-ecological systems concepts in restoration planning. Italic text illustrates applications to the contextual setting in the case study area (Paser District, East Kalimantan) in relation to a specific goal. Black boxes depict the social-ecological systems framework adapted from Ostrom (2009) including direct links (solid arrows) and feedbacks (dashed arrows). Blue boxes depict steps in systematic decision-making, adapted from Gregory et al. (2012) and Ban et al. (2013). Grey shading shows the links between elements of the two frameworks.

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