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Current Opinion in Environmental Sustainability

# Forest landscape restoration for livelihoods and well-being

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The scope and current investment for forest landscape restoration (FLR) is great, as are the demands put upon it for improving livelihoods and well-being. International leaders have pledged 350 Mha for FLR as part of international sustainability agendas. FLR is implemented primarily through incentives and institutions, with an emphasis on the role of active planting and land tenure reforms. Despite recent attention and a growing literature that assesses the contributions of FLR and related projects to livelihood and well-being, there is a dearth of evidence linking FLR to social, economic, or political outcomes. We present a simple framework to understand environmental and social effects of FLR interventions and we review the evidence linking FLR to livelihood and well-being outcomes. We suggest that to enhance benefits to local populations from FLR, it is necessary to better integrate socioeconomic and political data into FLR planning and implementation, to increase the role of informational implementation, and to develop monitoring and evaluation protocols to assess direct and indirect environmental and social impacts from FLR projects.

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**Current Opinion in Environmental Sustainability** 2018, **32**:xx–yy

This review comes from a themed issue on **Environmental change issues**

Edited by **Arun Agrawal**, **Chuan Liao**, **Cristy Watkins**, **Laura Vang Rasmussen** and **Reem Hajjar**

Received: 27 November 2017; Accepted: 09 May 2018

https://doi.org/10.1016/j.cosust.2018.05.007



## Introduction

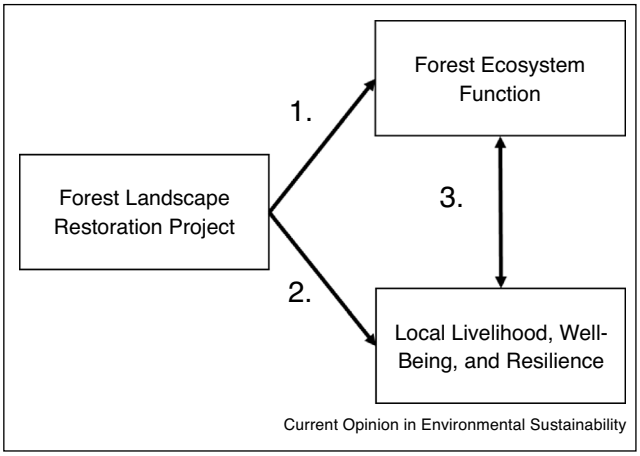
Global forests are under immense pressure from a suite of human activities, such as agricultural expansion and natural resource exploitation, in addition to global environmental change. Large-scale forest restoration is essential to ensure the continued flow of vital, forest-related
ecosystem services, including carbon sequestration, biodiversity conservation, and livelihood contributions [1,2]. Through the Bonn Challenge, international leaders have emphasized the importance of forest landscape restoration (FLR) by pledging to restore forests on 350 Mha of land using an integrated 'landscape approach' to environmental management [3•].

The landscape approach is an emerging concept that integrates social and environmental objectives across land-use sectors and scales of governance [4,5,6•]. Although implementation of, and research on, the landscape approach is nascent [7,8], numerous national and international stakeholders are rapidly incorporating it into processes that determine how natural resources are managed. The landscape approach relies on a combination of multi-stakeholder governance and iterative cycles of monitoring, evaluation, and implementation of social and environmental initiatives and interventions. As a landscape approach to forest restoration, FLR combines adaptive management and multi-stakeholder governance to unite forest restoration and regeneration with improvements in local livelihoods, well-being, and climate change resilience (LLWR) [5,9,10•]. In this review, we use a basic framework to understand how different approaches to FLR can influence social and environmental outcomes. We then present how forest restoration and LLWR are measured and consider the evidence linking FLR to livelihoods and well-being. Finally, we advance several strategies to help improve LLWR outcomes through FLR.

## Linking forest landscape restoration to environmental and social outcomes

FLR projects aim to restore forest ecosystem function and contribute to LLWR, but they differ in their specific objectives, methods, or causal pathways of influence and impact [11•]. Under a first pathway, FLR projects are mainly designed or targeted to influence forest outcomes (Pathway 1, Figure 1), with LLWR outcomes considered as a secondary aim or knock-on effect (Pathway 1–3, Figure 1). Common forest restoration objectives include the rehabilitation of ecological function in degraded forests; reconstruction of forest systems on land previously used for different purposes (e.g. agriculture); and reclamation of severely degraded land that has experienced significant soil erosion and may be devoid of

**Figure 1**




Pathways linking forest landscape restoration (FLR) to forest and local livelihood, well-being, and resilience (LLWR) outcomes. Through pathway 1 → 3, FLR projects/interventions influence forest outcomes, with LLWR as an indirect outcome. Through pathway 2 → 3, FLR projects/interventions directly influence LLWR outcomes, indirectly affecting forest ecosystem function.

vegetation [1,12•]. These objectives are pursued through specific methods for planting, removal, and site preparation activities (Table 1). These methods are generally implemented by public (governments or NGOs) or private entities (landowners) that receive incentives or enforce institutions to promote forest ecosystem function. The 'success' of these activities in relationship to a specific forest restoration goal is often measured through one or many indicators (Table 2).

Under a second pathway, FLR projects are directly designed and predominantly targeted towards LLWR outcomes (Pathway 2, Figure 1), with forest outcomes occurring as a downstream effect (Pathway 2–3, Figure 1). Methods and benefit mechanisms linked to improved LLWR outcomes within the context of FLR often rely on the creation of incentive mechanisms, capacity building, and institutional development (Table 1). These methods include direct payments, market-based incentives, increased and diversified employment opportunities, and devolution of natural resource management and land rights [13,14]. Many studies identify improved LLWR as a contributor to reduced pressure on forest resources as well as forest-cover change; the growing payment for ecosystem services literature investigates the conditions, context, and value of trading capital for afforestation, reforestation, and reduced deforestation [15–17]. Indirect benefits are often the focus of continued monitoring and evaluation (Table 2), rather than the ongoing or longitudinal impact of direct benefits. These indirect benefits include forest-related regulating, supporting, and provisioning services that 'pay-off' over longer time scales [18,19].

## Measuring forest landscape restoration environmental and social outcomes

To measure progress toward environmental and social objectives, FLR projects require specific metrics and baselines. Recent scholarship re-emphasizes the benefit of structural complexity as an indicator for monitoring and evaluating forest ecosystem function [20•]. This is in contrast to other commonly used measures, including remotely sensed land-cover data that categorizes land-cover into 'forested' versus 'non-forested' areas [21,22]. Although

**Table 1**

**Direct and indirect methods for improving forest ecosystem function and livelihood, well-being, and resilience through FLR (adapted from [12•,77•])**

| Pathway 1<br>Direct forest mechanisms | Pathway 2<br>Direct livelihood, well-being, and resilience mechanisms | Pathway 3<br>Indirect impacts |
|---|---|---|
| **Planting**<br>• Inter-planting, enrichment planting, agroforestry, taungya<br>• Plantation/mono-cropping<br>• Native regeneration/recolonization | **Livelihood**<br>• Direct cash/non-cash transfers<br>• Local marketing/business development<br>• Tenure security/clarification | **Improved livelihood, well-being, and resilience**<br>• Sustainable/reduced forest use<br>• Enhanced regulation of forest use<br>• Formal/informal planting, site preparation, other management techniques |
| **Removal**<br>• Removal of unwanted species<br>• Partial canopy removal<br>• Selective removal<br>• Fuel reduction | **Well-being**<br>• Local participation in land management<br>• Educational/training opportunities<br>• Infrastructure investment<br>• Conflict resolution/mediation<br>• Clarification of stakeholder rights and responsibilities | **Improved forest ecosystem function**<br>• Improved tree species richness<br>• Presence of desired tree floral and faunal species<br>• Improved soil stability, fertility, organic matter<br>• Reduced soil erosion or flammable materials<br>• Improved surface water, groundwater, water quality<br>• Enhanced biomass productivity, carbon sequestration |
| **Site preparation**<br>• Mulching, fertilizing, burning<br>• Flooding/draining/connecting hydrological networks<br>• Building barriers | **Resilience**<br>• Employment alternatives<br>• Adaptive management planning | |

**Table 2**

**Indicators for improved forest ecosystem function and livelihood, well-being, and resilience resulting from FLR (adapted from [77•])**

| Forest ecosystem function | Livelihood, well-being, and resilience |
|---|---|
| **Forest growth** | **Household level** |
| • Tree growth performance and survival rate | • Increased and more diverse income, consumption, asset holdings |
| • Stand density | • Improved health and nutrition |
| • Area intact or maintained | • Increased education attainment, attendance, or opportunities |
| • Ecosystem services provision | • Higher rates of self-reported satisfaction |
| **Vegetation cover** | **Community livelihood, well-being, and resilience** |
| • Canopy cover/height/ structural complexity | • Increased and more diverse local employment opportunities |
| • Ground/litter/shrub cover | • Local empowerment, improved institutions for local governance, transparency, accountability |
| | • Stable prices for local goods |
| | • Wider diversity and greater availability of goods for purchase (food, fiber, etc.) |
| | • Improved infrastructure (roads, hospitals, schools) |
| **Species diversity** | |
| • Improved (tree) species richness | |
| • Presence of desired species | |
| **Ecosystem functions** | |
| • Improved soil stability, fertility, organic matter | |
| • Reduced soil erosion | |
| • Improved surface water, groundwater, water quality | |
| • Enhanced biomass productivity, carbon sequestration | |
| • Reduced landslides, wildfires, flooding, crop disease, invasive species | |

dichotomous tree-cover indicators can complement other techniques that account for structural complexity, they are neither necessary nor sufficient for assessing forest restoration [20•,23]. Further, assessing forest restoration necessitates a baseline against which later ecological indicators are measured [24,25]. Thus, although specific indicators of forest restoration may vary across projects and landscapes, they are ultimately concerned with a measurement of increased structural complexity measured against a particular moment in time.

The sustainable livelihoods framework [26–28] provides a method for conceptualizing socioeconomic and political outcomes by combining human, financial, social, material and natural assets. Contemporary work on multidimensional poverty operationalizes this livelihood framework by combining indicators common across nationally representative surveys to provide information on health, education, and assets to generate widely applicable indicators that enable longitudinal comparisons across regions and countries [29,30•]. Assessing LLWR through a focus on common indicators that represent the sustainable livelihoods framework can provide a series of useful metrics. Income, economic consumption, and assets can be considered as livelihood indicators; health and education as well-being indicators; and income diversity as well as the availability of natural, social and human assets as indicators of resilience. Although these metrics are not exhaustive, they provide a strong base from which to understand, assess, and compare LLWR outcomes across projects and regions.

It is important to distinguish the measurement and assessment of FLR outcomes from establishing project or intervention 'success.' Assessing stated project/intervention objectives in reference to carefully measured outcomes can determine the effectiveness of FLR. However, a growing body of literature advocates for the inclusion of efficiency and equity as measures of project or intervention success [31–33]. In this vein, a collection of studies extend the direct evidence of FLR impact, aggregated from specific indicators, to understand how FLR effects broader social change, including inter-household equity, policy, and social as well as environmental justice [33–36]. Regardless of how project/intervention success is defined, the longitudinal measurement of ecological or LLWR indicators is a crucial, though perhaps initial, step in gathering evidence of FLR outcomes.

## Evidence of forest landscape restoration outcomes for local livelihood, well-being, and resilience

The impact of FLR projects on LLWR remains largely theoretical with limited rigorous analysis of socioeconomic and political outcomes [6•,14,37•]. However, recent research indicates that decentralized FLR projects promote local empowerment; that income benefits from FLR occur through context-specific pathways; and that FLR outcomes are linked to human migration patterns, which are reconfiguring rural spaces [38].

Decentralization leading to LLWR benefits from FLR often occurs through one of two mechanisms. FLR projects can decentralize and/or privatize state land, providing land rights to communities and/or individuals [39–42] or, they can provide support to local communities/individuals to restore and manage forest areas [34,43–45].

Although there is mounting evidence that these processes can empower local populations and contribute to positive LLWR outcomes [46], little research addresses temporal variation in outcomes during and after institutional transitions, or how different institutional precedents combine with decentralization from FLR projects to influence LLWR.

FLR impacts generate LLWR outcomes through pathways that are determined by a variety of contextual factors. FLR projects can increase income/consumption within households and communities through direct payments [47,48]. They can also indirectly increase participation in off-farm income generating activities [35] and alter agricultural activities [34,49]. Direct payments provide a clear example of incentive-based implementation of forest restoration, and payments are part of many large-scale forest restoration programs. However, some evidence suggests that assistance from direct payments is often marginal, with little effect on poverty outcomes [16,50•], and can generate unforeseen or perverse consequences for conservation [51]. Indirect benefits from FLR projects, such as increased opportunity to pursue off-farm jobs and altered agricultural livelihoods, are highly contingent upon available opportunities and market prices. In areas with many off-farm opportunities for employment and income, off-farm income contributes significantly to livelihood benefits, and is often associated with increased out-migration [35,52,53•].

Migration, FLR, and LLWR are interrelated but poorly understood [54]. Although out-migration can contribute to forest restoration by changing household forest-dependence and agricultural production strategies, migration-driven effects appear to be dependent on agricultural production systems [55–57]. Furthermore, migration may also reduce community-level resilience through population decline, labor force reduction, and the erosion of local institutions [58,59]. Exploring the link between FLR and migration will remain important to assessing impacts from FLR on LLWR.

Shortcomings of the trends identified here include a lack of focus on FLR failures (or socio-ecological tradeoffs) and a geographical bias. FLR failures refer to declines in LLWR from project implementation and/or negative environmental impacts from forest restoration. Several studies provide evidence of negative outcomes from FLR programs, including heightened insecurity of employment; the loss of use, control, and/or authoritative land rights; reduced income and consumption; violence; and illegal logging [60–64]. However, such studies remain uncommon. Understanding FLR failures through causal identification is crucial to understand the full range of FLR outcomes and improve implementation. Additionally, there is a strong and growing literature on FLR and livelihood research in East Asia, specifically China [14,18,33,39,48,55,58,64–66]. Although these studies contribute valuable information for understanding the role of large-scale FLR and LLWR, it is unclear if their findings are robust across geographical contexts.

## Enhancing the effectiveness of forest landscape restoration

As a landscape approach to forest restoration, FLR enshrines the value of continuous monitoring, evaluation, and adaptation [67]. To enhance the effectiveness of FLR, practitioners and researchers might identify landscapes for FLR using multiple sources and time points of socioeconomic and political data, expand the role of information for catalyzing FLR, and conduct more rigorous impact analysis with a focus on causal inference using counterfactuals.

Combining local engagement with spatio-temporal socioeconomic and political data when identifying FLR project sites and methods could enhance LLWR outcomes, reduce costs, and guard against dis-services. Methods to identify degraded and deforested landscapes using high spatial resolution land-cover and ecological data have improved the ability to select suitable sites for restoration [68–71]. However, these data-driven planning efforts often ignore socioeconomic and political contexts [72•,73,74]. Socioeconomic contexts which influence LLWR outcomes can include forest dependence, employment opportunities, and preferred incentive and distribution mechanisms; political contexts include local land rights and tenure, policy enforcement and regulation, administrational and bureaucratic structures, and inter/intra-jurisdictional differences, among others [14,32,36,75,76,77•,78,79]. Some conservation organizations have made substantial advances in formalizing processes for including local engagement (i.e. local expertise and community engagement) and using spatially explicit socioeconomic data in FLR planning [80]. However, even these advances rarely account for spatial and temporal trends of indicators that are demonstrated to affect FLR outcomes. Such indicators include population density and migration [81,82], access and infrastructure [83,84], resource-use histories [85,86], cultural values and perceptions of justice [33], as well as intergovernmental cooperation and oversight [61,87,88]. Incorporating information on socioeconomic and political trends into FLR planning and implementation can better position projects to deliver their objectives.

The role of information dissemination in providing FLR must be expanded and studied more comprehensively. Implementation and research focused on incentives and institutions that promote FLR dominate current literature. Exploring informational dissemination of FLR can pertain to analyzing and communicating where and why forest restoration occurs, including active methods as well as passive regeneration, and its impact on LLWR [89], as

well as using education and training opportunities to promote forest restoration [52]. As a mechanism for forest governance, FLR may uniquely benefit from informational implementation, given the promise natural regeneration holds for restoring large tracts of deforested and degraded lands [90,91]. Providing information to scientific, donor, and local communities on where and why natural regeneration is occurring, and potentially coupling active LLWR benefits in these areas, can increase FLR visibility and provide low-cost project options.

If FLR projects are going to deliver the LLWR outcomes they are charged with providing, it will remain essential to monitor households and communities before, during, and after project implementation. Through direct provision of LLWR resources, including cash and non-cash payments, educational opportunities, infrastructural enhancements, and other methods of rural development, FLR programs can provide shorter-term benefits to local communities in advance of indirect benefits from improved ecosystem function. Understanding the distinction between direct and indirect benefits can facilitate more efficient project planning and enable the identification of specific causal mechanisms and pathways [11•,53•,66]. Assessing direct and indirect outcomes from FLR projects will require rigorous causal analysis that relies on counterfactual assessment. Few studies perform such assessments. Greater efforts are needed to coordinate information on how forest restoration, livelihood, well-being, and resilience to climate change can best proceed together.

## Conclusion

FLR is an emerging concept that employs existing methods to generate environmental and social benefits [9]. It often proceeds through planting, removal, and site preparation aimed at improving forest ecosystem function. To directly promote LLWR, FLR relies upon employment, payments, tenure decentralization, and institutional development. Indirect benefits between improved forest ecosystem function and LLWR accrue over longer timescales, and should play an equally significant role in evaluating FLR outcomes.

Evidence for the outcomes of FLR on LLWR remains limited, but a growing body of research is contributing to understanding how FLR programs are planned, implemented, and evaluated, and with what outcomes for forests and local populations. This research indicates that decentralization via FLR tends to empower local communities and provide LLWR benefits, livelihood improvements from FLR programs are largely dependent on context, and the relationship between migration, FLR, and LLWR is fundamentally important but requires further analysis. Extending future research to understand when FLR improves the structural diversity of forests or LLWR across geographical contexts remains important.

Continued monitoring, evaluation, and readjustment are integral to the FLR approach. Incorporating multiple types of socioeconomic and political data into planning stages, increasing the role of informational FLR, and pursuing rigorous counterfactual analysis of direct and indirect FLR outcomes for local populations hold potential for enhancing FLR. Although it has gained significant attention and international funding, it remains to be seen whether FLR can provide the ecological, socioeconomic, and political improvements to which it aspires.

## Acknowledgements

The authors would like to thanks colleagues from the Forest and Livelihoods: Assessment, Research, and Evaluation (FLARE) research community, the International Forestry Resources and Institutions (IFRI) research group, and the National Socio-Environmental Synthesis Center (SESYNC) conference on 'Social Dimensions of Reforestation Pathways in the Tropics' for their valuable support and insights. In addition, the authors thank C Liao, R Hajjar, and S Wilson for reviewing earlier versions of this text. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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