



## Levers for alleviating poverty in forests

Reem Hajjar<sup>a,\*</sup>, Peter Newton<sup>b,\*</sup>, Markus Ihalainen<sup>c</sup>, Arun Agrawal<sup>d</sup>, Jennifer Alix-Garcia<sup>e</sup>, Sarah E. Castle<sup>f</sup>, James T. Erbaugh<sup>g</sup>, Monica Gabay<sup>h</sup>, Karl Hughes<sup>i</sup>, Samuel Mawutor<sup>a</sup>, Pablo Pacheco<sup>j</sup>, George Schoneveld<sup>i</sup>, Joleen A. Timko<sup>k</sup>

<sup>a</sup> Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR 97331, USA

<sup>b</sup> Environmental Studies Program, University of Colorado Boulder, Boulder, CO 80303, USA

<sup>c</sup> Center for International Forestry Research (CIFOR)-World Agroforestry (ICRAF), Bogor 16115, Indonesia

<sup>d</sup> School for Environment and Sustainability and Ford School of Public Policy, University of Michigan, Ann Arbor, MI 48109, USA

<sup>e</sup> Department of Applied Economics, Oregon State University, Corvallis, OR 97331, USA

<sup>f</sup> Department of Natural Resources and Environmental Sciences, University of Illinois Urbana-Champaign, Urbana, IL 61801, USA

<sup>g</sup> Department of Environmental Studies, Dartmouth College, Hanover, NH 03755, USA

<sup>h</sup> Instituto de Investigación e Ingeniería Ambiental, Universidad Nacional de San Martín, Argentina

<sup>i</sup> Center for International Forestry Research (CIFOR)-World Agroforestry (ICRAF), Nairobi, Kenya

<sup>j</sup> World Wildlife Fund (WWF), Washington, DC, USA

<sup>k</sup> Hatfield Consultants, Vancouver, BC, Canada

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### ABSTRACT

An extensive set of policies, programmes, technologies and strategies have been implemented in the forest sector. Collectively, these 'levers' cover a diverse range of approaches, at a variety of scales and are governed by many different stakeholders. It is important for decision-makers to understand which levers might be most useful in achieving poverty alleviation. This paper seeks to answer the question: which forest management policies, programmes, technologies and strategies have been effective at alleviating poverty? We studied 21 different rights-based, regulatory, market and supply chain, and forest and tree management levers for which we could identify a plausible theory of change of how implementation of that lever might alleviate poverty. For every lever we: define and describe the lever; describe the logic or theory of change by which the lever might plausibly be expected to alleviate poverty; summarize the available evidence showing how the lever has alleviated poverty; and discuss the variables that explain heterogeneity in outcomes. Overall, we found limited evidence of these levers being associated with reducing poverty (i.e. moving people out of poverty). Some of the strongest evidence for poverty reduction came from ecotourism, community forest management, agroforestry and, to a lesser extent, payments for ecosystem services (PES). However, we found substantial, varied and context-dependent evidence of several levers being associated with mitigating poverty (i.e. by improving well-being). A multitude of cases showing positive outcomes for poverty mitigation came from community forest management, forest producer organisations, small and medium forest enterprises, PES, and tree crop contract production. A combination of more rigorous and long-term research designs, along with examinations of the cost-effectiveness of different levers, would go a long way to contributing to the design of effective interventions for poverty alleviation.

### 1. Introduction

A diverse array of policies, programmes, technologies and strategies have been implemented in the forest sector. These 'levers' (from hereon) include regulatory or institutional interventions (e.g., protected areas, log export bans) and voluntary strategies based on incentives (e.g.,

payments for ecosystem services programs, certification programs) (Agrawal et al., 2018). These levers have been implemented at a variety of scales, from local reforms in tenure rights to national policies to internationally recognized certification programs. These levers affect different individuals and groups, including indigenous, traditional, and other forest-dependent people (Byron and Arnold, 1999). And these

\* Corresponding authors.

E-mail addresses: [reem.hajjar@oregonstate.edu](mailto:reem.hajjar@oregonstate.edu) (R. Hajjar), [peter.newton@colorado.edu](mailto:peter.newton@colorado.edu) (P. Newton).

<sup>1</sup> co-lead authors; shared the work equally.

levers are governed by many different stakeholders, including governments, donors, international organisations, companies and communities.

Many forest-sector levers are primarily concerned with forest conservation, management, or restoration, and aim foremost to reduce deforestation, conserve biodiversity or reduce greenhouse gas emissions. However, many forest-sector levers also aim to improve human well-being or to reduce poverty, as a primary or secondary goal. That is, many levers have explicitly stated aims to protect or improve rural livelihoods, and/or include social safeguards to ensure that indigenous and traditional forest-dependent people are not harmed by forest conservation or management interventions.

Considerable research has explored the impacts of individual forest-sector levers on rural livelihoods, using case studies, comparative methods, and quasi-experimental work. More recently, several systematic reviews have generated syntheses of evidence on the effectiveness of individual levers at a global scale. For example, one systematic review examined the global outcomes of community forest outcomes on forests, incomes, and resource rights (Hajjar et al., 2021). Another synthesized the literature on land tenure intervention impacts on well-being and the environment (Tseng et al., 2020), although this study did not focus exclusively on forest lands. A third review characterized the impacts of agroforestry interventions on social and environmental outcomes (Castle et al., 2021). Finally, the effects of payments for environmental services on poverty have also been reviewed (Samii et al., 2014).

However, there has been little synthesis of this research across interventions in relation to poverty. As such, several knowledge gaps remain. First, it is unclear how much research identifies poverty as an outcome of interest, rather than broader or more general metrics of livelihoods or wellbeing. Second, there is a relatively limited understanding of the strength and rigor of the aggregate evidence for whether an individual lever has reliably or consistently alleviated poverty. Third, the absence of evidence synthesis means that there is little understanding of which levers are most effective at alleviating poverty, relative to each other.

To address these knowledge gaps, we conducted a review of the literature to address the research questions: Which forest management policies, programmes, technologies and strategies have been effective at alleviating poverty? How? And, to what extent?

## 2. Methods

We identified forest-sector levers that could plausibly alleviate poverty, and evaluated the strength of available evidence for the effect that each lever has had on reducing poverty (moving people above a certain threshold of income or consumption) and mitigating poverty (lessening deprivation or disadvantage such that well-being is improved). That is, we focus on two roles that forests and tree-based landscapes play in poverty alleviation as identified in Jagger et al. (2021): 1) moving people out of poverty and 2) supporting people's well-being. We identified 21 levers and reviewed them individually.

To identify the key levers, firstly four authors brainstormed the full range of possible levers. All other members of the Global Forest Expert Panel on Forests and Poverty (Miller et al., 2020a) subsequently reviewed the list to suggest any additional levers that were missed during the first step. No new levers emerged, for a final list of 21 levers. While this provides some confidence in the robustness of the initial list, we cannot be certain that some relevant levers did not escape our initial search and scan.

We selected levers for assessment and analysis if they met two criteria. First, the lever had to be clearly related to forests and/or trees within a wider landscape: that is, they had to specifically address the management, use, conservation or restoration of forests or trees. Levers that were principally related to the agricultural sector or to other landscapes were not considered, even if they in principle could affect the poverty of people living in or around forests. For example, certification

programmes that target agricultural products, or welfare programs targeting rural areas, may affect people living in and around forests, but were not included. Second, the lever had to have some plausible expectation of alleviating poverty, even when alleviating poverty was not its primary purpose. This was interpreted broadly and included any lever with an identifiable theory of change supporting the provision of one or more socio-economic benefits from forest products and services. For example, protected areas are often used as an intervention primarily to conserve forests; however, it is plausible that communities living around the protected areas might benefit from increased ecotourism or ecosystem services related to the protected area.

We categorized the 21 levers into four main categories: 1) rights-based levers; 2) other regulatory levers; 3) market and supply chain levers; and 4) forest and tree management levers (Table 1). Rights-based levers, levers that focus on clarifying and enhancing forest-related rights, tend to be developed and implemented by local, sub-national or national governments, with their implementation often supported by civil society actors. Included in our list of rights-based levers are: tenure reform; community forest management; concessions; and protected areas. Although rights-based interventions are a form of regulatory lever, we also review other regulatory levers that are principally oriented around laws, policies and regulations that determine how forests and trees are managed, used, conserved and/or restored. Regulatory levers tend to be developed and implemented by local, sub-national or national governments. We reviewed: decriminalisation and formalisation of informal operations; modification or simplification of regulatory frameworks; log export bans; and procurement policies. For market and supply chain levers, we reviewed levers that are based on market mechanisms and whose success depends, at least in part, on commodification or commercialisation of trees, forest products or forest ecosystem services. Market and supply chain levers may be developed and implemented by governments, private sector bodies, or NGOs. Participation in such levers is generally voluntary. We reviewed: payments for ecosystem services; REDD+; ecotourism; small and medium forest enterprises; market access; forest producer organisations; company-community partnerships; contract production; certification; zero deforestation commitments; and boycotts. Lastly, we reviewed agroforestry and forest restoration, reforestation, and afforestation as levers having directly to do with forest and tree management.

For every lever we: defined and described the lever; described the logic or theory of change by which the lever might plausibly be expected to alleviate poverty; summarised the available evidence showing how the lever has alleviated poverty (e.g. by increasing income, assets or well-being) and, where available, the magnitude of those changes; and discuss the variables that explain heterogeneity in outcomes. This information is summarised in Table 1 for all levers, and presented in detail in Hajjar et al., 2020.

There are some important caveats to note. First, drawing lines between different interventions was sometimes partially arbitrary. There is considerable overlap between some of the levers. For example, REDD+ can be conceived as a particular type of payment for ecosystem services (PES) programme, community forest management (CFM) can emerge through tenure reform, and small and medium forest enterprises (SMFEs) can include ecotourism. As such, separating the literature and consequently the effects of these levers on poverty into discrete categories is somewhat interpretative. It seems at least conceivable that two or more of these levers in tandem could have greater impacts on poverty than any one of them alone. We did not explore such multiplicative interactions, except to the degree that any of the literature did so by virtue of the cases or sites that they studied.

Second, many of the reviewed levers were implemented based on multiple objectives and a win-win logic: improving both conservation and well-being outcomes. In this review, we have not taken into consideration poverty outcomes in relation to other potential programmatic or policy objectives. Thus, while the levers presented may not have been the most impactful or cost-effective from a poverty

**Table 1**  
Forest-sector levers that may alleviate poverty.

Lever	Theory of change	Summary of the evidence: quantity and type of studies	Summary of the evidence: conclusions
<b>Rights-based levers</b>			
Tenure reform	Secure access to land and forest resources is often seen as a first step for forest-reliant poor to be able to reliably benefit, monetarily and non-monetarily, from forests.	Mostly case studies and some quasi-experimental studies. Much more evidence for land tenure reform in agricultural settings, but a fair amount also on forest property rights. Very limited assessments of tree tenure reform on poverty.	A systematic review of forest property reforms found generally positive or mixed impacts on income consumption and capital, and that devolution of more limited rights were less likely to alleviate poverty than the devolution of more extensive rights. Effectiveness of tenure reform in impacting poverty is enhanced by the presence of a number of enabling conditions and additional intervention levers discussed in this paper. Social differentiation in tenure reform impacts is substantial.
Community forest management interventions	In recognizing the rights of local user groups to common forest resources, it is expected that the users will benefit directly and indirectly from forest products and services for subsistence and commercial purposes.	There are few reliable national level assessments of the contributions of community forests to poverty alleviation. But there is a wealth of both case literature and reviews of research on community forestry. A predominant focus on South Asian cases, qualitative analyses, and data and analytical gaps prevent generalisable conclusions about observed socio-economic and environmental outcomes of community forest management.	Much case study evidence points to clear material benefits from CFM for the poor, but its potential has not been realised in most countries. Rigorous national-level analyses have shown that CFM has reduced poverty or provided economic benefits to the poor in Indonesia, Madagascar and Nepal.
Forest concessions	Central governments or forest departments provide companies and communities with forest resource (typically timber) extraction rights in commercially valuable forests in exchange for a stream of revenues. Besides stumpage or taxes paid to governments, concession agreements often include provisions for local public goods such as employment, schooling and healthcare.	National-level statistics on concessions contributions to national incomes are available, but contributions of concessions to local incomes and poverty alleviation are only visible for specific locations through case studies. Limited studies using national panel data or a large number of case studies.	Households living near a concession had greater wealth in Cameroon and Liberia. In Gabon, NTFPs from forest concessions minimally affected livelihoods. Case studies in general only provide limited evidence of their contributions to poverty reduction even as they generate substantial benefits and profits for large logging companies.
Protected areas (PAs)	PAs can support livelihoods by securing rights of people to forest lands, supplying ecosystem services, generating income from tourism opportunities and improving rural infrastructure.	Several national-level studies, using quasi-experimental quantitative methods. Few multi-national, quantitative studies.	Several studies show that PAs can reduce poverty, particularly where ecotourism opportunities exist (e.g. in Costa Rica and Thailand) and where local people are involved as stakeholders. However, much documentation exists of physical and livelihood displacements of rural poor for the sake of conservation.
<b>Regulatory levers</b>			
Decriminalisation and formalisation of informal workers	Formalisation can allow the poor to convert their possessions and labour into capital, which can in turn be used to generate added value (e.g. through accessing credit); can enhance protection of rights; encourage productive investments; fetch higher prices for products; and minimise risks from forest law enforcement.	A few studies (mostly case studies) in the forest sector in the tropics have focused explicitly on the relationship between formalisation and poverty alleviation.	Mixed results, as formalisation alone does not guarantee success of enterprises. Some formalisation efforts have further marginalised poor small-scale workers; others have improved access to credit and markets, and have supported social projects.
Modifying/simplifying regulatory frameworks, including management plans	Overly burdensome regulations keep the forest-reliant poor from engaging in formal forestry sector. Simplified management plans can make it easier for them to engage and benefit from formal activities.	A few case studies in Latin America and Africa have examined the effects of simplified forest management plans on poverty, but none have attempted to empirically disentangle the effects of simplified management plans on poverty from the effects of other factors (such as tenure reform, market access and other barriers to SMFEs).	Mixed results. One study found that simplified management plans brought financial benefits to some communities, but did not compare the effects of simplified plans relative to non-simplified plans. Many studies continue to point to the difficulties associated with overly bureaucratic and technical processes to participate in the formal sector.
Log export bans (LEBs)	Log export bans are put in place to enhance domestic forest industries and thus domestic employment.	Empirical studies and economic models have examined the effects of log export bans on domestic processing and employment. One study specifically modelled effects on households in poverty.	Empirical and economic models have found no evidence that log export bans target the poor, or increase overall employment in the country. One model indicated that a LEB in Indonesia would result in decreased incomes across agricultural and rural households.
Procurement policies	Sourcing legal timber in international trade has resulted in bilateral trade agreements that have pushed for domestic governance reform – an opportunity for pro-poor policy reforms. Domestic procurement policies can also favour small scale or community-owned forest businesses.	No studies have effectively traced the effects of bilateral or international agreements on poverty reduction. We found one case study of a domestic procurement policy enhancing community forestry.	Authors have pointed to negative effects of international procurement policies affecting small-scale producers. There are cases showing improved small-scale production with domestic procurement policies that purchase from community forests, but specific links to poverty were not examined.
<b>Market and supply-chain levers</b>			

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Table 1 (continued)

Lever	Theory of change	Summary of the evidence: quantity and type of studies	Summary of the evidence: conclusions
Payments for Ecosystem Services (PES) programmes	Payments for ecosystem services are expected to either have no impact on poverty (if they exactly compensate for lost profits from forgone environmental activities) or increase incomes.	A number of large-scale, rigorously designed studies.	Small positive impacts on household incomes or assets. One study found a small but significant decrease in poverty in a PES programme in Mexico. Evidence of positive contributions to food security. Where there is annual income variation, timing payments to the moment when incomes are lowest may generate important impacts on poverty.
Reducing Emissions from Deforestation and forest Degradation (REDD+)	REDD+ initiatives provide monetary compensation in exchange for reductions in terrestrial emissions through fostering conservation, sustainable management of forests and enhancement of forest carbon stocks. REDD+ initiatives may influence poverty via two pathways: 1) through REDD+ payments to governments and local bodies and benefit sharing of such payments, and 2) as a result of changes in forest benefits to local users and governments as they limit use of forests to conform to REDD+ objectives.	No comprehensive and rigorous assessments of the effects of REDD+ on poverty but several localised case studies, comparative analyses and reviews.	Two comprehensive reviews showed small or insignificant REDD+ contributions to income across cases. Case studies are mixed, with many showing small increases in incomes (at least in the short term), and others showing increasing inequalities in communities following REDD+. One quasi-experimental study found negative effects on well-being. Local tenure security was enhanced in many cases.
Ecotourism	Ecotourism can contribute to poverty reduction in four different ways: 1) improvements in employment and wages of those who find employment, 2) visitor fees for forested locations in protected areas, 3) revenues from visitor purchases of local goods and services, and 4) infrastructure development with spillover effects in areas with high numbers of travellers and visitors.	Estimates of its economic contributions to national economies and some local communities are available, but not specific to poorer groups. Evidence tracked through number of visitors and their effects on local and national economies. Thousands of case studies at the local level.	Case studies have focused on measures of development and poverty-related impacts in terms of generation of local jobs and incomes. A number of studies have examined local effects of ecotourism and point to positive outcomes in relation to livelihoods, socio-economic development, and poverty reduction. Many studies suggest that those who are better off will be more likely to benefit, exacerbating local income inequalities. Difficult to isolate evidence of impacts of the presence of SMFEs, as a number of other levers are relevant to creating an appropriate enabling environment for SMFEs to thrive.
Small & medium forest enterprises (SMFEs)	SMFEs generate local employment opportunities in rural areas and spread wealth locally.	Many case studies showing their positive contributions to local prosperity but few impact assessments linking SMFEs directly to poverty reduction. Primarily case studies.	Mixed and context-dependent evidence that this lever reduces poverty, due to the number of additional factors at play in producers' ability to make use of enhanced market access. Several studies show that producers who were members of a larger organisation or cooperative had higher incomes than non-members.
Market access	Enhanced market participation can lead to positive impacts on household income and poverty alleviation.		
Forest producer organisations	Producer organisations can help forest producers overcome a number of challenges they face in deriving economic benefits from forests (including market access, technical services and information, and collective bargaining).	A large number of case studies, both econometric and qualitative.	
Company-community partnerships	Partnerships provide leverage for local forest communities to enter capital-intensive timber production or better access markets, potentially improving incomes and net returns from land and labour.	Despite many examples of CCPs, only a few case studies have carefully examined the explicit impacts of company-community contracts on poverty alleviation.	Mixed results. Some partnerships resulted in increased incomes and employment and improvement to social infrastructure. Other, poorly negotiated contracts, resulted in greater inequities, dependency and other negative effects.
Contract production	Contracts between producers and processing or marketing companies help poor producers overcome many market and technical barriers, potentially translating into higher incomes and more resilient livelihoods.	Mostly case studies of particular contracting relations. Some quasi-experimental studies on tree crops. Most studies of timber were largely qualitative, published as grey literature, relied on descriptive statistics, and/or failed to consider counterfactuals.	Considerable evidence of positive effects with agricultural tree crops. Less evidence with respect to timber or NTFPs. Some evidence that contract production can exacerbate social differentiation.
Certification	Certified products are expected to either fetch a higher price or help producers to reach dedicated markets. Adoption of practices prescribed by certification standards may improve productivity and reduce production risks.	Mostly case studies. Many studies are grey literature, with unclear methods and analytical rigor. Few studies on certified community forest management conform with standards for impact assessment.	There is no robust evidence that certification has reduced poverty, particularly because of the difficulties that small-scale producers have in acquiring and maintaining certification. Some evidence of improved income and well-being from cacao certification.
Zero deforestation commitments	Zero deforestation commitments frequently include guarantees to improve a company's conduct towards various groups of people, including indigenous and other forest-dependent people who live in and around forests used for commodity production; labourers employed by commodity-producing or processing companies; and smallholders who produce commodities and sell them into larger supply chains. Therefore, if companies that adopt zero deforestation commitments honour their pledges then poverty may be reduced in one or more ways.	No evidence.	We found no evidence that supply-chain commitments have reduced poverty or improved human well-being.

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Table 1 (continued)

Lever	Theory of change	Summary of the evidence: quantity and type of studies	Summary of the evidence: conclusions
Boycotts	Coordinated consumer action can hurt the profitability of a company, nudging it to adopt more sustainable production practices for timber, including social standards with potential poverty reduction ramifications (e.g. adoption of FSC standards).	No evidence.	Some suggestion that boycotts led to wider adoption of FSC certification. Impacts on poverty depend on whether FSC certification in turn has led to poverty reduction.
Forest and tree management levers Agroforestry	Agroforestry and tree planting can deliver additional income directly through sale of tree products or indirectly through increasing crop and livestock productivity, PES, and value-adding certification systems.	Many studies available on contributions to incomes, food security: some impact assessments with high risk of bias; very limited randomised control trials; and several studies using non-randomised regression analysis.	Several studies show that with extension and training, agroforestry adoption can lead to increased yields, household income, food security and dietary diversity, and tree planting can lead to diversifying incomes and improving livelihoods. A few studies have found that agroforestry programmes are associated with significant poverty reduction.
Forest restoration, reforestation and afforestation	Restoration, reforestation or afforestation can reduce poverty through transfer of payments for tree planting activities, PES, improvements in forests goods and services, securing tenure rights and trainings.	Multiple case studies. Few studies with robust counterfactual analysis.	Evidence shows that forest restoration, reforestation or afforestation can result in short-term livelihood benefits from direct involvement in tree planting (e.g. via payments and increased asset ownership). There is little evidence that livelihood benefits from services provided by restored forests meaningfully benefit proximate households to alleviate poverty.

reduction perspective, they should not be discounted as they may have had multiple positive outcomes in other realms.

Third, it bears repeating that we did not conduct a systematic review of all available literature on each of these levers. As such, some relevant evidence may have been missed.

Fourth, we did not systematically evaluate how contextual factors (e.g., social, economic, environmental, and policy variables) influence the relative success of each lever in reducing poverty. We did include consideration of such factors in cases where the original authors of the reviewed articles reported on their effects. But pragmatic considerations prevented us from exploring all possible impacts of all contextual factors for all levers. Greater detail on the influence of context can be found in Hajjar et al. (2020) and Oldekop et al. (2021) in this Special Issue.

Finally, we acknowledge that alternative taxonomies of levers relevant to this review have been developed by others (e.g. Newton et al., 2013; Agrawal et al., 2018), and that some levers could fall into multiple categories (e.g. community forest management as an intervention often combines aspects of rights-based and regulatory reforms while engaging in markets and introducing new forest management practices). The taxonomic division of levers into different categories would only become pertinent if one were trying to understand whether, for example, regulatory levers were more or less effective than market and supply chain levers as an aggregate category, or if rights-based levers as a whole might be more appropriate than regulatory levers for particular country contexts. We discourage use of this review to try to extract such high-level conclusions.

### 3. Results

A summary of evidence for all the levers is presented in Table 1, and more detailed reviews of the literature for each lever are presented in Hajjar et al., 2020. Here, we summarize results by the strength of the available evidence for poverty reduction and poverty mitigation. We differentiate strength of evidence based on the number, quality, and rigor of studies that document poverty reduction and/or mitigation for individual levers. We also consider the magnitude of any impact found and the consistency of findings between different studies of the same lever.

#### 3.1. Strongest evidence for poverty reduction

From the studies that specifically examined poverty reduction (i.e. moving people above a certain poverty-level threshold), some of the strongest evidence – in terms of magnitude of impact and/or methodological rigor of the impact assessment – came from community forest management (e.g. Oldekop et al., 2019), ecotourism, protected areas (particularly those associated with ecotourism (e.g. Naidoo et al., 2019; Ma et al., 2019)), and agroforestry (e.g. Islam et al., 2012). Payments for ecosystem services have been shown to have a small but statistically significant impact on poverty reduction in some cases (Sims and Alix-Garcia, 2017).

##### 3.1.1. Community forest management

Community forest management (CFM), where some degree of rights and responsibilities over forests are decentralized to local, place-based communities, has been promoted throughout the world for achieving dual objectives of forest conservation and livelihood improvement. It is expected that in recognizing the rights of local user groups, users will be able to benefit directly and indirectly from forest products and services. Much case study evidence points to clear material benefits from community forest management for the poor (Thoms, 2008; Beauchamp and Ingram, 2011), with a recent systematic review examining 697 published cases of CFM finding that 68% of cases that reported on livelihood outcomes indicated that community or household incomes increased after CFM implementation (Hajjar et al., 2021). Several rigorous, national-level analyses have provided additional evidence on CFM's effectiveness: In a rigorous analysis of 18,000 community forests in Nepal, Oldenkop et al. (2019) show that CFM reduced both poverty and deforestation; in a similar national-level analysis, Rasolofson et al. (2017) found that CFM in Madagascar had a small but positive impact on household living standards, particularly for those closer to forests and with more education; similarly, Santika et al. (2019) show that Indonesian village forests contributed to win-win outcomes and substantial economic benefits to the poor, but that the flow of poverty reduction benefits was linked to higher order variables related to land use classifications and zoning regulations. Studies show that CFM success and sustainability depend on a suite of factors that differ across, and even within, countries (Arts and De Koning, 2017; Baynes et al., 2015), and many initiatives fail to achieve their intended objectives (Gilmour, 2016).



### 3.1.2. Ecotourism

Ecotourism, a low impact form of tourism that helps conserve nature and generates socio-economic benefits for local populations, can help reduce poverty through employment, visitor fees and revenues from visitor purchases, and infrastructure development. Balmford et al. (2015) estimate that visitors to protected areas globally are associated with USD 600 billion per year in direct in-country expenditure and USD 250 billion per year in consumer surplus. At the local level, thousands of case studies of ecotourism suggest that it contributes effectively both to local employment and incomes, but also that these contributions tend to benefit those who are better off and with the capacity to provide hospitality services to visitors. One example is a study of ecotourism around six Panda Reserves in China that found that ecotourism reduced poverty but increased income inequality, particularly for households residing within the reserves (Ma et al., 2019). A number of other studies have similarly examined local effects of ecotourism and point to positive outcomes in relation to livelihoods, socio-economic development and poverty reduction (Simpson, 2012; Yi-fong, 2012; Snyman, 2017; Lonn et al., 2018).

### 3.1.3. Protected areas

A number of large-scale studies using rigorous impact assessment methods have examined the effectiveness of protected areas (PAs) in reducing poverty. In many cases, PAs have led to livelihood displacements through the restriction of resource access to those living in or around PAs. But in other cases, PAs have supported poverty reduction by securing the rights of people to land and valuable natural resources, supplying ecosystem services, generating economic benefits including through ecotourism, and improving infrastructure in remote areas. A national-level study in Costa Rica and Thailand employing quasi-experimental methods found that PAs in areas associated with high poverty did, on average, reduce poverty while also reducing deforestation (Ferraro et al., 2011). Another study using data from 190,000 households across 34 countries found that households near PAs with tourism had higher wealth levels and a lower likelihood of poverty (by 16%) than similar households living far from PAs (Naidoo et al., 2019). However, a quasi-experimental panel study of three PAs in Cambodia found limited impact on poverty of households within the PAs as compared to their matched controls (Clements and Milner-Gulland, 2015). Another study using matching methods found an overall negative PA impact on household wealth in China (Duan and Wen, 2017).

### 3.1.4. Agroforestry

Agroforestry, the intentional integration of trees and other woody perennials in crop and livestock systems, can improve farmer livelihoods and resilience through diversifying agricultural production and income sources (Kuyah et al., 2020). A recent systematic review identified only eight studies of agroforestry interventions that reported on income and that used rigorous quasi-experimental impact evaluation methods. A meta-analysis of these studies found a small, positive, but not statistically significant effect of agroforestry interventions on income (Castle et al., 2021). However, a number of studies using regression analysis and other methods found that agroforestry contributed substantially to incomes and food security (Miller et al., 2020). A large-scale study of five countries in sub-Saharan Africa found that a third of rural smallholder households grow trees, which contribute an estimated 17% of total annual gross income for these households (Miller et al., 2017). In Malawi, agroforestry adoption contributed to a 20–35% increase in yields, which provided increased income opportunities as well as better food security (Coulibaly et al., 2017; Amadu et al., 2020). In Bangladesh, a participatory agroforestry programme was associated with significant poverty reduction, improving the poverty situation of 33% of participating households, reducing the poverty gap of 10% of participating households, and reducing the severity of poverty of 5% of participating households (Islam et al., 2012). Along with improving incomes through increased yields or incentive provision, agroforestry can enhance

resilience and support farmers to adapt to climate change (Verchot et al., 2007; Thorlakson and Neufeldt, 2012; Quandt et al., 2019).

### 3.1.5. Payments for ecosystem services

Programmes of payments for ecosystem services (PES) are conditional cash transfers intended to encourage environmentally favourable activities (Wunder, 2015). When they yield additional environmental benefits, PES programmes are expected to compensate participants for the value they forego by not carrying out the productive activity in which they were going to engage in the absence of the payments (Engel et al., 2008). It should be the case that PES payments either have no impact on poverty (if they exactly compensate for lost profits) or increase incomes (in the event that they exceed the amount of lost profits). Much evidence on PES comes from Mexico, China, and Costa Rica (Alix-Garcia et al., 2015; Uchida et al., 2009; Robalino et al., 2014; Treacy et al., 2018; Liu and Lan, 2018), countries with large existing PES-type programmes that started in the early 2000s. Additional evidence comes from a broader range of countries including Vietnam (Phan et al., 2018), Mozambique (Jindal et al., 2012; Hegde and Bull, 2011), Uganda (Jayachandran et al., 2017), and Burkina Faso (Adjognon et al., 2019). Overall, there is no substantial evidence that PES programmes hurt participants' incomes nor that they lead to large reductions in poverty, but there are multiple rigorous studies that report either no effect on poverty or small reductions in poverty. For example, Sims and Alix-Garcia (2017) found a small but significant decrease in poverty in Mexican PES-receiving localities from 2000 to 2010.

## 3.2. Strongest evidence for poverty mitigation

Out of the studies that more generally examined poverty mitigation (i.e. increasing income, assets and other aspects of well-being), a multitude of cases showing positive outcomes came from community forest management and PES (reviewed above), tenure and property rights reform (Tseng et al., 2020), forest producer organisations, (e.g. FAO and Agricorn, 2016), SMFEs (Macqueen, 2008), tree crop contract production (Morsello et al., 2012), and forest restoration and afforestation.

### 3.2.1. Tenure and property rights reform

Tenure and property rights reform is expected to improve the livelihoods and well-being of those whose rights are being formally recognized through secured access to resources, enable investments as a result of increased tenure security and, as a consequence, reduce poverty and inequality (Deininger, 2003; Meinzen-Dick, 2009; Lawry et al., 2017; Miller et al., 2021). A recent systematic review of this literature on the impacts of interventions to recognise individual/private land tenure on agricultural productivity showed substantial productivity and income gains, although these differed by region (Lawry et al., 2017). Another systematic review found that of 92 studies reporting on human well-being outcomes, 75 reported positive outcomes (Tseng et al., 2020). In the context of forests, a systematic review of the impact of forest property rights interventions on poverty reported generally positive or mixed impacts on income consumption and capital, although quasi-experimental assessments in the review reported positive and negative impacts in equal proportions (Miller et al., 2021). Overall, the available evidence shows that tenure reform can play a role in poverty reduction, but that it seems to work best when combined with other policy instruments (Carter, 2003; Werner and Kruger, 2007; Meinzen-Dick, 2009; Shyamsundar et al., 2020). The effectiveness of tenure reform is enhanced by interventions on access to justice and the rule of law, enforcement of property rights, technical support, and access to finance and basic infrastructure, e.g. water, electricity, roads, communications, schools, healthcare (Werner and Kruger, 2007; Prosterman et al., 2009; Meinzen-Dick, 2009; Akinola and Wissink, 2019; Gabay and Rekola, 2019). Indeed, tenure reform, including devolution of forest rights and enhancing tenure security, is often a necessary but not sufficient

enabling factor for the successful implementation of several levers discussed in this paper.

### 3.2.2. Forest producer organisations

Forest producer organisations (FPOs) are groups, associations, or cooperatives of forest producers that come together for producing, processing, or marketing forest goods (Pasicznik and Savenije, 2015; Tirivayi et al., 2018). They aid forest-based producers to overcome a number of challenges by facilitating the aggregation of products; enhancing bargaining power; improving access to capital, inputs, technical services and markets; and increasing political power of forest producers (de Marsh et al., 2014; Pasicznik and Savenije, 2015; Hajjar and Kozak, 2017; Tirivayi et al., 2018). A few studies explicitly assess the performance of producer organisations in terms of poverty alleviation specifically in a forest context. In Ethiopia, cash income from frankincense cooperatives resulted in a 3.6% reduction in poverty rates among member households, as well as significantly higher incomes and lower poverty levels than non-members, though the authors also note that membership in cooperatives was biased towards relatively better-off households. In Côte d'Ivoire and Ghana, a study of 453 cocoa producers across six sites found forest cooperative members to generate relatively higher incomes from cocoa than non-members (Calkins and Ngo, 2010). In Turkey, a study analyzed socio-economic household survey data from 203 small-scale timber producing villages, and also found cooperative members to have higher incomes in comparison to non-members, though wealthier households were significantly more likely to be members (World Bank, 2017). A number of largely qualitative case studies across a range of forest commodities indicate that FPOs can contribute significantly to poor members' incomes (e.g. Tiveau, 2008; Pandit et al., 2009; Pasicznik and Savenije, 2015; Tieguhong and Schure, 2015; Humphries et al., 2020). However, membership fees and other upfront investments associated with FPOs can effectively work to exclude the poorest community members (Kazooru et al., 2006; Oduro and Osei-Akoto, 2008; Pandit et al., 2009; Atmîş et al., 2010; Shiferaw et al., 2011). A few studies (e.g. Atmîş et al., 2010; le Polain de Waroux and Lambin, 2013) found that FPO membership had no or limited impacts on poverty alleviation; Markelova et al. (2009) cautioned against generalising from successful case studies since failures tend to receive less attention.

### 3.2.3. Small and medium forest enterprises

Small and medium forest enterprises (SMFEs) are small-scale forest-based businesses that generate income from a diversity of forest-related activities and products, including timber and fuelwood producers, carpentry shops, non-timber forest product (NTFP) producers and ecotourism (Macqueen, 2008). SMFEs can play an important role in the mitigation of poverty as they generate employment opportunities and spread wealth locally (Kozak, 2007; Tomaselli et al., 2012; Sanchez Badini et al., 2018). Positive evidence of this role comes from, inter alia, Bolivia, Brazil, Burkina Faso, Cameroon, China, The Gambia, Guatemala, Kenya, Mexico, Papua Guinea, Peru, Nepal and South Africa (Macqueen, 2008; Tomaselli et al., 2012; Foundjem-Tita et al., 2018). Yet, despite a strong theory of change and many case studies showing their positive contributions to local prosperity (Macqueen, 2008; Macqueen et al., 2020), there have been limited impact assessments linking SMFEs directly to poverty reduction. The difficulty in stating their impact in more generalisable terms is partly due to their diversity and the diversity of contextual conditions in which they operate that may help or hinder their success (Sanchez Badini et al., 2018).

### 3.2.4. Contract production

Tree crop contract production, a type of company-community partnership, is a form of vertical coordination within value chains in which

production is carried out through a fixed-term formal or informal sales agreement between a producer and a processing or marketing company (Little and Watts, 1994). While typically commercially driven, such arrangements are widely viewed by policymakers and development practitioners as a promising tool to overcoming the pervasive market imperfections that perpetuate rural poverty (Meemken and Bellemare, 2019). In countries such as India, Thailand and South Africa, timber species such as teak, pine and eucalyptus are also commonly cultivated under such arrangements (Sartorius and Kirsten, 2002; Boulay and Tacconi, 2012). Since many NTFPs suffer from diseconomies of scale, and quantities and qualities can be difficult to control (Pierce et al., 2008), few are harvested or processed under contract. Most documented cases come from the Amazon, typically involving some form of 'community-company partnership agreements' for comparatively high-value NTFPs such as Brazil nut, palm hearts and açai (Van Andel, 2007; Morsello et al., 2012). While some critics contend that contract production can be an exploitative and extractive mode of production due to the inherent power imbalances and uneven dependency structures (Little and Watts, 1994; Oya, 2012), several empirical studies employing econometric techniques indicate that contract production has been widely associated with household income and farm profitability gains (Bolwig et al., 2009; Miyata et al., 2009; Bellemare, 2012; Narayanan, 2014; Girma and Gardebroke, 2015). Since most of these studies are based on case studies of specific contracting relations or are confined to specific geographic areas, findings do tend to suffer from a lack of external validity (Meemken and Bellemare, 2019). Studies of timber contracts are largely qualitative and lacked counterfactuals (e.g. Cairns, 2000; Desmond and Race, 2000; Mayers and Vermeulen, 2002; Howard, 2005).

### 3.2.5. Forest restoration, reforestation and afforestation

A growing body of evidence demonstrates how forest restoration, reforestation, or afforestation provides direct livelihood benefits, particularly in the short-term. A large-scale afforestation programme in China, the Sloping Land Conversion Project, provided subsidies for afforestation activities to low-income, rural households. The programme has demonstrated that afforestation programmes can incentivise the intensification of smallholder agriculture and increase off-farm labour earnings (Zhou et al., 2007; Yin et al., 2014). Small-scale projects have also had positive livelihood benefits. A social forestry programme in South Kalimantan increased farm-based income and natural forest cover (Hiratsuka et al., 2019) and farmer-managed natural regeneration in Ghana increased asset ownership and income diversity (Weston et al., 2015). Many studies find that restored forests contribute to a diversification of livelihood strategies and increases in income from timber and NTFPs (Aronson et al., 2010; Le et al., 2012; Adams et al., 2016; Erbaugh and Oldekop, 2018; Ota et al., 2018). Indirect benefits from forest restoration also accrued to households in central China as a result of the Mountain-River-Lake (MRL) Programme in the Poyang Basin. The MRL Programme is associated with lifting 9 million people out of poverty between 1983 and 2008. These examples are promising, but they do not rely on counterfactual analysis, and so may falsely attribute poverty reduction to restoration activities. Despite their limitations, these examples show that indirect well-being benefits from restored forests can accrue over years or decades.

## 3.3. Mixed evidence for poverty alleviation

For some levers, we found evidence that was suggestive of a contribution to poverty alleviation. In some cases the evidence base was not strong, and in others it was difficult to disentangle the effect that could be attributed to that lever from that associated with other levers that were influencing the same households or communities at the same

time. These levers included decriminalisation and formalisation of informal operations, market access, company-community partnerships, and REDD+ (particularly in terms of its focus on tenure reforms - e.g. Lawlor et al., 2013; Duchelle et al., 2018).

### 3.3.1. Decriminalisation and formalisation of informal operations

Formalisation of previously informal forest activities can benefit producers through enhancing the protection of rights (Chen, 2007), encouraging productive investments (Hirons et al., 2018), reducing incentives for corruption (Zulu and Richardson, 2013), allowing producers to fetch higher prices for products on formal markets, and keeping producers out of law enforcement trouble and having equipment confiscated (Hajjar et al., 2011). A number of case studies in the forest sector in the tropics have found that formalisation alone does not guarantee success of enterprises. In some cases, formalisation has improved access to formal financial credit and international markets (Cerutti et al., 2019). Schure et al. (2013) suggested that taxes generated through formalised and decentralized woodfuel chain governance in Central and West Africa had been reinvested in local social projects. Hautdidier and Gautier (2005) found that woodcutters in Mali benefitted from formalisation through harvesting quotas, formally allocated selling points, and improved oversight. However, in many instances, various types of formalisation efforts in the forest sector have excluded and marginalised poor small-scale workers (Andersson and Pacheco, 2006), criminalised legitimate but informal livelihoods (Hansen and Treue, 2008; Purnomo et al., 2009; Cerutti et al., 2013; Hirons et al., 2018), reduced incomes (Chen, 2007; Wynberg et al., 2015), limited access rights to key commodities (Anderson et al., 2015), as well as increased elite capture and exploitation by more powerful actors (Lele et al., 2010; Ndoye and Awono, 2010; Schure et al., 2013; Weng and Putzel, 2017).

### 3.3.2. Market access

Improving market access, in the context of poverty alleviation, refers to interventions that enhance physical and technical conditions of smallholders to access markets, as well as enhance their capacities to engage with those markets (Chamberlin and Jayne, 2013). Enhanced market participation can lead to positive impacts on household income and poverty alleviation (IFAD, 2015). Yet, greater market engagement may also increase risks or the ability for smallholders to capture economic rents, which may flow to actors better positioned in the value chain (Pacheco, 2012). For benefits to accrue to smallholders, several factors, processes and conditions shaping smallholders' market engagement have to be reversed or improved. These include technical, economic, policy and regulations, and institutional factors. Yet beyond markets, overall outcomes of market participation concern other conditions that facilitate access to other factors (e.g. technology, infrastructure, finance) (Torero, 2011). Clear evidence of the impacts that enhancing market access has on alleviating poverty of smallholders in forest landscapes is limited and context-dependent, based primarily on case studies. The variation in outcomes suggests the importance of looking at the other factors and conditions explaining such variation. When specifically considering smallholder forestry and tree-farmers, the most important variables may include clear ownership of trees, reliable markets, sympathetic legal and regulatory frameworks, and availability of technical options (Midgley et al., 2017), as well as access to information and contractual agreements (Russell and Franzel, 2004).

### 3.3.3. Company-community partnerships

Forest-related company-community partnerships refer to a range of formal and informal relationships and agreements between communities and companies with the expectation of realising gains from sharing capacities and risks (Mayers, 2000; Ros-Tonen et al., 2008; Le Tourneau and Greissing, 2010). Company-community partnerships are expected to result in the vertical integration of disconnected rural forest enterprises into global supply chains by providing rural producers with

better access to markets and capacity (Mayers, 2006; Vermeulen et al., 2008), improving incomes and net returns from land and labour (Brubacher, 1998; Mayers, 2006; Ojwang, 2000). A number of case studies have described various company-community contracts, but few have carefully examined the explicit impacts of these contracts on poverty alleviation (Mayers, 2006). Case studies describe benefits from company-community partnerships such as: increased incomes; access to markets and sometimes premium prices; employment opportunities; improving land use options; securing land rights; and upgrading social infrastructure (Le Tourneau and Greissing, 2010; Mayers and Vermeulen, 2002; Menton et al., 2009; Morsello et al., 2012; Vermeulen et al., 2008). In many cases, however, the inequitable distribution of benefits within communities can deepen social inequity and weaken social cohesion, while power imbalances between partnering communities and companies can increase community dependence on external actors and result in unfair or inequitable distribution of benefits in these partnerships (Mayers, 2006; Menton et al., 2009; Ros-Tonen et al., 2008; Le Tourneau and Greissing, 2010). A number of factors can help to ensure that these partnerships contribute to poverty alleviation, including building consensus on partnership aims, governance reforms that secure tenure and land rights for local communities, improving capacity of local communities to negotiate partnerships, equitable risk sharing, long-term commitment to the partnership, ethical business practices, and periodic evaluations (Desmond and Race, 2000; Mayers and Vermeulen, 2002).

### 3.4. REDD+

Policies, projects and other interventions related to Reducing Emissions from Deforestation and forest Degradation (REDD+) are among the more prominent attempts to mitigate climate change since 2010 (Parrotta et al., 2012). REDD+ may influence poverty through payments or by changing forest benefit flows. Two studies at the local level did not find evidence for effects of REDD+ on material indicators of well-being or poverty and suggest that positive effects of REDD+ payments are possible but have been modest at best (Danielsen et al., 2011; Awono et al., 2014). A study of benefit sharing for REDD+ in Nepal found that direct contributions of REDD+ projects to households' incomes were nominal – from 3.2% of income of poorest households to 0.3% of the income for the less poor households (Shrestha et al., 2017). A systematic review of 350 local-level REDD+ projects across the tropics found few studies that provided careful causal estimates of outcomes but numerous studies of well-being outcomes that “highlight small or insignificant results” (Duchelle et al., 2018). A review of 41 REDD+ projects across 22 countries found that participants received a wide range of payments (from USD 1 to USD 134 per year) and that contributions to infrastructure and education services were modest and that the more important contribution of these projects was to local tenure security (Lawlor et al., 2013).

### 3.5. Limited ability to alleviate poverty

Two levers, forest concessions and certification, are well-studied, but show limited ability to alleviate poverty.

#### 3.5.1. Forest concessions

The private concession model, where central governments provide companies and community resources with extraction rights to forest resources (often timber) in government-owned forests (Agrawal et al., 2008; Bulkan, 2014), exists around the world through various concessionary arrangements. Private and corporate forest concessions are the dominant form of forest governance in tropical forests in Southeast Asia, parts of the Amazon, and especially in Central and West Africa (World Bank, 2002), with some community concessions existing in Central America (Gretzinger, 1998; Taylor, 2010). Concessions generate substantial income through timber harvesting and trade, particularly for



logging companies (Ross, 2001; Medjibe and Putz, 2012; Straumann, 2014), and theoretically can contribute to poverty alleviation in rural areas through employment, income and service provision, as well as indirectly through infrastructure enhancement and sales of goods and services to concession employees. However, there is limited evidence of their contributions to poverty reduction even as concessions generate substantial benefits and profits for large logging companies (Scudder et al., 2019).

### 3.5.2. Certification

Forest certification, where a third party certifies that a forest product, process, or service adheres to certain standards, has similarly underperformed in alleviating poverty. Certification by smallholders and community-based organisations is widely viewed as an important rural development mechanism. The theory of change holds that adoption of better practices can enhance productivity and resilience, and reduce production risks, while creating opportunities to sell to buyers that can offer improved terms of trade (e.g. price premiums, offtake guarantees, services). These could lead to higher and more stable income for smallholders, thus contributing to poverty reduction. Yet, certification of timber and NTFPs has not performed as promised for poverty alleviation, with high certification costs and other barriers to entry for those in poverty situations, and limited price premiums and low profit margins (Schoneveld et al., 2019; Brandi et al., 2015; Burivalova et al., 2017). With the exception of the cocoa and coffee sectors, certification rates remain low among small producers and community forest management units and enterprises.

## 3.6. Insufficient evidence on poverty alleviation

We were unable to find much evidence on the poverty impacts of a number of other levers, despite in some cases strong theories of change, due to few studies explicitly looking at poverty implications. These included modifying or simplifying regulatory frameworks, procurement policies, export bans, zero deforestation commitments, and consumer boycotts.

### 3.6.1. Modifying or simplifying regulatory frameworks

Among the oft cited barriers preventing communities and smallholders from engaging in the formal forestry sector are overly bureaucratic and technical processes in completing forest management plans, obtaining permits and other legal documents, and complying with burdensome regulations (Medina et al., 2008). As such, one proposed solution has been to require simplified management plans that are easier to complete by smallholders and communities, with the intention of bringing their forest activities into the formal sector and allow them better market access. Yet very few studies have examined the poverty impacts of simplified management plans (Pacheco, 2012; de Koning, 2011; Bruggeman et al., 2015), and we did not find any study that has attempted to empirically disentangle the effects of simplified management plans on poverty from the effects of other factors (such as tenure reform, market access and other barriers to small and medium forest enterprises (SMFEs)).

### 3.6.2. Procurement policies

Timber procurement policies aim to ensure that timber is coming from legal and/or sustainable sources, and often result in domestic governance reforms that could be used to promote pro-poor policies such as strengthening land tenure and access rights for marginalised rural communities and indigenous peoples (Hobley and Buchy, 2013; Richards and Hobley, 2016; Tegegne et al., 2017). Yet, we did not find studies showing that this pathway has resulted in poverty reduction or enhanced economic opportunities for the forest-reliant poor. Instead,

some authors have pointed to potential negative effects of these legality policies on small-scale timber producers, particularly if they are required to bear the cost of implementation or if self-employed people in the informal sector are squeezed out, exacerbating poverty in forest-reliant communities (Eba'a Atyi et al., 2013; Hajjar, 2015).

### 3.6.3. Log export bans

Export bans (or high export taxes) for unprocessed log timber have been implemented in many countries (predominantly in low and middle-income countries, but also in some high-income countries) to counter deforestation and environmental degradation associated with the timber trade and/or to induce development of a domestic processing industry. Some empirical studies and economic models have documented log export bans (LEB) having positive impacts on domestic processing capacity, exports of secondary processed wood products and employment in the domestic processing sector (reviewed in Goodland and Daly, 1996), and one estimating that Indonesia lost millions of dollars by banning log exports (Gillis, 1988). Yet few studies have focused on poverty effects. A number of models show that the increased employment in the processing sector does not compensate for the number of jobs lost in logging operations, where rural poor may more likely be employed, following LEB policies (Resosudarmo and Yusuf, 2006). We found one study that specifically modelled the effects of an LEB on households in poverty, showing that an LEB in Indonesia would result in decreased incomes across agricultural and rural households, at least in the short run (Resosudarmo and Yusuf, 2006).

### 3.6.4. Zero deforestation commitments

Zero deforestation commitments, commitments made by private sector entities to adopt more sustainable sourcing policies, in relation to one or more commodities (e.g. timber, soy, palm oil, beef), frequently include guarantees to improve a company's conduct towards various groups of people, including indigenous and other forest-dependent people who live in and around forests used for commodity production; labourers employed by commodity-producing or processing companies; and smallholders who produce commodities and sell them into larger supply chains (Newton and Benzeev, 2018). However, a recent review of the impacts of ZDCs on social outcomes, including poverty, identified very few studies that examined the relationship between supply chain initiatives and poverty alleviation (Newton and Benzeev, 2018).

### 3.6.5. Consumer boycotts

Consumer boycotts of timber from particular companies, countries, or regions have been promoted as a mechanism by which to encourage more sustainable and more responsible timber production. Any impacts of boycotts on poverty are most likely to be manifested through the adoption of sustainability standards such as FSC certification, which companies may adopt to demonstrate sustainability to consumers. As such, we encountered no studies that showed direct evidence that boycotts have led to measurable poverty reduction or to changes in other measures of human well-being. But to the extent that boycotts are effective in promoting the adoption of sustainability standards, and to the extent that the adoption of sustainability standards in turn leads to poverty reduction, there may be an indirect cause-and-effect connection between boycotts and poverty reduction.

## 4. Discussion

We reviewed the evidence that forest-sector policies, programmes, and strategies (i.e. levers) have alleviated poverty (through poverty reduction or poverty mitigation). We studied 21 different rights-based, regulatory, market and supply chain, and forest and tree management levers for which we could identify a plausible theory of change of how

implementation of that lever might alleviate poverty (Table 1).

Overall, while we found substantial, varied, and context-dependent evidence of these levers being associated with mitigating poverty, including by supporting or improving well-being, we found limited evidence of these levers being associated with reducing poverty (i.e. moving people out of poverty). It is worth reiterating, however, that many of these levers were primarily set up for forest conservation or other non-poverty related objectives, rather than with the explicit aim to reduce poverty.

From the studies that specifically examined poverty reduction (i.e. moving people above a certain poverty-level threshold), some of the strongest evidence came from ecotourism, protected areas (particularly those associated with ecotourism (e.g. Naidoo et al., 2019; Ma et al., 2019)), community forest management (e.g. Oldekop et al., 2019) and agroforestry (e.g. Islam et al., 2012), although by no means were these effects uniform across all contexts. Rigorous studies on payments for ecosystem services show small, but statistically significant, decreases in poverty in some cases (e.g. Sims and Alix-Garcia, 2017).

Out of the studies that more generally examined poverty mitigation (i.e. increasing income, assets and other aspects of well-being), a multitude of cases showing positive outcomes came from community forest management (e.g. Rasolofson et al., 2017), tenure and property rights reform (Tseng et al., 2020), forest producer organisations, (e.g. FAO and Agricorn, 2016), SMFEs (Macqueen, 2008), PES (e.g. Adjognon et al., 2019), tree crop contract production (Morsello et al., 2012) and forest restoration and afforestation.

#### 4.1. Differentiated impacts

Few studies provided socially disaggregated information on poverty outcomes by showing how the levers included in the review affected different groups. However, a number of studies highlight the importance of social heterogeneity in the context of the assessed levers, including those levers with the strongest evidence of poverty alleviation. The assessed studies generally attributed socially differentiated outcomes, including differentiated opportunities, benefits, and trade-offs, to a combination of underlying material and sociocultural inequalities and the failure of a given lever to sufficiently account for and address those inequalities. For instance, insufficient financial resources may hinder the poorest producers from complying with formal standards (e.g. Obidzinski et al., 2014) or paying the membership fees for producer organisations (e.g. Shiferaw et al., 2011). While ecotourism may reduce poverty, it also risks increasing income inequality between households (Ma et al., 2019). Gender differences (Stoian et al., 2018), variations in ethnicity (Elias and Arora-Jonsson, 2017) or other axes of social differentiation often accentuate exclusionary outcomes. For instance, a number of studies on ecotourism noted that women were typically relegated to lower-paying, gender-conforming jobs, while more remunerative positions were taken up by men (Gentry, 2007; Tran and Walter, 2014). Women also experienced a disproportionate loss of income due to forest closures associated with a PES programme (Tuijnman et al., 2020), while many agroforestry practices increased women's labour burden, often without generating commensurate or accessible benefits (Kiptot and Franzel, 2011). Women's participation and benefits were lower than those of men in PES programmes in Kenya (Kariuki and Birner, 2016), while in a global comparative study on REDD+, women in project sites reported declines in subjective well-being in comparison to male-dominated groups within the same sites and women in control sites (Larson et al., 2018).

#### 4.2. Interpretation

An absence of clear and high-quality evidence that forest-sector levers have moved people out of poverty does not necessarily constitute evidence that such levers cannot or even have not reduced poverty. Rather, it appears that relatively few researchers have explicitly

explored poverty reduction, per se, through forest sector interventions. Many more studies have explored indicators of poverty mitigation, including impacts on income, assets and well-being. As an example of this distinction, there remains little concrete evidence of whether REDD+ has led to poverty reduction, but well-funded and coordinated efforts have systematically characterized REDD+'s contributions to livelihoods in cases globally. More studies are needed that explicitly speak to poverty reduction as an outcome variable of interest, rather than just poverty mitigation, in order to more fully assess forest-sector levers' impacts on poverty alleviation. Additionally, few studies have examined these phenomena at national or regional scales, instead typically examining impacts at the scale of a few communities or similar level administrative jurisdictions. Larger scale studies are needed to enable rigorous assessments of the role of these levers in relation to poverty.

The mixed conclusions on the efficacy of many of the levers is also an attestation to the importance of contextual differences, including the presence of enabling conditions and contemporaneous drivers of change (see Oldekop et al., 2021 in this Special Issue), in shaping the effects of different levers. For several levers, we did not find generalisable, clear-cut evidence of impacts, positive or negative, given that conditions on the ground vary widely across the globe. But site-specific studies do show that several levers have contributed to poverty mitigation under certain circumstances and in the presence of key enabling factors, including in conjunction with other levers. For example, having clear and secure local tenure rights to land and forest resources is key to the success of SMFEs, CFM, PES, community-company partnerships and agroforestry. Many SMFEs are reliant on tenure reform, market access, forest producer organisations and formalisation policies, to name a few necessary enabling conditions for their success. Market access alone is an insufficient condition to ensure poverty reduction; other factors enhance the effects of market access – among them the presence of forest producer organisations, certification and contract production. Protected areas in Costa Rica and Thailand were most effective at alleviating poverty when ecotourism opportunities were available. As such, the likelihood of success of a number of levers is intertwined with the functional presence of other levers.

Finally, a number of cross-cutting tools that often support programmatic interventions were not discussed in this paper, but are relevant to the success of many levers. For example, new and enhanced technologies including equipment upgrades, mechanisation and improved germplasm can be important components of SMFEs, CFM, reforestation and agroforestry (Burney et al., 2015; Haase and Davis, 2017; Hansen et al., 2019 see also Oldekop et al., 2021). Financial capital, in the form of credit, aid or subsidies, can be essential in implementing many of the reviewed levers (Macqueen, 2008; Humphries et al., 2012; Sanchez Badini et al., 2018). Capacity building, including financial literacy, financial inclusion and improved management practices, often accompany interventions that bring new practices and ventures to producers (Pokorny et al., 2010; Hajjar et al., 2011; Elson, 2012). Safeguards such as free, prior and informed consent (FPIC) and participation in intervention design are increasingly recognized in a rights-based discourse as essential components of interventions aiming to improve the lives of forest-reliant people (Lawlor et al., 2013; FAO, 2018). These supporting components of interventions may in and of themselves have poverty impacts, but we did not have the granularity to isolate and assess those outcomes.

We encountered significant variance in the methods used to study different forest-sector levers. The literature on some levers was dominated by econometric analyses (e.g. PES programmes, protected areas) while the literature on other levers was dominated by qualitative or mixed method case-studies (e.g. timber contract production). Different methodologies offer competing advantages, including the degree to which one can offer reliable conclusions about the contribution of any given lever to poverty alleviation. For example, probably the most rigorous evidence, in terms of being able to isolate and quantify the

impact of forest-sector levers on local people, comes from payments for ecosystem services programmes and protected areas analysis. Here, a number of controlled, econometric studies with large sample sizes found that PES programmes on the whole did no harm to participant households, and provided small increases in some cases to household incomes and assets, but also did not find support for a strong role in poverty reduction. Two recent randomised controlled trials found positive impacts on well-being measures (Jayachandran et al., 2017; Adjognon et al., 2019). Studies of protected areas have similarly utilised matching-based, quasi-experimental designs, and national and global datasets to show their positive impacts on poverty reduction, as well as the conditions that increase likelihood of impacts (namely, presence of ecotourism and locations at intermediate distances from major cities; Ferraro et al., 2011; Naidoo et al., 2019). For ecotourism, while not assessed through similarly rigorous study designs, evidence of impact has been tracked through the number of visitors and the benefits they bring in terms of expenditures in local and national economies. Meanwhile, several levers were predominately assessed using case studies in variable contexts (e.g. company-community partnerships, SMFEs). On their own these provide rich information on mechanisms and outcomes, but, in aggregate, the variability in case contexts makes it difficult to assess the specific contributions of the lever to poverty alleviation and challenging to make any generalised assessments across contexts. The absence of such evidence should not be interpreted as the ineffectiveness of these levers in potentially addressing poverty.

Importantly, this paper does not evaluate the poverty alleviation impacts of non-forest sector interventions. This includes programmes such as cash transfers, energy substitutions, education and infrastructure initiatives, non-tree related agriculture extension and other levers that are implemented both within but also outside of forested landscapes. Such levers are likely to have substantial impacts on the poverty status of forest-reliant people in rural areas. Indeed, many are more explicitly focused on dimensions of poverty alleviation as their primary objective. In contrast, many of the forest-sector interventions that we reviewed are focused primarily on forest conservation, and include social objectives only as a second-order concern. One example of a non-forest sector lever on poverty alleviation is the national cash-transfer programmes in Brazil that accounted for an average 54% of household income among agricultural households at the forest frontier (Dou et al., 2017). Relatedly, Indonesia's national anti-poverty programme reduced village-level deforestation by 30% by reducing the reliance of rural households both on deforestation as a coping strategy and on forest products as an alternative to market-purchased goods (Ferraro and Simorangkir, 2020). Such programmes and impacts are not captured in this review and should also be evaluated. Such an evaluation could assess the degree to which poverty-reduction programmes face particular constraints in reaching forest-dependent people (e.g. due to the uniquely remote location of some forest communities) or have differentiated impacts on forest-dependent people relative to other demographic groups.

#### 4.3. Knowledge gaps and future research

We identified five ways in which the evidence base for how different forest-sector levers contribute to poverty alleviation could be strengthened. First, where appropriate, research designs could control for varying contextual conditions and isolate the mechanisms and levers in question to help illuminate the role of these levers in poverty alleviation. Numerous social, economic, environmental, and political contextual factors affect forest-poverty dynamics (Oldekop et al., 2021). Careful research designs can also illuminate, and even quantify, the relative importance of different contextual factors. An improved understanding of the influence of these factors on the relative efficacy of different levers would enable decision-makers to make more informed and nuanced decisions about which levers to support in different geographies. Second, more studies are needed that look at promising levers' contributions to moving people out of poverty rather than focusing on well-

being. We found relatively little evidence for poverty reduction (i.e., moving people across a defined poverty threshold) and relatively more evidence for poverty mitigation (i.e., increasing wellbeing without necessarily moving out of poverty per se). In part this may reflect the limits of forest-based levers for achieving poverty reduction. But it also seems to reflect a relative lack of attention by researchers to poverty reduction as an explicit metric of focus. With small changes in the data that are collected and the ways in which those data are analyzed, it may be possible to considerably build out the evidence base for the extent to which forest-sector levers can alleviate poverty. For example, researchers could collect the data necessary to construct established multi-dimensional poverty indices. Or they could analyse income data with respect to established international or national poverty thresholds. Third, little research has examined the long-term poverty alleviation effects of forest-sector interventions. Much of the evidence we encountered drew conclusions from cross-sectional studies, with longitudinal studies being relatively rare. Yet poverty dynamics can play out over extended periods of time (Jagger et al., 2021), and some authors have called for greater research focus on life histories and intergenerational dynamics (Addison et al., 2008). Fourth, our review does not explore the relative economic costs of alternative levers. For decision-makers with finite resources, the cost-benefit of investing in particular interventions may be a crucial part of their analysis as to which levers to support and implement. Since poverty alleviation is seldom the sole or primary objective of forest sector levers, research might also consider ways in which such levers can alleviate poverty while leveraging synergies with multiple other environmental and socioeconomic priorities, such as those related to climate change mitigation and adaptation, biodiversity conservation, or rights and governance. Finally, future research could also address values and outcomes that are central to other Sustainable Development Goals. For example, reviews could examine how forest sector interventions affect rights, equity, adaptation and resilience, or carbon sequestration. The interactions among these additional outcomes and poverty alleviation are ripe for investigation; more broadly, future research might also ask, "[how] can inclusive, equitable and sustainable forest management contribute to poverty alleviation?" In sum, a combination of more rigorous and long-term research designs, along with examinations of the cost-effectiveness of different levers, would go a long way to contributing to the design of effective interventions for poverty alleviation.

#### 5. Conclusions

Forest-reliant communities are variously (and sometimes simultaneously) affected by rights-based, regulatory, market and supply chain, and forest and tree management levers within complex socio-environmental landscapes. Different actors, including governments, communities, private sector organisations and NGOs, variously develop, fund, and implement these levers. Teasing apart and isolating the effects of any one lever on poverty alleviation is challenging given available evidence. That said, there is evidence to demonstrate that some interventions – including ecotourism and community forest management – can have detectable and significant impacts on poverty reduction, while many of the reviewed levers have had positive impacts on poverty mitigation. To add to a rich body of case study research, further studies that explicitly focus on poverty reduction as an outcome of interest and that isolate causal mechanisms, including through quantitative methodologies with robust counterfactuals where appropriate, could help to extend this understanding of how forest-sector policies, programmes, and strategies can help to alleviate poverty among the rural poor.

#### Declaration of Competing Interest

The authors have no conflicts of interest to declare.



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