A Systematic Review of the Impact of Forest Property Rights Interventions on Poverty

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Daniel Miller[1*], Pushpendra Rana[1], Katia Nakamura[1], Samantha Forrest[2], Samantha H. Cheng[3], Sofia Ahlroth[4], Emilie Perge[5]

[1] Department of Natural Resources and Environmental Sciences, University of Illinois, Urbana, IL 61801, USA
[2] Department of Agricultural and Consumer Economics, University of Illinois, Urbana, IL 61801, USA
[3] Center for Biodiversity and Conservation, American Museum of Natural History, New York, NY 10024, USA
[4] The World Bank, Yangon Office, Yangon 11182, Myanmar
[5] The World Bank, 1818 H Street, NW Washington, DC 20433, USA

[*]*Corresponding author, dcmiller@illinois.edu*

Abstract: Secure property rights are widely understood as critical for socio-economic development and sustainable land management in forested areas. Policies and programs, ranging from devolution of specific resource rights to formal land titling, have therefore been implemented to strengthen forest tenure and property rights in countries around the world. Despite the prevalence and importance of these efforts, however, systematic understanding of their effects on poverty remains lacking. We address this gap by conducting a systematic review of the impact of forest-related property rights interventions on poverty worldwide. We drew from a recent systematic map of evidence on forest-poverty links (Cheng et al., 2019) and using a population-intervention-comparator-outcome (PICO) framework to identify relevant studies. Our final dataset included 61 articles published from 2002-2016 comprising 91 case studies across 24 countries. Of these, only 11 articles (22 cases) used quasi-experimental methods to control for confounders. We find that almost all studied interventions (n=88; 97%) focused on rights to access a forest area or withdraw resources from it. Relatively few studied interventions supported the more extensive property rights of exclusion (23%) and alienation (8%). Overall, reported impacts on both income/consumption and capital/assets dimensions of poverty were generally positive or mixed. Results from more robust quasi-experimental assessments were more variable, however, with an equal number of case studies reporting negative and positive impacts on both poverty dimensions. We find tentative support for the economic theory that more secure property rights yield positive welfare effects. However, evidence from more robust impact assessments remains limited, constraining our ability to draw more generalizable conclusions about the direction of poverty impacts from different kinds of forest property rights interventions.

Keywords: Property rights; land tenure; poverty; livelihoods; forest policy; forest management

1. Introduction

Strengthening property rights is widely touted as a means to spur economic development and sustainable resource management. Theory suggests that well-defined and secure property rights help reduce risk of land and resource loss, increase incentives to invest over the long-term, and reduce expenditures on land and resource protection (Besley, 1995; Deininger and Feder, 2009; Holden et al., 2013). Clarifying and strengthening land rights through adjudication, registration, and other means is therefore seen as a cost-effective way to increase tenure security and advance major multilateral policy objectives, including the UN's Sustainable Development Goals (SDGs) and the Convention on Biological Diversity (CBD) (Holden et al., 2013; World Bank, 2011).

Forests play an important role in sustaining ecosystem services that support the livelihoods of millions of rural people across the globe (FAO, 2014). Wealth accumulation through improved access and strengthening community rights over such services in forests has been identified as a key potential pathway out of poverty for people living in and around forests (Angelsen et al., 2014; Jagger et al., 2014). Secure tenure rights can encourage local communities to invest in the long-term improvement of forest resources and reduce their incentives to make claims over forests through deforestation (Chomitz, 2007; Karsenty and Ongolo, 2012; Shyamsundar et al., 2020). Clearly defined rights can establish boundaries governing the use of forest resources, help exclude outsiders, and discourage land grabbing (Ostrom, 1990; Zoomers, 2010). In turn, such rights, can facilitate community control over natural capital for income generation (Larson et al., 2010). Secure forest rights can also enhance the capacity of local communities to cope with external market and climate-induced shocks. For example, the option to use forest resources such as food, fodder, fuelwood, and non-timber forest products may help households manage during periods of drought and other extreme weather events (Chhatre et al., 2012; Larson, 2011). Finally, secure forest property rights may help foster human, social, and other forms of capital through stabilization of resource access and reduction in conflict (Ho, 2014; Larson et al., 2013)

Despite the benefits tenure security can bring, however, property rights to forests and the resources within them have remained weak and insecure in many low- and middle-income countries (RRI, 2018; World Bank, 2019). To address this issue, NGOs, donors, and government agencies have promoted, implemented, and otherwise supported land reforms and other efforts to strengthen forest-related property rights in Africa, Asia-Pacific, and Latin America and the Caribbean over the past quarter century. Interventions have often had both socio-economic and environmental objectives and range widely from devolution of resource rights to formal land titling (Table 1).

The environmental impacts of different types of forest property rights interventions and regimes have been relatively well studied. Comprehensive reviews have summarized the broad literature on this topic (Ojanen et al., 2017; Robinson et al., 2014) while several recent studies use quantitative impact evaluation techniques to assess the effect of land titling and other property rights reforms on deforestation (Blackman et al., 2017; Buntaine et al., 2015; Holland et

al., 2017; Miteva et al., 2019). However, the extent to which forest property rights interventions have reduced poverty and through what mechanisms remains much less well known. Here we address this gap in knowledge by carrying out a systematic review of available evidence on this topic. Our review addresses the following three questions:

1. What are the impacts of forest property rights interventions on poverty?
2. Do secure property rights over forest resources reduce poverty?
3. What are the pathways through which forest property rights interventions affect poverty?

To answer these questions we draw from a recently published systematic map of evidence on forest-poverty linkages (Cheng et al., 2019), which provides a comprehensive set of potentially relevant articles assessing the impacts of forest property rights interventions. Below we detail the data and methods we used in this review. We then present and discuss results before offering concluding remarks.

2. Data and Methods

2.1. Criteria for including articles in this review

To be included in this systematic review articles needed to meet criteria in a population-intervention-comparator-outcome (PICO) framework as described below.

2.1.1. Population

The population of interest for this review are discrete human populations living within or near forested or formerly forested areas in any country of the world.

2.1.2. Intervention

We examined interventions that sought to affect property rights related to forests and forest resources. To be included, studied interventions had to involve the introduction, promotion, or support of strengthened forest property rights or other action to change the allocation of such rights. Table 1 and the Data Extraction Codebook (Appendix 1) describe different intervention types and illustrative activities included in this review.

Table 1. Types of forest property rights intervention and illustrative activities

Intervention type	Illustrative activities
Promotion of land titling	Communal land mapping
	Policy advocacy
	Provision of technical assistance
Land titling	Land titles given
Legal recognition of forest rights	Land area or resource rights distributed
Devolution of forest/property rights from government to community, private, and other actors	One or more of bundle of rights devolved to households, communities or other actors
	Rights given for specific resources (e.g. trees, NTFPs)
Tenure administration through recordkeeping, taxation, spatial planning, and other means	Cadastral and other recordkeeping
	Taxation
	Spatial planning
Dispute resolution relating to forest property rights	Development or use of existing institutions (e.g., courts) to resolve property rights disputes
Restitution for loss of legitimate property rights	Return of original holdings to those who lost them
Redistributive land reforms	Allocation of public land or expropriation of private land for public purpose
Other	Other

Sources: FAO (2012); Ojanen et al. (2017)

Property rights define the range of privileges granted to individuals, communities, or other entities relating to specific assets or resources (Libecap, 1989). In this review, we follow established literature in defining a property right as an enforceable claim to use, control or otherwise benefit from a resource (Bromley and Cernea, 1989; Macpherson, 1978). We used a bundle of rights approach to structure our analysis of evidence on how different property rights might affect poverty outcomes. This review focuses on the bundle of five property rights originally identified by Schlager and Ostrom (1992):

- **Access**: the right to enter a defined physical property;
- **Withdrawal**: the right to enter a defined physical area and obtain resource units or products of a resource system (e.g., cutting firewood or timber, harvesting mushrooms, diverting water);
- **Management**: the right to regulate internal use patterns and transform the resource by making improvements (e.g., planting seedlings and thinning trees);
- **Exclusion**: the right to determine who will have right of withdrawal and how that right may be transferred;
- **Alienation**: the right to sell or lease withdrawal, management, and exclusion rights.

These rights can be conceived of as a hierarchy, from the most minimal rights (access) to most extensive (alienation). For our analysis, we assumed that holding a higher level right

implies having lower level ones as well. For example, a case that considered alienation assumes that the other four rights are also present.

Our analysis also assumed that more extensive rights are likely to be associated with greater security of rights. The literature distinguishes between *form* and *security* of land tenure and property rights where the former is about the content of the rights (e.g. their duration, marketability, and breadth) and the latter is about the assurance that the rights will be upheld by the government and society (Naughton-Treves and Wendland, 2014; Sjaastad and Bromley, 2000). In practice, measures of form and security are correlated in many empirical studies of the effect of land tenure and property rights (Arnot et al., 2011) and data limitations inhibit efforts to draw wider conclusions specific to rights and tenure security (Robinson et al., 2014). Given these considerations, we treated more extensive property rights, particularly those of exclusion and alienation, as more likely to imply greater tenure security.

2.1.3. Comparators

Only articles that used a spatial, temporal, or between-group comparator were included in this review. Temporal comparators compare the effects of interventions over time and include analysis based on before and after, continuous time series, interrupted time series, or perceived change data. Spatial comparators examine the effects between different sites, where each site represents a distinct location, from individual plot to broader scales, such as community, protected area, or other sub-national spatial unit. Between-group comparators compare effects between human populations in relation to the intervention, species, type of ecosystem or the presence/ absence of an intervention. Spatial and between-group comparators that failed to include a control group were excluded, such as between-group comparators characterized only by the disaggregation of socioeconomic status, gender, race and ethnicity.

2.1.4. Outcome

This review includes articles that assess the impact of forest property rights interventions on poverty. Poverty can be defined broadly as a pronounced deprivation or disadvantage that limits possibilities for a certain level of wellbeing (Schleicher et al., 2018; Sunderlin et al., 2005). It is a multidimensional concept that encompasses material income or consumption, education, health, and security, among other aspects of human wellbeing attributes (Alkire et al., 2015; World Bank, 2018). Following Cheng et al. (2019), we classified evidence on poverty outcomes into two broad dimensions:

1. Income and consumption, and
2. Capital and assets.

These two categories allowed us to capture studies not only using monetary constructs of poverty as most commonly done in the literature on forest-poverty linkages (Cheng et al., 2019; Miller and Hajjar, 2020) but also those examining other dimensions of poverty. Revenue generated from the direct sale of goods, wage labor, and use of forest goods are illustrative indicators for income and consumption outcomes (Table 2). Indicators for capital and assess include credit, savings, forest assets where sale and exclusion rights exist, forest-based knowledge and skills, and community institutions, among others.

Table 2. Poverty outcome categories, subcategories, and illustrative indicators

Category	Subcategory	Indicators
Income and Consumption	Total income	Per capita monetary income
	Monetary forest income	Revenue from direct sale of goods Wage labor earnings Value addition/ entrepreneurship
	Forest-related consumption (physical forest income)	Use and consumption of forest products such as timber, fuelwood, food, NTFPS, etc. Time saving from fuelwood collection
	Consumption	Expenditure (as a proxy for consumption) Per capita consumption
Capital and assets	Financial capital	Credit, savings and debt (relating to forest sources)
	Natural capital	Forest assets owned/claimed Land assets owned/claimed
	Physical capital	Forest-based material assets owned/claimed Livestock owned/claimed Change in assets
	Human capital	Perceptions of forest-based knowledge and skills Number of people trained in forest-related activities
	Health and education	Expenditure on education and healthcare Prevalence of malaria and other disease Access to school/health facilities
	Social capital	Inequality Presence and composition of community forest management and other local institutions

Source: Adapted from Cheng et al. (2019) and FAO et al. (2016).

2.2 Study Types

Our review focused on primary impact evaluation studies that used experimental, quasi-experimental, or non-experimental approaches. To be included in the original systematic map (Cheng et al. 2019), articles had to include quantitative data, so all articles in our review are quantitative, though some articles also used qualitative data. We excluded theoretical or

modeling articles, purely qualitative research, editorials, and literature reviews that did not describe the methods used for the search. We searched for systematic reviews or traditional reviews on this topic in the Cheng et al. (2019) database, but did not find any for inclusion.

2.3 Identification of studies

To identify studies for inclusion in this review we used data collated in Cheng and colleagues' (2019) systematic map of evidence on forests and poverty alleviation. We extracted data on articles found at the intersection of rights (governance and individual rights/empowerment) and any poverty-related outcome in that map. We used the criteria described above to screen the articles for ultimate inclusion in this systematic review.

Some articles included information on more than one case. In such instances, we coded cases separately. To qualify as a separate case study, a given study had to present information from distinct geographical or institutional contexts on at least one intervention. The intervention studied could be the same but implemented in different geographic areas. More than one intervention could be implemented in a given area, with each studied separately. Our approach to distinguish between case studies and articles follows that of Malkamäki et al. (2018) and other systematic reviews. Thus, the number of cases we report is greater than the number of articles included in our dataset.

2.4. Data extraction

For each article included in this review, we started with data previously extracted by Cheng et al. (2019) and then extracted additional information specific to the topic of property rights. Information on the specific data extracted is available in Appendix 1 and the related codebook (Appendix 2). Our final dataset included information on the following from Cheng et al. (2019): general study information, type of intervention, outcomes (broad category and specific indicators), causal mechanisms reported, and study design. We then added more detailed information on each studied property rights intervention, such as the specific rights it sought to affect, the intended beneficiary group(s), duration of implementation, and funding source (Appendix 1). The dataset also included further information on the methods used in each study, including sampling and statistical analysis. Finally, we included information on reported direction of the outcome(s).

Information on direction of outcome was reported for each outcome type and indicator measured in the article. However, the magnitude of change was usually not recorded, thus, our data on outcome direction represent a heuristic measure of change and not an absolute measurement. Included studies discussed up to five outcome indicators. We classified each such indicator by outcome type and then recorded the outcome direction as positive, negative, mixed, or neutral. Classification of outcome direction was determined based on statements by the author(s) in the results and discussion sections of included articles. Where more than one indicator was used in a given case study, we grouped the outcome indicators by outcome type and defined a grouped outcome direction for each outcome type. For example, if a case study had two income and consumption-based outcomes with a negative and positive outcome directions, the overall outcome direction for income and consumption for that case study was

recorded as mixed. To be recorded as positive or negative, an outcome needed to have all indicators with the same direction. A neutral outcome direction did not affect the overall direction recorded.

2.5. Data analysis

We set out to conduct meta-analysis for this review, but the wide diversity of outcomes and indicators prevented us from doing so. We therefore present quantitative summaries of key findings using tables, charts, and heat and spatial maps. Our analysis and reporting on results distinguishes between those studies that used quasi-experimental methods and those that did not. Finally, we carried out a narrative synthesis to examine evidence on mechanisms linking different forest property rights interventions to poverty.

3. Results

3.1. Overview of the evidence base

A total of 61 articles comprising 91 case studies met our inclusion criteria. Figure 1 shows the step-by-step results from our search and screening approach, beginning with the 243 articles identified as potentially relevant in the Cheng et al. (2019) systematic map. All included articles are listed in Table A1.

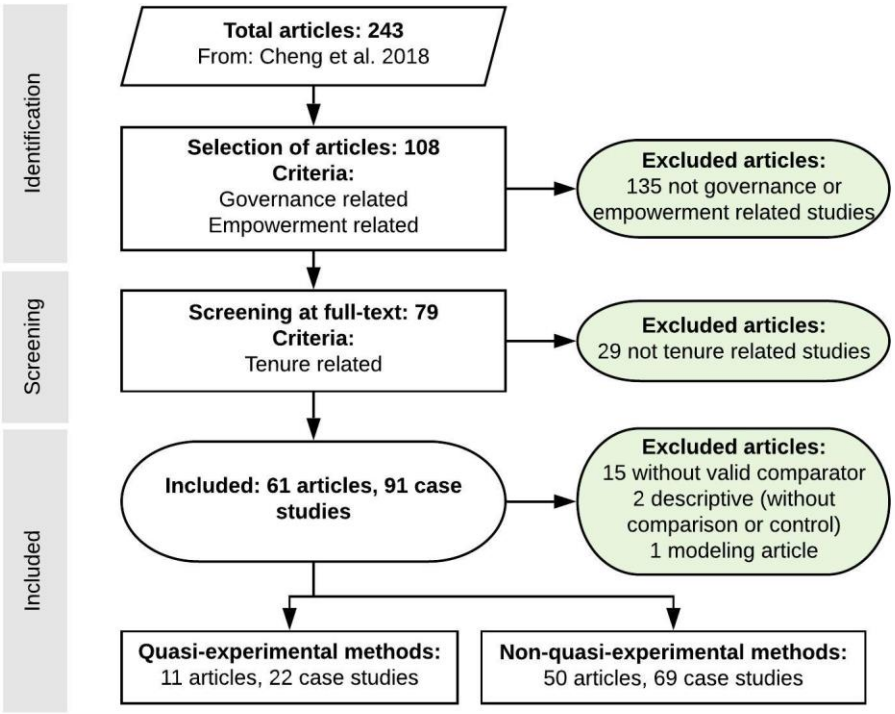

Figure 1. Diagram illustrating articles identified from the initial systematic map (Cheng et al. 2019) and included following screening and full text assessment.

Only 11 articles (18% of the 61 total) comprising 22 case studies (24% of the 91 total) used quasi-experimental methods that controlled for potentially confounding factors. Our search did not yield any studies using experimental methods (e.g. randomized control trials (RCTs)). The remaining 50 articles comprising 69 case studies used other quantitative methods that did not explicitly control for potential confounding factors. We note that 47 case studies also used qualitative methods in addition to quantitative ones, with only one of these being a quasi-experimental study (Persha and Meshack, 2016).

Property rights interventions are not implemented randomly, but rather respond to national or international policy prerogatives. Methods that do not account for such non-random assignment therefore risk leading to biased estimates of policy impact (Ferraro, 2009; Gertler et al., 2011). Quasi-experimental approaches seek to create treatment and control groups that are as similar as possible on key dimensions (potential confounders) but differ only in that one group received the treatment (here, a forest property rights intervention). Identification of potential confounders is based on contextual knowledge of the study area and theoretical understanding of how each might affect intervention impacts. Through such careful choices, quasi-experimental impact evaluation methods, such as matching and differences-in-differences, function as reasonable approximates of RCTs (Gertler et al., 2011). The quasi-experimental cases included in our review used a range of methodologies. Matching based methods (n=17; 77%) were the most frequently used followed by differences-in-differences methodology (n=5; 29%).

Our results show a general trend toward an increasing number of articles on this topic over time, though recent years have shown considerable variability (Figure 2). Studies using quasi-experimental approaches (the black part of the bars in Figure 2) have become somewhat more frequent in recent years, but still comprise a small proportion of all studies on this topic.

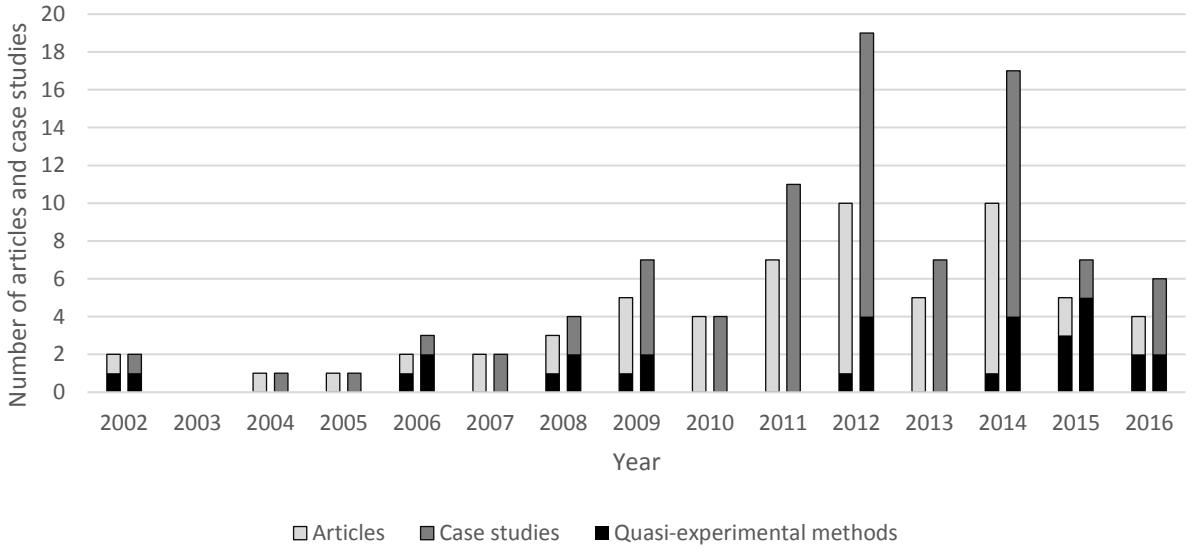

Figure 2. Number of articles and case studies by publication year. *Note:* Black shaded part of bars indicate number of articles and case studies using quasi-experimental methods with the remainder of each bar showing the number that did not use such methods.

The 91 case studies we identified were distributed across low- and middle-income countries (Figure 3), with only one case in a high-income country (the United States; Charnley et al., 2008). However, geographic coverage was highly uneven, with many cases concentrated in a few countries in Africa and Asia. In all, articles included cases from 24 countries. Despite the importance of forests in wide swaths of Latin America and Southeast Asia, very few articles focused on these regions.

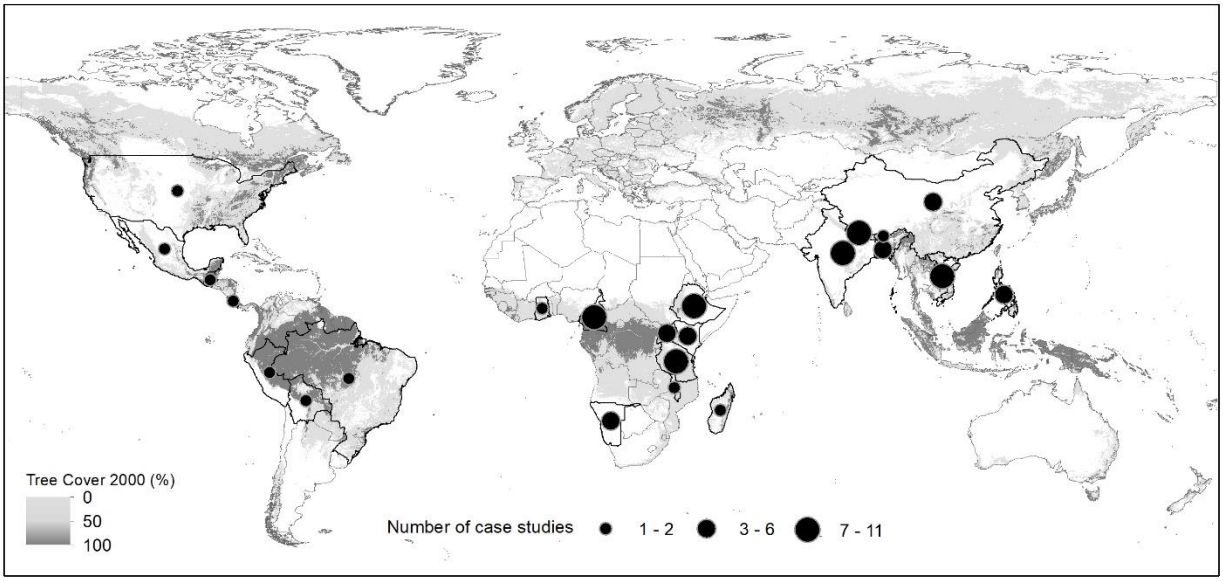

Figure 3. Global tree cover, country boundaries, and geographic distribution of case studies (n=91). *Note*: Tree cover data from the year 2000. Source: Hansen et al. (2013).

3.2. Intervention types and property rights targeted

A large majority (n=82; 90%) of the case studies in this review examined devolution of forest property rights from government to community or private actors. Within this broad intervention type, our review uncovered a range of more specific policies. Those most frequently studied were community forestry (n=20 case studies), community-based forest management (n=11 case studies), and joint forest management (n=14 case studies). Other specific policies in our dataset that involved devolution of forest property rights included integrated conservation development projects (ICDP), Forest Stewardship Council (FSC) certification, forest compensation schemes, and wildlife management areas.

The other two broad intervention types we found were administration of tenure through recordkeeping, taxation, spatial planning and other means (n=4; 4%) and legal recognition of forest rights (n=4; 4%). The remaining study was classified as "other" and assessed the poverty-related impacts of a national law in Peru that affected how timber could be extracted (L'Roe and Naughton-Treves, 2014).

All studies included in our review analyzed property rights interventions where the intended beneficiaries were members of local, usually forest-proximate communities. We did not identify any studies that examined impacts on companies or private individuals beyond such communities.

Nearly all articles focused on cases where property rights were strengthened or augmented. However, two articles examined cases where property rights were taken away or restricted. One article (Ameha et al., 2014) involved lessening of two rights (access and withdrawal) and the other involved maintenance of access rights but a lessening of withdrawal rights (Charnley et al., 2008).

All studied interventions where property rights were strengthened included rights to access a given forest area and rights to withdraw at least some resources from it (Figure 4). More than three quarters of the case studies (n=69; 76%) reported results from an intervention that promoted management rights for a given forest area. However, relatively few studied interventions promoted the more extensive property rights of exclusion (n=21; 23%) and alienation (n=7; 8%). Of those studies investigating exclusion and alienation rights, none used more rigorous quasi-experimental methods.

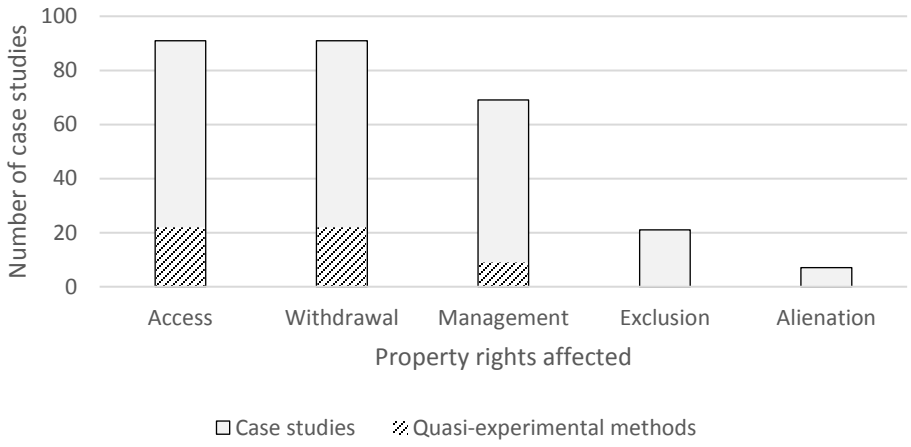

Figure 4. Property rights affected in studied tenure interventions. *Note:* The shaded part of each bar indicates the number of case studies using quasi-experimental methods with the remainder showing the number that did not use such methods. Rights affected are assumed to include the most extensive right reported as well as the less extensive ones that precede it in the continuum of property rights. For example, the column labeled alienation means all property rights (access, withdrawal, management, exclusion, and alienation) were affected.

3.3. Poverty impacts

Of the 91 cases in our review, 75 reported on interventions affecting income/consumption and 59 reported changes in capital/assets for beneficiary groups (some studies looked at both dimensions). We identified 16 case studies using quasi-experimental methods to examine income/consumption dimensions and 14 such studies examining capital/assets dimensions.

Specific income/consumption measures of poverty studied included total household income, income from specific forest activities such as timber sale, employment, and per capita consumption among populations affected by the forest property rights intervention. Specific capital/assets measures studied varied widely. Some examples include: participation in governance of forest resources, perception of power to change decisions, agricultural land holdings, investment of community funds into physical infrastructure, and access to credit and savings, among others.

The majority of studies reported either positive or mixed (e.g. at least one positive and one negative) impacts on poverty, though a number did report negative or neutral (e.g. no) impacts. This finding held for both income/consumption and capital/assets aspects. For the former set of impacts, 19 studies reported positive results (25%) and 34 reported mixed results (45%) with 8 (11%) reporting negative results and a further 8 neutral results. Those studies using quasi-experimental methods were less sanguine, however: they report an equal number of positive and negative outcomes (5 each of the 16 such studies). Four quasi-experimental studies reported a mixed outcome (25% of such studies compared to 45% of all studies).

Aggregate results from the set of studies examining capital/assets impacts were similar to those for studies on income/consumption impacts, with 19 (32%) reporting positive results and 27 (46%) reporting mixed results. Six studies reported negative results (10%) and only two reported neutral results. Those studies using quasi-experimental methods reported a similar number of positive outcomes (4 studies of 14 or 29%) compared to all studies investigating capital/assets dimensions of poverty (32%). However, a much larger proportion of quasi-experimental studies found negative impacts (29% compared to 10% of the total studies).

These results provide an overall picture of the evidence on the direction of impact of forest property rights interventions on poverty, but they should be interpreted carefully. For instance, the evidence base includes comparatively few studies that explicitly account for confounders through quasi-experimental methods. Further, simple count data on reported direction do not convey the magnitude or heterogeneity of impacts. Insufficient information in many of the included studies prevented us from drawing more generalizable conclusions. However, the evidence base did permit more detailed analysis of reported effects of interventions targeting more or less extensive property rights (next section) and also some discussion of mechanisms linking different property rights interventions with changes in poverty (section 3.5).

3.4. Specific linkages between property rights interventions and poverty impacts

Figure 5 summarizes evidence on the linkages between the property rights affected in studied interventions and the dimensions of poverty assessed. Interventions that supported property rights up to management of forest land and resources were the most well studied, with 38 case studies examining impacts on income/consumption dimensions of poverty and 29 examining capital/assets dimensions. Interventions supporting rights up to withdrawal and exclusion were about equally well studied. Relatively few studies examined interventions that promoted the full bundle of rights for beneficiaries (seven such studies examined income/ consumption and three examined capital/assets outcomes).

Figure 5. Heatmap of evidence on linkages between different property rights affected in studied interventions and broad poverty outcome categories.

3.4.1. Poverty impacts of interventions supporting increased property rights

Less than a quarter of the cases in our review controlled for confounders. Evidence from such studies using quasi-experimental approaches focused on interventions relating to a more minimal set of rights (e.g., access and withdrawal only). None of them assessed interventions supporting the more extensive property rights of exclusion and alienation used quasi-experimental methods.

Some evidence from non-quasi-experimental studies on these more extensive property rights was available, with 19 studies examining income/consumption dimensions of poverty and 15 examining capital/asset dimensions. Results tended to be positive or mixed (13 studies reported positive outcomes, 17 reported mixed outcomes, and 5 neutral outcomes), but potential bias arising from not addressing potential confounders means these results must be interpreted with care.

We identified nine quasi-experimental case studies analyzing interventions seeking to strengthen forest management rights. Research by Ameha et al. (2014) is illustrative of the overall mixed results reported across the studies. The authors conducted case studies of Participatory Forest Management (PFM) in two sites in Ethiopia, finding divergent outcomes. In the Dodola forest area, where commercial timber harvest was allowed, PFM resulted in higher livestock assets and forest income among members of forest user groups. By contrast, members of such groups under PFM in the Chilimo forest area were found to have lower total incomes and assets than non-members. In the Dodola case, however, while members of newly created forest user groups benefited from PFM and the changes in property rights it brought, non-members lost access to forest products and grazing, leading to income shocks (Ameha et al. 2014).

The remaining 13 quasi-experimental case studies in our review examined interventions promoting forest access and withdrawal rights. Interestingly, several of these case studies were

from the same country, often presented in the same article, but with differing outcomes. For example, Jagger (2008) examined the impact of greater access and withdrawal rights under two different forest management authorities in Uganda, with different reported outcomes. In one case, there was no significant change in average annual household income from forests, but in the other households living adjacent to a forest reserve saw significant gains in average annual household income from forests. However, she found that increases were limited to the wealthiest households and derived primarily from sale of illegally harvested timber. Other quasi-experimental studies in our review also found inequalities in income gains from increased access and withdrawal rights (e.g., Coleman and Fleischman, 2012; Jumbe and Angelsen, 2006)

3.4.2. Poverty impacts of interventions restricting property rights

In addition to those interventions that promoted expanded forest property rights, some studied interventions restricted rights. We identified three such cases. Two case studies used quasi-experimental methods. Ameha et al. (2014) reported on two PFM interventions that restricted both access and withdrawal for some groups. As described above, non-members of forest user groups in the Dodola case lost access to forest resources and grazing areas which led to negative impacts on both dimensions of poverty. In the Chilimo district, the opposite scenario held: members of forest user groups were reported to have lower income levels compared to non-members.

A third study by Charnley et al. (2008) described a situation in which access was granted but withdrawal was restricted among those living near government-owned forests in the US Pacific Northwest due to a policy shift from intensive timber harvesting to ecosystem management. The outcome direction reported in this study was negative, with those living within five miles of US federal forestland were more likely to have experienced a decline in socio-economic well-being compared to those living further away. This study provides rich qualitative detail about the case, but did not use quasi-experimental methods to address potential confounders.

3.5 Causal pathways linking property rights interventions and poverty outcomes

Enhancing property rights for households, communities, and other actors may lead to improved social and ecological outcomes through multiple pathways. Such pathways may be comprised of one or more causal mechanisms—processes by which an intervention causally affects a specific social or ecological variable through one or more intermediate variables (Ferraro and Hanauer, 2014a; Hedström and Ylikoski, 2010). Causal mechanisms are frequently moderated by contextual factors, leading to variable outcomes in different places (Ferraro and Hanauer, 2014a). Pathways centered on strengthening property rights may also interact with other pathways, like increased labor and resource productivity or better market linkages, that synergistically connect forest management to poverty outcomes. Such interlinked pathways may even be required to yield sustained poverty-reduction over the long-term in forest landscapes (Shyamsundar et al., 2020).

However, despite the diversity of potential rights-based pathways and their policy and research interest, the evidence base on specific mechanisms linking change in forest property rights to poverty outcomes was relatively thin. Only six articles comprising 11 of the 91 total case studies in our review explicitly discussed such mechanisms and none provide robust quantitative evidence on the identified causal mechanisms through, for example, mediation analysis or other means (Imai et al., 2011; MacKinnon, 2012). Just one of these articles (Ameha et al., 2014) used quasi-experimental methods and discussed a specific mechanism. Our review of the 11 case studies suggested at least five kinds of causal mechanisms. We discuss each mechanism in turn and comment on how the nature of property rights supported and key moderating factors might also shape how the mechanisms affect ultimate poverty outcomes.

3.5.1. Sale of forest products

Commercialization of timber and other forest products was identified as a causal mechanism linking a forest property rights intervention to poverty alleviation in four articles using quasi-experimental designs (Ameha et al., 2014; Gelo et al., 2016; Jagger, 2008; Rahut et al., 2016). This mechanism requires at least the rights to access and withdraw forest resources. It also likely necessitates additional resources, such as facilitation of market linkages and technical expertise in sustainable harvesting, to be viable at larger scales and over the long term (Ameha et al. 2014; Gelo et al., 2016). In addition, it requires that forest resources to which local actors have rights are valuable enough to sell.

Evidence in our review also suggests that wealthier households are more likely to gain benefits via this pathway than poorer ones. For example, in her Uganda study, Jagger (2008) found that wealthy households benefitted from selective monitoring and enforcement of rules by forest officials by offering bribes that facilitated illegal timber extraction. By contrast, poorer households faced more strict enforcement of rules that limited their income opportunities.

3.5.2. Resources for livestock grazing

Changing access and withdrawal rights to forests can affect availability of fodder and pasture necessary for raising livestock, an important asset for many rural households around the world. This mechanism was identified by several studies in our review. For instance, a case study in Nepal found that restricted access to forest resources for conservation led to reduction in livestock holdings, exacerbating food insecurity, particularly among poorer households (Dhakal et al., 2010). Our review found other cases where the intervention strengthened local rights such that grazing livestock on forest land was permissible. Ameha et al. (2014) found that PFM in one of their cases (Dodola) led to increased income for forest management group members due to greater livestock assets developed through increased grazing.

3.5.3. Trust and social capital

The two previous causal pathways may be possible without higher order property rights like management and alienation, but other pathways affecting poverty will require more extensive rights. One example is the building of trust and social capital that can occur through efforts to strengthen property rights. Granting more extensive rights can encourage collective

action leading to increases in social capital, better forest management and, ultimately, improved livelihoods outcomes. Three studies in our review explicitly mentioned this pathway (Baral and Stern, 2011; Coleman and Fleischman, 2012; Jarzebski et al., 2016). In their study of forest decentralization in Uganda, Coleman and Fleischman (2012) found that strengthening local property rights helped empower local actors and provided incentives for improved collective action leading to more equitable wealth outcomes. Baral and Stern (2011) reported positive outcomes as well from two case studies in Nepal. However, case studies from the Philippines (Jarzebski et al., 2016) and in Bolivia, Kenya, and Mexico (Coleman and Fleischman, 2012) were mixed.

The length of time that communities have received rights and have participated in forest management may help explain these divergent outcomes. To illustrate, Rahut and colleagues' (2016) study in Bhutan found that community members with more than 10 years of experience in community forestry had higher income and food security levels than those with less than 10 years. Coleman and Fleishman's (2012) work supports this finding. They argue that forest decentralization tenure reforms are likely to be mutually-reinforcing over time, with impacts stronger in countries having a long history of decentralized forest governance.

At least one quasi-experimental study in our review (Jumbe and Angelsen, 2006) discussed this social capital pathway, but found it could also lead to negative consequences for poverty. With new rights come new potential responsibilities (Galik and Jagger, 2015). So, new management rights often imply the need for more intensive participation by local community members. Increased management responsibilities require time and effort, which can take away from other income-generating activities. In their Liwonde forest case study in Malawi, Jumbe and Angelsen (2006) found a significant income reduction among participants in a forest co-management program, which they attributed to a sacrifice in forest income due to participation in the program. The cost of participation fell especially heavily on women and more forest-reliant households.

3.5.4. Equity

A study of Traditional Community Based Forest Management in Kenya's Loita forest highlighted equity as a mechanism linking strengthened property rights under broader forestry reform to poverty outcomes (Mbuvi et al., 2015). In this case, the composition of forest management committees was carefully considered so that members were of average well-being status and depended more on forest resources than community elites, who were deliberately excluded as a means to ensure equity. There was also a strong traditional support system of taboos, practices, and social obligations reinforcing the value of equity within and across generations. For example, the children of the poor were prioritized to receive forest-related assets. In turn, benefits of forests were thought to be more equitably distributed. The reported result on capital/assets was positive, though the study did not control for potential confounding factors.

3.5.5. Forest resource improvement

The final mechanism identified in our review was improvement in forest resources. To work, this mechanism likely requires connection with at least some of the preceding ones. The state of the forest resource base will determine possibilities for making use of it and thereby influence poverty outcomes. Two studies mentioned this mechanism explicitly. An assessment of the Tamil Nadu Afforestation Project in India found that increased management rights under the project led to an improvement in forest quality which resulted in improved local socio-economic conditions (Sreedharan and Matta, 2010). At least one case study in the Philippines also pointed to increased natural capital as contributing to increased community resilience and eventually positive capital/assets outcomes (Jarzebski et al., 2016).

4. Discussion

4.1. Impacts of forest property rights interventions on poverty

A major conclusion of our review is that robust evidence on the poverty impacts of different forest property rights interventions that accounted for potential confounding factors remains limited. The paucity of such evidence constrains our ability to draw strong conclusions. Overall, available evidence points to positive and mixed poverty outcomes of studied property rights interventions. However, results from more robust quasi-experimental assessments tended to be more varied, reporting both negative and positive impacts. These general findings held for both income/consumption and capital/assets dimensions of poverty.

That so much of the evidence base reported mixed outcomes may be due to a number of factors. First, because poverty is multidimensional, included studies often used more than one poverty indicator, which may increase the likelihood of different outcome directions. Different kinds of forest property rights interventions might also be expected to affect different dimensions of poverty and these may be in contradiction. For example, granting management rights might affect social capital and empowerment aspects of poverty but also lead to increased responsibilities that reduce income earning opportunities. Second, granting new rights to indigenous people to use forests is often merely formal recognition of existing de facto rights, which does not immediately translate into welfare improvements (Larson et al., 2010). Finally, changes in the allocation of forest property rights can alter who benefits from forest resources, leading, for example, to some groups to increase benefits and others to suffer losses.

This last point highlights another major finding from this review: the benefits—and costs—from forest property rights interventions were often unequally distributed. Many studies reported positive poverty-related outcomes, but noted that wealthier households, better educated individuals, or men tended to benefit more (e.g., Jagger 2008; Lewark et al., 2011; Persha and Andersson, 2014)). Other cases reported mixed outcomes where such groups profited at the expense of poorer or less educated people or women. In some cases newly empowered forest management groups experienced positive outcomes while non-participants saw their rights curtailed with detrimental welfare effects. These findings support a broader literature concluding that dimensions of inequality, such as gender, education, and wealth, are likely to result in inequitable outcomes from forest policy reforms (Adhikari, 2005; Andersson and Agrawal, 2011; Rocheleau and Edmunds, 1997). Careful institutional design, including linkages between local forest user groups and external organizations as an accountability

mechanism, can help to mitigate the risk of elite capture and reduce inequality in benefit sharing (Persha and Andersson, 2014).

Besides a major gap in evidence from quasi-experimental studies, we also found other important biases in the literature relating to overall poverty outcomes. For example, only one broad class of rights interventions was studied: devolution of rights to communities, including allocation of new rights and titling. Other interventions like those relating to administration of tenure, dispute resolution, or restitution were rarely, if at all studied. Given the widespread decentralization of natural resource governance in countries around the world over the past three decades (Ribot, 2004), it would make sense that downward transfers of property rights would be relatively well-studied. Nevertheless, more information on other types of interventions, which have also been widely implemented, is needed to strengthen knowledge of how reallocation of forest property rights affects poverty.

This review also revealed major geographic biases. Studies from many countries with substantial forest cover were absent in our dataset. There are several possible reasons for this. There may not have been any relevant forest property rights intervention in some countries, though this is unlikely given the known prevalence of such reforms. Such intervention may also have not been studied at all. Alternatively, they may have been studied, but with results published in a language other than English and so outside of our search or they used different terms for property rights and tenure that were somehow not included in the initial search string.

Finally, another important bias revealed in this systematic review is a focus on a limited range of property rights promoted in studied interventions. The right to manage forest resources was the most commonly studied, with the poverty impacts of exclusion and alienation rights receiving very little attention in the literature. We found no quasi-experimental evidence on these more extensive property rights and in general quasi-experimental studies tended to focus on "use" rights of access and withdrawal rather than the more "authoritative" rights of exclusion and alienation (Sikor et al., 2017). The next section reflects on implications of this bias.

4.2. Do more secure forest property rights reduce poverty?

We find only tentative evidence that more secure property rights reduce poverty. There were no quasi-experimental studies of interventions promoting more extensive forest property rights which may be associated with greater security. Existing evidence was positive, mixed, or neutral, with no studies reporting negative impacts from interventions that provided exclusion and alienation rights. We caution, though, that none of these studies accounted for potential confounding factors in their research designs and there may also be a publication bias toward studies reporting positive results.

The quasi-experimental studies in our review do, however, give a clue that approaches that affect more limited use rights of withdrawal and access are less likely to alleviate poverty than more extensive rights. Those studies reported a much greater proportion of negative outcomes (7 or 11 studies) than those that did not use a quasi-experimental design. One reason for this result is that property rights interventions that only support more limited "use" rights may be more likely to lead to elite capture and illegal timber harvesting. A number of studies in

our review reported this finding, including several quasi-experimental ones (e.g., Jagger 2008; Jumbe and Angelsen, 2006; Sikor and Nguyen, 2007). This finding is suggestive that more extensive rights may help address such inequitable and unsustainable outcomes. At minimum, it indicates care is needed, particularly in designing interventions only targeting such use rights.

If theory and extant empirical evidence suggest more extensive property rights are critical for delivering sustainable benefits from forests over the long-term, why were there relatively few studies on interventions promoting them? One reason may be that such interventions are simply less prevalent in the world than ones promoting less extensive use or management rights. This explanation seems plausible, but there are many cases where reforms include the full bundle of rights for indigenous and local communities (Larson et al., 2010; RRI, 2018). Further, a set of recent quasi-experimental studies have begun to examine the impacts of interventions supporting a fuller extent of forest property rights on deforestation (Blackman et al., 2017; Buntaine et al., 2015; Holland et al., 2017; Miteva et al., 2019) and on poverty (Oldekop et al., 2019). A more plausible explanation may therefore be that lack of data and time lags between environmental and socio-economic impacts inhibit evaluations of the poverty impacts of such interventions (Miller et al., 2017).

4.3 Pathways through which forest property rights interventions affect poverty

Our review found few studies that explicitly identified causal mechanisms linking forest property rights interventions to poverty outcomes. This finding is similar to other studies relating to forest-poverty linkages more generally, including in the systematic map on which our review is based (Cheng et al., 2019). The limited emphasis on description let alone testing of such mechanisms presents a major challenge to understanding how forest property rights generate impacts. This lack of knowledge, in turn, constrains efforts to design and improve the effectiveness of forest property rights and tenure interventions.

Our results are, however, do raise some important issues for further exploration. For example, sale of timber and also other forest products seems to be a major causal mechanism as also found in another recent review of forest-poverty linkages (Miller and Hajjar, 2020). However, that pathway raises serious questions about potential overharvest of timber resources and elite capture as discussed above, which threaten the ability of forest property rights interventions to yield durable results over the long-term.

Other pathways not found in our review may also exist. For example, allocation of more extensive property rights to biodiverse or otherwise culturally interesting forestland could allow for revenue generation through ecotourism. This mechanism was identified and tested in research on protected areas in Costa Rica that used quasi-experimental methods (Ferraro and Hanauer, 2014b).

Another important finding emerging from our review is that multiple causal mechanisms interacting are likely required for sustainable forest-based poverty alleviation. This result comes through in recent synthetic work based on the peer-reviewed literature and World Bank experience (Shyamsundar et al., 2020) as well as case studies on forest enterprises around the world (Humphries et al., 2018; Macqueen et al., 2018). Research examining such interactions

and linkages among mechanisms and moderating factors is sorely needed to further our understanding of the differnet ways in which forest property rights interventions—and indeed other kinds of interventions—can create pathways to poverty impact.

4.4. Potential Limitations

Our review may be subject to some limitations. The first relates to the comprehensiveness of our search. It is possible that we missed relevant studies due to use of different terms for forest property rights and tenure than those in the original search string used by Cheng et al. 2019. Recent work has sought to update and reconceptualize Schlager and Ostrom's bundle of property rights and it is possible that the original search did not use some keywords used in those studies. However, Cheng et al. (2019) did include several different terms related to this topic, including more recent ones related to, for example, payments for environmental services schemes like REDD+, so we believe this concern may be minimal. A more likely source of bias in the evidence we present is that Cheng et al. (2019) only included studies published in English. Potentially relevant studies published in French, Mandarin, Portuguese, Spanish or other languages were therefore not included in our review. This is unfortunately a common limitation of many systematic reviews and future work should address it.

Finally, as discussed above, we assumed that extensive property rights, particularly those of exclusion and alienation, implied greater tenure security. Though the form of property rights (e.g. the rights of the bundle given or held) is often correlated with security (Arnot et al., 2011) this may not always be the case. A related point is that the right of alienation, the most extensive right in the Schlager and Ostrom typology, may not imply full property security. Given long histories of their rights being abrogated, many indigenous groups now advocate for communal property rights that are unsaleable and in-mortgageable (D. Kaimowitz, Pers. Comm.).

5. Conclusion

We have conducted a systematic review of the evidence on the impacts of forest property rights interventions on poverty. Our results provide tentative support for economic theory as well as advocates arguing that more secure property rights are more likely to lead to positive welfare effects. On balance, the evidence suggests interventions to strengthen forest property rights have led to positive or mixed outcomes. Further, interventions promoting more extensive rights of exclusion and alienation appear to more often lead to positive outcomes on both income/consumption and capital/assets dimensions of poverty. However, we caution that evidence from more robust causal impact assessments is still limited, particularly for interventions targeting a more extensive range of property rights. Our ability to draw strong conclusions about the direction of poverty impacts from different kinds of forest property rights interventions, in turn, remains limited.

5.1 Policy implications

Our results suggest that investments in strengthening forest property rights for local communities can help boost livelihoods and alleviate poverty, generally, but that promotion of more extensive rights is likely to be more effective.

However, our results suggest that care is needed in designing politics and programs so that they do not further exacerbate existing inequalities—or create new ones. In particular, careful attention is required to ensure that new rights do not impose (uncompensated) costly responsibilities for the poor, women, and those with heavy reliance on forest resources for their livelihoods. While allocating new rights, there is also a need to provide supporting skills so that rural communities have capacity to use these rights to earn higher income. Moreover, adequate care is required to ensure provisioning and utilization of new rights within the acceptable sustainable limits of forest resource use.

Another key policy implication is the need for funding for further research on forest property rights interventions. In particular, there is a need for more rigorous quasi-experimental studies on this topic. Beyond that there is an important opportunity for policymakers to work with researchers to design RCTs on interventions as done in other sectors (see e.g., efforts supported by the DIME group at the World Bank) and increasingly in relation to forests (Jayachandran et al., 2017). Recent advances in measuring poverty using technology, including remote sensing (Jean et al., 2016), also holds promise for cost-effective application to assess impact in this domain.

5.2. Research implications

Key research implications of this systematic review include the following. First, as noted, there is a major need for new studies using experimental and quasi-experimental research designs to advance knowledge on this topic. This need is particularly acute in relation to interventions promoting more extensive forest property rights. Fortunately, several studies included in our review (e.g. Pailler et al., 2015; Ameha et al., 2014) and new work (Oldekop et al., 2019) demonstrate that such research is possible. These studies share in common that they are guided by theory, make use of publicly available data, clearly explain their research designs, and perform sensitivity analyses and robustness checks. Second, further research on the causal mechanisms and broader pathways connecting property rights changes to poverty outcomes is also urgently needed. Research in these two areas promises to enhance our understanding of the impacts of forest-related property rights reforms and in so doing build theory and inform policy relating to how forests can contribute to improved human welfare over the long-term in diverse contexts around the world.

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Appendix

Table A1. Included articles with number of case studies extracted from each one. Articles with a quasi-experimental study design are shown first (1-11), followed by articles with non-quasi-experimental study design (12-61).

Number	Reference	Number of case studies
Quasi-experimental study design		
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