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Research Frontiers on Forests, Trees, and Poverty Dynamics

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Abstract

Forests and trees provide a range of goods and services vital for human well-being, particularly for people who live below the poverty line. Yet a number of important knowledge gaps remain regarding the relationship between forests, trees, and poverty dynamics. Here, we highlight five research priorities that require urgent attention if policy makers and practitioners are to realize the potential for forests and tree-based systems to contribute to poverty alleviation. These are: examining forest-poverty dynamics, especially over the medium- to long-term; assessing the relative effectiveness of different forest-related policy and management interventions for poverty alleviation; identifying the key barriers to more equitable, just, and sustainable use of forests and trees, and ways to overcome them; expanding the evidence base to cover under-represented geographies and contexts; and bringing to light the 'hidden dimensions' of forest contributions to poverty alleviation.

Keywords: poverty alleviation; poverty reduction; equity; under-represented geographies; intervention effectiveness; hidden dimensions

Introduction

Forests and trees provide a range of goods and services vital for human well-being, particularly for people who live below the poverty line (Angelsen et al. 2014; Miller and Hajjar 2020). The articles in this Special Issue review and synthesize available scientific evidence on the complex relationship between forests, trees, and poverty (Jagger et al.; Razafindratsima et al.; Oldekop et al. this issue), summarize the state of knowledge on poverty related outcomes associated with forest-related policy and programmatic interventions (Hajjar et al. this issue), and highlight global forces that are likely to affect future forest-poverty dynamics (Shyamsundar et al. this issue). These papers point to several important knowledge gaps, primarily that we do not have sufficient empirical evidence to fully understand the potential role of forests and tree-based systems in moving people out of poverty (Jagger et al. this issue). We posit that future research on forests and poverty should give attention to development of both theoretical frameworks and

empirical evidence to explore the heterogeneous role of forest and tree-based systems in poverty alleviation[1] across spatial and contextual dimensions.

Here, we highlight five research priorities that require urgent attention by the research community to clarify the role that forests play in poverty dynamics. Beyond advancing knowledge more broadly on human-environment interactions, the urgency behind these research priorities reflects the need to inform evidence-based policy making and practice, so as to realize the potential for forests and tree-based ecosystems to contribute to poverty alleviation. These research priorities were identified during meetings of the Global Forest Expert Panel on Forests and Poverty (GFEP; see Miller et al. this issue), and further refined through the peer review process of the GFEP report and with feedback the authors received when presenting the report to policy making and practitioner audiences. We call for more concerted research effort on: 1) forest-poverty *dynamics*, particularly over longer time periods; 2) the relative effectiveness of different forest-related policies and interventions; 3) the key barriers to, and solutions for, just and equitable use of forests; 4) under-represented geographies and contexts; and 5) the hidden dimensions of forest contributions. The research priorities, and related research questions, are summarized in Table 1.

Research priority 1. Examine forest-poverty dynamics, especially over the medium- to long-term

Knowledge of how, and the extent to which, forests and trees can help the poor to temporarily or permanently escape poverty - or prevent people from slipping into poverty - stands as a particularly acute research need. Reviews in this Special Issue have shown that the literature on the relationship between forests, trees and poverty primarily consists of observational cross-sectional analyses or at most two-period pooled cross-sections or panel studies (Jagger et al.; Hajjar et al., this issue). These studies have significantly enhanced our understanding of the myriad ways forests and tress contribute to livelihoods as well as economic and material living standards. This literature could be strengthened in two ways.

First, few studies reviewed in this Special Issue have examined poverty as an explicit metric of focus. Rather, they often use earned income and/or assets as indicators of or proxies for poverty, but not stated results in terms of national or global measures of poverty. As such, a study might show an increase in income across a population without any insights into whether that represents an actual reduction in poverty as defined by nationally accepted poverty thresholds. Or the study might show some gain in assets among households without collecting additional data needed to construct and report on established multidimensional poverty indices (Alkire et al. 2015). Linking income metrics to established definitions of poverty can provide more context for understanding the prevalence of poverty among forest-reliant communities and changes in poverty over time (including as a function of governance interventions). A challenge for this

[1]Consistent with other articles in this Special Issue, we understand poverty alleviation broadly as a lessening of deprivation or disadvantage such that well-being is improved. This lessening may include movement above a certain income or consumption threshold, such as international or country-specific poverty lines (termed 'poverty reduction'). It may also include a lessening in the degree of poverty experienced or avoiding falling into poverty (termed 'poverty mitigation') (Sunderlin et al. 2005; World Bank 2001). Poverty alleviation could ultimately lead to poverty eradication or the the complete or near absence of people or households in poverty (UN 2020).

effort is to overcome the methodological hurdle of incorporating the value of forest and tree-based goods and services that support subsistence needs (vs. those that are marketed) into calculations of monetary poverty. Angelsen et al. (2014) and the experience of CIFOR's Poverty Environment Network (PEN) along with subsequent efforts by the World Bank and the FAO provide guidance on standardized methodologies for addressing this issue (Bakkegaard et al. 2017).

Second, relatively few studies examine the temporal, both inter- and intra-annual, dimensions and dynamic nature of forest-poverty relationships, particularly over longer time periods (e.g., more than five years) and across different contexts and spatial scales (Oldekop et al. this issue). Without a better understanding of the long-term, dynamic relationship between forests and poverty, it is difficult to draw conclusions about the use of forests or trees as a pathway out of poverty, or conversely, as a poverty trap. Despite the seasonal fluctuations of forest use and reliance, few studies collect data at multiple time points within the same year, though exceptions like the data collected by PEN do exist (Angelsen et al., 2011; see also Cavendish, 2000 for an early example). Medium to long-term studies (e.g. 5 to 50 years) and studies that collect data across seasons are one means to address these gaps. However, when these studies are not viable, a focus on well-established poverty metrics and indices estimated from settings with similar exogenous characteristics (e.g., biophysical conditions, market access, population density) could generate new insights by comparing well matched studies conducted at different times by different researchers.

New data sources, including satellite imagery of land use and land cover change and spatially explicit socio-economic datasets from continuous data collection efforts (e.g. the World Bank's Living Standards Measurement Survey), present promising opportunities to address current knowledge gaps on forest-poverty dynamics. Remote sensing data, along with advanced machine learning methods, have been used to assess household wealth and poverty (Jean et al. 2016; Steele et al. 2017; Watmough et al. 2019). More studies are using existing nationally representative household surveys and longitudinal analysis to explore changes in poverty levels over time and at larger scales (Dyngeland, Oldekop, and Evans 2020; Jagger and Perez-Heydrich 2016; Oldekop et al. 2019). Panel data collection efforts that track households over time are less common but can greatly illuminate poverty dynamics, including how people cope with widespread deforestation and forest degradation. The use of common instruments for data collection (such as FLARE's Livelihoods and Wellbeing (LivWell) tool) could build a comprehensive database of cases across contexts, allowing for more comparison and synthesis among smaller case studies examining forest-poverty dynamics. Qualitative and quantitative research that focuses on life histories and intergenerational dynamics can help us better understand the long-term poverty alleviation effects of forest and tree use (Addison, Hulme, and Kanbur 2008). Research using long-term data is crucial for decision-makers to compare the poverty alleviation potential of forests and trees with their other strategies, such as biodiversity conservation and climate change mitigation, and to consider trade-offs between different land use policies. Such research can also inform policymakers of the potential for forests and trees to provide goods and services, manage risk and provide a pathway out of poverty when compared with levers for poverty alleviation in other sectors.

Research priority 2. Assess the relative effectiveness of different forest-related policy and management interventions for poverty alleviation

Hajjar et al. (this issue) consolidate current evidence on the effectiveness of different forest- and tree-related policies and programmes in addressing the challenge of poverty alleviation. However, major gaps in our knowledge remain. Foremost among these is knowledge of which kinds of levers are likely to be most effective in particular contexts, for whom, and why. We know that, regardless of context, forest policy effectiveness hinges on factors such as responsive macro-institutional frameworks, collaborative processes, clear performance indicators and monitoring systems, and adaptive management and learning (Agrawal et al. 2018). Yet, decision-makers lack clear guidance on which, among the range of policy choices –from incentive-based mechanisms like payments for ecosystem services to regulatory mechanisms like establishing and enforcing strict protected areas– may be most appropriate for a given situation. Researchers are beginning to address this topic (e.g. Dyngeland et al., 2020; Sims and Alix-Garcia, 2017), but more work is needed to build evidence, advance theory and inform policy.

Policy and programme development aims to be increasingly evidence-based (Arnold, Werf, and Rametsteiner 2014; Head 2010; Hetemäki 2019), raising demand for research that analyses causal impacts (Ferraro and Hanauer 2014). In this regard, the broad field of environmental and natural resource policy continues to lag behind other policy fields (e.g., education, health, social policy) in building a rigorous evidence base that sheds light on the impact and cost-effectiveness of various policy options (Baylis et al. 2016; Börner et al. 2020; Caplow et al. 2011; Ferraro and Pattanayak 2006). Randomized control trials on the poverty impacts of forest and agroforestry interventions are exceedingly rare (Alpízar and Ferraro 2020; Cheng et al. 2019; Miller et al. 2020) in part because they are challenging to implement. Studies that use methods with high potential for establishing causal linkages between interventions and outcomes for forests and poverty typically include baseline or pre-intervention and endline data and collection of data from control or comparison groups (Sills et al. 2017). Although these typically quantitative, experimental or quasi-experimental research designs are often considered the "gold standard" in establishing causality and attribution (Ferraro and Hanauer 2014), process tracing, qualitative comparative analysis, and other forms of qualitative analysis have also been used to robustly evaluate impacts of programs on poverty alleviation (Hartman and Kern 2020; Schmitt and Beach 2015). Integrating quantitative and qualitative research approaches using mixed methods, as well as multi-method research approaches that combine novel tools such as systematic qualitative analyses, machine learning, and modelling approaches to impact evaluation, can potentially provide new and robust insights (Oldekop et al. 2020). Quantitative and qualitative impact evaluation studies that use careful research designs and draw on well informed theories of change can greatly enhance the evidence base needed to make decisions on programs and policies. Such studies are made even more useful when they also give focused attention to heterogeneous impacts across different social groups, geographies and contexts. Lastly, cost-effectiveness analyses of different levers operating in particular contexts can be of highest value to decision-makers who often have limited resources to disburse. As the field of environment and sustainability lags behind on generating rigorous evidence for policy making, the risk of failing to capture policy maker attention and resources is real, while health, education, and the social policy sectors bring evidence of effective poverty reduction programmes and policies to the table.

Research priority 3. Identify key barriers to more equitable, just, and sustainable use of forests and trees, and ways to overcome them

The articles in this Special Issue have highlighted that forests and tree-based systems provide many benefits to different social groups, but these benefits and costs are frequently unequally distributed (Angelsen et al. 2014). Studies have shown that gender, ethnicity, poverty levels, and other axes of social and economic differentiation often shape heterogeneity in outcomes (Hajjar et al. this issue). For example, women in several cases experienced disproportionate loss of income due to forest exclosures, and experience increased labor burden, lower-paying jobs and lower benefits than men following forest-related interventions (Kiptot and Franzel 2012; Razafindratsima and Dunham 2015; Tran and Walter 2014; Tuijnman et al. 2020). Poorer households are less able to take advantage of new markets and interventions (Ma et al. 2019; Obidzinski et al. 2014; Shiferaw, Hellin, and Muricho 2011).

There is an urgent need to rigorously synthesize available evidence and then conduct new empirical investigation into barriers to a more just, equitable and sustainable distribution of benefits and costs. Most of our existing knowledge on inequities related to forests is at the micro-scale – differentiated impacts within or between communities. More work is needed to examine such inequities, and how to overcome them, at the meso- or macro-scale – differences at the sub-national, national and international scale. Doing so will require analysis of the political economy of forest and land use policies within and across countries, as well as attention to both the influence of international investment and trade on the allocation of benefits from forests and the influence of rules governing access to forests on the global distribution of prosperity. Work being done in this sphere on REDD+ and community forest management (e.g. Agarwal 2010; Barr and Sayer 2012; Chomba, Treue, and Sinclair 2015; Minang and Van Noordwijk 2014) can be extended to examine forest-poverty dynamics. Such research could focus on uncovering the underlying causes preventing the full potential of forests and trees to contribute to poverty alleviation, and could help us to understand how these causes may be effectively addressed to support better outcomes, especially for financially poor and politically and socially marginalized populations. Such research could also focus on promoting just and sustainable solutions to emerging global issues -such as pandemics- and agendas -such as renewed focus on forest restoration.

Research priority 4. Expand the evidence base to cover under-represented geographies and contexts

Major geographic limits exist in our knowledge of the contribution of forests and tree-based landscapes to poverty alleviation. Nearly half of the current evidence base on forests-poverty linkages comes from just five countries: Bangladesh, Brazil, China, India and Nepal (Cheng et al. 2019). Evidence on the relationship between agroforestry and poverty also exhibits geographical bias, with considerable representation from Brazil, Mexico, India, Indonesia and Ethiopia (Miller et al. 2020). Similarly, academic research related to particular forest-based interventions often does not reflect the distribution of such interventions globally; for example, REDD+ academic studies have largely focused on Brazil, Colombia, Peru, Indonesia, and Kenya, despite REDD+ projects being initiated in over 50 countries (Duchelle et al. 2018).

Based on our review of the English language literature, our understanding of forest-livelihood linkages in Europe, North America and West and Central Africa are especially limited.

Three other dimensions of geography stand out as particularly important to advancing our knowledge of forest-poverty dynamics. First, the majority of our knowledge is based on studies of forests and poverty in tropical forest ecosystems. Woodlands, dryland, temperate and boreal forests have received less attention from scholars and in policy debates. Similarly neglected is the role of forests in rural poverty alleviation in high-income countries that have high rural-urban wealth disparities (Miller and Hajjar 2020). For example, in many regions of the United States, rural areas, many of which are (or were) recently timber-dependent communities, are characterized by higher poverty and lower employment rates than urban areas (Pender et al. 2019). Authors have found that forest dependence is generally associated with higher rates of poverty in the U.S. South (Bliss et al. 1992; Cook 1995 cited in Patriquin et al., 2007), and with increased incomes but unstable employment in Boreal Canada (Patriquin, Parkins, and Stedman 2007). Timber-dependent communities in the US West were particularly hard hit by forest policy changes in the 1990s that resulted in extensive mill closures and job losses (Weber and Chen 2012). The role of forests in contributing to prosperity remains critical for disadvantaged rural communities in high-income countries, particularly as they seek new and transformative economic opportunities in changing landscapes and policies. While some knowledge on forest-poverty dynamics from low- and middle-income countries might be relevant, further investigation of these dynamics is warranted in the economic and institutional contexts of high-income countries that have large wealth disparities.

Second, the importance of forests and trees for poverty alleviation in urban landscapes has been poorly studied. Attention to forest poverty dynamics in urban settings is critical given demographic trends towards urbanization in many low- and middle-income countries. Recent work has begun to examine the linkages between urban forests and well-being of vulnerable populations (Endreny 2018; Kaoma and Shackleton 2015), the effects of urban forests on gentrification of neighborhoods (Donovan et al. 2021), and other aspects of urban forest poverty dynamics. But there has been comparatively little investigation of the role of urban forests as pathways to prosperity for the urban poor, when compared to such scholarship in rural areas (Kaoma and Shackleton 2015).

Finally, there is a need to investigate the contribution of forests and trees to poverty alleviation at spatial scales beyond the site or community level, giving more attention to landscape, sub-regional, national and regional scales. Advances in the conceptual and empirical frontiers of social-ecological systems research provide important guidance on addressing the challenge of the frequent scale mismatch in studies that seek to analyze both social and ecological system co-benefits (Bruyninckx 2009). Multi-scale analysis is critically important for understanding spillovers and the aggregate effects of policies and programmes.

In order to better compare and expand our knowledge base across geographies, coordinated research efforts targeting understudied areas could be modeled after existing efforts such as the Poverty and Environmental Network (PEN), which collected the same data across a diversity of regions in 24 countries (Angelsen et al. 2011), or the International Forestry Resources and

Institutions (IFRI) research program, with collection of ecological, socio-economic and institutional data across forest community sites in 18 countries (IFRI 2013).

Research priority 5. Bring to light the 'hidden dimensions' of forest contributions to poverty alleviation

Many of the roles that forests and trees play in supporting human well-being and addressing poverty are not captured in official statistics because they are not sold in formal markets. First, there is a great deal of domestic trade in non-timber forest products (NTFPs), but statistics to quantify the economic contribution, value addition and supply chains related to these goods are largely absent. For example, fuelwood is used as a primary cooking energy source throughout low- and middle-income countries. The vast majority of it is collected and used in homes (for subsistence) or traded for other goods or services. Additionally, trade in both timber and NTFPs that is either illegal or marketed through informal channels means that the full economic contribution of forests is not recorded in government statistics, which are in turn used for designing policy (Belcher 2005; Ghosal 2013). For example, in the wood sector in Africa, it is estimated that at least three times more people are employed in the informal sector as in the formal sector (FAO 2014), and charcoal trade in particular accounts for a large share of incomes within the informal forest products sector (Chiteculo et al. 2018; FAO 2014; Mwampamba et al. 2013).

Second, beyond marketed goods provided by forests and trees, other forest benefits are hidden from view because of their indirect or intangible nature. For example, there is growing evidence that forests and trees on farms provide ecosystem services that increase agricultural productivity (e.g., soil fertility, pollination, drainage, microclimate regulation) (Cohn 2017; Kremen and Merenlender 2018; Miller et al. 2020) and regulate macroclimate and atmospheric moisture recycling (Bovolo et al. 2018; Keys et al. 2019), benefits that rarely enter into policy discussions or national accounts. Finally, more work could be done to examine how forests and trees contribute to aspects of subjective well-being, security, equity, health, spirituality, and social relations – understudied dimensions of well-being and broader prosperity (Miller and Hajjar 2020).

There is a need to both improve the evidence base on this topic and to better communicate current knowledge about these positive, yet often hidden, dimensions of forests and tree-based systems. More work is needed to quantify and qualify the value of these hidden services, which may entail developing innovative poverty indicators and measures that acknowledge the diverse values of forests and trees to the forest-reliant poor (Schleicher 2018).

Conclusions

This article highlights five priority areas to address in order to realize the potential for forests and tree-based systems to contribute to poverty alleviation. Research on this subject is increasingly more urgent as development agents race to mitigate the negative and potentially irreversible impacts of climate and environmental change and to accomplish the Sustainable Development Goals by 2030. It is also critical to advance forest-poverty scholarship given an overall trend towards evidence-based policy making, cost-effectiveness analysis, and results-based financing,

which demands that the forestry and agroforestry sectors bring clear information to policy makers so that they can make informed decisions about the role for forests and tree-based systems in poverty alleviation. Given the potential for forests to alleviate poverty, more long-term research in more diverse geographies is needed so that the hidden dimensions of forest can be valued, the effectiveness of forest-related policies can be understood, and the barriers to more equitable forest management can be overcome.

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Table 1. Research priorities and key questions

Research priority	Key questions
1. Examine forest-poverty dynamics, especially over the long term	Under what circumstances can forests and tree-based systems provide a pathway out of poverty? How do different types of forests and tree-based systems affect poverty outcomes over time? And across different spatial scales? How do these outcomes compare with other outcomes, like biodiversity conservation and climate change mitigation? What are the trade-offs and synergies over time and across space of these different outcomes?
2. Assess the relative effectiveness of different forest-related policy and management interventions for poverty alleviation	Which interventions are most effective in alleviating poverty, in which contexts? Which are most cost-effective? What trade-offs do they imply? How do different factors mediate and moderate impacts? What explains heterogeneity of impacts? How can costs and benefits of different policy options be more equitably distributed?
3. Identify key barriers to more equitable, just, and sustainable use of forests and trees, and way to overcome them	What are the barriers to more equitable, just, and sustainable distribution of the benefits and costs of forests and tree-based systems? What are the opportunities for overcoming them and how? How do forest and tree-related market supply chains affect the poorest?
4. Expand evidence base to cover under-represented geographies and contexts	What contributions do forests and tree-based systems make to poverty in comparatively understudied regions like Europe, North America and West Africa? What is their contribution in urban contexts? What insights might we gain from investigating this topic in both low- and middle-income countries and high-income countries? What cost-effective means can be developed to ensure an updated, easily accessible evidence base for decision-makers, researchers and the public?
5. Bring to light the 'hidden dimensions' of forest contributions to poverty alleviation	What is the contribution of NTFPs to poverty alleviation? Can more accurate estimates of the contribution of informal and illegal trade in timber and other forest products be made? What is the contribution of forests and trees on farms to agriculture? How do intact forests affect human health? How do forests contribute to security, subjective well-being, social relations, culture and spirituality?