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MIGRATION AND FOREST CONDITION LITERATURE REVIEW

HOW DO MIGRATION EVENTS AND PROCESSES AFFECT TROPICAL FORESTS AND RURAL LIVELIHOODS?

KEY FINDINGS

How does rural out-migration affect tropical forests and rural livelihoods? Migration out of rural landscapes has important consequences for the persistence and conservation of forests and forest-based resources in the global South. Ensuring that tropical forests are protected and remain ecologically functional will determine whether humans are able to avert catastrophic disruptions to food, water, and energy systems caused by climate change. In some instances, out-migration reduces pressure on forests and forest-based resources and allows for limited natural regeneration of forests in abandoned agricultural parcels. However, in other cases, rapid out-migration of able-bodied laborers weakens local customary land and forest tenure institutions, leading to the mismanagement of forests and an erosion in cultural norms surrounding sustainable use of forest-based resources. Moreover, in most cases, rural out-migration threatens the persistence of rural livelihoods as depopulation results in the loss of able-bodied laborers and subsequent reductions in agricultural production.

The variability in forest outcomes following out-migration makes it difficult to draw broad generalizations from the diverse and disparate case studies available, especially due to the lack of high quality, interdisciplinary or multi-disciplinary studies that couple longitudinal analyses of demographic change with household surveys, spatial data analysis, and ecological surveys of forest condition.

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However, some recurring themes and patterns do emerge and can help inform evidence-based interventions that are tailored to a particular geographic region. The recommendations outlined below are not exhaustive and should be carefully considered in the context of local customs, norms, histories, and socioeconomic conditions – if properly implemented, these interventions could increase rural livelihood security and improve forest condition and management.

1. **Protect and promote forest regeneration through active management** – while most landscapes are unlikely to return to pre-disturbance biodiversity levels and ecosystem functioning, these landscapes can provision some ecosystem services including aboveground carbon storage and habitat for wildlife. One possible mechanism to implement this recommendation is through the provision of direct incentives to rural smallholders to actively manage and protect regenerating forests on abandoned agricultural land. These incentives could be created through payments for ecosystem services schemes, carbon finance, or government programs.
2. **Strengthen customary and communal tenure institutions** so that they can adapt to the loss of local participants while still actively managing forests for sustainable use. Labor scarcity and the erosion of cultural norms brought on by rural out-migration threatens the persistence of customary forest and land tenure institutions. Supporting local communities as they build adaptive capacity will be critical to ensure that they continue to manage forests for sustainable use and buffer against the encroachment of large-scale commercial interests. Case studies from Oaxaca, Mexico (Robson & Berkes, 2011) demonstrate that it is possible to build adaptive capacity in customary forest tenure institutions by allowing for flexibility in participation and by ensuring that community members have access to resources for managing forests with a reduced pool of laborers.
3. **Invest in agricultural extension programs** that increase livelihood security for rural smallholders while empowering individuals in their choice to migrate out of or remain on their land. Migration of able-bodied laborers is leading to labor scarcity and a reduction in the cultivation of agricultural land. Subsidies for key agricultural inputs and incentives for crop production would ameliorate some of the pressure caused by out-migration and the loss of laborers for those smallholders who actively choose to continue inhabiting rural landscapes. By providing incentives for smallholders to sustainably intensify their production, these populations can act as a buffer against large-scale land acquisitions for commercial production.
4. **Invest in improvements in basic services in rural landscapes;** access to quality education, health care, and off-farm employment opportunities is needed to empower rural smallholders to make the choice to stay or leave. Protecting rural livelihoods is an important strategy to ensure protection and conservation of tropical forests in conjunction with strong environmental protection policies. While improvements in socioeconomic status or livelihood security of rural smallholders may also lead to an increase in out-migration, investment in improving basic services ensures that individuals and families who wish to remain on their land are better supported in their choice.
5. **Invest in supporting women-headed households in certain rural landscapes where men make up the majority of outmigrants.** Investments in improving tenure security of rural landholdings and supporting the participation of women in customary tenure institutions and both on-farm and off-farm livelihood opportunities can help to alleviate pressure on women-headed households where out-migration is primarily of able-bodied men. Case studies from Nepal (Jacquet et al., 2015) and Oaxaca (Angelsen et al., 2020) point to a lack of support for women-headed households in areas where out-migration of men has shifted the burden of maintaining and cultivating rural landholdings to women. Subsequent loss of productive agricultural land due to labor scarcity is in some cases increasing the socioeconomic precarity of these households and increasing pressure on forest-based resources.

INTRODUCTION

Migration has played a central role in the development and progression of human civilization as humans have moved in search of food, water, and land for cultivation and settlement. Today, migration remains, "...a livelihood, investment and resilience strategy" (Hecht et al., 2015, p. V), especially for rural smallholders caught between the forces of globalization, climate change, and ever-increasing economic precarity driven by the consolidation of rural land ownership. Proactive migration events are entirely distinct from forced displacement driven by conflict, natural disaster, climate change, or other events. In the case studies of migration covered in this review, the decision to migrate is entirely personal and dependent on individual and family circumstances, as well as local socioeconomic and environmental conditions. However, the effects of migration reverberate far beyond the confines of an individual or family unit. As Jacquet et al. (2015) make clear, "Today, it is not population growth which affects the landscape and the environment, but depopulation" (p. 158), and increasingly in many tropical rural landscapes, depopulation is being driven by out-migration, urbanization, and the movement of laborers across boundaries both within and across nations.¹

Out-migration from tropical rural landscapes has important consequences for the protection and conservation of forests and forest-based resources. Confronted with the existential threat posed by climate change, the protection of carbon-sequestering forests has never been more imperative for the persistence of humans and the protection of life-sustaining ecosystem services and biodiversity conservation. The global South contains the largest extent of standing forests anywhere on the globe. Ensuring that tropical forests remain intact and ecologically functional will play a major role in determining whether humans are able to avert catastrophic disruptions to food, water, and energy systems caused by climate change. However, the goal of protecting and conserving forests is no easy task, as forests face multiple interacting and synergistic threats from overexploitation of forest-based resources, encroachment of agriculture, mining, and ranching. Moreover, disease, drought, and forest fires have only become more frequent and intense as climate change acts as a threat multiplier by introducing variability in climatic patterns that sustain important hydrological and biophysical processes.

Amidst these complex and interrelated challenges to the persistence of tropical forests, migration can both mitigate against forest loss by allowing for regeneration of forested lands and can exacerbate forest loss by opening up land for investment by large-scale commercial interests. As Fox (2018) states, "Migration decisions influence forest and other natural resource management decisions in both origin and destination locations in diverse ways" (p. 626). Out-migration from rural areas to urban centers both nationally and internationally threatens the persistence of rural livelihoods and land-dependent populations, but it does not necessarily entail the hollowing out of rural areas or the loss of local land stewards. Evidence from the literature demonstrates that forests are regenerating and expanding in some geographic regions that are experiencing intense waves of out-migration as marginal lands are brought out of production because of labor shortages driven by the loss of able-bodied workers. In other regions, while some forests may be regenerating, ever more forested land is being lost to capital interests due to large-scale land acquisitions in rural landscapes and the conversion of forests for commercial commodity crop production. Moreover, the particular nature of a migration event, including whether the event is permanent or circular, involves only certain individuals or entire family units, and/or is characterized by migrants sending back remittances or not, also mediates the impact of migration on forest condition. All these factors are important to understand in analyzing the site-specific impacts of migration on forest condition.

What emerges from the case studies reviewed herein is an understanding that the relationship between out-migration, rural livelihoods, and forest condition is incredibly varied and dependent upon the

¹ Depopulation is not consistent across all tropical rural landscapes; certain regions like sub-Saharan Africa are still experiencing population growth and are projected to continue growing in the coming decades.

interaction between markets, land tenure regimes, customary norms, climatic variability, and ultimately histories of state land control and land use. Even within the same region in a country, there are instances where out-migration results in regeneration of fallowed and abandoned lands with an overall net increase in forest cover. Yet in other cases, out-migration results in investment in less labor-intensive but more land-extensive livelihood strategies such as conversion of forests into pasture for cattle ranching. Despite these contradictory trends, some key findings and patterns emerge from a review of the literature. While not generalizable beyond the case study in question, these patterns do support possible evidence-based interventions that overall may result in increased livelihood security in rural landscapes as well as forest protection or improvements in forest condition. Increasing livelihood security for rural smallholders by providing basic access to health care, education, and employment opportunities, as well as subsidies for smallholder agricultural production, empowers individuals in their decision to migrate out of or remain on their land. Coupled with protection of naturally regenerating forestlands and investment in strengthening customary forest and land tenure institutions where they already exist, these strategies may ultimately help improve rural livelihood security while also conserving intact and regenerating forested lands.

APPROACH AND METHODOLOGY

This review was commissioned by the United States Agency for International Development's (USAID's) Integrated Land and Resource Governance Program (ILRG) to understand how out-migration influences forest condition and rural livelihoods in the tropics. A central objective of this targeted literature review was to tease apart any patterns or generalizable trends emerging from case studies of forest transition in rural regions of the global South. These patterns were then organized into the recommendations presented here within. Further, gaps in the literature were also identified. These gaps demonstrate the need for further research and synthesis across the multiple disciplinary fields that engage with the topics of rural out-migration, land and land use change, and natural resource management.

To understand how migration affects forest condition and rural livelihoods, 37 papers published between 2000 and 2022 were reviewed. These papers were identified through keyword searches using Google Scholar. The key terms included migration; rural out-migration; international out-migration; land and land use change; forest transition; remittances; demographic change; rural landscapes; depopulation; new rurality, and forest use. Additional papers were provided by staff of USAID and ILRG. The case studies reviewed include every continent with tropical forest landscapes, although clear biases in the literature meant that some continents and regions were extremely overrepresented while others were underrepresented. For example, case studies from Nepal and Brazil were overrepresented in the literature, whereas case studies from sub-Saharan Africa were underrepresented. Further, certain literatures were intentionally excluded from this review or only superficially examined because they were deemed outside the scope of the project. This includes the literature on large-scale migrations from Central America to the United States, climate change-driven migration, and forced displacement due to violence or land grabbing. The expansive literature on the effects of remittances on rural livelihoods and land and smallholder relations was also not a direct focus of this review, although case studies where remittances played a role in mediating forest outcomes were included. In addition to case studies, a handful of reviews on the topic of migration and land use change were also examined to gain a better sense of the state of the literature and pre-existing analytical frameworks.

In addition to making note of the demographics of migrant populations, the governance structures in forested lands, and the drivers of migration, including any market-based dynamics, the literature was reviewed with the following questions in mind:

1. How does local context and the characteristics of local populations – including demographics, socioeconomic status, histories of land and land use change, and state governance – mediate forest outcomes?
2. What is the role of the state and sub-national authorities in regulating forest use, management, and control?
3. How does the presence of customary land tenure regimes mediate forest outcomes following migration events?
4. How are resources claimed, controlled, and managed following out-migration? What general characteristics of the settling, resettling, or returning populations mediate these resource control strategies?

After examining the compiled literature and producing an analytical framework and conceptual synthesis, recommendations were drawn out from the patterns that emerged from case studies. The results, organized by study region are presented below, following these results, recommendations for possible interventions are set forth.

RESULTS BY STUDY REGION

NEPAL – NET INCREASE IN FOREST COVER AT THE COUNTRY LEVEL BELIES LOCAL TRENDS IN FOREST DEGRADATION AND EROSION OF SOCIAL NORMS IN COMMUNITY FOREST USER GROUPS

In the Asia-Pacific region, the literature on migration and forest condition is heavily biased towards Nepal, where a high proportion of the adult population, particularly men, are engaged in long-term international labor migration in search of higher wages and economic advancement opportunities in international labor markets (Oldekop et al., 2018). Nepal is overrepresented in the literature on migration and land use change, likely because it is one of the few places where there is a long history of devolved land tenure. Formally codified in the Nepalese constitution in the early 1990s, community forest user groups (CFUGs) were given state owned lands and granted territorial rights and governance over these forest parcels (Fox, 2018). As a result, Nepal provides a good jumping off point for understanding how migration affects forest transitions (Rudel et al., 2005) in areas where governance is decentralized.

In Nepal, the existing literature documents an increase in forest cover in the last twenty years driven by regeneration of forests in marginal agricultural lands left abandoned or fallow due to labor out-migration (Fox, 2018; Sunam & McCarthy, 2018; Oldekop et al., 2018; Poudel et al., 2018; Jacquet et al., 2015). While at a national level forest cover is increasing, local forest conditions differ markedly between regions and in certain regions there is evidence of forest degradation coupled with expanding forest area (Jacquet et al., 2015; Fox, 2018). Illustrating this dynamic, Fox (2018) documents the erosion of CFUGs through a thirty-year longitudinal study of long-term labor out-migration in the Nepalese village of Bhogteni. In Nepal, more than half of households are involved in foreign labor migration and the loss of able-bodied workers has affected the ability of CFUGs to collectively manage forested lands, leading to a weakening of cultural norms surrounding sustainable forest resource use (Sunam & McCarthy, 2016). Fox (2018) administered decadal demographic surveys to villagers in Bhogteni and collected data on forest condition including tree density, species frequency, and dominance in eight forest patches throughout the village. He posited that “The concurrent impact of a strong community forestry program and the globalization of labor could result in delinking of household livelihood and land resources, and an improvement in forest cover” (p. 612).

Contrary to the author's expectations, the migration of able-bodied men and subsequent reduction in land under cultivation did not increase livelihood security for villagers or improve forest condition. Instead, Fox (2018) finds that labor shortages have resulted in a movement away from agrarian livelihoods and towards commercially based livelihoods that are increasingly reliant on remittances sent back by migrants. Moreover, during the 30-year study period, forest condition as measured by tree species diversity and density improved only slightly in some forest patches while declining in others. Fox argues that those forest patches that saw an improvement in forest condition were those that were being actively managed by CFUGs and still had high community buy-in. Smaller forest patches were seen as not worth the effort to maintain and experienced degradation, while larger forest patches were too hard to actively manage given the loss of able-bodied laborers. These results illustrate the tradeoffs that community members face in the wake of out-migration – either investment in maintenance of communal forest lands or investment in the maintenance of personal subsistence agricultural lands.

In accordance with the findings of Fox (2018), Poudel et al. (2018) find that at a macro level, forest cover is increasing in the districts of Parbat and Lamjung in Nepal, but at a local level, these forests are facing crises of mismanagement due to labor scarcity brought on by rural depopulation. Poudel et al. (2018) found a positive correlation between out-migration and forest cover, documenting a modest increase (five to six percent) in forest cover between 2000 and 2016. While the authors report some positive effects of out-migration on forests, including less pressure on forest-based resources like timber and fuel wood, they note that farmland abandonment is resulting in the encroachment of low-value shrubby species onto agricultural lands.

An increase in shrublands is not the only management challenge in Nepal's abandoned farmlands. Jacquet et al. (2015) find that in the Kaski District of Nepal, long-term rural out-migration is leading to the spread of invasive species in areas of natural regeneration and the expansion of cattle ranching onto these farmlands is reducing soil fertility. While the authors maintain that most community CFUGs restrict cattle grazing, abandoned farmlands provide an opportunity to expand ranching activities without straining already scarce labor sources. Even within the same district, forest conditions can differ markedly depending on where migrants leave from and where their remaining family members move to; as Jacquet et al. (2015) explain, in the Kaski District, uphill and downhill areas diverge in forest condition:

This subwatershed shows an increasingly diverging development path between uphill areas and valleys, as is typical for many mountain regions worldwide. Uphill, a marked decrease in population has consequences such as land abandonment, spread of invasive species, decline in soil fertility, and lack of terrace management. Downstream, population increase has led to more intensive land use, reduction of vegetation cover, soil fertility decline, and encroaching on land close to the riverbeds. (p. 169)

The authors' findings underscore the importance of examining local forest conditions to determine whether increases in forest cover are also accompanied by improvement in forest condition.

Another important process that mediates the effects of out-migration on forest condition in Nepal is the investment of remittances into livelihood diversification. Fox (2018) notes that remittances from migrant family members in Bhogteni are rarely if ever used to invest in improving agricultural practices or acquiring land in home villages. Instead, these remittances are most often used to diversify livelihood strategies by investing in commercial opportunities like opening small stores. Respondents stated that a lack of government subsidies and disruption in government services had discouraged further investment in agriculture, such that off-farm opportunities were viewed as more attractive than agrarian livelihoods. This finding suggests that investment in agrarian livelihoods through subsidies for key inputs or capacity training for cultivation of commercial crops could alleviate some of the pressure to migrate if and when markets for these products are readily available and can absorb the increased production.

Sunam and McCarthy (2016) further reinforce the idea that migration-driven labor scarcity can have uneven impacts on rural landscapes, arguing that migration leads to the commodification of land and land-based resources, changing the patterns in land use and tenancy such that those who can migrate and send remittances back to their families are more likely to diversify their livelihood strategies. The authors explain how this process unfolds:

First, with respect to land and agriculture... remittances allow households to accumulate. The injection of capital in turn inflates land prices, driving the commodification of land and decreasing the capacity of the poor to access land. (p. 41-42)

As a result of the inflation in land prices, some households are driven further into poverty with dire consequences for forest resource use. While forest condition was not the explicit focus of Sunam and McCarthy's paper, their findings shed light on how migration may engender further impoverishment in some communities and lead to widening income inequality. According to the authors, impoverishment of rural smallholders leads to further dependence on forest and subsistence agricultural systems and potentially, overexploitation of communal forest lands. The divergence in socioeconomic status between those who can afford to migrate and those who cannot is an important recurring point that helps to explain some of the uneven outcomes resulting from rural depopulation in different areas across the tropics. It is also an important point to consider in terms of potential interventions as more impoverished rural smallholders could greatly benefit from government subsidies for agricultural production or diversification of livelihood strategies. These investments would improve economic inequality while also reducing pressure on forest and other land-based resources for those that decide to stay behind.

CHINA – FOREST COVER GAINS DRIVEN BY RAPID URBANIZATION AND STRONG STATE CONTROL OVER RURAL LANDSCAPES

In China, the literature on migration and forest condition focuses almost entirely on permanent internal migration caused by the rapid urbanization of China's rural regions and subsequent interventions by the Chinese central state in reforestation projects located in depopulated rural landscapes (Huang et al., 2020; Zhang et al., 2022). More than half of all regions in China have seen a decline in rural population in the last 20 years, coupled with increases in aboveground carbon stocks from active reforestation and afforestation of these rural landscapes. Zhang et al. (2022) delve deeply into these trends by documenting the increases in forest cover caused by massive-scale rural depopulation, analyzing demographic data together with spatial data to measure the effects of rapid urbanization on aboveground carbon stocks. The authors find that initially urbanization increased carbon dioxide release due to conversion of forest and agricultural lands, but after some time, these losses were offset through urban greening and afforestation projects in depopulated rural areas. Reforestation on abandoned rural lands and natural forest regeneration increased the size of aboveground carbon stocks while only resulting in a slight decrease in cultivated agricultural areas.

While Zhang et al. (2022) examine broad trends in Chinese land and land use change, Huang et al. (2020) focus on the Gan River Basin in China and find similar patterns in forest regeneration following rural depopulation caused by permanent out-migration. Huang et al. (2020) examined changes in vegetation and hydrological conditions by analyzing the normalized difference vegetation index (NDVI), sediment loading, temperature, precipitation, and streamflow in the Gan River Basin from 1981 to 2017. The authors found that there was widespread farmland abandonment following rural out-migration that accelerated in the period from 1998 to 2017. They postulated that farmland abandonment is driving increases in vegetation cover as measured by NDVI and reductions in sediment loading in rivers. They also examine the effects of climate change on these variables and find that:

The effect of climate change on the vegetation–hydrological process was found to be not significant on the annual scale, but rather one of the main reasons for the vegetation restoration and sediment load reduction was rural depopulation. (p. 778)

The improvements in ecosystem function documented by Huang et al. (2022) raise important questions regarding the long-term sustainability of regenerating landscapes as they face competing pressures to support the production of food to supply urban centers, while also provisioning important ecosystem services. In the case of China, the central state can maintain control over these depopulated rural lands, but in other countries such as Brazil, these lands may become a target for expansion of large-scale commercialized agricultural production. The long-term sustainability of these landscapes will be dependent on whether nation states can set aside this land in protected areas and whether carbon finance or payments for ecosystem services schemes can provide incentives to rural smallholders to protect land for reforestation.

AMAZONIA – STATE INTERVENTIONS IN LAND USE AND LAND CONTROL MEDIATE THE EFFECTS OF MIGRATION ON FOREST CONDITION AND SHAPE PATTERNS IN LAND USE CHANGE

The Amazon Basin spanning nine countries and covering almost 7,000,000 square kilometers of tropical lowland rainforest is the most diverse of all study regions covered in this review with respect to the effects of out-migration on forest condition and rural livelihoods. The literature coming out of Amazonia is understandably biased towards Brazil, which claims the largest area by far of the Amazon Basin, but case studies from Peru also help to elucidate the effects of out-migration on forest vulnerability to disturbances such as wildfires. In Brazil, the five studies reviewed herein demonstrate the importance of understanding histories of state intervention in land use and land control. Each case study from the Brazilian Amazon highlights how mid-20th century policies promoting internal colonization of the Amazon by rural smallholders led to deforestation of forested lands but have now given way to agricultural intensification and land sharing, wherein out-migration to urban and peri-urban centers is leading to the consolidation of land into the hands of fewer and more powerful corporate and state-corporate actors.

Tritsch and Le Tourneau’s (2016) study examining the relationship between population density and deforestation rates in the Brazilian Amazon provides a good overview of the patterns in out-migration and forest and land cover change. The authors find that the relationship between population density and deforestation rates is weak and that instead, local context better explains the trends in forest loss and gain throughout the Brazilian Amazon. In particular, they note that the expansion of commodity crops has driven deforestation even in areas where there is low population density due to the conversion of smallholder agricultural lands into large-scale commercial agricultural ventures. Tritsch and Le Tourneau’s findings speak to the importance of contextualizing broad patterns in forest cover loss or gain, given that agricultural intensification and the expansion of cattle ranching can both occur within the context of rural depopulation. To prevent further degradation of rural landscapes, the authors call for strengthening institutions that can regulate and enforce limits on deforestation.

Forest cover in the Brazilian Amazon is increasing on marginal lands (Hecht, 2014), like those in the upper slopes of the Paraíba Valley, located in Brazil’s Atlantic Coast, between Sao Paulo and Rio de Janeiro. Da Silva et al. (2017) examine the patterns driving forest regeneration on marginal lands, noting that:

Between 1962 and 2011, the forest cover increased 102%. During the second half of the 20th century and the early 21st century, the scenario of industrialization, economic development, rural socioeconomic crisis (especially in dairy farming), fostered rural depopulation followed by forest regeneration on abandoned pastures in mountainous regions. (p.16)

As is evident in other regions experiencing intense out-migration, forest regeneration tends to occur on marginal lands. In the case of the Paraíba Valley, pasture lands on steep slopes were the first to be abandoned. Common to both the Nepalese and Brazilian case studies is an understanding that labor shortages are inevitable products of out-migration and that in agriculturally-dominated landscapes, this shortage of labor tends to result in land abandonment or in marginal land falling out of production. In the Paraíba Valley, internal migration to urban centers was often permanent. In contrast, in Nepal, there are documented instances of land abandonment, but rural smallholders still retained ties to their land through rental or sharecropping agreements (Fox, 2018; Sunam & McCarthy, 2018).

Brazil's strong central state has in recent years moved towards stronger environmental policies and land zoning practices aimed at conserving and protecting forested areas through the designation of Indigenous territorial reserves and protected areas (Hecht, 2014). Klingler and Mack (2020) present a fascinating case study of southwest Pará State, examining trends in forest loss and gain over an 18-year study period from 2000 to 2018. The authors find that despite a large investment by the central state in implementing environmental regulations during the mid-2000s and early 2010s, territorial zoning and demarcation of conservation areas have not been entirely effective in reducing deforestation. The authors attribute the still high rates of deforestation to a lack of secure land tenure on undesignated public lands and public lands designated for sustainable use where pressures from cattle ranching result in forest conversion to pasture. Moreover, political shifts towards environmental deregulation under Bolsonaro have fostered impunity amongst those that skirt environmental regulations resulting in forest conversion to pasture in areas with weak enforcement. Klingler and Mack's findings demonstrate the need for strong environmental governance in the Amazon region and enforcement of existing environmental regulations.

PERU – STATE PROMOTION OF COMMERCIAL EXPORT CROPS INCENTIVIZES IN-MIGRATION TO FORESTED FRONTIERS AND CONVERSION OF FOREST LANDS

In Peru's western Amazon Basin, state interventions promoting the cultivation of commercially significant crops like oil palm, is driving in-migration to rural regions with negative consequences for forest cover. In the department of Ucayali in Peru's central Amazon, Bennett et al. (2018) examined the socio-ecological effects of increasing oil palm cultivation. The authors analyzed how government interests in promoting oil palm development affected formalization of landholding for smallholders and consequently patterns in land use and land use change. Using household surveys and demographic data, Bennett et al. find that the expansion of oil palm has led to in-migration into the region by smallholders from other rural areas looking for economic opportunities in oil palm cultivation, they note:

There was a strong link between migrants and oil palm, with a notable absence of palm on non-migrants' farms. It seems that the migrants—and not the local people—are the ones engaging the most in smallholder oil palm production. (p. 92)

Bennett et al.'s findings reinforce an important trend that is under examined in the literature on migration and forest condition, which is that in-migrants tend to cultivate lands with less respect for cultural norms that might promote forest conservation and sustainable land use. These findings are also reinforced by Gregory and Coomes (2019) who document that in the Loreto region in the northern Peruvian Amazon, in-migration into Pacaya Samiria National Park from other Amazonian regions is driving the overexploitation of fishery and forest-based resources. In addition to in-migration into the national park, out-migration of locals to urban centers is causing an erosion in cultural norms that dictate the sustainable use of natural resources, resulting in overexploitation of forest and fishery-based resources. These two cases demonstrate how interventions to promote the integration of migrants into host communities through cultural exchange and an exchange of values could improve outcomes in forests and fisheries conservation. In contrast to the case studies from Brazil, these two cases from Peru

demonstrate how state promotion of commercial agricultural production is leading to negative consequences for forested lands in the Amazon. The difference between these cases is that in Brazil, agricultural intensification has occurred on already cleared lands, whereas in Peru, the expansion of commercial agricultural ventures is occurring on forested lands. This discrepancy points to the potential for interventions in Peru that restrict agricultural conversion of forest lands and enforce limits on deforestation.

FOREST VULNERABILITY TO FIRES IN THE WESTERN AMAZON

In the Western Amazon, Uriarte et al. (2012) examine the frequency and intensity of forest fires in the Peruvian Amazon and find that out-migration is positively correlated with increased fire frequency. They attribute this relationship to the loss of laborers that once helped to manage fires that are set to clear agricultural lands for cultivation and to increased fuel loads on abandoned farmlands that are experiencing an increase in shrubby vegetation. They note that:

Our results at the local scale highlight two potential mechanisms to account for the positive association between rural outmigration and fire frequency. First, communities with a larger percentage of land in fallow had a greater risk of more fires and larger burn scars. Second, burn scars were larger in communities that had a greater proportion of farmers who did not reside in their properties. (p. 21547)

Fires, droughts, and increasingly variable rainfall patterns all interact with and shape patterns in migration to and from rural areas. In turn, rural out-migration can sometimes exacerbate forest vulnerability through the loss of active management or through the conversion of agricultural lands to more intensive models of production. In sub-Saharan Africa, the effects of increasing rainfall variability are further stressing subsistence agricultural production and as a result, rural smallholders are abandoning agricultural cultivation and shifting towards cattle ranching which can degrade soils (Rosenstock et al., 2019). Migration may exacerbate the vulnerability of tropical forests to disturbances like fire, drought, and disease, but knowing this, interventions can be designed to mitigate these risks. Possible interventions in the western Amazon could include early-warning systems that alert local authorities to forest fires and investment in fire-fighting infrastructure and training.

CENTRAL AMERICA – REMITTANCES PROVIDE LIFELINES FOR RURAL AGRARIAN SMALLHOLDERS WHILE POSING A CHALLENGE TO THE LONG-TERM SUSTAINABILITY OF CUSTOMARY FOREST GOVERNANCE INSTITUTIONS

The literature on migration's effect on forest condition and rural livelihoods in Central America is largely biased towards case studies in Mexico and Guatemala (Angelsen et al., 2020; Taylor et al., 2016; Robson & Berkes, 2011; Davis & Lopez-Carr, 2014; García-Barrios et al., 2009; Carr, 2010). In Mexico, as in Nepal, many case studies examine how customary land tenure institutions mediate the effects of out-migration on forests and land use. Looking across four communities in Oaxaca and four in rural Guatemala, Angelsen et al. (2020) examined the relationships between out-migration and remittances using mixed methods including household surveys and remote sensing data. The authors found little evidence to suggest that out-migration reduced pressure on forest resources, instead documenting how remittances were invested into agricultural intensification.

In contrast to the case studies in Nepal, remittances were often invested into agricultural intensification in Guatemala and Oaxaca. In Ixcán, Guatemala, Taylor et al. (2016) find that the relationship between migration and land use change, including forest cover loss and gain, is not unidirectional or permanent. Instead, the interplay between off-farm income received through remittances and a changing political economy of rural land development resulted in opportunities for African palm cultivation. The resulting expansion in palm cultivation has led to the conversion of forest lands and a net loss in forest cover. In Chiapas, where customary land tenure institutions restrict the conversion of forest lands to agricultural

or ranching lands, Angelsen et al. (2020) found no change in forest cover with increasing out-migration over a 30-year period. The authors attribute the lack of forest clearing to the cultural norms and communal governance of forested lands. In contrast, in the study villages in Guatemala, Angelsen et al. documented a decline in forest cover of approximately one percent per year over the last 20 years. They state that, "...when attractive opportunities exist to invest in agriculture and land expansion, remittances and returnee savings provide fresh capital that is likely to increase pressure on forests" (p. 1). In the case of Guatemala, out-migration is not resulting in rural depopulation but instead is creating new flows of capital through remittances that are invested in agricultural intensification. An important factor in explaining the investment into agriculture is the lack of suitable alternatives; the authors note that "...agriculture continues to be the most viable alternative for farmers as long as it permits that they maintain control over their means of production" (p. 300).

García-Barrios et al. (2009) elucidate the threats posed by expanding agricultural intensification and commodity crop production in depopulated rural landscapes in Mexico. The authors investigate the role of rural out-migration and investment in industrial agriculture as drivers of land use change and deforestation in Mexico. They point to the role of remittances in stimulating agrarian smallholder economies but ultimately demonstrate that while investments in agricultural intensification are prevalent, the dominance of commercial, industrial agriculture is responsible for increasing deforestation and outweighs the forest cover gains from afforestation on abandoned smallholder lands. García-Barrios et al.'s findings show how the confluence of neoliberal reforms, the withdrawal of government subsidies for smallholder staple crop production, and large scale out-migration, weakening customary land and forest governance institutions, have all led to the degradation of existing forests. These findings once again reinforce the importance of strengthening customary land tenure institutions and promoting smallholder agricultural production in conjunction with enforcing protections for remaining forested lands.

To contend with agricultural intensification driven by investment of remittance income, Robson and Berkes (2011) discuss opportunities for fortifying customary land tenure institutions by proactively introducing reforms that increase the flexibility and adaptability of these institutions. Their study, conducted in two communities in Oaxaca, demonstrates how cross-community relationships can help customary tenure institutions adapt to changes brought on by depopulation:

Anticipatory, planned institutional adaptations tend to incur both lower long-term costs and are more effective than reactive adaptations. Although Analco and Comaltepec have now made (or are in the process of making) changes to their communal statutes to manage future migratory flows, the delay in implementing such deliberate strategies attests to their reactionary nature. (p. 188)

The literature from Central America suggests an opportunity for proactive investment in supporting communities with customary land tenure institutions as they navigate the pressures on these institutions caused by out-migration. Out-migration is causing community members to become less reliant on the communal systems that once supported their livelihoods and as a result participation in these customary institutions and interest in collective benefits has declined in some areas. However, if anticipatory adjustments to the terms of participation are enacted, then there is the possibility that even with the loss of community members, these institutions can persist into the future. Support for these communities does not necessitate direct, outside intervention into the governance of communal land holdings but could instead be aimed at empowering community members to participate in communal tenure institutions.

SUB-SAHARAN AFRICA – FOREST REGENERATION AND FOREST DEGRADATION COEXIST IN A REGION CHARACTERIZED BY CLIMATE-INDUCED VULNERABILITY

The literature on sub-Saharan Africa demonstrates that the relationships between out-migration, forest condition, and rural livelihoods are deeply dependent on local socioeconomic conditions as well as

changes in environmental conditions such as increasing climate variability. While underrepresented in the broader literature on migration and forest condition, the case studies from Sub-Saharan Africa raise important points regarding how climate change is interacting with and driving migration in rural landscapes populated by agrarian smallholders.

In the Gambia, Freudenberger (2000) provides an early account of the disruption in agrarian economies caused by out-migration of youth in rural communities dependent on subsistence agriculture. Much like the case studies from Nepal and China, Freudenberger documented a reduction in land under cultivation caused by the out-migration of roughly half of the young adult population in the village of Dumbutu. While remittances provided a significant source of income for rural smallholders, Freudenberger argues that the loss of able-bodied laborers and subsequent reduction in land under cultivation increased livelihood insecurity as households became more dependent on unpredictable remittance income. Moreover, the loss of young men led to a reduction in the participation of individuals in customary tenure institutions and an erosion in social norms surrounding land use. Much like the cases in Oaxaca, Freudenberger's case study shows how remittances are insufficient replacements for the social, cultural, and economic roles that migrants play in their sending communities.

Pires (2012) traces the evolution of land and land use change in southeastern Senegal's Peanut Basin by examining the histories of colonial and post-colonial state interventions in land access, use, and control. Pires historicizes and politicizes current accounts of environmental degradation in the region, using a political ecology approach to integrate an analysis of the political economy of peanut cultivation with data on environmental changes in the region. Pires finds that colonial histories of population resettlement, motivated by economic development of export oriented peanut production, resulted in desertification and land degradation in the Peanut Basin and a collapse in agricultural production during the early 1990s.

The author makes the important point that historical patterns in resettlement and migration greatly influence present day patterns in environmental degradation and land use change. Pires states that:

In the present example, it is important to recognize that current land use patterns and natural resource management practices in the southeastern Peanut Basin reflect in large part the history of economic, social, political, and ecological factors that over time have shaped the regional landscape (p. 104).

Ordway (2015) presents arguably the most compelling case study out of Sub-Saharan Africa, analyzing changes in forest cover prior to and following the Rwandan armed conflict period of 1986 to 2003. Ordway finds that, "During the period of conflict, protected areas observed a total area loss of 22% compared to a 9% gain in forest cover over the same period" (p. 454). The spatial pattern in loss and gain corresponded with areas where active conflict was occurring (loss), where displacement happened (gain), and where resettlement resulted in loss due to forest clearing. Almost all the forest cover loss occurred inside Gishwati Forest Preserve, a protected area with minimal presence of state agents such as park rangers. For Ordway, the movement of peoples displaced by conflict caused a "redistribution of pressures" on the forested lands. Ordway's findings raise the important point that coarse scale trends in forest cover gain can obscure local level forest loss and protected areas when actively managed can buffer against forest cover losses.

Rosenstock et al. (2019) analyze several pathways through which agroforestry and associated landscape change affect human migration, the spread of infectious diseases, food security, and non-communicable disease transmission in sub-Saharan Africa. Rather than a detailed case study of any one particular locality, the authors draw conclusions from general trends in spatial extent of agroforestry and indicators of disease, food security, and migration. In contrast to the other case studies presented here, this paper does not take migration as a factor driving forest cover losses or gains, but instead looks at how the expansion of agroforestry might affect human migration patterns. While this paper does not

present any rich case study from which to draw conclusions, it does raise important questions related to migration and forest condition. The authors state:

... while conventional wisdom suggests that economic improvement is a means to reduce rural-urban migration, the opposite may also be true. A modest increase in income such as that provided by agroforestry products, especially when they represent wild harvesting on communal lands as opposed to investment in the land itself, may provide the money required to migrate rather than the incentive to remain in place. (p. 337)

Improvements in rural livelihood security through investments in education, health care, and employment opportunities may not have the intended consequence of facilitating smallholders' persistence on rural landscapes if livelihood improvements only marginally increase smallholder capital enough to allow for rural out-migration. Migration comes at a cost for individuals and households; whether this cost is met by subsistence farming or fishing as in the case presented by Gregory and Coomes (2019) or whether this comes from accumulated savings due to development interventions like the agroforestry initiatives described above, it is important to recognize that there is no guarantee that investments in improving rural livelihood security will necessarily result in less out-migration. In fact, these improvements could lead to further urbanization or environmentally unsustainable intensification of smallholder production if not coupled with efforts to strengthen governance institutions and implement and/or enforce protections of existing forests. Further study is needed to determine whether improvements in livelihood conditions in rural landscapes engender greater rates of out-migration.

GAPS IN THE LITERATURE

GENDER AND MIGRATION

A prominent gap in the literature on migration and forest condition is the absence of explicit analysis surrounding gendered dynamics in migration including migrant populations and migrant-sending households. Information on the gender, age, and socioeconomic status of both migrants and migrant-sending households would allow for further analysis of the impacts of migration on rural livelihoods, including how migration affects household division of labor, land control and access, natural resource management, and power dynamics in rural landscapes. Jacquet et al. (2015) was the only article reviewed that explicitly mentioned the gendered effects of migration on rural livelihoods. The authors describe how international out-migration of able-bodied men in the Kaski District of Nepal creates additional pressures for women who are tasked with caring for the elderly, taking care of their land, and looking after children, all while maintaining subsistence agricultural production. The added pressures brought on by out-migration resulted in abandoning land under cultivation and in some instances incentivized a movement away from agrarian livelihoods. While gender was not an explicit focus of this literature review, the gendered aspects of migration are an important topic for future research that could further our understanding of the intersection between global patterns in labor and climate-driven migration, vulnerability in rural livelihoods, and forest condition in rural tropical landscapes. One starting place for this future research could be in the literature on the effects of remittances on land and livelihood relations in rural landscapes (see Peluso & Purwanto, 2017).

INTERDISCIPLINARY STUDIES THAT INTEGRATE HIGH QUALITY SPATIAL DATA WITH HOUSEHOLD SURVEYS OR OTHER DESCRIPTIVE LIFE HISTORY ANALYSES ALONG WITH LOCAL-LEVEL ECOLOGICAL DATA ON FOREST CONDITION

Most of the literature examined in this review either presented high quality spatial data that documented trends in forest cover loss or gain over time and coupled this data with national- or municipality-level data on population size or examined local dynamics in out-migration and explained how governance structures and institutions mediated the movement of individuals out of rural areas. Unfortunately, both of these types of studies do little to explain why people are migrating or what the effects are on local

forest condition. Simply put, forest condition cannot be surmised from remote sensing data. Research must integrate local-level demographic and household survey data with long-term ecological data on forest species diversity, ecological function, and extent. It is no surprise that very few studies are able to combine such diverse and multi-disciplinary data sets over long enough time periods to draw conclusions regarding the effects of migration on forest condition and rural livelihoods. The only paper that came close to fulfilling this high marker is Fox's (2018) study on the relationship between migration and forest condition in Nepal. In the absence of studies that integrate both livelihood and forest condition data with demographic data such as gender, age, and socioeconomic class of migrants and migrant-sending populations, a meta-analysis of existing literature could draw out more trends that could be used to contextualize broad patterns in forest cover loss and gain at a national level.

EXPLICIT FOCUS ON GOVERNANCE AND ESPECIALLY THE ROLE OF STATE AND NON STATE ACTORS IN GOVERNING LAND USE, ACCESS, AND CONTROL

Much of the existing literature either provides a detailed examination of governance structures, institutions, and processes that mediate forest condition and migration (Thaler et al., 2016; Klingler & Mack, 2020; Taylor et al., 2016) or completely negates the role of governance in mediating forest outcomes following migration events (Carr, 2010; Oldekop et al., 2018; Rosenstock et al., 2019). Future studies that examine the relationship between out-migration, forest condition and rural livelihoods should explicitly analyze the role of governance structures, such as customary tenure institutions, co-management institutions, community forest or land management institutions, smallholder land tenure arrangements, and others, in mediating forest outcomes. Importantly, these future studies should also consider how non-state actors like non-governmental organizations and private companies in alliance with state agents are influencing the patterns in migration and forest use in rural landscapes through the control and access of land.

LINKS BETWEEN ECONOMIC INEQUALITY AND MIGRATION

Another avenue of research that should be explicitly encouraged is the understanding of how widening income inequality affects individuals' decision to migrate or not, and also how income inequality comes to mediate the effects of out-migration on sending populations in rural landscapes. For example, economic inequality could result in the consolidation of rural landholdings in the hands of more capitalized smallholders or could result in the further marginalization of the poorest smallholders who might turn to subsistence cultivation of abandoned agricultural lands. The divergence in socioeconomic status between those who can afford to migrate and those who cannot is an important point that helps to explain some of the uneven outcomes resulting from rural depopulation in different areas across the tropics.

CONCLUSIONS AND RECOMMENDATIONS

There is sufficient evidence in the literature to support the following interventions and approaches if they are developed in concert with local communities and with respect for cultural norms and communities' right to self-determination:

- I. Protect and promote forest regeneration through active management** – while most landscapes are unlikely to return to pre-disturbance biodiversity levels and ecosystem functioning, these landscapes can provision some ecosystem services including aboveground carbon storage. One possible mechanism to implement this recommendation is through the provision of direct incentives to rural smallholders to actively manage and protect regenerating forests on abandoned agricultural land. These incentives could be provided through payments for ecosystem services schemes, carbon finance, or government programs.

Case studies from Nepal and Mexico both point to the need for active investment and management in rural landscapes where families that are left behind must manage their own land for subsistence or economic production activities but where labor scarcity makes the tradeoff between management of communal land and management of individual land untenable. Interventions could include payments for local landowners to reforest abandoned lands with commercially or culturally valuable tree species or incentives to clear invasive species from naturally generating lands.

Zhang et al. (2022) demonstrate how investments in reforestation should be targeted to areas where there are less dense populations and where agricultural lands won't face competition from reforested and afforested patches. Zhang et al. found the largest increases in aboveground biomass were in rural regions where there was low pressure on croplands, i.e. there was lower population density. In these areas, revegetation of abandoned farmlands drove gains in aboveground woody biomass. In areas where market pressure still demands a large proportion of agricultural lands, reforested and afforesting parcels may face threats from agricultural conversion.

- 2. Strengthen customary and communal tenure institutions** so that they can adapt to the loss of local participants while still actively managing forests for sustainable use. Labor scarcity and the erosion of cultural norms brought on by rural out-migration threatens the persistence of customary forest and land tenure institutions. Supporting local communities as they build adaptive capacity will be critical to ensure that they continue to manage forests for sustainable use and buffer against the encroachment of large-scale commercial interests. Case studies from Oaxaca, Mexico (Robson & Berkes, 2011) demonstrate that it is possible to build adaptive capacity in customary forest tenure institutions by allowing for flexibility in participation and by ensuring that community members have access to resources for managing forests with a reduced pool of laborers.
- 3. Invest in agricultural extension programs** that increase livelihood security for rural smallholders while empowering individuals in their choice to migrate out of or remain on their land. Migration of able-bodied laborers is leading to labor scarcity and a reduction in the cultivation of agricultural land. Subsidies for key agricultural inputs and incentives for crop production would ameliorate some of the pressure caused by out-migration and the loss of laborers for those smallholders who actively choose to continue inhabiting rural landscapes. By providing incentives for smallholders to sustainably intensify their production, these populations can act as a buffer against large-scale land acquisitions for commercial production.
- 4. Invest in improvements in basic services in rural landscapes;** access to quality education, health care, and off-farm employment opportunities is needed to empower rural smallholders to make the choice to stay or leave. Protecting rural livelihoods is an important strategy to ensure protection and conservation of tropical forests in conjunction with strong environmental protection policies. While improvements in socioeconomic status or livelihood security of rural smallholders may also lead to an increase in out-migration, investment in improving basic services ensures that individuals and families who wish to remain on their land are better supported in their choice.
- 5. Invest in supporting women-headed households** in certain rural landscapes where men make up the majority of out-migrants. Investments in improving tenure security of rural landholdings and supporting the participation of women in customary tenure institutions and both on-farm and off-farm livelihood opportunities can help to alleviate pressure on women-headed households where out-migration is primarily of able-bodied men. Case studies from Nepal (Jacquet et al., 2015) and Oaxaca (Angelsen et al., 2020), point to a lack of support for women-headed households in areas where out-migration of men has shifted the burden of maintaining and cultivating rural landholdings to women. Subsequent loss of productive agricultural land due to labor scarcity is in some cases increasing the socioeconomic precarity of these households and increasing pressure on forest based resources.

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