World Development 168 (2023) 106251

Contents lists available at ScienceDirect

World Development

journal homepage: www.elsevier.com/locate/worlddev

Development Review

Remittances and land change: A systematic review

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ARTICLE INFO

Article history:
Accepted 27 March 2023
Available online 12 April 2023

Keywords:
Remittances
Migration
Land systems
Land change
Land use
Rural

ABSTRACT

Remittances—funds sent by migrants to family and friends back home—are an important source of global monetary flows, and they have implications for the maintenance and transformation of land systems. A number of published reviews have synthesized work on a variety of aspects of remittances (e.g., rural livelihoods, disasters, and economic development). To our knowledge, there are no reviews of work investigating the linkages between remittances and land change, broadly understood. This knowledge gap is important to address because researchers have recognized that remittances flows are a mechanism that helps to explain how migration can affect land change. Thus, understanding the specific roles remittances play in land system changes should help to clarify the multiple processes associated with migration and their independent and interactive effects. To address the state of knowledge about the connection between remittances and land systems, this paper conducts a systematic review. Our review of 51 journal articles finds that the linkages uncovered were commonly subtle and/or indirect. Very few studies looked at the direct connections between receipt of remittances and quantitative changes in land. Most commonly, the relationship between remittances and land change was found to occur through pathways from labor migration to household income to agricultural development and productivity. We find four non-exclusive pathways through which households spend remittances with consequent changes to land systems: (1) agricultural crops and livestock, (2) agricultural labor and technologies, (3) land purchases, and (4) non-agricultural purchases and consumables. In the papers reviewed, these expenditures are linked to various land system change outcomes, including land use change, soil degradation, pasture degradation, afforestation/deforestation/degradation, agricultural intensification/extensification/diversification, and no impact. These findings suggest four avenues for future research. One avenue is the use of the theoretical lens of telecoupling to understand how remittances may produce wider-

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https://doi.org/10.1016/j.worlddev.2023.106251
0305-750X/

scale changes in land systems. A second avenue is further examination of the impacts of shocks and disturbances to remittance flows on land change both in migrant sending and in remittance receiving areas. A third avenue is scholarship that examines the extent that household uses of remittances have a "ripple effect" on land uses in nearby interlinked systems. A fourth avenue for future work is the use of spatially explicit modeling that leverages land cover and land use data based on imagery and other geospatial information.

Contents

1. Introduction

Remittances—funds sent by migrants to family and friends back home—are an important source of global monetary flows. They also play an important role in influencing land systems, including their maintenance and transformation. Over the last two decades, the financial value of these funds has grown significantly, especially those flowing to lower and middle income countries (LMICs), making understanding the impacts of remittances for land systems increasingly important. The World Bank has estimated that LMICs received less than $50 billion in remittances in 1990 (Ratha, De, Kim, Seshan, & Yameogo, 2019) but they received approximately $540 billion a decade later (Ratha, Kim, Plaza, & Seshan, 2021). Globally for 2020, the World Bank estimated total flows of about $700 billion (Ratha et al., 2021). Remittances now account for more than 20% of GDP in a number of countries ranging from Tonga, Lebanon, Kyrgyzstan, and Tajikistan to El Salvador, Honduras, and Nepal (Ratha et al., 2021). Remittance flows are widely recognized as an increasingly important source of foreign currency that can influence pathways of socio-economic development (Faist, 2008; Kapur, 2004). Consequently, we argue that it is time to review the state of our empirical knowledge on the impact of remittances on land systems—what do we know about how remittances influence pathways of land system change?

A number of published reviews have synthesized work on a variety of aspects of remittances, such as factors driving their flows and how the funds are used by recipients (Russell, 1986). More recent reviews have examined the connection between remittances and economic development (Adams, 2011), disasters (Le De, Gaillard, & Friesen, 2013), and rural livelihoods (Cole, Wong, & Brockhaus, 2015). Reviews have also examined non-monetary remittances and their associated impacts (Crush & Caesar, 2018). To our knowledge, there are no reviews of the extant body of work investigating linkages between remittances and land change, broadly understood.

An interdisciplinary community of researchers has established a growing understanding of the many connections between migration and land change, with remittance flows as a central mechanism for how migration affects land system change (Jokisch, Radel, Carte, & Schmook, 2019; Radel et al., 2019). However, major debates persist including, for example, the role of out-migration or labor migration in forest transitions (Rudel, Bates, & Machinguiashi, 2002; Schmook & Radel, 2008), land abandonment (Gray, 2009; Jokisch, 2002), and extensification versus intensification of agricultural systems (Adger, Kelly, Winkels, Huy, & Locke, 2002; Gray, 2009; Jokisch, 2002; Rudel et al., 2005; Zimmerer, 2013). In addition, migration may impact sending communities via influences on land tenure, cultivation practices, and intra-household divisions of land- and agriculture-related decision-making and labor (Kelley, 2020; Radel, Schmook, McEvoy, Mendez, & Petrzelka, 2012). Many studies analyzing migration do not disentangle migration and remittances, even though it is possible to have migration activity without remittances. In this sense, migration is a necessary but not sufficient condition for receiving

remittances (Goldring, 2004; Pugliese, Ray, & Esipova, 2016; Liang & Song, 2018). Migration without remittances may happen because a migrant chooses not to send money, may not have steady employment, or may not make enough money to remit surplus funds back home (Goldring, 2004; Pugliese et al., 2016; Liang & Song, 2018).

In this review we acknowledge that migration and remittances are intrinsically linked (Taylor, 1999; Isabaeva, 2011; Rindfuss, Piotrowski, Entwisle, Edmeades, & Faust, 2012; Nguyen et al., 2019), but we focus here on remittances specifically in order to disentangle financial flows from the movement of people. We do this because we hypothesize that the cash flows from remittances allow people to adapt to the impacts of lost labor from migration and also use these cash flows to make further adaptations to changing environmental, political, and economic conditions. We further hypothesize that the use of remittances to make adaptations is reflected in broader impacts on land systems and seek to review the literature that analyzes these changes that go far beyond making up for lost labor alone. Thus, reviewing the existing literature about remittances and land change can advance our understanding about how one aspect of the multiple processes associated with migration can influence land systems more broadly. Our review starts with a summary of theoretical frameworks noted to be important to the broader question of migration's impact on land and land systems. We then describe our methods for identifying a set of articles that constitute the core empirical studies reviewed here. Following a presentation of the findings from our review, we turn to a discussion of those findings and conclude outlining directions for future work.

2. Theoretical approaches to the study of migration and land system change

To situate our review of the impact of remittances on land change, we briefly review the existing body of theories frequently employed to link migration to land change, namely the New Economics of Labor Migration (NELM), Agrarian Transition Theories, and Forest Transition Theory (FTT). We also describe Telecoupling as a conceptual framework that has been seldom applied but has high potential relevance. These theories were either developed or later applied to explain dynamics associated with migration, either in particular or as part of a wider set of changing processes, and they may vary in their ability to address relationships specifically between remittances and land change. The theories identified come from diverse disciplines and fields of study such as geography, economics, sociology, anthropology and political ecology and, thus, they stem from different methodological and intellectual traditions. They also arose out of research aimed at distinct geographic and institutional scales and as such address distinct causal pathways. We introduce each framework and highlight the linkages that each (potentially) identifies between remittances and land change dynamics. Then, in Findings section 4.4, we assess the degree to which these particular theories (and others) have been invoked in the empirical studies we reviewed.

2.1. New economics of labor migration

The New Economics of Labor Migration (NELM) was developed in the 1980 s by economists revising neoclassical economic approaches to migration that focused on individual decision-making (Stark, 1991; Stark & Bloom, 1985; Stark & Taylor, 1989). NELM's most important modifications were (1) to conceptualize the household as the decision-making unit (rather than the individual), (2) to view migration as resulting from relative deprivation, and (3) to conceptualize migration as a household strategy to diversify risk and overcome market constraints. These household-level decisions about migration are explicitly connected to anticipated impacts at the migration origin. Remittances can overcome a lack of credit, act as informal insurance, and allow for productive investments into agriculture and other activities. The actual utility of remittances, however, is contingent on numerous conditions at the migration origin (such as access to markets) and, thus, may not necessarily lead to positive economic outcomes. NELM has also been conceptualized as a non-deterministic framework to understand the development impacts of migration. De Haas, for example lauds NELM for understanding the "heterogeneity of migration-development outcomes" because the framework makes no *a priori* assumptions about positive or negative effects of migration (De Haas, 2010, p. 241–242). Research on whether or not remittances overcome credit, liquidity, or other economic constraints to increase agricultural productivity and incomes is ongoing (Davis & López-Carr, 2014; De Haas, 2006; Nguyen, Grote, & Nguyen, 2019; Taylor & López-Feldman, 2010). The explicit links to land change dynamics within this theoretical framework are primarily associated with the potential to shift the type or intensity of agricultural land uses.

2.2. Agrarian transition theories

Work on agrarian transitions has focused on how capitalist relations transform agriculture, social relations, and livelihoods; and on the political implications of such shifts (Kautsky, 1988) [1899], (Lenin, 1964) [1899]. Work in this vein has explored, for instance, changing agricultural production relations and agriculture's role as a source of cheap labor, low-cost goods, or surplus capital for industrial development (Akram-Lodhi & Kay, 2010; Byres, 1977). Although "agrarian questions of capital" remain core to agrarian transition work, since roughly the 1970s, globalization processes have increasingly brought "agrarian questions of labor" to the fore (Bernstein, 2004). For scholars of Latin American agrarian transitions, the 1980s and 1990s saw a shift to a "New Rurality" with labor out-migration as a central characteristic of rural Latin American spaces. Such themes have direct relevance to remittance flows and their role in diversification and hybridization of agrarian livelihoods and income streams (Bernstein, 2010; Bryceson, 2002; Rigg, 2006). Remittances can also flow back into agrarian regions to shift circumstances of land use, control, and cover (McKay, 2003; 2005). Research has explored, among other topics, the gendered and generational contours of migration and agrarian labor relations (Barney, 2012; Peluso & Purwanto, 2018). These explorations include the "agrarian orientations" that continue to inform the lives and remittance transfers of even those migrants who remain in work site contexts (Gidwani & Ramamurthy, 2018), and the forms of social difference that inform uneven access to paid work and remittance capital (Silvey, 2006; Sunam, Barney, & McCarthy, 2021). Work on New Ruralities has also explored how land and property relations in agrarian areas condition remittance investments and the resulting "remittance landscapes" (McKay, 2003; Radel, Schmook, Carte, & Mardero, 2018; Rigg, Salamanca, Phongsiri, & Sripun, 2018). In this context, these theories position the potential land impact of remittances as contextual and contingent.

2.3. Forest transition Theory

Forest Transition Theory (FTT) emerged as a generalized description of the pathways through which countries lose and then gain forest cover in the course of broader economic development (Mather, 1992; Perz, 2007; Rudel et al., 2005). While scholars have critiqued the approach as overly deterministic (Perz, 2007), this national economic-development-based theory of land cover

change has proved a useful framework for a range of work testing the relationship between forest loss and recovery across socio-economic and biophysical conditions (Rudel, Schneider, & Uriarte, 2010). These analyses have led to a range of hypothesized causal pathways for transition or the lack thereof, including exogenous and endogenous drivers of forest cover change (Kull, Ibrahim, & Meredith, 2007; Redo, Grau, Aide, & Clark, 2012). Migration and resulting remittances are hypothesized drivers of forest cover expansion through loss of labor and remittances as investment potential (García-Barrios et al., 2009; Hecht & Saatchi, 2007; Radel et al., 2019; Schmook & Radel, 2008). Labor lost in rural areas due to migration leads to either abandonment of cultivated land and/or intensification of production in select areas, leaving other regions open to either passive or active reforestation (Redo et al., 2012; Walker, 2008). Limitations on the explanatory power of FTT have been recognized: remittances enable continuities in land use or shifts to new non-forest production (García-Barrios et al., 2009; Radel et al., 2019). Yet, FTT remains a primary theoretical approach to connect migration explicitly to land changes.

2.4. Telecoupling

The conceptual framework of telecoupling emerged from an increasing appreciation for the complexity of the coupled dynamics of human and natural systems in the early 21st century (Liu et al., 2007; 2013). Telecoupling is a technical framework for understanding two or more coupled human-natural systems that interact despite being physically distant (Liu et al., 2013). Thus, this framework should be applicable to studying causal pathways between remittances and land change. The paradigm recognizes three types of interacting systems (sending, receiving, spillover) with the dynamics emerging from their joint interactions giving rise to phenomena of interest. Telecoupling has been applied to land change dynamics (Friis & Nielsen, 2017), including the rise of soybean production in the Global South (Silva et al., 2017; Yao, Hertel, & Taheripour, 2018), and a few scholars have applied telecoupling to the complex interacting phenomena of migration, remittances, and land change (Zimmerer, Lambin, & Vanek, 2018). Although this framework has not often been applied explicitly to understand the relationship between migration and land change, the ideas that undergird the telecoupling framework have clear relevance. Radel et al. (2019) called for its use to understand migration as a feature of land system transitions. Application of the telecoupling lens to understand livelihoods as "enmeshed in a set of relations with actors and dynamics in multiple places" (le Polain de Waroux, 2019) can also highlight how migration and remittances may influence land management or land use through livelihood changes.

3. Methodology

As indicated previously, we located no comprehensive review papers about remittances and land system change. This knowledge gap is critical since remittances are a prominent source of global monetary flows, and have widespread implications for land system maintenance and transformation. To fill this gap, we conducted a systematic review of the literature, using an *a priori* and comprehensive plan for identifying and synthesizing the extant work focused on monetary remittances and land change (Uman, 2011). This type of review, which seeks to mitigate selection bias, differs from descriptive, narrative reviews that use a subset of articles selected based on authors' selection and availability (Uman, 2011).

In this review, we defined remittances as monetary flows, both domestic and international. We did not review papers discussing food remittances or social remittances. We also did not review the phenomenon of "collective remittances", those funds raised by a group for the purpose of benefiting a group or community via various types of projects including (1) basic infrastructure and communications projects, (2) public service infrastructure and capitalization, (3) recreation and status-related projects, and (4) other community or urbanization projects (Goldring, 2004; Kayaoğlu, 2017; Liang & Song, 2018; Smyth, 2017). Although collective remittances can result in land change, prior studies have noted that they are used primarily for basic infrastructure and social welfare projects (Fox & Bada, 2008; Kayaoğlu, 2017; Liang & Song, 2018). We defined "land change" broadly and operationalized it using a variety of phrases, including the following: land use; land change; farming practices; agricultural investments or practices; agrarian transitions; forest transitions or changes; land relations; land management; livestock management. We excluded, however, articles examining remittances solely used to build/rebuild shelter, make home improvements or home investments.

To identify candidate papers for the review, we searched in four databases (Scopus, Web of Science, Econlit/Proquest, ScienceDirect) for peer-reviewed journal articles in English that were published between 2000 and 2020. Thus, our search did not include the following outlets for scholarly work: books, book chapters, working papers, dissertations, theses, newspaper articles, magazine articles, and other media (e.g., radio, film, blogs, *etc.*).

This search process produced an initial list of 861 articles. We supplemented this list with an additional 66 articles recommended through the knowledge of research team members who represent regional expertise on remittances, migration, and/or land use from around the world. We took this step because we recognize that some journals critical to our topic are not indexed in databases (e.g., *Remittances Review*). We combined these two lists and removed duplicate articles. Next, research team members reviewed papers for relevance: we focused on papers whose central research question focused on land change and remittances. We also considered papers with findings pertaining to land use change and remittances even though this topic was not the primary research question of the paper. Based on this systematic review of the literature, we determined that 51 articles dealt directly with the primary theme within the guidelines of this review. The articles listed in Table 1 are the focus of the findings and discussion sections.

4. Findings

4.1. Core article characteristics

Most of these articles (80%, n = 41) were published since 2010 and 51% (n = 26) of these articles were published since 2015, suggesting the topic of remittances and land change is relatively new and attracting growing scholarly interest. The earliest papers about the topic within the 2000–2020 search window appeared in 2002 in *Ambio* (Adger et al., 2002) and *Human Ecology* (Jokisch, 2002). Since this time, articles have appeared in 37 different scholarly journals, indicating broad interdisciplinary engagement in this topic. These outlets deal with a broad range of disciplines including economics, geography, ecology, environmental studies, and development studies. Three journals—*Population and Environment*, *Land Use Policy,* and *Human Ecology*—had the most publications with four articles in each.

There were clear patterns in the geographic distribution of articles. Most articles pertained to Latin America (53%, n = 27). Within the group of Latin American articles, studies of remittances from Mexico (n = 9) and Guatemala (n = 8) appeared most often. Nepal also accounted for a large cluster (n = 7) of articles. These geographic concentrations may reflect the relative importance of remittances in these countries or it may be an artifact of scholar-

Table 1
List of 51 Core Articles Summarized in Review.

Authors	Year	Journal Title	Title
Abdelali-Martini and Hamza	2014	Journal of International Development	How do migration remittances affect rural livelihoods in drylands?
Adger et al.	2002	AMBIO: A Journal of the Human Environment	Migration, remittances, livelihood trajectories, and social resilience
Aguilar-Støen	2020	Canadian Journal of Development Studies	Between a rock and a hard place: rural transformations and migrant communities in Guatemala
Aguilar-Støen	2012	European Review of Latin American and Caribbean Studies	'Con nuestro propio esfuerzo': Understanding the Relationships between International Migration and the Environment in Guatemala
Aguilar-Støen et al.	2016	Journal of Agrarian Change	Agriculture, Land Tenure and International Migration in Rural Guatemala
Angelsen et al.	2020	Land	Migration, remittances, and forest cover change in rural Guatemala and Chiapas, Mexico
Barney	2012	Critical Asian Studies	Land, livelihoods and remittances: A political ecology of youth out-migration across the Lao-Thai Mekong Border
Böhme	2015	Agricultural Economics	Does migration raise agricultural investment? An empirical analysis for rural Mexico
Carte, Radel, and Schmook	2019	The Geographical Journal	Subsistence Migration Smallholder food security and the maintenance of agricultue through mobility in Nicaragua
Caulfield et al.	2019	Land Use Policy	How rural out-migrations drive changes to farm and land management: A case study from the rural Andes
Cedamón et al.	2018	Agroforestry Systems	Adaptation factors and futures of agroforestry systems in Nepal
Chaudhary	2020	Remittances Review	Influence of Remittances on Socio-Economic Development in Rural Nepal
Damon	2010	The Journal of Development Studies	Agricultural land use and asset accumulation in migrant households: The case of El Salvador
Davis and López-Carr	2010	Population and Environment	The effects of migrant remittances on population-environment dynamics in migrant origin areas: international migration, fertility, and consumption in highland Guatemala
De Haas	2006	Geoforum	Migration, remittances, and regional development in Southern Morocco
Fox	2018	Journal of Peasant Studies	Community forestry, labor migration and agrarian change in a Nepali village: 1980 to 2010
Gray	2009	Population and Environment	Rural out-migration and smallholder agriculture in the southern Ecuadorian Andes
Gray and Bilsborrow	2014	Land Use Policy	Consequences of out-migration for land use in rural Ecuador
Hecht and Saatchi	2007	BioScience	Globalization and forest resurgence: Changes in forest cover in El Salvador
Holder and Chase	2012	Environment, Development and Sustainability	The role of remittances and decentralization of forest management in the sustainability of a municipal-communal pine forest in eastern Guatemala
Jokinen	2018	Population and Environment	Migration related land use dynamics
Jokisch	2002	Human Ecology	Migration and Agricultural Change: The Case of Smallholder Agriculture in Highland Ecuador
Kapri and Ghimire	2020	World Development Perspectives	Migration, remittance, and agricultural productivity: Evidence from the Nepal Living Standard Survey
Li et al	2013	China Agricultural Economic Review	Migration, remittances, and agricultural productivity in small farming systems in Northwest China
López-Feldman and Chávez	2017	Ecological Economics	Remittances and Natural Resource Extraction: Evidence from Mexico
López-Feldman and Escalona	2017	Applied Economics Letters	Remittances and labour allocation decisions at communities of origin: the case of rural Mexico
Maduekwe and Adesina	2017	GeoJournal	Remittances economy, remittances landscape: an analysis of the economic and socioecological implications of remittances to households in South Eastern Nigeria
Manivong et al.	2014	Human Ecology	Rice and Remittances: Crop Intensification Versus Labour Migration in Southern Laos
McKay	2003	Journal of Southeast Asian Studies	Cultivating new local futures: Remittance economies and land-use patterns in Ifugao, Philippines
McKay	2005	Geografisk tidskrift	Reading remittance landscapes: Female migration and agricultural transition in the Philippines
Nguyen et al.	2019	Economic Analysis and Policy	Migration, crop production and non-farm labor diversification in rural Vietnam
Oldekop et al.	2018	Global Environmental Change	An upside to globalization: International outmigration drives reforestation in Nepal
Peluso and Purwanto	2018	Singapore Journal of Tropical Geography	The remittance forest: Turning mobile labor into agrarian capital
Piras et al	2018	Land Use Policy	Remittance inflow and smallholder farming practices. The case of Moldova
Radel and Schmook	2008	Journal of Latin American Geography	Male Transnational Migration and its Linkages to Land-Use Change in a Southern Campeche Ejido
Robson et al	2018	Journal of Agrarian Change	Migration and agrarian transformation in Indigenous Mexico
Romankiewicz et al	2016	Die Erde	Adaptation as by-product: Migration and environmental change in Nguith, Senegal
Sagynbekova	2017	Mountain Research and Development	Environment, Rural Livelihoods, and Labor Migration: A Case Study in Central Kyrgyzstan
Sauer et al	2015	Agricultural Economics	Migration and farm technical efficiency: evidence from Kosovo
Schmook and Radel	2008	Human Ecology	International Labor Migration from a Tropical Development Frontier: Globalizing Households and an Incipient Forest Transition: The Southern Yucatán Case
Schmook et al	2013	Human Ecology	Persistence of Swidden Cultivation in the Face of Globalization: A Case Study from Communities in Calakmul, Mexico
Schoch et al	2010	Natural Resources Forum	Migration and animal husbandry: Competing or complementary livelihood strategies. Evidence from Kyrgyzstan
Sunam and McCarthy	2016	Journal of Peasant Studies	Reconsidering the links between poverty, international labour migration, and agrarian change: critical insights from Nepal
Taylor and López-Feldman	2010	Journal of Development Studies	Does Migration Make Rural Households More Productive
Taylor et al	2006	Geoforum	Land, ethnic, and gender change: Transnational migration and its effects on Guatemalan lives and landscapes
Taylor et al.	2016	Land Use Policy	International migration, land use change and the environment in Ixcán, Guatemala
Uddin and Igbokwe	2020	Human Geographies	Effects of international migration and remittances on rural households in Edo State, Nigeria
VanWey et al.	2012	Population and Environment	Out-migration and land-use change in agricultural frontiers: Insights from Altamira settlement project
Williams and Paudel	2020	Environmental Management	Migration, Remittance, and Adoption of Conservation Practices
Yarnall and Price	2010	Journal of Latin American Geography	Migration, Development and a New Rurality in the Valle Alto, Bolivia
Zimmerer	2013	Proceedings of the National Academy of Science	The compatibility of agricultural intensification in a global hotspot of smallholder agrobiodiversity (Bolivia)

ship bias. Data from the World Bank indicate that international remittances accounted for 14.7% of GDP in Guatemala and about 23.5% of GDP in Nepal in 2020 (The World Bank Migration and Remittances Data 2020, 2020). Although remittances do not constitute a large fraction of Mexico's GDP (just 4% in 2020), the magnitude is substantial (over US$42B in 2020), making it the second largest recipient of international remittances after India (World Bank Personal remittances received (current US$) 2022, 2022). Most papers (94%, n = 48) studied the link between remittances and land change in rural contexts. This focus makes sense because migration is a well-known adaptation strategy for households given the paucity of employment opportunities in rural areas (Aguilar-Støen et al., 2016; Gray, 2009).

4.2. Sources and types of data

4.2.1. A remittances data

<!?A3B2 tlsb=0.06'?>The plurality of articles focused just on international remittances (59%, n = 30), several articles considered both domestic and international remittances (27%, n = 14), and a few (12%, n = 6) did not explicitly state which kind of remittances were included in their study. Only one article focused on domestic remittances within Vietnam (Adger et al., 2002). In terms of sources for these data, the majority of studies relied on survey data alone (59%, n = 30) and 18% (n = 9) only used interview data. Four studies (8%) relied on government surveys as a source of remittance data. For example, (Taylor & López-Feldman, 2010) used data from the Mexico National Rural Household Survey conducted in 2003. Sauer, Gorton, and Davidova (2015) used data from the Annual Agricultural Household Surveys conducted by the Statistical Office of Kosovo (SOK), and Kapri and Ghimire (2020) used survey data from the Nepalese Government's Nepal Living Standard Survey. Approximately a quarter of the studies relied on multiple sources of data on remittances (24%, n = 12). For example, Jokisch (2002) used a combination of surveys, semi-ethnographic techniques, and oral histories to examine the impact of migration on smallholder agriculture in Ecuador.

4.2.2. B Land Use/Land cover data

Similar to the data for remittances, the sources of data for land use and land change were varied, and some studies also used multiple sources and types of qualitative and quantitative data. The majority of studies (53%) relied on survey data about land change and land use collected by research team members (n = 27). Several studies used qualitative interviews (n = 15) and just one study relied on ethnographic data. Some studies used multiple sources of data (n = 11). For example, Jokisch (2002) collected data using an agricultural survey focusing on land tenure, agricultural yields, labor, and agricultural characteristics. These data were paired with soil quality tests, which were designed to capture variations in land quality. Fox (2018) paired survey data about agricultural and forest-use practices with information from eight forest patches about tree cover, tree density, tree species and their dominance in a study of forest condition and labor migration in Nepal.

Twelve (24%) of the fifty-one articles used remotely sensed data from spaceborne sensors or aerial photos to track changes in land cover. These data primarily came from Landsat and MODIS or from unnamed imagery sources. From these studies, we identified three levels of engagement from lower to higher complexity: (1) visual interpretation of images or maps; (2) derivation of spatial quantities for use in aspatial statistical models; and (3) change detection through comparison of multiple time periods of classified forest cover. One article engaged in interpretation only (Romankiewicz, Doevenspeck, Brandt, & Samimi, 2016) and a second (Jokinen, 2018) used both interpretation of older imagery and geospatial analysis of recent satellite imagery. Five articles used spatial data to derive quantities (e.g., areal estimates of land cover types) that were then incorporated into aspatial models (Gray & Bilsborrow, 2014; Maduekwe & Adesina, 2017; Radel & Schmook, 2008; Schmook & Radel, 2008; Zimmerer, 2013). Five articles conducted geospatial analysis of forest cover change (Aguilar-Støen, 2012; Aguilar-Støen et al., 2016; Angelsen, Aguilar-Støen, Ainembabazi, Castellanos, & Taylor, 2020; Hecht & Saatchi, 2007; Taylor, Aguilar-Støen, Castellanos, Moran-Taylor, & Gerkin, 2016). Yet, it is rather surprising in this age of ready access to imagery and geographic information systems that so few of the articles relied on any spatially explicit data in their assessments.

4.3. Methods of analysis

The articles covered in this review employed a blend of qualitative and quantitative approaches to analyze the linkages between remittances and land change. To understand trends in the variety of methods employed across this set of papers, we classified articles into one of three categories: quantitative studies, qualitative studies, or mixed methods studies. We defined quantitative studies as those that use geographic information systems (GIS) and/or remote sensing techniques to classify data and/or statistical analyses that go above and beyond descriptive statistics (e.g., regression models, cluster analyses). Oldekop, Sims, Whittingham, and Agrawal (2018) is an example of a quantitatively focused paper: it used regression-based matching to analyze the linkages between forest cover changes and migration. Qualitative methods are defined as techniques used to collect and analyze ethnographic and interview data as well as descriptive analyses of secondary or survey data. Examples of qualitative studies include Peluso and Purwanto (2018) study of labor migration and forests in Java, Indonesia using ethnographic techniques, and the Romankiewicz et al. (2016) study about the link between environmental change and migration in Senegal, which used both ethnographic and interview data. We classified studies as mixed methods when aspects of both qualitative and quantitative techniques were used. An example of a mixed methods study is Abdelali-Martini and Hamza (2014), which paired Poisson and ordinary least squares (OLS) regression analysis of survey data with interview data to understand the impact of remittances on Syrian livelihoods. Of the articles reviewed, 37% (n = 19) used quantitative methods, 24% (n = 12) used qualitative methods, and 39% (n = 20) used mixed methods.

4.4. Theoretical frameworks

Table 2 provides examples of the frameworks utilized in the 51 articles reviewed. Studies used three primary theoretical frameworks to discuss the pathways by which remittances may influence land use, land management, or land cover and, therefore, land systems: (1) New Economics of Labor Migration (NELM) (17 articles, 33%), (2) Agrarian Transition Theories and the associated concepts of New Ruralities (11 articles, 21.6%), and (3) Forest Transition Theory (11 articles, 21.6%). Some articles utilized multiple frameworks (Angelsen et al., 2020; Radel & Schmook, 2008). Additional concepts invoked by the authors—explicitly or implicitly—include social-ecological systems (Maduekwe & Adesina, 2017), sustainable livelihoods/livelihood adaptations (Schoch, Steimann, & Thieme, 2010), and land sparing versus sharing debates (Hecht & Saatchi, 2007). As a group, the articles were generally informed by migration theories, and some papers drew on theories developed to explain land change. No reviewed article drew explicitly on the Telecoupling framework, in part reflecting the focus of articles on the impact of remittances on land change within single coupled human-natural systems.

There were clear correlations between the theoretical framings and analytical approaches used in particular articles, and these were likely rooted in or informed by the authors' epistemological perspectives. Papers building from NELM often used an econometric or regression modeling approach (Böhme, 2015; Li et al., 2013), whereas, those focused on agrarian transitions were more likely to take a qualitative analytic approach. For example, work on New Ruralities (Hecht, 2010) has also explored how land and property relations in agrarian areas condition remittance investments and resulting "remittance landscapes" (McKay, 2003). Articles that engaged directly with agricultural transition theories and sustainable rural livelihoods were primarily based on Southeast Asia, while those drawing from forest transition theory were based in Mesoamerica. Overall, papers that considered NELM were more likely to deploy quantitative or mixed methods, as were those that examined Forest Transition Theory. Those papers that deployed an agrarian transition framing were predominantly qualitative or mixed in their methods; however, most qualitative papers employed an implicit rather than an explicit theoretical framework in their analyses.

4.5. Empirics of how remittances are spent and any AsRadeociated impacts on land systems and land cover

Our coding of the contents of the 51 core articles suggested four major patterns of how remittances are spent and how these change

Table 2
Theoretical frameworks in core articles.

Theoretical framework	Examples
New economics of labor migration (NELM)	Böhme (2015); De Haas (2006); Jokinen (2018); Li et al. (2013)
Agrarian transition	Aguilar and Støen et al. (2020); Fox (2018); McKay (2005)
Forest transition	Radel and Schmook (2008); Schmook and Radel (2008); Taylor et al. (2016)
Socio-ecological systems	Maduekwe and Adesina (2017)
Sustainable livelihoods	Schoch et al. (2010); Cedamón et al. (2018)
Remittance landscapes	Gray (2009); Gray and Bilsborrow (2014)
Land-sparing-land sharing	Hecht and Saatchi (2007)

households' interactions with land systems (see Table 3). These included direct investments related to land: (1) investments in agricultural crops, livestock, or technologies; (2) investments in hired agricultural labor; (3) investments in land purchases or land titles; and (4) investments in non-agricultural activities and consumables that change land use or relationships to land. These remittance-spending patterns produce land system and cover changes, including through changing cropping system intensity, modifications to types of crops cultivated and livestock practices, and soil or pasture degradation. Forest cover and use may also be affected by remittance spending patterns. Forest cover and use may also be affected by remittance spending patterns. Remittances do not always lead to changes in land use or cover, however, as remittances may be used instead to support extant systems. The uses of remittances listed below may be undertaken individually or in combination, with resulting land system changes; for example, a household buying more land may do so in order to change their practices, expanding into livestock production (Taylor et al., 2016). The repetition in citations across categories reflects this range of uses. These four investment types occur in papers produced through different methodologies and framework types, with no readily discernable trends.

4.5.1. Investments in agricultural crops and livestock

Many households receiving remittances work in agriculture and invest remittances in this important livelihood activity, including investments in higher value crops and livestock. For instance, a common use of remittances was to move agricultural activities from lower value subsistence crops to higher value commercial crops (Adger et al., 2002; Barney, 2012; Damon, 2010; Gray & Bilsborrow, 2014; Li, Wang, Segarra, & Nan, 2013; Van Wey, Guedes, & D'Antona, 2012). McKay (2003; 2005) reported in studies from the Philippines that higher value crops, like bean cultivation, became more common and replaced less valuable wet-rice cultivation. Adger et al. (2002) reported that remittances enabled households to shift from rice cultivation to cash crops. In northwest China, Li et al. (2013) found that remittances were used to invest in apple orchards and labor to work in the orchards, which were viewed as a high return cash crop in the region. Similarly, Yarnall and Price (2010) and Zimmerer (2013) found that in Bolivia, international remittances were used to shift from subsistence agriculture towards market-oriented peach production. Zimmerer (2013) noted that subsistence cultivation of maize was not entirely replaced; instead, remittances were also used to intensify maize production and the cultivation of diverse maize landraces continued. In Laos, Barney (2012) found that remittances, especially from young people working in Thailand, enabled the introduction of new crops and commodities planted on family land. In contrast, Damon (2010) found that in El Salvador, migration and remittances reduced areas for cash crop and pasture and increased areas for basic grains.

Several studies indicated that remittances can reduce household dependence on subsistence agriculture and can enable households to shift cultivation practices towards commercial crops. These types of remittance investments can shift land control. Barney (2012) explains how remittance investments enabled permanent crops to be planted in village commons, privatizing the space, and creating hardships for capital-strained households. In other cases, instead of shifting agricultural practices, remittances allowed households to maintain subsistence farming despite harsh social conditions (Carte, Radel, & Schmook, 2019). Increased dependence on remittances for income may reduce the importance of cultivation and forests to livelihoods, freeing lands for regeneration (Oldekop et al., 2018; Peluso & Purwanto, 2018). Alternately, remittance funds for investment may lead to increases in forest clearing, for new crops or pasture (Davis & López-Carr, 2014; Van Wey et al., 2012).

Remittances can also be invested in livestock, as has been documented for Guatemala (Taylor et al., 2016), Kyrgyzstan (Sagynbekova, 2017; Schoch et al., 2010), Syria (Abdelali-Martini & Hamza, 2014), Ecuador (Jokisch, 2002), Mexico (Radel & Schmook, 2008; Schmook & Radel, 2008), and Indonesia (Peluso & Purwanto, 2018). Livestock serve as a "bank-on-the-hoof" with ready access and high liquidity. Subsequent sale of livestock may finance a variety of purposes including education and celebrations (e.g., weddings and funerals) (Peluso & Purwanto, 2018; Sagynbekova, 2017).

The resultant changes in land use can produce varying land cover and environmental quality outcomes that might be viewed as negative or positive. Few studies offered empirical data about these outcomes, although some presumed or hypothesized negative environmental impacts associated with agricultural investments. While the evidence suggests that expanding livestock herds and intensifying cultivation practices commonly leads to higher outputs and greater productivity (Kapri & Ghimire, 2020), they can also result in negative environmental outcomes such as overgrazing (Sagynbekova, 2017; Schoch et al., 2010), soil degradation (Caulfield, Bouniol, Fonte, & Kessler, 2019), and water pollution. In Kyrgyzstan, remittances invested in livestock increased grazing pressure on nearby pastures with implications for range

Table 3
Remittance Uses in Core Articles.

Specific investment	Description	Examples
Agricultural crops and livestock	Funds used for changing agricultural practices, such as shifting to higher-value crops, shifting to livestock/pasture	Adger et al. (2002); Aguilar-Støen (2012); Aguilar-Støen (2020); Gray (2009); Li et al. (2013); McKay (2005); Nguyen et al. (2019); Peluso and Purwanto (2018); Radel and Schmook (2008); Sagynbekova (2017); Schoch et al. (2010); Schmook and Radel (2008); Taylor et al. (2016); Van Wey et al. (2012); Zimmerer (2013)
Agricultural labor and technologies	Funds applied to efforts to sustain or increase productivity of existing landholdings through hiring labor; labor hiring; purchasing fertilizer and chemicals, purchasing machinery, etc.	Carte et al. (2019); De Haas (2006); Holder and Chase (2012); Gray (2009); Jokinen (2018); Jokisch (2002); Kapri and Ghimire (2020); Manivong et al. (2014); Piras et al. (2018); Romankiewicz et al. (2016);
Purchase of land/ ability to maintain ownership of land	Funds allow for increasing land holdings or securing land through registration and titling processes	Abdelali-Martini and Hamza (2014); Angelsen et al. (2020); Aguilar-Støen et al. (2016); Aguilar-Støen (2012); Chaudhary (2020); Davis and López-Carr (2010); De Haas, 2006; Gray and Bilsborrow (2014); Jokisch (2002); Sunam and McCarthy (2016); Uddin and Igbokwe (2020); Yarnall and Price (2010)
Non-agricultural products, services, and consumables	Funds used for a range of non-farm and non-land related goals, ranging from purchasing basic goods (food from markets, fuel), and home improvement, to paying for educational services, and entrepreneurship	Adger et al. (2002); Barney (2012); Cedamón et al. (2018); Chaudhary (2020); De Haas (2006); Fox (2018); Holder and Chase (2012); Jokisch (2002); López-Feldman and Escalona (2017); Manivong et al. (2014); Sagynbekova (2017); Schoch et al. (2010); Schmook and Radel (2008)

degradation (Sagynbekova, 2017; Schoch et al., 2010). A few studies had more specific findings on negative outcomes. In the Philippines, McKay (2005) found that remittances invested in high value crops and logging resulted in reduced water availability. Similarly, one study of Guatemala found remittances invested into cattle ranching resulted in high rates of deforestation (Taylor et al., 2016).

Few studies uncovered positive environmental impacts. In their study of Indonesia, Peluso and Purwanto (2018) saw an increase in fodder production in forest undergrowth as a result of changes to forest management practices in the wake of outmigration and remittances. Studies of agricultural investment have also found a lack of evidence of any type of impact. For example, Williams and Paudel (2020) reported no discernible impact of remittances on soil and water conservation practices.

4.5.2. Investments in hired agricultural labor and technologies

Remittances can help households overcome labor shortages resulting from migration (Gray, 2009; Jokisch, 2002) through hiring of additional labor or the adoption of labor saving technologies (Kapri & Ghimire, 2020). Many studies found remittances are used to hire workers to compensate for missing labor (Carte et al., 2019; De Haas, 2006; Gray, 2009; Jokinen, 2018; Piras, Vittuari, Möllers, & Herzfeld, 2018). Gray (2009) for example, found that households in rural Ecuador were able to use international remittances to increase the amount of hired labor and chemical inputs to overcome the impacts of labor lost to migration. Similarly, Piras et al. (2018) found that family labor was substituted by contract labor.

Some studies revealed remittances could enable households to invest in labor-saving agricultural technologies (Kapri & Ghimire, 2020; Manivong, Cramb, & Newby, 2014). These investments were associated with a shift away from subsistence agriculture to crops produced for markets (Caulfield et al., 2019; De Haas, 2006; Holder & Chase, 2012; Romankiewicz et al., 2016; Yarnall & Price, 2010). Using data from the Nepal Living Standard Survey 2010/11, Kapri & Ghimiri (2020) found that remittances helped households overcome financial constraints, enabling them to make investments in equipment (e.g., tractors) that increased agricultural productivity. A detailed account by De Haas (2006) showed how remittances were invested in agricultural technologies in Morocco by digging wells and installing diesel pumps, hiring machinery, and other avenues.

The findings are mixed on how remittances spent on hired labor and technology affect land system outcomes. Some studies found few impacts of investments in agricultural technologies on land productivity (Jokinen, 2018; Jokisch, 2002; Manivong et al., 2014; Piras et al., 2018). For example, Manivong et al. (2014) found investments in agricultural technologies produced minimal increases in productivity. One reason for minimal increases in productivity was the use of less than the recommended amount of fertilizer. Other studies found investments in agricultural technologies did increase agricultural productivity (Holder & Chase, 2012; Kapri & Ghimire, 2020) as well as more nuanced impacts on households. In Bolivia, investments in mechanization and irrigation changed agricultural norms for families with migrants—a manifestation of the New Rurality. These investments enabled households to invest in profitable products for market production, such as peaches in Yarnall and Price (2010) or apples in Li et al. (2013). In Senegal, Romankiewicz et al. (2016) found that remittances invested in various technologies increased households' independence from local agro-ecological conditions, by enabling deep wells and water holes for their livestock and vegetable gardens. In southern Morocco, the remittance investment in mechanical technologies fostered a profound transition with intensified oasis agriculture, resulting in large monocultures and purely individual water management systems (De Haas, 2006). In Syria, remittances were used to pay for mechanical removal of rocks from fields to clear additional area for planting (Abdelali-Martini & Hamza, 2014).

4.5.3. Investments in land and tenure security

Many studies found households receiving remittances increased landholdings or land available for agricultural production. In Guatemala, remittances were used to purchase land for coffee production, increasing tenure security and social prestige among migrant households (Aguilar-Støen, 2012; Aguilar-Støen et al., 2016). In other cases, remittances were used to purchase additional lands for pastures to raise cattle (Davis & López-Carr, 2010; Taylor, Moran-Taylor, & Ruiz Land, 2006) or to rent land for cultivation (Carte et al., 2019). Jokinen (2018) noted that remittances can secure land tenure by enabling migrant households to hold onto their land for farming practices rather than being forced to sell it. Studies also found that the influx of capital in the form of remittances can generate new forms of land inequality. Sunam and McCarthy (2016) detailed how remittance investments in Nepal inflated local land prices, driving the commodification of land and increasing barriers to land access by the rural poor.

In terms of land cover and land change, some studies suggested land acquisitions used to provide space for home construction may also withdraw land from agricultural uses (Davis & López-Carr, 2010; Romankiewicz et al., 2016). Angelsen et al. (2020) noted in Guatemala that land purchases by remittances-receiving households plugged them into international markets for palm oil and coffee. An earlier study by Aguilar-Støen, Taylor, and Castellanos (2016) found mixed effects of remittances invested in land in their study of forests in Guatemala. Depending on the sub-national region, they found forest decline, forest expansion, or no substantial change, thereby pointing to the importance of contextual factors for explaining migrant household decision-making and subsequent impacts.

4.5.4. Investments in non-agricultural products, services, and consumables

While the studies we reviewed all examined land system changes in some way, many also found that non-agricultural activities and household consumables were key uses for remittances, which can in turn have indirect effects on land dynamics. These uses include investments in private enterprises (De Haas, 2006), housing (Barney, 2012; Chaudhary, 2020; De Haas, 2006; Jokisch, 2002; Schmook & Radel, 2008; Schoch et al., 2010), daily household needs (Barney, 2012; Manivong et al., 2014; Sagynbekova, 2017; Schoch et al., 2010), and educational services (Adger et al., 2002; Barney, 2012; Cedamón, Nuberg, Pandit, & Shrestha, 2018; Schoch et al., 2010). While the purchase of non-agricultural products, services, or consumables may not appear as directly linked to land change, studies have illustrated this type of remittance use can influence land use when existing lands (or newly acquired lands) are used for alternative purposes, thereby decreasing the importance of agriculture or other land uses that served as the basis for rural livelihoods (Cedamón et al., 2018; Davis & López-Carr, 2010; Fox, 2018; Gray & Bilsborrow, 2014; Romankiewicz et al., 2016). For example, in Ecuador, Gray and Bilsborrow (2014) found remittances to be associated with less cultivated areas despite an increase in the size of farms. They suggested that households might have shifted to less labor-intensive production or substituted agricultural production with remittances income. In Nepal, López-Feldman and Escalona (2017) found that remittance-receiving households had more disposable income, which allowed them to have more leisure time, leading to a move away from very low-return agricultural and nature-based activities.

This group of studies is clearly linked to Forest Transition Theory. Some of these studies found that remittances invested in non-agricultural activities and consumables enabled receiving households to move away from direct resource extraction (Adger et al., 2002; Holder & Chase, 2012; López-Feldman & Chávez, 2017). Holder and Chase (2012) found remittances reduced forest extraction, mainly through widespread adoption of gas stoves and non-timber building materials. Importantly, these changes often go hand-in-hand with reforms in forest governance resulting from changing tolerance of traditional forest management practices by migrants who spent large amounts of time outside of their villages. Results from Fox (2018) were mixed with respect to the link between migration and forest cover: although some forest patches exhibited improved conditions, the majority of forest patches showed no improvement. Cedamón et al. (2018) found that remittances were linked to abandonment of cultivated fields and changes in agroforestry practices. The changes in agroforestry practices were linked to the resource endowments of the households; resource-rich households were more likely to employ woodlot agroforestry while resource-poor households were more likely to employ terrace-based agroforestry.

5. Discussion

There were five general trends in our review of the 51 core articles that met our study criteria. First, few papers had a central research question explicitly examining linkages between remittances and land use and/or land change; these dynamics were evident in the data or findings, but not the central motivation of the study. Second, very few studies looked at the direct connections between remittance receipts and changes in land systems. Instead, the linkages uncovered were frequently subtle and/or indirect. Third, the relationship between remittances and land change was often a secondary finding emerging from research that focused instead on impacts of labor migration on household income and agricultural development and productivity. Accordingly, several articles mentioned multiple indirect connections between remittances, how they are spent, and how households interact with the land. Fourth, many of the papers relied on mixed methods. Among the mixed methods papers, a range of data and methods were used. A common theme of the mixed methods papers was the importance of context in understanding how remittances are related to land change. Fifth, by focusing on remittances, our review uncovered a more comprehensive set of impacts on land systems that go above and beyond replacing the labor lost to migration activity.

Our systematic review identified four non-exclusive pathways (Figure 1) through which households spend remittances with subsequent impacts on land systems: (1) agricultural crops and livestock, (2) agricultural labor and technologies, (3) land purchases, and (4) non-agricultural products, services, or consumables. For some households, remittances enabled them to sustain subsistence agriculture, despite unfavorable conditions in their origin communities (Carte et al., 2019). Many more studies identified a pathway for land system change through investments of remittances in crops and livestock, finding that remittances enabled households to move from cultivating lower value crops to higher value crops and/or move away from subsistence to commercial agriculture. Remittances were also spent on livestock, especially expanding cattle herds and the pastures they require.

Other articles characterized a pathway to land system change through the use of remittances on agricultural labor and technologies, such as irrigation, agrochemical inputs, and mechanization. These expenditures facilitated the movement from subsistence agriculture towards market oriented crops. This use is related to the third pathway: land system changes resulting from the purchase of land. These purchases enhanced land tenure security and also facilitated the move towards market-oriented crops. The fourth pathway evident in the reviewed articles is land system change resulting from the use of remittances to replace income

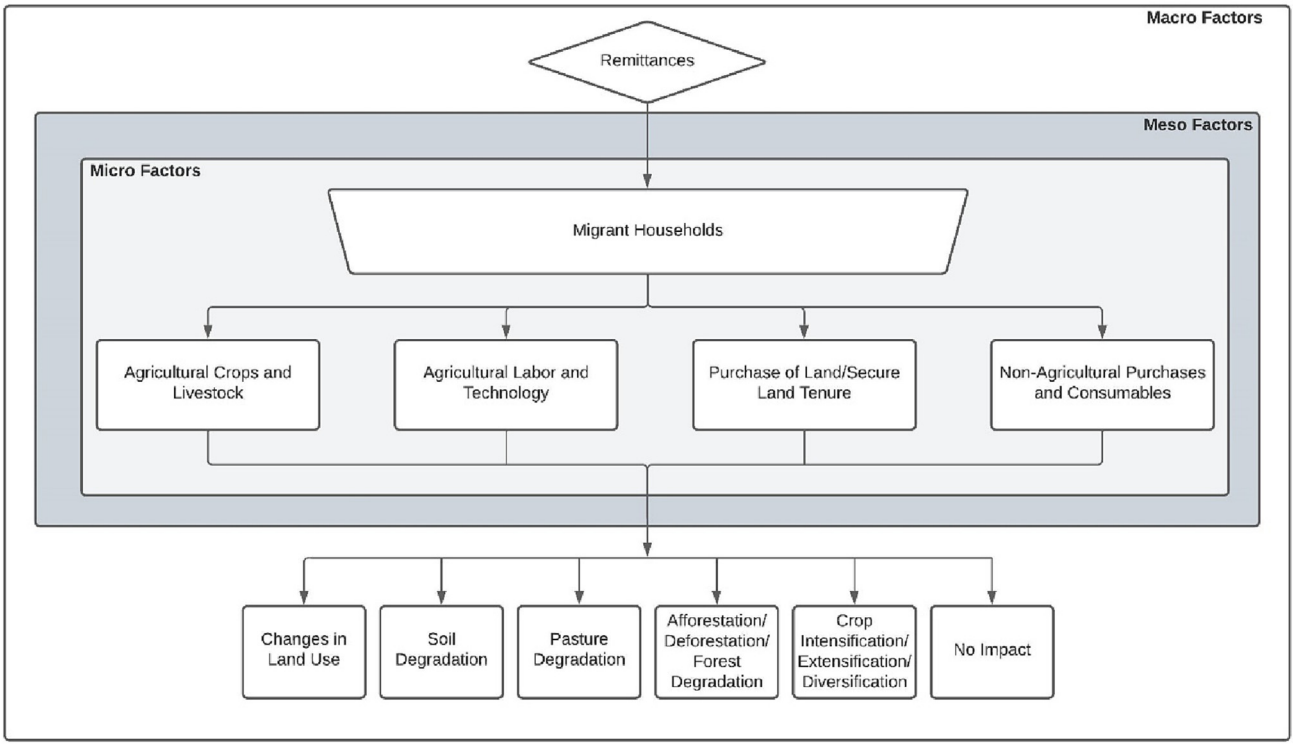

Figure 1. Remittances Expenditures by Migrant Households and Associated Impacts on Land Systems.

or agricultural production. Rather than remittances being deployed for purchases relating to land or agriculture, these studies found remittances were used for a variety of purchases, including private enterprise, daily needs, housing, and educational services.

Expenditures could lead to changes in land use, environmental quality, forest extent and quality, and the intensity, extensity, and/or diversity of cultivation (Figure 1). For example, remittances spent on crops shifted cultivation towards commercial crops (Yarnall & Price, 2010; Barney, 2012; Li et al., 2013), which enabled households to produce output for external markets rather than subsistence alone. Several of the articles discussed remittance expenditures and their implications for forest cover. Within this group, some articles found that remittances reduced the importance of forest products as an income stream for households, thereby leading to forest regeneration (Oldekop et al., 2018; Peluso & Purwanto, 2018). Other studies found that the expenditure of remittances on new crops or pasture land actually increased the incidence of deforestation or forest degradation (Van Wey et al., 2012; Davis & López-Carr, 2014; Taylor et al., 2016). Some studies found mixed evidence about the relationship between remittance expenditures and forest cover. For example, Aguilar-Støen et al. (2016) found that the use of remittances to purchase land yielded evidence of forest decline, expansion, and no change across the forests of Guatemala. That study and others (Radel & Schmook, 2008; Taylor et al., 2016) highlight how the relations between remittances and forest vitality may change across regions and over time, depending on household conditions, policy, and the broader contexts of migration and remittances. Articles discussing non-agricultural uses of remittances were most clearly related to forest transition impacts. This group of studies highlighted how additional funds from remittances enabled households to change labor and consumption practices that reduced deforestation and/or forest degradation (Adger et al., 2002; Holder & Chase, 2012; López-Feldman & Chávez, 2017).

In contrast to these findings of change, there were cases where the flow of remittances did not translate into significant changes in land systems (Fox, 2018; Piras et al., 2018; Williams & Paudel, 2020). In these cases, either the funds were used for non-land-based purposes or simply to maintain existing agricultural activities. Given the commonly theorized relations between rural out-migration and the decline of farming labor, we expected to find evidence of links between remittance income and land abandonment. Surprisingly, we found little evidence in the literature that remittances led to full-scale land abandonment or that rural households use remittances to leave land-based livelihoods—such as agriculture—altogether. The idea that remittances could enable the maintenance of rural livelihoods and communities emerged as a trend across regions, even where and when those livelihoods might have become less economically viable under globalization or climate change (Fox, 2018). In these cases, remittance use did not have clear impacts on *changing* the land use but rather preserving agrarian practices and sustaining rural communities through remittances that functioned effectively like subsidies. Alternately, the absence of land abandonment in our core articles may be a by-product of our review methods: we searched for and examined articles that addressed remittances and land change. If migrant households sold land or moved into other livelihoods, those articles may not have been captured by our search and review.

A clear lesson to draw from the literature reviewed is that the effects of remittance expenditures on land change depend heavily on local context and constraints. Even quantitative articles empirically assessing this relationship were place-based, highlighting the importance of contextual factors. These contextual factors can be macroscales (i.e., global/continental/national levels) and mesoscales (i.e., subnational/regional/local scales) relating to land tenure regimes, land markets, forest and agricultural policies, and market conditions for agricultural products, land use histories, and more. Contextual factors can also occur at more micro-scales (e.g., neighbors, households, and individuals), relating to household dynamics and ecological conditions. How contextual factors are handled in the literature varied between quantitative, qualitative, and mixed methods studies. Quantitative studies often used regression analysis to test hypotheses about land impacts related to remittances. In these models, contextual factors at the household and village levels are included as control variables (Damon, 2010; Li et al., 2013; Nguyen et al., 2019). In contrast, articles with qualitative case studies explain the role of contextual factors in more detail, but not necessarily in a synthetic way (De Haas, 2006). For example, product prices and access to markets can affect the degree to which remittances lead to commercialization of agricultural products (Manivong et al., 2014; McKay, 2005; Yarnall & Price, 2010; Zimmerer, 2013). In the Philippines, when accompanied by land constraints, market integration led to upland forest clearing. In contrast, a switch to market-based chili production led to forest regrowth in Mexico (Radel & Schmook, 2008). National-level policies to incentivize forest recovery or conservation can influence remittance investment trends (Hecht & Saatchi, 2007; Holder & Chase, 2012), as can the presence (or absence) of government anti-poverty or social safety net programs (Davis & López-Carr, 2010).

At microscales, the context of the migrant-sending households and their dynamics also influence how remittances are spent and on what. Articles reviewed here tended to adopt the household as the unit of analysis for exploring remittance-land relations; however, some did highlight how gender, age, ethnicity, and class can shape migration, remittance use, and land systems (Sunam & McCarthy, 2016). Studies find that both migrant gender and gender composition of the non-migrating household can influence land-oriented remittance use (McKay, 2005; Peluso & Purwanto, 2018). The land use changes linked to remittance use and transnational livelihoods have been shown to shift gender roles in remittance receiving communities (Gray & Bilsborrow, 2014; McKay, 2005).

Studies examining other factors at household and community scales considered socio-ecological factors, such as the amount of land controlled by a household, the ecological conditions of household land holdings, and the formality of household land tenure in influencing remittance use. The availability of land, water, and other resources necessary to agricultural production can constrain or enable different pathways for land change. Where water availability for agriculture is constrained, for example, households may choose not to invest remittances in continued agricultural activity (Jokinen, 2018). Some authors focused on the histories of migration within a community, such as long-standing migration under the *bracero* program that brought Mexican labor to the United States from the 1940s versus more recent patterns of migration, which may also affect how households use remittances and potential impacts for land systems (Robson, Klooster, Worthen, & Hernández-Díaz, 2018). Overall, contextual factors determine both the way remittances are spent and the way land is used, managed, or changed (Aguilar-Støen et al., 2016; Maduekwe & Adesina, 2017). While many authors noted the importance of contextual factors (Aguilar-Støen et al., 2016), we did not find an explicit consideration of how context may shape relationships across spatial and temporal scales.

The findings described above are specific to the articles considered in this review. Even careful systematic reviews may miss some articles that touch on the focal topic—here remittances and land change. It is possible that we may have inadvertently missed articles with different findings. One challenge uncovered in constructing the methodology for this paper was the use of varied terms used to refer to remittances. For example, many articles dealing with "migration" actually referred to remittances in the main text of the paper. To

address this challenge, we added papers that indicated migration as the topic of the paper but actually dealt with remittances and land use (see Section 3 Methodology). We elected to include this step in lieu of adding "migration" to our list of search terms since adding it yielded many thousands of papers, thereby rendering a thorough systematic review infeasible. Another limitation of this study, and all remittance studies, is the fact that remittances flows are not evenly or randomly distributed across countries. Rather, remittance corridors link specific countries in which migrants work with the specific countries receiving the remittances. These corridors can arise due to geographical proximity, historical connections, cultural and linguistic affinities, and more. For many LMICs, remittances do not contribute a significant part of their GDPs; yet, remittance are a substantial portion of the GDP of some LMICs, particularly highly mountainous countries, with the notable exception of Switzerland (Mack, Henebry, & Mongeon, 2021). Finally, another limitation of studies of remittances, is that some significant but unknown portion of global remittances occur outside of the international banking system, making them more difficult to track. Such remittance transfers may be hand-carried on home visits (Ratha et al., 2021) or remitted through informal value transfer systems—*hundi* in South Asia and *hawala* in the Middle East and Central Asia (Freund & Spatafora, 2008; Martin, 2009). These alterative remittance conveyances means that formal data sources about remittances (e.g., the World Bank) do not capture the full volume of remittances flows between countries. It also focuses attention on those remittance corridors that rely on the international banking system to transfer remittances.

6. Conclusions

Our systematic literature review highlights that remittances are a significant financial force influencing land change in many receiving countries. Given the magnitude of migrants and the increasing amount of resulting financial flows back home, it is likely that remittances will continue to contribute to further land changes and impacts on the livelihoods of people who depend on that land. Future work needs to consider these relationships between remittances and land change more thoroughly. Although Fox (2018, p. 264) argues, "The complexity of the various nested factors means that it is nearly impossible to establish causality between specific outcomes and inputs," in the context of migration, remittances, and land use, we outline four productive avenues for future research.

One avenue is to use the theoretical lens of telecoupling when analyzing the impact of remittances on land systems. In the migration literature, telecoupling is increasingly recognized as a useful lens to approach the relationship between remittance receiving and sending areas/countries (Baird & Fox, 2015; le Polain de Waroux, 2019). Yet, our systematic review found no articles explicitly using this framing. Past migration-telecoupling work has examined the impacts of land concessions for large-scale rubber plantations in Laos and Cambodia and identified three distinct types of telecoupling that influenced land use, which they labeled "nearby telecoupling", "transnational labor telecoupling" and "opportunistic telecoupling", with the latter two being associated with international and domestic remittance flows, respectively (Baird & Fox, 2015). Furthermore, le Polain de Waroux (2019) discussed how migration and remittances may influence land management and land use, noting that remittance receipt can result in land system disruption. Mack et al. (2021) used a telecoupling framework to analyze the enduring financial linkages between Russia and the countries emerging from the breakup of the Soviet Union at the end of 1991. These examples and the importance of contextual factors highlight the utility of telecoupling as a theoretical framework to analyze the impact of remittances on land systems.

Use of a telecoupling framework to analyze the connection between physically distant places via remittances may also further our understanding about the impacts of various types of shocks and disturbance on land systems. However, we found no studies for this review that analyzed how specific shocks and disturbances to remittance networks affected land use, land management, or land cover in the remittance receiving areas. Therefore, we suggest as a second avenue for future research to examine the impact of shocks and disturbances to remittance flows on land change in migrant sending and remittance receiving areas (Nolte, Sipangule, & Wendt, 2022). Evidence from the past twenty-five years provides examples of how remittances are affected by economic shocks (Borja, 2012; Yang, 2008), disease outbreaks such as COVID-19 (Dinarte, Jaume, Medina-Cortina, & Winkler, 2021; Withers, Henderson, & Shivakoti, 2022; Piquer-Rodríguez et al., 2023), natural disasters and extreme weather events (Bettin & Zazzaro, 2018; Bragg, Gibson, King, Lefler, & Ntoubandi, 2018; Ebeke & Combes, 2013; Mohapatra, Joseph, & Ratha, 2012), and regional and interstate conflict (Fransen & Mazzucato, 2014; Mack et al., 2021). The shock/disturbance effects can range from temporary, short-term disruptions or enhancements of remittances flows to longer-lasting geographic restructuring of remittance networks. When analyzing shocks and disturbances to remittance networks, three factors are important to consider. First, the spatial extent of the shock/disturbance (e.g., macro, meso, micro) is important to understand the magnitude of the system disruption. Second, the tempo (e.g., abrupt or gradual) can affect the ability of people to prepare for and adapt to the shock or disturbance. Terrorism, earthquakes, and armed conflicts are examples of abrupt system shocks. Regional climatic warming and shifts in precipitation patterns (amount, intensity, frequency, timing), such as drought and snow seasonality, are examples of disturbances that develop gradually. Third, research examining remittance shocks and associated impacts on land systems need to consider how contextual factors amplify or diminish the impacts of these disruptions. For example, the quality of institutions may influence the coping capacity of people affected by the shock (Berman, Quinn, & Paavola, 2012; Kelly & Adger, 2000; Lioubimtseva & Henebry, 2009). At the micro-scale, household income level can affect the ability to deal with disruptions in remittance frequency or amount.

Numerous studies covered in our review document how remittances transform household land use or land management, but relatively little research has evaluated how remittances may produce larger-scale changes in land systems. This research gap presents a third avenue for future research because decisions made by households receiving remittances can have a "ripple effect" on land uses in nearby interlinked systems. Based on our review, remittances are linked to the purchase of land and shifting land use from subsistence to market-targeted production. Households also use remittances to engage in non-agricultural pursuits, which may lessen pressure on land uses and convert cultivated land to pasture, altering labor demand, possibly land tenure, and making land available to other households in the region. Under either scenario, changes made by remittance households can affect the economic and environmental context in which land use and land management decisions are made by other households in the region. Such effects should have noticeable impacts on land systems beyond the scale of individual households. Therefore, a fruitful avenue for future work is to connect how uses of remittances influence land systems beyond the household scale.

A fourth future research area is the use of spatially explicit modeling that leverages land cover and land use data based on imagery and other geospatial data. In our review, most studies used a variety of data sources rather than imagery for information about land use and land over (e.g., surveys, interviews, ground-level observations). We are in an era of increasing availability of

earth observation (EO) data from satellite, airborne, and near-ground level sensors (Ustin & Middleton, 2021). These data are providing researchers with an unprecedented ability to monitor and assess changes in land use and land cover; yet, these rich sources of data have yet to be routinely used by researchers interested in remittance impacts on land change. These data present an opportunity to incorporate more EO and other spatially explicit data on land use and land management activities to characterize land change. We also encourage researchers to consider incorporating geospatial data into their analyses to generate spatially explicit models linking household decision-making with land change. Spatial panel models (Chakir & Le Gallo, 2013; Ferdous & Bhat, 2013; Li, Feng, Lu, Qu, & D'Haese, 2021), agent based models (Janssen & Ostrom, 2006; Parker, Manson, Janssen, Hoffmann, & Deadman, 2003; Robinson et al., 2007), and other approaches have been used within the land system science community to link household surveys, administrative statistical yearbook data, and even qualitative data with spatially explicit data on land and climate to understand causal drivers and project future change in a diversity of landscapes (Castella, Kam, Quang, Verburg, & Hoanh, 2007; Mertens & Lambin, 2000; Pocewicz et al., 2008; Sohl, Sayler, Drummond, & Loveland, 2007). We further encourage remote sensing scientists and others working on land change and deforestation studies to consider remittances as potentially important drivers of changes in land use, land management, and land cover. Such endeavors would certainly benefit from collaboration with social scientists researching the relationships between migration and remittances.

In the pursuit of the four research avenues noted above—telecoupling lens, shocks and disturbances, investigations beyond the household scale, inclusion of geospatial data—it will be crucial to differentiate between migration and remittances. While remittances are certainly a key aspect of migration activity, a focus on remittances is distinct from a focus on migration for two reasons. First, migration is a necessary but not sufficient condition for receiving remittances. A migrant, for example, may choose not to send money back to their household or may not make enough money to do so (Goldring, 2004; Liang & Song, 2018; Pugliese et al., 2016). Second, remittances may be sent to people who are not from a migrant's household. Remittances may be sent, for example, to communities via hometown associations instead of to individuals or households (Kayaoğlu, 2017; Liang & Song, 2018; Smyth, 2017; Tong & Piotrowski, 2010). We encourage the research community to recognize this distinction in future studies.

Remittances are an important and increasing source of global monetary flows. The magnitude of these flows and their uses can have important implications for land systems. Given the importance of these flows in many rural areas across the planet, the goal of this study was to conduct a systematic review of the literature examining the connection between remittances and land change. The peer-reviewed articles examined here appeared in a wide variety of journals, indicative of an emerging area of cross-disciplinary scholarship. The variety of data sources, theoretical frameworks, key concepts, and analytical approaches employed in the reviewed articles is further evidence of the novelty of the topic, which brings together multiple communities of scholarship. The final lesson of the review is the need for additional scholarship to articulate the environmental conditions, institutional constraints, and contextual factors under which remittances are deployed to change land use, land management, or land cover in specific landscapes in the developing world.

Data availability

No data was used for the research described in the article.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

We acknowledge the Global Land Project (https://glp.earth) for facilitating our Working Group on Remittance Dynamics and Land Change (https://glp.earth/how-we-work/working-groups/remittance-dynamics-and-land-change). In addition, we acknowledge support from the following sources that helped contribute to this review: NASA LCLUC projects 80NSSC20K0411 and 80NSSC21K1431.

Author Contributions

The following outlines each author's contribution to the manuscript: Conceptualization, EAM, GMH; methodology, EAM, GMH, LAS, BS, CAR; formal analysis, LAS, BDJ, EAM, GMH, GRHA, BS, YH, CAR, GC, CKS, KN, NC, SL, LK; writing, LAS, BDJ, EAM, GMH, GRHA, BS, YH, CAR, GC, CKS, KN, NC, SL, LK; visualization, EAM, LAS; funding acquisition, GMH; page charges, GMH and NC. All authors have read and agreed to the published version of the manuscript.

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