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Do Financial Remittances Build Household-Level Adaptive Capacity?

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Soumyadeep Banerjee, Dominic Kniveton, Richard Black, Suman Bisht, Partha Jyoti Das, Bidhubhusan Mahapatra, and Sabarnee Tuladhar†

Abstract

This paper examines the role of financial remittances on the adaptive capacity of households in flood-affected rural communities of Upper Assam in India. Findings reveal that remittances-receiving households are likely to have better access to formal financial institutions, insurance and communication devices than nonrecipient households. This study indicates that the duration for which remittances are received by a household has a significant and positive association with structural changes made by the household to address flood impacts, farm mechanization, the household's access to borrowing, and participation in collective action on flood relief, recovery and preparedness. The adaptation potential of remittances can be realized if policy attention is given to attempts to enable gains in financial capital to be translated to gains in other types of capital and how the social element of remittances can be used to boost social capital. For example, by facilitating an increase in financial literacy and skills training, particularly among the poorer households in areas likely to be affected by the impacts of climate change and variability.

Keywords: adaptation, adaptive capacity, remittances, migration, flood, Assam, India

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1. Introduction

The impacts of climate change are likely to be felt most by those countries already facing the development challenges of widespread poverty and poor governance (McCarthy et al. 2001). Although some progress has been made toward ameliorating the causes of climate change, namely, agreements for reducing greenhouse gas emissions, there remains a pressing need for countries and their peoples to build their ability to adapt to the impacts of future climate change. Many adaptations by individuals, households, and communities are likely to occur where the impacts of climate change are felt. However, it has been suggested that as an alternative to in situ adaptation and as the limits of in situ adaptation are reached, migration for work is an option in households' adaptation portfolios. Temporary and seasonal migration enables people to stay in their rural homes over the longer term when faced with shorter-term environmental challenges (Tacoli 2009). Financial remittances sent back by migrant workers contribute to the welfare of the household in origin communities and support their sustenance during climate shocks and stresses (Stark and Levhari 1982; Yang and Choi 2007). Financial remittance inflows are more stable than other forms of private capital flows, particularly during crisis (Ratha 2003; Kapur 2004; De et al. 2016). Apart from financial remittances, migrants facilitate the circulation of ideas, practices, and identities between destination and origin communities (Levitt 2001). In a study in Thailand, Sakdapolrak (2014) finds that returning migrants introduced ideas about new local businesses (for example, Internet cafes), or crucially influenced the introduction of new innovative agricultural practices. Indeed, migration forms one of a number of livelihood strategies already chosen by individuals and households in response to other transformative pressures and opportunities (for example, higher wage potential in urban areas, perception of relative deprivation, and improved access to communication and transportation infrastructure) even without the impacts of climate change.

Over the past decade the humanitarian aspect of mobility in the context of environmental risks, as manifested in displacement and emergency response, has received increased attention from academics, think tanks, and international organizations (for example, Fussell and Harris 2014; Kalin 2015; McAdam 2015). The humanitarian approach perceives the displaced population as a victim of externalities such as extreme events and the failure of state mechanisms for social protection. While these issues of safety and protection of displaced populations needs to be addressed, the growing dominance of this approach within the environmental change and migration discourse increases the risk of ignoring the idea that migration can also be a proactive household strategy for addressing the impacts of environmental disasters.

The environmental migrant-centric approach within the environmental change and migration discourse has sidelined the contribution of migrants (including members of the diaspora) whose decision to move may not have been influenced by environmental stressors. This does not prevent these migrants from contributing to the climate change adaptation of their families left behind in origin communities. For example, migrants belonging to a flood-affected community are likely to provide assistance to their families in origin communities irrespective of whether their decision to migrate had been influenced by flood impacts. The influence of environmental stressors on the migration decision is not the sole criterion that determines whether financial or social remittances will be used to address the impacts of those stressors. Therefore, a wider set of migrants has a potential role in climate change adaptation.

During the same period, research studies (see McLeman and Smit 2003; Bardsley and Hugo 2010; Foresight 2011; Asian Development Bank, ADB 2012) have attempted to position migration as an adaptation response to perceived future climate change impacts. Although there is growing consensus among migration scholars regarding the potential contribution of migration to the lives of the migrants and their families left behind, the extent to which migration can contribute to climate change adaptation among migrant-sending households is complex and requires further exploration. The contextualization of migration in terms of terminology associated with climate change adaptation—vulnerability, adaptation, resilience, coping, adaptive capacity—lacks clarity. For example, McLeman and Smit (2006) suggest that throughout history migration has been a vital component of adaptation to changes in natural resource conditions and environmental hazards, and this is unlikely to change in the future. Agrawal and Perrin (2008) recognize mobility as one of the four analytical types of coping and adaptation strategies in the context of livelihood risks.³

Although Adger et al. (2009) recognize migration as an adaptation strategy, they consider involuntary migration to be undesirable for migrants leaving their homeland since a disruption of economic ties, social order, cultural identity, knowledge, and tradition would be detrimental to a successful transition. However, Meze-Hausken (2000) perceives permanent distress migration as a last resort. In turn, Felli and Castree (2012) have criticized the notion that migration can be an adaptation strategy because of the overemphasis on autonomous actions by individuals or communities and market mechanisms to deal with environmental degradation, rather than on political economy transformations. This divergence of opinions is a reflection of the limited empirical evidence on the relationship between environmental degradation and migration, and the methodological challenges in exploring this relationship (Tacoli 2011). The ambiguity in what constitutes adaptation, partly because of the disciplinary backgrounds and ideological positions, adds to this lack of clarity. Besides, migration outcomes (for example, financial and social remittances) are context specific and depend on the type of migration, financial resources, skills, social networks, generic development levels in origin and destination countries, and role of institutions (Barnett and Webber 2009). Little empirical research has addressed migration outcomes in different environmental and socioeconomic contexts.

Despite the growing attention received by migration in climate change and disaster risk reduction policy discourses (for example, the Sendai Framework for Disaster Risk Reduction or the United Nations Framework Convention on Climate Change), the role of human mobility, particularly labor migration and remittances, in climate change adaptation has received little attention in national-level adaptation planning and policies, including in the countries of the Hindu Kush Himalayan region.⁴ Instead, migration is mostly perceived as a challenge to development goals as well as to adaptation goals. The relationship between environmental change and migration remains at the fringe of migration research in most of the Hindu Kush Himalayan countries.

This paper explores the relationship between financial remittances and household-level adaptive capacity in flood-affected rural settlements. A better grasp of the determinants that shape the adaptive capacity of a remittances-recipient household is vital to understanding the mechanisms underlying adaptation. Presently, there is little understanding of the determinants of a remittances-

³ Agrawal and Perrin (2008) classify the basic coping and adaptation strategies into four analytical categories: mobility, storage, diversification, and communal pooling. They suggest that market-based exchange can substitute for any of these categories for households and communities with access to markets.

⁴ The countries in the Hindu Kush Himalayan region include Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan.

recipient household's adaptive capacity, which is further complicated by a lack of empirical evidence. The paper is organized as follows: Section 2 explores adaptation and adaptive capacity. Section 3 turns to the potential role of remittances as a means for building the adaptive capacity of remittances-recipient households. Section 4 presents an overview of research methodology and a description of study area. Section 5 presents empirical evidence on household-level flood responses, livelihood practices, as well as characterizes the nature and determinants of adaptive capacity of remittances-recipient households compared with households that do not have access to remittances, specifically in the Eastern Brahmaputra Subbasin in Upper Assam, India. The paper finishes with a discussion of the implications and limitations of the work in section 6.⁵

2. Adaptation and Adaptive Capacity

Adaptation and adaptive capacity are defined in a number of ways, but the most commonly accepted definition is that of the latest assessment report of the Intergovernmental Panel on Climate Change (IPCC), which defines adaptation as “the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities” (IPCC 2014, 5). Under this definition, climate change adaptation constitutes a continuous stream of activities, decisions, and changes in attitudes by individuals, households, communities, groups, sectors, or governments in response to impacts generated by—or potentially generated by—climate change or variability. The scale of adaptation varies from the adaptation of an individual or household to a particular climatic stress to the adaptation of a community to multiple stresses to that of the global system to all stresses and forces (Adger, Arnell, and Tompkins 2005; Smit and Wandel 2006). Adaptation can be classified as anticipatory or reactive, autonomous or planned, structural or nonstructural, in situ or ex situ, and incremental or transformational (see Fankhauser, Smith, and Tol 1999; Smit et al. 1999; McCarthy et al. 2001; Bardsley and Hugo 2010; Kates, Travis, and Wilbanks 2012).

A key component of adaptation is the development of the adaptive capacities of actors in the context of climate change and variability. The IPCC (2014, 21) defines adaptive capacity “as the ability to adjust, to take advantage of opportunities, or to cope with consequences.” Adaptive capacity is determined by the complex interplay of social, political, economic, technological, and institutional factors (Adger 2003; Pelling and High 2005; Smit and Pilifosova 2001; Yohe and Tol 2002) whose interactions vary depending on the scale of analysis (Vincent 2007). Previous research has attempted to assess adaptive capacities at various scales, such as communities (Pelling and High 2005; Smit and Wandel 2006), sectors (Eakin et al. 2011), districts (Sharma and Patwardhan 2008), countries (Tol and Yohe 2006), and regional systems (Schneiderbauer et al. 2013). In essence, these studies agree that the enhancement of adaptive capacity is largely dependent on resources (Chapin et al. 2006; Wagner, Chhetri, and Sturm 2014). Bebbington (1999) argues that a household can build adaptive capacity by expanding its asset base, including the tangible resources used to maintain livelihoods (such as natural capital and productive resources) and capabilities to do so (including social and human capital). The knowledge of actions surrounding past stress events (for example, droughts, floods, storm surges) has

⁵ Parts of this working paper are drawn from Soumyadeep Banerjee (2017), *Understanding the Effects of Labour Migration on Vulnerability to Extreme Events in Hindu Kush Himalayas: Cases Studies from Upper Assam and Baoshan County*, a PhD thesis prepared under the supervision of Professor Dominic Kniveton and Prof Richard Black at the University of Sussex.

been used as a proxy for how systems might build and mobilize (or not) their adaptive capacity to prepare for and respond to future climate change (Engle 2011). In this framing, future changes in climate, which will potentially stretch the boundaries of previous extremes, are assumed to be gradual, with societies and institutions able to adapt alongside. It is assumed that these incremental adaptations will buy valuable time to implement more appropriate responses, such as new innovations or paradigm shifts (Cornell et al. 2010) if the pressures associated with climate change far exceed those experienced by the system in the past (Engle 2011).

3. Migration, Remittances, and Adaptive Capacity

Migration for work is a household-level strategy that spreads the risk of environmental stressors and potentially builds adaptive capacity. Previous research (Adger et al. 2002; Yang and Choi 2007; Mohapatra et al. 2009; Foresight 2011; ADB 2012) has indicated that migration can provide significant benefits to migrants, their families, and origin communities in environmentally vulnerable regions through accumulation of savings and asset creation; livelihood diversification; improved access to food across seasons; increased access to information; acquisition of new knowledge, skills, and resources; or by creating, extending, and consolidating social networks across regions; or provide a safety net in times of extreme weather events. These studies share an underlying assumption that migrants have the agency to take the initiative to assist themselves, their families, and communities in changing their vulnerability to extreme environmental conditions. Migration can be a proactive strategy, in anticipation of the impacts of natural disasters in the future, but also based on experience of such events. Ellis (2003) suggests that the act of moving indicates an enterprise to resolve problems. However, others argue that migration is a manifestation of a failure of adaptation or a last resort after other response strategies to disasters have failed (see Baro and Deubel 2006; Renaud et al. 2007; Stern 2006; Penning-Rowsell, Sultana, and Thompson 2013).

In considering migration as a potential adaptation strategy, it is not this paper's intention to position it as some kind of bottom-up alternative to state-led planned adaptation. Governments continue to have a vital role in creating enabling conditions for adaptation in general—including enabling the potentially adaptive impacts of migration. However at present, migration is not considered in Indian institutions' adaptation planning and practices, either at the local, provincial, or national levels, and such consideration is rare elsewhere. A lack of awareness and understanding of the interrelationship between environmental stressors, migration, remittances, and adaptation is evident among national stakeholders, both government and nongovernment ones. In the context of state of Assam, this lack of awareness is in part a result of the inadequate empirical evidence on the role of financial and social remittances in adaptation in this region. The little evidence that is available is context specific, so largely unhelpful in state-level policy and planning.

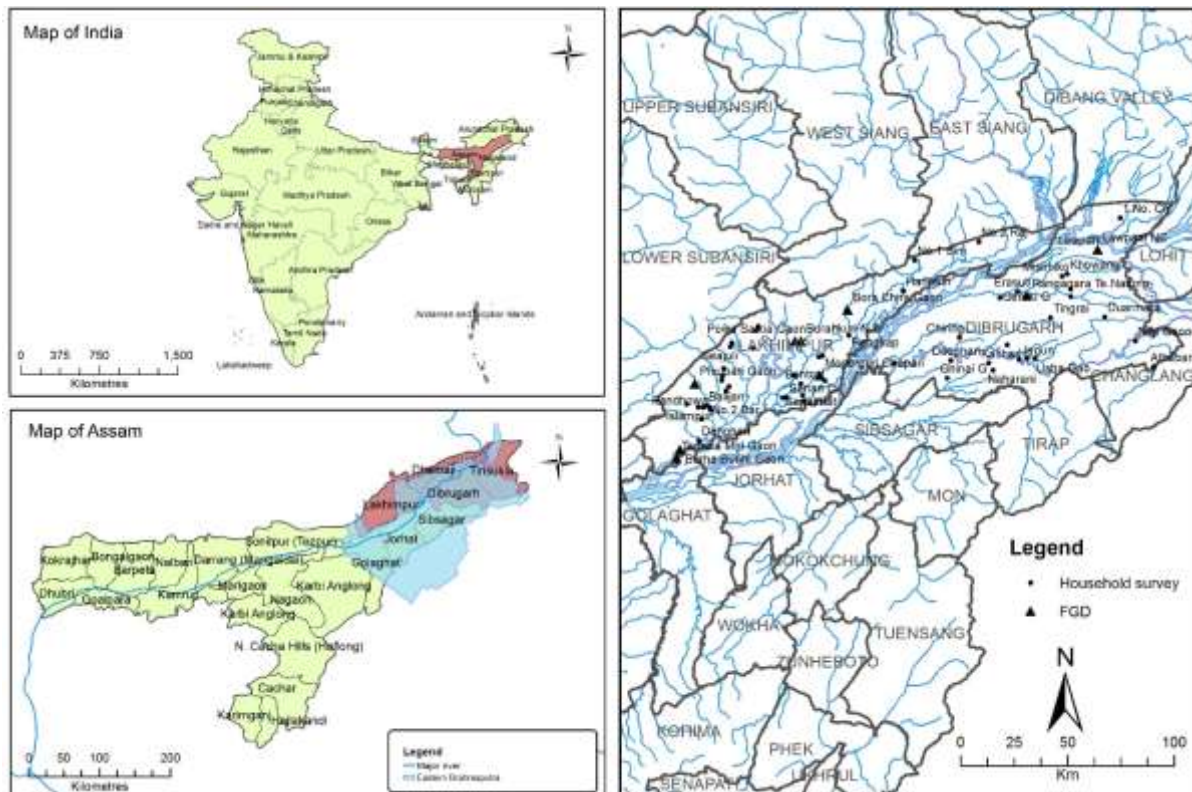
4. Adaptive Capacity in Flood-Affected Rural Areas

4.1 Case Study: Eastern Brahmaputra Subbasin in Upper Assam, India

The state of Assam is located in the middle of the Brahmaputra and Barak river basins in northeastern India. According to the 2011 Census of India, Assam had a population 31.17 million and a population density of 397 persons per square kilometer. The monsoon rainfall is highest from June to August, when the floods usually occur (Goyari 2005). Based on the probability of occurrence and the potential to cause significant damage and loss of life, the 2005 Disaster Management Plan of Assam identified flooding as a significant hazard (The Energy and Resources Unit, TERI, 2011, 60). The state's flood-

prone areas amount to 3.1 million hectares, which is some 40 percent of the total geographic area and includes more than 90 percent of the agricultural land (Das and Bhuyan 2012). Projections indicate that there could be an increased risk of flooding in the Brahmaputra basin because of differences in seasonal distribution, including increased summer (monsoon) flow, and peak runoff (Nepal and Shrestha 2015). The exposure to flood hazard has been on the rise due to population increases in flood-prone areas, the construction of new infrastructure and housing, expansion of economic activities, changes in land use, encroachment into wetlands and low-lying areas, temporary flood control measures, and poor maintenance of embankments (TERI, 2011, 61). The Eastern Brahmaputra Subbasin is a research site for the Himalayan Climate Change Adaptation Programme (HICAP).⁶ This case study is part of the HICAP. The flood impacts differ from one rural community to another because of the nature, frequency, and magnitude of the floods as well as local vulnerabilities. According to the Flood Hazard Atlas of Assam (2011), 50–60 percent of the area in Lakhimpur district, 40–50 percent in Dhemaji district, 30–40 percent in Dibrugarh district, and 10–20 percent in Tinsukia district was considered to be flood affected (National Remote Sensing Centre, NRSC, 2011). This case study was conducted in these four districts (see map 1).

Map 1 Study Area in the Upper Assam, Eastern Brahmaputra Subbasin, India



Floods have direct and indirect effects on the lives of people in this study area. On average, an estimated US\$47 million in annual crop production is lost because of floods, while damage to homesteads and livelihood affects some 3 million people (ADB 2006). For instance, houses are often

⁶ The HICAP is implemented jointly by the International Centre for Integrated Mountain Development (ICIMOD), the Center for International Climate and Environmental Research Oslo (CICERO), and Grid-Arendal in collaboration with local partners.

inundated by flood water, which also leaves behind sediment and debris. Household members shift to safe locations (for example, the road, embankments or relative's house), or take shelter in relief camps that are set up by the local administration. Local houses primarily use bamboo as the construction material. Weakly constructed houses are susceptible to collapse and need to be rebuilt. Common livelihood strategies (for example, agriculture, livestock rearing, and fishing) in rural Assam are dependent on natural resources (Das, Chutiya, and Hazarika 2009) and ecosystem services. For example, agriculture contributed more than 25 percent of the State Domestic Product during 2009–10 (TERI, 2011, 4). The combination of high reliance on natural resources–based livelihoods and location in a flood-prone river basin exposes the local population to an increased risk of flooding.

Floods cause widespread damage to the agricultural sector. The standing crops, particularly paddy crops, are damaged by floods. A lack of early warning about the arrival of flood water provides little time to save valuables, including farming equipment. Strong currents of flood water erode the fertile topsoil, which affects crop production and yield. Floods deposit sand (sandcasting) and other sediments that bury standing crops or render farmland unsuitable for farming. Livestock are swept away by floods, starve to death because of shortages of fodder or forage, or die from diseases that occur in the aftermath of floods. Flood impacts have significant implications for food security. Households traditionally used to meet their annual requirement for rice from paddy they produce. Rice is the main staple for the locals. Over the past decade, floods have damaged the main paddy crop with increasing regularity. At present, households increasingly depend on the local market for procuring rice. Daily wage labor and selling of small livestock (for example, poultry or goats) provide the cash required to procure rice and other food items. Focus group discussions (FGDs) suggest that because of the spike in demand and shortage of supply due to flood inundation, the price of rice (as well as other food items) increases during the flood season. Households end up paying a higher price for rice. In addition, transport disruption is common during the flood season because of inundation or damage to roads and bridges, which prevents students from attending school or college, wage earners from reaching their work places, the sick from seeking urgent health care services, and families from visiting local markets to procure essential commodities. The repetitive and significant losses experienced by settlements and the economy because of floods make it a major concern for Assam (TERI, 2011, 61).

4.2 Research Methodology and Method

Based on the adaptive capacity literature (for example, Vincent 2007; Sharma and Patwardhan 2008; Eakin et al. 2011; Aulong et al. 2012; Gerlitz et al. 2016) and the Sustainable Livelihoods Approach (SLA), this study conceptualizes the adaptive capacity of a household to comprise five subdimensions: natural assets, financial assets, social assets, human assets, and physical assets (see ANNEX 1, table 1).

4.2.1 Natural Assets

The studied area—Upper Assam—is predominantly dependent on agriculture. Access to agricultural land and livestock is an important component of a rural household's adaptive capacity (Eakin et al. 2011; Aulong et al. 2012) and represents an accumulation of wealth (Vincent 2007). Thornton et al. (as cited in Nair et al. 2013, 11) suggest that livestock can be considered a savings measure because livestock can be sold by the farmers for cash in case of crop failure due to disaster. The “farm size diversification index” and “livestock diversification index” are selected as attributes of a household's natural assets. Previous research (Hassan and Nhemachena 2008; Below et al. 2012) suggests that

households modify agricultural practices to address impacts of environmental stressors. For example, modification in farming practices due to floods in Upper Assam include changes in the farming calendar, the growing of flood-resistant varieties of paddy, an emphasis on vegetable farming in the nonflood (mainly winter) season, and a reduction of the area under paddy crop. The change in livestock rearing practices involves reduction in the number of cattle, ducks, or poultry. Other attributes of this subdimension include “changes in farming practices” and “changes in livestock rearing practices”.

4.2.2 Financial Assets

Thomalla et al. (2006) identify those with inadequate access to economic assets (credit, welfare) as among the most vulnerable to natural hazards. Access to formal financial institutions is considered to be an attribute of financial assets in Upper Assam. Vincent (2007) considers investment in insurance to protect assets from climate risk to be a manifestation of adaptive capacity. Public and private institutions provide various products to insure life, health, crop, or livestock. The investment in insurance to manage risks to life indicates generic adaptive capacity. Only one-third of households surveyed in Upper Assam have life insurance. None of the households in the study sample in Upper Assam have crop or livestock insurance. Hence, “access to life insurance” is identified as an attribute of financial assets in Upper Assam.

4.2.3 Social Assets

Social relationships continually reshape the adaptive capacity of social systems to climate change (Pelling and High 2005), and social capital is one of the resources required to implement adaptation strategies (Brooks, Adger, and Kelly 2005). Social assets in Upper Assam comprise three attributes: assistance during floods, borrowing due to floods, and participation in collective action on flood relief, recovery and preparedness. A household that receives assistance from several sources (for example, its social network, community-based organizations, the government, nongovernmental organizations, and others) during floods is likely to have a robust social network. Furthermore, networks are exclusive in nature, and their members have a shared identity. The terms of trade for a network member are likely to be different (possibly better) than those for an outsider (Dasgupta 2003). Therefore, sources from which a household has borrowed because of flood (for example, borrowed money from relatives or friends, a cooperative or village fund, or other financial services provider) represent the extent of risk pooling within a network. Different social actors seldom have identical access to a community-level participatory process. There is always a possibility that the decision-making process and outcome may be disproportionately influenced by the elite or special interest groups (Bloomfield et al. 2001; Hillier 2003). Therefore, the extent of a household’s involvement in collective action for flood relief, recovery, or preparedness is used as a proxy for social cohesion. For example, FGD participants report that this collective action involves the setting up of a relief camp, repairing local infrastructure (for example, embankment, bridge), erecting a barrier to slow the speed of the flood water or prevent debris from flowing in the flood water, or building a raised platform to keep cattle during flooding.

4.2.4 Human Assets

Access to information is one of the components of adaptive capacity (Brooks, Adger, and Kelly 2005). People would be less vulnerable to hazards, and may even be able to avoid a disaster, if they have better access to information, cash, rights to the means of production, tools and equipments, and social networks (Wisner et al. 2004). Possession of a mobile phone or other type of telephone, radio,

television, cable network, or computer can ensure that a household's sources of information are not limited by the geographical boundary of the village or the social network. In addition, communication between affected households and various local institutions during an emergency (such as floods) is critical.

4.2.5 Physical Assets

Housing quality is a vital component of a household's adaptive capacity (Vincent 2007; Sharma and Patwardhan 2008). Making structural changes in houses to address flood impacts was a common practice in Assam (Hazarika 2006; Das, Chutiya, and Hazarika 2009). Indicators of structural changes to a house include raising the plinth of the house, toilet, or cattleshed; and increasing the height of the wall of a well or height of a tube well. The term *mechanization* is generally used as an overall description of the application of tools, implements, and powered machinery to enhance agricultural production and productivity and reduce drudgery (Clarke 2000). Past research from Assam (TERI, 2011) and FGDs conducted as part of this study indicate a gradual shift toward *rabi* crops, that is, crops sown in winter and harvested in spring. This shift in cropping pattern was one of the ways devised by the local farmers to avoid the flood risk to the *kharij* or monsoon crops. The use of tractors to plow the farm during the rabi season is required to support this change in cropping pattern. In addition, expert input suggests that a growing shortage of farm labor in Upper Assam is also contributing to a gradual mechanization of farming activities.⁷ In this study, farm mechanization in Upper Assam involves the use of tractors to plow the farm during the rabi season or ownership of a tractor, power tiller, or mechanized threshers. Water transport is a major mode of transportation when communities are inundated by floods. Boats or rafts are used for evacuation, transportation, and even shelter during flood inundation (Hazarika 2006; Chahliha et al. 2012). Lack of contact with essential services, work places, or educational centers heightens the vulnerability of households in submerged areas.

Agrawal and Perrin (2008, 6) suggests that even complete livelihood failures could be avoided if storage is combined with "well constructed infrastructure, low levels of perishability, and high level of coordination across households and social groups". In the flood-affected areas in the study, storage indicates that a household stored valuables in a safe place (for example, a raised platform within the house); the granary had either stilts or a raised plinth; or firewood, fodder, or food was stored for safekeeping during floods.

Adaptive capacity could be distinguished between *specific* and *generic* adaptive capacity. Some capacities are aimed at reducing the impacts of a particular climate hazard. These are referred to as specific adaptive capacity (Sharma and Patwardhan 2008). The effectiveness of specific adaptive capacity depends on elements of human development, which constitute generic adaptive capacity (Adger et al. 2004; Sharma and Patwardhan 2008). In this study, generic adaptive capacity includes access to formal financial institutions and insurance, farm size, number of livestock, and access to information. Specific adaptive capacity to floods includes changes in agricultural practices; access to assistance and borrowing; participation in collective action for flood relief, recovery, and preparedness; structural changes in the house; farm mechanization; transport during flood; and storage.

⁷ Input received during an expert meeting in Guwahati, Assam, in October 2015.

4.3 Regression Analysis

The statistical association between various attributes of household level adaptive capacity (AC) and a number of independent variables is assessed through the following models. A separate regression is performed for each attribute or indicator of adaptive capacity.

$$AC = f(\text{Household characteristics, Remittances characteristics, Infrastructure, Institutional access}) \quad (1)$$

in which

Household characteristics = household head's gender, caste, and literacy; household size; and average monthly per capita expenditure on consumption

Remittances characteristics = remittances-recipient household or nonrecipient household

Infrastructure = time to reach nearest paved road, local market, or bank

Institutional access = time to reach the village office; village-level meeting on or flood preparedness.

Within the New Economics of Labor Migration approach, the decision to migrate is made at the household level. The costs of and returns to migration are shared by the migrant and the household (Stark and Bloom 1985; Stark and Lucas 1988). Migration is considered to be a risk-sharing behavior on the part of the household to diversify its resources (Stark and Levhari 1982). Remittances serve as income insurance (Lucas and Stark 1985). Migration reduces the number of individuals that a household supports and establishes a network that could assist potential migration of other family members (Stark 1991). Remittances epitomize the functional linkage between the migrant worker in the destination and the migrant-sending household in the origin community.⁸ The remittances-recipient status of the household (recipient or nonrecipient) is the indicator of mobility in this study. Remittances-recipient status of the household (non-recipient 0, recipient 1), gender of the household head (female 0, male 1), caste of the household head (scheduled castes 0, scheduled tribes 1, others 2), literacy of the household head (nonliterate 0, literate 1), and meetings organized in the village to discuss flood preparedness (no 0, yes 1) are categorical variables. The time required to reach nearest paved road, bank, village office, and local market are recorded in the survey as continuous variables.

To quantify the marginal effect of remittances a number of other independent variables need to be taken into account. These independent variables were identified through a literature review and FGDs. Household characteristics have an important role in shaping the adaptive capacity of a household. The gender of the head of the household is a relevant independent variable since traditional social barriers limit women's access to information, land, and other resources (Tenge, de Graaff, and Hella 2004). The head of a household has an important role in resource allocation, planning, and decision making at the household level. Education of the household head is strongly associated with economic well-being (Hunzai, Gerlitz, and Hoermann 2011). Education is represented by the literacy status of the household head. Social entitlement and endowment, which is facilitated by attributes such as caste, play a crucial role in the shaping capacities of a household. For example, the Scheduled Tribes and Scheduled Castes are eligible for affirmative action (such as access to education, social protection, and

⁸ In this study, a household was considered to be a migrant-sending household if any household member had lived and worked in another village or town in the same country or another continuously for two months or more at any time during the past 30 years. Households not conforming to this definition were considered nonmigrant households.

government employment).⁹ Household size is a measure of the capacity for work (Aulong et al. 2012). The economic status of the household is represented by average monthly per capita expenditure (MPCE) of the household, which comprises food and nonfood expenditure. The institutional context, which can either facilitate or constrain, provides the setting within which individual adaptation decisions are made (Vincent 2007). Research on adaptive capacity (Agrawal and Perrin 2008; Engle and Lemos 2010; Gupta et al. 2010) is increasingly recognizing that institutions, governance, and management are important determinants of a system's ability to adapt. The time taken to reach the nearest paved road, local market, and bank are indicators of physical accessibility to infrastructure (Fafchamps and Shilpi 2013; Notenbaert et al. 2013). The time taken to reach the village administration office is an indicator of physical accessibility to institutions. The village-level meeting on flood preparedness is a proxy for information exchange between local institutions (both government and nongovernment) and households in the study area.

A modified version of the model is used to characterize the adaptive capacity of the remittances-recipient households in the study area. The pattern of remittance use changes over the migrant's life cycle. The life cycle and initial economic resources of the migrant influence the motives for savings (Osili 2005). It incorporates duration of remittances receipt as an independent variable. Duration of remittances receipt is the time period between the first and latest instances of receipt of remittances by the household. It is recorded as a continuous variable in the household survey.¹⁰ Because it does not follow a normal distribution, it is converted into a categorical form with two subcategories: short duration (below median value) and long duration (above median value). Short-duration remittances-recipient household is the reference category. This model is expressed as

$$AC = f(\text{Household characteristics, Remittances characteristics, Infrastructure, Institutional access}) \quad (2)$$

All variables are defined as in equation (1) except *Remittances characteristics* = duration of remittances receipt.

In the model in equation (2), attributes of a household's specific adaptive capacity are disaggregated into two subcategories: "adopted before first episode of migration from a household" and "adopted after first episode of migration from a household." The latter subcategory is likely to be influenced by remittances. The year of first migration from a household and year in which a particular flood-response strategy or capacity was adopted by a household are recorded through the household survey. The year of first migration from a household could be identified from the migration history of individual migrant workers from the households, which is recorded in the "migration schedule." The year of adoption of a specific response strategy or capacity is available from the "household schedule." If an indicator of adaptive capacity was adopted by a household before the first instance of migration for work from the same household, it could not have been influenced by remittances (coded as 0). However, a strategy adopted after the first migration could have been influenced by access to remittances (coded as 1). For example, if a household raises the height of the plinth of a house in response to flood before the migration of a household member, then this strategy is not likely to have been influenced by access to remittances. On the other hand, if this measure is adopted after the first migration, it is probable that access to remittance may have an effect on it.

⁹ For further information on the Scheduled Tribes and Scheduled Castes refer to <http://tribal.nic.in/Content/DefinitionProfiles.aspx>.

¹⁰ A question in the survey had inquired about the duration (in months) for which a household had received remittances.

4.4 Mixed Methods Approach

The study adopted a mixed methods approach that included FGDs and household surveys. The FGDs were conducted in 12 villages across the four selected districts in Assam. In each of these villages, six FGDs were conducted respectively with migrant workers, women from migrant-sending households, men and women (separately) from poor and nonmigrant households, and men and women (separately) from nonpoor and nonmigrant households. The qualitative information collected from the FGDs and from the review of existing literature was used to build a narrative, inform hypotheses, and design the survey questionnaires. The four districts of Dhemaji, Dibrugarh, Lakhimpur, and Tinsukia were considered to be one aggregated areal unit, Upper Assam, during the survey. Because one of the research objectives was to understand adaptive capacity in flood-affected villages, a list of all flood-affected villages was prepared.¹¹ The selection of households involved a two-stage process. In the first stage, villages were selected using Probability Proportional to Size, and in the second stage, an equal number of households was selected using systematic sampling within each selected village. A sample size of 580 was estimated, 290 each for remittances-recipient and nonrecipient households. A household was classified as either a recipient household if at any time during the past 30 years it had received financial remittances, irrespective of the relationship of the remittances sender to the household, or as a nonrecipient household. Within the sample, only migrant-sending households had received remittances. The primary sampling unit was 20 households (10 each for remittances-recipient and nonrecipient households) in each village; therefore, 29 villages were covered. At the end of the survey, a sample size of 576 was achieved—289 remittances-recipient households and 287 nonrecipient households.

5. Results

5.1 Household-Level Response to Floods

Over the years, households in the flood-affected rural communities of Upper Assam have developed a wide range of flood responses. These household-level responses to floods in the study area can be divided into responses during the flood period (when houses and farms are inundated), the immediate aftermath of the flood (when flood water has receded), and the periods between two distinct flood events. Findings indicate that there is little difference in the responses between remittances-recipient and nonrecipient households in the flood-affected rural communities (see figures 2a, 2b, and 2c). During the flood, household responses are geared toward evacuation and relief. Households try to move cattle to safe locations (for example, roads, embankments), build rafts from banana plants, move family members to a safe location (to an embankment, road, railway line, or shelter or relief camp set up by local administration or NGOs), boil or filter drinking water, buy food on credit, build a raised platform within the household to take shelter or store valuable possessions, spend savings on food, and contact the district administration for assistance. Though it has been decades since many of these strategies were first adopted, they are short term and reactive in nature. In the immediate aftermath of a flood, the household-level responses are focused on recovery measures. Households seek to clean and repair the house and cattleshed; contact the health care service, district administration, and veterinarian; arrange for safe drinking water; prepare for farming; spend savings on food or buy food on credit; and repair local infrastructure. These strategies are short term in nature,

¹¹ If a village had experienced a riverine flood or flash flood at least once since 1984 it was considered to be a flood-affected village. The non-flood-affected villages had not been affected by a riverine flood or flash flood since 1984.

and help households cope with flood. Household-level responses to flooding in the period between two flood events commonly include raising the plinth of the house, toilet, cattleshed, and granary. In addition, some households mortgage or sell assets or reduce the number of cattle. Livestock are prone to diseases in the aftermath of floods, and there is a fodder shortage during this period. Selling the livestock helps the household supplement their income. Moreover, floods deposit large quantities of debris (including sand and silt) on farms. The shortage of fodder and diseases during floods weaken the bullocks, which are then unable to plow the farm through the debris. But tractors can plow the farm even through flood debris. About one-third of households surveyed had used a tractor to plow the farm during the winter cropping season. Use of a tractor supports modification of the farming calendar (for example expediting planting) to avoid the flood period. Overall, the household-level flood response is based on ex post short-term flood response measures. The number of short-term strategies used by households during the flood or in its immediate aftermath outnumbered the long-term strategies adopted between flood events (table 2). There is a lack of ex ante flood preparedness strategies associated with awareness generation, risk pooling, financial inclusion and alternative livelihood strategies.

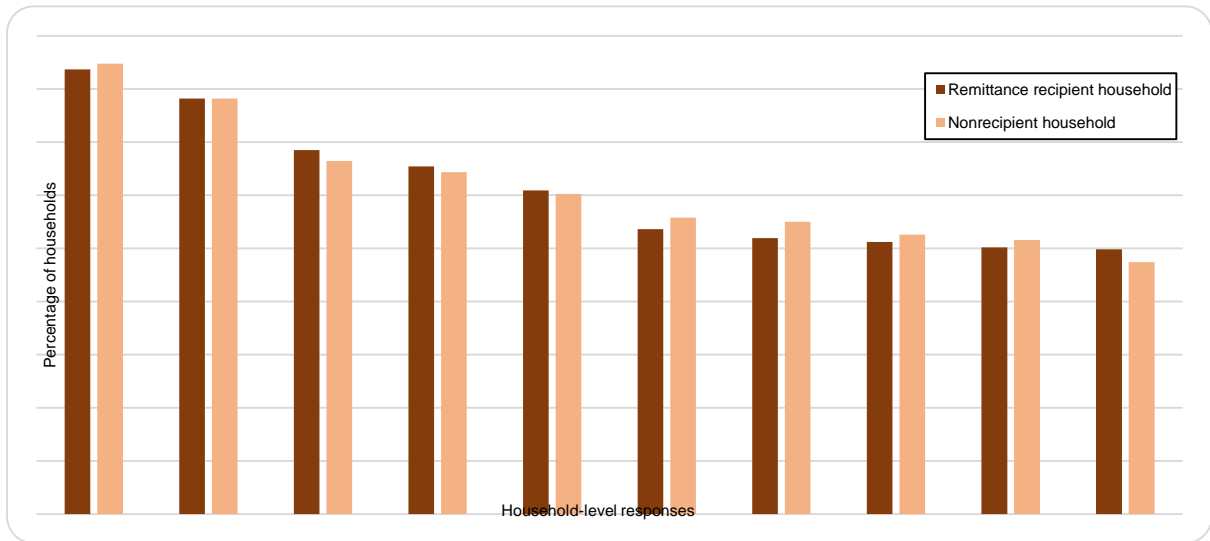
Table 2 Average Number of Household-Level Flood Responses by Monthly per Capita Expenditure Terciles in Upper Assam, Eastern Brahmaputra Subbasin, India

Background characteristics	During flood		Immediate aftermath of flood		Between two flood events	
	Remittances-recipient households	Nonrecipient households	Remittances-recipient households	Nonrecipient households	Remittances-recipient households	Nonrecipient households
MPCE ^a tercile						
Bottom	11	11	10	9	5	4
Middle	11	11	10	10	6	5
Top	14	13	12	11	8	7

Note: MPCE = monthly per capital expenditure.

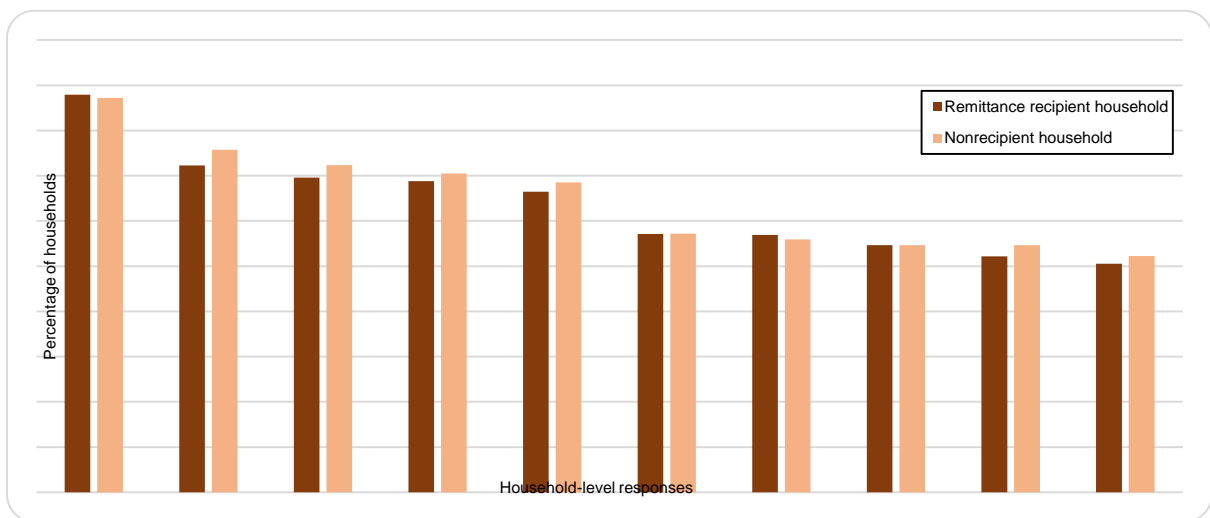
- a. Monthly per capita expenditure adjusted for adult equivalent. Source: Computed by authors from HICAP Migration Dataset.

Figure 2a Household-Level Responses during the Flood in Upper Assam, Eastern Brahmaputra Subbasin, India



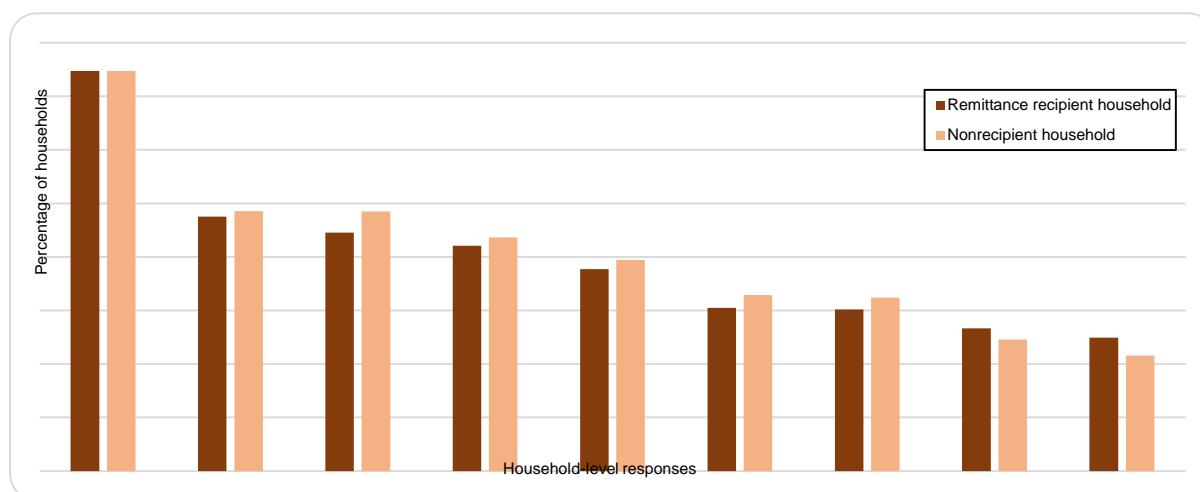
Source: Computed by authors from HICAP Migration Dataset.

Figure 2b Household-Level Responses in Immediate Aftermath of the Flood in Upper Assam, Eastern Brahmaputra Subbasin, India



Source: Computed by authors from HICAP Migration Dataset.

Figure 2c Household-Level Responses between Two Flood Events in Upper Assam, Eastern Brahmaputra Subbasin, India



Source: Computed by authors from HICAP Migration Dataset.

5.2 Livelihood Practices and Income Sources

A majority of the surveyed households have access to farm land, most of which is owned by the household (table 3). On average, households have access to 1.17 hectares of land, which is marginally higher than average farm size for the state (1.10 hectare) (DoES 2015). Major crops grown in this area include main paddy, early paddy, winter vegetables, winter potato, and mustard. On average, the sale of crops contributes to the income of one-third of nonrecipient households and a quarter of remittances-recipient households. However, fewer than one-twentieth of households reported the sale of crops as a major source of household income. The average income from crop sales during the year preceding the survey was estimated to be US\$137. These figures indicate that farming is predominantly subsistence in nature. Common types of livestock include poultry, cattle, and goats. On average, the sale of livestock and livestock products contributes to the income of more than half the households. However, it is the major source of household income for fewer than one-twentieth of households.¹²

Table 3 Access to Agricultural Land, Land Area, and Land Ownership among Households, in Upper Assam, Eastern Brahmaputra Subbasin, India, 2013–14

	Remittances-recipient household	Nonrecipient household
Number of households		
Households who have access to agricultural land (%)	69.3	79.5
Mean total agricultural land area (hectares) ^a	1.2	1.2
Mean per capita agricultural land (hectares) ^a	0.2	0.2

¹² An income source that contributes more than 50 percent of a household income is considered to be a major income source.

Ownership of land (%)^a		
Owned	91.0	90.5
Leasehold	5.7	4.3
Share cropped	3.3	5.2
Share of land use (%)^a		
Crop farming	86.8	88.8
Orchard and tree crops	1.6	0.9
Grassland or pasture	0.8	0.0
Kitchen garden	6.6	7.8
Fallow	4.1	2.6
Access to irrigation		
Share of household who have irrigated land (%) ^a	2.2	2.0
Mean crop sales in US\$ (standard deviation)		
	135.8 (430.8)	137.7 (329.2)

a. Computed among those who have access to agricultural land.

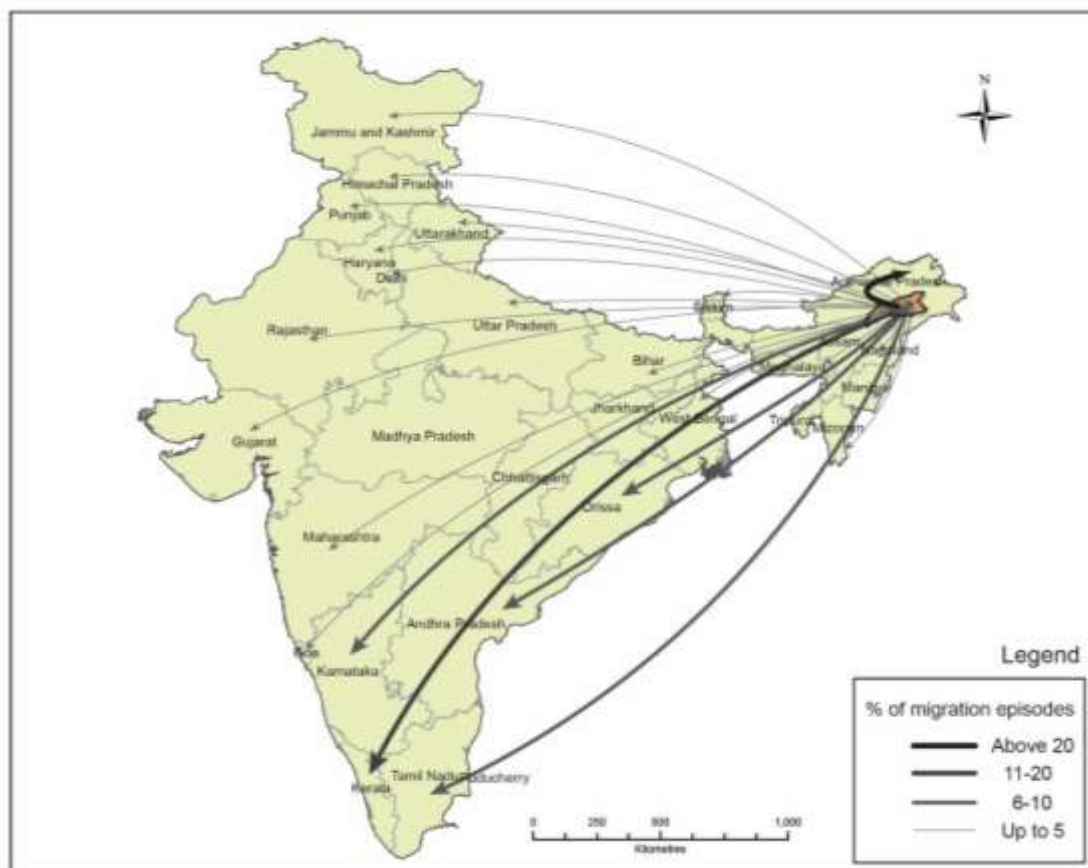
Source: Computed by authors from HICAP Migration Dataset.

Salary or wage income from nonfarm sources in the locality provides a potential alternative to farming and is part of the strategy to spread risk. Nonrecipient households have better access to nonfarm opportunities in the locality. About one-fifth of nonrecipient households and one-tenth of remittances-recipient households earn an income from salaried employment from nonfarm sources. Salaried employment is a major source of household income for one-fifth of the nonrecipient households and one-twentieth of remittances-recipient households. Daily wages from nonfarm sources in the locality contributes to the income of nearly half of the nonrecipient households and over two-fifths of remittances-recipient households. It is a major source of income for one-fifth of remittances-recipient and one-third of nonrecipient households.

Labor migration is an emerging livelihoods option for local households. Among the surveyed migrant households, almost nine-tenths have one migrant worker and nearly one-tenth reported two migrant workers during the past 30 years. Labor migrants from the villages studied were predominantly young men of working age. The majority of migrant workers from the studied villages were educated. About three-fifths of the surveyed migrant workers had attended a secondary school (61.0 percent). Nearly one-fifth of the surveyed migrant workers had completed a higher secondary level of education (16.8 percent). Only one-twentieth of the surveyed migrant workers were illiterate (5.5 percent). Migration for work in the study area was predominantly internal and circular in nature, and facilitated by the social network. The household survey collected information about the destination and occupation for 1,022 migration episodes since 1984. About 28.8 percent of these migration episodes are associated with a destination in the province of Assam, another 28.7 percent of the destinations are located in

other northeastern provinces in India, and the remaining destinations are located elsewhere in India.¹³ Arunachal Pradesh, Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra, and Gujarat are the major destinations of the interstate migrant workers from Assam (map 2). About nine-tenths of the 1,022 migration episodes are oriented toward urban destinations (87.2 percent). Major employers are the manufacturing (30.0 percent); construction (28.3 percent); and services (11.5 percent) sectors. Most migrant workers are wage employees (93.6 percent). These migrant workers are mainly part of the informal sector. For example, fewer than one-tenth of the surveyed migrant workers receive social security benefits (pensions, provident funds, or insurance) as part of their present or last job in the destination. Only a third of the surveyed migrant workers are provided paid leave in their present or last job in the destination. This job profile contributes to the circular nature of this migration. The migrant workers who moved to a destination in Assam or northeast India return home every few months and during major local festivals. Many of the migrant workers who are based in urban centers in the south and west of India are able to visit family in Assam every couple of years. For example, the distance between the town of North Lakhimpur in Assam and the city of Thiruvananthapuram in the state of Kerala, which is located along the southwestern coast of India, is 3,925 kilometers. A one-way trip between these two destinations—mostly on the railways and partly by road—takes a minimum of three days. These migrant workers receive a long enough furlough every couple of years to visit their families in Assam.

Map 2 Destination of Interstate Migrant Workers from 1984 through 2014



¹³ Other northeastern provinces include Arunachal Pradesh, Meghalaya, Nagaland, Manipur, Mizoram, Tripura and Sikkim.

Remittances are a major income source for two-fifths of remittances-recipient households. The mean amount of remittances received by migrant households during the 12 months preceding the survey was estimated to be US\$538.5. The mean duration of remittances receipt was estimated to be 40.7 months. Remittances are commonly used for food, health care, community activities, consumer goods, education, and transport. For example, nine-tenths of remittances-recipient households (91.5 percent) spent an average of US\$220.6 to procure food. Few households have invested remittances in housing; savings; disaster relief, recovery, and preparedness; and loan repayment (see ANNEX 2, figure 3).

5.3 Household-Level Adaptive Capacity and Remittances

A better understanding of the determinants that shape the adaptive capacity of a remittances-recipient household would be useful for local-level adaptation planning that aims to improve households' adaptive capacity. A system's capacity to develop is reflective of its financial and economic resources (Aulong et al. 2012). Regression analysis indicates that the remittances-recipient households are more likely to have a savings bank account than nonrecipient households (Pr = 0.093) (see table 4). Nearly three-quarters of remittances-recipient households in Upper Assam had a savings bank account compared with about two-thirds of nonrecipient households. Insurance penetration is low in the study area. Remittances-recipient households are more likely to have an insurance product than are nonrecipient households (Pr = 0.045). Only one-third of households surveyed have life insurance. In a case study of rural livelihoods vulnerability in the state of Tamaulipas, Mexico, Eakin and Bojórquez-Tapia (2008) characterize the high-vulnerability households as having very low values for insurance and credit indicators. In fact, none of the households in the study sample in Upper Assam have crop or livestock insurance. Smit and Pilifosova (2001) identify information as one of the determinants of adaptive capacity.¹⁴ The communication-device diversification index is negatively associated with the remittances-recipient status of a household (Pr = 0.012). Households that receive remittances are likely to have more types of communication devices (for example, cable network, mobile phone, radio, or television) than nonrecipient households. This diversification indicates that remittances-recipient households are exposed to more sources, and thereby different types, of information. Some of these communication devices could be used by the local administration to disseminate information on disaster risk reduction. Throughout the disaster-response process, the poor, the elderly, women-headed households, and recent residents are at greater risk (Morrow 1999). Remittances-recipient households in Upper Assam are more likely to receive assistance during flood from fewer sources than nonrecipient households (Pr = 0.058). Because of gender-specific roles, the women and elderly household members from remittances-recipient households may have limited access to social resources during floods in the absence of male household members who are custodians of a household's social capital.

¹⁴ Smit and Pilifosova (2001) identify economic resources, technology, information and skills, infrastructure, institutions, and equity as the determinants of adaptive capacity.

Table 4 Effects of Remittances on Household-Level Adaptive Capacity to Floods in Upper Assam, Eastern Brahmaputra Subbasin, India

Subdimension	Measurement	Remittance-recipient household	Nonrecipient household	Adjusted odds ratio (beta coefficient)
Physical	% of households that had not raised plinth of the house	24.7	25.9	0.9 (-0.096)
	% of households that had not raised plinth of the cattleshed	59.2	56.9	1.1 (0.079)
	% of households that had not raised plinth of the toilet	73.7	76.3	0.9 (-0.132)
	% of households that had not used a tractor to plow land during the winter cropping season ^l	59.8	55.2	1.2 (0.200)
	% of households that did not have access to a boat or raft during flood	17.8	17.8	1.0 (0.051)
	% of households that did not have access to storage options above median value [§] during flood	67.9	67.0	0.9 (-0.125)
	% of households that had not raised plinth of the granary	53.6	54.4	1.0 (0.033)
	Financial	% of households that did not have a savings bank account	25.1	30.3
% of households that did not have insurance		62.9	69.2	0.7 (-0.377**)
Social	% of households that did not have access to sources of flood assistance above median value [#]	91.1	86.6	1.7 (0.532*)
	% of households that did not have access to financial borrowing during flood	59.5	65.4	0.8 (-0.221)
	% of households that did not participate in collective action on flood relief, recovery, and preparedness	25.5	22.4	1.1 (0.132)
Natural	Farm-size diversification index	0.4	0.5	-0.019
	Livestock diversification index	0.2	0.2	-0.0006

	% of households that had not changed farming practices in response to floods	67.0	70.2	0.8	(-0.186)
	% of households that had not changed livestock rearing practices in response to floods	64.3	66.8	0.8	(-0.166)
Human	Communication-device diversification index	0.4	0.5	-0.050***	

Legend: * $p < .1$; ** $p < .05$; *** $p < .01$.

Source: Computed by authors from HICAP Migration Dataset.

Note: Models were adjusted for household head's gender, ethnicity, and literacy; household size; adjusted total expenditure; time to reach nearest paved road, local market, bank, or Panchayat office; and village-level meetings on flood preparedness.

The characteristics of adaptive capacity among the remittances-recipient households in the study area indicate that the duration for which remittances are received by a household is an important determinant of household-level adaptive capacity. The results appear in table 5. The remittances-recipient households in the study sample are classified into two categories: long-duration and short-duration households. The long-duration remittances-recipient households are more likely to have raised the height of plinth of the house ($Pr = 0.000$), cattleshed ($Pr = 0.002$), or toilet ($Pr = 0.006$) than the short-duration remittances-recipient households. These structural changes to the dwelling specifically address flood impacts. A boat or raft is an essential mode of transportation in those parts of Upper Assam where floods lead to inundation. Sometimes a boat could also double as a shelter during displacement (Hazarika 2006). The shorter the duration of the receipt of remittances by a household, the more likely it is that the household does not have access to a boat or raft during the flood period ($Pr = 0.020$). Agrawal and Perrin (2008) identify storage as an important type of coping and adaptation strategies. Households that have been receiving remittances for a long duration are more likely to have better access to storage options (that is, above median value) than households receiving remittances for a shorter duration ($Pr = 0.001$). Among the former, households who also engage in farming activities are more likely to raise the plinth or height of the granary ($Pr = 0.067$).

Previous studies by Goyari (2005) and Mandal (2010) report that farmers in Assam are adjusting the cropping pattern or season (or both) to minimize production risk due to recurring floods. The floods largely affect the kharif (monsoon) food crops. The area under the kharif foodgrain has progressively declined. Instead, there has been an increase in the area under rabi (winter) food crops and vegetables. In addition, experts have highlighted a growing shortage of farm labor in Upper Assam.¹⁵ In the absence of able-bodied migrant family members and amid lack of farm labor, tractors are being used to plow the farm. The long-duration remittances-recipient households that are engaged in farming activities are more likely to use a tractor to plow the farm during the winter cropping season than short-duration remittances-recipient households ($Pr = 0.002$). This indicates growing mechanization of farming among the former. However, this should be contextualized with another finding that long-duration remittances-recipient households are more likely to reduce the size of their

¹⁵ Input received during an expert meeting in Guwahati, Assam, in October 2015.

landholdings (Pr = 0.008). The likelihood of mechanizing farming activities even while reducing farm size may suggest that this mechanization is partly driven by labor shortages due to the absence of able-bodied young men. Moreover, long-duration households are more likely to reduce the number of cattle or poultry in response to floods (Pr = 0.002). Farming is a risky proposition because of the vagaries of weather, prices, and crop and animal diseases (Lucas 2014). Smaller farm size among long-duration remittances-recipient households may indicate a downsizing of farming activities and growing dependence on remittances or other nonfarm income sources. This reflects the risk-averse nature of these households and growing connectivity between rural and urban markets, and suggests growing dependence of rural households on the local market for food and other essentials.

Access to savings and credit are essential components of a household's capacity to manage risks from recurrent extreme weather events. Long-duration households are more likely to have a savings bank account (Pr = 0.042) and insurance (Pr = 0.094) than short-duration households. Risk pooling within a network could be an important strategy for reducing disaster risks. The reputation or credit rating of remittances-recipient households in Upper Assam increases over time. For example, short-duration remittances-recipient households are less likely to have access to borrowing during floods than long-duration remittances-recipient households (Pr = 0.049). Mosse et al. (2002) conducted a study on seasonal migrants from the Bhil tribal villages in India. The social position of wealthier migrant households in the origin villages improved as a result of the income generated from migration. The creditworthiness of these households among local moneylenders increased because of this improvement in social position. These households could then borrow large sums of money from indigenous financial institutions for major social events such as marriage. Participation in community activities is a proxy for social cohesion and access of a household to village institutions. Over time the participation of remittances-recipient households in collective action on flood relief, recovery, and preparedness increases (Pr = 0.000). This may indicate increased participation of remittances-recipient households in community-level activities.

Table 5 Effect of Duration of Remittances Receipt on Household-Level Adaptive Capacity among Remittances-Recipient Households, Upper Assam, Eastern Brahmaputra Subbasin, India

		Short- duration households	Long- duration households	Adjusted odds ratio (beta coefficient)
Physical	% of households that had not raised plinth of the house	64.3	35.5	0.3 (-1.211***)
	% of households that had not raised height of the cattleshed	80.0	42.5	0.2 (-1.762***)
	% of households that had not raised plinth of the toilet	48.5	27.0	0.1 (-1.988**)
	% of households that had not used a tractor to plough land during the winter cropping season ^l	62.5	27.7	0.1 (-1.838***)
	% of households that did not have access to a boat or raft during flood	89.9	70.1	0.3 (-1.307**)

Financial	% of households that did not have access to storage options during flood	87.0	50.0	0.4 (-1.139***)
	% of households that had not raised height of the granary	69.1	50.0	0.4 (-0.885*)
	% of households that did not have savings bank account	30.7	19.8	0.5 (-0.605**)
	% of households that did not have insurance	69.3	56.6	0.6 (-0.443*)
Social	% of households that did not have access to flood assistance	8.57	12.50	1.6 (0.471)
	% of households that did not have access to financial borrowing during flood	73.9	54.7	0.3 (-1.031**)
Natural	% of households that did not participate in collective action on flood relief, recovery, and preparedness	86.7	50.0	0.1 (-1.856***)
	Farm-size diversification index	0.5	0.6	0.070**
	Livestock diversification index	0.1	0.1	-0.004
	% of households that had not changed farming practices in response to floods	77.3	68.0	0.5 (-0.737)
	% of households that had not changed livestock rearing practices in response to floods	79.5	45.0	0.2 (-1.978***)
Human	Communication-device diversification index	0.05	0.02	0.6 (-0.499)

Legend: * p<.1; ** p<.05; *** p<.01.

Source: Computed by author from HICAP Migration Dataset.

Note: Models were adjusted for household head's gender, ethnicity, and literacy; household size; adjusted total expenditure; time to reach nearest paved road, local market, bank, or Panchayat office; and village-level meetings on flood preparedness.

6. Discussion

The combination of available assets, resources, policies, and institutions shapes the adaptive capacity of a system (Smit and Wandel 2006). Adaptive capacity manifests in the ability of a system to absorb and recover from impacts of a stressor. Sophisticated risk management (ex ante) and risk-coping strategies (ex post) are developed by rural and urban households located in risky environments. These strategies include self-insurance through savings and informal insurance mechanisms. Precautionary savings involve building up savings in "good" years and using the stock in "bad years" (Dercon 2002). Though remittances-recipient households in Upper Assam are likely to have better access to formal financial institutions and insurance than nonrecipient households, few remittances-recipient (1.5

percent) and nonrecipient households (2.5 percent) have undertaken targeted savings as a strategy for managing environmental risks. The FGD findings from Upper Assam suggest that savings are, generally, meant for funding education, weddings, and health care emergencies. Insurance penetration remains low in Upper Assam, and is mostly limited to life insurance.¹⁶ The government of India launched a national financial inclusion program in August 2014 (Pradhan Mantri Jan Dhan Yojana),¹⁷ which has increased access to formal financial institutions, life and health insurance, and government subsidy programs, particularly in rural areas. However, regular interaction and an awareness campaign among rural beneficiaries of this scheme, particularly women, about a wider array of financial products, the significance of establishing creditworthiness in the eye of formal financial institutions, the utility of financial inclusion in flood risk management, as well as capacity building of bank employees in rural areas are required to realize the potential of this program.

Awareness among individuals depends on the household's access to information, which, in turn, is contingent upon access to communication devices. Possession of the communication devices manifests in the ability of a household to gather information from beyond the geographical limit of the village or the social network. This study finds that households that receive remittances are likely to own more types of communication devices than nonrecipient households. Mohapatra et al. (2009) reports that international remittances-recipient households in Burkina Faso and Ghana have greater access to communication equipment. In particular, those households receiving remittances from high-income developed countries. Based on this observation, Mohapatra et al. (2009) suggests that remittances-recipient households are better prepared for natural disasters. These communication devices could be a critical conduit of information between the local administration and residents during an extreme weather event. For example, a pilot on community-based flood early warning systems in Upper Assam alerts vulnerable villagers downstream about the impending flood through text messages or phone calls.¹⁸ Particularly in the context of flash floods, the time between the dissemination of flood alert and arrival of flood water is a crucial factor in saving lives and livestock, and minimizing damage to property. District-level government institutions need to explore the use of communication devices to disseminate information on financial literacy, disaster risk reduction, livelihoods diversification, and government programs. However, remittances-recipient households in Upper Assam are more likely to receive flood assistance from fewer sources than nonrecipient households. In aftermath of a disaster, assistance from government and nongovernment institutions may not always be provided at the doorstep of the affected population. Hence, access to assistance may require follow-up with nodal teams of the local administration or major nongovernmental organisations. In the absence of young male household members, it is probable that women and the elderly household members of remittances-recipient households will have limited access to institutions providing flood assistance. This could have an adverse effect on rescue, delay access to relief, and impede institutional support for recovery.

Only after the obligations associated with daily consumption, debt repayment and education are met would remittances be used for "consumptive" investment such as land purchase, hiring of labor, or labor-saving mechanization (Lipton 1980) or establishment of grocery shops or small restaurants (Penninx 1982). This pattern of use of remittances could be one of the plausible explanations for

¹⁶ None of the households in the study sample in Upper Assam reported having crop or livestock insurance.

¹⁷ <http://www.pmjdy.gov.in/home>.

¹⁸ http://www.business-standard.com/article/news-ians/community-based-flood-alarms-saving-assam-lives-115072600233_1.html.

adaptive capacity among remittances-recipient households. This study of adaptive capacity of remittances-recipient households in Upper Assam indicates that the duration for which remittances are received by a household has a significant and positive association with the structural changes made in the household to address flood impacts, farm mechanization, the household's access to borrowing (or creditworthiness), and participation in collective action on flood relief, recovery, and preparedness. Since the migrant workers from the study area are predominantly engaged as wage employees in the informal sector, the volume of remittances remains low. Remittances are commonly spent on basic needs (food, health care, and education), social events and community activities, consumer goods, and transportation. This spending pattern also reflects a household's prioritization of expenditure. As indicated in figure 3, few households invest remittances in housing, savings, or disaster relief recovery in the short term. In addition, the lack of awareness raising exercises about flood preparedness at the village level indicates a lack of information about disaster risk reduction, which could have otherwise influenced household-level expenditure patterns.

The State Action Plan on Climate Change of Assam was drafted in 2011 (TERI, 2011). The plan ignores the potential of remittances to address the unmet adaptation needs of remittances-recipient households. Remittances are a stable source of capital for households in times of crisis (Ratha 2003). Remittances are used to procure essential commodities and basic amenities during a crisis such as a flood. Ways must be found to increase the adaptation potential of remittances. de Haas (2012) suggests that the development potential of migrants and migrant resources can be realized if an attractive investment environment is created and trust in the political and legal institutions of origin communities is built. The role of remittances needs to be explored by government institutions as part of adaptation plans, disaster risk reduction programs, and the sustainable development agenda.

Some caveats must, however, be noted, the most important of which is that the research presented here is based on cross-sectional data and is unable to explore the long-term implications of remittances for the adaptive capacity of remittances-recipient households. Future research needs to explore whether the effect of remittances on structural and nonstructural adaptation measures varies depending on the phase of a migrant's life cycle, and consider more directly the circumstances in which migration might erode the adaptive capacity of migrant households. Further analysis could also focus on how the differential impacts of migration on men and women play out in the context of adaptation; whether the skills learned by migrants at their destinations assist migrant households in origin communities in addressing risks from extreme weather events; and on the institutional processes that shape the migration consequences in context of adaptation.

In the meantime, policy interventions might reasonably aim to increase the level of remittances flowing back to migrant households through increasing financial literacy; financial inclusion; and skills training, particularly among the poorer households in areas likely to be affected by the impacts of climate change and variability. Additionally, policy attention might be given to attempts to enable gains in financial capital to be translated to gains in other types of capital and how the social element of remittances can be used to boost social capital.

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ANNEX 1.

Table 1 Subdimensions and Attributes of Household-Level Adaptive Capacity in the Upper Assam, Eastern Brahmaputra Subbasin, India.

Subdimension	Attribute	Measurement of attribute	Survey question	Source
Natural	Farm size diversification index	The inverse of (farm size +1) reported by a household. For example, a household that has three hectares of farm will have a Farm Size Diversification Index = $1/(3+1) = 0.25$.	How much land does your household have for agriculture (that is, crops, grass, trees, orchard, fallow, and so on)?	Adapted from Hahn, Riederer, and Foster 2009; Eakin et al. 2011; and Aulong et al. 2012
	Livestock diversification index	The inverse of (number of livestock +1) reported by a household. For example, a household that has 19 head of livestock will have a Livestock Diversification Index = $1/(19+1) = 0.05$.	How many of the following animals (cattle, buffaloes, goat, sheep, horses/donkey/ mules, pigs, poultry/ducks) does your household own?	Adapted from Hahn, Riederer, and Foster 2009; Eakin et al. 2011; and Aulong et al. 2012
	Made changes in farming practices because of flood	Percentage of households that did not change farming calendar, grow flood-resistant varieties of crops, reduce area under paddy crop, or emphasize vegetable farming.	During the past 30 years, did your household make any changes in the farming calendar between two flood events in response to flood impacts? During the past 30 years, did your household grow flood-resistant varieties of crops between two flood events in response to flood impacts? During the past 30 years, did your household reduce the area under paddy	Adapted from Hassan and Nhemachena 2008 and Below et al. 2012

			between two flood events in response to flood impacts?	
			During the past 30 years, did your household increase its emphasis on vegetable farming between two flood events in response to flood impacts?	
	Changes in livestock rearing practices due to flood	Percentage of households that did not reduce number of ducks, poultry, and cattle.	During the past 30 years, did your household reduce the number of poultry or ducks between two flood events in response to flood impacts?	Developed for the purposes of this study
			During the past 30 years, did your household reduce the number of cattle between two flood events in response to flood impacts?	
Financial	Access to formal financial institution Access to insurance	Percentage of households that did not have a savings bank account. Percentage of households that did not have any insurance product.	Did the household have a savings bank account? Did the household have any type of insurance?	Adapted from Thomalla et al. 2006 and Gerlitz et al. 2014 Adapted from Vincent 2007 and Gerlitz et al. 2014
Social	Access to flood assistance	Percentage of households that did not have access to flood assistance from more than the median number of sources.	During the past 30 years, who of the following assisted the household (for example, government institutions, social network, community based organizations, or NGOs) to deal with the effects of the flood?	Adapted from Gerlitz et al. 2014

Access to financial borrowing during to floods

Percentage of households that did not have access to financial borrowing to deal with flood impacts.

During the past 30 years, did the household borrow money from a bank, social network, or community-based organization during flood to deal with its impacts?

Adapted from Dasgupta 2003 and Gerlitz et al. 2014

During the past 30 years, did the household borrow money from a bank, social network, or community-based organization in the aftermath of a flood to deal with its impacts?

During the past 30 years, did the household borrow money from a bank, social network, or community-based organization between two flood events in response to flood impacts?

Participation in collective action on flood relief, recovery, or preparedness

Percentage of households that did not participate in setting up a relief camp, repairing local infrastructure, erecting a barrier to slow the speed of flood water, or building a raised platform to keep cattle during flood.

During the past 30 years, did the household participate in setting up a relief camp during flood?

Adapted from Bloomfield et al. 2001 and Hillier 2003

During the past 30 years, did the household participate in repair of local infrastructure in the aftermath of a flood or between two flood events to deal with its impacts?

During the past 30 years, did the household erect a barrier to slow the

			speed of water or arrest garbage flowing in flood water?	
Human	Communication Device Diversification Index	The inverse of (number of communication devices +1) reported by a household. For example, a household that has three types of communication devices will have a Communication Device Diversification Index = $1/(3+1) = 0.25$.	During the past 30 years, did the household participate in construction of a livestock platform between two flood events to deal with its impacts? How many of the following items (radios, televisions, mobile phones, dish antennae) does your household have?	Adapted from Brooks, Adger, and Kelly 2005 and Gerlitz et al. 2014
Physical	Structural changes in the house because of flood	Percentage of households that did not raise plinth of the house, cattleshed, or toilet.	During the past 30 years, did the household raise the plinth of the house between two flood events in response to flood impacts? During the past 30 years, did the household raise the plinth of the cattleshed between two flood events in response to flood impacts? During the past 30 years, did the household raise the plinth of the toilet between two flood events in response to flood impacts?	Developed for the purposes of this study

Farm mechanization	Percentage of households that did not use a tractor to plow the farm during the winter cropping season.	During the past 30 years, did the household use a tractor to plow the farm during the winter cropping season?	Developed for the purposes of this study
Transport during flood	Percentage of households that did not use a boat or raft during flood, or build or procure a boat between two flood events.	During the past 30 years, did the household arrange for a boat or build a raft from banana plant during flood? During the past 30 years, did the household build or procure a boat between two flood events in response to flood impacts?	Developed for the purposes of this study
Storage during flood	Percentage of households that did not have more than the median storage options.	During the past 30 years, did the household store firewood during flood? During the past 30 years, did the household store fodder during flood? During the past 30 years, did the household store fodder in the aftermath of a flood to deal with its impacts? During the past 30 years, did the household store food during flood? During the past 30 years, did the household store food between two flood events in response to flood	Developed for the purposes of this study

impacts?

During the past 30 years, did the household store valuables during flood, in its aftermath, and between two flood events in response to flood impacts?

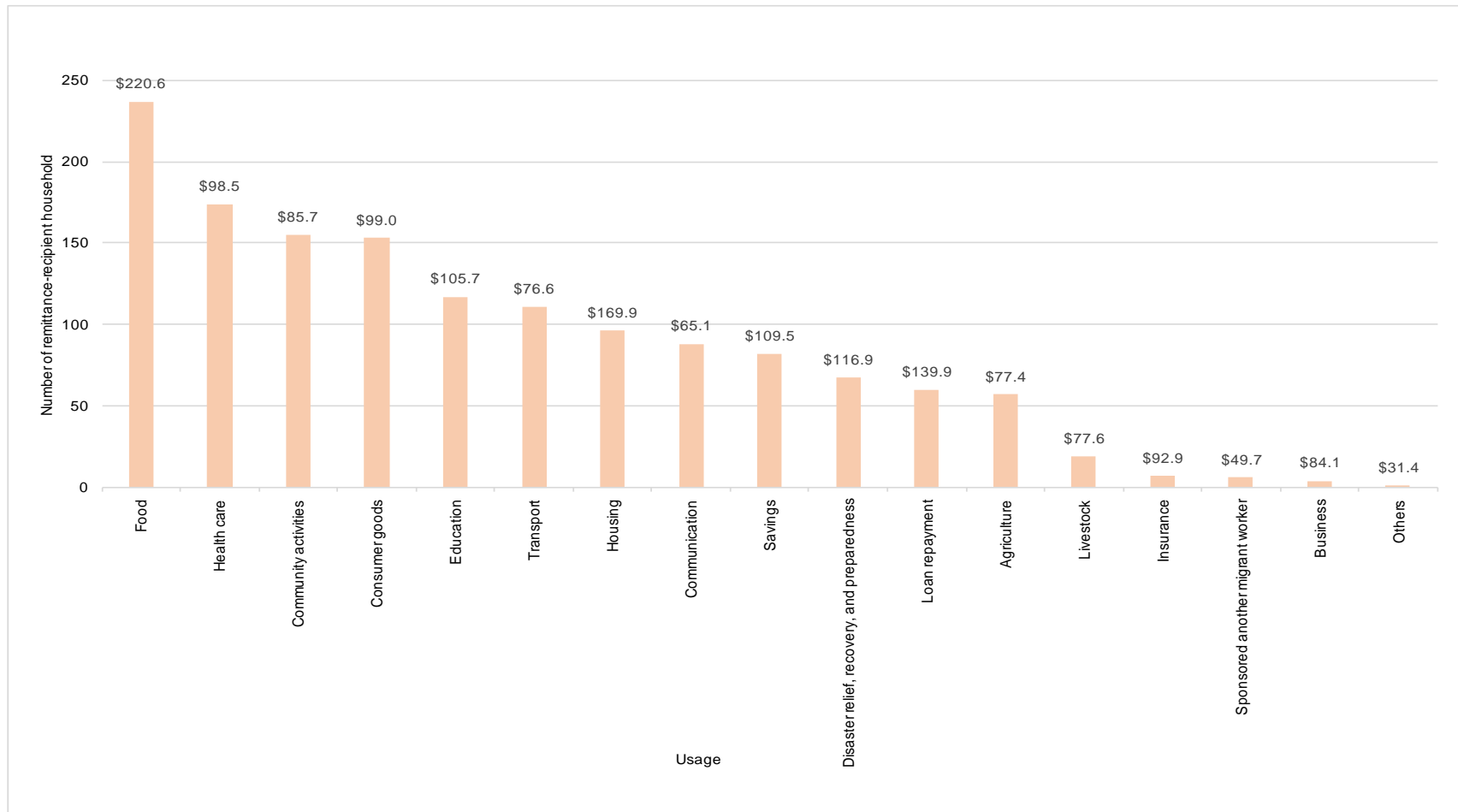
Percentage of households that did not raise plinth of the granary.

During the past 30 years, did the household raise the plinth of the granary between two flood events in response to flood impacts?

Note: NGO = nongovernmental organization.

ANNEX 2.

Figure 3 Usage of Financial Remittances in Upper Assam, Eastern Brahmaputra Subbasin, India, 2013–14



Source: Computed by authors from HICAP Migration Dataset.

Note: Use of remittances during the 12 months preceding survey. Average remittances expenditure on a particular item is provided on top of each bar.