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RESEARCH ARTICLE

Climate shocks and adaptation strategies in coastal Bangladesh: does microcredit have a part to play?

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ABSTRACT

Microcredit has become a component of global development. Recently, the climate change and disaster community have proposed that it may be able to facilitate climate change adaptation, but whether this is the case remains under-researched. Addressing this gap, this paper examines the question in relation to microcredit's ability to support adaptation strategies that effectively address vulnerability to climate shocks in three villages in the Bagerhat and Chattogram districts of coastal Bangladesh. The findings provide qualitative evidence that at-risk people often use microcredit as a response to climate shocks. However, the case study only finds evidence that microcredit supports coping and incremental adaptation. Findings suggest shocks (some climate-related and some not) can result in reduction in food consumption, erosion of assets, depletion of savings, increased debt, and debt default, 'trapping' at-risk people in indebtedness through a process of cumulative vulnerability. Lack of outreach of microcredit, erosion of assets, supply barriers, and lack of credit alternatives reduce microcredit's potential to address the persistent determinants of vulnerability.

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Climate change adaptation; vulnerability; coping; microcredit; informal lending; indebtedness; Bangladesh

1. Introduction

While microcredit groups are not formed with the specific objective of providing strategies to respond to climate change, the disaster and climate change community has shown growing interest in recent years in the potential of microcredit as a strategy to enhance responses to climate change (e.g. Caretta, 2014; Di Falco & Sharma, 2018; Fenton et al., 2017; Johnson et al., 2019; UNDP, 2018). This is a relatively recent development in the three-decade history of microcredit's increasing role in global development. This system of extremely small loans for unsalaried borrowers, with little or no collateral, has emerged as a tool to help the poor who often lack access to traditional forms of credit because of absent or insufficient collateral, employment instability, verifiable credit histories, and social discrimination (Otero & Rhyne, 1994).[1] However, microcredit remains controversial. There is some empirical evidence that microcredit can alleviate poverty by fostering entrepreneurship; helping increase income, assets, and savings; smoothing consumption; and enhancing the ability to cope with risk (Banerjee et al., 2015; Collins et al., 2010; Haftom, 2013; Islam & Maitra, 2012; Pitt & Khandker, 1998). However, a United Kingdom government-funded systematic review of the impact of microfinance concluded that robust data regarding the nature, magnitude, and effects of microcredit over the last 30 years are both limited and inconclusive (Duvendack et al., 2011; see also Maîtrot & Niño-Zarazúa, 2015; Roodman & Morduch, 2009; Stewart et al., 2012). Increasingly, independent impact analyses find that microcredit schemes have no significant effects on poverty (Angelucci et al., 2015; Crépon et al., 2015; Meager, 2019; Swain & Floro, 2012) and can negatively affect the poorest or indeed exclude them (Adjei & Arun, 2009; Bateman & Chang, 2012; Dattasharma et al., 2016; Roodman & Morduch, 2014; Wski, 2002) and is more likely to benefit the middle- and upper-poor than the poorest (Hulme & Mosley, 1996).

In light of the mixed evidence, the suggestion that microcredit can be used as an adaptation strategy to climate change should be thoroughly interrogated. This paper aims to examine the potential of microcredit to support adaptation that effectively addresses vulnerability to climate shocks[2] in coastal Bangladesh. Bangladesh is a suitable place for this research because it is one of the most vulnerable countries to global climate change and has a well-established and vibrant microcredit industry. According to the findings, as a response to climate shocks, at-risk people often use microcredit within a broader set of credit and lending arrangements. However, the case study establishes that although microcredit can add to poor people's often complex portfolio of financial activities, it only supports coping and incremental adaptation, which has reduced its capacity to address the persistent determinants of vulnerability.

The paper begins by conceptualizing the correlation between adaptation and microcredit, followed by a discussion of the empirical approach adopted for this research. Further, it situates microcredit within the context of broader relationships of exchange and reciprocity providing monetary support at the local level. Next, cases that highlight the potential for microcredit as a response to climate shocks are briefly outlined, followed by the establishment of four key factors (outreach, expansion or erosion of assets, and credit supply and alternatives) influencing the potential of microcredit to facilitate adaptation. It concludes with an appraisal of microcredit,

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questioning the capacity of microcredit to support at-risk people's adaptation strategies to climate shocks.

2. Conceptualizing adaptation and microcredit

2.1. Adaptation to climate change

Adaptation to climate change typically involves long-term changes in behaviour and practices aimed at reducing vulnerability to future climate change (Pelling, 2011). It is ideally a dynamic process with multiple (overlapping) responses to a range of climate and non-climate shocks on various temporal and spatial scales. It typically includes reactive, concurrent or anticipatory changes (Pelling, 2011; Smit et al., 2000). Adaptation may involve diversifying crops, livestock and/or poultry better suited to changing climatic conditions. In contrast, selling assets to obtain money to survive and rebuild after a climate shock might be a coping strategy. Coping with climate change ensures immediate, short-term survival in a crisis; it does not affect underlying vulnerability (Antwi-Agyei et al., 2018; Berman et al., 2015). Coping can actually undermine adaptation (Eriksen et al., 2005). For example coping may intensify vulnerability to future climate change by prioritizing short-term resource availability (Ahmed et al., 2019; Antwi-Agyei et al., 2018; O'Brien et al., 2007; Vincent et al., 2013). The objective of adaptation is in part to reduce the need for coping (Eriksen et al., 2005). However, determining whether an action is an example of coping or adaptation is context and scale dependent (Vincent et al., 2013).

Coping and adaptive strategies can co-occur despite being distinct, and coping strategies may develop into adaptive strategies over time (Berkes & Jolly, 2002). The factors that shape the capacity to cope may complement the factors that influence the ability to adapt over longer timescales. Indeed, the same context, assets, and exposure to shocks shape both coping and adapting (Adger et al., 2004; Smit & Wandel, 2006). Asset portfolios of individuals, households, and communities are critical for both processes (Chambers & Conway, 1992; Jordan, 2012; Moser & Satterthwaite, 2008; Nune, 2018; Rahman et al., 2018a). Those with access to diverse assets tend to have greater choice and flexibility in the strategies they adopt to respond to climate change (Jordan, 2019). Those with eroded assets have access to weaker strategies and fewer choices as to those they employ (Jordan, 2012). Furthermore, the intensity, scale, location, timing, duration, and frequency, by which different types of climate shocks occur can erode the very assets needed for both future coping and adaptation (Rahman et al., 2018b).

Adaptation to climate change is largely happening incrementally worldwide (Fedele et al., 2019; Lesnikowski et al., 2013; Mapfumo et al., 2017; Wise et al., 2014). Incremental adaptations are interventions that do not significantly change existing political, social, or household structures and norms and are therefore often referred to as the business-as-usual approach (Eriksen et al., 2015; Kates et al., 2012; Park et al., 2012). It addresses immediate and anticipated shocks through minor and small-scale adjustments to existing practices to make them better suited to dealing with climate change (Fedele et al., 2019; Kates et al., 2012; Mustak, 2018; Park et al., 2012). Unlike coping, incremental adaptation reduces vulnerability (proximate causes) in the case of re-exposure to the same climate shock. It might involve rebuilding a house that was damaged in a flood to new specifications, which make it more resilient to flood risk, for example, raising the plinth of the homestead (Fedele et al., 2019). In contrast, a coping strategy might involve a household migrating to earn funds to rebuild their house to the same specifications (Vincent et al., 2013). This ensures their immediate survival but makes them no more resilient to a flood of similar or greater magnitude (Antwi-Agyei et al., 2018; Vincent et al., 2013).

Although there is little agreement on what qualifies as effective adaptation in practice (Owen, 2020), it is unlikely that incremental change on its own will be enough to avoid intolerable risks; adaptation that will address how vulnerability is produced is needed (Eriksen et al., 2015; Fazey et al., 2018; Fedele et al., 2019; Tschakert et al., 2013).[3] Transformational adaptation is necessary to address the root causes of vulnerability to climate change (e.g. social, cultural, and economic relationships, and power hierarchies) through challenging and significantly changing the fundamental attributes of existing social structures and power relations (Blythe et al., 2018; Brown, 2016; Gillard et al., 2016; O'Brien et al., 2014; Pelling et al., 2015). Transformational adaptation occurs at the long-term end of the adaptation spectrum; cementing systematic and behavioural changes requires longer timeframes compared to the implementation of incremental adaptation or coping (Few et al., 2017). Responses to climate change that fall short of transformational change can be valuable; indeed, poorly planned transformational change may maintain or reinforce vulnerability (Nalau & Handmer, 2015; O'Brien, 2012). There are many more barriers to implementing transformational adaptation than actions associated with incremental adaptation or coping (Chung Tiam Fook, 2017; Pelling, 2011).

Although the outward objective of adaptation is to reduce vulnerability, the assumption that attempts to do so are always successful ignores the complexity of the relationship between two types of adaptation – incremental and transformational – and their diverse effects on addressing vulnerability. Indeed, adaptation may not effectively reduce vulnerability if it only deals with proximate causes of vulnerability, without also addressing the fundamental root causes as to why people are vulnerable in the first place (Bankoff, 2018; Jordan, 2019; Rühlemann & Jordan, 2019). For example, Bellante (2017) found that Mexican farmers not only addressed extreme weather and pests to boost crop yields but also developed a local cooperative to expand access to markets and secure equitable crop prices for their produce.

Past research shows that due to multiple drivers and the spatial and temporal complexity of climate change problems and responses, people in different places and at different times may have differing perspectives on the success of a particular adaptation measure (Atteridge & Remling, 2017; Barnett & O'Neill, 2010; Magnan et al., 2016). Adaptation measures may simply fail to reduce vulnerability to climate change impacts without doing actual damage; they can also become maladaptation. Juhola et al. (2016) distinguished three types of maladaptive outcomes: those that increase current or future climate change vulnerability of target beneficiaries or

implementing actors (rebounding vulnerability), those that transfer negative effects to someone not considered by the intervention (shifting vulnerability), and those that lead to negative feedbacks on a global scale (eroding sustainable development) (see Antwi-Agyei et al., 2018; Mikulewicz, 2020; Neset et al., 2019).

2.2. Links between adaptation and microcredit

Given that adaptation measures do not always succeed and the diverse effects on vulnerability of those that succeed in part, it is far from evident that microcredit will have a positive impact. As Dowla (2018) points out, climate change threatens microfinance institutions (MFIs) themselves (both directly through destruction of offices, equipment, and records and indirectly through dampening their efficacy in creating economic growth), which means they may not be in a position to fully assist those vulnerable to it. Unfortunately, little research has examined whether microcredit is likely to support climate change adaptation.

Much of what we know about the impact of microcredit on how at-risk people may react to climate change comes from studies that focus on disaster risk management or coping (e.g. Becchetti & Castriota, 2011; Parvin et al., 2014; Shoji, 2010). For example, Khandker's (2007) assessment showed that microcredit increased the ability of at-risk people to cope with economic hardship by increasing consumption and asset stocks during the 1998 flood in Bangladesh, but the study did not address adaptation. Becchetti and Castriota (2011) found that microloans obtained after the Sri Lankan tsunami had a positive effect on worked hours and income creation, but it does not examine whether this reduces vulnerability to future disasters. Vatsa (2005) documents that some MFIs have become involved in relief activities, such as when Bangladesh Rural Advancement Committee (BRAC) provided non-monetary support to its clients during the 1998 floods in Bangladesh, including selling rice at subsidized rates to clients and assisting severely affected clients in identifying reconstruction employment options (Pantoja, 2002), but these activities appear to be strictly coping mechanisms.

Studies that address adaptation are based largely on conceptual arguments rather than empirical evidence (e.g. Dowla, 2018; Hammill et al., 2008; Heltberg et al., 2009). According to Hammill et al. (2008) and Heltberg et al. (2009) microcredit's capacity to facilitate adaptation to climate change likely lies in its ability to enable accumulation and diversification of assets and livelihoods. However, this pathway only leads to vulnerability reduction in the long-term if it directly tackles climate change (Fenton et al., 2017). Indeed, accumulation of assets and diversification of income can increase vulnerability if the assets and income sources are not resilient to climate change.

Studies of adaptation related to empirical evidence include Agrawala and Carraro's (2010) assessment of the synergies and potential conflicts between microfinance and adaptation in Bangladesh and Nepal. Focusing at the level of MFIs, they find that microcredit can play an important role in enhancing long-term adaptation to climate shocks. But this study is not based on empirical evidence at the local level. The framed field experiment by Di Falco and Sharma (2018) in the Fiji Islands did focus at the local level. They found that having a current microloan positively influenced the intention to select climate adaptive investments which consider future income and livelihood security over short-term coping strategies. However, the analytical framework lacks clarity, complicating critical analysis of the results. Di Falco and Sharma (2018) define climate adaptive investments as those that increase resilience, but it is unclear how investment portfolios are categorized as adaptive or non-adaptive, and how adaptive investments specifically build resilience to climate change.

A recent study by Fenton et al. (2017) set in Satkhira district in southwest Bangladesh is, to the best of my knowledge, the only peer-reviewed journal article that empirically examined the role of microfinance on actual (rather than potential) adaptation outcomes at the local level. It did find evidence that microcredit supports adaptation to climate shocks. But the adaptation was incremental and may not meaningfully reduce vulnerability and may lead to maladaptive outcomes through over-indebtedness. Indeed, there are a small number of studies that provide empirical evidence on the connection of climate change to indebtedness,[4] as in the study by Zhang et al. (2018) of Inner Mongolia, which found that the cumulative impact of repayment pressure, market uncertainty, and highly variable weather often trapped pastoralists in a cycle of 'take loans, produce, repay, and then take loans again', leading to reduced herd sizes due to forced sales for repayment and/or larger loans. If borrowers become unable to repay such loans they may strain the financial sustainability of MFIs, ultimately making them irrelevant to the funding landscape. Considering the mixed evidence, the suggestion that microcredit can be used as an adaptation strategy that meaningfully addresses vulnerability to climate shocks should be thoroughly interrogated, particularly given the emerging evidence of possible links to maladaptation.

3. Research design and methods

3.1. Description of study sites

This paper is based on empirical case study research in three villages in Bangladesh. Case study village 1 is Sarikait Union in Sandwip Upazila,[5] within Chattogram[6] district in the southeastern part of the country (Figure 1). Case study village 2, Chila Union, and case study village 3, Chandpai Union, are both located in Mongla Upazila within Bagerhat district in the country's southwest (Figure 2). These sites were selected based on key informant interviews with local and national NGOs and community-based organizations. MFIs are active in all three villages, and, while the sample is not representative, the three selected are quite typical of villages in the risk-prone coastal zone, which is exposed to cyclone and storm surges, sea-level rise, salinity intrusion, and erosion (CCC, 2009). They are archetypes of places that will experience more intense manifestations of climate change over the coming decades, including an increase in extreme weather and climate events. Thus, adaptation is urgent in all three villages.

Bangladesh is the second largest microfinance market in the world, with 22 million active borrowers in 2016 (Maîtrot, 2018). By 2013, almost 60% of households in rural Bangladesh

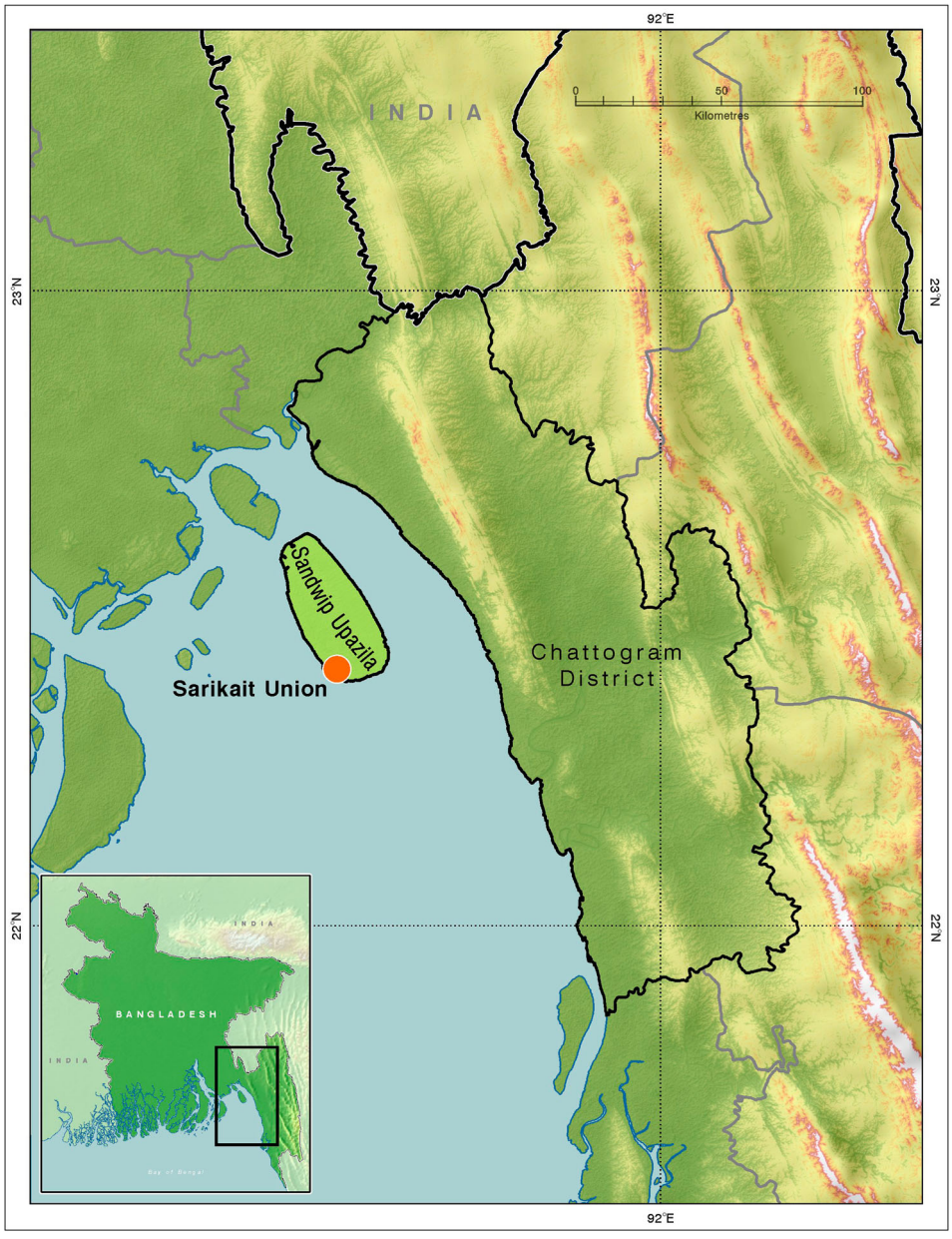

Figure 1. Location of case study village 1.

had taken microcredit at some point (Osmani, 2016). Four MFIs, Grameen, BRAC, Basic Unit for Resources and Opportunities (Buro), and the Association for Social Advancement (ASA) have provided two-thirds of microfinance supply over the last decade (Chen & Rutherford, 2013). While district-specific numbers are not available for ASA or Buro, BRAC, and Grameen Bank have provided numbers for 2012. At that time, BRAC made loans to 11,793 people (BRAC, 2015) and Grameen Bank made loans to 144,100 people (Grameen Bank, 2015) in Chattogram, where case study village 1 is located. That same year BRAC made loans to 34,516 people (BRAC, 2015) and Grameen Bank made loans to 33,599 people (Grameen Bank, 2015) in Bagerhat, where case study villages 2 and 3 are located.[7]

In interviews and focus group discussions, inhabitants of case study village 1 identified coastal erosion and cyclones as the most critical climate-related shocks they experience. While the extent to which climate change causes erosion is unclear (Gibbons & Nicholls, 2006), evidence suggests climate change will exacerbate coastal erosion, primarily due to rising sea levels but also through changes to river flow and other hydrological dynamics. Brammer (2014) estimated that 40% of Sandwip was eroded from 1984 to 2007 (see WARPO, 2002). The Upazila has also suffered from enormous cyclone damage. The most severe cyclone that hit the Upazila was Cyclone Gorky in 1991; estimates say it affected 4.5 million people in Bangladesh (Sevenhuysen, 1991), killing 139,000 people and injuring 460,000 (Haque & Blair, 1992), killing 500,000 livestock, destroying 522,000 houses and damaging 431,000 (Hillmore, 1991), and damaging crops worth US$105 million (Sevenhuysen, 1991). Overall, economic losses incurred from Cyclone Gorky have been calculated at over US$2billion (Haque & Blair, 1992). Chattogram, where case study village 1 is located, was the worst affected area (Haque & Blair, 1992).

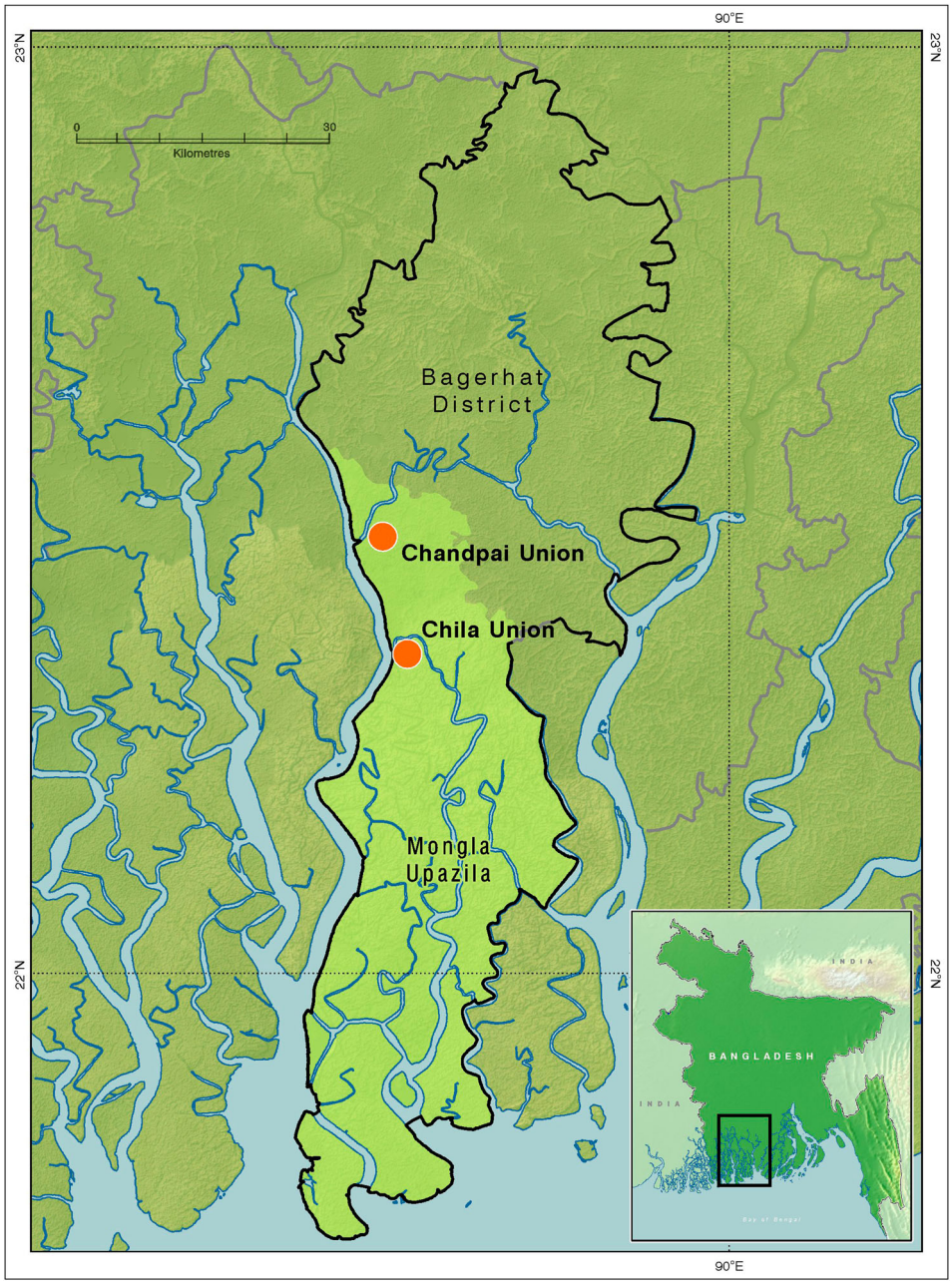

Figure 2. Location of case study villages 2 and 3.

Residents of case study villages 2 and 3 identified salinity intrusion and cyclones as the most critical climate-related shocks. There are high levels of salinity for 6 months of the year. Bagerhat has one of the highest salinity levels in the coastal districts, with a surface water salinity of 5 > 10 parts per thousand and a soil salinity of 4 > 15 parts per thousand (CCC, 2009). This has led to a range of effects on livelihoods, including loss/sickness of livestock and poultry, loss of crops, and loss of local fish species. Moreover, this reduction in fresh water supply has led to a range of health effects, including diarrheal diseases, skin diseases, and preeclampsia (see Khan et al., 2008). They have also suffered from huge cyclone damage. Estimates say that Cyclone Sidr in 2007 affected 8.5 million people in Bangladesh, killing 3406 people and 1.2 million livestock, damaging nearly 1.5 million houses, and destroying 2.4 million acres of crops (Alam et al., 2009; Government of Bangladesh, 2008). Overall, economic losses incurred from Cyclone Sidr have been calculated at US$1.7 billion (Government of Bangladesh, 2008). Bagerhat district, where case study villages 2 and 3 are located, was one of the worst affected districts, with 62.22% of the population experiencing the impact (World Food Programme, 2007).

3.2. Research methods and approach

This paper, as indicated, is based on a multi-sited case study that provides insights into past and present adaptation processes and microcredit's role in it, which may be relevant for adaptation to future climate change. Case study research was chosen because of its explanatory power and its in-depth,

real-life context, which is particularly relevant for achieving an in-depth examination of how at-risk people experience climate shocks and microcredit's impact on that in diverse, multifaceted, and complex ways (Flyvbjerg, 2006; Verschuren, 2003; Yin, 2009). This required a qualitative, textual, and interpretive approach, emphasizing context, quality, depth, richness, understanding, and prolonged engagement to build rapport and trust with participants and to reach saturation in the data (Gelo et al., 2008; Guest et al., 2006; Valentine, 2001).

A multi-method qualitative approach provided multiple lines of sight and contexts to understand complex realities and processes. The case study is based mostly on in-depth, one-to-one semi-structured interviews with 54 village inhabitants lasting approximately 2 h, and 20 gender-disaggregated focus group discussions[8] with 105 village inhabitants from the case study villages, each lasting approximately 3 h. These participants were selected through random sampling. Semi-structured interviews were also conducted with 13 key informants from the case study villages (seven informal village leaders and six informal moneylenders), lasting approximately 2 h. Key informants were randomly selected from a list of informal village leaders and moneylenders that was developed through interviews with village inhabitants during a scoping study in the three sites. Participant observation, informal conversations, transect walks, research diaries, and notes taken during interviews and focus group discussions were used to supplement the above data collection methods. In sum, this case study involved a total of 172 participants (81 females and 91 males with a mean age of 41 years). All participants provided informed verbal consent prior to participation in the study.

The semi-structured interviews and focus group discussions incorporated features of the standardized open-ended interview and the interview guide approach (see Longhurst, 2010; Patton, 1990). Although the wording and sequence of questions and associated probes were determined beforehand, the style of interviewing was flexible and adaptive, so the questions asked and the depth of responses to these questions varied between interviewees. However, each interview and focus group followed a similar overarching format, which involved discussion on the following key categories of questions: What climate-related shocks affect you? How are you impacted by these climate-related shocks? What strategies do you use to deal with these impacts? Who do you go to when you need support? What role do MFIs have in supporting you? How were these strategies financed? What effect has microcredit on your strategies for dealing with climate shocks? What was the outcome of these strategies? How has meeting debt repayments affected you? What inhabits your efforts to deal with the impacts of climate shocks? Both interviews and focus groups were conducted in Bangla, recorded with the participants' consent, transcribed in Bangla, translated verbatim to English, and were lightly edited to ensure that the meaning of interviewees' responses was not misinterpreted and that the interviewees and people they mentioned could not be identified.

3.3. Analysis

The transcripts of interviews and focus group discussions were coded manually through intensive content analysis to draw out key themes, subthemes, and patterns (Saldaña, 2016). The process of developing the coding structure was a circular, iterative process; it involved critically reading transcripts numerous times and developing and adapting codes during and after data collection (Cope, 2010). The first set of codes was developed by reading the transcripts separately, highlighting important sections and creating codes for each transcript. This stage of coding was unrestricted to 'open up' the data (Cope, 2010). These detailed codes were then developed to produce a range of broader themes; this involved rereading the transcripts one by one and then reading across transcripts within each site, looking for similarities, differences, linkages, and contradictions within the data (Jackson, 2001). This did not involve using quantitative estimates to analyse the data for two reasons, namely, to maintain narrative analysis and analytical generalizability (Yin, 2009) and to emphasize the depth of themes rather than amounts (Maxwell, 2010; Weiss, 1994). Cross-site analysis was then carried out to refine the themes and subthemes to develop representations of the data that provide an interpretation of the most significant findings. Although this paper is based on empirical findings from three different case study locations, the evidence has highlighted common patterns and challenges among the three.[9] Research diaries, notes taken during interviews and focus group discussions, and memos explaining coding processes and choices were used to support the above data analysis.

4. Results

The following sections discuss the findings. The first establishes that in relationships of exchange and reciprocity, providing monetary support, in the case study villages is a key strategy of at-risk people when responding to climate shocks. The next situates microcredit within these broader relationships of exchange and reciprocity, briefly outlining cases that highlight microcredit's potential as a response to climate shocks. The empirical evidence then highlights four key factors that influence the potential of microcredit to facilitate adaptation that effectively addresses vulnerability to climate shocks: microcredit outreach, expansion or erosion of assets, and credit supply and alternatives.

4.1. Relationships of exchange and reciprocity providing monetary support

Participants in all three villages described relationships of exchange and reciprocity that provide monetary support as a key strategy supporting at-risk people to cope with and execute incremental adaptation to climate shocks. Such relationships vary from informal credit and lending arrangements among family, friends, neighbours, colleagues, and traders to formal monetary support provided by MFIs. For example, a focus group participant in case study village 2 described the advantage of familial, kinship and neighbourhood networks thus:

> [My household] sometimes borrow[s] small amounts of money from close relatives; we do not have to pay any interest. If we borrow money from close neighbours, [the interest is] 100 tk.[10] for 1000 tk. per month [10% interest rate per month]. Sometimes we do not have to pay with interest if it is a very close neighbour.

> They give money on the condition, when I need money you will lend me money. This is for a small amount of money lent for a short period of time, maximum 1,000 tk. for one week. (#24)

While such comments suggest that access to familial, kinship and neighbourhood networks can assist people in coping with climate shocks, they also suggest that such networks do not usually have a sufficiently high level of support to facilitate adaptation. Furthermore, the poorest are unable to even access familial networks that provide monetary support with flexible lending arrangements, as another inhabitant of case study village 2 explained in an interview:

> Even if I borrow from my brother, the interest rate is the same as neighbours' rate, 100 tk. per month for 1,000 tk. [10% interest rate per month]. We cannot negotiate the interest rate. (#8)

Another weakness of informal exchange systems is that in times of covariate shocks (particularly sudden-onset shocks, like cyclones),[11] even those with greater access to exchange systems may find them unavailable, as the shock will affect their family and kin that live in the same locality, and neighbours as well. As one participant from case study village 2 explains in an interview:

> During the cyclone everyone is busy, it is chaotic. [It feels] like it comes out of nowhere, I only found out about the last cyclone a day before […]. I [can] only look after my family and myself, we cannot help others […]. There is high salinity for [several] months of the year, we know when it will come. It is tough, we cannot always help each other. (#9)

The participant did say 'we try' to help others, referencing group trips to bring water from far away during high salinity, but it is clear that cyclones can destroy or significantly disrupt livelihoods, and as at-risk people's economic capital declines, it can become more challenging to commit time and resources to familial or kinship networks.

Because of the inadequate support provided by most familial and kinship networks, the poor are often 'forced' into borrowing from informal moneylenders (known as *Mohajans*). The poorest, who lack collateral to secure such loans, are particularly vulnerable. Participants across the three villages stated that these informal credit networks use extremely high interest rates of 10%-20% and even more per month, and they typically rise to 50% or more per month during a crisis. In addition, incentives to repay can include harassment and intimidation and participants in case study villages 2 and 3 describe occasional instances of physical assault.

Microcredit has clear advantages over informal exchange systems. For example, in the case study villages, microcredit interest rates are substantially lower than those of an informal moneylender, with the majority carrying an annual percentage rate of 24% to 30%.[12] As a participant from case study village 1 stated in an interview:

> My family cannot lend me much money, so I borrow from [informal] moneylenders sometimes, but I do not like to do that because once I could not pay them back within a week and they kept the jewellery that I had given as collateral. They shout and say bad things. I prefer to borrow from BRAC; they are more flexible and understanding. (#12)

Participants' comments suggest that for a minority of at-risk people in each of the three case study villages, microcredit can support incremental adaptation to climate shocks through increasing investment in the diversification of income sources. Common activities into which livelihoods are diversified include small-scale livestock rearing, poultry, microenterprise, and migration for jobs. This has the potential to increase overall income and/or income stability for the upper-poor. This can reduce the impact of climate shocks on at-risk people's livelihoods, particularly for those that are able to diversify into economic activities less sensitive to climate shocks. It also can increase the ability of borrowers to recoup their losses from climate shocks. As one inhabitant of case study village 3 explained in an interview,

> My husband always tells me to take loans from NGOs. By getting loans, I have all [these assets]. We got a loan [from Grameen Bank] to build a stronger house; we have a shop, poultry and a motorcycle. My husband earns by driving people to far away places. We have more money now […]. I think we can deal with cyclones and other weather problems better than others, but it is hard. When a cyclone comes what will happen our shop? Will people be able to pay for goods? (#33)

Participant #33's comments highlight that microcredit can have the greatest impact on adaptation by supporting the fortification of dwellings to make them more resistant to future climate shocks, and diversification of livelihoods. However, as the participant noted, the adaptation is limited. The vulnerability of her neighbours will continue to create vulnerability for her household, as they depend on people's ability to pay for goods in the store and rides on the motorcycle. It is also the case that muddy or blocked roads following a cyclone could render it impossible to use the motorcycle to generate income.

4.2. Factors influencing adaptation outcomes

Participant #33 is from an upper-poor household, and findings suggest that only this small number of borrowers can benefit substantially from microcredit. Four key factors that limit the potential of microcredit to support adaptation to climate shocks emerged in the data.

4.2.1. Microcredit outreach

Participants' comments suggest that the poorest in the villages are less likely to join MFIs. These participants relied on informal credit because they had no access to microcredit. While informal credit is often important for coping, it has limited capacity to create increased or even secure benefits for the poor. There appears to be little potential for this strategy to even provide short-term coping for the poorest because they are often excluded from familial, kinship, or community-based support systems providing monetary support, due to limited, or no assets. As a participant in case study village 2 stated in an interview:

> We do not have anything we can use as [collateral] to get a loan from our neighbours or lenders. Our close relatives do not even give us money. Everyone knows we do not have enough food to feed ourselves. [No one] can trust us to pay them back. I have not taken a [microcredit] loan, there is no certainty that I will be able to pay the loan so I am afraid to take it. (#21)

While there is a strict repayment system for microcredit loans, and incentives to repay microloans can include the loss of membership, fines, social shame, seizure of assets, and

exclusion from future access to credit, participants' comments suggest that microloans are less predatory than loans from moneylenders, given lower interest rates, lower likelihood of harassment and intimidation, lack of physical assault, and no threat of losing collateral.

4.2.2. Expansion or erosion of assets: savings and/or indebtedness

The statements of participants across the three villages suggest that most village inhabitants use loans for non-productive purposes (e.g. buying their children's clothes). Borrowers may also take overlapping loans, using one loan to pay off another loan. While both purposes may be vital to the well-being of at-risk people, it limits the possibility that microcredit can facilitate adaptation to climate shocks.

A participant from case study village 2 said that she had taken out a loan from an informal moneylender to help her family recover after a cyclone, then used a microcredit loan to pay it back and to buy food for the family as her husband was unable to work due to sickness (#22). Her family had a duck, which represented an adaptation to climate change – chickens cannot swim and are therefore more vulnerable to climate shocks, and more expensive to house than ducks – and indeed it had survived the cyclone and the family was eating the duck's eggs. However, she resorted to borrowing food from others to save money to pay the loan instalments (known as *Kisti*). She then had to sell the duck to keep up the payments to avoid the microcredit officer seizing her assets. It seems likely that she would have had to borrow food and sell the duck earlier if she had not been able to take out the microcredit loan, and she would have been continuing to amass debt at a higher interest rate. But ultimately it had not prevented her from continuing to sell assets and reduce food consumption or default on her loan repayments, which seems likely as her income remains as uncertain and small as it was before the family took the microcredit loan.

Climate shocks cause significant depletion of at-risk people's asset base, and some study participants described losing their homes and/or land. Recovering causes reduction in savings and can increase debts, especially if households must buy land and rebuild their dwelling. As a participant from case study village 1 said in an interview:

> We become poorer because of erosion. […] It requires a lot of money to rebuild. We did not have enough money, so when our house eroded, we move a little, then again, our house eroded and then again we moved. [We] bought the land and made this [new] house two years ago. My husband took a 100,000 tk. [micro]loan. We are still paying [it back]. This house will go into water [i.e. be submerged in the body of water] after one or two years and then we [will] need 300,000 tk. to 400,000 tk. to make a new house. We do not have enough money for a safer place. How will we survive? With little earning [how] can we eat properly or send our children to school? (#8)

As Participant #8 describes, the succession of debt due to the need to rebuild after erosion makes at-risk people increasingly vulnerable, as they have never had access to sufficient capital to live in a place not vulnerable to submersion within a year or two.

A participant from case study village 3 described in an interview how her household's use of microcredit to diversify its income base had increased her family's exposure to cyclones:

> We bought 200 chickens, which cost 25,000 tk. We got a [microcredit] loan of 17,000 tk. before the cyclone to pay [for them]. During the cyclone, our poultry houses [were destroyed, and] almost all our chickens died. We took a loan of 6,000 tk. from BRAC three months after the cyclone. We used some of that money to pay for [repairing] our house and buying food. I could not get another loan, a bigger loan, until I paid that back. So I took a loan of 10,000 tk. from a moneylender in Shilabonia to help pay it back. We had to mortgage some gold ornaments [to get this money]. (#46).

Participant #46's comments highlight that her household not only lost assets that would have continued to generate an income, but that she has to pay loan instalments on the microloan taken to purchase these assets, increasing risks of loan default and increased debts. As her story illustrates, using loans to diversify livelihoods into climate sensitive activities, such as rearing chickens, increases the risk of asset loss, limiting microcredit to supporting coping.

Another participant (#52) from case study village 3 said that her household diminished its personal savings of 68,000 tk. and increased its debt by borrowing 32,000 tk. from MFIs and 50,000 tk. from a relative (albeit with no interest) to rebuild their house after the cyclone. Additionally, their overall income decreased because, while their chickens and poultry house survived, their house did not. They sold their chickens and lived in their poultry house for several months after the cyclone. Thus microcredit had helped the household cope with the shock, ultimately through the sale of the chickens, but they had no capacity to adapt and remained more vulnerable to the next shock in spite of substantial savings before the cyclone.

Many interviewees had reduced their food consumption and sold assets to help repay microloans they have taken before a climate shock. Not only did sudden-onset climate shocks temporarily lower the market price of goods, but many at-risk people had to sell assets that might have continued to generate income or food to make loan payments, such as, ducks, and in the case of an interviewee from case study village 2, a trawler (#50). This coping strategy, however vital, reduced the capacity to manage future climate shocks and can reinforce vulnerabilities, particularly for women, as an elderly widow explains:

> After the cyclone, my son sold everything he could. He had to pay the [microloan] back, but he could not manage it, so he had to get a loan from a moneylender. We have nothing left. I only get food if it is leftover. My son eats first, then my grandchildren, my daughter-in-law, then me, if there is enough. What can I do? I cannot ask my son to give me food; when he must work, he would have nothing. (#40)

Participant #40's comments draw attention to inequities in intrahousehold resource distribution, involving the allocation of food, who eats first, and who must reduce consumption when resources are scarce. The statements of participants across the three villages suggest a range of factors that influence this 'choice'; food is usually prioritized to those that are perceived as having a greater ability to increase the household's capacity to respond to shocks (i.e. usually male), whereas other household members are 'chosen to starve' (i.e. females, particularly poor elderly widows). This suggests that the

potential for families to provide significant mutual support is limited, particularly during times of shock. Given the realities of poverty, this means that 'rational' decisions on whether to extend support to family members are made in the context of limited capital assets.

4.2.3. Credit supply and alternatives

Contrary to the narrative that microcredit is particularly valuable for responding to climate shocks, microcredit's potential to support adaptation is particularly limited post-disaster, especially for sudden-onset shocks. A participant from case village 2 explained in a focus group discussion:

> The interest rate is a lot lower when [you] borrow from an NGO, but they do not give money quickly. When I need money urgently, I go to neighbours or moneylenders […]. After the cyclone it was worse: there were no loans from [MFIs] for months. I got a loan from a moneylender. They are exploiting us because of the cyclone. We have no other choice. (#15)

The disaster had created significant need, limited familial and kin-based zero or lower-interest loans, and led informal moneylenders to increase their already high interest rates to over 50% per month, but there was no access to microcredit after cyclones for about 3 months. However, some MFIs did reschedule existing loan instalments for some borrowers affected by cyclones, which ameliorated the burden on those borrowers.

5. Conclusion

This case study adds to the evidentiary foundation on the links between microcredit and adaptation by providing a nuanced understanding of how at-risk people experience climate shocks and how microcredit plays a role in it. The findings provide qualitative evidence that at-risk people who could afford to access microcredit often use it within a broader set of credit and lending arrangements, as a response to climate shocks. However, these findings establish that although microcredit can add to poor people's often complex portfolio of financial activities, in contrast to Di Falco and Sharma (2018), it only supports coping and in a small number of cases, incremental adaptation and therefore fails to offset the ongoing impacts of climate shocks in the villages. This limitation arises from the lack of outreach of microcredit, erosion of assets, supply barriers, and lack of credit alternatives.

It is unlikely that microcredit will be enough to meaningfully reduce vulnerability under current climatic conditions in the case study villages, let alone those of future climate change and indeed it may lead to maladaptation. The most evident example in this study of microcredit contributing to maladaptation is through over-indebtedness. Existing microcredit-adaptation literature has not adequately recognized over-indebtedness in microcredit or addressed the dynamics that underly this indebtedness. This is problematic as it fails to recognize that microcredit can potentially compromise the ability of at-risk people to respond to climate change and lead to lock-in effects, which can 'trap' them into sub-optimal trajectories.

The present research provides evidence of negative lock-in effects contributing to, what Juhola et al. (2016) terms, rebounding vulnerability, where at-risk people are put on a trajectory of greater risk to future climate shocks, in which shocks (some climate-related and some not) can lead to a range of detrimental outcomes: reduction in food consumption, erosion of assets, depletion of savings, increased debt (microcredit and/or informal credit), and loan default, 'trapping' at-risk people in indebtedness. In this cumulative process, a climate shock results in the depletion of at-risk people's asset base, either because the climate shock destroys the asset or they sell them in order to cope, sometimes to pay back loans. The economic costs of rebuilding assets that were destroyed by a cyclone cause reduction in at-risk people's savings and can increase debts. Because climate resilient assets can cost more than more vulnerable assets, at-risk people emerge with diminished ability to face future climate shocks.

Although a small number of studies (e.g. Fenton et al., 2017; Zhang et al., 2018) highlighted that microcredit could lead to over-indebtedness, they do not highlight informal credits complex role in this cumulative process. Most participants in the present study had relied on informal credit even if they had access to microcredit (c.f. Armendáriz de Aghion & Morduch, 2010) and the poorest had the greatest reliance on sometimes predatory informal loans. While informal credit often provides important forms of support that allow people to survive climate shocks, high interest rates (10%-50% plus per month) limit its potential to increase the resilience of those who use it, and moneylenders, who certainly always charge exorbitant rates, routinely practice harassment and intimidation to secure repayment.

The evidence in this study suggests that informal moneylending and microcredit are complementary, or at least that informal moneylending is used to 'prop up' microcredit. Some participants take out microcredit loans to pay back such informal loans to mitigate their repayment costs and avoid danger, which means they are not using microcredit for more productive purposes, including those that might support adaptation. Conversely, the findings also provide evidence that borrowers can be forced to take more expensive loans from informal moneylenders to meet repayments on microloans to avoid pressures from microcredit officers, seizure of assets, social shame, and in the hopes of ensuring access to more and larger future loans from the MFI. Such actions can lock at-risk people into sub-optimal trajectories and delay transformation, leading to rebounding vulnerability.

Shoji (2010) argues that the rescheduling of loan instalments could act as a safety net during times of shock, unlike the standard system that imposes frequent repayments on microloans. However, this study suggests that this would only partly address the burden borne by many households, particularly after dramatic and sudden shocks, as overall cash flows decline post-disaster. To the best of my knowledge, past research has not addressed the fact that post-disaster, microcredit becomes unavailable and many familial and kinship networks that might have provided informal loans or even food are drained or inaccessible because stress prevents the shoring up of such relationships (e.g. de Mel et al., 2012), but participants in the present study described taking loans from informal moneylenders charging at least 50% in interest per month due to the crisis because of this lack of options. Cyclones can deplete at-risk

people's asset base and destroy or disrupt livelihoods, leaving them without access to significant and flexible forms of monetary support Thus, at-risk people can enter a cycle of increasing debts at higher interest and loss of assets through debt default. As the cycle continues, borrowers may be unable to provide even non-traditional collateral to secure loans from informal moneylenders, further increasing the risk of defaulting on microloans taken prior to the climate shock. This may contribute to borrowers being further disfranchised by both formal and informal networks that would otherwise provide monetary and sound support in the future, a possibility that further research should examine.

Adaptation outcomes resulting in maladaptation and lock-ins make it clear that the suggestion that microcredit can be used as a strategy to enhance responses to climate change needs to be treated with caution. Microcredit should not only provide strategies that allow at-risk people to survive climate change, particularly when it involves detrimental behaviour, such as reinforcing or exacerbating gender-inequitable distribution of food within the household, but also enable them to thrive despite climate change and the uncertainty that it brings. In this context, similar to other research (Brown, 2016; Jordan, 2019; Pelling et al., 2015), adaptation requires moving towards a more radical, transformational, and power sensitive dimension that has the potential to deal with the fundamental root causes as to why people are vulnerable in the first place. Although, it is recognized that there are many barriers to implementing transformational adaptation, a failure to do so, risks further reinforcing vulnerabilities. The implication is that microcredit itself needs to adapt, there is a need for new types of credit mechanisms that can be grounded in longer-term concepts of adaptation that purposefully challenge the conditions that generate or perpetuate risk and credit mechanisms that come into force at time of acute need, particularly after dramatic and sudden climate shocks. Rather than disciplining the poor in the ways of the market, social-finance structured around preferential rates, technical support and flexible repayments can make a disproportionate impact on the lives of the most vulnerable.

Notes

1. Microcredit extends loans to individuals using social rather than material collateral.
2. The case study analyses adaptation to climate shocks – risk to human life and livelihoods – rather than climate change – future anthropogenic change in climate in either environmental or social aspects. One way to classify climate shocks is temporal: rapid-onset events and slow-onset processes. Rapid-onset events include cyclones, which are sudden and dramatic and last for a short period. By contrast, slow-onset processes include salinity intrusion and erosion, which takes place over a longer period of time but has significant impact.
3. However, sequences of incremental adjustments (if they are additive) may set in place pathways toward transformation (Rickards and Howden, 2012). Conversely, additive incremental actions can lock systems into sub-optimal trajectories and delay transformation, potentially increasing risk (Matyas and Pelling, 2015; Vermeulen et al., 2018).
4. See Schicks (2014) for an in-depth overview of over-indebtedness in microfinance.
5. An Upazila is a sub-district in Bangladesh.
6. Formerly known as Chittagong.
7. Grameen Bank made loans to 8.64% of households in Chattogram and 10.35% in Bagerhat. BRAC made loans to 0.71% of households in Chattogram and 10.63% in Bagerhat. Neither entity would clarify how their criteria led to these distinctions.
8. Female and male focus group discussions were conducted separately to encourage females to participate and express their opinions freely and openly.
9. This paper will only refer specifically to case study village 1, 2, or 3 when the evidence is specific to that particular location. Otherwise the evidence presented refers to the findings of all three of the case studies.
10. 1 British pound = 105 Bangladeshi taka.
11. Covariate shocks affect entire communities or large parts of the population at the same time (e.g. cyclones).
12. Approximately 1.82% to 2.21% monthly equivalent compound interest rate.

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