Livelihood impacts of flash floods in Cox's Bazar District, Bangladesh

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Abstract

This article aims to understand local views and understandings of livelihood impacts of flash floods, and how to tackle the challenges. The work is completed through case studies of two villages in Cox's Bazar District in south-east Bangladesh, Manirjhil and Chotojamchori. Based in theoretical understandings from disaster research of how underlying conditions rather than hazards cause disasters, this empirical study combined household surveys and participatory rural appraisal (PRA) techniques for collecting field data. The results detail local perspectives of underlying conditions—namely poverty, inequity, precarious livelihoods, and few contingency options—impacting livelihoods, especially highlighting food, water, disease, and migration, all of which link directly to livelihoods. A significant concern is the need to take out loans which can contribute to continuing poverty. Suggested strategies for dealing with flash flood impacts were based in local contexts and did not always account for broader remits, such as the deep-seated gendered nature of societal roles in Bangladesh or power and governance structures within the Bangladeshi context.

Keywords

Bangladesh, floods, livelihoods, participatory rural appraisal

Introduction

Bangladesh experiences numerous forms of floods, including storm surge from tropical cyclones, slow-rise river floods, and flash floods from intense rainfall and run-off. Drivers and impacts of flash floods in hilly regions of Bangladesh have long been studied (Brammer 1990; Islam et al. 2018; Kamal et al. 2018; Lu, Zhang, and Rahman 2018; Karim 1995). This work provides important and significant detail regarding how flash floods affect households and communities while delving into baseline reasons for adverse impacts, such as power structures (Choudhury and Haque 2016; Sultana 2010) and landscape engineering (Choudhury Paul, and Paul 2004). Flash floods are particularly common in the north-eastern and south-eastern hilly areas of the country, the latter of which includes the Arakan Mountains in the east with the Bay of Bengal to the west. ACAPS (2015) calculates that, among the deaths from flash floods in Bangladesh, 70% are due to drowning, 25% are due to snake bites, and 5% occur for other reasons which might include physical trauma and electrocution.

While some flash flood studies from Bangladesh discuss impacts on livelihoods (Rahman et al. 2018), limited empirical work exists which emerges from baseline disaster research theory focusing on underlying conditions reducing people's ability to deal with hazards including flash floods (Britton 1986; Drabek 2012; Dynes, De Marchi, and Pelanda 1987; Hewitt 1983; Hewitt 1997; Lewis 1999; Wisner et al. 2004). These underlying conditions might include power and governance structures and systems, resource and wealth distribution, inequity and discrimination, and exploitation of the environment, people, and cultures. One aspect is the state of livelihoods, typically defined as the means of making a living (Chambers and Conway 1992) or meeting

"basic needs" (Chambers 1988, p. 9), which are frequently inadequate for reducing disaster impacts, especially when people are barely able to eke out a subsistence lifestyle. Disaster-affected people might be servile or underpaid, thereby removing households' control over their own livelihoods and preventing them from enacting disaster-related measures. Exploring ever-present underlying conditions of livelihoods can help to understand better why flash floods in Bangladesh continually repeat the same adverse impacts as well as providing local perspectives of recommendations for reducing the impacts.

The lessons would be relevant for other places around the world experiencing similar adverse impacts from recurring hazards. Even where hazards or hazard parameters differ, disaster research demonstrates how baseline vulnerabilities can be the same, making case study specific lessons transferable elsewhere (Hewitt 1983; Hewitt 1997; Lewis 1999; Wisner et al. 2004). In particular, the key is examining from this foundational literature how supporting livelihoods is a disaster risk reduction measure while failure to do so induces vulnerability. As such, disasters are not necessarily unexpected, unscheduled, or unusual (Hewitt 1983), because the process of creating and then failing to absolve vulnerability (Lewis 1999) means that dynamic pressures lead in a known manner to tenuous livelihoods in dangerous locales (Wisner et al. 2004). This baseline disaster theory does not suggest that livelihoods are everything about disaster risk, but they are a necessary and substantive component regarding how people, politics, power, and the environment interact to yield or to avoid a disaster when a hazard manifests.

This research aims to analyse and recommend ways of reducing adverse livelihood impacts of flash floods based on local perspectives. The case study area is the hilly parts of south-east

Bangladesh, namely the Cox's Bazar District. Household surveys and participatory rural appraisal (PRA) techniques are combined, both of which have previously been shown to be appropriate for investigating flash floods in Bangladesh (Brammer 1990; Choudhury et al. 2004; Choudhury and Haque 2016; Karim 1995). Then, results and analysis together present livelihoods-focused data and local perspectives on flash flood impacts and on underlying conditions while interpreting the data in the context of previous literature. The concluding section presents recommendations, directs further studies, and suggests relevance beyond Bangladesh.

The case study area

Cox's Bazar, Bandarban, and Chittagong Districts (all within Chittagong Division) experience significant flash flood impacts in Bangladesh, with a long history of deaths, damage, and disruption (Choudhury et al. 2004; Choudhury and Haque 2016; Ramu Upazila 2017). Kauerkhope Union (a Union is the smallest electoral unit in Bangladesh) and Kachhapia Union in Ramu Upazila (an Upazila is a sub-district) each comprise several villages which have been severely affected by flash floods and which were seeking external help to deal with the impacts.

Manirjhil village from Kauerkhope Union and Chotojamchori village from Kachhapia Union were selected as case studies for this research (Figure 1). These two villages were selected based on their flash flood history and potential through reconnaissance surveying, discussions with the residents, verification of literature, and observations of the severity of flash flood impacts. The communities also had to be interested in and supportive of the work being completed.

Figure 1 about here.

Manirjhil (21°25'11.09"N and 92°8'4.38"E; Figure 1b) is situated on the banks of the Bakkhali River which originates in Myanmar (Burma), flows through the Bandarban Hill Tract, and becomes a major flash flood channel in Kauerkhope Union. This river divides Manirjhil into two parts: Uttar Manirjhil and Modho Manirjhil for which part of the latter is the focus of the research here (the red-bordered area in Figure 1b). The case study is surrounded by Uttar Manirjhil to the north, Naikhongchari Upazila to the east, Sonaichari Upazila to the south, and Umkhia to the west. After a flash flood, the village typically remains inundated for 5-12 hours, although sometimes for up to a day. Devastating and fatal flash floods impacted this area in 1988, 1992, 1998, 2012 and 2015. Water levels rose to about 2.1-2.4 metres and led to significant agricultural and infrastructure damage, with many people evacuating to the hills.

Chotojamchori (21°25'45.67"N and 92°12'14.78"E; Figure 1c) is situated near the Naikongchori Hill Tract with the Bakkhali River running through it and with Garjania and a Bakkhali River branch to the north, Duchari Union to the east, Sonaichari Upazila to the south, and Naikhongchari Sadar Union to the west. The village is on relatively high ground, so flash floods tend to proceed rapidly through it. As with Manirjhil, heavy rainfall in Myanmar (Burma) or the Bandarban Hill Tract can lead to a large amount of water passing through, such in 1988, 1992, 1998, 2012 and 2015. The water tends to rise about 1.5-1.8 metres and at least three people around the area drowned during flash floods in 2012. Agriculture and infrastructure experience extensive damage, with people evacuating to adjacent hilly regions.

Methodology

Household questionnaires contribute to producing mainly quantitative results, whereas participatory rural appraisal (PRA) is useful for obtaining and interpreting principally qualitative data, each technique with its own limitations (Bryman 2016; Shaffer 2013). PRA is a suite of evaluative methods and tools for assessing group and community resources, identifying and prioritising problems, and proposing and appraising strategies for solving these problems (Chambers 1994). While noting PRA's long-standing critics and responses to the criticisms (Cornwall and Pratt 2011; Leurs 1996; Mosse 1994), its tools are useful for adopting a strong livelihoods basis (Chambers and Conway 1992; Chambers 1995), allowing participants to share their experiences about hazard impacts and to establish priorities for improving difficult situations (Ahmed and Kelman 2018; Bar-On and Prinsen 1999; Pretty 1995).

People from outside the communities participate as facilitators and provide logistics and advice on how to run the exercises and how to prepare the PRA diagrams and maps, but they do not control the process. Instead, people from the communities lead the techniques, whereas household surveys tend to be controlled, led, and organised by outsiders (Bryman 2016). To overcome each technique's limitations and legitimate critiques (Bryman 2016; Cooke and Kothari 2001; Cornwall and Pratt 2011; Leurs 1996; Mosse 1994; Pretty 1995; Shaffer 2013), a mixed methods research approach combining household surveys and PRA was applied in the case studies. The respondents were surveyed anonymously following institutional ethics approval (UCL ethics project ID: 10295/001).

The household survey was administered from 13-16 July 2017 by a 14-member team comprising four women and ten men who approached all 132 households across both villages. Some residents declined to participate due to lack of time or interest, yielding a total of 41 respondents from Manirjhil and 72 respondents from Chotojamchori village who were surveyed—an overall response rate of 85.6% (Table 1). Table 1 indicates representativeness of the sample (79% and 90% respondents, respectively for Manirjhil and Chotojamchori) with the data obtained at household rather than individual level. The household questionnaire listed 78 questions mixing tick-box and open-ended questions in nine sections covering general household information, livelihoods, health and sanitation, food and nutrition, water, migration, gender, flash flood experiences, and actions regarding flash floods.

Table 1 about here.

Then, for the PRA techniques, nine team members worked as facilitators in each case study, recruiting local villagers to be participants as volunteers from 20-26 July 2017. In Manirjhil, 21 people participated of whom seven are female and fourteen are male. In Chotojamchori, twelve people participated of whom three are female and nine are male. Whereas the surveys focused on households in order to better understand opportunities and challenges at that scale, PRA techniques complement the household approach by determining more collective or community perspectives (Chambers 1994; Kumar 2002), which here are from adults publicly discussing the material and their ideas, while recognising the inherent power relations which occur in any group, consultative, and community setting (Cooke and Kothari 2001; Pretty 1995; Titz et al.

2018). Due to this study's focus on livelihoods impacts of flash floods, the PRA techniques reported here are those most relevant for livelihoods: resource maps, flood severity matrices, seasonal diagrams, impact diagrams, and dream maps (Ahmed and Kelman 2018; Kumar 2002).

The PRA data were obtained through exercises run during a day-long participatory workshop in each location during which all PRA diagrams were newly prepared by the participants with all materials provided by the project team. First, the participants were asked to draw a resource map and seasonal diagram of their village. Resource maps depict natural resources, housing patterns, important buildings such as religious and health centres, land use types, transportation networks, and other infrastructure identified as being important by the participants. Resource maps are useful for identifying views about natural assets, accessible infrastructure, and services available within a community, here especially for dealing with flash floods. A seasonal diagram helps to understand livelihood patterns, economic opportunities, and people's coping mechanisms during different seasons. As a balance, the resource maps provide principally spatial information while the seasonal diagrams provide mainly temporal information. Both maps were drawn by the workshop participants while the PRA team members watched without actively participating.

The next PRA-based exercise was trend analysis to explore temporal dimensions focusing on changes and trends related to variables covering flash flood experiences and actions. For the work here, a flash flood severity matrix as a form of trend analysis was developed by asking participants to list historical flash floods and to identify a set of impact criteria. For a set of criteria for each flash flood they identified, they assigned a score of between zero and five, with five representing a high impact and zero representing no impact. From these numbers, impact

diagrams were used to identify and depict flash flood impacts (positive or negative) as a flowchart, helping to explain and detail both the direct and indirect impacts at different levels, and the links among different impacts.

The final activity was developing dream maps. Dream maps within PRA depict the future in terms of participants' aspirations, generally indicating the aspects which people would seek to have and the changes that they would want to have from the present, here focusing on reducing the livelihoods impacts of flash flooding in their communities. To prepare the dream map, participants were asked to look at their resource map and to draw a new map of their desired future situation in which flash floods and their other socio-economic concerns would be addressed. For all maps, the original sheets were collected from the participants and digitised, retaining the original shape and size. They could then be returned to the participants so that they could use their own material while also being analysed and presented as data, as completed in this paper.

Results and discussion: Underlying conditions

Basic data from the household surveys are provided in Table 2. In the case study region, households earning less than BDT 12,000 (BDT represents the Bangladeshi Taka with 1 BDT ≈ 0.0125 USD at the time of the research reported here) per month are considered to live below the poverty line (BBS 2017). Most families in Manirjhil (72%) and in Chotojamchori (79%) are extremely poor (Table 2).

Table 2 about here.

Not everyone can afford to take a loan or wants to. In Manirjhil, 39% of lenders, and in Chotojamchori, almost 27% of lenders—including banks, microcredit organizations, and NGOs—charge more than 25% interest rate per year, leading to debt which is difficult to escape. Table 3 indicates the diversity of reasons for taking loans, including for basic necessities on many occasions. In Chotojamchori, the need for food-related loans is evident, showing the level of poverty of the community and hence the challenges of storing food before a disaster in order to have it available during times of disaster. When people cannot afford to feed themselves each day, setting aside extra is not possible because there is no extra available.

Table 3 about here.

Livelihood interruption and income decreases during flash floods were noted in the household survey in both case studies. Inundation means that customers cannot reach service-related industries while people cannot get to their jobs, such as in the fields. Instead, they sit at home without receiving the day's wages. This interruption is common and devastating, meaning less food and often having to use the small amounts of any stored assets to survive.

Not all aspects of livelihoods (including the economy) are cash-related. Household surveys cannot always capture the full range of bartering, exchanges of time and skills, neighbourly assistance, and gifts. Additionally, gender distribution between cash and non-cash aspects of livelihoods are not always clear. In both case studies, the household survey results indicated that

few families allow women to take part in earning significant cash income (28% in Manirjhil and 20% in Chotojamchori). It was unclear, though, the extent to which women are involved in the non-cash economy or how their knowledge, skills, networks, and contributions to their household might or might not influence the household's or village's underlying conditions.

For the resource maps, participants identified clinics, community centres (none in Chotojamchori), education centres, religious centres, roads, ponds for Manirjhil and one pond and the river channel for Chotojamchori, low-lying land, water sources, and sanitation. Most households in each case study have latrines (92.7% in Manirjhil and 94% in Chotojamchori), while the rest tend to use open defecation without any specific place. Neither community has a specific playground for the children, so they typically play in the low-lying areas. Manirjhil's map notes a few small green tobacco processing units around the community for earning money (Figure 2). Chotojamchori's map notes that some people have cattle and livestock in or around their houses. Residential houses are situated along the road with a big agricultural zone in the southern and lower part of the village (Figure 3).

Figure 2 about here.

Figure 3 about here.

The seasonal diagrams (Tables 4 and 5) indicate the prevalence across both case studies of resources and livelihoods outside the rainy season of June-August and their inhibition during it, mainly due to flash floods. December-February are good months, with food and employment

available due to the harvest and neither disease nor migration being extensive. Conversely, from June-August, people often indicate that they would want to migrate to seek employment, but they cannot because floods interfere with transportation. Migration is also sought to avoid the diseases which come with flash floods, including diarrhoea, dysentery, malaria, and typhoid. Those in Chotojamchori who can migrate tend to head to the hills where they can cultivate some crops, although wild elephant herds can attack people and destroy agricultural and fruit crops such as banana and jackfruit.

The temporal delineation of food shortages further indicates how flash floods undermine this baseline. Even when the monsoon begins during the March-May period, food is not a major concern despite some difficulties with employment, disease (mainly diarrhoea and dysentery), and seed damage due to flooded fields. After the flash floods, the dry season starts and progresses September-December. Food shortages continue, because the flash flood undermined basic living conditions. The people, at least, can start getting back to work and disease is not so much of a concern, so people are less inclined to migrate.

Table 4 about here.

Table 5 about here.

Results and discussion: Flash flood impacts

The underlying conditions demonstrated in the previous section indicate that the people in the case studies start out with chronically precarious livelihoods and with few contingency options. Now, flash flood impacts can be explored, of which the PRA methods particularly highlighted food, water, and evacuation. Most of the respondents (90% in Manirjhil and 83% in Chotojamchori) said that food scarcity is a major problem during and after flash floods. The same figures for water are 73% in Manirjhil and 87% in Chotojamchori, often because the flood overtops a tube well, contaminating the water in it.

Food is highlighted in Table 6 as being one of the most frequently described flash flood impacts in Manirjhil and Chotojamchori alongside houses being damaged. Livelihood impacts are further emphasised through the high frequency of economic loss and loss of cattle. The historical flash flood severity matrices (Tables 7 and 8) cover the years which the participants mentioned as being floods they remember and they identify water shortage as a problem. Food shortages and starvation are consistently rated as being amongst the worst flash flood impacts, followed by livelihoods and water scarcity, the latter of which is also linked to disease being identified as a major concern. Table 9 indicates how the people cope with post flash flood food and water shortages.

Table 6 about here.

Table 7 about here.

Table 8 about here.

Table 9 about here.

The impact diagram provides further details regarding flash flood impacts on livelihoods. The identified impacts were almost identical in the two case studies, so a combined impact diagram was produced (Figure 4). The immediate loss of agricultural land leads to less employment and increased food scarcity, so that affected people often take up loans with high interest rates. Paying off loans can require selling assets and property, diminishing further livelihood prospects and leading to continuing poverty. If forced to sell cattle, then cultivation becomes more challenging and livelihood diversity decreases. Lack of clean water due to flood-related contamination and subsequent diseases were also concerns (Figure 4).

Figure 4 about here.

Infrastructure damage is listed as an impact. Chotojamchori has 94% semi-manufactured houses (masonry with a corrugated iron sheet roof) which experience a lot of flood damage, leaving people homeless. Damage to roads inhibits transportation. Some immediate responses to a flash flood include evacuating temporarily to the high hills or school premises (93% in Manirjhil and 92% in Chotojamchori) if the water level is above about 2 metres. If the inundation lasts for longer than a day, longer-term migration might result when people who are seeking improved livelihoods move to larger cities, often ending up in informal settlements. In many cases, health-related problems including death are one final outcome in the impact diagram (Figure 4), but it was not identified as the most pressing concern in either Manirjhil or Chotojamchori.

Strategies for dealing with flash flood impacts

Based on discussion around developing and interpreting the dream maps (Figures 5 and 6), participants provided specific recommendations which they suggest would reduce the adverse livelihoods impacts from flash floods.

Figure 5 about here.

Figure 6 about here.

In Manirjhil, the flash floods flow down via a branch of the Bakkhali River coming through the Sonaichori Hill Tract. To avoid the flow entering the village, building a dam was suggested for channelizing the river's flow along with dredging the river channels and widening the channel to take extra water. Similarly, Chotojamchori suggested building an embankment, dredging, and widening the channel, with particular concern expressed about the mud which comes with flash floods.

These measures could support the reduction of flash flood flow into the village, but would not solve all the flash flood hazard or risk problems. Any measures would have a limit to how much water they could divert from the villages. If the people would not realise that they could still be flooded, then they might assume they are entirely safe, take fewer flood risk reduction measures, and thus experience more damage in future flash floods. This phenomenon has been documented

around the world (Criss and Shock 2001; Etkin 1999; Fordham 1999; Tobin 1995) including for Bangladesh (Choudhury et al. 2004; Smith and Frankenberger 2018), so it would be important to ensure that any structural measures taken would not cause more problems than they solve.

Other examples of structural approaches suggested for Manirjhil were constructing two bridges, one at the entrance to the village and another at the connecting point of the Naikhongchori Road. These bridges would help for accessing the community and thus for bringing goods and materials in and out. Manirjhil and Chotojamchori each asked for a two-storey shelter outside the floodable zone for use during flash floods, for people to stay on the top floor and to use the ground floor for cattle for protecting livelihood assets. Gender-differentiated shelters were not mentioned. Both villages also requested a storehouse of food to be stocked prior to the rainy season and then used for alleviating food shortages during floods. This suggestion assumes that the food would not rot, become contaminated, be stolen, or be vandalised, and that the storehouse would be maintained.

Similar assumptions were made regarding recommendations for other infrastructural changes, such as both case studies requesting that houses be built with more concrete and less brick. As well, internal roads should use more durable materials. If the materials and expertise required for such houses and roads are not available locally, then materials and maintenance costs could increase along with dependence on external support. Further consideration would have to be given to how the climate and vegetation would impact these materials. If not built with proper ventilation, then concrete structures can heat up in the summer. Meanwhile, improved roads through a village lead to faster drivers which can be dangerous to children and animals.

Raising all buildings to be above the height of flash floods was another possibility noted. This approach could help for floods, but if the soil becomes eroded and undermined, then the entire structure might collapse rather than just being inundated. For Chotojamchori, the concern is not only inundation, but also mud which takes time to clean up afterwards. The potential for earthquakes across the region (Steckler et al. 2016) needs to be considered. Even if flash flood risk is reduced by raising land, then risks to other environmental hazards could be augmented.

The requests from both dream maps (Figures 5 and 6) focused on many fundamentals of day-to-day living. To tackle disease and to improve the quality of life, another community health clinic, an emergency health treatment program, a community club or centre, additional shops to avoid the trek to local markets, a tube well for every household, and a personal sanitary latrine for every household were requested. A healthier population and less time spent walking to and from water collection points can provide more time for livelihood opportunities. The Chotojamchori dream map (Figure 6) highlighted the low literacy rate. Suggestions included local government programmes to assist people with health, sanitation, and hygiene advice along with a much cheaper bus fare for the local public transportation system, given Chotojamchori's remoteness from the Ramu Upazila. Government intervention to improve electricity access in Chotojamchori was on their list, especially increasing solar generation options.

Quandaries then might manifest that increased water use has the potential to decrease the supply while increased commercialisation or market access could shift to a more cash-based economy. The latter is not necessarily detrimental but could shift livelihood interests as well as

dependencies. Other solutions proposed in both places could help to overcome some of these potential concerns. Emphasis was placed on a rainwater harvesting plant to increase drinking water supplies. Diverse livelihoods were sought. Both men and women indicated that women could develop 'cottage industries' including handicrafts and pottery, described as supporting the women to become more independent in their livelihoods and living. Advanced poultry farming and agricultural systems using external advice were desired and were suggested as bringing increased livelihoods stability.

For Chotojamchori (Figure 6), a tobacco processing unit was desired to provide livelihood options given that the adjacent area of Garjania (Figure 1c) has numerous tobacco fields but no nearby processing centre. While this is a creative use of local industry to help with livelihoods and to build up cash savings, there are obvious health risks from tobacco (WHO 2015). Tobacco has long been raised as being problematic in Bangladesh (Cohen 1981) including tobacco expenditure exacerbating poverty (Efroymson et al. 2001). Yet the findings here corroborate Ray-Bennett et al.'s (2010) health security analysis in the context of dealing with disasters in Bangladesh, indicating the dependence of some groups on tobacco for livelihoods without acknowledging the risks created by tobacco.

Finally, loans at subsidised rates after a disaster were put forward for both case studies in order to help people recover from a flash flood. This recommendation did not extend to having reasonable interest rates for loans all the time. Part of the underlying conditions which cause problems in flash floods were indicated as being poor access to credit and a debt cycle due to high interest rates. Conversely, discouraging loans by using high interest rates can be positive in

terms of encouraging people not to get into debt, but instead to slowly build up assets and contingency funds rather than risking bankruptcy. Finance programmes tested elsewhere, and lessons from them including their transferability, could assist in determining the advantages and disadvantages of post-flash flood loan programmes. For instance, non-profit loans, microcredit, and other microfinance initiatives (e.g. Mia 2016) alongside microinsurance and creative flood-related insurance approaches (e.g. Clarke and Kumar 2016; Crichton 2008; Yore and Faure Walker 2019), could be considered for the specific contexts of Manirjhil and Chotojamchori.

Conclusion and future studies

Flash floods have a regular and severe impact on villages around Bangladesh and places around the world. For flash floods in Bangladesh, limited previous empirical work emerges from baseline disaster research theory focusing on underlying conditions which lead to difficulties in people reducing their own adverse flash flood impacts on livelihoods. Through household surveys and PRA in the Bangladeshi villages of Manirjhil and Chotojamchori, Cox's Bazar District, livelihood-based underlying conditions were examined. This work indicated how and why adverse flash flood impacts are perceived to arise while considering recommendations from local perspectives to improve the situation.

The work here matches well with disaster literature in the context of development (Britton 1986; Hewitt 1983; Hewitt 1997; Lewis 1999; Wisner et al. 2004) which highlights underlying conditions, rather than a hazard such as a flash flood, as leading to disaster impacts witnessed. Much of this work (with examples for Bangladesh being Cannon 2002; Brouwer et al. 2007; and

Choudhury and Haque 2016) emphasises how wide-scale, deep-seated influences, such as power structures and governance, tend to place people in challenging day-to-day and season-to-season situations. These situations remove options for addressing the challenges faced when experiencing a hazard like a flash flood.

In the work here, neither the household surveys nor PRA raised, detailed, or integrated these broader contexts and issues which leave the people with insufficient livelihoods and inadequate livelihood choices long before a flash flood occurs. Instead, the approaches here succeeded at their purpose which was to determine local views and understandings of livelihood impacts of flash floods in Cox's Bazar District, Bangladesh. The approaches here did not express the deep-seated gendered nature of societal roles in Bangladesh (Cannon 2002; Sultana 2010) or interrogate prominent topics such as corruption-created disasters (Khan 2003; Lewis 2011) for the Bangladeshi context. Future studies should examine how community-based techniques might better identify the absence of such wider considerations and fill in any gaps, while seeking to overcome selection bias and response bias.

Consequently, a lesson for Bangladesh and beyond is that top-down and bottom-up approaches need to be combined to include all contributing factors. Top-down approaches refer to actions coming from outside the two villages, which might be regional authorities, the Bangladeshi government, external non-governmental or private sector organisations, or aid-driven work. Bottom-up approaches refer to initiatives starting from people in the villages, such as the suggestions provided through this research. Neither local perspectives nor non-local suggestions should be denigrated, nor should either presume to cover all considerations. Previous top-down

analyses at various scales about governance (e.g. Quarantelli 1988), conflict (e.g. Quarantelli and Dynes 1976), poverty (e.g. Fothergill and Peek 2004), and development (e.g. Crush 1995) could better inform disaster-related contexts, being aware that not all aspects might apply for all situations. These points refer to other case studies and literature informing Bangladesh.

Thus, the work here informs studies beyond Bangladesh and the wider literature in two main ways. First, by indicating the importance of linking topics beyond strict disaster risk, namely livelihoods and underlying conditions, to how people view and respond to disaster and other risks. Second, the possible limitations of community-based development research techniques in terms of not necessarily capturing wider and deeper issues. The work presented here has yielded insights into, and therefore advanced knowledge of, livelihood impacts of flash floods and how to prevent difficulties. For Bangladesh and elsewhere, any interventions would need to take account of wider and deeper background and contexts, especially beyond the local level, to ensure that they would succeed.

References

ACAPS. 2015. *Flash Floods in Cox's Bazar, Bandarban and Chittagong Districts June-July 2015*. Dhaka: Government of Bangladesh.

Ahmed, Bayes and Ilan Kelman. 2018. "Measuring Community Vulnerability to Environmental Hazards: A Method for Combining Quantitative and Qualitative Data." *Natural Hazards Review*, 19(3): 04018008.

519 Bar-On, Arnon A. and Gerard Prinsen. 1999. “Planning, Communities and Empowerment: An
520 Introduction to Participatory Rural Appraisal.” *International Social Work* 42(3): 277-294.
521 BBS. 2017. *Preliminary Report on Household Income and Expenditure Survey 2016*. Dhaka:
522 Bangladesh Bureau of Statistics (BBS), Statistics and Informatics Division Ministry of
523 Planning.
524 Brammer, H. 1990. “Floods in Bangladesh: Geographical Background to the 1987 and 1988
525 Floods.” *The Geographical Journal* 156(1): 12-22.
526 Britton, Neil. 1986. “Developing an Understanding of Disaster.” *Journal of Sociology* 22(2):
527 254-271.
528 Brouwer, Roy, Sonia Akter, Luke Brander, and Enamul Haque. 2007. “Socioeconomic
529 Vulnerability and Adaptation to Environmental Risk: A Case Study of Climate Change and
530 Flooding in Bangladesh.” *Risk Analysis* 27(2): 313-326.
531 Bryman, A. 2016. *Social Research Methods*. Oxford: Oxford University Press.
532 Cannon, Terry. 2002. “Gender and Climate Hazards in Bangladesh.” *Gender and Development*
533 10(2): 45-50.
534 Chambers, Robert. 1988. *Sustainable Livelihoods, Environment and Development: Putting Poor*
535 *Rural People First*. Discussion Paper 240. University of Sussex, Brighton: Institute of
536 Development Studies.
537 ----. 1994. “The Origins and Practice of Participatory Rural Appraisal.” *World*
538 *Development* 22(7): 953-969.
539 ----. 1995. “Poverty and Livelihoods: Whose Reality Counts?” *Environment and Urbanization*
540 7(1): 173-204.

---- and Gordon R. Conway. 1992. *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century*. Discussion Paper 296. University of Sussex, Brighton: Institute of Development Studies.

Choudhury, Mahed-Ul-Islam and C. Emdad Haque. 2016. "'We Are More Scared of the Power Elites Than the Floods': Adaptive Capacity and Resilience of Wetland Community to Flash Flood Disasters in Bangladesh." *International Journal of Disaster Risk Reduction* 19: 145-158.

Choudhury, Nusha Yamina, Alak Paul, and Bimal Kanti Paul. 2004. "Impact of Costal [sic] Embankment on the Flash Flood in Bangladesh: A Case Study." *Applied Geography* 24(3): 241-258.

Clarke, Daniel J. and Neha Kumar. 2016. "Microinsurance Decisions: Gendered Evidence from Rural Bangladesh." *Gender, Technology and Development* 20(2): 218-241.

Cohen, Nicholas. 1981. "Smoking, Health, and Survival: Prospects in Bangladesh." *The Lancet* 317(8229): 1090-1093.

Cooke, Bill and Uma Kothari (eds.). 2001. *Participation: The New Tyranny?* London: Zed Books.

Cornwall, Andrea and Garett Pratt. 2011. "The Use and Abuse of Participatory Rural Appraisal: Reflections From Practice." *Agriculture and Human Values* 28(2): 263-272.

Crichton, David. 2008. "Role of Insurance in Reducing Flood Risk." *The Geneva Papers on Risk and Insurance* 3: 117-132.

Criss, Robert E. and Everett L. Shock. 2001. "Flood Enhancement Through Flood Control." *Geology* 29(10): 875-878.

Crush, Jonathan (ed.). 1995. *Power of development*. London: Routledge.

564 Drabek, Thomas E. 2012. *Human System Responses to Disaster: An Inventory of Sociological*
565 *Findings*. New York, NY: Springer-Verlag.
566 Dynes, Russell R., Bruna De Marchi, Carlo Pelanda (eds.). 1987. *Sociology of Disasters:*
567 *Contribution of Sociology to Disaster Research*. Milan: Franco Angeli.
568 Efroymson, Debra, Saifuddin Ahmed, Joy Townsend, Syed Mahbubul Alam, Amit Ranjan Dey,
569 Ranjit Saha, Biplob Dhar, Aminul Islam Sujon, Kayum Uddin Ahmed, and Oliur Rahman.
570 2001. "Hungry for Tobacco: an Analysis of the Economic Impact of Tobacco Consumption
571 on the Poor in Bangladesh." *BMJ Tobacco Control* 10: 212-217.
572 Etkin, David. 1999. "Risk Transference and Related Trends: Driving Forces Towards More
573 Mega-Disasters." *Environmental Hazards* 1: 69-75.
574 Fordham, Maureen. 1999. "Participatory Planning for Flood Mitigation: Models and
575 Approaches." *Australian Journal of Emergency Management* 13(4): 27-34.
576 Fothergill, Alice and Lori A. Peek. 2004. "Poverty and Disasters in the United States: A Review
577 of Recent Sociological Findings." *Natural Hazards* 32(1): 89-110.
578 Hewitt, Ken (ed.). 1983. *Interpretations of Calamity from the Viewpoint of Human Ecology*.
579 London: Allen & Unwin.
580 ----. 1997. *Regions of Risk: A Geographical Introduction to Disasters*. Essex: Addison Wesley
581 Longman.
582 Islam, Mir Rabiul, Valerie Ingham, John Hicks, and Elaine Kelly. 2018. "From coping to
583 adaptation: Flooding and the role of local knowledge in Bangladesh." *International*
584 *Journal of Disaster Risk Reduction* 28: 531-538.
585 Kamal, A.S.M. Maksud, Mohammad Shamsudduha, Bayes Ahmed, S.M. Kamrul Hassan, Md.
586 Shahidul Islam, Ilan Kelman, and Maureen Fordham. 2018. "Resilience to flash floods in

wetland communities of northeastern Bangladesh." *International Journal of Disaster Risk Reduction* 31: 478-488.

Karim, Nehal. 1995. "Disasters in Bangladesh." *Natural Hazards* 11(3): 247-258.

Khan, Mohammad Mohabbat. 2003. "State of Governance in Bangladesh." *The Round Table* 92(370): 391-405.

Kumar, Somesh. 2002. *Methods of Community Participation: A Complete Guide for Practitioners*. London: ITDG Publishing.

Leurs, Robert. 1996. "Current challenges facing participatory rural appraisal." *Public Administration and Development* 16(1): 57-72.

Lewis, James. 1999. *Development in Disaster-prone Places: Studies of Vulnerability*. London: Intermediate Technology Publications.

----. 2011. "Corruption: The Hidden Perpetrator of Under-Development and Vulnerability to Natural Hazards and Disasters." *Jàmbá* 3(2): 464-475.

Lu, Qing-Chang, Junyi Zhang, and Sertajur Rahman. 2018. "Location choice behavior adapting to flood and cyclone hazards." *International Journal of Disaster Risk Reduction* 27: 189-198.

Mia, Md Aslam. 2016. "Microfinance Institutions and Legal Status: An Overview of the Microfinance Sector in Bangladesh." *Journal of Asian Finance, Economics and Business* 3(2): 21-31.

Mosse, David. 1994. "Authority, Gender and Knowledge: Theoretical Reflections on the Practice of Participatory Rural Appraisal." *Development and Change* 25(3): 497-526.

Pretty, Jules N. 1995. "Participatory Learning for Sustainable Agriculture." *World Development* 23(8): 1247-1263.

610 Quarantelli, Enrico L. 1988. “Disaster Crisis Management: A Summary of Research Findings.”
611 *Journal of Management Studies* 25(4): 373-385.
612 Quarantelli, Enrico L. and Russell R. Dynes. 1976. “Community Conflict: Its Absence and Its
613 Presence in Natural Disasters.” *Mass Emergencies* 1: 139-152.
614 Rahman, H.M. Tuihedur, Md. Ekhlas Mia, James D. Ford, Brian E. Robinson, and Gordon M.
615 Hickey. 2018. “Livelihood exposure to climatic stresses in the north-eastern floodplains of
616 Bangladesh.” *Land Use Policy* 79: 199-214.
617 Ramu Upazila. 2017. *Upazila Nirbahi Officer Ramu (D form).* Cox’s Bazar: Ramu Upazila.
618 Ray-Bennett, Nibedita S., Andrew Collins, Abbas Bhuiya, Ross Edgeworth, Papreen Nahar, and
619 Fariba Alamgir. 2010. “Exploring the meaning of health security for disaster resilience
620 through people’s perspectives in Bangladesh.” *Health & Place* 16(3): 581-589.
621 Shaffer, P. 2013. *Q-Squared: Combining Qualitative and Quantitative Approaches in Poverty*
622 *Analysis*. Oxford: Oxford University Press.
623 Smith, Lisa C. and Timothy R. Frankenberger. 2018. “Does resilience capacity reduce the
624 negative impact of shocks on household food security? Evidence from the 2014 floods in
625 Northern Bangladesh.” *World Development*,102: 358-376.
626 Steckler, Michael S., Dhiman Ranjan Mondal, Syed Humayun Akhter, Leonardo Seeber, Lujia
627 Feng, Jonathan Gale, Emma M. Hill, and Michael Howe. 2016. “Locked and Loading
628 Megathrust Linked to Active Subduction Beneath the Indo-Burman Ranges.” *Nature*
629 *Geoscience* 9: 615-618.
630 Sultana, Farhana. 2010. “Living in Hazardous Waterscapes: Gendered Vulnerabilities and
631 Experiences of Floods and Disasters.” *Environmental Hazards* 9(1): 43-53.

Titz, Alexandra, Terry Cannon, and Fred Krüger. 2018. “Uncovering ‘Community’: Challenging an Elusive Concept in Development and Disaster Related Work.” *Societies* 8: article 71.

Tobin, Graham A. 1995. “The Levee Love Affair: A Stormy Relationship.” *Water Resources Bulletin* 31(3): 359-367.

WHO. 2015. *WHO Global Report on Trends in Prevalence of Tobacco Smoking*. Geneva: WHO (World Health Organization).

Wisner, Ben, Piers Blaikie, Terry Cannon, and Ian Davis. 2004. *At Risk: Natural Hazards, People’s Vulnerability and Disasters*, 2nd ed. London: Routledge.

Yore, R. and J. Faure Walker. 2019. “Microinsurance for disaster recovery: Business venture or humanitarian intervention? An analysis of potential success and failure factors of microinsurance case studies”. *International Journal of Disaster Risk Reduction* 33: 16-32.

644 Table 1: Households completing the questionnaire

Village	Total households	Number of respondents	Female respondents	Male respondents
Manirjhil	52	41 (79%)	21 (51%)	20 (49%)
Chotojamchori	80	72 (90%)	48 (67%)	24 (33%)

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647 Table 2: Basic data from the household surveys

Data category	Response category	Manirjhil	Chotojamchori
Age range	Youth (18-24 years)	17%	10%
	Primary working (25-54 years)	66%	69%
	Mature working (55-64 years)	7%	6%
	Elderly (65 years or older)	10%	15%
Formal education	Limited formal education	25%	47%
	Primary	46%	28%
	Secondary	17%	14%
	Higher secondary	5%	8%
	Graduate	7%	3%
Income source (more than one answer is permitted, so the totals exceed 100%)	Agriculture	46%	39%
	Service	24%	6%
	Business	12%	10%
	Day labour	15%	32%
	Other (Boat handler, tailor, rickshaw puller)	20%	15%
Income range in BDT per month	Up to 3,000	0%	0%
	3,000-6,000 with 1 earner	24%	33%
	3,000-6,000 with 2 earners	0%	1%
	6,001-9,000 with 1 earner	24%	20%
	6,001-9,000 with 2 earners	5%	3%

	6,001-9,000 with 3 earners	3%	0%
	9,001-12,000 with 1 earner	16%	16%
	9,001-12,000 with 2 earners	0%	5%
	9,001-12,000 with 3 earners	0%	1%
	12,001-15,000 with 1 earner	5%	6%
	12001-15,000 with 2 earners	0%	3%
	12,001-15,000 with 3 earners	0%	1%
	15,001-18,000 with 1 earner	3%	0%
	15,001-18,000 with 2 earners	0%	3%
	15,001-18,000 with 3 earners	0%	0%
	Over 18,000 with 1 earner	14%	0%
	Over 18,000 with 2 earners	3%	3%
	Over 18,000 with 3 earners	3%	5%

Table 3: Reasons for taking a loan

(Totals do not add up to 100% due to rounding.)

Reason for taking a loan	Manirjhil	Chotojamchori
Food	23%	43%
House building	31%	26%
Health	8%	0%
Education	8%	0%
Other: Transportation, business, travel abroad, or marriage.	31%	30%

Table 4: Seasonal diagram of Manirjhil

(Scale of 0-5, with 5 being the highest impact)

Season → / Aspect ↓	December-February (Winter)	March-May (Summer)	June-August (Rainy)	September-November (Autumn)
Food scarcity	0	0	5	4
Lack of employment	0	2	5	0
Diseases emerge	3	4	5	1
Migration	0	0	2	0
Flash flood	0	0	5	1
High precipitation	0	2	5	1
Loss of asset/ agricultural damage	0	5	4	1

Table 5: Seasonal diagram of Chotojamchori

Season → Aspects ↓	December-February (Winter)	March-May (Summer)	June-August (Rainy)	September-November (Autumn)
Food scarcity	1	1	5	5
Lack of employment	1	2	5	5
Diseases emerge	2	3	5	3
Migration	0	0	2	0
Flash flood	0	0	5	0
High precipitation	1	1	5	2
Loss of asset/ agricultural damage	3	3	5	0

662 Table 6: Perceived flash flood impacts

663 (Totals do not add up to 100% because respondents could select more than one answer.)

Flash flood impact	Manirjhil	Chotojamchori
Fatalities	12%	1%
Loss of agriculture	76%	56%
Economic loss	34%	25%
Houses damaged	71%	60%
Loss of cattle	49%	25%
Disease	22%	7%
Other (e.g. health problems, education interrupted, and poverty increased)	7%	1%

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Table 7: Flood severity matrix of Manirjhil covering the flood years which the participants mentioned

(Scale of 0-5, with 5 being the highest impact)

Flash flood year → Aspects ↓	1988	1997	2004	2012	2015
Lack of food	4	3	1	5	2
Scarcity of water	3	2	1	5	2
Migration	1	0	0	1	0
Starvation	3	1	1	5	2
Diseases	3	2	2	4	2
Lack of employment	5	3	3	5	4
Compelled sale of assets (e.g. livestock, gold, silver, utensils) for cash	2	1	1	4	1
Compelled sale of land	2	0	0	4	1

671 Table 8: Flood severity matrix of Chotojamchori covering the flood years which the participants

672 mentioned

673 (Scale of 0-5, with 5 being the highest impact)

Flash flood year → Aspects ↓	1988	1991	1994	1995	1997	2012	2015
Lack of food	5	2	2	2	4	5	3
Scarcity of water	2	1	1	2	2	4	3
Migration	1	1	0	0	0	1	0
Starvation	3	1	2	2	1	5	3
Diseases	2	1	1	1	1	3	2
Lack of employment	2	1	1	2	1	3	2
Compelled sale of assets (e.g. livestock, gold, silver, utensils) for cash	2	1	2	1	1	3	1
Compelled sale of land	1	0	0	0	0	2	0

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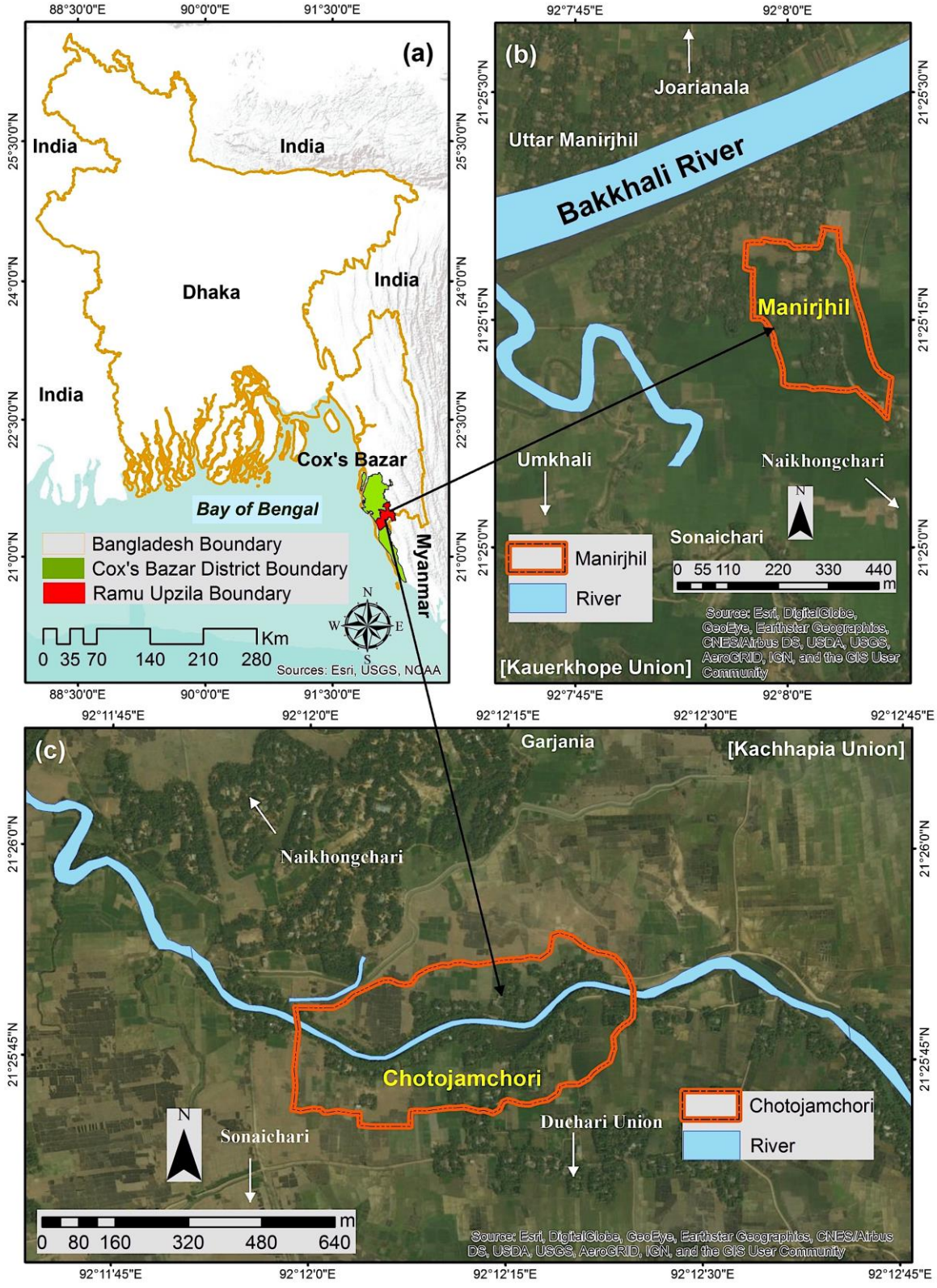
Table 9: Coping with post flash flood food and water shortages

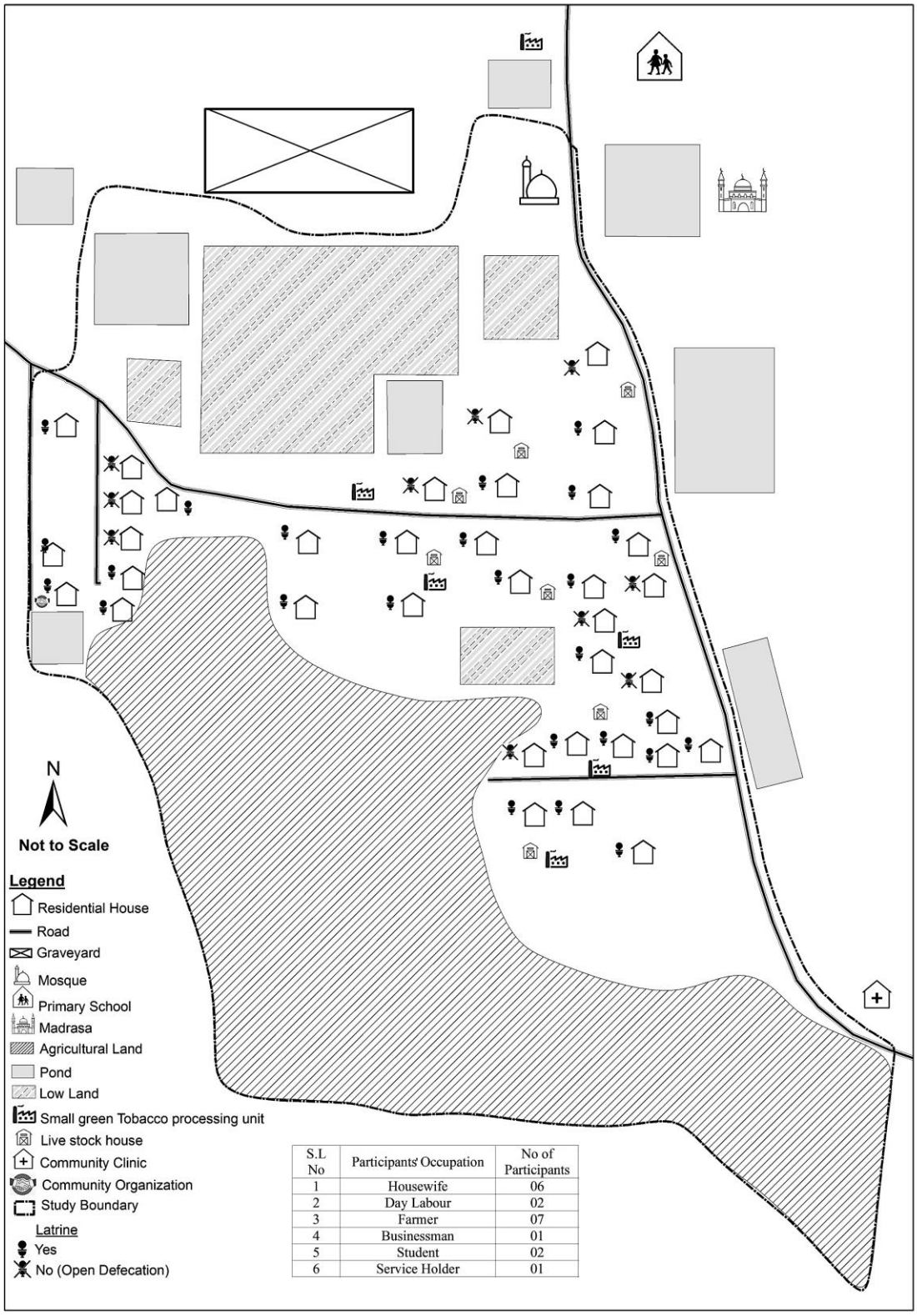
(While respondents had the opportunity to select more than one answer, none did. Totals for food and water separately do not add up to 100% due to rounding.)

Flash flood impact	Manirjhil	Chotojamchori
Food		
Eating dried food such as biscuit, flattened rice (*chira*), and puffed rice (*muri*).	29%	17%
Eat previously cooked food.	5%	15%
Cook on the roof.	5%	7%
Cook in a disaster shelter.	16%	23%
Do not eat much.	26%	27%
Other (evacuate to the hills carrying food, borrow food from others, and food aid from the government or NGOs)	18%	12%
Water		
Collecting rainwater	59%	28%
Place freshwater in high places such as the roof (*macha*) which the flood is unlikely to reach	38%	64%
Other (collect water from hill locations or from neighbours)	3%	8%

Figure 1: Location of Manirjhil and Chotojamchori villages in Bangladesh



681 Figure 2: Resource map of Manirjhil.



S.L No	Participants' Occupation	No of Participants
1	Housewife	06
2	Day Labour	02
3	Farmer	07
4	Businessman	01
5	Student	02
6	Service Holder	01

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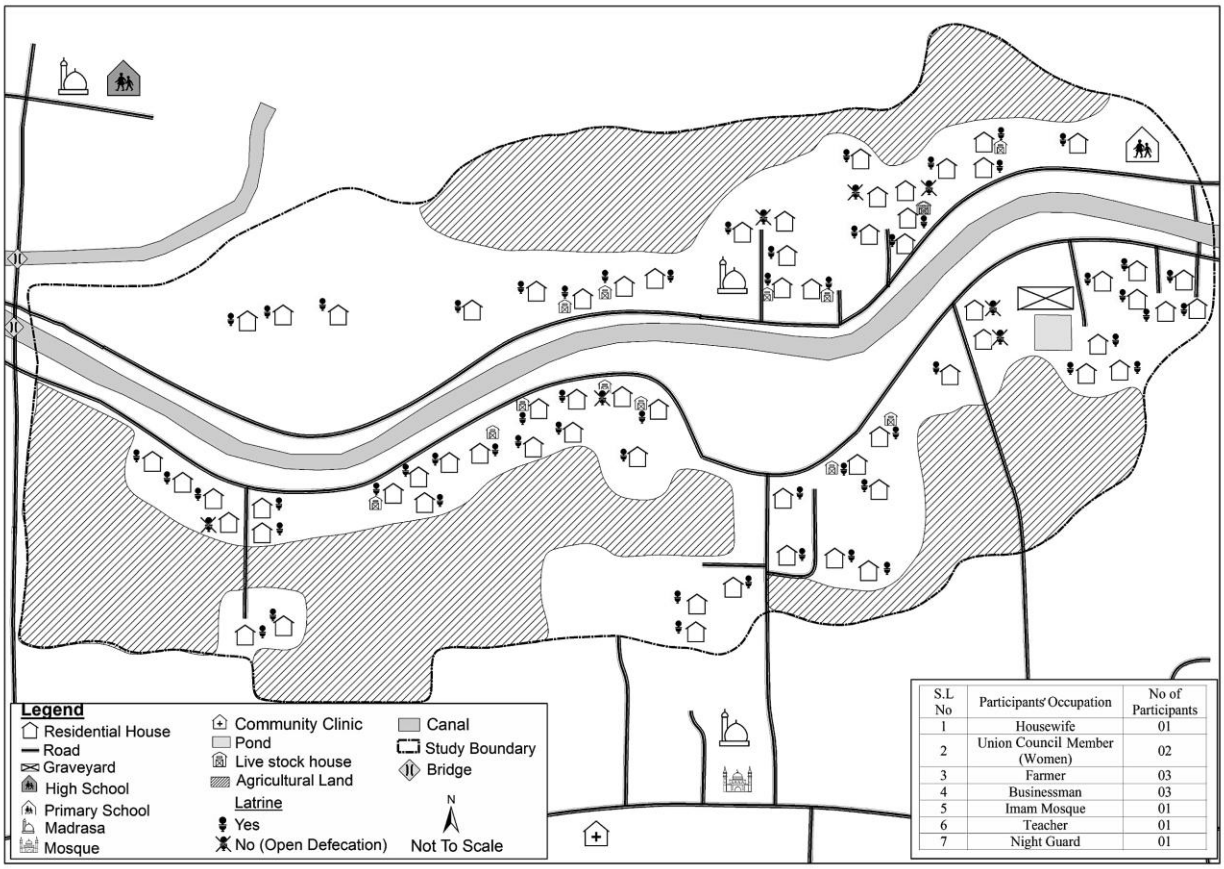
683 Figure 3: Resource map of Chotojamchori.



S.L No	Participants' Occupation	No of Participants
1	Housewife	01
2	Union Council Member (Women)	02
3	Farmer	03
4	Businessman	03
5	Imam Mosque	01
6	Teacher	01
7	Night Guard	01

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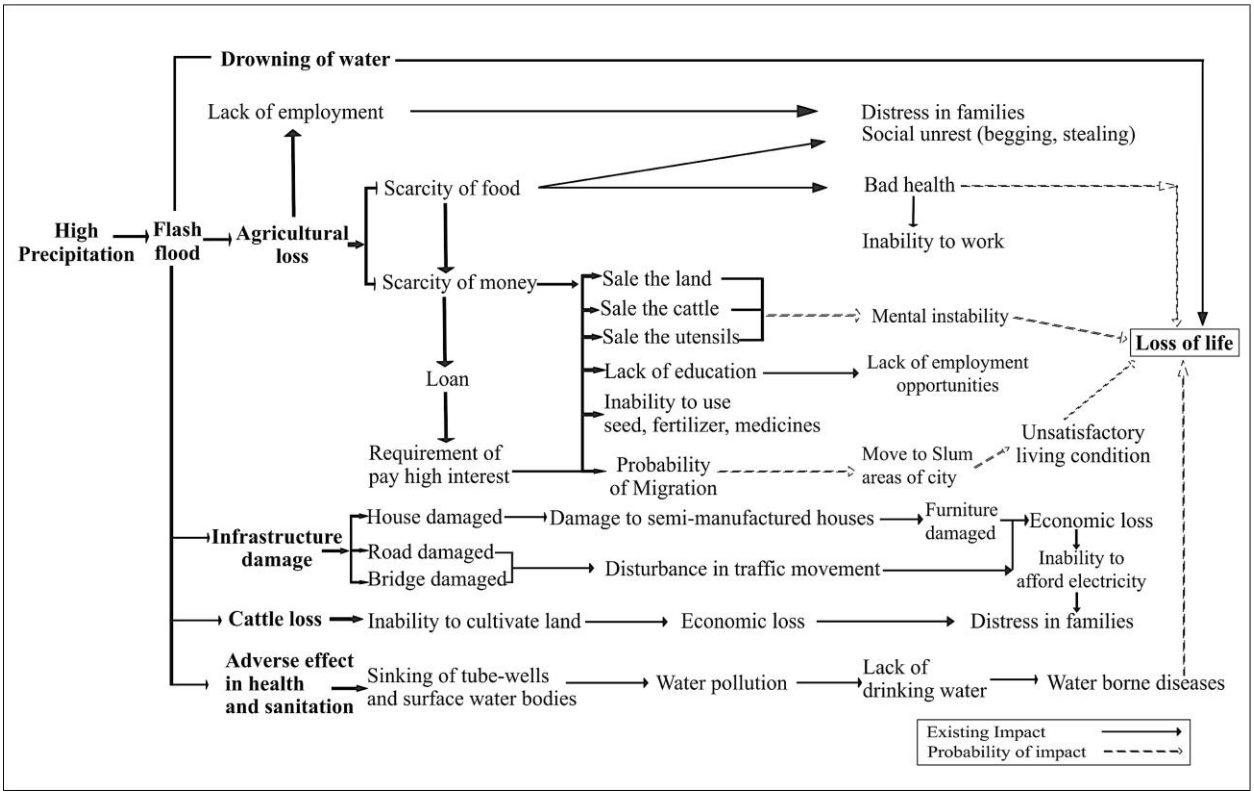
686 Figure 4: Combined impact diagram for Manirjhil and Chotojamchori.



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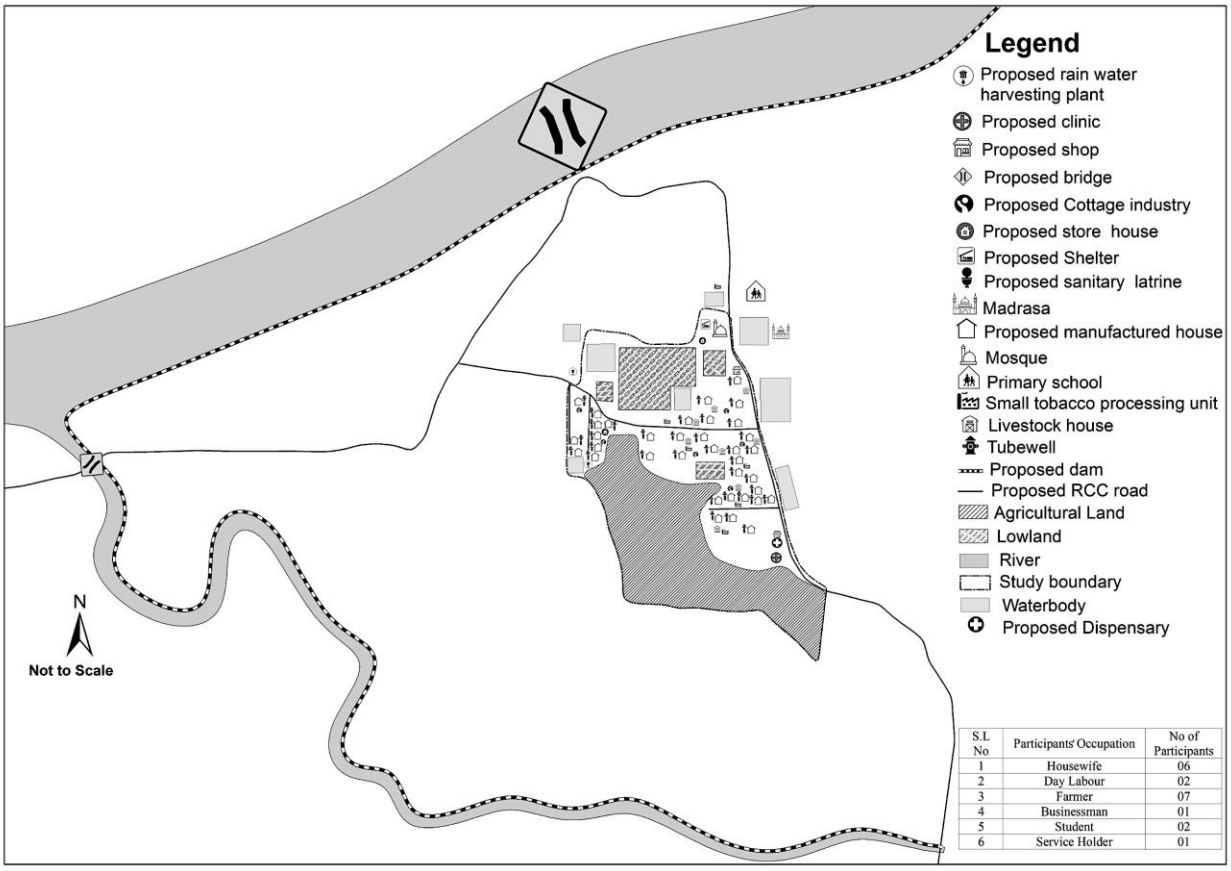
689 Figure 5: Dream map for Manirjhil.



S.L No	Participants' Occupation	No of Participants
1	Housewife	06
2	Day Labour	02
3	Farmer	07
4	Businessman	01
5	Student	02
6	Service Holder	01

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Figure 6: Dream map for Chotojamchori.