

Electronic Supplementary Material of the paper (Literature review)

The costs of living with floods in the Jamuna floodplain in Bangladesh

Md Ruknul Ferdous, Anna Wesselink, Luigia Brandimarte, Kymo Slager, Margreet Zwarteveen and Giuliano Di Baldassarre

Paper and citation	Coping and or adaptation	Location	Economic and social effects (livelihoods)	Adjustments: technical measures and/or migration	Data used, collected	What type of analysis	Statements/ results
Ayeb-Karlsson et al (2016): Ayeb-Karlsson, S., van der Geest, K., Ahmed, I., Huq, S., & Warner, K. (2016). A people-centred perspective on climate change, environmental stress, and livelihood resilience in Bangladesh. Sustainability Science, 11(4), 679-694. Doi: 10.1007/s11625-016-0379-z	<ul style="list-style-type: none">• Adaptation	<ul style="list-style-type: none">• Bangladesh (Barguna, Pirojpur, Bagerhat, Kishoregan, Naogaon, Dhaka)	<ul style="list-style-type: none">• Floods, riverbank erosion, and droughts cause damage to agricultural lands, crops, houses, and properties.	<ul style="list-style-type: none">• People manage to adapt by modifying their agricultural practices, switching to alternative livelihoods, or using migration as an adaptive strategy.	<ul style="list-style-type: none">• 28 Semi-structured interviews	<ul style="list-style-type: none">• Qualitative research analysis• Livelihood resilience against cyclones, flood, riverbank erosion, drought	<ul style="list-style-type: none">• Environmental stress, shocks, and disturbances affect people’s livelihood resilience and adaptation measures could be unsuccessful.• ‘We lost everything’, is one of the most commonly used expressions in the Livelihood History interviews. Clearly, the informants did not lose ‘everything’, but it is a strong way of conveying how severely their living conditions and livelihoods have deteriorated because of the stress.• Adaptation strategies: Modifying agricultural practices, Switching to alternative livelihoods, Migration as an adaptive strategy,• Taking advantage of new livelihood opportunities is one way to adapt to limited, reduced or unavailable natural resources. Adaptation strategies like these are still sometimes not enough, to cope with extreme events and natural hazards.• Seasonal migration can be a successful adaptation strategy that enhances livelihood security. However, it often comes at a cost; working conditions tend to be challenging and dangerous.• People who are forced to migrate permanently from rural to urban areas often end up in slums with difficult living conditions.• Adaptation strategies, such as agricultural change, livelihood diversification, and migration, can be ways to enhance livelihood resilience.
Banerjee (2011): Banerjee, L. (2011). Creative destruction: Analysing flood and flood control in Bangladesh. Environmental Hazards, 9(1), 102-117. Doi: 10.3763/ehaz.2010.SI03	<ul style="list-style-type: none">• Coping	<ul style="list-style-type: none">• Bangladesh	<ul style="list-style-type: none">• Severe flooding may cause decline in agricultural yield rate in disaster months, they may also provide open-access irrigational input that lead to significant increases in post-flood productivity.	<ul style="list-style-type: none">• n/a	<ul style="list-style-type: none">• Secondary data (monthly data on crop productivity for 1978–2000 in Bangladesh)	<ul style="list-style-type: none">• Quantitative analysis of effects of riverine floods on agricultural productivity• Analyse structural measures	<ul style="list-style-type: none">• Not all farms, however, can benefit in the post-disaster period. Only the comparatively richer farms can benefit from the creative aspects of disaster. Crops produced in the post-flood (dry winter) season require intensive use of supplemental inputs, including artificial irrigation, fertilizers, pesticides and high-yielding variety (HYV) seeds, which have high unit costs. An agent’s ability to cultivate post-flood crop is, thus, closely tied to his purchasing power. Poverty and uneven agrarian structure will result in an uneven distribution of flood risks and benefits.• Over time, experiences with the structural measures, especially embankments and polders, showed that neither were they sufficient for flood control nor were they necessary for irrigation. While the structural measures prevented the ‘normal’ monsoon overflow of rivers, they failed to prevent ‘extreme’ floods. Thus, on the one hand, the customary practices of wet-season cultivation of low-input but low-yielding rice with flood irrigation was disrupted in the ‘normal’ (disaster-free years) and, on the other, in years of ‘flood disasters’, the average damage loss per event became extremely high.• Wet-season crops are low cost, but also have lower productivity and higher flood risk. Dry-season crops have higher productivity and lower flood risk, but are more costly to produce. Thus, the pre-existing income distribution of the farmers determines their vulnerability to disaster.
Brammer (2004): Brammer, H. (2004). Can Bangladesh be	<ul style="list-style-type: none">• Coping and Adaptation	<ul style="list-style-type: none">• Bangladesh	<ul style="list-style-type: none">• n/a	<ul style="list-style-type: none">• n/a	<ul style="list-style-type: none">• Secondary data• Data from	<ul style="list-style-type: none">• Qualitative and quantitative analysis	<ul style="list-style-type: none">• Traditional settlements in Bangladesh's floodplain areas are well adapted to normal seasonal flooding and occasional high floods. They usually are located on the highest land available on river-banks and on floodplain ridges which mark the site of former river-banks.

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Protected from floods? Dhaka: The University Press Limited.					published papers		<ul style="list-style-type: none"> Individual homesteads generally are constructed on raised earthen mounds, the height of which is determined by local experience of previous high flood-levels. Main roads and railways are built on embankments to raise them above, high flood-levels, and they need to be provided with many bridges and culverts-to allow the passage of floodwater, which is expensive. Rural roads and paths between settlements generally follow the highest land available and are usually also built on embankments to raise them above normal flood-levels. Farmers' traditional cropping patterns and practices in Bangladesh are closely adapted to seasonal flooding characteristics and the risk of floods. Farmers' take precaution strategies to cultivate crops and they select crops as per land elevation.
Brouwer et al (2007): Brouwer, R., Akter, S., Brander, L., & Haque, E. (2007). Socioeconomic vulnerability and adaptation to environmental risk: a case study of climate change and flooding in Bangladesh. Risk Analysis: An International Journal, 27(2), 313-326. Doi:10.1111/j.1539-6924.2007.00884.x	<ul style="list-style-type: none"> Adaptive coping mechanism 	<ul style="list-style-type: none"> Meghna river floodplain (Homna) 	<ul style="list-style-type: none"> Floods cause social disruption and result in scarcity of drinking water as surface water gets contaminated by organic and inorganic substances. Cases of diarrhea, cholera, and other intestine diseases increase remarkably during and after floods. 	<ul style="list-style-type: none"> Poor flood-affected families are allowed to take shelter in village schools or higher local government buildings, where they can stay as long as the area remains flooded (weeks/months). A study based upon survey data collected after the 1988 flood disaster (Haque & Zaman, 1994) shows that around 70% of the affected farmers in Bangladesh mitigated their income and asset losses by selling land, livestock, and other belongings. The positive relationship between environmental risk, poverty, and vulnerability. Poorer segments of society live closer to the river, and therefore face a higher risk of flooding and are thus more vulnerable. 	<ul style="list-style-type: none"> 672 Household surveys 45 Semi structured key informant interviews 	<ul style="list-style-type: none"> Quantitative analysis Community vulnerability and adaptive coping mechanisms 	<ul style="list-style-type: none"> People need flood protection Households with lower income and less access to productive natural assets face higher exposure to risk of flooding. Disparity in income and asset distribution at community level furthermore tends to be higher at higher risk exposure levels, implying that individually vulnerable households are also collectively more vulnerable. The people that face the highest risk of flooding are the least well prepared, both in terms of household-level ex ante preparedness and community-level ex post flood relief. Income inequality also plays a role in determining sources of collective vulnerability. Disparity in income and asset distribution at the community level tends to be higher at higher risk exposure levels, implying that individually vulnerable households are also collectively more vulnerable. The poor suffer most from being exposed to environmental risk by further examining the relationship between flood damage and income, income distribution, income dependency on natural resources, and access to these natural resources. Households living further away from the river not only have more income (and income is more equally distributed), they also have significantly more sources of income. Hence, at the household level the relationship between flood damage and income diversity suggests that the latter is an effective coping mechanism for environmental risk, but at the village level communities that face the highest risk of flooding seem to be the least well prepared.
Chowdhury (1988): Chowdhury, M. (1988). The 1987 flood in Bangladesh: an estimate of damage in twelve villages. Disasters, 12(4), 294-300. Doi: 10.1111/j.1467-7717.1988.tb00679.x	<ul style="list-style-type: none"> Coping and adaptation 	<ul style="list-style-type: none"> Bangladesh (12 villages: 7 in Manikganj district and 5 in Joypurhat district) 	<ul style="list-style-type: none"> The damage due to this exceptionally deep flood was enormous. Nationally the cost has been put as high as 40 billion taka (or US\$ 1.3 billion). More than 24 million people of Bangladesh - a fifth of the country's population - are either homeless or without food after the worst floods in the country's history. 	<ul style="list-style-type: none"> People do not face much difficulty as they adjust their lives to it, for example, by growing deep water rice and by building house structures on raised land. A shelter is an immediate need and the poor or near-landless go on borrowing from money lenders by mortgaging whatever they have, including any land. 	<ul style="list-style-type: none"> 1595 Household surveys 	<ul style="list-style-type: none"> Statistical analysis 	<ul style="list-style-type: none"> A landless family lost an amount of taka 2,540 in Manikganj and taka 1,644 in Joypurhat. Compared to this the landowners lost taka 14,389 and taka 7,024 respectively in Manikganj and Joypurhat. The major difference between landowning and landless households occur in losses due to damage to standing crops, which is natural as the landless possess no or very little arable land. Losses in respect of damage to house structures may be mentioned, where the loss has been 20% of the total for the landless. The poor people's structures are more dilapidated, allowing them to be destroyed more easily by calamities, including flood waters. In comparison, the houses of the richer sections are strongly built with brick and corrugated iron sheets, making them less vulnerable to floods. The loss incurred by poor families in Bangladesh during the 1987 flood was very substantial - nearly 50 percent of a year's income.
Fenton et al (2017): Fenton, A., Paavola, J., &	<ul style="list-style-type: none"> Adaptation 	<ul style="list-style-type: none"> Coastal (Satkhira) 	<ul style="list-style-type: none"> All households are exposed to multiple 	<ul style="list-style-type: none"> Embankments (polder) is the reason for flooding as no good drainage system. 	<ul style="list-style-type: none"> 266 Household surveys 	<ul style="list-style-type: none"> Qualitative analysis An in-depth qualitative empirical examination of 	<ul style="list-style-type: none"> Socioeconomic status is linked to patterns of transformative adaptation; households with low socioeconomic status do not have equal access to adaptation measures and existing government extension programmes often accentuate inequalities.

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Tallontire, A. (2017). Autonomous adaptation to riverine flooding in Satkhira District, Bangladesh: implications for adaptation planning. Regional Environmental Change, 17(8), 2387-2396. DOI 10.1007/s10113-017-1159-8.			hazards but particularly to riverine flooding.		<ul style="list-style-type: none"> • 38 Semi structured interviews • 13 Short interviews • 4 Focus Group Discussions 	autonomous household adaptation to deem whether adaptations are incremental or transformational.	<ul style="list-style-type: none"> • While the risk hazard approach is well-suited to understanding autonomous adaptation, equity and long-term considerations need to be given additional attention. • Adaptation is distinct from ‘coping’ which refers to immediate responses to events: in contrast, adaptation prepares households for expected future events. • Household interviews brought up numerous and often interlinked adaptations to flooding such as changing composition of poultry stocks, homestead and plinth improvements, domestic and international migration, conversion of agricultural land for aquaculture, halting of summer cultivation and salaried labour. • Low-cost transformations were often involuntary, uncontrolled and negative in their consequences. High-cost transformations were in turn voluntary, planned and helped to take advantage of emerging opportunities. Each type of transformational adaptation was closely associated with the socioeconomic status of households. Poorer households adopt low-cost transformations such as domestic migration while wealthier households adopt costlier transformations such as international migration and aquaculture.
Gray & Mueller (2012): Gray, C. L., & Mueller, V. (2012). Natural disasters and population mobility in Bangladesh. Proceedings of the National Academy of Sciences, 201115944. Doi:10.1073/pnas.1115944109	<ul style="list-style-type: none"> • Adaptation 	<ul style="list-style-type: none"> • Bangladesh (14 Districts) 	<ul style="list-style-type: none"> • Migration 	<ul style="list-style-type: none"> • Migration 	<ul style="list-style-type: none"> • 1,700 Household surveys 	<ul style="list-style-type: none"> • Quantitative analysis • investigate the consequences of climate-related natural disasters for long-term population mobility • Used statistical models (logit model, multinomial model) 	<ul style="list-style-type: none"> • Multivariate event history models are used to estimate the effects of flooding and crop failures on local population mobility and long-distance migration. • Flooding has modest effects on mobility that are most visible at moderate intensities and for women and the poor. Crop failures unrelated to flooding have strong effects on mobility in which households that are not directly affected but live in severely affected areas are the most likely to move. These results point toward an alternate paradigm of disaster-induced mobility that recognizes the significant barriers to migration for vulnerable households as well their substantial local adaptive capacity. • Exposure to disasters did not have consistently positive effects on overall mobility. Effects were positive and significant only for crop failure at the sub-district level, were largely nonsignificant for flooding, and were negative for household-level crop failure. This result indicates that although mobility can serve as a post-disaster coping strategy, it does not do so universally, and disasters in fact can reduce mobility by increasing labor needs at the origin or by removing the resources necessary to migrate.
Haque (1988): Haque, C. E. (1988). Human adjustments to river bank erosion hazard in the Jamuna floodplain, Bangladesh. Human Ecology, 16(4), 421-437. Doi:10.1007/BF00891651	<ul style="list-style-type: none"> • Coping 	<ul style="list-style-type: none"> • Jamuna floodplain, Bangladesh (Kazipur, Sirajganj) 	<ul style="list-style-type: none"> • Land loss 	<ul style="list-style-type: none"> • The general trend among floodplain inhabitants is to adopt multiple coping strategies like Abandoned land, Protected land, Sold livestock, Sold cultivable land, Sold homestead land, Sold belongings, Dismantled housing structure, Cut trees, Moved family to other area, Moved livestock to other area, Moved belongings to other area etc. • It appears that the most common adjustment strategies among displaces are abandoning of land, salvaging housing structures, and transferring the family from erosion affected areas. 	<ul style="list-style-type: none"> • 547 Household surveys 	<ul style="list-style-type: none"> • Quantitative analysis • Human adjustment strategies to cope with river bank erosion hazard among inhabitants of the Jamuna floodplain of Bangladesh. 	<ul style="list-style-type: none"> • Although the adjustment strategies to adapt to flooding have received considerable attention in the literature on Bangladesh the issues and problems relating to bank erosion have remained untouched.

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				<ul style="list-style-type: none"> Only 2.8% of displace respondents attempted to protect their land from the physical impact of the river. This kind of measure consists primarily of building protective bamboo structures, locally called chegar. The majority of respondents try to reduce hazard loss by salvaging housing structures and/or try to bear loss by abandoning the land. Most destitute families take shelter on the bandh (the embankment) as an emergency and temporary adjustment in the hope that they might return in the near future to the re-emerged land. In most cases, these hopes are not fulfilled. Others move to a nearby relative's or friend's house or migrate to rural areas of other districts where land or work might be available. A few move to towns and cities. 			
Haque and Zaman (1993): Haque, C. E., & Zaman, M. Q. (1993). Human responses to riverine hazards in Bangladesh: a proposal for sustainable floodplain development. World Development, 21(1), 93-107. Doi: 10.1016/0305-750X(93)90139-Z	<ul style="list-style-type: none"> Coping and adaptation 	<ul style="list-style-type: none"> Bangladesh (Sreenager Upazila of Munshiganj district) 	<ul style="list-style-type: none"> Several thousand people become homeless during a normal flood season. During 1988 flood, more than 45 million were uprooted Brahmaputra, and the Meghna. The watershed and over 2,000 died. 	<ul style="list-style-type: none"> People took coping strategies like sold land, sold livestock, sold belongings, Mortgaged land, Dismantled housing structure, Borrowed money, Spent previous savings, Moved family to other areas, Moved livestock and belongings to other areas One of the most common strategies is the construction of homesteads on relatively elevated natural levees. The plinth of houses, locally called bhiti, is further raised by digging earth from local depressions. The rural non-metalled roads (i.e., kutchra), courtyards of local schools and mosques are often raised to the level of abnormal floods, and used as flood shelters. People also build platforms or machans using bamboo, straw, water hyacinth, and banana stalks during abnormal flooding years. Adaptive varieties of rice. Certain varieties of aus rice are cultivated only in elevated areas (i.e., runs). Since some broadcast and transplanted aman grow with flooding, and are harvested following the recession of flood water, they are grown in the low lying areas (i.e., dhoabs) such as backswamps, channel scars, and shallow beds of oxbow lakes. Chamura, a broadcast variety of 	<ul style="list-style-type: none"> 280 Household surveys 	<ul style="list-style-type: none"> Quantitative analysis This study examines causes and impacts of the 1988 flood and evaluates the range of possible human adjustments in mitigating such hazards. The central purpose of this paper is to critically evaluate some of the elements of this debate within the context of the 1988 catastrophic flood, and to determine the major limitations and potentials proffered by the two paradigms. 	<ul style="list-style-type: none"> Discussed against flood control measures supporting living with floods. Physical prevention of floods through means of "technological fix." Is likely to pose serious threats to long-term sustainability of floodplain ecology and sociocultural resources of Bangladesh. Because of the predominance of subsistence agriculture, Bangladesh is one of the most intensively cultivated areas in the world, often supporting in excess of 12 people per hectare of arable land. While the most devastating flood on record occurred during the late monsoon of 1988, other catastrophic flooding occurred in 1954. 1955, 1974, 1977, 1985, and 1987. About one-quarter of Bangladesh experiences a regular annual flood. Various types of indigenous adjustments, particularly the adaptation of different types of crops to varied flood depths, should be reinforced.

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				<p>amun, can grow by more than 15 cm in a day with the rising flood levels.</p> <ul style="list-style-type: none"> Over time, people of the region have also developed numerous adaptive strategies to reap the benefit from this regular event. Floodplain users' concerns are therefore focused only on abnormal floods which surpass their adjustment ability and may have devastating effects both on their lives and resources. An analysis of flood loss in Bangladesh reveals that the people are highly adaptive to floods relative to other extreme natural events. Majority of the respondents took some corrective measures to minimize flood loss. That is, more than 71% of respondents attempted to reduce their loss to floods by selling their land, livestock or belongings; some moved housing structures, livestock, and family members to other safer places. It is evident that flood victims opted for a number of responses aimed at reducing hazard loss through deliberate measures. Developing the social and institutional networks can be effectively employed in minimizing hazard effects. 			
Hutton and Haque (2004): Hutton, D., & Haque, C. E. (2004). Human vulnerability, dislocation and resettlement: adaptation processes of river-bank erosion-induced 5isplaces in Bangladesh. Disasters, 28(1), 41-62. Doi: 10.1111/j.0361-3666.2004.00242.x	<ul style="list-style-type: none"> Adaptation 	<ul style="list-style-type: none"> Jamuna (Sariakandi of Sirajganj district) 	<ul style="list-style-type: none"> Each year destruction by river encroachment renders a large population landless and homeless. In 1995, the Flood Plan Coordination Organisation (1995) estimated that river-bank erosion displaced over 728,000 people between 1981 and 1993 along the Jamuna, Ganges-Padma and Meghna rivers. 	<ul style="list-style-type: none"> In 1989, when a comprehensive study was undertaken to determine the number of displaces living in Sirajganj, approximately 5,550 of the 30,000 slum dwellers residing in the city were found to be erosion-affected displaces. This constituted about 5 per cent of Sirajganj's total population of 100,000 and over 18 per cent of the city's destitute. This intention to try to remain near their previous home is rooted in several factors: (1) lack of economic affordability to move to the urban areas; (2) to avoid uncertainty in unfamiliar urban environment and not to lose the advantages of being part of a larger social network in the rural areas; and (3) the hope of regaining charland in the future. 	<ul style="list-style-type: none"> 468 Household surveys 	<ul style="list-style-type: none"> Quantitative analysis Economic and social adaptation among riverbank erosion induced displacees 	<ul style="list-style-type: none"> Displaces experience substantial socio-economic impoverishment and marginalisation as a consequence of involuntary migration. Normally, adjustment to river-bank erosion among the rural poor means a recovery of a subsistence livelihood. Displaces are involuntary migrants, compelled to relocate for reasons other than economic gain. When disasters strike, the poor survive by selling off land, livestock, housing materials and personal belongings — all of which further their impoverishment. The magnitude of poverty and marginalisation endured by displaces is such that it ameliorates whatever advantages that more 'advantaged' displaces (namely younger, more-educated men) may bring to resettlement.
Indra, D (2000): Indra, D. (2000). Not just dis-	<ul style="list-style-type: none"> Adaptation 	<ul style="list-style-type: none"> Jamuna (Kazipur, Sirajganj) 	<ul style="list-style-type: none"> Displacement 	<ul style="list-style-type: none"> Forced migration due to riverbank erosion Many vegetable plants are trained to grow up and over the houses.22 Catkin planted around houses provides building material 	<ul style="list-style-type: none"> Household surveys <i>(but did</i> 	<ul style="list-style-type: none"> Qualitative analysis 	<ul style="list-style-type: none"> Most people displaced by riverbank erosion, are already poor and disempowered before being uprooted by the shifting local channel of the Jamuna River.

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placed and poor: How environmentally forced migrants in rural Bangladesh recreate space and place under trying conditions. Rethinking refuge and displacement: Selected papers of refugees and immigrants, 8, 163-191.				and household privacy. Women often keep a chicken or two, or more rarely a goat (often owned by share or acquired through sharecropping). <ul style="list-style-type: none"> Some poor and older women and girls range the embankments and riverbanks to collect roots, grass, sticks for fuel, and wild plants used for food and animal fodder. 	<i>not mention number</i>		<ul style="list-style-type: none"> Having experienced high rates of both general social change and riverbank erosion for more than a generation, they are adept at reconfiguring “tradition” to better address new circumstances. As forced migrants, they have been resilient, resourceful and innovative in ways that their conventional representation as passive victims of natural and social forces outside their control would not suggest. embankment dwellers appears to be “very poor” Each of these one-story dwellings is made of modules that can be disassembled quickly, and with little waste of materials, when faced with immanent erosion. Each of the modules can be transported rapidly by no more than six to eight men. A typical house can be re-erected in a day or two, using only household labor, particularly if extensive preparation of the new site is not required. If necessary, the reconstructed house can be made smaller and the surplus materials sold. Most other chattel property is easily transportable and can be quickly set up in a new place. Once on the embankments, people have generated a rich variety of orderly adaptations to life in restricted circumstances. Regarding erosion and forced migration in Bangladesh, we are at present far from achieving a diverse, polyphonic discourse.
Islam et al (2012): Islam, M. S., Hasan, T., Chowdhury, M. S. I. R., Rahaman, M. H., & Tusher, T. R. (2012). Coping techniques of local people to flood and river erosion in char areas of Bangladesh. Journal of Environmental Science and Natural Resources, 5(2), 251-261. Doi: 10.3329/jesnr.v5i2.14827	<ul style="list-style-type: none"> Coping 	<ul style="list-style-type: none"> Jamuna chars 	<ul style="list-style-type: none"> flooding and erosion have disastrous impacts on people’s socioeconomic condition as well as on the environment 	<ul style="list-style-type: none"> Coping strategies against flood/River bank erosion People use various preventive techniques includes the placing of barriers around the house, raising the platform of the house. Other techniques like bamboo or platform, houses build with either bamboo or wooden ceiling in the upper part of the shelter where people live, reducing the number of meals and relying on inexpensive food, depending on relief, taking shelter along raise part like road, neighbour house, searching for alternative sources of income, selling assets, borrowing and selling land and other productive assets to mitigate the negative impacts of flood. The following subsections discusses overall preventive and mitigative strategies. 	<ul style="list-style-type: none"> 200 Household surveys Focus Group Discussion (<i>did not mention number</i>) key informant interviews (<i>did not mention number</i>) Field observations 	<ul style="list-style-type: none"> Quantitative analysis Statistical analysis 	<ul style="list-style-type: none"> Household’s ability to adapt with flood and river erosion depends on people’s socioeconomic and environmental conditions, such as education, income and occupation. Though, flood and river erosion cause the loss of lives and properties, people’s indigenous coping techniques could significantly reduce their vulnerability without outside assistance. Several loss reduction techniques such as salvaging housing structure, sale livestock, cutting trees and standing crops are taken by the displaces of both villages to minimize from erosion attack. The shift of lives and properties from erosion threatened homestead to a safer place is one of the corrective strategies taken by the displaces. Displaces of both villages widely use the movable housing materials in constructing their houses on the char land. It is a purposive type of adaptation techniques. Investment pattern is quite different. Majority of the displaces invested their capital for purchasing livestock and land lease for farming. People adopted multiple techniques in accepting loss, reducing loss, and in shifting their lives and properties due to flood and riverbank erosion. Although flooding and river erosion always generates socioeconomic and health related hazards and environmental and infrastructural damage, people’s indigenous coping techniques can significantly reduce their vulnerability to disaster.
Islam et al (2014): Islam, M. S., Sultana, S., Saifunnahar, M., & Miah, M. A. (2014). Adaptation of char livelihood in flood and river erosion areas	<ul style="list-style-type: none"> Adaptation 	<ul style="list-style-type: none"> Jamuna 	<ul style="list-style-type: none"> Riverbank erosion is causing loss of lands and livelihood along major rivers. Riverbank erosion is a major environmental and social problem in Bangladesh, where 30-40% of the population lives close to river banks. 	<ul style="list-style-type: none"> Adaptation of char livelihood against flood/River bank erosion Purify drinking water Temporary migration 	<ul style="list-style-type: none"> 200 Household surveys Open Discussion (<i>did not mention number</i>) 	<ul style="list-style-type: none"> Quantitative analysis Statistical analysis 	<ul style="list-style-type: none"> The people in char land with high flood proneness and low socio-economic circumstances were more likely to fail to adopt with impacts compared to people in areas with high and sudden flooding. The char people use their indigenous knowledge to adapt through this diverse situation. The study explores a negative fact that without any organizational support, the people of char have to formulate and undertake various adaptation techniques in their own way. Due to riverbank erosion, many farmers become poor overnight. They lose homestead, houses, cultivable land, trees and other properties.

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through indigenous practice: A study on Bhuapur riverine area in Tangail. Journal of Environmental Science and Natural Resources, 7(1), 13-19. Doi:10.3329/jesnr.v7i1.22138					<ul style="list-style-type: none"> key informant interviews (<i>did not mention number</i>) Field observations 		
Joarder and Miller (2013): Joarder, M. A. M., & Miller, P. W. (2013). Factors affecting whether environmental migration is temporary or permanent: Evidence from Bangladesh. Global Environmental Change, 23(6), 1511-1524. Doi: 10.1016/j.gloenvcha.2013.07.026	<ul style="list-style-type: none"> Adaptation 	<ul style="list-style-type: none"> Bangladesh (Companiganj, Jaintiapur, and Gowainghatupazila) 	<ul style="list-style-type: none"> Drought, riverbank erosion or flood were the main general reasons for migration. 	<ul style="list-style-type: none"> Haque and Zaman (1989) investigated displacement induced by riverbank erosion in one of the worst case in Bangladesh. Mahmood's (1995) findings, based on a survey in Bangladeshi urban slums, showed that up to 50 percent of squatter dwellers had moved to the cities due to river bank erosion. According to Black et al. (2011b, 442), “. . .displaced people initially try to relocate themselves within the village, or in neighbouring villages, reflecting the fact that the annual cycle of flooding both erodes land and may slowly create new areas for potential settlement as a result of siltation. While river bank erosion may occur overnight, sedimentation is a considerably longer process and may not necessarily occur in the same location”. 	<ul style="list-style-type: none"> 1,770 Household surveys 	<ul style="list-style-type: none"> Quantitative analysis and qualitative analysis Econometric analysis Cross-sectional binary logit model for statistical analysis 	<ul style="list-style-type: none"> The probability of intending to move temporarily is significantly affected by the prior occupational experience: Migrants who were previously engaged in agriculture or fishing are more inclined to migrate permanently. Those households who reported that they had lost assets due to environmental hazards are shown to have a higher probability of becoming permanent migrants. In contrast, loss of livestock and crop failure are associated with a greater likelihood of temporary migration. Importantly, for many Bangladeshis affected by environmental change, migration is an adaptation strategy.
Khandker (2007): Khandker, S. R. (2007). Coping with flood: role of institutions in Bangladesh. Agricultural Economics, 36(2), 169-180. Doi:10.1111/j.1574-0862.2007.00196.x	<ul style="list-style-type: none"> Coping 	<ul style="list-style-type: none"> Bangladesh (32 Thanas) 	<ul style="list-style-type: none"> Both vulnerability and poverty have in general declined in Bangladesh 	<ul style="list-style-type: none"> Coping mechanism: skipping a meal during a flood reveals a vulnerability of a household exposed to a shock. Households may also borrow to cope with a flood. Haque and Zaman (1993) found that more than 71% of the households sold their land, livestock, or belongings to reduce the losses due to the flood, and many moved their housing structures, livestock, and family members to safer places. Another study found that the three major coping strategies adopted during the 1998 flood were reducing expenditure, selling assets, and borrowing, with borrowing being the most important (del Ninno et al., 2003). 	<ul style="list-style-type: none"> 2,600 Household surveys Years 1991-92 and 1998-99 but no time series analysis 	<ul style="list-style-type: none"> Quantitative analysis 	<ul style="list-style-type: none"> The flood reduced both consumption and asset, and forced many households to adopt some coping mechanisms to mitigate the adverse effects of flood. Consequently, natural disaster such as flooding increases households' vulnerability to poverty. However, post-flood bumper crop production and operation of targeted programs such as microfinance helped compensate the losses of flood. The article's main conclusion is that not all poor households are vulnerable and thus did not need any coping during flood, and that public institutions, including microfinance institutions, play an important role in mitigating the adverse impacts of flooding on household welfare. Even if the flood caused distress and forced 60% of all households to adopt coping measures, the economy made a speedy recovery due to bumper crop production, and government and nongovernment interventions. After 1998 flood, impact on human lives and economic assets was not so devastating. This was partly because of effective institutional (public, private, and NGOs) support during the flood followed by a bumper crop.

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							<ul style="list-style-type: none"> Households in flood-prone areas are more vulnerable than those in unaffected areas, but the number of poor is lower in flood-affected areas than in non-affected areas, at least in 1998/99. Both vulnerability and poverty has declined over time, but the extent of vulnerability has declined much more than poverty.
Lu et al (2015): Lu, L., Lu, Q. C., & Rahman, A. B. M. (2015). Residence and Job Location Change Choice Behavior under Flooding and Cyclone Impacts in Bangladesh. Sustainability, 7(9), 11612-11631. Doi:10.3390/su70911612	<ul style="list-style-type: none"> Adaptation 	<ul style="list-style-type: none"> Bangladesh (both coastal and inland) 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> 942 Household surveys 	<ul style="list-style-type: none"> Quantitative analysis Multinomial logit model used to analyse the data 	<ul style="list-style-type: none"> Flooding/cyclone factors and income, land owned, and number of family members significantly affects people's location change choice. If there are changes in flooding impacts, the inland people will first consider to change their job locations. People with high income, less land, and fewer family members are encouraged to migrate to safety places It is important to guarantee accessible road infrastructure under flooding or cyclone failing of which might significantly lead to people's residence location change.
Mamun (1996): Mamun, M. Z. (1996). Awareness, Preparedness and Adjustment Measures of River-bank Erosion-prone People: A Case Study. Disasters, 20(1), 68-74. Doi: 10.1111/j.1467-7717.1996.tb00516.x	<ul style="list-style-type: none"> Adaptation 	<ul style="list-style-type: none"> Bangladesh (Hizla Thana) 	<ul style="list-style-type: none"> It seems that river-bank erosion does not affect livestock very much as they can be moved to safer places or sold ahead of time. In vulnerable areas, livestock often constitute the only tangible asset available to peasants that can be readily converted into cash (Rogge and Haque, 1987). 	<ul style="list-style-type: none"> It is observed that after initial impact, the majority of households (58.4 per cent) remain near their eroded land. It is found that the average distance moved by the affected households (3.60 km) after each erosion episode is not significantly different and, in fact, they frequently remain within the territory. Over time, many households, whether affected or not, have adopted one or more secondary occupations. 	<ul style="list-style-type: none"> 381 Household surveys 	<ul style="list-style-type: none"> Quantitative analysis 	<ul style="list-style-type: none"> Communities' lack of success in combating erosion can be attributed to their poverty and to their not knowing about any means to mitigate its effects. The major parameters that influence the adjustment measures after erosion are the education, skills, occupation and financial state of those affected. Those most vulnerable are households very much dependent on agriculture: for them resettlement to distant urban areas is not an option. The study confirms that vulnerable households and migrants recognise the threat of erosion more than others. The educated group perceive the effects of erosion mostly as damage to farm land, disruption to education and increased population density. It also indicates the decrease in the buying capacity of local people. Local elites and influential groups take advantage of the situation because local marginalised farmers in many cases are forced into distress selling. People living in areas prone to river-bank erosion are aware of the problem and its damaging effects. Many of them also perceive erosion as an inevitable fact of life. The majority of households are eager to move to safer zones and build a more secure livelihood. Unfortunately, they remain in the vulnerable areas because of kinship, poverty and dependency on agriculture.
Montgomery (1985): Montgomery, R. (1985). The Bangladesh floods of 1984 in historical context. Disasters, 9(3), 163-172. Doi: 10.1111/j.1467-	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Bangladesh 	<ul style="list-style-type: none"> Overall food availability, as measured by total rice production or total grain production disguises profound losses suffered by certain regions and masks the true degree of severity of the problem caused by flood damage during the monsoon season. 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Secondary data 	<ul style="list-style-type: none"> Statistical analysis 	<ul style="list-style-type: none"> There is considerable contention in the literature on the lessons to be learned about the relationship between floods, overall food shortages, and famines in Bangladesh. Rice crop gains from additional rainfall on higher elevation fields cannot in a social sense offset flood losses, even were the absolute magnitude of gain to be exactly equal to the magnitude of the flood loss.

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7717.1985.tb00933.x							
(19) Paul (1984): Paul, B. K. (1984). Perception of and agricultural adjustment to floods in Jamuna floodplain, Bangladesh. Human Ecology, 12(1), 3-19. doi: 10.1007/BF01531281	<ul style="list-style-type: none"> • Coping 	<ul style="list-style-type: none"> • Bangladesh (Ghatail Thana of Tangail district) 	<ul style="list-style-type: none"> • Flood damages • Any major fluctuation of floods with regard to timing, duration, and magnitude causes widespread damage to crops and properties and sometimes to animal and human lives. The agriculture of Bangladesh is, thus, both flood-dependent and flood-vulnerable. 	<ul style="list-style-type: none"> • The farmers of Bangladesh have successfully adapted their lifestyles and agriculture to the annual flooding's that commence and recede in due time and attain normal height. 	<ul style="list-style-type: none"> • 78 Household surveys • Field observation 	<ul style="list-style-type: none"> • Qualitative analysis • This study of the perception of farmers inhabiting the Jamuna floodplain of Bangladesh regarding normal and abnormal floods observed how individuals cope with annual inundation and how they respond to abnormal floods. 	<ul style="list-style-type: none"> • Respondents' perception of flood is conditioned by the key role played by floods in their lives. • The respondents successfully cope with the normal floods. In cases of abnormal floods, they practiced several adjustments to reduce damages. • Agricultural adjustments to normal floods are reflected in crop selection, since aus and jute cannot tolerate excessive amounts of standing water, farmers cultivate these two crops in comparatively higher land. Broadcast aman, on the contrary, thrives best in deeply flooded land, hence, lowlands are given over to broadcast aman. This crop continues to grow as fast as the flood rises. • Agricultural adjustments to bonna in the study village are limited and practiced during the flood time. Among the four adjustments practiced in the years of abnormal flood [bonna], only one is related to a crop. As a protection against strong wind and water currents, farmers who cultivate broadcast aman in low-lying areas usually place bamboo sticks a few feet apart in the field to support the growing crop. • The respondents of the study villages have been living with floods since their births, and they are fully aware of the phenomenon.
Paul (1997): Paul, B. K. (1997). Flood research in Bangladesh in retrospect and prospect: a review. Geoforum, 28(2), 121-131. Doi:10.1016/S0016-7185(97)00004-3	<ul style="list-style-type: none"> • Coping and adaptation 	<ul style="list-style-type: none"> • Bangladesh 	<ul style="list-style-type: none"> • n/a 	<ul style="list-style-type: none"> • n/a 	<ul style="list-style-type: none"> • Secondary data from literature 	<ul style="list-style-type: none"> • Review of flood research 	<ul style="list-style-type: none"> • The available studies clearly suggests that research into the impact of flooding on human settlement and other relevant aspects is much less developed in Bangladesh than the body of literature focusing on human adjustment to flood hazard. • Bangladesh has experienced 28 major floods during the past 42 years (1954-1996), of which 11 were classified as 'devastating' and five as 'most devastating'. • A normal flood (barsha) resulting from usual monsoon rainfall is considered a resource by farmers in Bangladesh. It is beneficial in the sense that it makes the land productive by providing necessary moisture and fresh silt to the soil. • Abnormal flood (bonna), which occurs once every few years and results from excessive rainfall, is regarded by farmers as an undesirable and damaging phenomenon. It causes widespread damage to standing crops and properties and sometimes costs animal and human lives. Although the people of Bangladesh have evolved numerous adaptive strategies to benefit from normal flooding, an abnormal one surpasses their ability to adjust. • Flood control measures so far drawn up by the Bangladesh government seem to have a bias toward structural-engineering solutions. But the bulk of the current literature has concentrated on the adjustment strategies farmers use to lessen the severe impact of flood. The literature shows that most responses are non-structural and include adaptive actions taken by communities and farmers either individually or collectively before, during, and after floods. Selling land, livestock, and belongings, borrowing from friends and relatives, or spending of previous savings are some of the non-structural adjustments farmers generally practice to mitigate loss caused by flooding. • The people of Bangladesh have long been familiar with flooding and they have adopted numerous adjustments to cope with abnormal flood utilizing available indigenous technological, and material and societal resources. Most of the adjustments are of a corrective type, which are practiced to minimize the damage caused by flood. Some of the corrective type of adjustments are related to social organizations and relationships; others are associated with material responses at an individual level. • The respondents attempted to reduce their loss caused by floods by selling land, livestock, or other belongings. Some moved housing structures, livestock, and family members to safer

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							<p>areas. They further claim that most of the villagers received some assistance following a disastrous flood from a variety of sources: relatives (79%), other community members (33%) local government sources (7%) national government sources (4%), and relief agencies and other institutions (18%).</p> <ul style="list-style-type: none"> • Farmers have made a careful selection of the most adaptive varieties of rice (aus, aman, and bore) over the centuries, to enable them to face abnormal floods. • Because of the lack of systematic time series data on flood damage and loss in Bangladesh, a number of studies have provided micro and macro level accounts of damage caused by flood of a particular year. • Since the magnitude and frequency of floods would be expected to decrease with the increase of distance from a major river, it was anticipated that the responses of the farmers would differ. • Author suggested that another fruitful area of flood &search in Bangladesh would be a longitudinal study to compare the changes and the process of change over time because of natural disasters. Flood adjustments, for example, may vary over time and from place to place.
Paul & Routray (2010): Paul, S. K., & Routray, J. K. (2010). Flood proneness and coping strategies: the experiences of two villages in Bangladesh. Disasters, 34(2), 489-508. Doi: 10.1111/j.1467-7717.2009.01139.x	<ul style="list-style-type: none"> • Coping 	<ul style="list-style-type: none"> • Jamuna and coastal (Bannabari and Suvagacha in Tungipara upazilla, Gopalganj district, and in Kajipur upazilla, Sirajgonj district) 	<ul style="list-style-type: none"> • Flooding has disastrous impacts on people’s socioeconomic condition as well as on the environment, which depend not only on the magnitude of the event but also on some other variables such as income, lack of awareness, level of education, occupational structure and physical location of the area. 	<ul style="list-style-type: none"> • People are used to relying on various indigenous strategies; the adoption of a particular set of strategies depends on people’s socioeconomic circumstances and the characteristics of the flood. • Preventive strategies includes the placing of barriers around the house, raising the platform of the house, avoidance of construction materials susceptible to flooding. • mitigate strategies includes using muchan and pataton, reducing the number of meals and relying on inexpensive food, collecting wild food, depending on relief, taking shelter along an embankment with one’s personal belongings, searching for alternative sources of income, selling unproductive assets, and borrowing, mortgaging and selling land and other productive assets. 	<ul style="list-style-type: none"> • 94 Household surveys • Interviews with key informants • Unstructured interviews • Focus Group Discussions 	<ul style="list-style-type: none"> • Quantitative analysis • Statistical analysis 	<ul style="list-style-type: none"> • This paper explores peoples’ indigenous survival strategies and assesses variations in people’s ability to cope with floods in Bangladesh. • People continuously battle against flood vulnerability in accordance with their level of exposure and abilities, with varied strategies employed at different geophysical locations. • People in an area with low flooding and with better socioeconomic circumstances are more likely to cope with impacts compared to people in areas with high and sudden flooding. • Households’ ability to cope varies depending on people’s socioeconomic conditions, such as education, income and occupation. Although floods in Bangladesh generate socioeconomic misery and cause damage to the environment, health and infrastructure, people’s indigenous coping strategies have helped them to reduce significantly their vulnerability. • External assistance as a determinant of coping strategies; Flood characteristics as a determinant of coping strategies; Distance from riverbank as a determinant of coping strategies. • It is evident that in response to a flood, people adopt different indigenous preventive and mitigative measures or coping strategies in a sequential order. The implementation of such strategies may fluctuate due to variations in aforementioned factors. Coping techniques adopted by households fall into three distinct stages: preventive measures, adaptive measures and distress migration.
Sultana and Thompson (2018): Parvin Sultana and Paul Thompson (2018): Migration and flood-erosion hazards: influence of local institutions and infrastructure.	<ul style="list-style-type: none"> • Coping 	<ul style="list-style-type: none"> • Bangladesh (Lalmunir hat, Gaibandha and Kurigram district) 	<ul style="list-style-type: none"> • Many households obtained cash to survive the effects of loss of property and crops, moving, and loss of work by borrowing, selling livestock and/or migrating for work. 	<ul style="list-style-type: none"> • All households changed their eating practices to cope with the floods reducing the number of meals and amount eaten, and mostly also eating lower quality / less preferred foods as well as limiting how much adults ate. • A minority of households did casual labour for food. • Migration for work as a coping strategy in 2016 may have been under-recorded as members of some households may have migrated for work in response to flood impacts but after the survey date, depending 	<ul style="list-style-type: none"> • 9 Focus Group Discussions • 120 Household surveys 	<ul style="list-style-type: none"> • Quantitative analysis and qualitative analysis 	<ul style="list-style-type: none"> • The study found many of the strategies and responses of flood and erosion affected households to cope with these hazards have not changed over time. • Not only are households living in the unprotected chars linked with the hydro-social landscape of flood protected areas through finding shelter on embankments and other protected public spaces, they are also more closely linked through employment than in the past with areas where hazard exposure is different, including urban areas. • Households may at best manage to recover their lives after floods and erosion since the vast majority reported that savings had declined in the past five years. Moreover the future prospects for these households are uncertain as flood hazards are perceived to be increasing in frequency. • Temporary evacuation was widely adopted by flooded households to move to safer locations. Migration for work, mostly by men, is very common in all of the study sites,

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https://hydro-social-deltas.un-ihe.org/sites/hydro-social-deltas.un-ihe.org/files/fhrc-migrationfloods-20162017_complete_final.pdf				on how long men from flood and erosion affected households needed to be with their families.			particularly in the more hazardous areas. This is either to cities and their edges for work in construction, labouring, pulling rickshaws, and rarely in factories; or to distant districts as teams/groups to work planting and harvesting crops during peaks in demand for agricultural labour. Especially from the more vulnerable locations, this is seasonal migration for six or more months of the year, usually in several trips, and these men avoid migrating for work in the flood season to be ready to cope and safeguard their homes.
Rahman (2010): Rahman, M. R. (2010). Impact of riverbank erosion hazard in the Jamuna floodplain areas in Bangladesh. Journal of Science Foundation, 8(1-2), 55-65. doi: 10.3329/jsf.v8i1-2.14627	<ul style="list-style-type: none"> Adaptation 	<ul style="list-style-type: none"> Jamuna 	<ul style="list-style-type: none"> Caused riverbank erosion a considerable proportion of the victims are compelled to leave the original homestead plot and take shelter by the road side embankment, neighbors land and relative land. 	<ul style="list-style-type: none"> Impact of riverbank erosion (migration) About one million people are directly affected each year by bank erosion in the country. The total monetary loss is estimated to be approximately US\$500 million a year. An estimated 300,000 displaced persons usually take shelter on roads, embankments and government-requisitioned lands. 	<ul style="list-style-type: none"> Secondary data from reports Structured questionnaire household data (<i>number not given</i>) 	<ul style="list-style-type: none"> Qualitative analysis 	<ul style="list-style-type: none"> Caused riverbank erosion every year unemployment, landless and poverty are increasing which is responsible to country wide unstable condition. It has been estimated that tens of thousands of people are displaced annually by river erosion in Bangladesh, possibly up to 100,000. The majority of the affected people perceive riverbank erosion as a natural phenomenon but in many cases the people believe erosion to be the 'will of God'. Riverbank erosion is seen as one of the major causes for national poverty. The impact of land loss involves primarily the loss of homestead land, housing structures, crops, cattle, trees and household utensils. Loss of homesteads forces people to move to new places without any option and puts them in disastrous situations.
Rahman et al. (2014): Tanvir Rahman, M. A., Islam, S., & Rahman, S. H. (2014). Coping with flood and riverbank erosion caused by climate change using livelihood resources: a case study of Bangladesh. Climate and Development, 7(2), 185-191. doi: org/10.1080/17565529.2014.910163	<ul style="list-style-type: none"> Coping 	<ul style="list-style-type: none"> Jamuna (Kazipur, Sirajganj) 	<ul style="list-style-type: none"> For floods, the following three major impacts were identified: crop damage, house damage and spread of water-borne disease. In the case of riverbank erosion, the major impacts are loss of land, including agricultural and non-agricultural land, loss of settlement and loss of income. 	<ul style="list-style-type: none"> Coping with floods and riverbank erosion The main strategies people use to cope with hazards include part-time work, rebuilding houses on an emergency basis, treating disease, taking temporary shelter on embankments and changing professions. The most effective coping strategy for flood and riverbank erosion was found to be doing part-time work. Physical and financial resources are the most effective means of coping with both hazards, while natural resources do not provide sufficient support. Social resources are comparatively more effective in helping people cope with riverbank erosion, as are human resources for flooding. 	<ul style="list-style-type: none"> 40 Key informant interviews 1 Focus Group Discussion 	<ul style="list-style-type: none"> Qualitative analysis Hazards and its impacts, livelihood resources (i.e. natural, physical, financial, human and social resources as well as practiced coping strategies of the study area) were identified using the PRA tools (i.e. KII and FGD). 	<ul style="list-style-type: none"> Riverbank erosion causes more physical non-recoverable damage than flooding, which in turn results in more human death than riverbank erosion. Coping and adaptation not only differ in terms of timescale, but also in terms of the action and strategy. Coping strategies are those that are possible within the current institutional settings, and adaptation strategies imply activities with longer term implications, more likely to involve more fundamental changes in the type of livelihood activity or location. In the post-disaster phase, the number of daily labourer increases with a decrease in wage of labour. Doing part-time work is the most effective and well-practiced coping strategy against the impacts of the both hazards. Natural resources do not give adequate support for people in coping with hazards.
Rasid & Mallik (1995): Rasid, H., & Mallik, A. (1995). Flood adaptations in Bangladesh: is the	<ul style="list-style-type: none"> Adaptation 	<ul style="list-style-type: none"> Bangladesh (19 districts) 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> 484 Questionnaire survey 	<ul style="list-style-type: none"> Statistical analysis 	<ul style="list-style-type: none"> These terms are somewhat abstract, but most of the floodplain farmers recognize normal floods as barsha (in Bengali)-recurrent annual flooding resulting from normal monsoon rainfall-and abnormal floods as damaging, high magnitude bonna. Nature of adjustments: early harvesting of aus; preparation of seedbeds for transplant aman; planting older and taller seedlings on lands liable to second or third flooding; retransplanting salvaged seedlings; protection of rice plants from water hyacinth by floating

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compartmentalization scheme compatible with indigenous adjustments of rice cropping to flood regimes?. Applied Geography, 15(1), 3-17. doi: 10.1016/0143-6228(95)91059-7							<p>bamboo fences; increase in area of cultivation of transplant aman; post-flood cultivation of lentils, pulses, mustard, etc; post-flood increase in winter vegetables and wheat cultivation.</p> <ul style="list-style-type: none"> Perhaps the most common adjustment of rice cropping to uncertainties of natural flood regimes was evident from the practice of intercropping aus and broadcast aman together. This measure ensured that at least flood-tolerant aman would be secured during an abnormal flood regime, even if flood-vulnerable aus were lost or damaged. During a normal flood regime both aus and aman would succeed, often resulting in a bumper crop.
Rasid and Paul (1987): Rasid, H., & Paul, B. K. (1987). Flood problems in Bangladesh: Is there an indigenous solution?. Environmental Management, 11(2), 155-173. Doi: 10.1007/BF01867195	<ul style="list-style-type: none"> Adaptation 	<ul style="list-style-type: none"> Bangladesh (Poa Kolaha, Kutubpur, Bahadipur, and Pakutia) 	<ul style="list-style-type: none"> Abnormal floods that occur once in every few years cause serious damage to crops and properties. Of all crop losses, rice and jute, the two most important crops of Bangladesh, are affected most seriously. 	<ul style="list-style-type: none"> To minimize flood losses, a number of modern engineering projects have been constructed within Bangladesh. The main shortcoming of engineering works is that complete protection against all probable flood events cannot be provided by a designed structure, despite substantial expenditures for construction, because eventually a flood of higher magnitude will occur which will exceed that for which the project was designed. Designing adequate structures is thus difficult, particularly for large and complex river systems such as those of Bangladesh. 	<ul style="list-style-type: none"> 78 Household surveys Review and field observations 	<ul style="list-style-type: none"> Qualitative analysis Review 	<ul style="list-style-type: none"> The river floods are normal annual events and human settlements and agricultural practices have adapted admirably well to their regimes. In the absence of adequate flood protection structures, the inhabitants of the floodplains in Bangladesh have developed a series of indigenous or traditional adjustments to floods over a period of many generations. Some of these measures involve adjustments of indigenous structures to floods, whereas others are related to agricultural practices. The term adjustment has been defined in natural hazards research as a human activity intended to reduce the negative impact of a hazard, that is, an extreme event. The most common practice is the building of homesteads on natural levees, which remain above the normal flood levels. In most cases, the construction of homesteads on highlands, generally called bhiti, involves further raising of the levees by digging earth from local depressions. During abnormal floods, however, water levels may rise above the bhiti, frequently flooding the floors of houses, which may force their occupants to take shelter on different types of platforms. Another structure that is usually constructed on elevated lands to keep it above the normal flood levels is the rural mud road system. Indigenous country boats, generally called dingis, provide an alternative means of transportation during such emergency. Elaborate adaptations of different crops to varied flood depths at different levels of the floodplains have been the most classic response of the farmers of Bangladesh to the recurrent flood problems. Morphologic features of the floodplains have been utilized to the fullest extent for these adaptations. Other adaptations are Brick-built houses with flat roofs, Adoption of floating rice, Placing bamboo sticks in the rice field, Placing bamboo fences in the rice field. Coming back to the original question —whether there is an indigenous solution to the flood problems in Bangladesh--the answer is a mixed one. The ultimate solution, that is, the effective control of downstream flood levels, will depend on the international collaboration for basinwide unified systems planning. In the absence of such collaboration, the flood control authorities in Bangladesh should develop a selected number of small-scale polders for controlling local flood levels and should encourage and reinforce various types of indigenous adjustments to floods.
Schmuck (2000): Schmuck, H. (2000). "An Act of	<ul style="list-style-type: none"> Coping 	<ul style="list-style-type: none"> Jamuna 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Perception and strategies to cope with floods Only 6 percent of the char-people leave their chars forever, which is much below the country-wide norm of leaving their home 	<ul style="list-style-type: none"> Formal and informal 	<ul style="list-style-type: none"> Qualitative analysis 	<ul style="list-style-type: none"> Despite these extreme living conditions, the char-dwellers do not leave for the mainland, be it temporarily or for-ever. They try to stay as long as possible in their home during high floods and in the case of erosion, dismantle it and transport it to another char which is less or not affected by floods and erosion at that moment.

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Allah": Religious Explanations for Floods in Bangladesh as Survival Strategy. International journal of mass emergencies and disasters, 18(1), 85-95.				villages in the countryside for the cities (ISPAN 1995, p. 3-14).	interviews • Group discussion • Life stories on flood		<ul style="list-style-type: none"> The riverine people behave pas-sively towards floods and erosion and only developed some "adjustment strategies" which enable them to live on the chars and the banks of the Jamua. They would undertake "corrective type of responses at individual levels rather than preventive measures". A large part of those were "incidental" rather than "purposeful" adjustment strategies. They followed strategies which have proven efficient for generations: they built platforms out of reeds and banana shoots for their animals, fixed their large wooden bed just below the roof, and cooked on portable ovens which every household has made during the dry sea-son for this case. They lived on the stocks of food they had preserved from the winter harvest and temporarily switched to income sources other than agriculture, expecting their crops to be severely damaged. In addition, they help each other and solidarity in crisis situations. At the same time, they expressed their faith to Allah, interpreting the high floods as His means to test their belief in His almighty power and at the same time demonstrating this power.
Shaw (1989): Shaw, R. (1989). Living with floods in Bangladesh. Anthropology Today, 5(1), 11-13. DOI: 10.2307/3032853	• Coping and adaptati on	• Banglades h	• n/a	• Temporary migration	• Field observati ons • Literatur es	<ul style="list-style-type: none"> Qualitative analysis Review 	<ul style="list-style-type: none"> Whereas the English term 'flood' implies abnormality, in Bengali distinctions are made between 'normal' and 'abnormal' floods. In the Dhaka region in the centre of Bangladesh, the term bor- sha refers to the wet season as well as the rain and the annual inundation which characterise it, associating 'normal' floods with regularity and seasonal cycles. This is contrasted with an 'abnormal flood,' bonna, which people define in terms of their own capacity to adapt to it. Houses are built on plinths (bhiti), platforms of raised earth, and may also contain a 'false roof' (kar), an area under the roof in which goods can be stored and people themselves can live if necessary. If water enters the house the household cooks, eats, sleeps and stores food on the bed, raising it higher if necessary by putting bricks under the legs. Other goods are stored on high shelves or hung from the roof in jute nets, and livestock are protected by wooden platforms (machan) built for them, or by being taken to a nearby road built on an embankment, if there is one. Serious floods have afected the area for centuries, but over the past few decades the adaptive capacity of the majority of Ban- gladeshis has been eroded further and further. Deteriorating levels of poverty have meant that increasing numbers of households can no longer afford a bed, cannot spare the necessary labour and money to build a false roof or to repair the plinth of their homes, have no surplus to enable them to absorb the losses of a spoiled harvest, and have moved into more marginal and flood-prone areas. For both women and men, the first priority was the protection of the means to cook and consume food: cooking pots, plates, and the knife. Control over the cooking process was of considerably more than practical importance. There was already considerable indebtedness due to damaged houses and lost property from the 1987 flood, although most families had managed to repay the bulk of their loans through occasional help from relatives, and through 'eating simpler food'. Over the next few months and years, further indebtedness will lead to even more drastic regimes of 'eating simpler food', in- creased malnutrition, increased levels of disease, in- creased numbers of abandoned wives left to feed children alone, increased sales of remaining assets, in- creased rural landlessness, increased migration to the cities, and increased vulnerability to future floods.
Sultana and Rayhen (2012): Sultana, N., & Rayhan, M. I.	• Coping	• Banglades h (Jamalpur, Sirajganj, and	• In the time of the flooding, rural people in Bangladesh suffer from the lingering effects of labor market	• Initially, households try to minimize risks and maintain some minimal level of sustenance. Gradually, the households start the disposal of assets in several phases (divestment) as a coping strategy.	• 595 Househol d surveys	<ul style="list-style-type: none"> Quantitative analysis Statistical analysis 	<ul style="list-style-type: none"> A major proportion of households are found to borrow money or resources from informal sources, such as nearby shops or the pharmacy, friends or relatives, or local money lenders, to buy food items and other essentials. Households initiate coping with borrowing money after the realization of floods, and gradually lead to cope with savings and selling assets as the duration of flood increases.

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(2012). Coping strategies with floods in Bangladesh: an empirical study. Natural hazards, 64(2), 1209-1218. DOI 10.1007/s11069-012-0291-5		Sunamganj)	disruption and income deficiency.	<ul style="list-style-type: none"> The highest frequency is observed for borrowing goods and cash from the nearby shop or pharmacy. The coping strategies are borrowing, using savings, selling items, changing habits, taking aids, begging, mortgage lands etc. The loss of assets is positively related with the amount of borrowing but households with more income are less likely to borrow. 			<ul style="list-style-type: none"> Frankenberger (1992) defines coping strategies as the fallback mechanisms when habitual means of meeting needs are disrupted. If households suffer from a shock like a flood, they utilize the resources and options they have to survive. The actions for survival strategies are mentioned as coping strategies. According to Rashid et al. (2006), coping strategies of flooded households are categorized into three stages: ‘current adjustment’, ‘unsecured borrowing’, and ‘secured borrowing / divestment’. Current adjustment strategies include reducing household food consumption, shifting to less preferred foods with lower cash cost, and reallocating household labor to increase current income. Unsecured borrowing refers to borrow against expected future incomes from relatives, moneylenders, merchants, and NGOs. Finally, households may cope with flood shocks by divestment or borrow against their liquid and productive assets. Better access to public financial services like banks could enhance households’ ability to cope with floods and help them to recover from the debt cycle.
Thompson and Tod (1998): Thompson, P., & Tod, I. (1998). Mitigating flood losses in the active floodplains of Bangladesh. Disaster Prevention and Management: An International Journal, 7(2), 113-123. doi: 10.1108/09653569810216333	<ul style="list-style-type: none"> Coping and adaptati on 	<ul style="list-style-type: none"> Jamuna chars 	<ul style="list-style-type: none"> Surveys of the impact of severe floods found that total losses and the dislocation to their lives is substantial. 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> 300 Household surveys 	<ul style="list-style-type: none"> Statistical analysis 	<ul style="list-style-type: none"> Major flood projection works are not possible in these areas where floods and erosion annually affect many vulnerable people. In Bangladesh rural people have adjusted to floods as far as possible, while government has mostly attempted to control floods. One of the most critical impacts of continuing flood losses in the chars shown by the survey is the decline in cattle numbers. The inhabitants of the active floodplain of Bangladesh’s main rivers receive little government support to help them cope with floods and have developed their own strategies. Damages to standing crops, trees, and boats are difficult to prevent with improved flood warnings and floodproofing. Avoidable losses, such as evacuation related costs, livestock losses, structure damages and losses to house contents which could be avoided by floodproofing measures. Coping placed pressure on the resources owned by both men and women, men tend mainly to own land and livestock and hence higher percentages sold these assets, but women also sold some of the few assets they possessed, including jewellery and household goods. Household members were forced to find paid work, including migrating away from the charlands, and also depended on the charity of both local people and outside relief agencies. Combined with direct loss of assets in floods, and loss of the key productive asset (land) to erosion, severe floods in the chars make vulnerable households and the community poorer. Small-scale floodproofing measures compare favourably with investments in larger flood control projects. Vulnerability of charland people could also be reduced by other measures both within the active floodplain and in other mainland areas, since the chars should not be considered in isolation from the rest of the country. Possible measures in the char areas include: improving agricultural returns in the dry season, better flood warnings based on upper catchment modelling in India, and implementing government policy for fair distribution of newly accreted land to erosion victims. In adjacent mainland areas there may be scope to diversify incomes and create new opportunities for employment of erosion victims and char people by assisting industrial development. However, small scale floodproofing in the charlands would be environmentally benign and bring immediate benefits to those at high risk.
Yasmin and Ahmed (2013): Yasmin, T., & Ahmed, K. M.	<ul style="list-style-type: none"> Coping with the changing climate 	<ul style="list-style-type: none"> Coastal and Jamuna 	<ul style="list-style-type: none"> Inhabitants have to spend maximum portion of their income for food and repairing houses that are often destroyed by 	<ul style="list-style-type: none"> The most suitable options for coping includes; eat fewer meals, borrowing money or take loan and sell labour in cheap at advance. All these copings are leading people to malnutrition, economic imbalance, 	<ul style="list-style-type: none"> 900 Household surveys Transect Walk 	<ul style="list-style-type: none"> Quantitative analysis and qualitative analysis used different tools of Vulnerability and Capacity Assessment techniques 	<ul style="list-style-type: none"> Community adaptations and implementation of proper indigenous knowledge is necessary to be resilient. Adaptive measures and coping is synonymous, according to International Strategy for Disaster Reduction (ISDR), coping is defined the ways people using their available resources and their abilities to face and manage adverse circumstance. Understanding of existing local

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(2013). The comparative analysis of coping in two different vulnerable areas in Bangladesh. International Journal of Scientific & Technology Research, 2(8), 26-38.			<p>recurring disasters just to survive.</p> <ul style="list-style-type: none"> Savings are almost zero and medical and education expenses are only amplifying their burden. 	<p>and domestic hostility along with mental instability which would hinder people's ability to take proper decision in time of risk or affect current coping ability with recurring events or the vice versa.</p> <ul style="list-style-type: none"> Pre-disaster coping: people made their beds or boxes with long legs to keep their valuables in time of floods. They also build extra ceilings underneath the main ones to store crops, food and fuel to protect from inundation. Post-disaster coping: The char land people generally cope by moving housing structures, livestock, and family members to safer areas during flooded season. 	<ul style="list-style-type: none"> Social and Institutional Network Analysis Direct Observation Key Informant Interview (KII) Social and Risk Mapping Focus Group Discussion (FGD) Livelihood Analysis Historical Profile Secondary data 	<ul style="list-style-type: none"> Transect Walk Social and Institutional Network Analysis Direct Observation (DO) Key Informant Interview (KII) Social and Risk Mapping Focus Group Discussion (FGD) Livelihood Analysis Historical Profile 	<p>coping mechanisms and their interrelation to the socio-economic dynamics as well as people's mental ability to cope in the long run will lead to the community resilience.</p> <ul style="list-style-type: none"> In Bangladesh, researchers emphasized on adaptation to flooding (Schmuck, 1996; Rasid, 2000; Delap, 2000; Del Ninno and Dorosh, 2003; Rasid, 2003; Few, 2003); indigenous adjustment strategies to flooding (Islam, 1991; Rasid and Paul, 1987, Rasid, 1993), adjustment strategies to agricultural cropping patterns (Islam, 1991, Paul, 1998; Rasid and Mallik, 1995) and; coping with riverbank erosion (Haque and Zaman, 2007; Mamun, 1996; Hutton and Haque, 2004). The inhabitants have to comprise with their basic needs just to survive due to coping with the vulnerabilities and being exposure at risks. Loan is very common in people to survive in the disaster events and aftermath. In this situation coping option has becoming narrower day by day.
Zaman (1993): Zaman, M. Q. (1993). <i>Rivers of life: living with floods in Bangladesh</i> . Asian Survey, 33(10), 985-996. doi: 10.2307/2645097	-	<ul style="list-style-type: none"> Bangladesh 	<ul style="list-style-type: none"> In 1988 nearly 66% of the land area was inundated, some 3,000 people died, and an estimated 45 million were at least temporarily dislocated. 	<ul style="list-style-type: none"> The destructive impact of the flooding is usually limited by the adjustments that peasants inhabiting the floodplain regions have historically made, adapting their agricultural practices, cropping patterns, and settlements to the annual deluge. But the high or abnormal floods, associated with widespread damage to standing crops, properties, and loss of human life are viewed as a calamity or disaster. Last decade Bangladesh experienced four such disastrous floods-in 1984, 1987, 1988, and 1993. 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Qualitative analysis This paper examine, within the context of the catastrophic 1988 and 1993 floods, the contemporary debate on the desirability of large-scale engineering schemes for flood "protection. This article expands on this position to develop an alternative to the "prevention" of floods through structural measures. 	<ul style="list-style-type: none"> Discussed against flood control measures supporting living with floods. During each monsoon season, almost all of Bangladesh's deltaic plain is submerged- most of it for about half the year. Flood control policies in Bangladesh should lead to the promotion and management of all resources of alluvial plains so that economic, social, aesthetic, and environmental needs can be fulfilled, while cultural integrity, essential ecological processes, biological diversity, and life support systems are maintained.