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Population displacement after cyclone and its consequences: empirical evidence from coastal Bangladesh

Bishawjit Mallick · Joachim Vogt

Abstract This study investigates the disaster-induced population displacement scenario at individual household level in Bangladesh. 'Population displacement' is seen here as an alternative adaptation option to natural hazard for the survivors after cyclone Aila. The changes both in origin and destination community due to population displacement are described here on the basis of social 'inclusion' and 'exclusion' concept. The field survey was conducted during March–July 2010, and a sample of 280 respondents from 12 villages in southwest coastal Bangladesh was interviewed. Findings show that at the end of emergency aid, male members of the family started moving towards nearer cities to find an income. Based on the income and asset distribution at the community level, this study developed a societal cluster of displacement and demonstrates the societal changes because of cyclone-induced population displacement.

Keywords Population displacement · Societal cluster · Cyclone Aila · Social change · Coastal Bangladesh

1 Introduction: research aims and objectives

'Population displacement'—whether temporary or permanent, internal or international, or forced or voluntarily—is very complex to define. The purposes and causes of migration often vary; it is difficult to know the root causes of population movements. The concept of 'pull' and 'push' factors is not new. There is ample evidence to describe these motivations in different ways. For example, Taylor (1999) focuses on the labour migration and the role of remittances in the migration process; Kontuly et al. (1995) evaluates the importance of culture for migration; Özden and Schiff (2006) raises the questions related to migration and 'brain drain'; Hunter (1998, 2005) describes the association between environmental

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problems and internal migration flows; Oliver-Smith (2009) analyses the impact of sea-level rise and the vulnerability of coastal peoples in the twenty-first century; McLeman (2009) assesses the impacts of population change on climate change vulnerability and adaptation; Black et al. (2011a, b) presents a framework for understanding the 'five families of drivers', which affect the migration decisions: economic, social, political, demographic and environmental drivers. Their research shows that individual migration decisions are mostly dependent on the combination of all these drivers, whereas the effect of environment is highly influenced by social, economical, political and demographic contexts (Black et al. 2011a, b).

Further, it is also very complex to define those 'displaced people'. Some researchers define the 'displaced people' based on their causes of displacement (Warner et al. 2009). Renaud et al. (2007, pp. 16) propose a decision framework for determining the subcategories of environmental migrants. They divide the 'environmentally displaced people' into three groups according to their relation to environmental disruption: environmental emergent migrant (EEM), environmental forced migrant (EFM) and environmental motivated migrant (EMM). Examples of slow-onset and rapid-onset drivers of migration are discussed while taking the nature of environmental disruptions into consideration (IOM 2009; Warner 2010). Conceptual contradictions between the 'displacement' and 'migration' are also evident (Black 1994; Black et al. 2011a, b; IOM 2008; Warner 2010).

Thereafter, the migration process—slow or rapid, forced or motivated, temporary or permanent—influences societal change (Mallick and Vogt 2012; Portesa 2010). Usually, societal change takes place due to internally driven transformation (i.e. demographic change) and external 'shocks' on the societal system (i.e. environmental disruption) and can be categorised in a hierarchy of 'micro-processes', 'meso-process' and 'macro-process' (Portesa 2010). The 'micro-process' refers to the changes observed involving individuals within their immediate surroundings, 'meso-process' describes the changes observed in entire communities and regions, and 'macro-process' depicts total societies and even the global system (Portesa 2010). Further, the total migration process has direct socio-economic and cultural impacts on society at both the origin and destination of the displaced peoples. Societal changes resulting from those impacts can be explained with a concept of societal 'inclusion' and 'exclusion' (Luhmann 1995; Rawal 2007), because 'displacement' has two directions 'origin' and 'destination', where the 'origin society' has a decreasing number of residents and 'destination society' represents an increasing number of residents. Such deviations in a population deform the societal structures, particularly the nature and structure of the local demographic and socio-economic situation.

Being accustomed with these theoretical and conceptual understandings, this paper first considers an environmental disruption (i.e. cyclone hazard) as an 'external shock' to a coastal community in Bangladesh. With empirical evidence, secondly, it assesses the 'nature of population displacement' described as 'micro-level consequences to the society' on the basis of 'forced' or 'voluntary' and 'with family' or 'without family'. Thirdly, the observed changes for individuals and their surroundings are discussed as an outcome of environmentally induced population displacement. Findings show that disparity in socio-economic status at the community level tends to be higher at risk exposure levels, implying that individually vulnerable people move in the aftermath of an environmental hazard to ensure their livelihood.

The remainder of this article is organised as follows. Section 2 describes the nature and pattern of societal changes due to population displacement and thereafter concludes with an assessment of the importance of this research in context of migration and climate change in Bangladesh. Section 3 introduces the empirical study and analysis tools. In Sect.

4, the 'displacement pattern' along with its causes in the social, economic and political context is examined. Observed socio-political consequences due to population displacement are presented in Sect. 5. Section 6 concludes the article.

2 Environmental change on human migration

2.1 Climate change and population displacement

Recent studies discuss the effects of climate change on human migration in the world. In that case, Myers (2002) estimates that 25 million people of the world were displaced in 1995 due to environmental disruptions. Further, he projects that by 2050, there will be 200 million people displaced, taking into account population change and climate change consequences to the environment. In contrast to Myers (2002), Biermann and Boas (2010) calculate the number of people who would be affected by the 2080s by storm surges with a sea-level rise of about 38 cm in different parts of the world. They come up with a result of 82 million people affected in Africa, 141 million in Asia and 2.5 million people for small island states (Biermann and Boas 2010). They provide statistics of estimated displacement induced by sea-level rise for each country, for example, 26 million in Bangladesh, 12 million in Egypt, 73 million in China and 20 million in India, all by the year of 2050. Additional, assuming a temperature increase of 4 °C by the end of twenty-first Century, Nicholls et al. (2011) state that up to 187 million people could be forcibly displaced because of sea-level rise over the century. Gemenne (2011) disagrees with this result, as it only reflects the number of coastal people at risk of flooding but does not consider the other factors of migration, such as poverty or alternative adaptation strategy. Another contradiction is observed in Christian Aid Report of 2007, which predicts that around one billion people could be forcibly displaced by 2050. This report also predicts that 300 million of those displaced people would be the result of environmental disruptions (Aid 2007). Further, in a media report of the American Association for the Advancement of Science (AAAS), Zelman (2011) predicts '50 million environmental refugees by 2050'. The forecasts of human displacement due to environmental changes and the predictions for future displacement scenarios along with their methodological difficulties are well discussed in Gemenne (2011). However, the 'number of displacement' does not always depict the extent of the impact of 'environmental disruption' to the community, and therefore, it is important to portray the whole spectrum of such impacts on a country, like Bangladesh, the most densely populated country in the world.

2.2 Understanding 'population displacement' in context of environmental hazard

The conceptual debate on the population movement due to environmental hazards is not a new one (see Black 2001; Myers 2002; IOM 2007; Warner 2010, etc.). A unique term to define those people, who are being displaced or who migrate due to environmental degradation at their original settlement, is still unclear or undecided. Potential terms include 'environmental-induced migrant' (IOM 2007) or 'environmental refugee' (Myers 1997, 2002). Black (2001, p. 1) states that the term 'environmental refugee' was first popularised by Lester Brown of the Worldwatch Institute in the 1970s and came into widespread usages after a 1985 United Nations Environment Programme Policy Paper written by E. El-Hinnawi entitled 'Environmental Refugees' (Warner et al. 2009). The definition of Essam El-Hinnawi (1985) is presented below:

Those people who have been forced to leave their traditional habitat, temporarily or permanently, because of a marked environmental disruption (natural and/or triggered by people) that jeopardised their existence and/or seriously affected the quality of their life [sic]. By 'environmental disruption' in this definition is meant any physical, chemical and/or biological changes in the ecosystem (or resource base) that render it, temporarily or permanently, unsuitable to support human life (El-Hinnawi 1985, p. 4).

Bates (2002) comments that El-Hinnawi's definition of 'environmental refugee' makes no distinction between the rapid-onset refugees (i.e. who flee volcanic eruptions) and slow-onset refugee (i.e. those who gradually leave their homes as soil quality declines). The next popular definition of the same term, 'environmental refugee' by Myers (2002), includes those who can no longer maintain a secure livelihood in their settlements because of environmental disruptions (i.e. droughts, floods, cyclone, etc.) and face problems of poverty. So many people can be classified under the umbrella of 'environmental refugee' that critics question the usefulness of the concept. Thereafter, the International Organisation for Migration (IOM) suggested a working definition of environmentally induced migration, which has been used in different research as an overarching concept (Black et al. 2011a, b; Renaud et al. 2011; Warner 2010). The IOM states: 'Environmental migrants are persons or groups of persons who, for compelling reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad' (IOM 2007). This definition of IOM depicts different aspects of 'migration process': temporal (sudden or progressive), subjective (forced or motivated) or objective (temporarily or permanently).

Recently, Renaud et al. (2011) had developed a 'decision framework' to understand the human migration due to environmental causes and divided the 'migrant/displaced' people into three categories: environmental emergency migrant (EEM), EFM and EMM. EEM are people who have to flee from their home because of the swiftness or rapidness of an environmental event (for example, cyclone, floods, tsunami, earthquake, etc.) and who have to seek refuge for the same reasons to save their lives (Renaud et al. 2011), whereas the EFM are people who have to leave their homes in order to avoid the certain environmental degradation/causes, like river bank erosion. People who are in the EFM category may not have an option to return back to their origin, and in most of the cases, their displacements are permanent. The third category is EMM, who 'may leave' their origin due to a foreseeable and deteriorating environmental condition. However, the patterns of environmentally induced population displacement categories vary regionally and globally for hazards having the same characteristics, particularly for the environmentally forced and environmentally motivated migrants (Renaud et al. 2007). This paper considers the displaced people as 'EEM'. However, the distinction between 'migration' and 'displacement' is mostly contextual and temporal (Bates 2002; Black et al. 2011a, b); this study uses the term 'population displacement' instead of 'migration' for further discussion.

2.3 Consequences of 'population displacement' to the society

Naik et al. (2007) focus on how natural disasters interplay with migration and development dynamic. Considering the Indian Ocean Tsunami in 2004 and migration issues in Indonesia, Sri Lanka and Thailand, they particularly describe the effect of natural disasters on migrant communities in regard to lack of access to assistance. Secondly, they highlight the migratory flows due to socio-economic changes. Finally, they describe the importance of an aftermath re-development process and its relation to migration decisions. However,

their findings do not provide details about the consequences of migration on the affected society. Black et al. (2011a, b) introduce a new approach for understanding the relationship between migration and climate change. They address the sensitivity of migration drivers in the specific context of climate vulnerable countries: Ghana and Bangladesh. They make a distinction between slow-onset changes associated with decreased rainfalls in Ghana and rapid-onset changes associated with floods and cyclones in Bangladesh. They conclude with a proposal for the development of an integrated assessment approach that holds significant potential for policy making aimed at adaptation to climate change; however, they do not depict the societal consequences due to migration. Carr (2005) considers local politics involved in the environment-induced migration process. He presents a framework that links the environment, economy and society in order to understand the decision-making process of migration and the role of environment in influencing those decisions. In developing the framework, he considers the environment, society and economy as a product of social differentiation and instrumental modes of social power and resistance. He applied this framework to illustrate the rural environment and migration process in Ghana and has concluded that the environment cannot be excluded from migration decision making because it is a key element of any local knowledge and power; therefore, it will always impact migration decisions.

The result of a disaster to the victims is a 'push' to leave the area and to see the incident as an opportunity creating a reason to move (Bates 2002; Poncelet et al. 2010). The disaster maximises the 'exclusion' for the original community and the 'inclusion' pressure to the new community (i.e. where they move). However, in this paper, 'social exclusion' is defined as 'a matter of detachment for an old member from the original settlement' and 'social inclusion' as 'a matter of addition of a new member to an (un)known social community'.

Ongoing discussions consider whether or not migration, if properly managed, could be a positive solution for climate change adaptation options as well as for development in general (IOM 2009). Many studies on natural disasters and migration focus on developing countries (Brown 2008; Najam 1996; Poncelet et al. 2010). While these studies have considered the socio-economic factors (Afsar 2003; Najam 1996) and environmental factors (Bates 2002; Dessai and Wilby 2011; Hunter 1998, 2005; Poncelet et al. 2010; Tacoli 2009) as indicators of migration decision following a disaster, they have neglected the societal consequences on migration. This research will fill this gap with regard to migration decision in coastal Bangladesh.

2.4 Relevance of this study on Bangladesh

The relevance of this study on Bangladesh is explained here, with emphasis on firstly, the importance of policy planning in response to the climate change consequences; and secondly, the research gaps that depicts the societal consequences of climate change induced population mobility.

In terms of total population and percentage of country's population living in the coastal areas, the world's third most vulnerable country to sea-level rise is Bangladesh. Presently, almost 40 million people lives in the coastal areas of Bangladesh (Pender 2007). The coastal area represents an area of 47,211 km^2 equalling 32 % of the country's total geographical area (PDO-ICZMP 2004). Current predictions claim that this coastal area will be increasingly submerged up to 3 per cent by the 2030s, 6 per cent in the 2050s and 13 per cent by 2080s as a result of a sea-level rise (Pender 2010). Therefore, it is very likely to generate a steady flow of displaced people to the inland areas of the country (Pender 2010),

and forced migration will be a major consequence. For example, in 1998 flooding, 68 % of the country's land area was submerged for 10 weeks, and temporarily, 30 million people were displaced (Pender 2007).

'Population displacement'-related research in Bangladesh can be divided into two groups: seasonal migration due to poverty (Afsar 2000, 2003; Khandker 2012; Qin 2010) and human mobility due to environmental disruptions (Ahsan et al. 2011; Gray and Mueller 2012; Kartiki 2011; Mallick and Vogt 2012; Penning-Rowsell et al. 2012; Poncelet et al. 2010). Because of centralised nature of economic opportunities at cities, rural-to-urban and seasonal migrations are very common in Bangladesh. Afsar (2003) analyses the inter-linkage between development and internal migration process in Bangladesh; she found that rural-to-urban migration is caused by an agriculture-dependent economic structure of the rural livelihood. Khandker (2012) depicts that 36 per cent of poor households in northwest Bangladesh migrate every year during the lean period to cope with seasonal deprivation.

However, people are now moving to cities as a result of natural hazard-induced inundation/loss of their settlement. Gray and Mueller (2012) investigate the consequences of climate-related natural disasters for long-term population mobility in rural Bangladesh. Their results indicate that flooding has modest effects on population mobility, particularly, for women and the poor. Additionally, crop failures without considering the flood impacts have also a strong impact of population displacement.

Azam (2011, p. iii) finds that the changes with agricultural have caused ecological disaster in the southwest area due to salinity intrusion and shrimp farming. People canalise the saline water from nearby river inside their shrimp farm. These man-made interventions to the surrounding environment lead to significant environmental transformation and threats to local resilience, resulting in the loss of trees, and livestock, grazing, rice cultivation areas. An arrival of cyclone-induced flooding in such situations decreases household resilience, and as a result, vulnerable people have to move outside their home territory to the urban, suburban areas or even other villages for jobs (e.g. paddy harvesting, rickshaw puller, day labour, etc.), where they stay, usually for 1 week to a maximum of 6 months. Similarly, Penning-Rowsell et al. (2012) seek to understand the 'push' and 'pull' factors affecting hazard-related migration in Bangladesh. They find that the poorest are always the hardest hit and are more likely to have some family members move after hazards, regularly or permanently. The main objective of the family member's (usually male) mobility is to seek work and most of them leave their wives and children behind. According to them, population movement appears generally to be the 'last resort'. Another study by Poncelet et al. (2010) reflects on the cyclone Sidr in 2007, its induced migration in Bangladesh, and the intervention programmes undertaken by the government in response to such population mobility. Their study concluded that those who were most helpless are the most likely to migrate. This finding is contradictory with the findings of Hatton and Williamson (Hatton and Williamson 2002), who found that most of the world's population do not want to move due to personal and financial constraints. With a focus on policy and social and economic impact, Kartiki (2011) observed people's movements in the aftermath of cyclone Aila[1] of 2009. She looked at factors influencing migration in five coastal villages of southwest Bangladesh and the migration experience. She noticed that 'remittance' was the main driver of population displacement after cyclone Aila (Kartiki 2011). Similar evidence is also reported in Mallick and Vogt (2012). Analysing the asset profiles of the sample

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[1] For details about cyclone Aila, readers are referred to UNDP (2010) report on "Cyclone Aila: Joint UN Multi-Sector Assessment and Response Framework".

respondents, they define a social cluster of 'displaced people'. Additionally, their analysis discovered local power disputes on the vulnerable women-headed families after the displacement of their male members from the family. Most of these analyses contribute to the catalogue of environmental-induced migration drivers of Bangladesh. Nevertheless, none of the aforementioned researches provide any issues related to societal consequences though the political instability and population movements associated with climate change could pose a threat to national security. Therefore, this study attempts to provide detailed information regarding the consequences of cyclone-induced population displacement on society. Particularly, this study concentrates on identifying those left helpless after cyclone Aila of 2009, their reasons of displacement, and the consequences due to the displacement at their 'origin' and 'destination' society. Results are presented on household response to cyclone-induced migration, with particular consideration of the individuals and their families' related information, i.e. a 'micro-level' analysis.

3 Empirical example

3.1 Background of cyclone Aila and population displacement in general

The cyclone Aila was a category 1 cyclonic storm. It hit the southwest coastal Bangladesh on 25 May 2009. The highest wind speed was recorded as 120 km per hour. Though the speed of cyclone Aila was not denoted as a severe one, the consequences of it were very long sustained. One of the main reasons was the breaches in the coastal embankment, which consequently submerged villages. These similar villages were also affected by cyclone Sidr on 15 November 2007 just 18 months before of Aila. The death toll of cyclone Aila was 234 (Mallick et al. 2011), which is comparatively very low from a Bangladesh perspective. However, the loss of infrastructure (Mallick et al. 2011), houses, institutions, cultivable land and crops, the livelihoods of the survivors were simply destroyed.

According to print media and local observations, four upazila[2]s under Khulna and Satkhira district[3]s were the mostly affected: Dacope and Koyra upazilas of Khulna district and Shyamnagor and Assasuni upazilas under Satkhira district. Around 234,000 houses were fully destroyed, and 370,000 were partially damaged in these four upazilas (Mehedi et al. 2010). A Aman[4] paddy of around 97,000 acres of land including around 14,000 acres of shrimp farm and fresh water fishes of 3400 village ponds all has been submerged and damaged (Mehedi et al. 2010). However, the survivors of cyclone Aila had tried to survive in these areas for at least 1 week after Aila (Kartiki 2011; Mallick et al. 2011; Mehedi et al. 2010). People then started to move nearby cities and villages when they faced food and water crisis. According to the report of Humanity Watch, a total of 123,000 people were displaced from the affected areas out of which 27 % came from Dacope, 34 % from Koyra, 30 % from Shyamnagor and 9 % from Assasuni upazila (Mehedi et al. 2010). This study considers the situation of Shyamnagor upazila.

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[2] Upazila is the second lowest official administrative unit of the local government in Bangladesh.

[3] District is the top-tier official administrative unit of local government in Bangladesh.

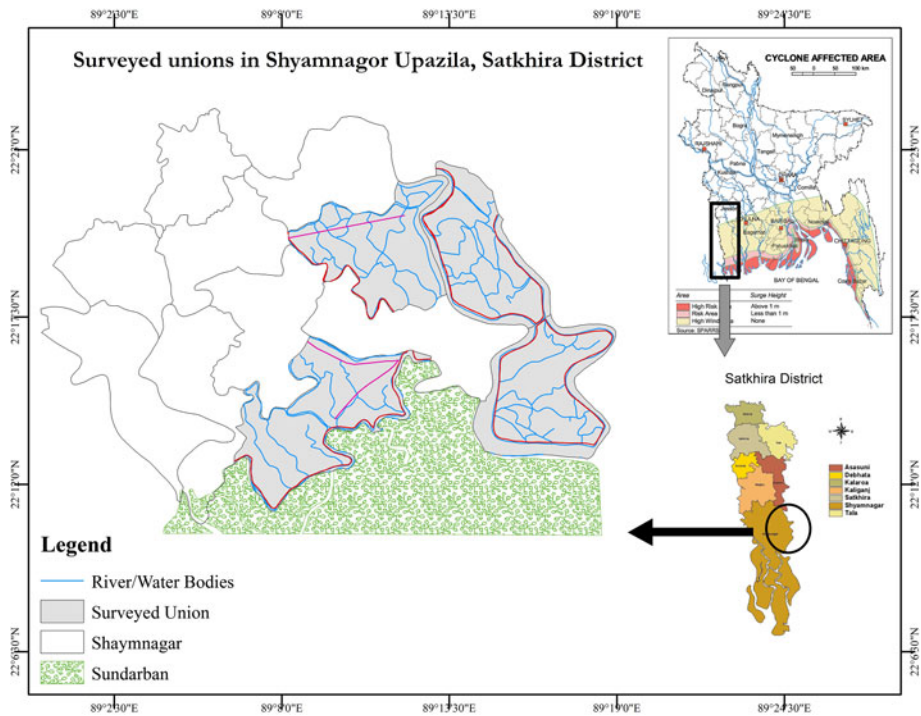[4] A term used in Bangladesh and West Bengal of India for lowland rice grown in the wet season during June–November.

Fig. 1 Map of study area

3.2 Study area

The geophysical, social, political and economic situation of the coastal area of Bangladesh is different from the inland area of the country (PDO-ICZMP 2004). The case study was carried out in 12 villages of four unions[5] (i.e. Padmapukur, Gabura, Atulia and Munshi-gonj) at Shyamnagor upazila of Satkhira district (Fig. 1). These unions are located in the southwest part of the country and adjacent to the Sundarbans[6] and were severely devastated due to cyclone Aila in 2009. Around 85,000 persons, mostly farmers and fishermen, are living in this study area of 134 km^2. Mostly, the inhabitants of these villages are strongly dependent on the resources of Sundarbans (Small and Series 2010). The areas' topography varies between 0.25 and 3.5 metres above sea level. The average annual rainfall is about 2025 mm, 75 per cent of which fall during the monsoon from June to October (Mallick and Vogt 2012).

3.3 Field survey

This field study was undertaken from April to June 2010, approximately 1 year after cyclone Aila hit on the study villages. Being assisted by a local research organisation, Coastal Research Foundation (CRF), the first author of this research has visited the affected

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[5] Union is the third lowest official administrative unit of the local government in Bangladesh.

[6] Sundarbans is the world largest mangrove forest and declared as world heritage by UNESCO.

villages and informally collected information about the devastation occurred by cyclone Aila. Comparing the collected information with locally available newspapers, reports and working papers, the household survey was planned. Two male and 2 female data collectors were hired and trained. A 2-day training session with the local expert, the CRF, was conducted for the data collectors. After two successful 'pre-test' rounds of the structured questionnaire, data collectors started to interview the respondents and completed 280 household interviews. Each interview lasted on average 30 min. A stratified sampling procedure was used, where 12 villages were chosen based on their extremity of damages and losses due to the cyclone Aila. In each of these 12 villages, every 18th household along one side of the main road was selected as sample. The sample size distribution at village level is presented here in Table 1.

The questionnaire was focused on the issues related to adaptive measures and strategies that they had taken in response to cyclone Aila and the pre- and post-cyclone intervention programmes implemented by different stakeholders. Socio-demographic profiles of the respondents were also collected during household surveys. Displacement of their family member was considered as an alternative strategy to secure livelihood; therefore, they were asked to respond about the displacement location, types of work, amount of remittances and future plans of migration. Those households which had reported 'displacement' (temporary/permanent) of at least one of their family members were taken into consideration in this paper. In this case, 98 of 280 respondents reported about their male members' displacement from the family to seek alternative income sources.

Additionally, 15 semi-structured in-depth interviews were carried out with questions focused on the 'displacement process, [and] its causes and consequences to them'. The participants of in-depth interview were selected according to their willingness during household survey. On average, each interview lasted around 2 hours. A snow-ball sampling method was applied to find out other 'displaced people' in Khulna city. Having collecting a number of contact addresses of the respondents' migrated family members in Khulna city, group discussion sessions were conducted at the displaced family members' new abode in Khulna. These group discussion sessions portrayed the migrants' livelihood challenges, especially changes in their social network and livelihood in their new residences.

Table 1 Sample size distribution	Union (sample)	Villages	Sample
	Padmapukur (49)	Garkumarpur	23
		West Pathakhali	26
	Munshigonj (40)	Mothurapur	10
		Kali nagar	17
		Munsiganj	13
	Gabura (139)	Chakbara	15
		Chandni mukha	26
		Kholsabunia	69
		Gabura	25
		Gain Bari	4
	Atulia (52)	Nowa baki	13
		Biralaxmi	39
	Total		280

3.4 Analytical framework

The most renowned 'Harris-Todaro' model of migration process analysis explores the 'push' and 'pull' factors, where the individual's earnings matter in the migration decision. This model simplifies the equilibrium of migration process based on the welfare levels of rural economy (Harris and Todaro 1970). Additionally, the 'gravity model' is commonly used in analysing the origin–destination of migration process (Letouzé et al. 2009); it shows the interaction between economic and social drivers by pointing to the importance of both drivers and attractions in migration decisions. Similar observation is mentioned by Findlay (2011). This concept is simplified in the Eq. 1.

$$M_{ij} = \frac{K \times P_i}{D_{ij}} \tag{1}$$

where M_{ij} = expected migration flow from origin i to destination j; P_i = population of origin i; K is constant that adjusts the gravity model estimates so that the number of actual and estimated migrants is approximately equal; D_{ij} = distance between origin i and j (km.). Here, the attraction factors of the origin society were ignored. The distance is less important if there are good transportation and communication facilities available. Taking attraction, i.e. the pull factor in context of gravity model to be proportional to the population size and inversely proportional to distance into consideration, this paper analyses the origin–destination of cyclone Aila triggered population displacement scenario of the studied villages.

Linear regression analysis is a very common way to point out the influential factors in any decision-making process. In the case of migration-decision analysis, Hatton and Williamson (2002) offer a quantitative assessment of economic and demographic factors that drive world migration. They make a distinction between migration 'pressure' and migration 'ex-post' and analyse the global scale of migration drivers. However, this paper concentrates on a local level analysis and considers the 'principle component analysis (PCA),[7] method to derive the factors of 'displacement decision' aftermath cyclone Aila.

4 Results

4.1 Socio-demographic profile of the respondents

According to the religion, the respondents are divided into 250 Muslims and 30 Hindus. Amongst them, 200 were males and 80 were female, of which 73 are Muslim women and 7 are Hindu women. The average age of the respondents is reported as 45 years (min 17 and maximum 86 years). About 40 % of the respondents are illiterate, 31 % possess primary education, 26 % possess secondary level and the rest (only 3 %) has university level education. Only 2 % of the respondents are identified as landless, 6 % receive Khas-Land from the government and the rest has their own land. Almost all houses are made of tally/goalpata (roof) and mud (both wall and floors). Again, 50 % of the households earn only US$ 57.14 monthly or yearly US$ 687. The average per capita income is US$110.8. Using the Basic Cost Need (BCN) calculated by the Bangladesh Bureau of Statistics for the

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[7] Principle component analysis (PCA) is a way of identifying the patterns in data, and expressing the similarities and differences in data.

calculation of poverty threshold (US$115 per capita per year), almost 50 % of the population included in the sample appear to live below the poverty line.

4.2 Livelihood after cyclone Aila

Agricultural-related activities were the main sources of livelihood, though after cyclone Aila approximately 63 % of the respondents reported day labour as their livelihood. There is a widespread variation in monthly income before and after cyclone Aila, as can be seen: average monthly income was about US$ 87.31 before cyclone Aila and US$ 57.32 after cyclone Aila. Half of the sample population earned only US$ 57.14 before cyclone Aila and US$ 42.85 after cyclone Aila. Furthermore, the average monthly expenditure was US$ 72.3 before and US$ 44.29 after cyclone Aila, respectively. Immediately after the cyclone, there was a lack of income sources, though few jobs were available for the community people, for example—the earth-work activities, reconstruction of embankments, roads, bridge, culverts, etc. To work in those rehabilitation and reconstruction works, one would give their name to the respective authority (contractors). This naming process requires support from local leaders and the social networks of the respondents (Mahmud and Prowse 2012). If the respondents' family members were unable to get enough income sources through locally organised rehabilitation works, they became the primary target for of displacement (35 % of the total respondents).

4.3 Social cluster of displaced families

The male members of 35 % of the sampled households moved towards nearer cities and villages immediately after the emergency relief works, within 4 weeks after the incident of cyclone Aila. Field data show the status of housing conditions after cyclone Aila also helped the displacement decision ($r = 0.039$; $p < 0.001$). Damage costs appear to be significantly and positively correlated with household income ($r = 0.391$; $p < 0.001$) at individual household levels, suggesting that respondents who were better off in economic terms were also most sensitive and vulnerable to suffer economic damages. That is the more one has, the more can be lost or is at stake to be lost. On the converse, the poorer one is, the easier it is to leave the damage behind for something better.

Again, damage cost is not that severe if the monthly income is decreased. The resource base or land is not important if there is no scope for agricultural productivity, because of the long-term inundation of farm land (Kartiki 2011; Mehedi et al. 2010). Therefore, a matrix is developed based on the following indicators and their classifications:

A) *Monthly family income*: less than US$ 30, US$ 30–75 and more than US$ 75

B) *Land ownership*: less than 0.10 Acre, 0.10–0.50 Acre and more than 0.50 Acre

C) *Damage cost due to cyclone Aila*: less than US$ 145, US$ 145–430 and more than US$ 430

All these conditions are taken into considerations as independent variables for the dependent variable 'displacement as adaptation strategy after cyclone Aila', and it was portrayed in the Fig. 2.

Figure 2 depicts that mostly the poorer segment of the studied society has reported displacement of their family members. Income poverty dominates the relationship with other factors, i.e. land ownership and damage costs to take 'displacement' decision. Figure 2 supports that household economic condition is the prime causes for population displacement (Afsar 2000; Poncelet 2009).
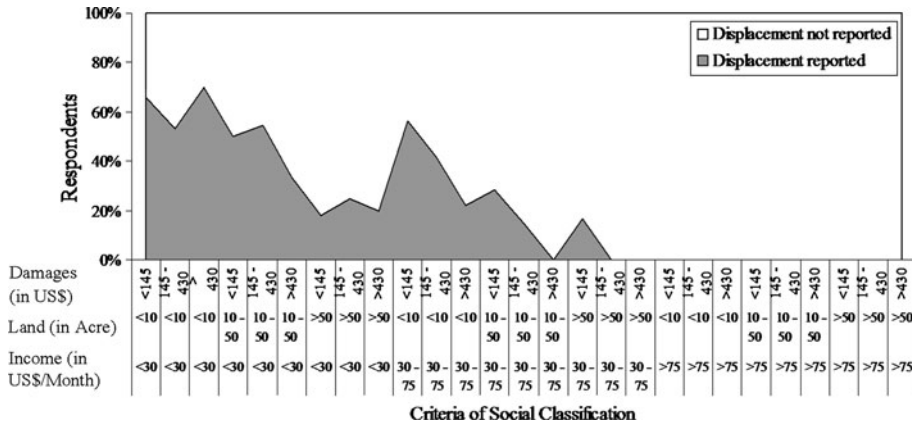
Fig. 2 Social cluster that adopted displacement as coping strategy after cyclone Aila

4.4 Spatial distribution of displacement

Most of the displaced families (78 %) report that their 'displaced family members' moved to nearby big cities, namely Satkhira, Khulna and Bagerhat, where there was a possibility to be hired to drive a rickshaw or van. Twelve percentage of the remaining 22 % moved to the capital city Dhaka because of offers to get work from their relatives, who had already migrated there. The last 10 % moved to Chittagong port to work in a dockyard or the fishing business. The actual and observed displacement statistics are placed in Table 2 according to the simplified equation of gravity model (Eq. 1). Addition to this, Table 2 represents also:

N_{ij} actual migration in sample HH; L_{ij} difference between expected and observed migration.

The mean K-value is 13, i.e. the population displacement is 13 times more than the expected one, which may be interpreted as consequence of cyclone Aila. Respondents of the families who have moved to Dhaka, Chittagong and other far places (22 %) cannot specify the activities of their displaced family members. They replied as they became informed about their displaced family members through mobile phones or members who have returned or visited home.

4.5 Factors that influence displacement

There is evidence of the displacement of poorer and helpless people after cyclone Sidr in Bangladesh (Poncelet 2009). The majority of people mention job and income as the primary reasons of their displacement. Accordingly, this study attempts to find the factors of helplessness. Data show that the cyclone Aila induced losses and damages, which have a direct impact on the decision of movement ($r = 0.079$, $p < 0.001$), and opportunity of diversified income suggests also to move towards nearby cities ($r = 0.031$; $p < 0.002$). These findings signify the environmental *push* and address the economic *pull* of migration theory. Accordingly, while identifying the causes of migration, the result of PCA is presented in Table 3.

A total of 16 variables were input to the PCA analysis and it explored three components: (1) individual capacity and community support, (2) involvement with micro-credit and (3)

Table 2 Actual and expected displacement statistics of sampled unions

Destination (cities)	Origin (sample union)	Atulia	Gabura	Munshigonj	Padmapukur	Total
	Total sample HH (Pi)	52	139	40	49	
Khulna	D_{ij}	122	137	124	135	
	M_{ij}	0	1	0	0	2
	N_{ij}	1	15	2	6	24
	L_{ij}	1	14	2	6	22
	K-value	2	15	6	17	40
Satkhira	D_{ij}	62	77	64	75	
	M_{ij}	1	2	1	1	4
	N_{ij}	5	26	1	10	42
	L_{ij}	4	24	0	9	38
	K-value	6	14	2	15	37
Bagerhat	D_{ij}	154	169	156	167	
	M_{ij}	0	1	0	0	2
	N_{ij}	2	7	0	1	10
	L_{ij}	2	6	0	1	8
	K-value	6	9	0	3	18
Dhaka	D_{ij}	334	349	336	347	
	M_{ij}	0	0	0	0	1
	N_{ij}	2	4	4	3	13
	L_{ij}	2	4	4	3	12
	K-value	13	10	34	21	78
Chittagong	D_{ij}	594	609	596	607	
	M_{ij}	0	0	0	0	0
	N_{ij}	2	4	1	2	9
	L_{ij}	2	4	1	2	9
	K-value	23	18	15	25	80

Source Field survey 2010

economic condition. Those components explain 74.6 % of the total variance (KMO = 0.746, $\chi^2 = 14927.59$, df = 118, $p < 0.000$). Table 3 describes, firstly, the displacement decision comprised of the individual motivation to mitigate future disasters along with the accessibility to community support services. The involvement with micro-credit organisations and the total number of loans are reported as second important factor that play vital role for deciding population displacement after cyclone Aila. Thirdly, income pattern and expenditure status after cyclone Aila are important in making a decision to migrate, which is very much similar of previous scientific findings (Afsar 2003; Bates 2002; Tacoli 2009). Micro-credit consequences were also reported by in-depth interview. One of the migrants who took his family to Khulna, now work as a rickshaw driver and lives in a slum close to the Khulna main railway station, explained his miseries:

> My father left 2 hectares of land for me and for my brother. I used to produce rice, but since 90 s I started shrimp farming. This was the beginning of my bad luck; gradually I lose my capital and borrow credit from NGOs. I took 50000 Taka (700 US$) immediate before cyclone Aila to invest in my Gher (shrimp farm) and I

Table 3 Causes of displacement/migration

Variables used in PCA	Component			Renamed variables/component (Total variance explained)
	1	2	3	
Monthly income after cyclone Aila	−.065	.005	.948	Economic condition (21.675)
Monthly expenditure after cyclone Aila	−.042	.001	.949	
Better prepared to handle a cyclone alike Aila	.937	−.036	.014	Individual capability and community support (45.039)
Causes of coping capability improvement	.917	−.040	−.103	
Accessibility to public supports—cyclone shelter, relief and rehabilitation works	.756	.010	−.043	
Involvement with micro-credit programme	−.026	1.00	.003	Involvement with micro-credit (33.286)
Precise numbers of your loans	−.026	1.00	.003	

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation. Rotation converged in 4 iterations. Cronbach's Alpha is 0.746

Source Field Survey 2010

> invested all. Aila washed out my farm; no fish was there, only water and water. Can you tell me, how I can repay the loan? I came here with my family to avoid the NGO supervisor, but he already got this address. I do not know where we shall move next!

The lessons from this interview depict the consequences of shrimp farming and also the miseries and taboos of micro-credits in coastal Bangladesh.

4.6 Livelihood situation after displacement

4.6.1 At origin

The respondents were asked about the frequency of getting remittance from their 'displaced' family members, and results show that 78 % used to receive the remittance once in a month. Another 12 % report receiving remittance every two months, 6 % report no regularities in receiving remittance; it may come twice in a month or nothing in a month. It depends on the opportunities that their displaced members have in the city to send money. They used to send money in the hands of their relatives or neighbours to save the transfer charge. The last 4 % report that they never received any money after the departure of their family member from the locality.

Figure 3 (left) shows that the respondents have spent the remittance on agricultural inputs (20 % of the respondents), children's education (2 % of respondent) and treatment of sick members (10 % of respondents), whereas two-thirds of respondents' families have spent the remittance only for basic needs. Figure 3 (right) shows how the remittance was used. A significant proportion of the remittance received by the families (for 70 % of all households) has been spent on food (86 %). The rest has been spent on house repairs (11 %), clothes (2 %) and medicine (1 %).

They were also asked how often the migrant members communicated with their families. It reveals that 46 % of all respondents' families received a phone call twice a week, 34 % reports one phone call per week, 12 % receive at least one call per month and the rest 8 % receive mostly no phone calls even after a month.
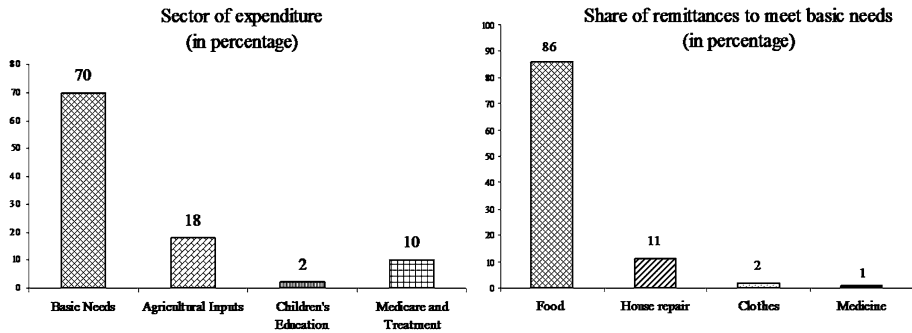
Fig. 3 Sector of Expenditure (*left*) and Share of remit to basic needs (*right*)

Due to such irregularities in receiving remittance and communication gap, their family members at original locations (especially females) are forced to lend money from neighbours (65 %), moneylenders (32 %) or even to move from their original locations (3 %). Housewives, who could not move to their displaced husbands in the city, face problems after problems. Their livelihood situation has become more vulnerable, and ways of earning a daily meal were almost out of hand. A few of them were forced to earn money by begging or even by working as maidservants to the local landlords or political leaders.

Few of them also attempted to take part in the aftermath rehabilitation works. None of them were selected for this employment though, because local elites took control over the leadership and manipulated the selection criteria of labours (Vogt et al. 2009). The local elites tried to maximise the participation of their like-minded peoples in those locally organised employment opportunities.

4.6.2 At destination

Applying 'snow-ball' sampling procedures, 'displaced people' in Khulna city were identified. Group discussion with the 'displaced members' found that 'personal network with local people' is the prime condition to get work in the city. Without any recommendation, no one can be hired to pull a rickshaw. Those temporary displaced peoples face insecurity of jobs. Forty percentage of the respondents report that their 'displaced' family members are out of any regular work. Thirty percentage of displaced members (those who participated in group discussion) report jobs as rickshaw/van pulling, 15 % work as wage labour, 5 % engage as industrial labour, 7 % work as agricultural labour and the last 3 % found themselves as vegetable sellers/hawkers. In the first few days, some of the displaced persons had to beg on different public places, like bus terminal or railway station. Furthermore, women and children members of those poor displaced families do not get easily any work in their village. If they are lucky, they have a chance to work as maidservants.

As a result, the displaced men have suffered from lack of access to nutrition, water and sanitation facilities. Usually, slums spring up in vulnerable areas such as along drains, around garbage dumps or adjacent to ditches or flood-prone areas. The health and hygienic conditions of these areas are usually very low, which in the long run might cause health hazard of the migrant families. Discussion reveals that persons known to them, who did not bring their families to the city, got married again. These displaced persons stopped communicating with their family members in the villages and started a new life in the city. Exceptional cases are also reported, in which they hid this new life information from their

families in the villages while they continued to bear the burdens of their family by sending regular money.

4.7 Societal 'inclusion' and 'exclusion'

The respondents recognise 'displacement' as a way of maximising their family's income and minimising the damages and losses induced by cyclone Aila. Displaced members and their families both obtain benefit from this displacement process: the 'displaced members' gain membership of a new society in urban areas and their families at original location get economic support from them. Field data show that 89 % family members, who moved to cities, look after their families at original location.

Problem-ranking sessions that were conducted with the 'displaced peoples', figure out a path-flow analysis (Fig. 4) of the whole stories of their displacement. It describes the social changes due to displacement. It depicts two sites of consequences: one describes the victims' new society at new places and other shows the victims' society at original places. The challenges of living in both societies are also described as social changes due to the displacement of cyclone Aila survivors. Those who moved with dependents but without any personal networks faced hardship to survival in cities—they were mostly without income, without shelters and without food. This situation led them to begging, sending women and children in underpaid jobs, etc. However, those who moved with families while having personal networks could manage income opportunities easier than other. Both of these groups are new inclusions to the slum communities. Hence, the dependents at original locations are out listed from community supports and have been suffered a lot of power exercise from the local elites, thus might be an example of social exclusion for them as well.

In case of the displacement of individuals or groups, some members of the household may remain to safeguard existing property, possessions and livelihoods, while others may return at a later date (either periodically or permanently). For permanent displacement, existence of social networks at the destination may influence the decision to move, because they can get support in terms of accommodation and employment connections, as well as providing a sense of community as this is very important for anyone moving to a new location.

5 Discussion

5.1 Nature of population displacement

Most of the inhabitants of the study areas are small-scale, marginalised farmers, fishermen and Sundarbans-dependent peoples. Other influential people started brackish water shrimp farming since 1980s and channelling saline water inside the polder[8]s breaching the ring embankment. It has changed the total societal scenario slowly; the marginal farmers, share croppers and agricultural labourers were forced to shift their livelihoods to shrimp-fry collectors. In such a vulnerable livelihood condition, an arrival of environmental hazard brings more pressure on their livelihood. Examples are clearly depicted in this empirical study and other related studies (Azam 2011; Kartiki 2011; Mallick and Vogt 2012; Mehedi et al. 2010).

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[8] A polder is a low-lying tract of land enclosed by embankments.
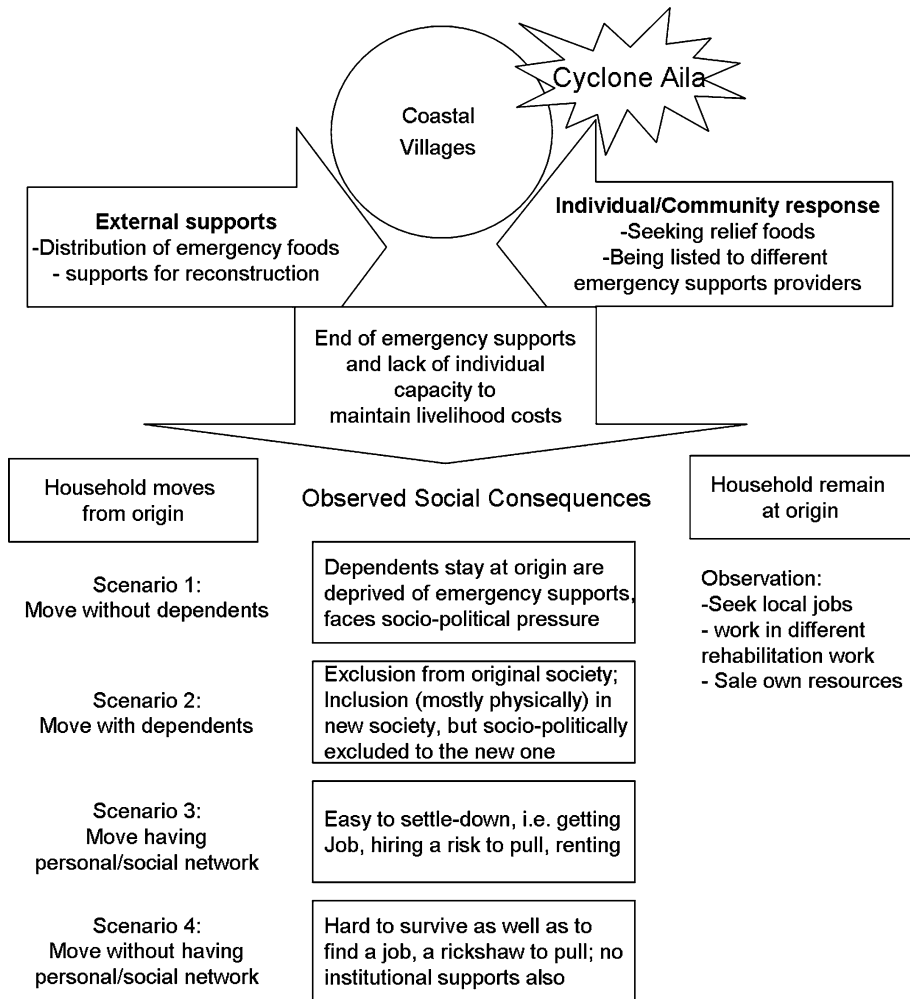
Fig. 4 Different scenario of population displacement after cyclone Aila

According to the findings of the study, 35 % of the respondents, who reported the displacement of at least one family member, are from the poorer sections of the cyclone affected peoples. To find a destination where the displaced family members can find work, respondents took support from their relatives and friends. Therefore, the displaced peoples are displaced in a scattered way. They were more or less forced to leave their original homes in search of work to maintain their families. In actuality, the forced displacement has roots in the long-time submerged condition of agricultural land, resulting in less productive land and less labour options in their local area. This has driven people to supplement their livelihoods in the vulnerable coastal region by extracting resources from outside the region. Other social and political factors are also involved in the displacement decision, namely the practice of nepotism in emergency relief/support distribution, listing out names of the earth-work labourers, etc. It is also clear from the study that population

displacement is taking place primarily for economic reasons induced by environmental hazard, in this case of cyclone Aila.

In addition to disaster-induced displacement, seasonal migration is another coping strategy in this area (Azam 2011) The main drivers of seasonal migration are economic incapability to provide for their family's needs since more than 50 per cent people in the area live below the poverty level. Azam (2011) reports that non-seasonal migration is taking place primarily for economic reasons/livelihood enhancing strategies that have been driven by land use changes for less labour intensive shrimp farming. People are being expelled from their land by shrimp farming industries and losing their base for self-sustaining agriculture that had existed before 1980 in the coastal region. Accordingly, rather than terming these 'displaced peoples' as 'environmental refugees' or 'permanent migrants', it is more appropriate and authentic to view 'displacement' as a transformational livelihood adaptation strategy to support their resilience to survive, which has failed in the local region due to a sudden environmental disruption to their lives alongside man-made interventions, like extensive shrimp farming (Azam 2011; Mehedi et al. 2010).

5.2 Consequences to society after displacement

While comparing the cyclone Aila-induced damage costs to the number of income sources, it is found that an increase in income sources showed earlier recovery of damages and losses. The damage costs increased significantly from one to two income sources, but decreased gradually from there onward, suggesting that diversification of income was indeed an effective coping strategy. Therefore, displacement was a way to search for alternative incomes. The poorest communities left their areas at the first shaking of cyclone Aila as they have to live hand-to-mouth and totally depend on daily income through labour. The other classes including lower middle class were displaced after a few days when they failed to survive in their home by their own capacity or resources.

The study has similarly identified the push factors of population displacement immediate after cyclone Aila (Table 3). Limitations of the use of gravity model analysis stand on the consideration of the attractions factor of the origin. The Eq. 1 used in the analysis describes that somehow the original location will present zero population in near future, which is not truly possible. It is also revealed by group discussion sessions that during relief distribution phases, few unknown families were present in the studied villages. Then, after the cyclone, unknown peoples who were already settled in cities moved towards cyclone Aila affected areas to get relief and rehabilitation supports with the help of their informal social network.

It has been seen in this empirical study that after the end of relief activities, people moved towards cities either with their families or without families. It depicts that there was lack of locally available employment or earning opportunities. It has been suggested that ensuring more locally organised income opportunities immediately after the end of relief works would lessen the push factor of climatic events and reduce the economic pull, allowing people to stay in their original locality (DMB 2010; Mallick et al. 2011). Though it was evident here that after the end of relief activities, government and other development organisations started to reconstruct the road networks, embankments, institutions and initiated other development activities, participation in such aftermath employment is mostly locally politicised. This is a very common practice in all over Bangladesh. The front-liner or so-called 'social supreme' (Mallick and Vogt 2011) manipulates the ways of development and blocks the access of the bottom-liners or underprivileged of the community to development initiatives. As a result, the out-listed families move out to the

nearest cities. These situations require the commitment of the government or NGOs to ensure participation of each and every family in publicly organised rehabilitation activities.

This study has identified also the consequences of livelihood due to displacement (Fig. 4). It shows the hardships and challenges of both societies and elaborates on the social consequences in particular. Figure 4 depicts also that risk is significant for the victims not only in their original locations, but also in the places to which they have been displaced. They live in substandard housing in slums areas and face income insecurity as they attempt to support their family burdens. It is also observed that currently none of the government or NGO controls the movement of displaced people. Furthermore, there is no institutional support neither from the government nor the non-government organisation for the migrants in the destinations. A. Poncelet et al. (2010) have observed the similar findings. Thus, it is necessary to develop or to assign some organisation or institution for taking care of the disaster-induced displaced peoples during their transition periods. These institutions or organisations should provide them with information regarding the available income opportunities, housing information or resettlement opportunities as a whole.

6 Conclusion

This paper has examined a number of pathways through which disaster may lead to population displacement, which in turn may lead to changes in affected communities. The relationship between poverty and damage costs appears to be more complex than the literature (Poncelet 2009) suggests. The poor suffer more in relative terms, but not in absolute terms. Average damage costs in absolute terms were significantly higher for wealthier households than the poorer one. Findings support that cyclone Aila had influences on migration decision of the respondents' families and assured the rural–urban displacement pattern of climate-induced population displacement debate in Bangladesh (Kartiki 2011; Poncelet et al. 2010). Individual capacity and community support are the main factors that assure the concept of individual resilience and community-based adaptation approaches (Wisner and Luce 1993), whereas the third factor entails the economic capabilities related with income and expenditure of the respondents. These findings support the hypothesis that vulnerability of a household determined by 'capability of income' (Adger 2006). In addition to this economic capability, micro-credit opportunities have been identified as the second major 'push' driver. Further research work is necessary to identify this interrelationship between micro-credit and disaster consequences.

Additionally, as this study was undertaken 1 year after the cyclone Aila, it shows only the immediate consequences on the society. New research needs to be conducted on the long-term consequences of observed displacement both for the destination and the original society. Finally, research is needed to find out the possible solutions to break down the walls of social elites (i.e. the socially and locally politicised dynamics of societal changes), so that the bottom-liners can enjoy the accessibility rights to mass development momentum in the aftermath of an environmental hazard while remaining at their original home.

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