

Analysis of Social and Psychological Terrain of Bank Erosion Victims: A Study Along the Bhagirathi River, West Bengal, India

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Abstract: Social psychology of people affected by hazards is different from normal psychology. For example, severe bank erosion in the lower reach of the Bhagirathi River in West Bengal has resulted in significant land loss (~60% of all households lost land over last 20 years) and affected the livelihoods of the people in the study villages along the river. Per capita income has almost halved from 1970–2012 due to land loss. This stark nature of land erosion and vulnerability of livelihood has had far-reaching repercussions on the fabric of society and the psychology of the people in this region. Results showed that erosion-affected villages have registered comparatively larger average family sizes (~4.1 as compared to ~3.9 in non-affected villages), lower literacy levels (< 50% compared to > 65% for the non-affected villages), and poor health. Reports of poor health as a result of land erosion include ~60% of the respondents having reported physical ailments such as headache and abdominal discomfort, as well as 3%–5% reporting loss of emotional and psychological balance. Villages suffering from erosion showed higher positive loadings in average-coefficient of variation (CV) differential (25%–40%) depicting objectivity in their opinions for select variables of social processes. Principal component analysis (PCA) portrayed maximum eigenvalues in the first principal component for interpersonal processes (~98%) and a minimum for intergroup processes (~80%). Categorical principal component analysis (CATPCA) depicted a cluster between interpersonal and intergroup processes and another between intra-individual and group categories. The positive loadings in female-male differences in CV of perceptions portrayed relative consistency of males over the females concerning fear/phobia and physical stress while negative loadings exhibited higher consistency for females regarding psychological stress and shock. Lastly, the Tajfel matrix portrayed a distinction between hazard psychology characterized by maximum joint profit as found in Rukunpur, and normal psychology characterized by in-group favoritism as found in Matiari.

Keywords: social terrain; psychological terrain; riverbank erosion; principal component analysis; Tajfel matrix; Bhagirathi River

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1 Introduction

Conceptualization of natural and man-induced hazards differs from one discipline to another. Geoscientists perceive ‘hazard’ as a physical phenomenon, whereas sociologists or anthropologists grasp more of a social dimension. Conversely, geographers hold an integrative outlook in terms of spatial analysis in geography. This is

expressed as construing a combinational mosaic of physical and social space in portraying the outlook of a hazard as capturing a physical event as the base, and social outcomes as the final point of enquiry. Social perspectives of hazards were instigated as a new philosophy, termed, the Behavioralism, through the perceptions of floods (White, 1945; Kates, 1962). Social geographers, therefore, study hazards like floods, cy-

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clones, or in the present case, riverbank erosion, as a behavioral study to understand outcomes such as hope, desire, and disappointment of hazard victims during or after the episode (Zaman, 1989; Rahman, 2010). Located in the tropical region, countries like India experience severe floods or cyclones, the two most important hazards occurring almost yearly. Riverbank erosion is frequent along the large rivers like the Ganga, the Brahmaputra, and other rivers like the Koshi (Das et al., 2014; Ray, 1953). However, riverbank erosion of the Ganga in India and the Padma in Bangladesh are so severe that the victims, though smaller in number than the victims of floods and cyclones, are among the worst to suffer since erosion triggers permanent land loss (Islam et al., 2012). As a result, inhabitants are forced to leave their familiar homeland and relocate causing immense psychological shock. Previous studies have investigated the devastating effects on communities in the wake of bank erosion in different parts of the world. In this study, we will use the terms ‘social and psychological terrain’ (abbreviated hereafter as socio-physiological terrain) after the ‘moral terrain’ of Proctor and Smith, 1999 and ‘emotional terrain’ of Moser, 2013, to describe the state of affairs in the social and psychological landscape of hazard victims from riverbank erosion. The socio-physiological terrain encompasses the areas of hardship socially and emotionally resulting from financial loss, loss of homeland, migration, disruption of education, etc. (Hossain, 1993; Mamun, 1996; Mutton and Haque, 2004). Further research in this direction confirms the emotional and psychological deterioration in women (Rogge and Elahi, 1989; Haque, 1997). It has been noted that displaced women have a higher level of perceived stress than their non-displaced counterparts (Taylor et al., 1976; Logue et al., 1979; Shore, 1986; Lima et al., 1991; Rubonis and Bickman, 1991). This corresponds to studies conducted along the Bhagirathi River in the works of Banerjee (1999), Parua (2009), Rudra (2011), Biswas and Biswas (2014) and Islam and Guchhait (2017). However, what seems lacking is the social and psychological analysis in terms of changes in social institutions, social processes, the social psychology of hazard, and hazard-induced social desire. These identifiers have not been presented previously in the literature. Thus, the present paper will address the following objectives: 1) to identify the severity of bank erosion along the Bhagirathi River from 1920–2014;

2) to analyze the influence of bank erosion on changing social and psychological terrain.

2 Materials and Methods

2.1 Study area

The study area in Eastern India (lower reach of the Bhagirathi River) is a part of the Bengal Delta. It is located between the Ajay-Bhagirathi confluence in Katwa and the Jalangi-Bhagirathi confluence in Nabadwip. It extends from 23°39'22"N to 23°24'40"N and from 88°08'14"E to 88°22'46"E (Fig. 1). This region is very unstable due to hydro-dynamic characteristics which are controlled by hydrologic input from the Farakka Barrage Project and the Ajay-Mayurakshi system (Guchhait et al., 2016). This area is densely populated, dominated by agrarian communities. The population density of this tract (Nadia District) is 1316 persons/km² while state figures (West Bengal) show 1028 with 46.94% workers involved in cultivation and agricultural labourers. In this region, 44.04% of the population are involved in the same occupation as the state as a whole (Census of India, 2011). Because of their dominant involvement in farming, land dependence and land-based livelihoods in these communities invite social vulnerability in the wake of riverbank erosion. The study area next to the Bhagirathi River is also erosion-prone and still experiencing active erosion. Hence, to assess the impact of bank erosion on socio-physiological terrain, four representative villages along the rivers of Bhagirathi, Matiari, Akandanga, Rukunpur, and Ganjadanga, have been taken into consideration in the present study (Fig. 1).

2.2 Data

This work is based on primary data collected from household surveys at the select villages. Using a systematic sampling design, total respondents interviewed for social analysis from Matiari, Akandanga, Rukunpur, and Ganjadanga were 122, 19, 62, and 20, respectively. Though this paper is based on primary observations (field survey), some data related to the economic and demographic structure of the people of the study area have been collected from the District Census Handbooks of Census of India (2001; 2011). Additionally, to compute the mouza- (smallest administrative unit of India for revenue collection) level land loss for the last century, the mouza map from 1920 and Landsat 8 OLI

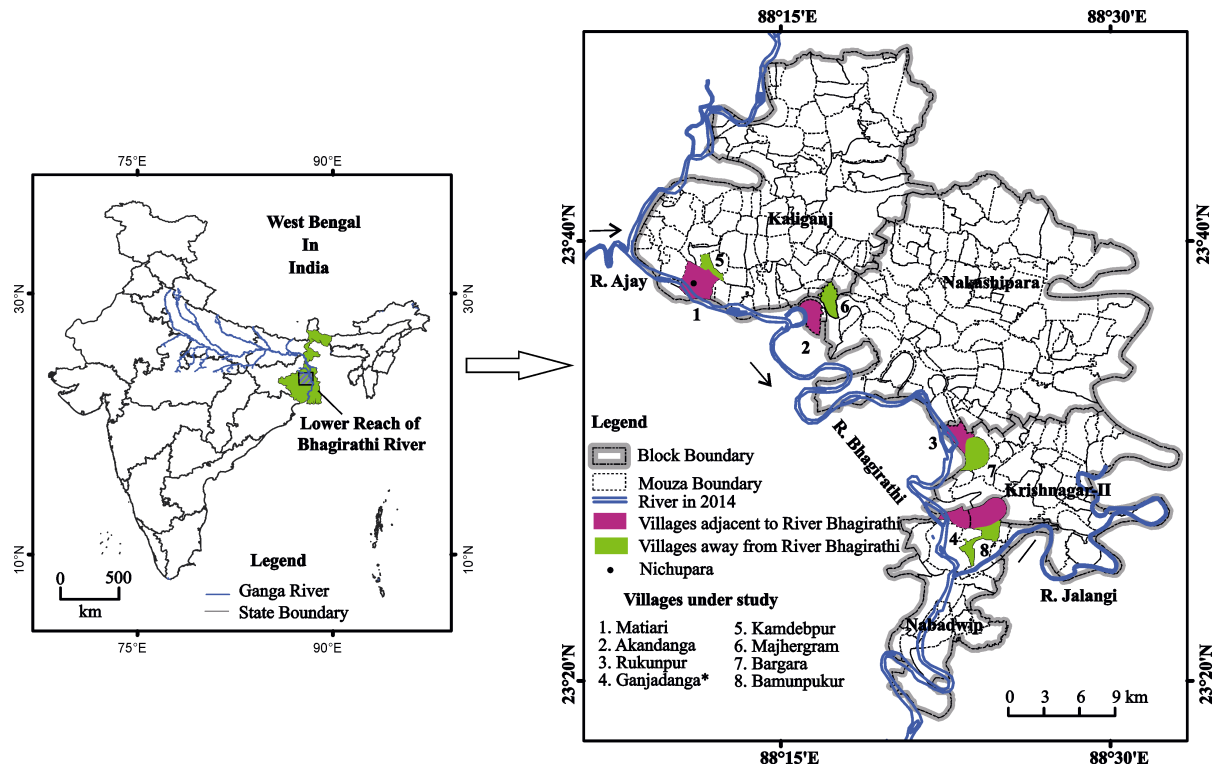


Fig. 1 Location of study area. *: western part of the Char-Kasthasali Mouza

images from 2014 (row 138 and path 44) have been used.

2.3 Methods

2.3.1 Sampling design and data collection

We adopted random sampling for collection of household data for its inherent virtue of being unbiased due to the homogeneity of the population. In this way, impartial results can be obtained (Department of Economic and Social Affairs, 2005). For deciding sample size, first, a pilot survey was conducted to ascertain the target population, i.e., the erosion victims of the villages. Results indicated that pilot surveys from total households that experienced land loss in Matiari, Akandanga, Rukunpur, and Ganjadanga villages were 61%, 69%, 83%, and 100%, respectively. Adopting the methodology of the Department of Economic and Social Affairs (2005), the sample size for the present study has been determined as follows:

$$nh = z^2 r(1-r) f \times k / (p \times n \times e^2) \quad (1)$$

where nh stands for the sample size to be selected; z : desirable confidence level (95% here); r : an estimate of a key indicator to be measured by the survey; f : the sample design effect assumed to be 2.0 (default value);

k : a multiplier of nonresponse (1.1 here); p : the proportion of the total population accounted for by the target population and upon which the parameter r is based; n : the average household size (number of persons per household); and e : the margin of error (0.01 here) to be attained.

Using the above formula, a statistically significant sample size of 674 erosion victim households (362 households in Matiari, 88 in Akandanga, 152 Rukunpur, and 72 in Ganjadanga) were found. However, to unfold bank erosion-induced social hazards, only severely victimized households have been considered here. For delineating the *severely victimized households*, two criteria of land loss were applied for analysis of the socio-physiological terrain. The two criteria are: 1) households with greater than 90% land loss; and 2) households with greater than six bighas (0.1338 ha per bigha in West Bengal) of land loss.

In the study villages, almost all of the households were victims of bank erosion, but the families who have lost a significant amount of agricultural land are not only economically exhausted but socially and psychologically depleted also. Those families were taken as a sample of the impact of bank erosion on society. Fol-

lowing this method, the number of respondents interviewed for social analysis from Matiari, Akandanga, Rukunpur, and Ganjadanga were 122, 19, 62, and 20 respectively, out of the total erosion victim households of 362, 88, 152, and 78 chosen according to the formula.

2.3.2 Estimation of land loss

To assess land loss during the last century (1920–2014) for the select mouzas, we adopted the following steps. In the first stage, mouza maps from the 1920s have been registered in the World Geodetic System, 1984 datum (WGS 84) and the Universal Transverse Mercator (UTM) projection with several ground control points (GCPs) derived from Google Earth (GCPs 14 for Matiari, 11 for Akandanga, 9 for Rukunpur, and 13 for Char-Kashthasali). In the second stage, the bank-line of the Bhagirathi River for each mouza during 1920 has been digitized. In the third stage, the bank-line of the same river for the corresponding mouzas in 2014 has been digitized in Google Earth as a kml file later exported to a shape file in the ArcGIS, and finally re-projected into a uniform datum and a projection sys-

tem. In the fourth stage, the bank-line positions (in the years 1920 and 2014) of the Bhagirathi River have been superimposed into the uniform datum (WGS 84) and the projection system (UTM). In the fifth stage, on the superimposed maps some polygons have been drawn for the areas of the mouzas under the river in 2014. Finally, the areas of land loss have been derived from the attribute tables of the polygons.

2.3.3 Measuring social processes

To assess the four broad groups of social processes (intra-individual, interpersonal, intergroup and group), some select parameters were taken into consideration. Six parameters for intra-individual processes (Tesser and Schwarz, 2001) were taken, four for interpersonal processes (Fletcher and Clark, 2003), five for intergroup processes (Brown and Gaertner, 2003), and six for group processes, (Hogg and Tindale, 2001). These parameters were chosen and respondents were asked to answer the questions for each parameter (Table 1) on a 100-point rating scale with a minimum of zero and a maximum of one-hundred.

Table 1 Social process and their measuring variables

Types	Social process	Measurements
Intra-individual processes	Social unconscious	How much love, craze, anger, and violence are repressed during disaster?
	Self-regulation	How much can you control yourself to repress love, craze, and anger during this period?
	Goal setting and goal striving	How much have you faced problems to fix a goal?
	Nature of emotion	How much is your emotion is repressed by this event?
	Value and ideologies	How much can the kids understand your economic and psychological distress aftermath hazard?
Interpersonal processes	Self esteem	How much is your self-esteem dwarfed?
	Helping and altruism	Do you think that your close relatives are sympathetic to you in distress?
	Death and rebirth of social psychology of negotiation	Do you think whether some social rituals and cults have died away or some new rituals have appeared?
	Affect/emotion	How much do you get affected by distressed conditions of others?
Intergroup processes	Self and identity	Are you, victims of erosion, united irrespective of caste, creed, and religion?
	Intergroup bias/prejudice	Do you think whether social and psychological gap among the victim groups has increased?
	Social justice	Do the common people (non-victim) think or air voice in favour of you?
	Majority-minority relation	Do you think whether social and psychological gap among the victim and non-victim groups has increased?
	Cultural mix and acculturation	Have you taken any united measures against bank erosion and how much is it effective?
Group processes	Trust and intergroup negotiation	Do the non-victims trust you in distress?
	Collective choice, judgment and problem solving	Have you taken joint initiative regarding arrangement of food and health facilities?
	Social categorization, depersonalization, and group behaviour	Do you move united (irrespective of caste, creed, religion) while in erosion danger?
	Group socialization and newcomer innovation	Are you careful about the families from where Heads of the families are outside for work?
	Mood and emotion in the group	Do any emotions or nostalgic situation appear from the group discussion?
	Social status and group structure	Do you think that rich-poor gap has reduced and they have come closer?
Collective identity	Do the victimized families work together during and after the erosion hazards?	

Notes: Processes chosen based on Brown and Gaertner, 2003; Fletcher and Clark, 2003; Hogg and Tindale, 2001; Tesser and Schwarz, 2001

2.3.4 Analysis of Socio-psychological data

The data collected from both primary and secondary sources have been analyzed using some simple statistical techniques such as percentage rating, average, and coefficient of variation (CV) to depict some simple but unique pictures. In addition to these simple analyses, some advanced statistical techniques such as principal component analysis (PCA), categorical principal component analysis (CATPCA) and Tajfel matrix have been used. The algorithm of advanced statistical techniques is briefly outlined in the following sections:

(1) Categorical Principal Component Analysis (CATPCA)

Simple bivariate correlation or regression are unable to express the multidimensional character of the degree of victimization as it not only depends on the severity of bank erosion but also on the other socio-economic factors. In the present research, it has been analyzed by two-stage PCA for finding the complex associations among social processes. The jerk in social and economic processes induced by hazard creates non-normal social interactions and psychological behaviors. These interactions and behaviors have different facets. Under such a consideration of social processes with different facets, objective judgment by major processes and their sub units are important through CATPCA (two-stage PCA) where sub variables are judged first, then the z-score or prin score (Z) of major variables (intra-individual, interpersonal, intergroup and group processes) were defined through sub variables (using the following formula) and treated in the second stage PCA.

$$Z_j = a_{j1}P_1 + a_{j2}P_2 + \dots + a_{jn}P_n, a_{ji} = \frac{PCA_r}{\sqrt{\lambda_r}} \quad (2)$$

where $i = 1, 2, \dots, n$, $j = 1, 2, \dots, m$, PCA_r = factor loadings of a particular stage, λ_r = eigenvalue of a particular stage and each of the observed variables was described as linear in terms of the uncorrelated components, P_1, P_2, \dots, P_n .

(2) Tajfel Matrix

The classic Tajfel matrix is widely used among scientists to assess the psychological makeup of an area (Bourhis and Gagnon, 2003) where there is scale for resource allocation having a minimum value of 36 and maximum of 132 points. In this system, there are four quadrants representing four broad categories of allocation (ingroup favoritism, maximum joint benefit, outgroup

favoritism, minimum joint benefit) having 3 allocations in each of the four quadrants and a center representing another category (the parity) thus constituting 13 pure allocations (Fig. 2). The Tajfel matrix in this paper has been applied to differentiate normal psychological patterns from social psychology inflicted by hazardous phenomena (riverbank erosion).

3 Results and Discussion

3.1 Severity of riverbank erosion

The course of the Bhagirathi-Hooghly River has undergone changes over the last few centuries (Chatterjee, 1989). Descriptions by various scholars (Rennell, 1788; Colebrooke, 1801; Sherwill, 1858; Hirst, 1915; Mukherjee, 1938; Bandyopadhyay, 1996; Ray, 1999; Rudra, 2011) have outlined the frequent shifting nature of the Ganga. Similarly, we observed the severity of channel shifting and bank erosion at the micro level. Virtually most of the villages and towns along the banks of the Bhagirathi in the Murshidabad, Nadia, and Barddhaman districts of West Bengal were impacted by episodic erosion between 1976–1978 (Rudra, 2011). There are 26 community development (C.D.) blocks along the banks of the Bhagirathi River out of which seventeen are in Murshidabad, five are in the Barddhaman district, and the remaining four are in the Nadia district (Guchhait et al., 2016). The villages of Matiari, Akandanga, Rukunpur, and Ganjadanga, located astride the left bank of the Bhagirathi River in the Nadia District (Fig. 1), have lost at least 10%, 4%, 21%, and 7% of total mouza land during 1920–2014, respectively (Fig. 3). Over the past decade, the rate of land loss is alarming for some villages, e.g., Rukunpur experienced an 8% land loss between 2006 and 2014. Village level primary surveys established that 60% of the households have lost their land in the last 20 years. Approximately 95% land loss was characterized as agricultural land (Fig. 4) barring the exception of the Ganjadanga where there was a 13% loss of settlement land due to erosion. This suggests agrarian decline and livelihood vulnerability.

Occupation diversification and income decline are the two common facets of bank erosion that have paralysed the socio-economic structure of the study area. During the observation period (1970–2014), per capita monthly income has been dwindling daily for all the erosion victim villages. The one exception is Matiari that has a strong brass metal industry that rescued some of the economic decline. In

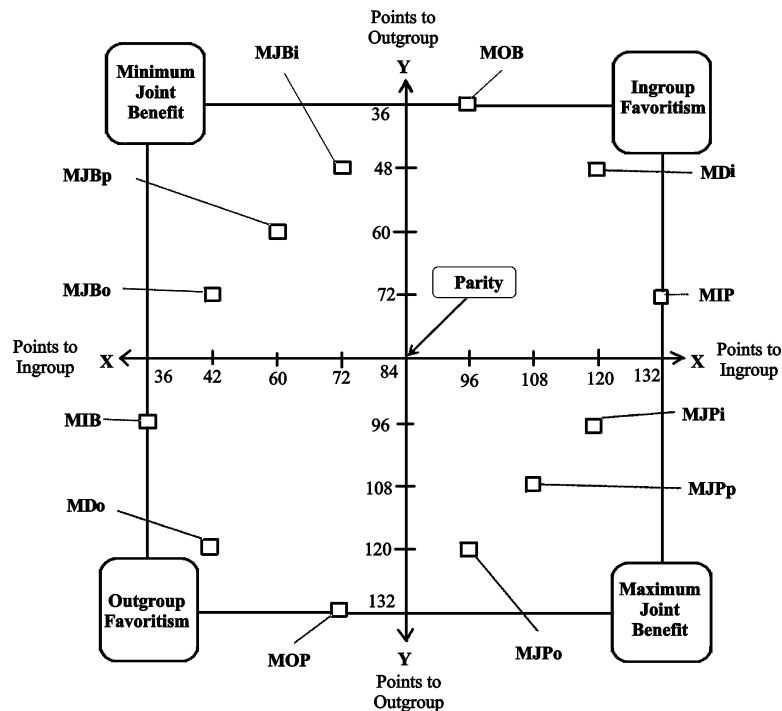


Fig. 2 Resource allocations in the Tajfel matrix after Bourhis and Gagnon, 2003 (MOB: Minimum Outgroup Benefit, Mdi: Maximum Differentiation Pro: Ingroup, MIP: Maximum Ingroup Profit, MJPI: Maximum Joint Profit Pro: Ingroup, MJPP: Maximum Joint Profit Pro: Parity, MJPO: Maximum Joint Profit Pro: Outgroup, MOP: Maximum Out: Group Profit, MDo: Maximum Differentiation Pro: Outgroup, MIB: Minimum Ingroup Benefit, MJBo: Minimum Joint Benefit Pro: Outgroup, MJBp: Minimum Joint Benefit Pro: Parity, MJBi: Minimum Joint Benefit Pro: Ingroup)

terms of per capita income, Rukunpur mouza has dropped to 614 Indian national rupees (INR) in 2012 from an average of 1104 INR in 1970. Similar decreases in per capita income are common in the other villages as well. Due to the decline in the agrarian economy, people in economic transition have been forced to diversify their livelihood for merely physical survival. However, the diversification that occurs by compulsion, not by choice, may have negative socio-economic impacts and unstable economic stature. People in the study area were diversifying their livelihood as a compulsion in the erosion economy except for the village of Matiari for the aforementioned reasons. This has resulted in the unfortunate situation where workers are involved in three or more occupations at different times per day or per season. Such a situation implies an absence of a strong economy that can assure workers a consistent minimum wage. In Rukunpur, 50% of the workers were engaged in two or more occupations. Workers in other villages also experienced a similar economic situation. Along with a common threat to a consistent livelihood, environmental refugees living in areas of bank erosion experienced the

vital problem of homelessness in some villages, particularly Rukunpur and Ganjadanga. Approximately 44% of the households in Ganjadanga have endured homelessness with approximately 15% in Rukunpur. This description signals economic marginalization and displacement that is correlated with deep-rooted social and cultural issues. The following sections will address the erosion-induced impoverished social and psychological terrain with the help of empirical data base analysis.

3.2 Social terrain

Society is a web of social relations that are intricate and complex. Social problems emerge from the very basic structures of society. Forces that contribute to a normal society will be diminished in a society inflicted by hazards. The present study attempts to investigate riverbank erosion-induced social hazards assessed for the families that are severely affected by erosion. Here, general social processes like economic production, social interaction, and social bonds are discussed in the context of riverbank erosion hazards. Thus, social institutions, social processes, and social psychology are more complex and deviate from normal standards.

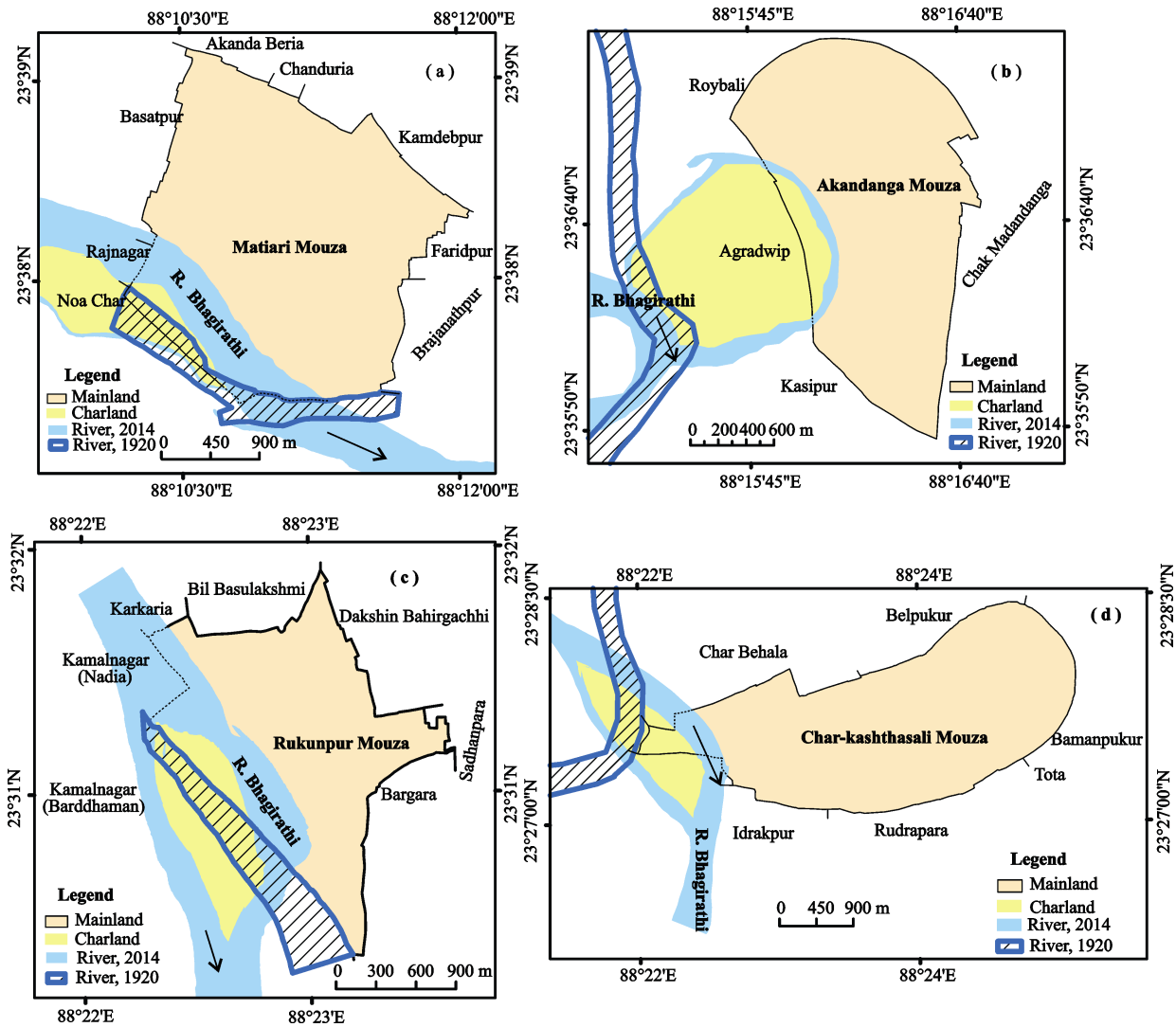


Fig. 3 Land loss due to bank erosion between 1920 and 2014. a. Matari, b. Akandanga, c. Rukunpur, d. Char-Kashthasali (Computed from mouza maps in 1920 and Google Earth images, 2014)

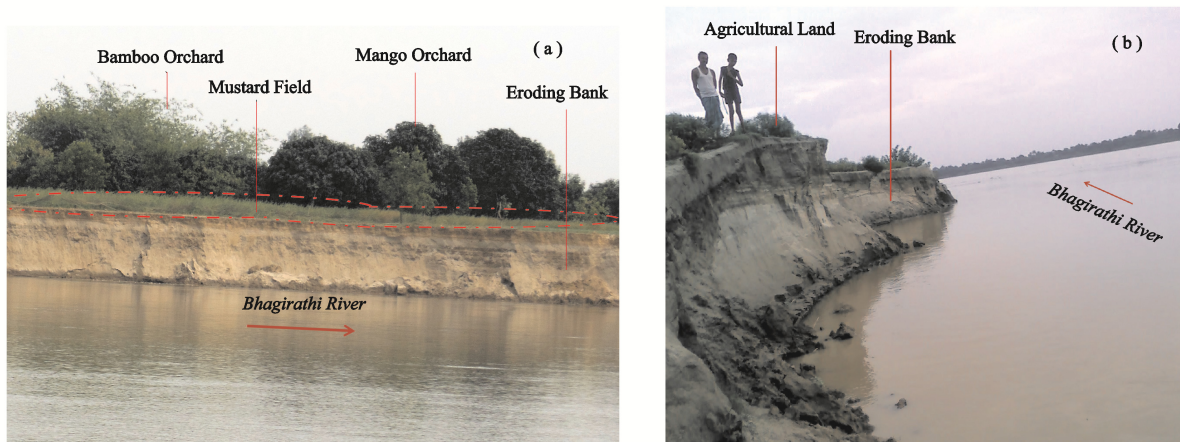


Fig. 4 Loss of agricultural land and orchards. a. Rukunpur b. Matari (Field photographs, 2012–2013)

3.2.1 Changes in social institutions

Social institutions are the integrated sets of norms, beliefs, and rules that support the stability of a given society. These constructs ensure survival by carrying out the basic functions of the society (Hodgson, 2006; Prodan-ciuc, 2012). In other words, if social institutions work improperly, the social fabric is bound to collapse. There are five primary social institutions, family, government, economy, education, and healthcare, that are essential for upholding a society. The study area, being severely affected by bank erosion, depicts diminished social interactions where normal social life is highly affected. In this section under familiar social institutions, the institutions of family, government, education, and healthcare will be discussed using a primary database with proper explanations.

(1) Family

The family is a group of people affiliated by consanguinity (by recognized birth), affinity (by marriage), or co-residence (as implied by the etymology of the English word 'family') and/or shared consumption (nurture kinship) (Schneider, 1984; Hammond, 2010). Family bonds between the individual members are stressed on a daily basis in the era of globalization (Edgar, 2004). As a result, normal society is experiencing a change in the nuclear family both in rural and urban settings (Bhasin, 2016). However, a hazard society impacted by riverbank erosion, as in the present study, shows a reverse trend in the family structure. In the study area, family size is higher for the villages next to the Bhagirathi River and smaller for those away from the river. The Matiari, Akandanga, Rukunpur, and Char-Kashthasali mouzas, located along the banks of the Bhagirathi River, have kept a fairly larger family size (4.7 in 2001 and 4.1 in 2011 Census) than in the villages (Kamdebpur, Majhergram, Bargora, and Bamunpukur having average family size 4.5 in 2001 and 3.9 in 2011) located far from the river (Fig. 1). Larger family size is likely to be found for a society characterized by poor economic conditions or inflicted by frequent hazards. This is an important trend in developing economies. This is particularly observed in stressed economies where large family size is a survival strategy by means of the 'principle of sharing of goods' (Lanjouw and Ravallion, 1995). For the present area, generation of individual income is so low that they have to live together, thus resulting in larger family size.

(2) Government

Aid from the government is critically important in a society stressed by hazards. On the one hand, the government keeps law and order, and plays a vital role in the welfare of people under stress. It is the responsibility of the government to save victims who are in utmost need (Rose, 2000). In the study area, a perception rating of the role of the government for hazard victims was conducted. The results were less than satisfactory. For example, only a few projects, such as riverbank protection work and mulberry plantations have shown success; others were not properly implemented. Riverbank protection work by the use of geotextiles, which is a popular method used worldwide (Ghosh et al., 2016), has achieved a higher positive rating (>40% average rating in all the villages except Akandanga). In Rukunpur, this project has had an overwhelmingly positive response (>65%); in recent times it has arrested riverbank erosion for the last three to four years. Mulberry plantations, on the other hand, are increasingly grown worldwide due to the vegetation's capacity to maintain a good microclimate and to conserve soil and water (Qin et al., 2012). However, the participation of farmers in mulberry cultivation is quite different at present. For example, mulberry cultivation is practised by villagers since it can also be used by homeless farmers as a shelter. For this reason, mulberry plantations, though having a limited capacity to bind the soil, have been increasing as a shock absorbing mechanism over the last decade as shown in the substantial success rate (>35%) in all villages with a maximum (>55%) in Rukunpur. But aid from the government is very limited for such kind of initiatives. As livelihood transformation is not possible in a purely agrarian system due to the huge land loss and absolute level of economic crisis in the study villages, especially Rukunpur, government assistance is preferred in order to provide more than just merely protecting the riverbank. Thus, for development of local areas, some projects like manufacturing and common property resource management should be implemented.

(3) Education

Education, one of the five important social institutions, determines cultural attainment. Achievement from education through knowledge networks strengthens the solidarity of a society, reducing social vulnerability (Komac et al., 2010). Education systems and environmental hazards are negatively associated in two ways:

first, if society experiences frequent hazards, education systems may collapse (Baki, 2014) and second, if education attainment is reduced, the shock absorbing capacity of that society becomes feeble. In the study area, hazardous effects of riverbank erosion hold negative effects for education. Villages adjacent to riverbanks, primarily Rukunpur and Ganjadanga, that were severely affected by riverbank erosion showed an overall literacy rate below 50%, with female literacy at an even lower rate (<40%). The general attitude of the people holds that literacy is a luxury and not a basic physical need. However, in Matiari, due to the brass metal industry as an alternative economy, people have overcome the decline in literacy due to riverbank erosion. The general literacy rate of Matiari is far greater (>65%) than the other villages.

A decline in the literacy rate is directly correlated with school dropout. The higher the school dropout, the lower the literacy rate. In villages adjacent to the riverbank, school dropout has been observed at a higher rate. For example, the rate of school dropout was at a maximum in Rukunpur and at a minimum in Matiari. In the last five years (2007–2012) in Rukunpur, nearly every household has registered school dropout (Table 2). In Akandanga and Ganjadanga, more than 50% of the households have had school dropout during the same period. It is interesting to note that male school dropout is higher than that of the females in all villages except Matiari. This has been shown worldwide (Burrus and Roberts 2012) perhaps due to the need of male members to work for family income. Female dropout is relatively less due to low work participation of women in rural areas. Parents of female children do not prefer to send their daughters to work which would affect negotiating marriage proposals for their daughters.

(4) Healthcare

The healthcare system is often called the physical backbone of a society. If healthcare collapses, a corresponding negative response is observed in that society.

Table 2 School dropout in relation to hazard in the study area during 2007–2012

Village	Sample households	Male	Female	Total
Matiari	122	16 (13.11)	18 (14.75)	34 (27.87)
Akandanga	19	8 (42.11)	6 (31.58)	14 (73.68)
Rukunpur	62	28 (45.16)	23 (37.10)	51 (82.26)
Ganjadanga	20	7 (35.00)	5 (25.00)	12 (60.00)

Notes: Computed from the field data in 2015. Figures within parentheses indicate percentage

Equity in health services keeps a society more healthy and mobile. Hazard or disaster is a threat to the health-care system. Any sudden shock imposed by a hazard triggers trauma, which in turn induces various psychological and psycho-physical health problems (Rahman, 2010). In Bangladesh, a higher level of perceived health problems for the elderly has been reported due to riverbank erosion. A study conducted by Hassan (2015) pointed out that 64% of elderly respondents suffered from unstable angina, 31% were victimized by fatal arrhythmias, and about 5% of the respondents had asthma problems. It is surprising to note that approximately 87% of elderly respondents have identified riverbank erosion as the main cause for their physical illnesses. In the study area, people of four villages (Matiari, Akandanga, Rukunpur, and Ganjadanga) have had various health problems due to riverbank erosion hazard, depending on the nature of the erosion and the socio-economic fabric of the concerned area. Approximately 60% of the respondents in the study area have experienced headaches and abdominal discomfort. The data showed that as a result of riverbank erosion, 5% of the respondents in Rukunpur and 3% in Ganjadanga lost their psychological balance in the wake of huge land loss. In Akandanga, health problems are not as high as that in Rukunpur and Ganjadanga due to a lesser amount of land loss. Alternatively, Matiari showed a deviation from this trend due to its alternative economy.

3.2.2 Social processes

Social processes are defined as observable and repetitive patterns of social interactions that have a consistent direction or quality (Bardis, 1979). The concept of social processes was first borrowed from the biological sciences in the 19th Century. However, it was Peter Kropotkin (1842–1921), the Russian geographer, who applied the concept of conflict and cooperation for the first time to the domain of geography. Gradually the arena of social processes was incorporated into geography. As such, there are four broad groups of social processes: intra-individual, interpersonal, intergroup, and group process. Intra-individual processes are concerned with interactions operating within an individual; alternatively, interpersonal processes deal with interaction between two individuals. Intergroup processes, on the other hand, encompass interactions between two different groups, while group processes connote interactions within a group. Thus, social processes are very important in highlighting social change. In the present study, social

processes have been taken into consideration to assess the impact of riverbank erosion on stressed behavioral patterns in the people of the study area.

(1) Pattern of social processes

Concerning the various indicators of intra-individual processes, empirical data proved a maximum hazardous terrain in Rukunpur with the highest number of victims in the study area. Respondents reported that under extreme stress, people's expression of the unconscious mind in emotions such as love, anger, and other basic bio-physical needs, are overlooked. Similarly, the control over the self is at a minimum for these parameters (Fig. 5a). Under these conditions, people do not express their will as in normal situations. This is manifested in many ways. For example, people shut down and cannot arrange a child's marriage, educate children, or make financial decisions. The survey results suggested that emotions are highly repressed due to the extreme stress of riverbank erosion hazard, especially in Rukunpur. In these hazard communities, values and ideologies deteriorate. When there is no food, people cannot be con-

cerned with values and ideologies. They often forget about themselves. It is interesting to note that average-CV differential depicted subjectivity of opinion in Akandanga (negative average-CV rating is about -20%), due to minimum land loss by riverbank erosion, while objectivity and consistency in opinion were observed in Rukunpur (high positive rating is above 40%) as land loss has occurred for every villager.

Regarding interpersonal processes, indicators mark maximum intensity of hazard in Rukunpur, followed by Matiari, Ganjadanga and Akandanga. For helping and altruism, there is a convergence of opinion between Matiari and Rukunpur. Close relatives of people in Rukunpur helped the victims selflessly while in Matiari, the well-off people had no problem helping the victims of 'Nichupara', a neighborhood located at a lower elevation than the main village dominated by environmental refugees (Fig. 5b). However, consistency of opinion in Matiari is weak for variable individual responses. Regarding the other variables, Rukunpur exceeded the scores of the other villages. Regarding death or rebirth

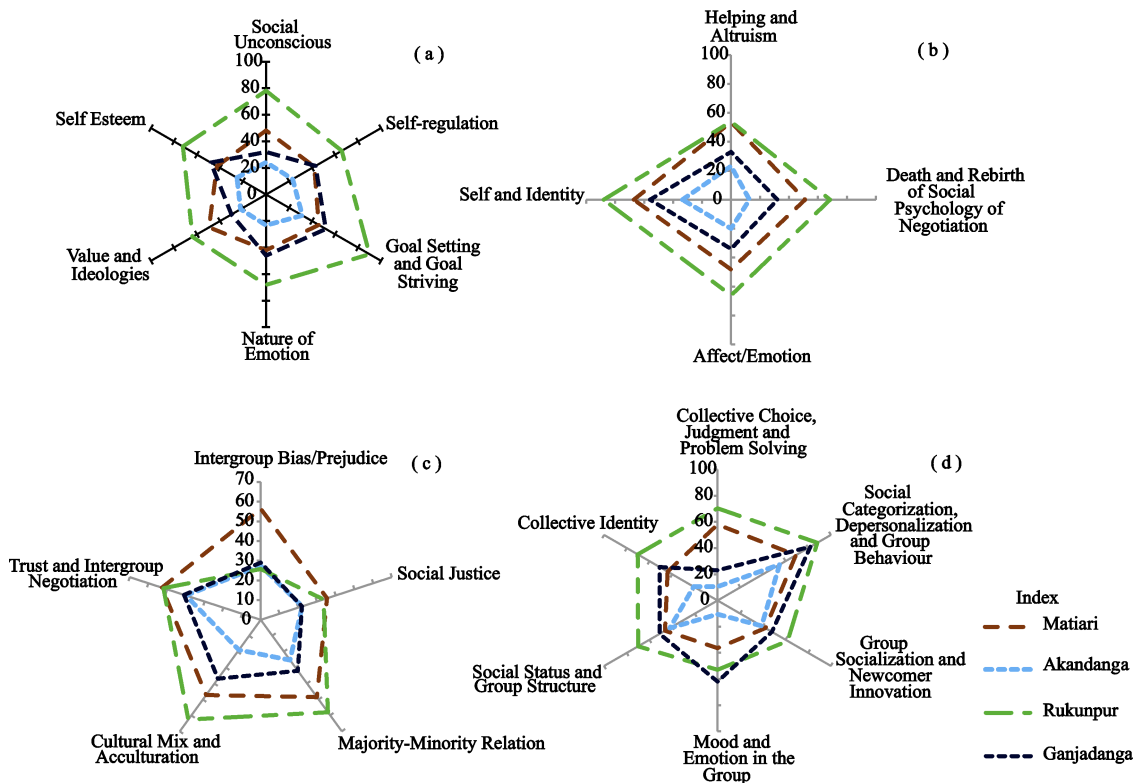


Fig. 5 Patterns of social processes (%). a. intra-individual, b. interpersonal, c. intergroup, d. group (Computed from field data in 2015; Sample size: Matiari: 122, Akandanga: 19, Rukunpur: 62 and Ganjadanga: 20)

of cults, the survey showed an average rating of 70% in Rukunpur. Like the intra-individual processes, we also observed event-controlled mechanisms in Rukunpur (high positive average-CV differential: 35% and above) and a perception controlled mechanism in Akandanga (negative average-CV differential: -15%) for this process. Riverbank erosion has led to variabilities in emotional stability and identity crisis due to differences in the intensity of the hazard. Almost all the respondents were unequivocally agreed in the rating of self and identity.

Intergroup processes are much more complex than processes operating at an individual level. Intergroup bias and prejudice was at a maximum in Matiari showing an increasing psychological gap among the villagers. This may be due to income inequality created by manufacturing activities. Regarding this variable, only Matiari recorded a positive average-CV differential suggesting objectivity of the phenomenon while the responses from other villages were fragmentary. The social justice average rating was neither satisfactory nor consistent (Fig. 5c). This may be due to the predominance of group differences existing in the area. Gaps in majority-minority relations (in terms of social and psychological gaps) between the victims and non-victims increased in Rukunpur since the suffering of victims is not fully perceived by non-victims.

The rating of this variable was inconsistent in Akandanga and Ganjadanga with an even greater inconsistency in both Matiari and Rukunpur. This strongly indicates a spatial variation in perception triggered by riverbank erosion. The variables of cultural mix and acculturation (united measure against riverbank erosion) were observed at a maximum in Rukunpur since it is the village most threatened by riverbank erosion. Therefore, this response reflects a unity among the people irrespective of caste (general : scheduled caste = 94 : 6), religious composition (Muslim : Hindu = 77 : 23), economic affluence (below poverty line people (BPL), having monthly per capita income below INR 783: above poverty line (APL) = 81 : 19), and nature of victimization (victim: non-victim= 83 : 17). This perceived unity is vital in protecting the village against hazards ultimately ensuring the survival of the community. In Matiari and Rukunpur, it was observed that non-victims trust the victims in distress. This is the only parameter in the intergroup processes that registered a positive average-CV differential among all the villages. In other words, this parameter shows an event controlled response.

For group processes, data taken from Rukunpur similarly depicts the highest average rating except for mood and emotion in the group (Fig. 5d). The collective efforts within the group, either for arranging food and shelter, or protection of the riverbank is higher in Rukunpur than in Akandanga and Ganjadanga (Fig. 5d). Group cohesion is clear in the Rukunpur village. People are united against any issue related to riverbank erosion. During the crisis period, people lay aside enmity between individuals within the same group. This again demonstrates a societal unity in the wake of hazards. Other villages have secured their position in accordance with the nature and severity of their vulnerability. This variable showed a positive loading in the average-CV differential, thus depicting the presence of event controlled mechanisms in the study area. In reference to group socialization, Rukunpur once again secured the first position. Socialization was shown more intense in the area induced by riverbank erosion. In Rukunpur most of the adult males (~29%, $n = 76$) work outside the state (province) to bring in an income for their families. In the case where the head of the family is absent, (i.e. the elderly) the villages take care of those families. Though the rating was positive, the intensity was not so high. Mood and emotion is purely a psychological issue. Significantly, the highest rating in this parameter was recorded in Ganjadanga due to of the memory of nostalgic events in the overall psychological mosaic since their land loss was not recent (prior to 1990s). In Rukunpur, the rating was relatively lower since the people are more involved in activity space rather than emotional space. Regarding social status, Rukunpur again occupies the top position in hazard-scape. The gap between the landlord (large-scale farmers having more than 15 bighas of agricultural land) and marginal farmers (having less than five bighas of agricultural land) has been drastically reduced in the past 20 years due to significant land loss. Recently, the gap between the 'haves and have-nots' has been reduced substantially in the post-erosion phase. However, in Matiari this parameter has increased substantially due to the brass metal industry. Collective identity was also at a maximum in Rukunpur. A shared sense of belonging to a group has developed largely under the stressed conditions in Rukunpur.

(2) Association of social processes

The above discussion revealed the real pattern of social processes. From the Principal Component Analysis (PCA), it became clear that the relation was strong for the

intra-individual and interpersonal processes while relatively weak for the intergroup and moderate for group processes (Table 3). This was due to group differences existing in the concerned area. For the intra-individual processes, the total variance explained at PC₁ was 95% and all the components showed high positive loadings. Self-regulation, had the maximum positive score, and directed the system toward positive in-loading. For the interpersonal processes, the total variance explained at PC₁ was maximum (>97%) in comparison to the others and all the components showed high positive loading in PC₁. Social psychology of rituals achieved 100% loading at PC₁ representing a uniform rating among the respondents. This variable dominated the system toward a positive direction. For the intergroup processes, the total variance showed that PC₁ was rather weak (79%) compared to the other categories, where all of the components had a high positive loading in PC₁ except for intergroup bias and prejudice (0.53). This low loading of intergroup bias and prejudice in PC₁ was attributed to a

wide divergence of opinion. Trust and intergroup negotiation showed the highest positive loading (0.995). For group processes, the total variance explained at PC₁ was 83% and all of the components had a high positive loading in PC₁. Collective identities with the maximum positive loading had a dominant influence on this variable.

The results gained from the second stage PCA clearly point out the relative strength of the factor loadings at PC₁ for the intra-individual (0.973) and the interpersonal groups (0.993) compared to the intergroup (0.921) and group (0.945). Additionally, the results indicated a close association between the intergroup and interpersonal processes and between intra-individual and intragroup (Fig. 6). The total variance explained at PC₁ was more than 90% indicating the strength of association among the social processes. Interpersonal and intra-individual processes were dominant within the social system while group processes were feeble due to existing group differences.

Table 3 First-stage PCA for response in variables and their underlying factors

Social processes	Variables	PC ₁ factor loadings	PC ₁ explained variation
Intra-individual processes	Social unconscious	0.967	94.683% ($\sum \lambda^2 = 5.681$)
	Self-regulation	0.993	
	Goal setting and goal striving	0.979	
	Nature of emotion	0.984	
	Value and ideologies	0.930	
	Self esteem	0.984	
Interpersonal processes	Helping and altruism	0.963	97.325% ($\sum \lambda^2 = 3.893$)
	Social psychology of rituals	1.000	
	Affect/emotion	0.994	
	Self and identity	0.989	
Intergroup processes	Intergroup bias/prejudice	0.523	79.18% ($\sum \lambda^2 = 3.959$)
	Social justice	0.983	
	Majority-minority relation	0.962	
	Cultural mix and acculturation	0.897	
	Trust and intergroup negotiation	0.995	
Group processes	Collective choice, judgment	0.764	83.25% ($\sum \lambda^2 = 4.995$)
	Group behaviour	0.966	
	Group socialization	0.953	
	Emotion in the group	0.830	
	Social status	0.940	
	Collective identity	0.998	

Note: Computed from the field data in 2015

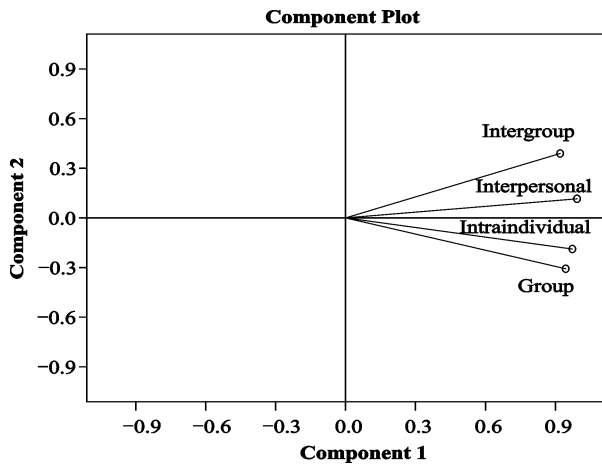


Fig. 6 Discrimination of social processes through CATPCA

3.3 Psychological terrain

3.3.1 Social psychology of hazard

Social psychology, a broad area of psychology, is concerned with thoughts, feelings, and behaviors influenced by the actual, imagined, or implied conditions of another (Allport, 1985). In the previous section under social processes, behavioral patterns were explored in depth. In this section, feelings of ‘body’ space and ‘mind’ space, influenced by the perceived or imagined image of riverbank erosion victims, will be examined with special reference to fear/phobia, stress, and shock. Fear and phobia are interlinked. ‘Phobias involve the experience of persistent fear that is excessive and unreasonable’ (Wilson, 2009). Those who have experienced fear of riverbank erosion are susceptible to experiencing phobias. In the strictest sense, fear/phobia is a pre-erosion phase event; physical and psychological stress is the in-phase event while shock is a post-phase event.

The perceived reality of fear and phobia is common in the erosion-prone coastal areas of Bangladesh. Victims easily become panicked by flashback images of erosion disaster (Hassan, 2015). This was evident in the present study area. Survey results indicated that psychological stress and shock dominated the post-bank period due to destabilization of society and the economy. During the erosion period, people hurriedly engaged themselves in affected fields to save their crops as well rushing to household activities to safeguard household assets. During this period victims work in a kind of ‘war-time vigilance’. In the post erosion phase, ecological refugees who have lost land work and toil for the survival of their paralyzed families. In addition, our studies revealed spatial and gender variations. From a spatial perspective, fear/phobia, stress, and shock were highest in Rukunpur, followed by Ganjadanga (Figs. 7a, 7b), and were lowest in Matiari.

From a gender perspective, it was observed that fear and phobia was much higher for male members than for females. This may reflect the direct experience of males in the field while females are not typically at the site of the disaster. Agricultural areas are seldom visited by the rural Muslim women due to social barriers. This is also observed in other countries as well (Hariharan, 2014). Males are busy in the field and females remain in the household for childcare and food preparation. Males are vigilantly involved in crop harvesting as well as dumping the crops in household yards during riverbank erosion. Again, during riverbank erosion, males are more involved in relocating household assets to a safe place. Male members thus experience more physical stress than females. Females, alternatively, have to shoulder the responsibility of all in-house property and asset management

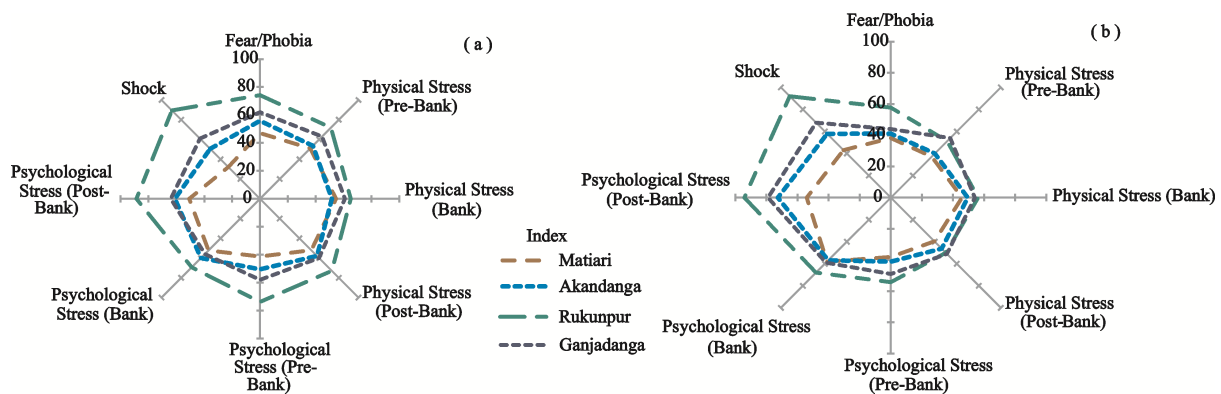


Fig. 7 Social psychology of hazard (%). a. Perception of males, b. Perception of females. Results reported in percentages (Computed from field data, 2015. Sample size: Matiari: 122, Akandanga: 19, Rukunpur: 62, and Ganjadanga: 20)

during the pre-event as well as the post-event phases. In the post-erosion phase, male members have to work hard for the survival of their families. It is notable that physical stress is much higher in the post-riverbank erosion phase than the pre-riverbank erosion as they lose regular income from farm operations. After the erosion, their monthly per capita agricultural income significantly declines. In Rukunpur, income has dropped to INR 411 in 2012 from INR 1026 in 1970. Thus, farmers are forced to adopt occupational diversity. Psychological stress in the pre-riverbank erosion phase is much higher for males than females since males retain the disaster images of land loss by riverbank erosion in their memory. However, in the post-erosion phase, psychological stress is much higher for females than males. This may be due to the higher stress experienced by women in managing daily family affairs especially preparation of food, shelter, and fodder for animals, since the household material assets are not rendering benefit to the community. Typically, females are the ‘home minister’ responsible for the daily family business within the sphere of the household. Psychological stress on males is relatively lower than that of females in this case because males work outside the home and do not directly face the household crisis of food preparation for family members or fodder for animals; rather they share their distress with others in the village. Concerning shock, both males and females experience a high level of trauma due to the extreme distress of riverbank erosion. Average rating for both males and females was above 90%. This may be due to the absence of shock-absorbing economic strategies in all of the villages except for Matiari. Although males and females are comparable in all villages; females often override the scores of males in emotional involvement regarding household property resource management. This may reflect differences in brain chemistry and social learning between the genders, which direct women to speak from more of an emotional perspective (Hess et al., 2000; Parkins, 2012). In summary, the perception survey indicated that the perception of males was more persistent than females concerning fear/phobia and physical stress while females exhibited higher incidence of psychological stress and shock (Fig. 8). Consistency of opinions in the study indicated an event-controlled mechanism while variations proved levels of perception conditioned by individual psychology.

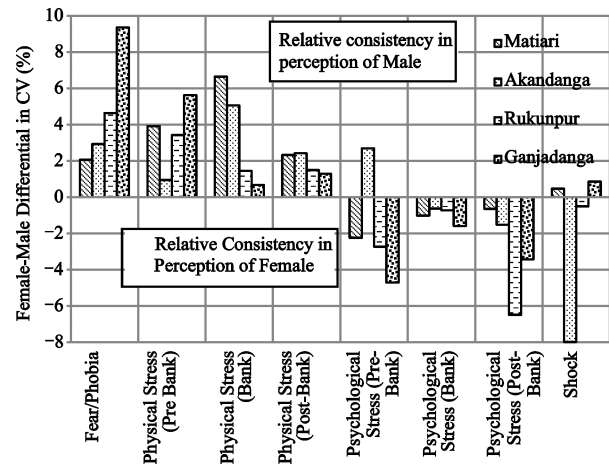


Fig. 8 Relative consistency of males and females in perception about different variables of social psychology (Computed from field data in 2015. Sample size: Matiari: 122, Akandanga: 19, Rukunpur: 62, and Ganjadanga: 20)

3.3.2 Social psychology of desire

Desire is a sense of hope in an individual for obtaining either an object or a certain outcome of an event. In the general population, desire is considered the aspiration of gaining something, but among psychologists, it is often viewed as the outcome of a given function (Anderson et al., 2015). This term is the opposite of disappointment. In this section, the psychology of desire will be assessed through the allocation of resources in the society. Food is a fundamental need inciting the feeling of craving in order to have it. Psychology of desire greatly differs from one society to another. A society inflicted by hazard will behave quite differently from a normal society. A perception survey was conducted in Rukunpur as a representative society of hazard and victimization, compared with Matiari, a representative hazard but non-victimized (normal) society. Respondents were given thirteen pure allocations following the Tajfel matrix (Fig. 2).

The survey results showed a general in-group favoritism in Matiari and a maximum differentiation in pro-ingroup in particular. Conversely, in Rukunpur there was an overwhelming response by respondents in favor of maximum joint profit in general and maximum joint profit pro-in-group in particular (Fig. 9).

Thus, a person in a normal society always tries to maintain a superiority gap that has been well depicted by the large response in maximum differentiation of the pro-ingroup indicating a maximum in-group profit. Even though they cannot sacrifice a maximum profit for others in maintaining the ‘gap’. In Rukunpur, most of

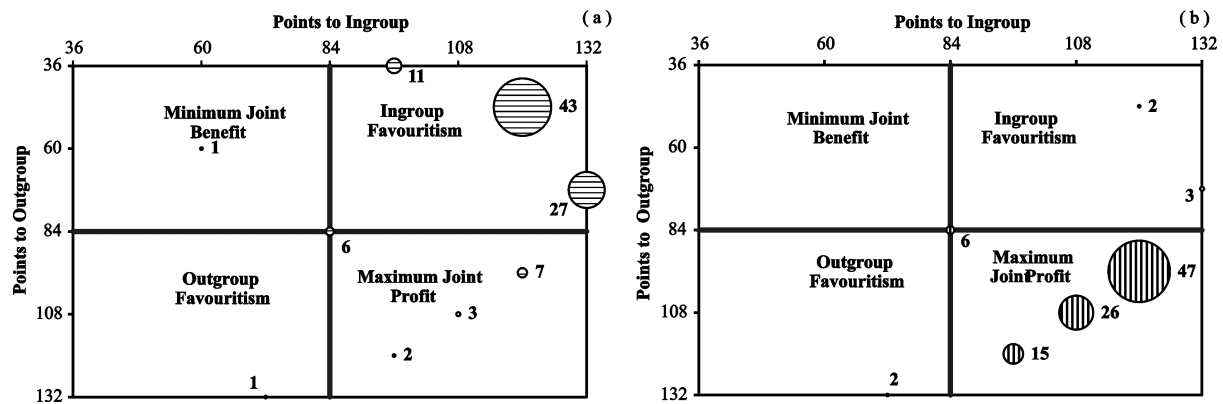


Fig. 9 Tajfel Matrix showing psychology of social desire vis-à-vis distribution of resources in the society. a. Matiari: a normal society, b. Rukunpur: a hazard dominated society. Numeric values adjacent to Scatter points are the percentage figure of number of respondents (Computed from the field data in 2015. Sample size: 122 for Matiari and 62 for Rukunpur)

the respondents believe in maximum joint profit pro-in-group indicating a mentality of sharing and ‘removal of the gap’ in a hazard society. This has been shown by Beck (1992) and Giddens (1999a; 1999b) in their classic notion of ‘risk society’. In this case, the appearance of a risk society emerges due to a united move of the people toward meeting basic needs such as food, shelter, healthcare, and education. These necessities are crucial for the sustenance and survival of the whole community; thus, the inhabitants set aside all mistrust, anger, and rivalry in the wake of natural or manmade hazards.

4 Conclusions

This study analyzed the severity of riverbank erosion along the Bhagirathi River in general and in select mouzas along the river in particular. Computation of land loss at the mouza level showed that the mouzas have lost ~5% to 21 % of total land from 1920–2014. What is more alarming is the rapid loss of land in the last decade, e.g., the Rukunpur mouza has lost ~10% of the land from 2008 to 2014. Empirical surveys showed that ~60% of the households lost land over last two decades. As most of the land (~95%) that was engulfed by the river was agricultural, the rural agrarian economy of the study area has met with extreme marginalization in terms of rural livelihood and income. Against the backdrop of the generalized increase in income in normal areas, some affected villages have almost halved their per capita income from just 1970–2012. This decline in the economy has led to an emergence of a social and psychological terrain in sharp contrast with that of

the normal society. This study has documented that the erosion-affected villages have a comparatively larger family size, lower literacy rate, higher school dropout and poor health. In addition to the decline in social institutions, this study revealed a pattern of deviant behavior in social processes. The indicators of intra-individual, interpersonal, intergroup and group patterns showed a maximum hazardscape for the villages that lost more agricultural land, such as Rukunpur. Minimum effects were observed for villages either not affected by erosion or having an alternative, non-agricultural economy such as Matiari. Like social processes, psychological trauma measured in terms of fear/phobia, stress, and shock was maximum for erosion victims. Social desire measured through the Tajfel matrix showed that hazard psychology of a community is different from normal psychology as normal community psychology is more free and spontaneous in expression. Community psychology of victims of hazards is more homogeneous as they are the results of stressed conditions and more akin to bipolarity for in-group and out-group processes. Significantly, in-group relation showed maximum joint benefit or profit due to Pareto optimality, while out-group profit or benefit occurred at a minimum level due to Pareto inequality. Thus, government or non-government organizations should take proper management steps to involve the victims in a single group irrespective of caste, creed, or religion and discourage out-group favoritism, which may increase fear, phobia, and shock within the victims leading to further psychological trauma. Finally, it must be stressed that such social and psychological terrain varies in terms of age, gender, in-group, and out-group consideration.

Therefore, this investigation indicates that only a materialistic outlook of hazard management is not a proper strategy. The study of social and psychological behavior of hazard victims is also necessary for co-operation and confidence building among hazard victims.

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