Transactions

Volume 31, No. 2, Summer 2009

Journal of the Institute of Indian Geographers

Trans. Inst. Indian Geographers
Vol. 31, No. 2, 2009

Floods and their Hazard Impact on Flood Plain Dwellers in Mangaldai Sub-Division, Assam: A Study in Geographical Geomorphology

N. Bhattacharjee and R. Barman

Abstract

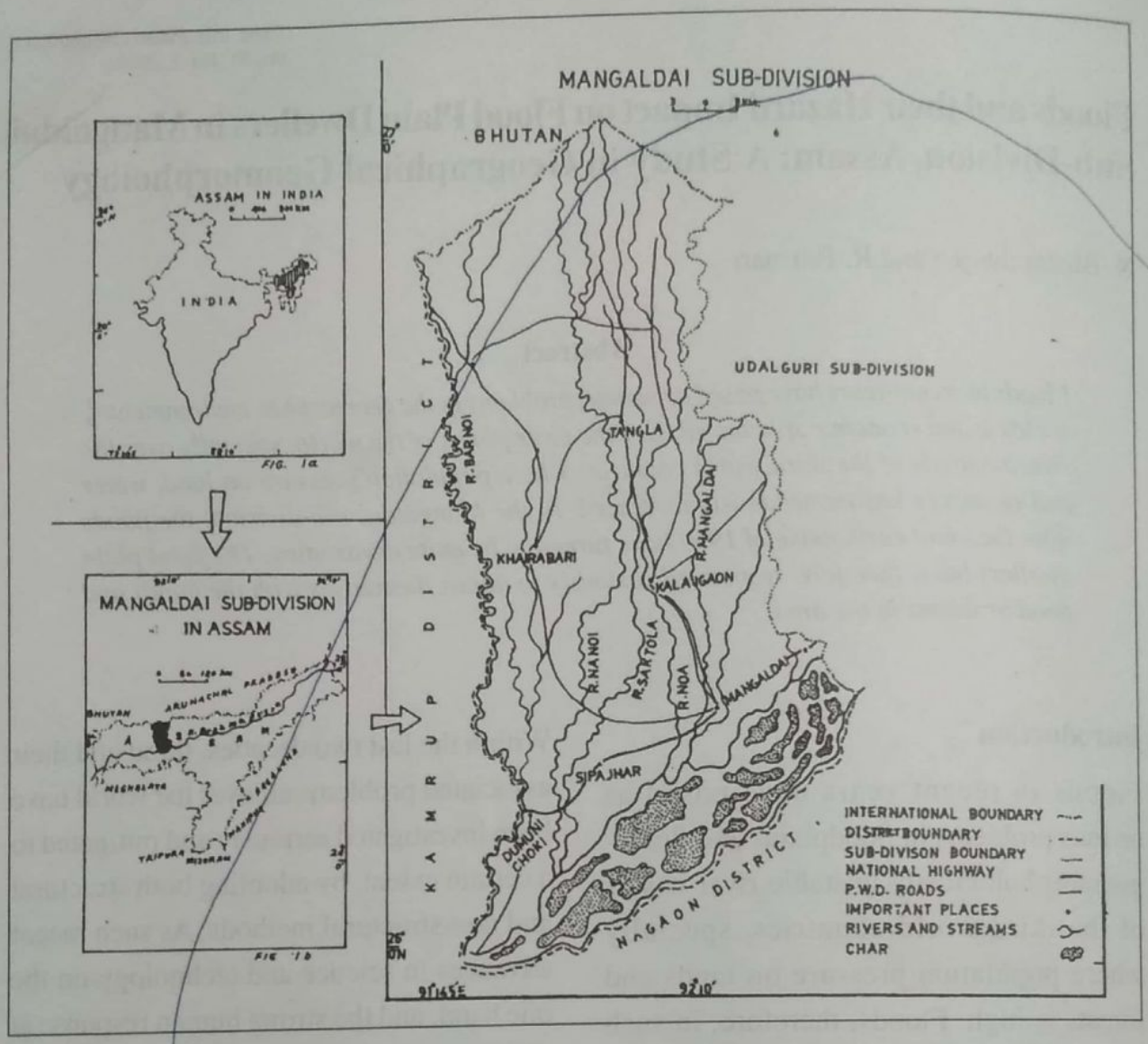
Floods in recent years have posed as serious problems in the geomorphic, environmental, ecologic and economic spheres all over the river plains of the world, specially over the riverine areas of the third world countries where population pressure on land, water and resources has tremendously increased. In the Mangaldai sub-division, the floods after the great earthquake of 1950 have turned to be quite devastating. The flood plain dwellers have, therefore, responded variously to adjust themselves with the floods and flood problems in the area.

Introduction

Floods in recent years have posed as serious problems in floodplains and fluvio-geomorphologically unstable river basins of the third world countries, specially where population pressure on lands and forests is high. Floods, therefore, in such areas are recognised as one of the most devastating natural calamities of high human significance. Even as flood prone riverine areas are fraught with the dangers of flood hazard and many a time disastrous events and problems, such resourceful areas have always been the concentrated social, cultural and economic efforts and activities of mankind, more specifically of the floodplain dwellers. For this reason, all the floodplains of the world have been the areas of high human significance in the interlinking arena of use-response-adaptation-management-development. Within the last two decades, flood and their associated problems all over the world have been investigated seriously and mitigated to a certain extent, by adopting both structural and non-structural methods. As such recent advances in science and technology on the one hand, and the strong human response at different levels and activities on the other are best applied for coping with the hazardous floods in a riverine area. In this paper a preliminary attempt is made to bring forward the nature of flood problems and human response to them in the flood prone areas of the Mangaldai sub-division in Assam.

The study area

The Mangaldai sub-division covering almost a flat riverine plain area of 2024.76 sq.km. and having a population of 84911 (as per 2001 census) distributed over as many as 815 revenue villages is bounded



by the Bhutan Himalaya in the north, the mighty Brahmaputra in the south and the plain parts of Darrang district and Kamrup district respectively in the east and west. This peculiarly disposed and displayed flat plain has been endowed with streams (Fig.1), from west to east, such as Barnoi, Nanoi, Saktola, Noanoi and Mangaldai noi and their tributaries. During the rainy season almost every year, these rivers remain in spate causing frequently disastrous floods, inundating even the high lands and damaging crops, lives and properties. Floods in the subdivision have, of late, turned to be increasingly disastrous, specially after the great earthquake of 1950. In spite of various structural works followed to contain floods and flood problems in the area, they are yet to be mitigated. The frequency and intensity of such problems have accelerated, in recent years, their intolerable limit. The people of the flood prone areas of the sub-division have their own responsive ways to floods and flood problems..

Objectives

The main objectives of the study under the title are:

(i) to examine the functional bases and causes of floods and flood related problems, (ii) to identify the areas of floods, their effects and hazard status (iii) to examine the perceptions and responses of the floodplain dwellers and to forward suggestions for the optimal management of floods and the for sustainability of human society.

Data base and methodology

Data and information for the study come partly from fieldwork and partly from secondary sources, viz. District Commissioner's Office, Block Development Offices, Water Resources Department, Govt. of Assam, Brahmaputra Board, Govt. of India, etc. Besides, personal experiences as regards the area of floods and flood problems in the Mangaldai sub-division. Topographical map of 1:50000 and satellite images of the same scale were also consulted.

Analysis

Flood is defined as the rising and overflowing of a body of water on to land, which is normally not inundated (Wisler and Brater, 1959). The Webster's New International Dictionary also gives a similar definition. The definition by Ward (1978) states that the flood is the body of water, which rises to overflow land, which is not normally submerged. Floods constitute complex events, which incorporate location, intensity and duration, dynamics of floods, and the perception of the flood plain dwellers as well.

Bases of floods

Floods of an area reflect a number of basic facts of their genesis, development and enhancement. Of these, the most pronounced ones are the climatic factors and the topographic ones coupled with geological and hydrological, edaphic and vegetational bases.

The geological base of the area is such that the area is an alluvial plain formed of recent to sub-recent alluvium that rest on the fore-deep (Krishnan, 1982) or the rift valley (Burrard,1915) caused by tectonic forces on the pre-Cambrian rock base below the southern slope of the Bhutan Himalaya. As such the area represents a part of the mobile and unstable region in the Himalayan zone. The foothill zone of the sub-division composed of alluvial fan and cones. The built-up plain on the middle part are constituted by fine-grained river-borne alluvium of sub recent origin whereas the low-lying flood plains of the like composition in the south signify the inherent topographic and fluvio-geomorphic basis for the ongoing geomorphic and hydrologic development. The area has been signified by absolute relief differences with the maximum contours of 450m, 100m and 50m respectively in the piedmont, built-up and chronically flood affected areas. The overall slopes, on the other hand, are more

Table 1: The Flood Affected Villages of the Mangaldoi Sub-Division. 2004

Name of the Circle	Mouza	Total no. of villages	Number of flood affected villages
1. Harisingha	Sekhar	98	
	Harisingha	90	
	Dakuba	35	Nil
2. Khoirabari	Mazikuchi	42	
	Chinkuna	49	Nil
3. Kalaigaon	Silputa	49	
	Kalaigaon	52	21
4. Patharighat	Sarabari	29	
	Roynakuchi	13	
	Dipila	23	
	Bonmajha	21	76
5. Sipajhar	Lokrai	28	
	Sipajhar	52	
	Hindughopa	13	93
6. Mangaldai	Dahi	19	
	Chapi	45	
	Rangamati	80	90
7. Dalgaon	Shyamabari	87	Nil

Source: Based on data collected from circle offices and field observation.

than 13 degrees, 1 to 3 degree, and within 1 degree respectively in the piedmont, built-up plain, and the chronically flood affected plains.

The soils in the piedmont zone are non-cohesive in nature mixed with boulders, pebbles cobbles, grit, sand and clay giving a suitable condition for easy and rapid percolation. The soils of the built-up area are mostly loamy with varying proportions of silt, sand and clay. Such types of soils form a sensitive base to most flood problems in the sub-division. There is only a very low proportion of vegetation cover in the area except the Bhabar or the piedmont zone where there is sparse but a high proportion of forest cover. This has been effective in allowing fairly free passage of floodwaters and the creation of associated erosion and sedimentation both along and across the channels of the rivers.

Climate is the basic factor of genesis and development of floods. The Mangaldai sub-division remains under the influence of monsoon rainfall ranging annually between 2500mm in the foothill zone and 1400mm in the southern part of the plain. About 80% of this annual rainfall comes during the months May to September. During high storm period in summer, the climato-genetically

generated excessive supply of rainwaters lies far below the carrying capacity of the streams and therefore, the area frequently comes under flash floods. Again during the winter or even sometime during the summer, several days at a stretch go without a single drop of rainwater. Such a state causes levelling down of stream water making the banks of the streams unstable and prone to erosion.

Flood hazard characteristics

Going with the definition of flood by Ward (1978) it is estimated that about 45% of the total area of the sub-division including southern lowlying tract of the Brahmaputra and its tributaries experience regularly high to very high floods and about 35% of the built-up plains get occasional floods of low to moderate magnitude. The piedmont zone along with some other raised plain areas (about 20%of the total area) experiences very transitory floods. Floods of devastating nature in the sub- division occurred in 1950, 1954, 1957, 1962, 1979, 1980, 1983, 1986, 1988, 1990, 1992, 1996, 1998, 2002, and 2004. In the sub-division all the rivers get flood deluge of different orders and magnitudes, sometimes occurring 4 to 5 times in a year. These waves of flood waters cause severe damage to crops and croplands, human habitats and the bio-environment. Although the flood magnitude and duration have not been so high in recent past, specially before the great earthquake of 1950, it is observed that during the last two decades the entire sub-division has been frequently and increasingly affected by floods.

Floods have been common and conspicuous features in the catchments of the Nanoi, Barnoi, Noanoi and Saktola rivers. Among all these rivers the Mangaldai river regularly inundates the southern part of the area known as the *Char* land. This area experiences four to five flood waves in a year due to combined waters of the river Brahmaputra and Mangaldai river. The Saktola and Noanoi rivers also regularly cause floods of high to very high intensity. These two rivers before the last two decades or so created low floods. The downstream parts of both the rivers are very much affected by chronic floods. The Nanoi and Barnoi are, of course, the main devastating flood-causing rivers in the study area. However the intensity and impact of floods caused due to the river Nanoi, as observed by the authors, are by far the largest in the sub-division. This river used to inundate new villages every year; Floods became more intensive with 7 to 15 days duration at a stretch in the downstream areas of the rivers Saktola, Nanoi and Mangaldai. This part of downstream lies in the influence of backwater of the Brahmaputra wherein flood waters remain stagnant during the days of flood. The comparatively small streams in the sub-division create only flash floods and that too partly by their own channelized water and partly by waters coming from other heavily flooded rivers. It is observed that there exist three to four high peaks of floods within June to September during the

years of floods of high to medium intensity bearing a great significance in respect of their hazard nature and status (Table 1) in the sub-division.

Floods and flood problems–their nature and impact

While peak flood levels and amounts of water discharge vary from river to river in the sub-division (Table-2) the river channels and basins are also fraught with various kinds of problems.

The edges between the basins have gradually lost their existence partly because of accelerated sheet and gully erosion on the comparatively raised plains and banks due to recurrent floods along the channels and across the basins, and also partly because of the leveling of the lowlying pockets by sediments carried down by the streams. As a result, the proliferation of floods has greatly increased during the last few years accentuating the harm and damage to water flow paths and storage, and both the natural and cultural landscape. For example during the floods of 2000, affected human habitats, agricultural land, etc. (Table-3). The river system and plan form have changed immensely in recent years. For example the tributaries like Dimila, Ghagra and Kalpani have highly changed their morphology during the last two or three decades.

Table 2: Nature of Peak Flood Levels of the Rivers of Mangaldai Sub-division

River gauge site and year of event (N.T. road crossing)	Peak flood level and discharge of flood waters	Standard deviation	Co-efficient of variation	Parameter
Mangaldai Noi 1989, 1992, 1995, 2000, 2004	53.37m -	1.48m -	2.77m -	Water level Discharge
Noa Noi 1980, 1991, 1999, 2000, 2004	54.86m 86.97 cumecs	1.82m 22.28cumecs	3.31m 25.62 cumecs	Water level Discharge
Saktola 1990, 1994, 1997, 2000, 2004	52.22m 82.26cumecs	1.39m 68.54cumecs	2.66m 83.32cumecs	Water level Discharge
Nanoi 1983, 1987, 1991, 1995, 1999, 2000, 20004	53.46m 121.60cumecs	0.46m 63.30cumecs	0.86m 52.05cumecs	Water level Discharge
Barnoi 1976, 1980, 1985, 1991, 1995, 2000, 2004	50.01m -	1.42m -	2.83 -	Water level

Source: calculated from the data collected from the Water Resource Dept. Assam

It is again observed that during the high floods the rivers like Saktola, Nanoi and Noanoi attained breaches of embankments having horizontal extent of 100 to 200 meter in length with a breadth of 10-20 meter and vertical erosion of more than 2 meters deep at certain points and places. Due to such regular bank erosion, most flood generating rivers have shifted their banks and channels by about 500meters during the last 4 or 5 decades. Thus the metamorphosis of rivers as Schumm, (1977) had pointed out became most conspicuous in the river morphology of the Mangaldai sub-division.

There had also occurred devastating floods during 2004. According to the Darrang District administration, more than 736 thousand hectares of land along with 40.7 lakh people in 372 villages were badly affected during this flood of 2004. The authorities had to open as many as 187 relief camps. The flood was so devastating that on the night of July 9, 2004 that there occurred as many as 11 breaches along the embankment of the Nanoi river. During this flood more than 85 and 1990 houses were completely damaged in the Sipajhar and Patharighat Revenue circles respectively.

Since the last two or three decades, floods have been repeatedly affecting the surface roads causing disruption to transport and communication system of the entire sub-division. The migration of people from the flood prone areas of the sub-division has been a common feature, wherein people even simply do not possess the awareness to cope with the floods.

The sub-division comprises many semi urban- like growth points and market and service centres. Of these the flood-affected centres are Sipajhar, Patharighat, Dipila, Chengalia, Jonaramchock, Khatara, Duni, Auwalachowka, Marai etc. These points and places forming 'hat' (a 'hat' is a periodic rural market that is held weekly or bi-weekly) act as an important functional entity (Sharma, 1972) of socio-economic importance to the rural mass. Many a time

Table 3: Flood Affected Areas and Damage, 2000

Category of damage	Amount/Quantity	Approximate value (million rupees)
Area affected	131.47sq.km.	Not available
No. of villages affected	343	Not available
Crop area damaged	500 hectares	Not available
No. of families fully affected	3240	12.90
No. of families parttialy affected	17121	25.68
No. of people affected	3,33,051	-
No. of human lives lost	1	-
Area eroded	262.50 hectares	Not available
No. of institution affected	196	0.98

Source: D.C. Office, Mangaldai Darrang District (Assam), 2000.

the locations of these hats are controlled by floods. The southern part of the Mangaldai sub-division shows a decrease in net area sown due to loss of land through channel and bank erosion by channel. Table-4 shows the damage of agricultural crops and production in the year 2000.

During floods every year, portions of surface roads are either submerged or breached when the force of the floods is very high. Wooden bridges and even the concrete bridges are damaged. During the 2004 floods many roads around the Mangaldai town were badly damaged and a few bridges were completely washed away. Heavy siltation adversely affected many wetlands of the area. Lowlying places in the basins of certain rivers came under sediment deposits. Our field observation reveals that heavy siltration due to floods are damaging the resourceful wetlands of the area. A survey conducted after the devastating flood of 2000 reveals that many of the lowlying spots and places in the river basins are being under sediment deposits of thickness ranging from less than half a meter to more than one and half a meter.

Dwellers' response to flood and flood problems

Floods in the Mangaldai sub-division like other riverine areas of Assam do create hazards to the floodplain dwellers who respond the floods and flood problems as persistent hazards of high to low significance. They respond such hazards at different levels of structural, non-structural and technological means and application. Abetment of floods and the dwellers' adaptation and adjustment with the flood hazards constitute some of the significant ways of response to floods. According to Burtone and White (1978) human perception is mainly based on the frequency and magnitude of floods. Even as the floods occur in 3 to 4 waves in a year, sometimes such floods go for about 7 to 15 days at a stretch in the lowlying areas. Even then the dwellers of the area, mainly the Muslim peasants of erstwhile East Pakistani origin take the land as resourceful and try always to react positively with the good and bad of the floods and flood problems of the area. They use land more intensively for raising different crops like jute, sugar cane, vegetable, and many others. On the other hand, in spite of occurring low

Table 4 : Damage to crops during year, 2000

Crops damaged	Area (Hectares)	Approx. value (million rupees)
Jute	388.00	1.0
Sugarcane	81.00	0.60
Paddy	23,715,00	157.4
Others	-	14.5

Source: Revenue and Relief Branch, Darrang. Govt. of Assam

floods of more or less recurrent nature in the lands and habitats of the indigenous people, such land and habitats are unable to either attract or give permanent shelters therein to those indigenous people. They, therefore, develop tendency to flee from the land and habitats. From the field study it is observed that the perception of the inhabitants to flood hazards varies according to the magnitudes, intensity and duration of floods. In an examination regarding the probability of frequency occurrences of hazardous floods in the sub-division, it is revealed that 85.5 percents of the total respondents replied in the positive, while the remaining 14.5 percent of the respondents expressed their negative views. Again, not only the Mangaldai sub-division but also all the other riverine areas of the Brahmaputra and the Barak like others have their historical influence on human habitation, land uses and kinds of adjustments of the dwellers to floods and flood problems. The people of the floodplains have now become more optimistic in the mitigation of floods and flood problems at the present state of uses of technological knowledge and know-how in the environmental assessment and management of land, water, etc. to favour the production processes, co-existence of the dwellers with floods and flood problems in the sub- division, speacially in the lowlying areas which have till now become one of the important area of intense human interaction with hydrology.

In the sub-division, floods heavily affect an area of about 60 sq.km. while an area of about 19.23 sq.km. on the average is submerged annually. The people are responding variously to such hazards. The damage caused by floods of the area are increasing day by day. In this connection the views of White that "what now seems self-evident, that human being adjust in a number of ways to the flood hazard and that their adjustment may represent a viable compliment to and in some cases substituted for the control of water in river channels or the whole-sale removal of intensive land use from flood-prone areas" (as cited from Ward, 1978) can well be maintained.

To tackle this problem, of course, people develop their own low-cost and locally adjustable solutions. The negative attitude of the floodplain dwellers towards the adjustment to flood hazard and damages cause the dwellers to feel sufferance and loss of mental strength. The most heart rending sentiment of the poor people of the flood-prone areas, is that they cannot do anything for themselves.

The emergency operation usually encompasses the transfer of persons and property from the areas of high flood after receiving flood warning from appropriate authorities. To warn others from floods or sudden rising of water levels is also included in emergency operation. People of the flood-prone areas ring bells or make sound by locally made "Singa" (a flute-like instrument made of buffalo horn) to warn others from floods or sudden rising of water levels. They take shelter on the raised land, specially on the river embankment and

public buildings such as schools, colleges, houses of village folks, etc. till the danger of floods is not eliminated. The dwellers also adjust themselves with the floods by adopting indigenous ways of raising platforms, constructing houses with low-cost flood resistant materials, growing banana (Bhimkal) plants for making "Bhur" or "Bhel", constructing wooden boats and storing less perishable food items.

The dwellers of the flood prone areas adjust themselves by evolving structural design of building, houses and huts, etc (Hoyt and Langbein, 1965). It helps to minimize the damage to immovable properties. Even though the people of the sub-division as a whole are not fully aware of the extreme damage caused by floods, the dwellers of the chronically flood affected areas, specially in the catchment of the Nanoi, raise the plinth of their houses above the level of high floods to protect themselves from the annual furry of floodwaters. The houses so constructed are structurally and materially much flood resistant. Such houses made of bamboo, jute stems and reeds are very common in the Muslim peasant dominated chronically flood affected areas very near the Brahmaputra.

The land use regulation has also a good relationship with the intensity of the flood hazards in the Mangaldai sub-division. While the Muslim peasants of the chronically flood affected areas adjust the cropping system by applying flood resistant crops of rice, sugar cane, jute, pulses, etc. and grow bananas around their small 'Bastis', the indigenous people of the flood affected areas grow trees, bananas etc as a protective means of floods and erosion on their lands. In many flood affected areas multiple cropping with rotation of crops is practised.

The Nanoi, Saktola and Barnoi, in their lower reaches have embankments to protect land, people, animals and properties from floods. Along the banks of the Barnoi river up to its confluence with the Brahmaputra there lie embankments of 20.20 km. length on both the sides of the channel. The river Nanoi has embankment of 85.06 km. length. The other rivers also have embankments for smaller lengths. However these embankments cannot protect the total area from flood. 'Bunds' are a common method of control. Though these bunds are not well maintained, they are seen to control flash flood in the area to a certain extent. Anti-erosion measures and river diversion

Table 5: People's perception to govt. help given to flood victims

Response	Percentage of the respondents (out of 110 people)
No assistance given	60.1
Help is available	22.3
Yes, relief operation is available	17.6

methods are lacking in the sub-division. The local people, with some non-government organizations are, however, trying to check sheet erosion, river erosion by adopting indigenous techniques. Proper and timely responses of government as well as non-government organizations are always found to be effective in rescuing marooned people. During the floods of 1998, 2000 and 2004, government and N.G.O's responded to give shelters of more than 4500 people of 35 flood marooned villages in as many as 16 relief camps established on embankments, National Highway (No. 52) and schools, etc. However the victims are rarely satisfied with the flood relief items supplied by the government and non-government organizations. They feel that they were not adequately cared in respect of their diseases like diarrhea, dysentery, cough and fever, etc. The result of a survey conducted to know the perception of floodplain dwellers is presented in tables 5 and 6.

Conclusion

It has been obsereved that floods in the Mangaldai sub-division have in recent days become more intensified with more and more devastating nature. But such floods are being mitigated to a limited extent only. It is perhaps because of lack of full knowledge and understanding of the floods and inadequate use of flood control measures. Floods in the Mangaldai sub-division have intensified in terms of their damaging impact in recent years. Flood mitigation measures seem not only inadequate but also of outdated mark. Up to date database is lacking far behind the urgent need of flood problem mitigation. While relief in terms of provision of food, cloth other essential commodities and shelter is provided, there is ample room for improvement of flood affected areas along with the marooned people and cooperation with them on the part of the government agencies. Thus different steps of relief and rehabilitation could be undertaken by the Deputy Commissioner of the concerned district. Unfortunately unlike in the neighboring Bangladesh where relief agencies provide adequate help and cooperation to flood victims, in the Mangaldai sub-division like other parts of Assam little effort is given in this regard.

Table 6: Perception to the success of govt. help

Response to the help	Percentage of the respondents (out of 110 people)
Adequate	0
Inadequate	91.4
Not certain	8.6

Source: Field Survey, 2004

References

Burrard,S.G. (1915): "Origin of the Gangetic Trough, Commonly Called the Himalayan Fore-Deep" *Proceedings of Royal Society, London, 91-a, pp.* 220-238.

Chorley, R.J., (1969) : *Water, Earth and Man,* Mathuen London.

Chow, V.T. (1956) : *Hydrologic studies of floods,* The US International Association of Science Publication.

Colman, J.M., (1969): Brahmaputra River Channel: Processes and Sedimentation, *Sedimentary Geology,* Vol.3.

Krishnan.M.S.,(1982) : *Geology of India & Burma.* (6th Ed.),CBSPublishers and Distributors, Delhi

Leopold, et,al,(1964) : *Fluvial processes in Geomorphology,* Eurasia Publishing House (Pvt) Ltd., New Delhi

Rout Vedt,et al.(1968): Summary of floods in the US during 1963. *US Geol. Surv. Wat. Sup.* Paper, 1830.

Schumm,S.A.(1977a): *The Fluvial System,* John Wiley Publication, Sydney, London

Schumm,S.A.(1977,b): River Metamorphosis. In Gregory,K.J.(Ed.) *River Channel Changes,* IASH/ UNESCO/ WMO(1977).

Ward, R.C., (1978) : *Floods - A Geographical Perspective,* McMillan, London.

Wisler, C.O. & Brater,E.F (1959): *Hydrology,* (2nd Ed.) John Wiley Publication, Sydney, : London.

N. Bhattacharjee
Lecturer
Department of Geography,
Pandu College

R. Barman
Professor
Department of Geography,
Gauhati University