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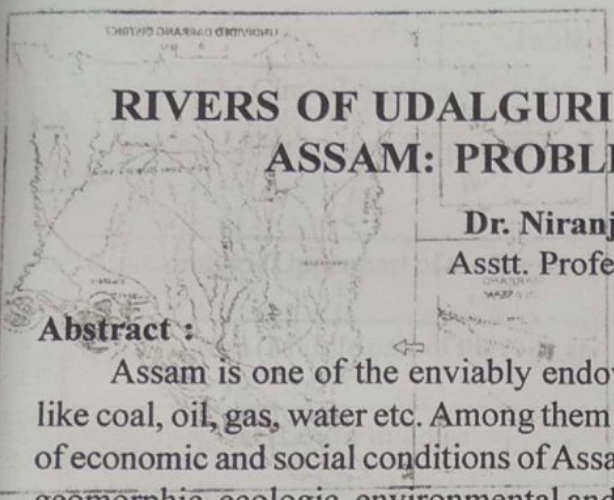

RIVERS OF UDALGURI AND DARRANG DISTRICTS, ASSAM: PROBLEMS AND MEASURES

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Abstract :

Assam is one of the enviably endowed states of India in terms of natural resources like coal, oil, gas, water etc. Among them water resource is remarkable for the development of economic and social conditions of Assam. Rivers are dynamic entities having hydrologic, geomorphic, ecologic, environmental and economic significances. They cause boon, belief, hazards and disasters mostly in their flat area characterished by high to medium rainfall and high concentration of human habitation. The river-basins have their characteristically distinctive interactions and interrelations between the man and the environment as the rivers are recognized as the life line of living beings and the cradle of human civilization. Even as there has been tremendous development of mankind due to use of imported resources, rivers have signified the unique bond which exists between men and nature. Even though rivers act as the powerful agent of positive development, they have on the other side adverse effects causing loss of lives, property and damage of land and environment.They need strategies for their control or eradication in favour of sustainable development of the concerned rural areas in terms of land and water use and management. Among the various problems created by nature on the earth surface, the ones caused by floods and river bank erosion are more common and quite substantially problematic in nature if they are more vulnerable.The districts of Udalguri and Darrang being a part of the Brahmaputra valley have been suffering from flood and river bank erosion problems.The districts being flooded frequently due to high storm rainfall in its catchment cause high damage to land including river landform, people and environment. Even as the governments have taken a number of steps to mitigate the flood problems, the land users are yet to get conducive relief from the flood menace. Therefore, there has been an utmost need to evolve area specific strategies for mitigation of flood problems in order to protect and progress land uses on the one hand and the socio-economic conditions on the other.

Introduction :

From the physiographical point of view, the entire districts are a deadly flat plain on an area of 3,481sq.km. This plain is contiguous to the flat plain of the district of Sonitpur in the east and to that of the district of Kamrup in the west. While in the north there lies the Bhutan Himalaya, the mighty Brahmputra flows all along the southern boundary of the districts. The districts extends latitudinally from 26° 20′N to 27° 0′N and longitudinally from 90° 50′E to 92°

20′ E. in the northern bank of the river Brahmaputra covering a portion of the lower part of the valley below the southern slopes of the Bhutan-Himalaya (Fig.1).The population of Darrang and Udalguri is 1,504,320 (Census 2001), with density of population 432 per sq km, which is higher than the state average of 340. The decadal variation of population for 1991-2001 is 15.82 percent, which had experienced much higher decadal variations during last several decades. Witnessing quite a sluggish process of urbanization, the overwhelming majority of people in Darrang and Udalguri live in the villages. More than 85 per cent of the total population in the districts is rural. The area has been drained by the Pachnoi, Dhansirinoi, Mangaldainoi, Noanoi, Saktolanoi, Nanoi and the Barnoi. All these streams fed by their sub- tributaries ultimately meet the Brahmaputra at different places of the districts. The districts comprising as many as 1382 villages have been suffering from floods of different magnitudes and duration almost every year.The south-western part of the Udalguri and Darrang district has since last few years been suffering from very high to medium floods. In other areas floods are occasional. During the flood times all the areas except the built-up areas are inundated at different levels by floods. Along with the floods there come soil erosion, river bank erosion and formation of new channels in the areas of volatile floods of both the districts. Even as the floods sometimes act as boon to the land tillers due to recoupment of agricultural land with silt, clay etc. (natural fertilizer).

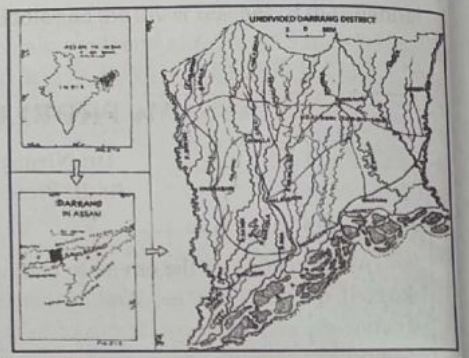

Fig.1 Location of Study Area

One of the major crises facing underdeveloped countries is that of food production.Throughout the underdeveloped countries themajor concern has been how to produce enough food to support the teeming population.Rural development traditionally based on the natural resources available on the surface of the earth. The infrastructural facilities are the vital element for the socio-economic development of a rural area.

Darrang and Udalguri districts are basically agrarian, where 85 percent of the population is engaged in agriculture and allied activities. Out of the total population the workforce constitutes 31.23 percent (OKDISCD, 2011) While males are predominantly in agriculture women of the districts are overwhelmingly in manufacturing and production in household and in small scaleindustry and in rearing of livestock and collection of forest woods etc. Like elsewhere, women are engaged in agricultural labour (More so specially in the villages of Udalguri district). Rural development criteria are mainly development

of education, health care, drinking water, transport and communication system, financial institutions, social institutions, electrification, market and commercial centers etc. in rural areas. In the districts of Darrang and Udalguri rivers plays an important part to determine the socio-economic development process. But due to severe flood problems the study area is still under develop. All these are badly affected by the flood of above mentioned rivers all most every year in 3 to 4 times in a year.

Objectives :

The main objectives of the study are

i) to investigate few hydrologic characteristics of the rivers of Darrangand Udalguridistricts,

ii) to examine the hydro-geomorphic problems and prospects of the rivers,

iii) to examine the impact of rivers of Darrang and Udalguri districts on environment and economic development,

iv) to formulate strategies to understand and mitigate the fluvio-geomorphic problems.

Methodology :

The Survey of India (SOI) topographical map (R.F.1:50,000) of 1972 and along with IRS LISS-III image of 2008 are used for the preparation of the basin map of the study area. Drainage basin analysis has been done with the help of the basin morphometric parameters such as linear aspects of the river basin were determined and computed. The drainage networks of the basin are then digitized on the basis of the basin map in order to identify hydrologic and morphometric characteristics and behavior along with areas of river associated problems. Finally, all the data have been arranged and represented by appropriate maps and diagrams. The objectives of this study were achieved by using GIS, this analysis related to various parameter of river basin. The maps and diagrams are then used to analyse and find the impact of hydro-geomorphic pattern on environment in the basin area by using GIS software like ArcInfo and Erdas.

Hydrological Characteristics of Rivers :

It has been observed that in the districts of Darrang and Udalguri all the rivers have been are agent of devastating floods, high bank-erosion and channel shifting, low to high sedimentation along the river channel and depressed areas in its downstream on the south-western part of the districts, the Dhansiri and Nanoiacts as the great agent of flowing waters creating heavy floods, bank erosion channel shifting and excessive sedimentation in the south eastern part o the districts (Bhattacharjee, 2009). Similarl the Noanoi and Saktola, create moderate t high floods causing moderate to high categor problems of flood, bank erosion and chann shifting in the lower middle part of t districts. The Barnadi river basin in t middle part of the north bank of t Brahmaputra below the high standing Bhu Himalaya has since the last 4-5 decades b observed to create flood menace to not o standing crops, human habitation but als other kinds of land uses in the area u the river's domain. The basin has its pecu landform characteristics that can be counted through surficial relief, sl dissection, drainage net, vegetational c

along with soil types and their capabilities yielding characteristic combination of land uses. All the rivers in their mid-courses across the built up and foothill areas are having little or no problems of floods, river bank erosion etc. It is observed that during the last three decades or so there have arisen various kinds of problems related to the hydrological, geomorphological and human regimes of the area. For example, the rivers like Noanoi, Saktola, Barnoi, Nanoi and the upper parts of the Galandi and Mangaldai and Dhansirinoicause high floods at their different locations. The present course of the Nanoi is quite new developed only about50 years ago from a small tributary between the Barnoi and Saktola rivers. Since then the Nanoi has taken a new shape to have its impact on landform in the districts (Bhattacharjee, 2015).

The morpho-unit wise gradients of the Nanoi river (Fig.2) are 20.83m/km (foothills or bhabar-tarai belt) 6.97m/km (builtup plain) and 2.88m/km (floodplain).The average channel gradient of the river is 10.22m/km.The total length of the main channel of the Nanoi river is 104 km in a catchment area of 520sq.km. The channel of the Nanoi has been marked by braiding courses and bars of small magnitude, especially in the lower course of the river. The braiding index of the river channel in this part is 0.159.The mean yearly maximum discharge of this river is 154.2 cumecs and the mean yearly maximum water level is 53.38m.

The Barnaoi or Barnoi(Fig.2) river has its total catchment area of 750sq.km. Even as the average gradient of the channel along its course in Assam is 4.61m/km, the upper, middle and the lower reaches of the channel contain gradients of 6.25, 6.25 and 1.35m/km respectively.

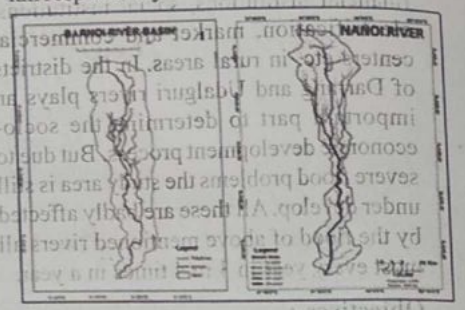

Fig 2. Barnoi and Nanoi River

The total catchment area of Saktola (Fig.3) river is 901sq.km. The river is flowing from the hilly part to the plains at irregular relief and slope. The maximum channel relief of the river is 260 m (in Assam part) between the boarder point and the mouth of the river along the length of 67 Km. It gives an average channel gradient of 7.85m/km. The gradient of the upper, middle and lower reaches of the river are respectively 15, 4.83 and 3.73 m/km. The river is fed by high amount of rainfall. The Saktola river basin receives mean annual rainfall of 2179.73mm. The mean discharge during 1988 to 2003 is recorded to be 71.37 cumecs whereas the mean water level is 54.47meters above the mean sea level durmg that period.

The maximum relief between the Assam-Bhutan boarder point and the mouth of Noariver (Fig.3) is 350m along the length of 72 Km. It thus shows an average channel gradient of 8.22m/km. The gradient of the upper, middle and lower reaches of the river are respectively 9.9, 9.9 and 4.86m/km. The

mean of the annual maximum discharges is 73.13 cumecs. While the mean of the maximum water levels of this river is 58.33m, It carries 166ton/km2 of sediment per year.

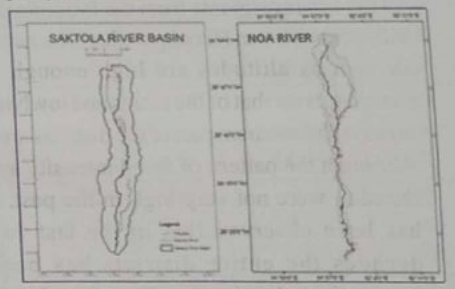

Fig. 3 Saktola and Noa River

The average gradient of Mangaldai (Fig.4) river is 9.16m/km, whereas the upper, middle and the lower reaches of the channel contain gradients of 10, 15, and 2.85m/km respectively. The river Mangaldai covers a total catchment area of 850sq.km. The total mean annual rainfall of this basin area is 2055.26mm. The river being fed with such heavy rain waters creates flash flood in the lower part of the basin. The mean yearly maximum discharge of this river is 62.73 cumecs and the mean yearly maximum water level is 55.46m. It carries sediments annually at the rate of 210 tons/km2/year.

The total length of Dhansiririver is 111km (Fig.4). The maximum the entire channel of the river is 387m thus giving on average them channel gradient of 7.80m/km. The gradient of the upper, middle and lower reaches of the river are respectively 12.5, 7.76, and 3.15m/km.

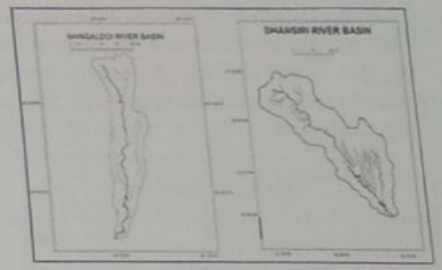

Fig.4 Mangaldai and Dhansiri River

The river is fed by high amount of rainfall along with snow melt. According to Wade (1978), the river confluence with the Brahmaputra was near Singri up to 1913. Now it has shifted towards west by about 30km. The river is very big and become furious during summer season. The Braided index of this river is high (1.02) in comparison to that of other rivers of the districts area. Within its entire course, the river embraces a number of tributaries in both the left and right banks. Many palaeo- channels are found in the south-western part of the Dhansiri river basin.

The total length of the Pachnoiriver (Fig.5) is 81 km. from total basin area of this river is 891sq.km. The maximum channel relief of the river is 405meters between the source and the mouth along the length o 81km. It gives an average channel gradien of 4.95 m/km. The gradient of the upper middle and lower reaches of the river ar respectively 8.33, 3.44 and 3.09 m/km alon the course of the river. The river basin is fe by high amount of rain waters. It receiv 2381.24 mm as mean annual rainfall whi encourages in developing high stage of wa level. The yearly meanmaximum dischar of the river is 21.35 cumces, which is qu

low in relation to that of the other rivers of the districts area. The maximum water level of this river is 83.14m. The riveron average carries sediments at the rate of 256 tons per sq. km per year.

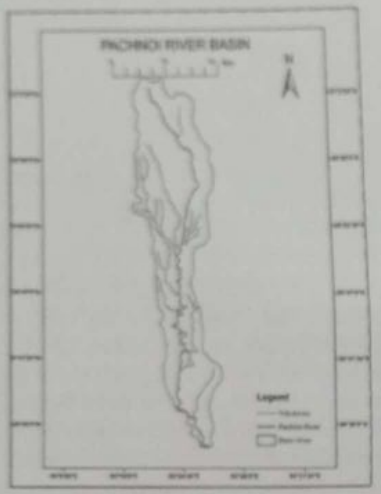

Fig. 5 Pachnoiriver

All the above mentioned rivers have their direct impact on the geomorphology, hydrology, geo-ecology and socio-economy of the districts. It is also found that almost all the rivers originate from the foothills and hills of the Bhutan Himalaya where the slopes as well as altitudes are high enough in comparison to that of the plains and lowlying areas in the southern part of the districts area. Although the pattern of flood intensity and duration were not very high in the past, it has been observed that in the last two decades the entire districts has been frequently and seriously affected by floods caused by the rivers like Nanoi, Noanoi, Saktola, Barnoi, Mangaldainoi and Dhansiri.

Table1. Hydrological Characteristics of the Rivers, 1988-2003

Name of the Rivers	Chanel Length	Basin Area	Maxi. Channel Relief(m)	Avg. Channel Gradient (m/km)	Mean Rainfall of 11 years (mm)	Mean Mini. Discharge 16 years (cumecs)	Mean Mini. Discharge 16 years (cumecs)	Mean Mini. Water level 16 years (m)	Mean Maxi Water level 16 years (m)	Specific Sediment yeild (ton/sq/km/year)
Pachnoi	81	891	305	4.95	2381.24	0.80	21.35	81.45	83.14	256
Dhansiri	111	1611	287	7.80	2381.24	3.55	285.6	82.13	84.05	463
Mangaldai	70	850	260	9.16	2055.26	0.31	62.73	49.44	55.46	210
Noa	72	907	410	8.22	2055.26	0.97	73.17	52.24	58.55	166
Saktola	67	901	260	7.85	2179.73	0.90	71.37	50.45	54.47	190
Nanoi	104	520	409	10.22	2499.05	2.52	154.2	50.16	53.38	228
Barnoi	74	750	305	4.61	2356.99	1.29	85.72	48.09	52	323

Source: Calculated from the data collected from the Water Resource Department, Govt. of Assam

Table 2 Channel Gradient of the Different Rivers at Different Sites,

Name of the River	Total Length the (km).	Length of Segment (km)	Maximum Channel Relief (m)	Channel Gradient (m/km) of the Segment	Site Name
Pachnoi	81	0-6 6-29 29-81	50 100 250	8.33 3.44 3.09	Foot hill-Tarai belt Builtup plain Active flood plain
Dhansiri	111	0-4 4-26 26-111	50 150 250	12.5 7.76 3.15	Foot hill-Tarai belt Builtup plain Active flood plain
Mangaldai	70	0-5 5-15 15-70	50 150 200	10 15 2.85	Foot hill-Tarai belt Builtup plain Active flood plain
Noanoi	72	0-11 11-22 22-72	100 200 350	9.09 9.09 4.86	Foot hill-Tarai belt Builtup Active flood plain
Saktola	67	0-10 10-31 31-67	150 150 250	15 4.83 3.73	Foot hill-Tarai belt Builtup plain Active floodplain
Nanoi	104	0-12 12-43 43-104	250 300 300	20.83 6.97 2.88	Foot hill-Tarai belt Builtup plain Active floodplain
Barnoi	74	0-8 8-16 16-74	50 100 100	6.25 6.25 1.35	Foot hill-Tarai belt Builtup plain Active floodplain

Source: Satellite Image and topographical maps of R.F.1:50000, 2008 and 1972

There are some tributaries and palaeo-channels in the area having their direct as well as indirect impacts on this area. Of this worth mentioning rivers are, the Galandi, Bengnoi, Mara-dhansiri, Mara-mangaldainoi, Kia gadhua, etc.

Impact of Rivers :

In many places, specially in the western countries riverine environment carries a high value of private homes. A drainage basin being the best unit for hydro-physical studies among many (Horton, 1945, Chorley, 1969), bears a great significance in today's fluvio-geomorphological investigation of channel network and drainage morphology along with flood events and their relationship with land, water and man (Chorley,1969b).

It is interesting to note that unlike the most parts of the Assam valley multiple

cropping is practiced here. It reflects far reaching impact of the frequent occurrence of flood on agricultural land, especially of the southwestern part of the districts. The mouzas like Bonmaza, Sarabari, Sekhar, Harisinga, Kalaigaon, Udalguri, Mazbat and Dakua are predominantly settled by tribal people. The tribal people living here do not exhibit any noticeable complexity in land uses. The tribal prefer to settle mostly in the forest and riverine environment which may help them in maintaining their occupational pursuits of traditional nature, such as duck rearing, pig rearing, firewood collection and fishing. Likewise the indigenous non-tribal and the schedule castes people do not exhibit any specific landuse character. On the other hand, the Muslim peasants of erstwhile East Pakistani immigrant origin are concentrated in the low-lying and the char areas of the district. This is the only group of people who could settle on the active flood plains. They know how to adopt with the riverine topography of low-lying nature. The multiple cropping is a common practice in this part of landscape of the study area.

Flood is defined as the rising and overflowing of a body of water on to land which is normally not inundated (Wisler and Bratner,1959).This kind of flood phenomenon has been more so in and around the gauge site mentioned in Table 3.The hydrological characteristic of the river makes clear the rivers are gradually increasing their water levels from the western boundary to the eastern boundary of the districts.

Table 3 Patterns of Highest Flood Flows, 1990-2003

River	Gauging Station at	Reduced Level (m)	Danger Level (m)	Highest Flood Level (HFL) (m)	Year of Occurrence	Lift of HFL Over Danger Level
1.Barnoi	NH-52 Crossing	48.09	51.00	52.90	2002	1.9
2.Nanoi	„	49.67	52.74	54.38	1998	1.64
3.Saktola	„	47.98	53.96	56.20	1990	2.24
4.Noanoi	„	56.60	58.68	58.99	1990	0.31
5.Mangaldai	„	53.58	55.70	56.26	1993	0.56
6.Dhansiri	„	82.52	82.60	84.64	1994	2.04
7.Pachnoi	„	-	83.21	83.98	2002	0.77

Source: Calculated data collected from Water Resource Dept. Govt. of Assam.

It is also found that almost all the rivers originate from foothills and hills of the Bhutan Himalaya where the slopesas well as altitudes are high enough in comparison to that of the plains and lowlying areas in the southern part.The Nanoi river basin is fed by high amount of rain waters. It receives 2499.05 mm as mean annual rainfall which encourages developing high stage of water level. Therefore every year it creates high to medium flood problem in the lower part of the Darrang district.A meander could not develop, if the banks were un-erodible or if they were completely unstable (Leopold, Miller and Wolman,1963).

Table.4 Flood Affected Villages

Name of the Circle/Location of Basin	Mouza	Flood magnitude
1. Harisinga (Upper part of the Nanoi and Saktola)	1. Sekhar 2. Harisinga 3. Dakuba	High
2. Khairabari (Upper part of the Barnnoi)	1. Mazikuchi 2. Chinakuna	Very low
3. Kalaigaon (Middle part of the Noa and Saktola)	1. Silputa 2. Kalaigaon	Low
4. Patharighat (Lower middle part of the Nanoi)	1. Sarabari 2. Roynakuchi 3. Diupila 4. Bonmajha	High
5. Sipajhar (Lower part of the Barnadi and Nanoi)	1. Lokrai 2. Sipajhar 3. Hindughopa	Very high
6. Mangaldai (Lower part of the Mangaldai)	1. Dahi 2. Chapai 3. Rangamati	High
7. (a) Dalgaon East(Lower part of the Dhansiri) (b) Dalgaon West (Lower part of the Dhansiri)	1. Shymabari 2. East Dalgaon 3. West Dalgaon 4. Kharupetia 5. West Sialmari 6. East Sialmari	Medium
8. Udalguri (Upper part of the Dhansiri)	1. Udalguri 2. Ambagaon 3. Bachiliugaon	Medium
9. Mazbat (Upper part of the Dhansiri&Pachnoi)	1. Mazbat 2. Orang 3. Rowta	Very low

Source: Data collected from the Circle offices of Darrang and Udalguri Districts.

The gravel as well as metalled roads including the National Highway (No.52) passing through the district across the rivers are often breached at different locations by floods. These sorts of breaches do occur specially in the areas of chronically flood affected areas. For example, the river Nanoi in 2000 caused damage of an iron bridge near Janasewa village. The Mangaldai – Duni road in the western part of the district, which comes under the influence of floods of 2004 was badly damaged. An iron bridge at Sonapur village along the gravel road connecting the village Sonapur with

Chamuapara in the lower catchment of the Barnoi was completely damaged making a total disruption of road communication. In the same way the river Mangaldai used to cause serious damage on the Mangaldai-Bhutiachang road, specially at the locations near the RamhariChwok village.In this portion of road also an iron bridge was damaged during the flood of 2004. It is also observed that near the Kahibari village in Udalguridistrict, combined flood waters of the Dhansiri and its tributary Galandi had breached one iron bridge during the flood of 2000.

The district of Udalguri and Darrang comprises many market points and centers in addition to four urban centers. Among the market points and centers the flood affected ones are the Narikali, Sonapur, Sipajhar, Patharighat, Chengeliajhar, Dipila, Khatara, Balikuchi, Jonaram Chwok, Khandajan, Awlachwoka, Sikanmati, Kowpati, Dakcwoki. The partly affected are theDalgaon and Dhula market points. Of the above mentioned market points, Dipila, Khatara, Patharighat, Narikali, Sipajhar, Jonaramchwok are located in the chronically flood affected areas of the districts.

It is significant to note that the regular incidence of floods has created an unexpected and harmful impact in the agricultural production and caused wide fluctuation on economic growth rate (Alam, 1987).

Measures :

It is also true that long continuous flooding in the riverine areas in Brahmaputra valley has been contributing towards creation and maintenance of natural fertility of soil and ecological sustenance of the wet land system (Bhagawati, 2007).So if we try to manage such types of events in the districts of Darrang and udalguri, the following steps we have to take in consideration.Government should specifically design and saddle with the responsibility of solving the flood problems and declining agricultural productivity and; for encouraging the diffusion of agricultural innovation to the rural areas in ways conducive to increased agricultural productivity and improved living standard of the rural dwellers.Government should try to expansion of employment opportunities at the rural levels and the need to develop surface and underground water domestic use.Local administration can provide water from reservoirs and lakes under the control of the concern authority for irrigation purposes to farmers and recognized association. With the help of local people government can develop fishes and improve navigation on the rivers, lakes, reservoirs in the flood affected areas.After flood government should undertake the mechanical clearing and cultivation of land for the production of crops and livestock etc.Local flood affected people can assist the state and local governments in the implementation of rural development works like construction of small dams, provision of power for rural electrification schemes, establishment of grazing reserves, training of staff, afforestation programe to develop their socio-economic conditions and to minimize the flood problems.

Conclusion :

The frequently occuring channel shifting, high floods, river banks erosion in many parts of the district, specially in the active floodplain areas have been rendering

out migration of a section of indigenous people who are unable to adjust with the floods. Such a feature of out -migration has occurred highly along the river Nanoi. The same problem has also been facing by river bank dwellers of the Dhansiri, Saktola and Barnoi in their lower reaches.

The floods and bank erosion problems in Udalguri and Darrang district, it is perceived after a pretty long discussion, that the problem is simple in appearance but very complex and serious in nature. Floods in the district could modify development and aspirations of the landform. The problem of flood has adverse effect on landform development. The present work has also included a humble attempt to evaluate the nature of damage. An indepth study on the line of flood problem and bank erosion is of outmost necessity to draw out the genesis and nature of flood hazard and its impact on the modification of land form in the district of Udalguri and Darrang. The facts and phenomena of flood hazard and its impact, intensity and magnitude if analysed properly, may help to planners to work efficiently for flood and floodplain management.

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