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MAPPING AND MONITORING OF THE IMPACT OF GULLY EROSION IN THE DISTRICT OF MEDINIPUR (WEST), WEST BENGAL, INDIA

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Abstract: **Gully is generally said to be a channel developed by extended rainfall. It is a common form of soil erosion in the lateritic highland of Medinipur(West) District in the state of West Bengal. It also causes siltation and sedimentation in the River Kansai and Silaboti catchments area. The erosion of the subsoil reduces soil productivity and the continuous extension of gully in the monsoon season threatens roads building, trees, etc. The magnitudes of this erosion depend on infiltration, slope pattern, shear stress for erosion, vegetation cover and as well as anthropogenic factor related to the this area. Deforestation on highland region and other areas increases the rate of erosion in a very rapid rate. The physical landscape is changing rapidly and at the same time cultural landscape is also affected with the advancement of gully in agricultural land, forested land and also other useful land. The focus of this research project is therefore on gully erosion and its impact western and north western part of the district. The natural causes of gully erosion are indirect actions of man which in some cases are even orchestrated for political reasons. In this study some major causes has been identified such activities as laterite excavations, bad farming practices, unplanned road construction and urbanization and other anthropogenic factors. These activities, coupled with annual flooding from rain water are causing havoc and untold hardship as gullies continue to develop and expand rapidly in the area. Utilizing the opportunities offered by Remote Sensing and Geographic Information System (GIS), this research came up with vital spatial datasets on the spatial distribution, development and impact of gully erosion in Western part of the district of Medinipur(West).**

Keywords: **Land Degradation, Landcover, Landuse, Topography, Soil Erosion, Settlements, Gullies, Vegetation.**

1. INTRODUCTION

The study area which is selected for present study is located in the district of Medinipur(West) with an extension of 20° 23' - 22° 56'N latitude and 86 ° 34' -87° 54' E longitudes. But, though the study deals with the impact of gully erosion on lateritic tract, the study has been conducted especially on the lateritic highland of the district of Medinipur **(**West) which covers the lower basins of, Kansabati, Silaboti from south-west to north-east (Figure-1, Figure-2) Tectonically this is a part of western geo-province of the Bengal Basin. Depositions of rivers like Kansabati, Silaboti play the vital role for the morphological development of this area during Tertiary and Quaternary periods. Various geological evidences are preserved in this area which strongly supports existence of marine coastal environment which is nearly 90-100 Km away from the present.

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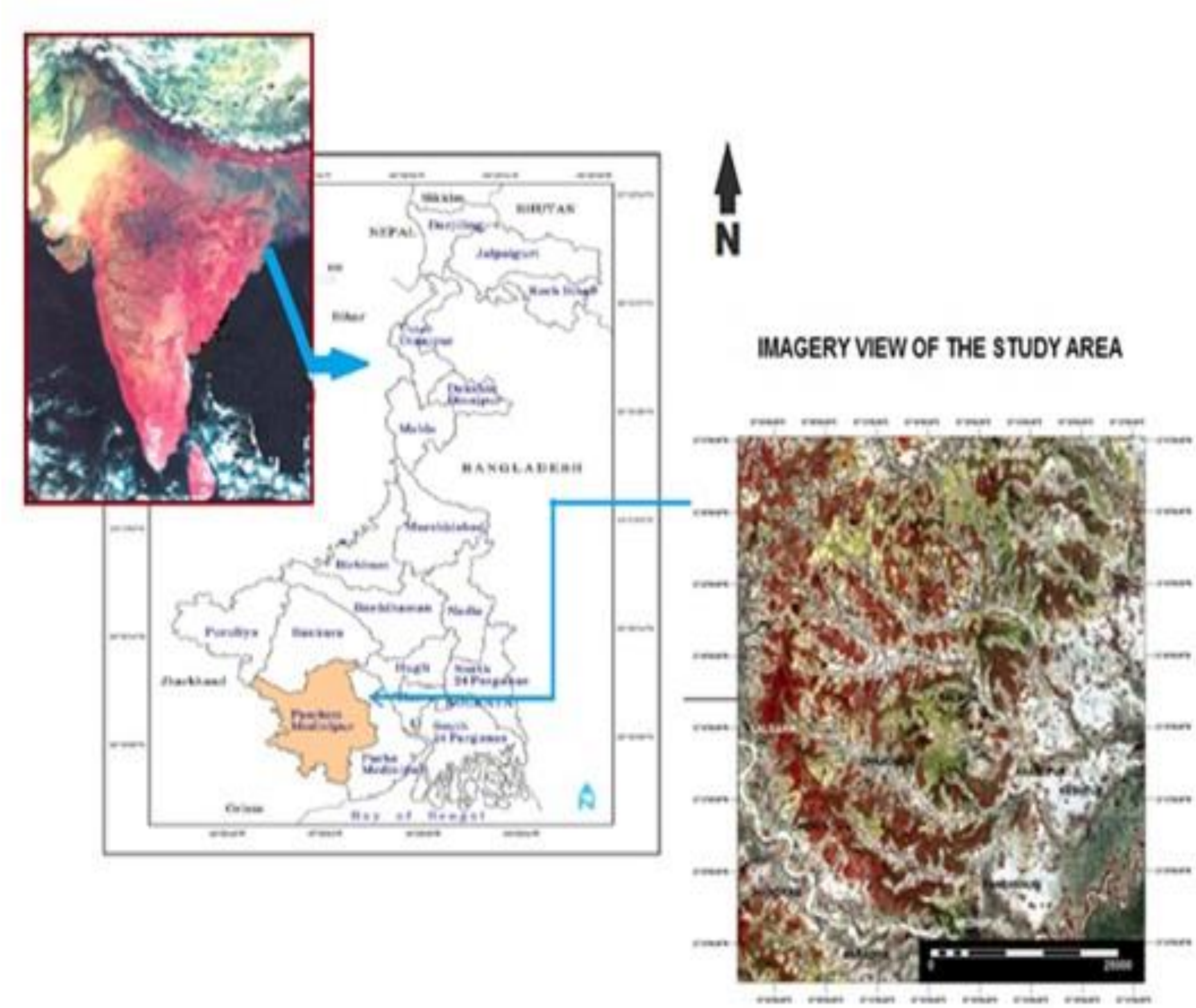

Figure-1: Location and Environ of the study area

Presently this area is lateritic highland which is characterized by undulating landform. In the north-west of the study area schist crop up from beneath the lateritic flats at some places indicating the geological history of the formation of the study area during Quaternary period. Towards the farther north a grey and bluish-grey micaceous schist band with gneissose character is found. Other important formation are quartzes grits, slates etc. The lateritic rooks are the dominating statigraphic formation of this area. Frequently nodular lateritic rooks are found some of which area cemented into a solid mass so far. Two major types of soil is found in this area namely laterite and alluvium soil. Most of the parts of this area are covered by lateritic soil which is very infertile in nature. The process of laterization is most vividly manifested only under tropical condition such as this study area. During this processes, neo formation of iron chiefly as ferruginous-quartz concentration form.

They accumulate at different depths from the soil surface and form a layer of concretions which area latter cemented by new supplies of iron into continues layers of different thickness. The present study area falls within subtropical humid climate with three distinct seasons viz. Pre-Monsoon (March-June), Monsoon (July-Oct), and Post-Monsoon (Nov-Feb). The maximum daily temperature ranges between 26.9ºC and 36.8ºC while the minimum temperature lies in between 5.7ºC and 24.7ºC (G.S.I., 1995,P-2). The range of average annual rainfall as recorded is 1192mm- 1956mm with relative humidity varying between 60% and 90%. Wind direction varies from season to season. In summer to rainy seasons wind blows generally from S-SSW direction while in winter season wind blows from NNE direction. The environmental setup of this area and the history of geomorphic evolution both are remarkably interesting from geo-scientific point of view which draws the attention of the researchers over the last 40 years.

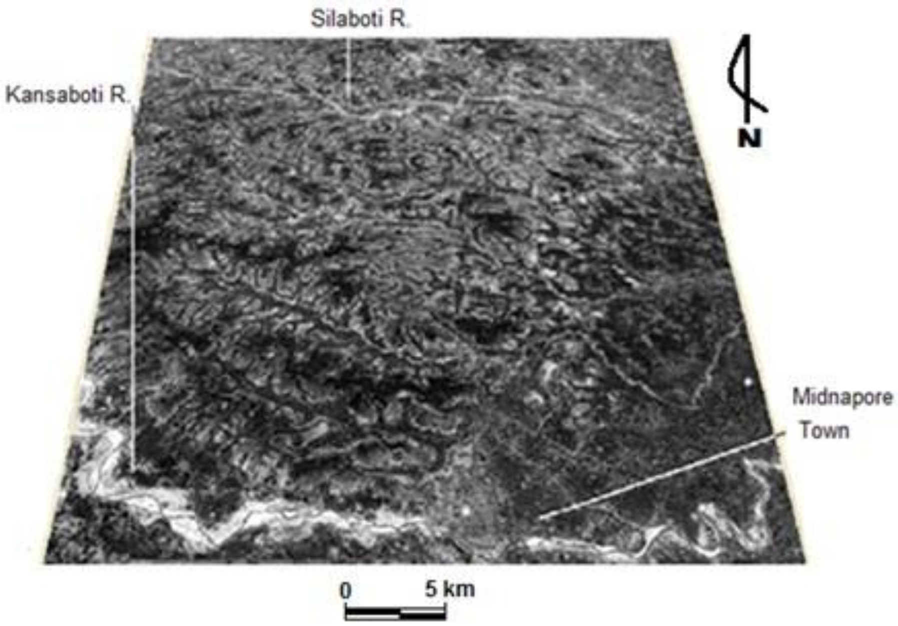

Figure-2: Topographic layout of the study area *(Source: Google image)*

2. METHODOLOGY

Using the various opportunities offered by Remote Sensing and Geographic Information System (GIS), we came up with vital spatial datasets on the spatial distribution, development and impact of gully erosion in western part of the district of Medinipur(West) especially in Rangamati and Garhbeta. The following procedure has been adopted

1. Landover and land use mapping of two different years.
2. NDVI mapping of two different years.
3. To realise the better change of landform status three different GIS mapping (Brightness Vegetation Index, Greenness Vegetation Index and Wetness Vegetation Index) has been prepared.
4. 3D digital Terrain Model has also been prepared for identification of gully.
5. Measurement of slope change by dumpy level, Prismatic Compass and Avnes Level survey.
6. Laboratory testing of soil and analysis.

Table-1: Maps used for the present study

Maps and Images	Numbers	Scale	Year of Publication	Name of publishers
Topographical Map	73 J/5	1:50,000	1979	Survey of India
Satellite Imageries	LANDSAT LISS-3	Not applicable	1990,2000, 2005 & 2015	Downloaded from ESDI (Global Land Cover Facility)
Map of Paschim Medinipur	NA	1:250,000	2001	District survey office
District Map	NA	1:250,000	2001	District survey office

The project was carried out with Landsat ETM+,Quick Bird and SRTM image data. For image analysis, the following software were used ArcGIS 9.0 Erdas Imaging 8.6 ILWIS GPS locations have been recorded to superimpose on the Google Map Image in order to find out the detailed geomorphologic configuration of the area. Pattern and characters of natural vegetation were studied systematically**.** Plant coverage on the bottom, slopes and top of the gully head were measured on the basis of their height. Base area of the plants also measured gradually. The major character of large part of plateau top and highlands tropical landforms is laterised in the beside this lateritic layer is also found in the low temperature area. Laterite layer in the valley floor is formed by the erosional work of river on the laterite layer of the plateau and mountainous region whereas the low land laterite is transferred by the affect of seasonal climate so that it could not be explained by ancient climate.The western part of Medinipur(West) district has experienced a very rich laterite layer of low land. Laterite is a subsoil product of weathering in humid tropical areas where there are alternating wet and dry seasons which lead to the formation of a mottled red yellow and grey mass, sufficiently soft to be cut out with spade but hardening on exposure to the atmosphere. In humid tropical conditions the soft grey clayey or sandy mater is leached of Silica and Alkali living a concentration of sesquioxides of Al & Fe. When cut and exposed to the air a sponge-like red rock is formed, hard enough to be used for building, especially as foundations for light structures, for path or secondary roads The process of formation is called laterization. Sometimes the rock is sufficiently rich in iron to be usable as an iron ore.

3. IMPACT OF GULLY EROSION

The present study consists of the modification of general slopes, removal of top soil cover and its impact, change of vegetation cover, degradation of environmental condition. Soil erosion by gully extension today is becoming a great hazard to us. Settlement area, forest and agricultural land are very much damaged and is decreasing continuously. The major impact of gully erosion in this region can be classified into two types: 1. Physical and 2. Socio-economic

3.1. PHYSICAL IMPACT OF GULLY EROSION:

Removing of top soil is making the soil unfertile and destructs the plants grown in this area by reducing soil available for rooting and for storing water available. The followings are the impact of gully erosion:

1. Deposition of sediments over farm tracks and ultimate damage of farm lands.
2. Damage of infrastructure and diminished property values.
3. Damage to public amenities and public infrastructure.

Gully is generally said to be a channel developed by extended rainfall. It is a common form of soil erosion in the lateritic highland of Medinipur(West) District and also in the Kansai and Silaboti River catchments area causing siltation, sedimentation in the valley floor. The erosion of the subsoil reduces soil productivity and the continuous extension of gully in the monsoon season threatens roads building, trees, etc. The magnitudes of this erosion depend on infiltration, slope pattern, shear stress for erosion, vegetation cover and as well as anthropogenic factor related to the study area. Deforestation on highland region and other areas increases the rate of erosion in a very rapid rate. The physical landscape is changing rapidly and at the same time cultural landscape is also affected with the advancement of gully in agricultural land, forested land and other useful land also.

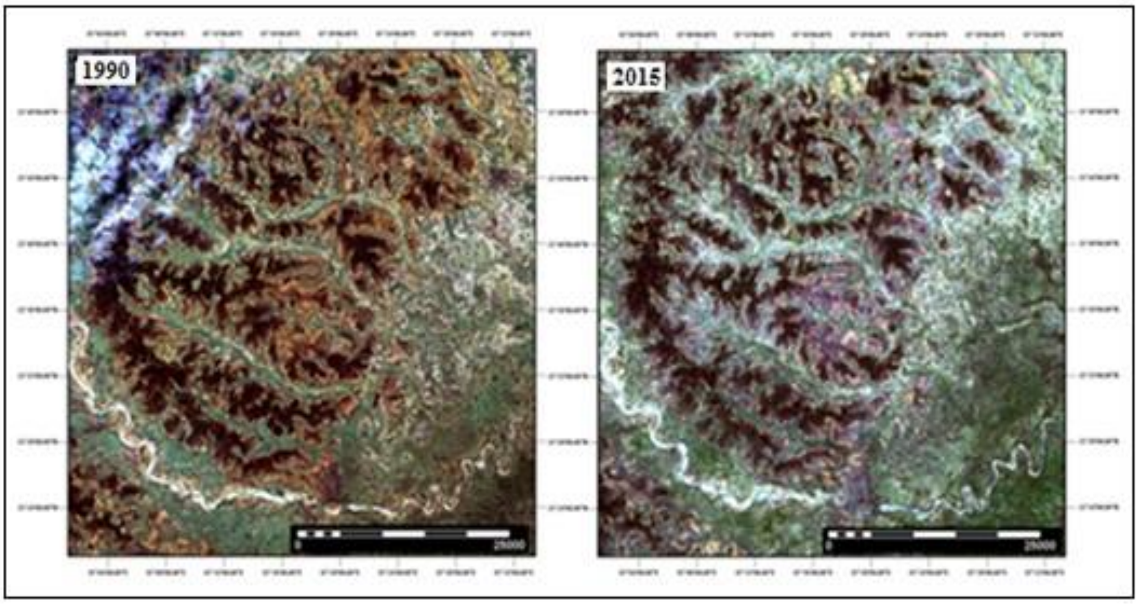

Figure-3: Standard FCC shows the change of badland environs between the Rivers Kangshabati and Silabati during 1990-2015

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The gully erosion sites of the study area are located mainly along the bank of the Kangsabati and Silabati River respectively. This region is very much dependent on agriculture and at the same time there is the location of tropical dry deciduous forest with species like Sal, Seguin etc. Gully extension over forest is common problem in this region damaging forest land.

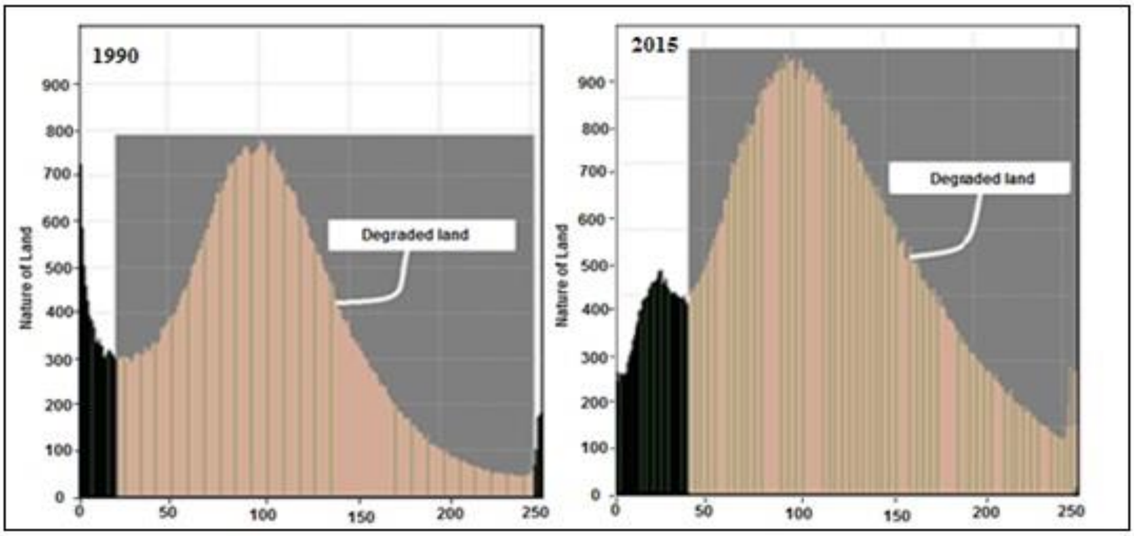

Figure-4: DN analysis of near infrared band of Landsat TM shows the change of degradation characters during 1990-2015

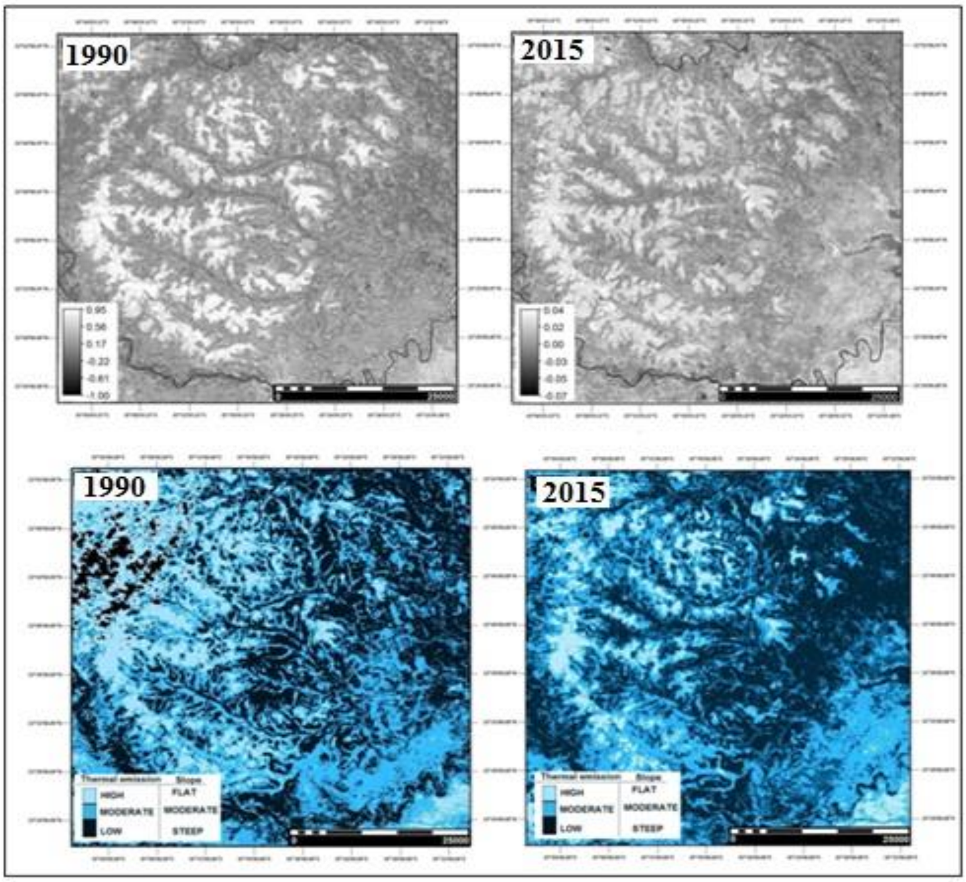

Figure-5: Upper tier: NDVI calculation shows the change of vegetation cover during 1990-2015. Lower tier: Overlaid views of TIR (Landsat) and NDVI shows that change of general thermal indicates the change of slopes between the Rivers Kangsabati and Silabati during 1990-2015

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3.2. TEMPORAL CHANGES IN BADLANDS:

The above FCC map on LANDSAT (TM) shows the nature of landscape of two different years 1990 and 2015 respectively. The difference in land cover is easily assessable by interpreting these two maps. In 1990 the gully and rill where shown in Lalgarh, Salboni, Garhbeta and Midnapore area. These badlands are getting more and more erosion by water flow which laid down this area to the present position. The difference is very prominently seen that the gully is more deepened in 2015 and wider than of 1990 which mean that more area are converted from good land to badlands in this area(Figure-3). Land degradation is increasing by the rapid extension of gully on the uncovered land especially along the southern bank of Silaboti River and in the northern bank of the Kangsabati River. The degradation of land is clearly shown in figure-4 by preparing histograms of two different years. The degradation of land area has more in 2015 than 1990 which proves that this area has experienced severe type of gully erosion during these years. Though the erosion rate in all parts of the study area has not same but the areas seeking gully and rill erosion have eroded mostly.

Plate-1: Change of landscape by gully erosion

To measure the landscape the landscape change the author has prepared two different FCC maps of different year using the Landsat -TM image which shows the landscape change of degradation or conversion of land from good land to badland during 1990 to 2015. The maps show that the gully has more deepened and extended in 2015 (Figures -4 & 5).

The cross sectional measurements of different gully channel has been taken in different years so that the change of gully channel by erosion can be monitor easily. In fig-8.5 there has been done a super imposed profile of two cross sectional profile of two different years (2006 & 2009) at Gangani which easily shows the erosional and depositional status and retreat of gully head. A residual relatively hard soil is lying on the re recent valley floor. It is also a symbol of differential erosion. Three places over merely steep slope segments show deposition for obstruction to grass and shrubs (Figure-6).

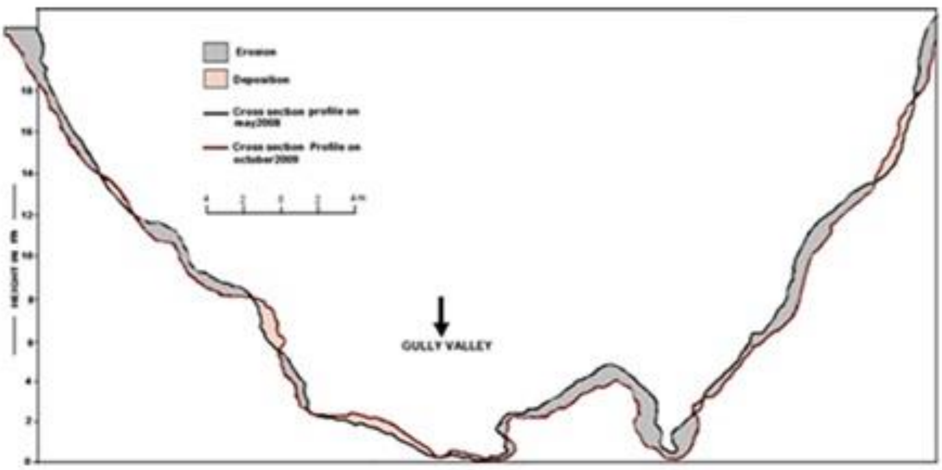

Figure-6: Field measurement of change of gully channel in very recent time

3.3 SOCIO - ECONOMIC IMPACTS OF GULLY EROSION:

The effects of gully erosion in the study area are very dangerous. I have identified the following as the major impacts of gully erosion In Paschim Medinipur, Kangshabati and Silabati river catchments area is highly affected due to expansion of gully sites.

In Rangamati gully basin along Kangshabati the erosion towards gully head is observed very high due to massive erosion by overland flow retreating every rainy season. The major linking roads in the areas have been virtually destroyed in many portions or completely cut off in Rangamati gully basin (Plate -1).

3.3.1. DESTRUCTION OF HOUSES:

Cracking of house, falling of buildings and trees and damage of roads into gully sites are common features in the erosion-prone areas of Paschim Medinipur District. Grazing (Plate-2) is a very common human activity which raises the Probability of erosion in the study area. Construction of houses, roads and railways by cutting and filling the gully sites of Rangamati (Plate-2) is increasing day by day to serve the increasing population.

3.4. MAGNITUDES OF EROSION PROBLEMS:

Erosion is very severe in the uplands which are generally fallow and are without any vegetation coverage. It is due to the undulating and sloppy areas and practically the sandy loam type of texture. Rill erosion is predominant and in the forest areas the gullies occur and it becomes wider and denser in the forest end area. The loose and soft type of soil in the bare land is very susceptible to erosion. The major problems in the study have identified as follows-

1. Severe erosion in uplands.
2. Lack of irrigation facilities.
3. Absences of green cover.
4. Soil of low organic matter content.
5. Reckless felling of forest plants.
6. Termite problem on uplands.
7. Uncertainty of cropping pattern at uplands.

Plate-2: Photographs (a, b, c,d & e) showing human activities on the Gully landscape in the study area

3.5. EXTENT OF EROSION IN THE STUDY AREA:

The study area has shown that the erosion affects more on the highland slope areas which are situated on the southern bank of Silabati River and northern bank of Kangsabati River. In uplands there is very severe type of erosion are seen. It has been watched that soil erosion due to non-coverage of land and overgrazing is very much common on the lateritic upland of the study area especially Rangamati including the northern bank of Kangsabati River, Salboni, Garhbeta, Jhargram, Lalgarh are highly affected by gully and rill erosion.

For better understanding of this erosion problem the two areas has been identified for the measurement of land degradation due to headword extension of gully towards the forested area and other built-up area. Two gully basins in two different locations respectively in the northern bank of Kangsabati River and southern bank of Silabati River have been surveyed carefully. A micro-level survey has been done in two places by sophisticated GPS in two years which has clearly represented the erosion intensity by marking the degraded area. In the same time the headword extension of gully has been recorded 15m in maximum at Gangani in the southern bank of Silabati River whereas Rangamati in the southern bank of Kangsabati River has experienced headword extension of 3m in maximum (Figure -7, Plate -3)

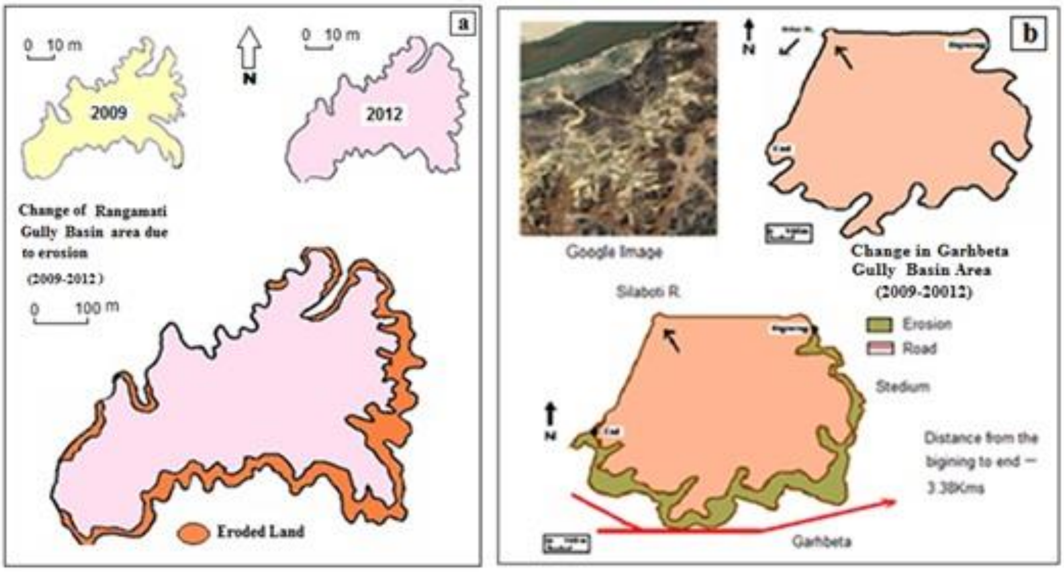

Figure-7: Change of gully basin area demarcated by G.P.S. at –a) Rangamati(2009-2012) b) Garhbeta(2009-2012)in the recent time

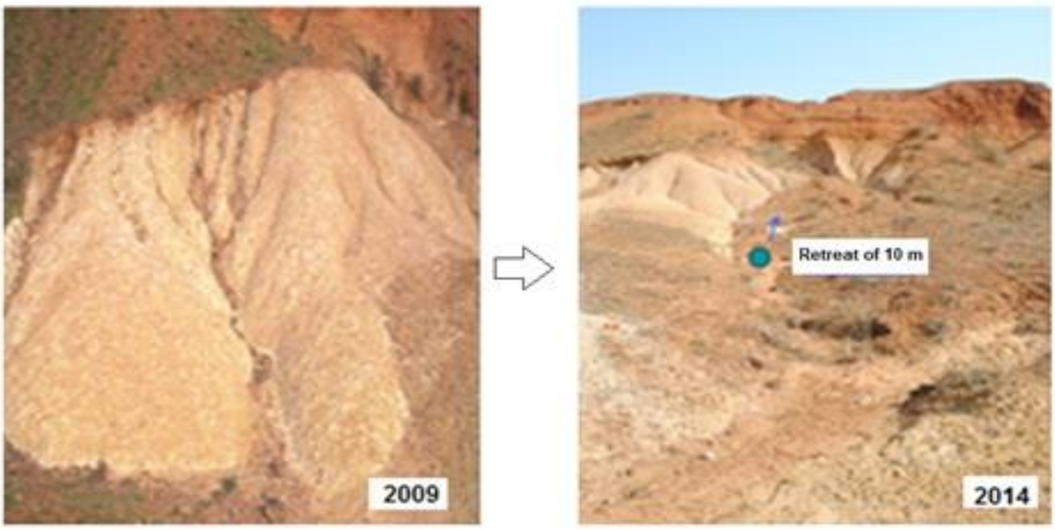

Plate-3: Photographs indicating the retreat of gully head in the study are

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3.6. LANDUSE AND LANCOVER STUDY:

Land-use and land-cover map of the study area have been prepared from Landsat TM image of different years in 2000 and 2010 respectively. In 2000 degraded forest was less due to more coverage of vegetation. This map has shown erosion which has taken place in the northern bank of Kangsabati River and in the southern bank of Silabati River. But, It has been seen in the map of 2015 that the degradation of land is higher than 2005. The major eroded part is lying in between the Silabati and Kangsabati River. Due to continuous degradation of forest gully and rill erosion are getting wider and rapid headword extension of gully has degraded forest land also (Figure-8, 9)

A change detection map has been prepared on the basis of vegetation, soil and also other parameter considered. In this map it is clearly revealed that the study area has changed in a large scale. In between the Silabati River in the north to Kangsabati River in the south including Garbeta, Salboni Jhargram and Medinipur where the maximum change has been seen in this map. Change in vegetation is high in term of loss of vegetation cover which indicates that soil erosion in this area is increasing rapidly. The legend shown in the map is represented in terms of decrease and increase of special change generated by erosion and other human activities like deforestation, farming and constructional activities (Figure-10)

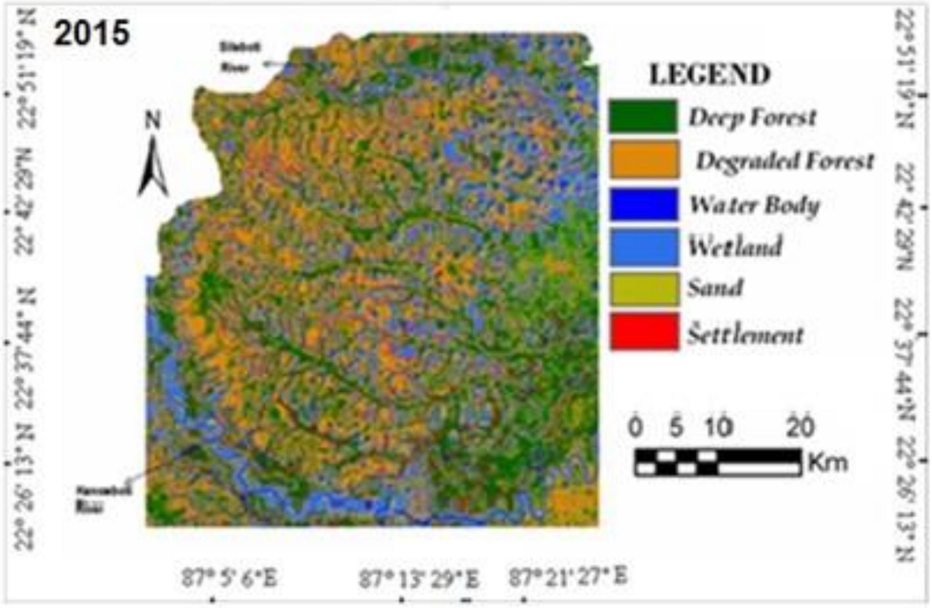

Figure-8: Land use and land cover map of the badlands environs of the study area during 2015

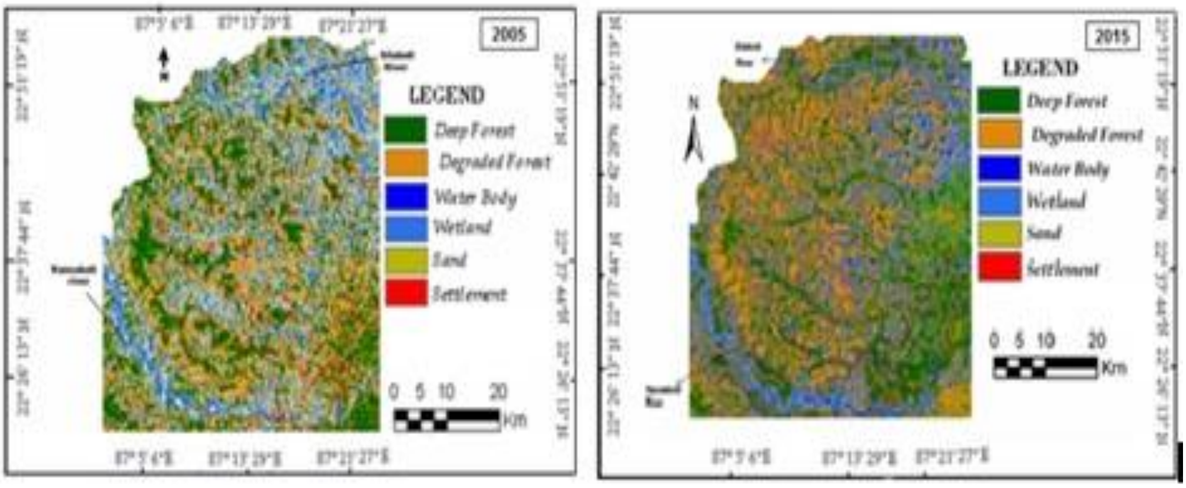

Figure-9: Land use and land cover maps of the badlands environs of the study area during 2005 and 2015

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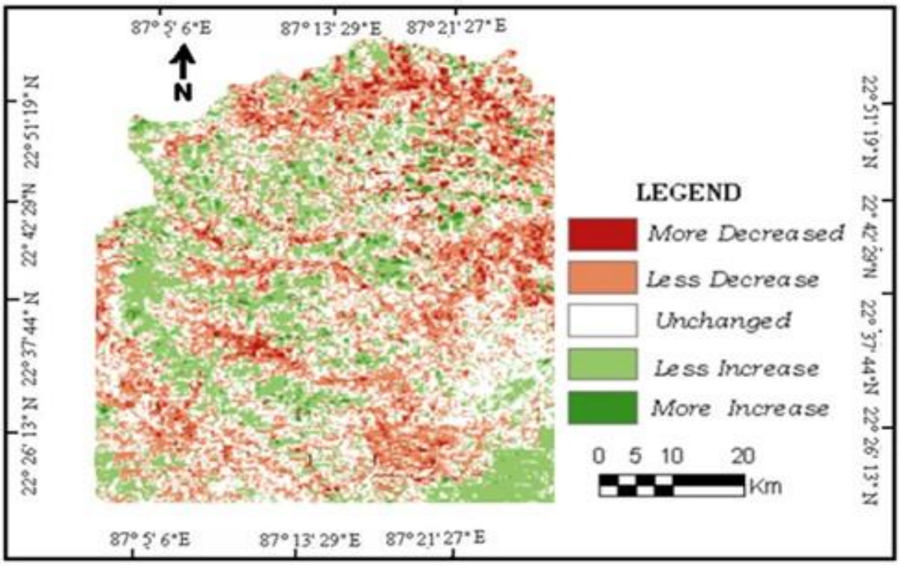

Figure-10: Change Detection map of the badlands environ of the study area

3.7. NDVI OF THE STUDY AREA:

The Normalized Difference Vegetation Index (NDVI) has been in use for many years to measure and monitor plant growth, vegetation cover, and biomass production from multispectral satellite data. The NDVI image maps shown here are prepared from ETM+ with 30m spatial resolution which covers from 0.45 to 2.35 µm regions of the electromagnetic spectrum. NDVI has been calculated as follows:

$$NDVI = \frac{NIR-RED}{NIR+RED} \ldots\ldots\ldots.Equation\ No.-1$$

As a result, vigorously growing healthy vegetation has low red-light reflectance and high near-infrared reflectance, and hence, high NDVI values. This relatively simply algorithm produces output values in the range of -1.0 to 1.0. Increasing positive NDVI values, shown in increasing shades of green on the images, indicate increasing amounts of green vegetation. NDVI values near zero and decreasing negative values indicate non-vegetated features such as barren surfaces.

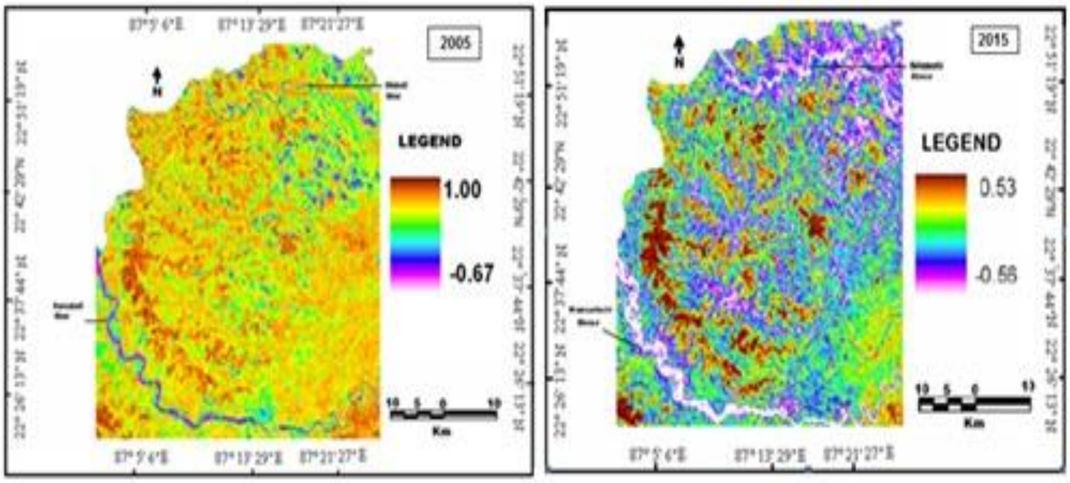

Figure-11: NDVI Map (2005 & 2015) of the badlands environ of the study area

NDVI is calculated from the visible and near-infrared light reflected by vegetation. Healthy absorbs most of the visible light that hits it, and reflects a large portion of the near-infrared light. Unhealthy or sparse vegetation reflects more visible light and less near-infrared light (Figure-11).

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3.8. VEGETATION INDEXES - WETNESS VEGITATION INDEX (W.V.I.), GREENNESS VEGITATION INDEX (G.V.I.), BRIGHTNESS VEGITATION INDEX (B.V.I):

Wetness Vegetation Index (W.V.I.) map has been prepared here to understand soil bonding capacity of different location of the study area. Soil bonding capacity is an important factor of soil erosion and for this two different W.B.I. map of different year (2005 and 2015) has been prepared to assume the change particularly the exposition of soil buy gully and rill erosion. In a W.B.I. map the existing soil moisture is an important physical character of soil usually affected on landscape change. The above W.B.I. Map is showing that the higher green vegetation with higher soil moisture indicates the higher soil bonding capacity which helps to resist erosion buy preventing gully or rill formation. But where the lower green vegetation with less soil moisture, erosion is high due to lesser soil bonding capacity Gangani is a very good example of massive gully erosion as a region of less vegetation cover. Same kinds of erosion are also seen at Rangamati and Gopegarh area. But quite less deep and wider forested gully has been found at Salboni and Gurguripal, Lalgarh, Bhadutala for high soil moisture with high soil bonding capacity due to relatively more vegetation cover. In the forest end there has been seen a common formation of relatively shallow gully in the study area which are highly responsible for the destruction forest land especially in the Jhargram gully sites (Plate-4,Figure-12&13)

Plate-4:a) A scour networking in afforested gully near Jhargram b) A linear gully drainage at jhargram

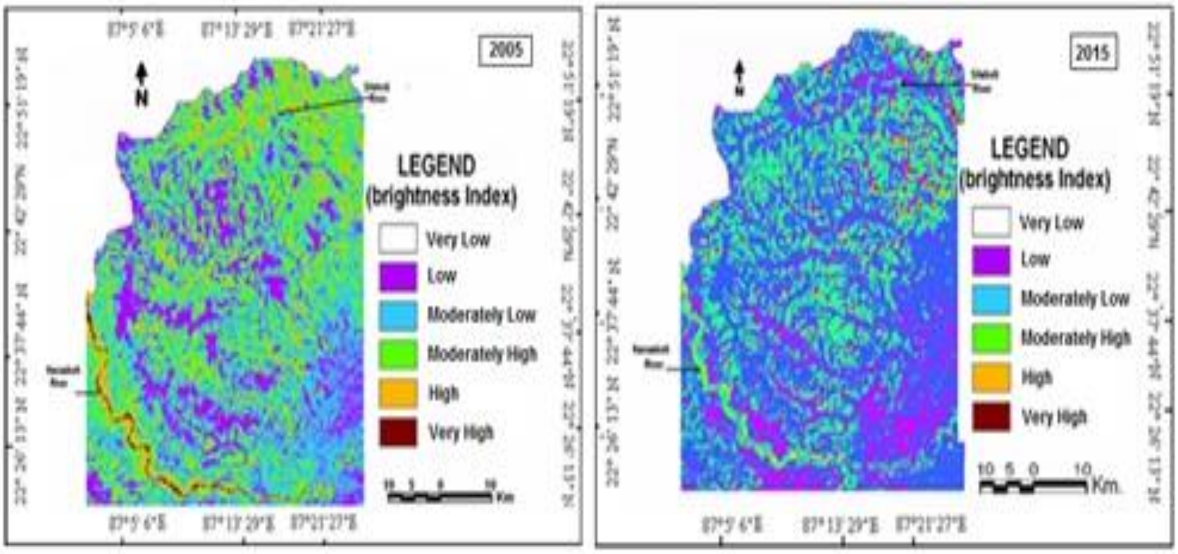

Figure-12: Brightness Vegetation Index (BVI) Maps (2005 & 2015) of the badlands Environ of the study area

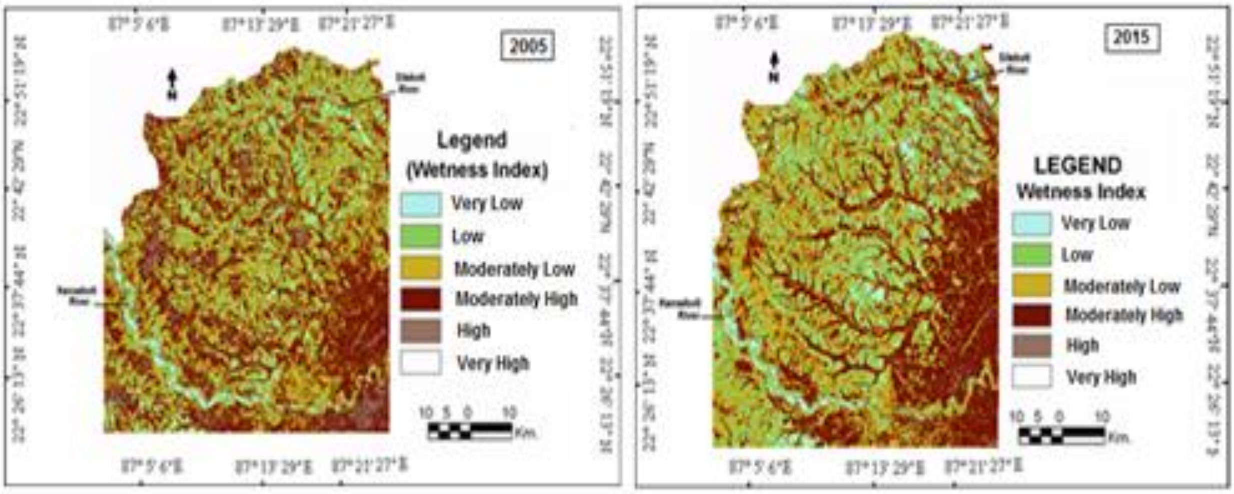

Figure-13: Greenness Vegetation Index (GVI) Map (2005 &2015) of the badlands environ

3.9. REMOVAL OF TOP SOIL COVER:

To measure the loss of top soils and headword extension and deposition in the gully floor some indicator of bamboo has been fixed for demarcation in different points on the gully floor and the gully head (Plate-5). It has very effective in measuring erosion and deposition. The GPS mapping also has been done in to different year for better realization of change in the study area Overland flow erodes and transports soil from slopes to the gullies in the study areas, which efficiently flush the eroded material out of the local system. This process has serious impacts for soil quality and inherent soil fertility. Natural top soils contain soil organic matter from the trees, bush and grass vegetation, that are recycled by future vegetation growth and support the biodiversity of the ecosystem. The removal of top soils from the exposed soil surfaces leads to a reduction of soil fertility. The author has experimented on some soil sample which has been collected along the gully and also across the gully in different year to measure the change of soil status in the study area (Table-3).

Table-3: Comparative Soil status (experiment from collected sample in October 2009 and 2014) of Gangani gully area of Garhbeta,West Bengal

SL. No.	pH	E.C. (Electrical Conductant)	Organic Matter (Percentage)	Nature	Colour
1	6.05	0.521 µs/cm	0.02	Hard	Reddish brown, Brownish, Yellowish, White,
2	5.52	0.045 µs/cm	0.03	Hard	
3	4.69	0.015 µs/cm	0.03	Soft	
4	4.29	0.069 µs/cm	0.04	soft	
5	4.37	0.135 µs/cm	0.05	Soft	
6	4.73	0.570 µs/cm	0.04	Soft	
7	4.67	0.399 µs/cm	0.07	Soft	

SL. No.	pH	E.C. (Electrical Conductant)	Organic Matter (Percentages)	Nature	Colour
1	5.05	0.028 µs/cm	0.04	Semi-hard	Redish brown, Brown, Yellowish
2	4.89	0.032 µs/cm	0.05	Soft	
3	5.59	0.016 µs/cm	0.05	Soft	
4	5.21	0.022 µs/cm	0.06	Soft	
5	5.19	0.028 µs/cm	0.06	Soft	
6	5.18	0.025 µs/cm	0.06	Soft	
7	5.17	0.029 µs/cm	0.05	Soft	

2009 2014

SL. No	Texture (Percentages)		
	Clay	Sand	Silt
1	5	15	80
2	10	30	60
3	25	75	0
4	30	70	0
5	10	80	0
6	15	15	70
7	10	90	0

SL. No	Texture (Percentages)		
	Clay	Sand	Silt
1	8	2	90
2	20	30	50
3	90	10	0
4	95	5	0
5	70	30	0
6	69	27	0
7	77	28	0

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Plate-5: Photograohs showing the processes of measurement of deposition on the gully floor at Garhbeta

3.10. CHANGE OF VEGETATION COVER:

The study area has experienced tropical deciduous species. The very common species is Sal grown in the major parts of this area. This area is covered predominantly with Sal of coppice origin on an average 60% area is covered with Sal and the rest is covered with plantation, scrub jungles and bushes. These forests occur in disjointed patches of varying sizes and in many instances an island among cultivation fields and habitation. The usual associates of Sal in this region are Pterocarpus marsupium, Madhuca latifolia, Schleichera oliosa, Terminalia arjuna, Terminalia belerica, Bombax ceiba etc.Plantation mostly includes Eucalyptus, Akashmoni, Bamboo and Kaju etc.For proper management of the forests the following Working Circles are adopted Besides this species like Mahul But the surveyed parts are a poor coverage of vegetation. The badlands of different parts of the study area have experienced only some shrubs and bushes in spite of some plantation species like casuarinas, and eucalyptus (Table- 2.&Plate-6).

Plate-6: Photograph showing the common species of the study are

Table-2: Common plant species found in the selected study area

Sl. No.	Scientific Name	Local name	Family	
1	*Croton bonplandianum*		Euphorbiaceae	Herb
2	*Mangifera indica*	Aam,Mango	Anacardiaceae	Tree
3	*Cleome viscosa*		Capparidaceae	Herb
4	*Mimosa pudica*	Lajjaboti	Mimosoideae	H
5	*Cassia sophera*		Caesalpinoideae	S
6	*Cassia tora*		Caesalpinoideae	S
7	*Cassia*		Caesalpinoideae	S
8	*Ricinus communis*	Reri	Euphorbiaceae	S
9	*Alstonia scholaris*	Chatim,Saptaparni		Tree
10	*Tridex procumbens*		Asteraceae	Herb
11	*Catharanthus roseus*	Nayantara	Apocynaceae	H
12	*Calotropis procera*	Akanda	Asclepiadaceae	H
13	*Lantana camera*	Bhoot bhairabi	Verbenaceae	H
14	*Clerodendron infortunatum*	Ghetu	Verbenaceae	S
15	*Duranta repens*	Duranta	Verbenaceae	S
16	*Leucas lavendulaefolia*		Labiatae	H
17	*Solanum xanthocarpum*		Solanaceae	H
18	*Solanum nigrum*	Kakmachi	Solanaceae	H
19	*Oldenlandia corymbosa*		Rubiaceae	C
20	Corchorus olitorius		Tiliaceae	C
21	*Coccinia cordifolia*		Cucurbitaceae	C
22	*Parthenium hysterophorus*		Asteraceae	H
23	*Cynodon dactylon*	Durba	Poaceae	H
24	*Chrysopogon aciculatus*		Poaceae	H
25	*Eragrostis ciliensis*		Poaceae	H
26	*Cyperus rotundus*		Cyperaceae	H
27	*Kyllinga monocephala*		Cyperaceae	H
28	*Alocasia indica*		Araceae	H
29	*Colocasia esculanta*		Araceae	H
30	*Dentella repens*		Rubiaceae	H
31	*Eragrostis tenella*		Poaceae	H
32	*Dactyloctenium aegypticum*		Poaceae	H
33	*Mikania scandens*		Asteraceae	Creepers
34	*Polycarpon*	Gima	Asteraceae	Creepers
35	*Azadirachta indica*	Neem	Meliaceae	Tree
36	*Sida acuta*		Malvaceae	Herb
37	*Vernonia cineria*		Asteraceae	Herb

1. Source: Field observation

4. DEGRADATION OF ENVIRONMENTAL CONDITION

Geo-environmental study of any regional context in India appears to be a real challenge because of its ever changing environmental conditions as well as the lack of availability of sufficient data (Prasad, 1992). Due to the dynamic nature of the environment missing links of the history often occur, creating any assessment of the past physical environment as well as socio-cultural evolution is very difficult.the recent environmental change has been shown in different profiles and maps. To measure the actual change in forest and ground cover the author have produced change detection map and recorded the change also from the sites. From this standpoint future prediction over any possible change is considered to be really very critical. For the study of environmental change of any forest area the physical and ecological history are very important but the relevant literature have often been very simplified considering the past changes of forest area and impact of social events. The present field report deals with the man-environment relationship of the selected highlands lands of Rangamati, Garhbeta, Jhargram in this study area.

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Plate-7 a) extension of gully towards plantation land at southern bank of Silabati river, b)Weathering in a laterite mining area near Godapiasal railway station.

The north-eastern part of study area has experienced intensive population and agricultural practice which is highly affected by gully extension. Gully erosion imposes serious effects on the inhabitants of the study area especially in the north western bank of Silaboti River. Active gulling is occurring in all studied locations. Large-scale land degradation and propagating gully systems are clearly visible from the digital satellite images showing very high gully densities in the study area. Most of the causes of landscape degradation are human induced in some location. The main causal factors are uncontrolled deforestation, overgrazing and surface compaction, and poor land management (Plate-7). The impacts are severe, the loss of top soil leading to silting of reservoirs and rivers, a chronic reduction of soil fertility near the gully systems, and the actual loss of productive land.

Different field measurements indicate that bare exposed surfaces near and around the gullies are extensively crusted. Since crusted surfaces inhibit rainfall infiltration and seed growth, the exposure of bare surfaces should be avoided in the in Gangani gully basin. The laboratory spectral analysis indicates that soil fertility is drastically reduced in the gullied areas, therefore limiting the ability of a gullied system and local ecosystem to recover.

The area is covered by less of vegetations which is mainly composed by some greases and bushes and some medium height (1-4 m) plants. The vegetation cover is very scattered and the rest of the area is uncovered by any type of vegetation cover. This is one of the main factors of the gully and rill development in this area. Animals like cow, goat, sheep etc are grazing in this place regularly. So, development of vegetation cover is under obstruction in this small area. Animals like fox, dog etc digging the area which is playing vital role for affecting the stability of the soil layers. Though this area is distributed trough out the western part of the Medinipur(West) District along the Kansaboti and Silaboti River bank but some prominent human interventions related to agriculture, sand mining, lateritic mining, travelling are found in this area.. Besides this the local people is using as grazing field for their domestic animals. The severe form of gully erosion in the area, seen today should be monitored temporally and also take measures to control rapid expansion of gully.

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