Ind. J. of Landscape Systems and Ecological Studies **43** (2) December - 2020, 16- 33 **ISSN 0971-4170**

Causes and Impact of Land Degradation in the Middle and Lower Catchment of the Subarnarekha Basin, West Bengal

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Abstract : *Land degradation is the deterioration or total loss of the productive capacity of the soils for present and future use. Most of the physical geographers and geomorphologists have attributed their ideas on land degradation. This phenomenon is predominant feature in the middle and lower catchment of Subarnarekha basin. The combination of both natural and anthropogenic factors results in catastrophic depletion of soil cover and affecting the general order of human life. The present paper aims at identifying and distinguishing the cumulative causes of land degradation and its impact over the study area. Field survey, collection of sediments, soils and water samples from different sub-environments of the study area are being used to analyse the extent of degradation. The causes were identified and analysed and proper suggestive measures were suggested to ameliorate the problem.*

Keywords : *Paschim Medinipur, Land pollution, Regional diversity, Soil erodibility*

Introduction

Land degradation is a significant global issue in the 21st century because of its adverse impact on agronomic productivity, the environment, and its effect on food security and the quality of life (Eswaran et al., 2008). Apart from natural factors, certain anthropogenic factors are also responsible for it. There are different land degradation types in the middle and lower catchment of Subarnarekha basin and causes menaces to its developmental activities.

There are numerous terms and definitions of land degradation. Some common terms used are soil degradation, land degradation and desertification. According to the Dictionary of Geography, Audrey N. Clark(1988)- (i) Land degradation refers to the process of lowering of surface by erosion and the removal of rocks waste; (ii) General Lowering of the surface of the land by erosion processes; (ii) In Soil Science-a change in the soil due to increased leaching. According to the United States Department of agriculture, Land degradation is a process that describes human induced phenomena

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which lower the current and / or future capacity of the soil to support human life. Land is degraded when it suffers a decline in its capabilities or loses its productive capacity (AISLUS, 2007).

Land degradation is caused largely by soil erosion by water and wind, but also by water logging. Most serious threat to the soil is posed by deforestation and over livestock grazing.. Some other factors responsible for land degradation are: Soil acidification, soil salinization and alkalization, agricultural depletion of soil nutrients through poor farming practices, irrigation and over drafting, land pollution including industrial waste.

Land degradation in the study area is mostly a man made phenomena. Loss of vegetation due to deforestation, over cutting beyond silviculturally permissible limits, unsustainable fuel wood extraction, encroachment into forest land, overgrazing, extension of agricultural activities in the forest land through forest cutting, non-adoption of adequate soil conservation measures, ingression of saline sea water in low lying areas of the coastal tract, water logging, seasonal rainfall, flood, drought and faulty agricultural practices are some of the important factors contributing land degradation in the study area.

The Study Area

The middle and lower catchment of Subarnarekha River Basin extends from 21º30'N, 22º23'N latitude and from 86º42'E to 87º30'E longitude (Fig.1). The river in this part including its tributaries runs through the extreme south western part of Paschim Medinipur district of West Bengal and eastern most part of Mayurbhanj and Baleswar district of Orissa. The study area includes the Community Development Blocks of Gopiballavpur-I & II, Sankrail, Nayagram, Keshiary and & Dantan-I of Paschim Medinipur (West Bengal), Moroda, Betnoti, and Rasgobindapur Community Development Blocks of Mayurbhanj district (Orissa) and Jaleswar, Basta, Bhograi and Baliapal Community Development Blocks of Baleswar district, Orissa (Fig.2). The whole study area covers an area of 3745 square km.

Topographycally, the area consists of a part of lateritic uplands, valley cuts and river valleys of Rarh plain in the north-west and coastal plain in the south. In the north western part of the study area, topography is moderately undulating and in the middle part it is gently undulating; While the southern part is characterized by flat alluvial plain of Subarnarekha delta marked by a number of parallel palaeo-beach ridges and sand dunes along the coast line of Bay of Bengal.

Objectives of the Study

Following objectives are categorized to continue the research work in the above mentioned study area.

i) To locate the land degradation sites in the middle and lower catchment of Subarnarekha basin and to identify various natural and anthropogenic causes for such degradation;

ii) To suggest suitable measures to prevent further land degradation.

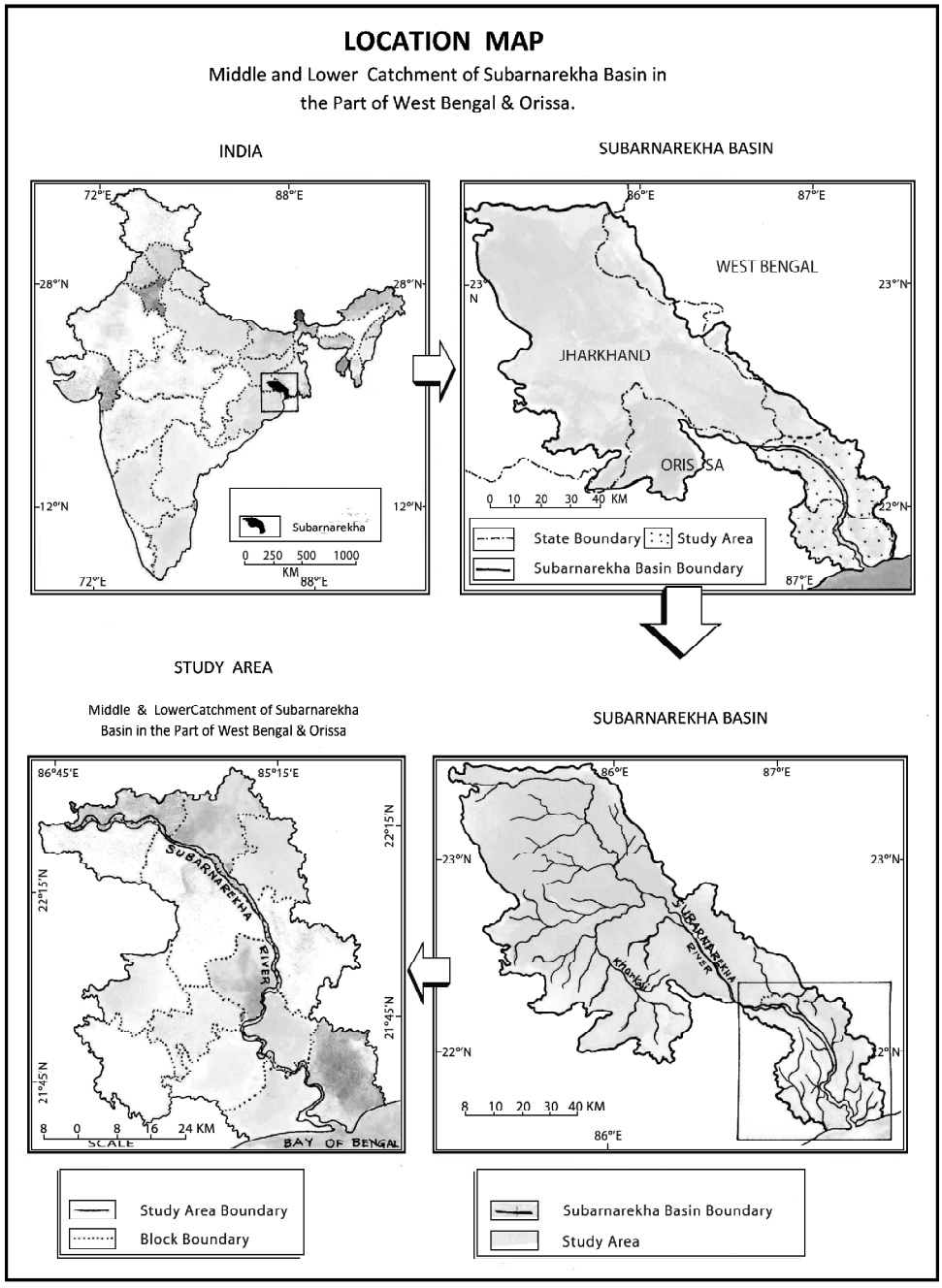
LOCATION MAP
Middle and Lower Catchment of Subarnarekha Basin in the Part of West Bengal & Orissa.
INDIA
SUBARNAREKHA BASIN
72°E
88°E
28°N
12°N
Subarnarekha
0 250 500 1000 KM
86°E
87°E
23°N
WEST BENGAL
JHARKHAND
ORISSA
0 10 20 30 40 KM
22°N
State Boundary
Study Area
Subarnarekha Basin Boundary
STUDY AREA
Middle & LowerCatchment of Subarnarekha Basin in the Part of West Bengal & Orissa
SUBARNAREKHA BASIN
86°45'E
85°15'E
22°15'N
21°45'N
SUBARNAREKHA RIVER
8 0 8 16 24 KM
SCALE
BAY OF BENGAL
KHARKAI
8 10 20 30 40 KM
Study Area Boundary
Block Boundary
Subarnarekha Basin Boundary
Study Area

Fig. 1

Review of the Relevant Literatures

Most of the earlier research work is done by the following persons on land degradation, forestry, socio-economic aspects and resource management, specially land and water. Mukhopadhyay (1980) studied in detail on the geomorphology of the Subarnarekha Basin. Malhotra and Dev (1991) in their study gave emphasis on the plantation programme in Medinipur District. Chatterjee et. al. (1998) made a comprehensive study on the forest resource use and wasteland development in the Nayagram Block and Binpur-II Block of Paschim Medinipur District, West Bengal. Paul.(1985) in his paper 'The development of Accumulation forms and Erosion in the Coastal Tracts of Balasore, Medinipur and 24-Parganas districts of Orissa and West Bengal' highlighted the forms of erosion and accretion and their impact in the coastal tracts of Balasore, Midnapore and 24 Parganas districts of Orissa and West Bengal. Paul (1988) in his work 'Morphoecological dynamics of the Coastal tract of West Bengal' described that dunes are important coastal ecological and geomorphological unit. Paul also described about the dune formation, different dune types and their morphology in Sundarban.

Research Methodology

The methodology includes a detailed study of books and analysis of various maps, topographical analysis, images, historical facts etc. Then various field measurement of land degradation features with surveying equipments in pre-monsoon and post monsoon seasons, followed by observation and identification of the different degraded lands found in different physiographic units. This was followed by accumulation, verification, tabulation, computation and statistical analysis of data preparation of various maps, charts, diagrams and Preparation of environmental status report of the middle and lower sections of Subarnarekha River Basin.

Regional Diversity of Land Degradation

A. Land degradation in the Upland Surface with Dissected Valleys

The laterite duricrust surfaces are found in the upland tracts of the interfluves in the middle catchment area Here laterization is the main process except in the narrow tract of river channels. The most affected areas lie in upland area of Gopiballavpur-I and II, Nayagram, Moroda, Betnoti and Rasgobindapur block.

Land degradation in the Flood Plains Dominated by Subarnarekha and Other Streams

Land conversion for agricultural uses is the main degradation type in this region. From field survey it was observed that most of the farmers use fertilizers, pesticides, insecticides unscientifically. Besides, they also use less organic manure leading to degradation of agricultural land. A very few number of farmers go to the soil testing laboratory to get the soils of their agriculture land to be tested. This picture is acute, especially in the forest agricultural land where most of the farmers

belonging to Scheduled Caste and Scheduled Tribal community have little bit knowledge about the fertility status of soil. Besides, more than 50% of the families belong to BPL category. Probably, illiteracy and poverty is the main cause of ignorance

Land degradation in the Deltaic Flat with Coastal Features

Land along sea beach and Subarnarekha river side in Bhograi and Baliapal block gets inundated by sea water during flood. As a result low lands remain uncultivated due to high degree of salinity of the soil. Aeolian process plays an important role in this area in land conversion. Aeolian erosion and accretion is going on in the coastal belt of the study area (Plate:2). As a result, land in this tract remains in degradation stage. Bare sand dunes are more susceptible to water and wind erosion. Here rate of soil erosion is 20-40 ton/ha./year. Consequently a number of sandy wastes have been formed in this belt. Sandy wastes are also found along the river channels in the form of deposits of sand brought down by the rivers flowing from the uplands.

Land Degradation and Its Effect on the Study Area

- Process of land degradation includes (i) Physical degradation (comprising crusting, compactation, erosion by water and wind etc.); (ii) Chemical degradation (comprising acidification, salinization, alkalization, leaching and faulty agricultural practices etc.). Some lands or landscape units are affected by more than one process of water and wind erosion, salinization, and crusting or compacting.

Land degradation and water erosion

Water erosion

Due to excessive population pressure, water erosion in soil starts when rain drops strike bare soil peds and clods, resulting the finer particles to move with the flowing water as suspended sediments. The soil along with water moves down the slope scouring channels along the way. Each subsequent rain erodes further amounts of soil until erosion has transformed the area into barren lands.

Over-cutting of forests, over grazing, removal of protective plant cover by tillage operation etc. are indulging soil erosion through water erosion process in the study area.

Wind Erosion and land degradation

Wind erosion takes place in the deltaic flat of Bhograi, and Baliapal block of the study area. Most serious damage caused by wind erosion is the change in soil texture. However, some factors influences the wind erosion, these are:

Table 1. Land Degradation Types and Process Response Systems

In the Middle and Lower Catchment of Subarnarekha River Basin in the Part of West Bengal and Orissa, 2019

Sl. No.	Land Degradation Types	Geomorphic Domain	Process Response Systems
1.	Laterite duricrust surface	Upland tracts of the interfluves	Accelerated laterisation
2.	Rills, gullies and ravines	Upland margins or river bank walls	Surface runoff concentration
3.	Soil erosion by Water	River banks slopping surface of the upland and shorelines	River floods, slope wash and waves and currents
4.	Sandy waste with wind erosion	Channel bars and coastal sand dunes	Aeolian process
5.	Land conversion for agricultural uses	Rolling surface and upland Surface	Anthropogenic surface modification
6.	Saline & alkaline tracts	Coastal belt, valley flats between sand dunes	Salt and alkaline accumulation
7.	Silting of agricultural land	Valley fill surface, flood plain and deltaic low land	River flood
8.	Agricultural depletion of soil nutrient	Upland margin, valley fill surface, flood plain, deltaic flats	Faulty agricultural practice

Source: District Emergency Operation centre, Balasore, Baripada,

Flood and land degradation

Flood is an attribute of physical environment and acts as both soil eroding and depositing factor. It promotes washing away of surface soils by its great force leading to soil degradation (De and Jana, 1997). During flood sand wasting, saline water inundation & salinization, bank erosion and loss of fertile land takes place. The increasing frequency of flood in India is largely due to deforestation in the catchment areas, destruction of surface vegetation, changes in land use, increased urbanization, and other developmental activities. Processes leading to flooding are becoming more common due to increased sedimentation and reduced capacity of drainage systems (Land Degradation in India, 2001, Part-III, google.co.in). The probability period of flood, drought and cyclone is detailed in the table. 2

Table 2. Probability Period of Flood, Drought and Cyclone

	Months											
	J	F	M	A	M	J	J	A	S	O	N	D
Flood						←	—	→				
Cyclone						←	—	—	—	→		
Drought							←	—	→			

Source: District Emergency Operation centre, Balasore, Baripada, 2019

Table 3. Rainfall in the Catchment Area Recorded (Subarnarekha) in normal rainy season

Date	Rain Gauge Station, (Rainfall in m.m.)					
	Jamsedpur	Ghatsila	Jamsola Ghat	Fekoghat	Rajghat	Bhograi
22.07.18	20.42	-	8.0	32.40	122.19	20.00
23.07.18	5.4	13.40	17.80	56.00	35.20	23.00
24.07.18	20.20	22.10	57.00	13.40	65.14	105.22
25.07.18	135.20	103.14	156.30	227.80	230.30	68.00

Source: District Emergency Operation Centre, Balasore, Baripada, 2019

Table 4. Water Level Position of River Subarnarekha & Jalaka

Name of the River	Warning Level (m.)	Danger Level (m.)	Peak Water Level (m.)	Date/Time
Subarnarekha	9.47	10.56	12.76	15.07.18, 7.00 a.m.
Jalaka	-	5.5	8.03	14.07.18, 10.00 p.m.

Source: District Emergency Operation Centre, Balasore, Baripada,2019

In the study area, runoff volume remains between low to high. Villages lying on the sand dune surface of the coastal tract are exempted from the devastating flood effect. Various types of lands are lost in the study area due to flood over the years. The historical record shows that Nayabasan, Gopiballavpur, Belduar, Kapasia, Bargidanga Sijua, Asuie etc. villages of Gopiballavpur-I block used to be flooded almost every year before 1980. Even a part of Gopiballavpur village was washed away in the devastating flood of 1950.The people of that area are now living in other part of the village. The flood embankment, constructed (in the year of 1982-83) in the north and north-western part of Gopiballavpur on the right bank of the river Subarnarekha, is now protecting the Nayabasan,

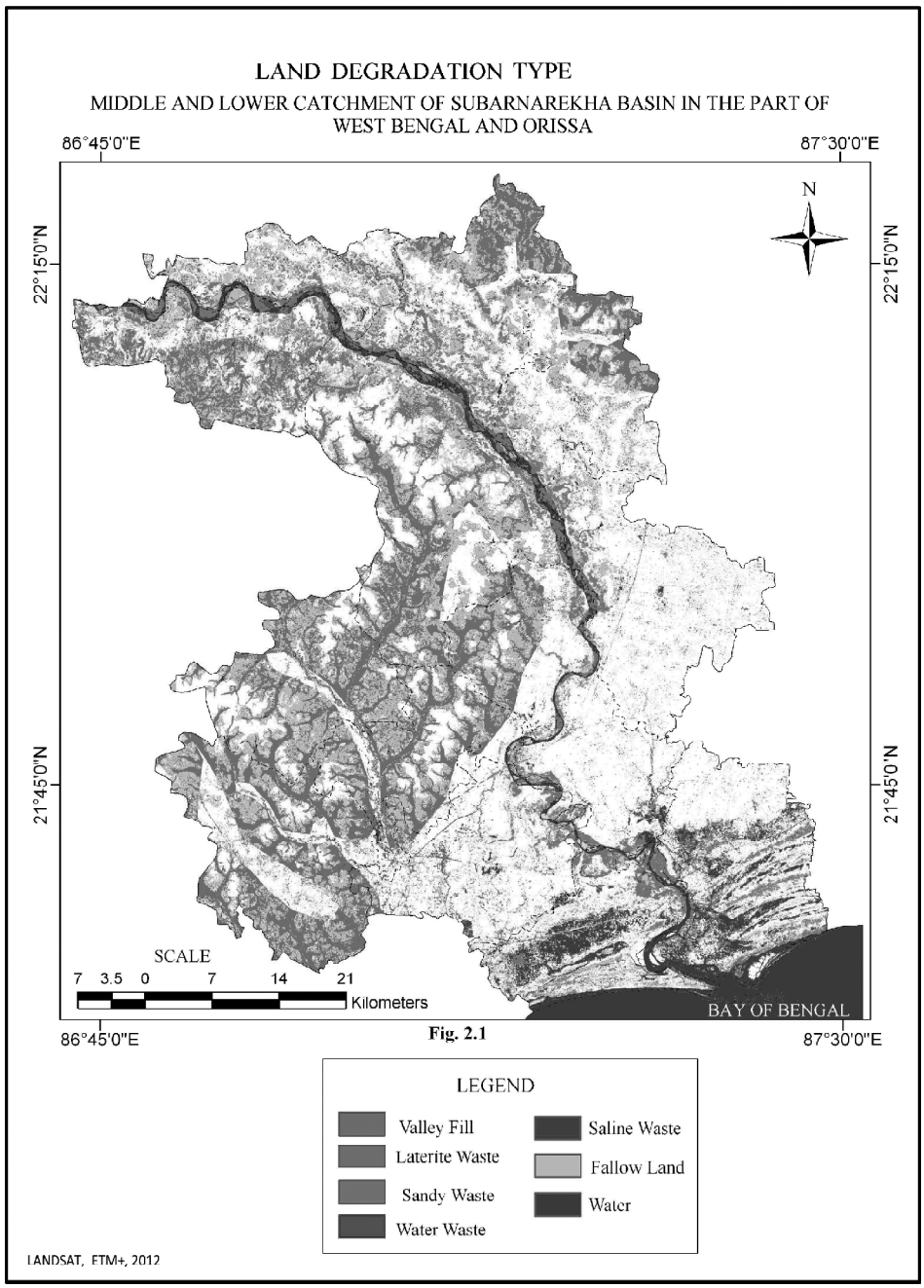
LAND DEGRADATION TYPE
MIDDLE AND LOWER CATCHMENT OF SUBARNAREKHA BASIN IN THE PART OF WEST BENGAL AND ORISSA
86°45'0"E
87°30'0"E
22°15'0"N
21°45'0"N
N
SCALE
7 3.5 0 7 14 21
Kilometers
BAY OF BENGAL
LEGEND
Valley Fill
Laterite Waste
Sandy Waste
Water Waste
Saline Waste
Fallow Land
Water
LANDSAT, ETM+, 2012

Fig. 2.1

Fig. 2

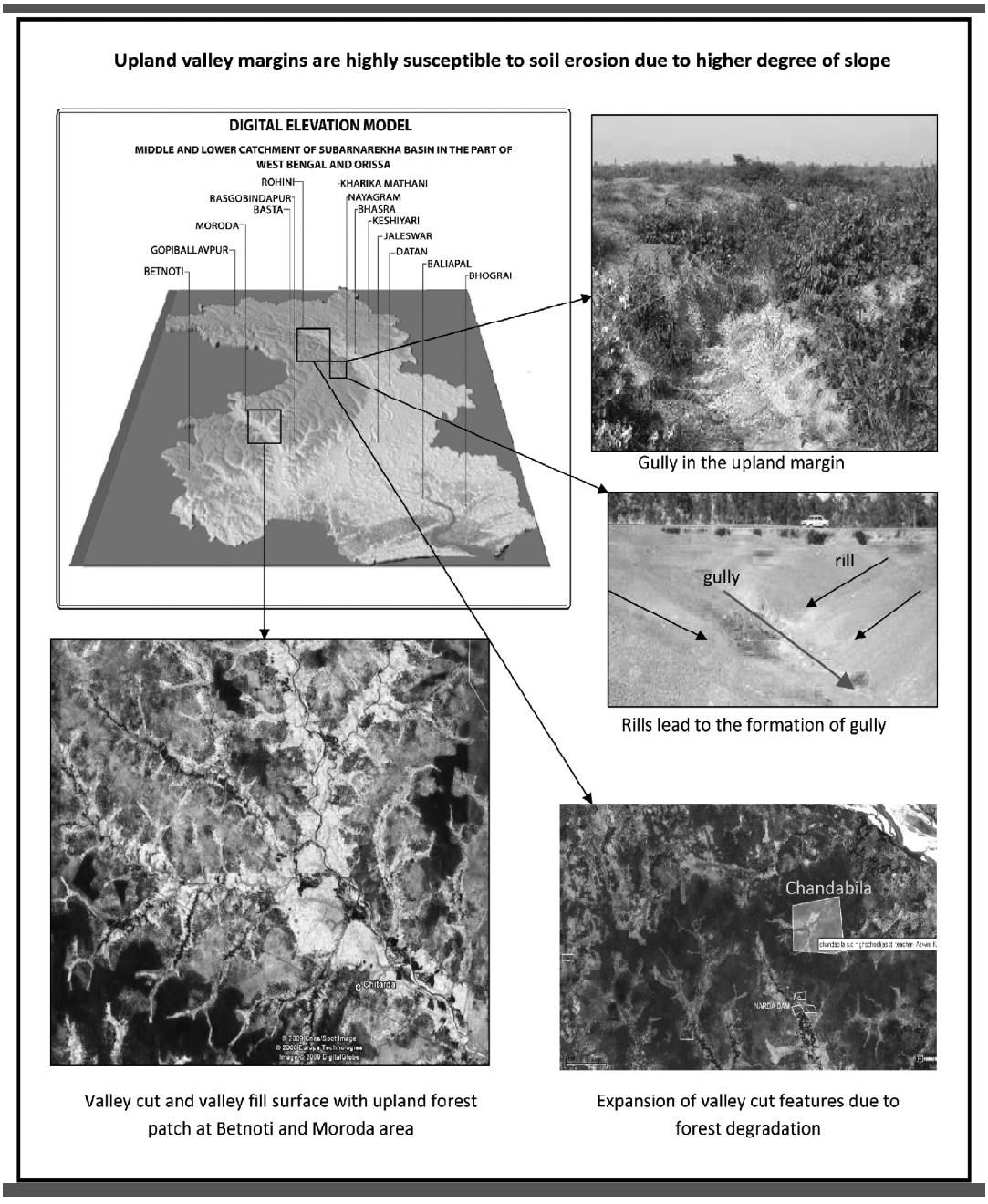

Fig. 3: Photo Credit: Prof Bidyut Kumar Patra, 17th April, part of Jamshola

Bargidanga, Gopiballavpur, Belduar, Kapasia etc. villages from flood and keep away the land degradation. Presently it is most fertile part of Gopiballavpur-I block. However, in the recent years, this situation has changed and the intensity of flood has also decreased.. Moreover, with the construction of flood relief centres in various part of the study area, has emerged as the savior for the flood prone villagers.

In the coastal belt flood due to cyclonic storm causes ingression of saline water in the agricultural land leading to salinization. In this area last cyclone occurred in 2018. Bhograi, Baliapal, Jaleswar and Basta block located in the coastal area have been identified as severe cyclone prone blocks in the study area.

Salinization and Alkalization Problems and Land degradation

Salinization refers to precipitation of soluble salts within the soil eventually to toxic levels for plants (3000-6000ppm salt results in trouble for most cultivated plants) and salinity is the level of salt in the soil.

There are about 50 square km. area in the study area which is affected by increased salinity. It includes marshy land at the Subarnarekha estuary and sandy beaches at the coast. Sometimes due to tidal inundation during devastating flood areas around the marshes are flooded.. People living in the coastal plain of the study area suffered from these damaging effects. The Bhograi, Baliapal, Basta, and Jaleswar are the suffering blocks

Soil acidity and land degradation

For practical purposes, soils having pH between 6.5 and 7.5 are considered neutral as this range is of no consequence as far as crop and plant growth is concerned. Soils having pH between 6.5 and 6.0 are considered slightly acid, those between 6.0 and 5.0 considered moderately acid, while those having pH less than 4.0 are extremely acid. Similarly, soils having pH between 7.5 and 8.0 are considered slightly alkaline. Those between 8.0 and 9.0 are moderately alkaline, those between 9.0 and 10.0 strongly alkaline, while those having pH greater than 10.0 are extremely alkaline. Crop growth is practically impossible in such soils.

Soil samples collected from agricultural fields of the blocks of the study area were tested to get the information regarding the soil acidity and alkalinity. On the basis of pH values obtained from soil samples . The data reflects that in the laterite upland with valley cuts soil pH ranges between 4.6 and 6.5 indicating acid in nature. Where as in the flood plain and deltaic flat the pH ranges between 6.5 to 7.2 indicating neutral in nature. It must be mentioned that the marshy area in the deltaic flat has pH more than 7.5. Moderately and strongly acid soil is noticed in the laterite upland of Gopiballavpur-I, Nayagram, Sankrail, Rasgobindapur, Moroda, Betnoti, and Jaleswar. In other blocks the soils are neutral in character.

Overgrazing and Land Degradation

The increasing trend of domesticated animals ,found in every block of the study area So,

Table 5. Salt affected soils and their characteristics

Characteristics	Saline Soil	Non-Saline-Alkali Soil	Saline-Alkali Soil	Degraded Alkali Soil
Content in soil	Excess soluble salts of sodium	Absence of soluble salt and presence of excess exchangeable sodium in the soil complex.	These soils are both saline & non-saline-alkali soil. It is a stage of transition; soil contains Na-clay as well soluble salts.	Hydrogen (H+) ions in the upper layer and sodium (Na+) in the lower layer.
Colour	White	Black	___	___
Dominant salts	Sulphate($SO4^{2-}$), Chloride(Cl^-) & Niterates (NO_3^-) of sodium	Sodium Carbonate (Na_2CO_3)	___	Sodium Carbonate (Na_2CO_3) in lower layer
Sodium Adsorption Rate (SAR)	less than 13	more than 13	More than 13	less than 13 in the surface and greater than 13 in the lower horizon.
Exchangable Sodium Percentage(ESP)	less than 15	more than 15	more than 15	Usually more than 15
Soil pH	less than 8.5	8.5-10.00	More than 8.5	About 6.0 in the surface soil and 8.5 in the lower layer consisting the main soil body.
Morphological character	White crust on the soil surface	Due to presence of high amount of exchangeable sodium and high pH clay colloids get dispersed & migrated downward through the soil profile and blocked soil pore spaces with clay deposition in the lower layer and simultaneously left the course soil fractions	___	___

		on the surface soil resulting coarse texture. Hydrolysis of Na-clay may even bring about the formation of silica gels. These silica gels together with humates may act as cementing agent in producing a hard pan in the sub-soil.		
Organic matter content	Slightly less than normal soils.	Very low due to the presence of sodium carbonate, because it absorbs organic matter and so there is great depletion of organic matter. Therefore, these soils	Variable	Low
Total Soluble Salt content(TSS)	More than 0.1 per cent. Due to presence of appreciable amount of soluble salts (Cl^-,$SO_4^{2-}$and HO_3^- of Ca^{2+} and Mg^{2+})in the soil, the osmotic pressure(O.P.) is high enough to prevent absorption of moisture and plant nutrients from such soils.	Less than 0.1 percent	More than 0.1 percent	Less than 0.1 percent
Soluble boron	Causes problem in this soil. Safe <0.7 ppm Marginal 0.7-1.5 ppm Unsafe >1.5ppm			
Electrical conductivity of saturation extract	> 4dSm^{-1} >4mmhos cm^{-1}	< 4dSm^{-1} <4mmhos cm^{-1}	> 4dSm^{-1} >4mmhos cm^{-1}	< 4dSm^{-1} <4mmhos cm^{-1}

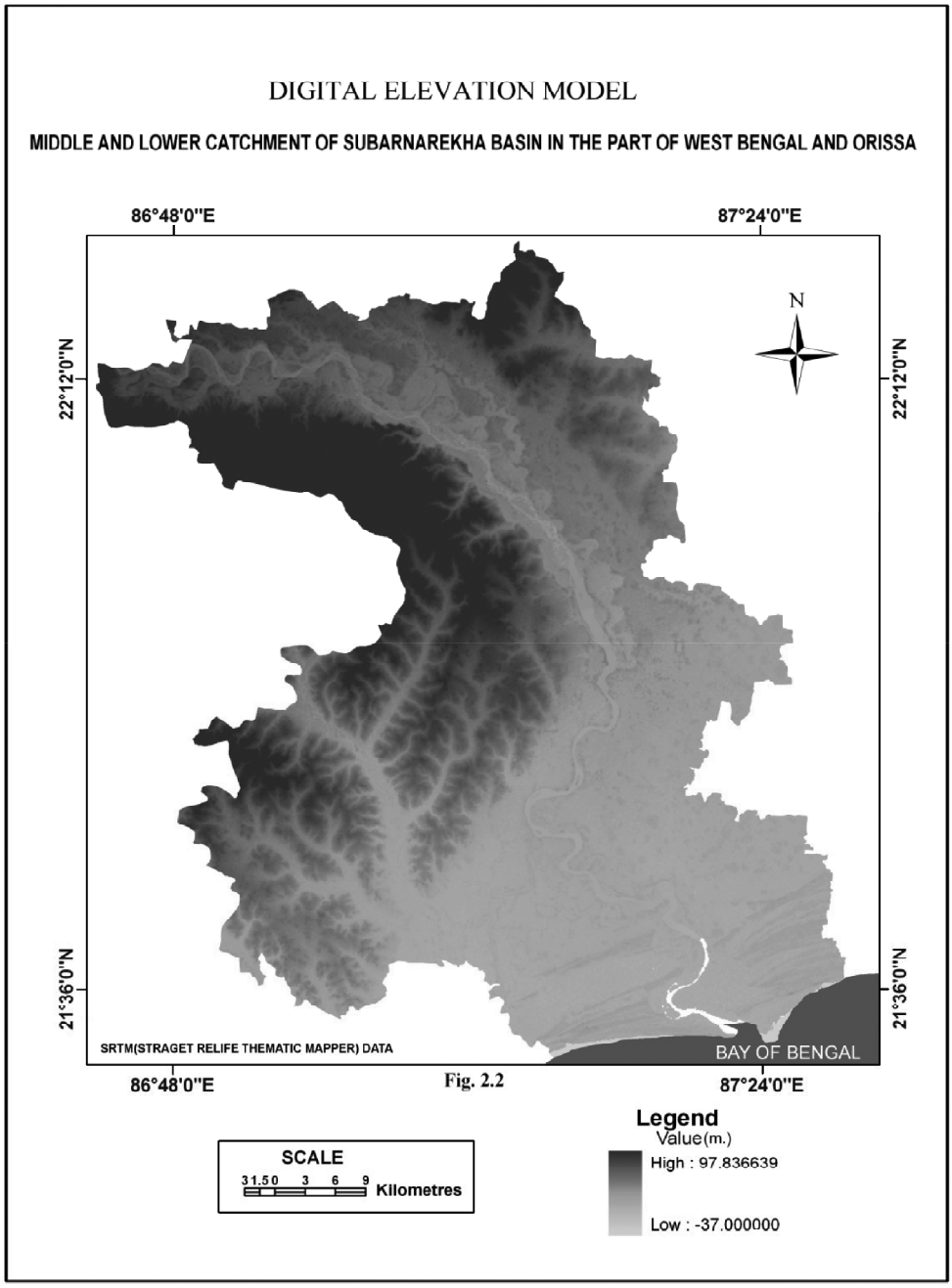

Fig. 4: DEM Model of the Study Area

there is an increase in livestock population with the passage of time. In absence of adequate grazing land, fodder requirement is met from the nearby forests in the form of grazing and cut fodder for stall- feeding. Overgrazing and over-extraction of green fodder, both lead to forest and land degradation through a loss of vegetation and physical deterioration in the form of compaction and reduced infiltration and increase in soil erodibility.

Land Degradation due to faulty agricultural practices

Soil fertility is defined as the plant nutrient content of the soil in the root zone, its pH, and water-holding capacity (Peterson, 1986). As the soil is the only natural medium of plant growth, it should be able to supply well-balanced food for the plant. Scientific methods have been developed to analyze the soil and to give reliable information about its nature, its deficiencies, and how best it can be improved with the help of different fertilizers. But it is matter of regret that scientific methods are not adopted properly all over the study area. As a result of this most of the lands are cultivated without proper treatment of soil. If it is less, the yield of the soil would not come up to expectation; if it is more, there would be an excess expenditure on fertilizer without any significant increase in output. We must, therefore, be cautious in recommending the optimum yield. An overdose of fertilizer may also have some adverse effects:

Developmental initiative through Land Reclamation and Modification of Environmental Factors

Legislation

Various laws have been framed by both the State Governments and Central Government for the protection of environment and some of these are cited below. The Ministry of Environment and Forests (MOEF) in the Government is responsible for protection, conservation and development of environment. The ministry works in close collaboration with other Ministries, Pollution Control Boards and a number of scientific and technical institutions, Universities, Non-Governmental Organization etc. The environmental (Protection) Act, 1986 is the key legislation governing environment management. Other important legislations in the area include the Forest (Conservation) Act, 1980; the wildlife (Protection) Act, 1972; the Air (Prevention and Control of Pollution) Act, 1981; the Prevention of Cruelty of Animals Act, 1960; the National environment Tribunal Act, 1995.

Formulation and enforcement of law are very important for trimming, protecting & preserving the natural resource mainly land, water & forest.

Much of indigenous vegetation in the study area has been cleared for human use since British period. The loss of these vegetations has been led to a decline in indigenous biodiversity and to degradation of water ways through increased sedimentation in Jaleswar Dantan-I, Bhograi and Baliapal blocks. Further, vegetation removal created accelerated erosion in the deforested upland areas of Nayagram, Gopiballavpur-I and II, Sankrail Betnoti, Rasgobindapur, Moroda with concomitant losses of soil and site productivity. Both flood control and re vegetation strategies is the need to deal with these problems began to be increasingly recognized from about the 1950s and culminated in the soil conservation and Rivers control act and Catchment Area Treatment act. This led to the

establishment of catchment authority that has specific functions for soil conservation and river and flood control. Side by side the Departments of Agriculture, Rural development, Environment and Forest are taking necessary measures in controlling the land degradation through soil erosion and sediment deposition. They are adopting techniques mentioned earlier in most cases.

The seeding and planting is the most common bioengineering techniques adopted in the study area. The deforested lands are being covered up by different exotic species like Eucalyptus, Akashmoni etc. But these species though control the soil erosion but fail to return the previous local biodiversity.

Maintenance of Coastal Buffers and Sustainability Evaluation of Land for Better Land Use Planning

Buffers are complex hydrologic and ecological areas in the environment. Actually these are the transitional zones between the surface waters and upland areas. Coastal buffers are vegetated areas adjacent to shoreline (DCR, 2004). It includes the mangroves, vegetated sand dunes, salt marshes, mud flats, tidal creeks etc. The plant communities of this area comprise a diverse variety of plant species representing a number of plant families. Buffers may also serve as attraction for tourists and community members, becoming green ways and recreation areas for birders, photographers, fishermen, picnickers and other outdoor enthusiasts (DCR,2004).

Table 8. Amendments recommended for Different Saline & Saline-alkaline Soil

Amendments	Soil conditions
Gypsum ($CaSo_{4,}$ $2H_2O$)	Saline & Alkaline soil having pH range upto 9.0
Sulphur Iron Sulphate Iron Pyrite	Alkaline & Saline-alkali soils having pH rangr 8.0-9.0
Limestone	Saline soils having pH less than 8.0

Source : (Das, 1999)

Cultivation of salt resistant crops: In agricultural field use of salt resistant crops is another important feature of successful management of saline alkali soils.

- Highly salt resistant crops: barley, sugarbeat, cotton etc.
- Moderately salt resistant crops: wheat, rice, maize etc.
- Low salt resistant crops: beans, radish etc.

Major Findings

I. The *upland surface with dissected valleys* suffers from land degradation and water scarcity to a great extent

II. Laterite and red gravelly soil in the upland and older alluvium soils in the flood plain are highly susceptible to erosion due to higher degree of slope, deforestation in the upland and large surface volume of runoff in the flood plain. On the other hand the deforested sand dunes with sandy soil in the coastal tract are also susceptible to soil erosion due to higher slope and high velocity wind.

III. Land and forest are getting degraded and ground water is being over exploited in the study area

IV. Land degradation is scattered all over the area but the types of degradation varies from area to area depending upon various factors. In the upland area, the deforestation and laterization processes are the major factors of land degradation. Whereas, salinization and alkalization dominates the low lands of deltaic flat. It is also evident that flood plain area is susceptible to land degradation due to faulty agricultural practices and occurrences of flood.

V. A large section of low lying saline and saline-alkaline area of Bhograi and Baliapal block has been converted into agricultural land after a long period of treatment. But presently these lands are being used for prawn cultivation.

Conclusions

There is no well defined land use policy in the whole study area. This lacuna is highly responsible for the current stage of land degradation and wasteland formation. The Land Use Commission should involve ministries/departments (Ministry of Environment and Forest, Ministry of Water Resource, Ministry of Rural Development, Ministry of Information etc.) NGOs & other stakeholders to develop a coordinated approach for sustainable land use & management & solving related cross cutting issues. National strategies for sustainable use of land resources need thorough harmonization. Dispute regarding land ownership and land tenure is an age –long problem. This problem should be sorted out at the earliest and be solved as much as possible. Proper steps should be taken to increase mass awareness of land use planning and land management, land fertility and farming system including their impacts and sustainability. Afforestation, reforestation and social forestry and agroforestry should be given special attention as it is a major tool for soil conservation and in maintaining ecological balance and conservation of biodiversity. Government should think about increasing the existing share held by the members of the FPC over the forest products (25% of fire wood and poles& 15% of timber, Forest Department, Government of West Bengal) in order to develop their interest in forest protection. The further reclamation of the salt affected area should be restricted & the same area should be used for the wetland biodiversity or pisciculture.

Several measures have been suggested towards the sustainable management of degraded lands. Governments in the part of West Bengal and Orissa of the study area respectively have taken initiatives in this regard but at a very slow pace. Integrated Sustainable watershed based land and water management strategies may have a better result towards the land and water management

of the study area. Study reveals that most of the peoples of the study area are unaware about the Central Government Schemes (NWDPRA, WDP and others) on watershed management; even they have no knowledge about the watershed. So, peoples' awareness, consciousness, participation and response is must in every step of management activities.

References

Ahmed Shakeel & Kanth T. A., (2007). Soil Erosion Intensity Zones in Liddar Basin, Kashmir, *Transections*, Vol.29, No.2, *Journal of the Institute of Indian Geographers*, Department of Geography , Pune University, Pune-07. pp. 163-169.

Ahuja Manoj and Singh S. P., (2005). *Computerization of Land Records: Inter-State Variations*, Kurukshetra-A journal of Rural development, Vol.53, No.7, May 2005, Publication Division, Ministry of I&B, Patiala House, New Delhi-110001, pp.15-20.

AISLUS (All India Soil and Land Use Survey), Ministry of Agriculture,(2007). Land degradation , *Geography and You*, Vol. 9, Issue- 52, January-February, 2009, (Ed.) Chottopadhyay, S. New Delhi- 70.

Akbulac C., Erginal A. E., Gonuz A , Ozturk B and cavus C Z, (2008). Investigation of Land Use and Coastline Changes on the Kepez Delta Using Remote Sensing, *J. Black Sea/Mediterranean Environment*, Vol.14, pp.95-106.

Akgul Mesut, Oztas Taaskin and Ucar Yusuf, (2005). The Effects of Irrigation on Land Degradation by Land Division, *Journal of Biological Science* 5(4), ISSN 1727-3048, Asian Network For Scientific Information. pp. 440-443.

Gill H.S. and Abrol I.P. (1989): *Problems and Prospects of Afforestation of Salt Affected Soils. In: Dimension of Wasteland Development,* (Ed.) Yadav Hridai Ram, Concept Publishing Company, New Delhi.pp.281-298.

Gonzales Patrick, Hassan Rashid, Lakyda Petro,McCallum Ian, Nilsson Sten, Pulhin Juan, Co.authors: Shvidenko Anatoly, Barder Charles Victor Barbar, Perssson Reidar, (2008). *Forest and woodland Systems*, Eds: Angeles Marian de los, Sasttry Cherla, pp.-586-614.

Gray, H. R. and Sotir, R.B. (1996). *Biotechnical and Soil Bioengineering Slope Stabilization* . John Wiley and Sons, Inc.

Joshi P K, Wani S P, Chopda V K & Foster J, (1996). *Farmers' Perception of Land Degradation: A Case Study, Economic and Political weekly*, Vol. 26, No. 26(Jun., 1996), http://www.jstor.org, pp. A89-A92.

Kamal Siddiqui (1997). *Land Management in South Asia: a Comparative Study,* Manohar Publishers, New Delhi pp.484.

Larson Bruce A, (1991). The Causes of Land Degradation along "Spontaneously" Expanding Agricultural Frontiers in the Third World: Comment, *Land Economics*, Vol. 67, No. 2 (May, 1991), Published by: University of Wisconsin Press, Stable ULR: http://www.jstor.org/stable/3146416, pp. 260-266.

Laxmi Vijay & Parikh Jyoti K, (1999). *Land Regeneration Programmes: Lessons from Successes and Failures,* Sustainable Regeneration of Degraded Lands, Parikh Jyoti and Reddy Sudhakara (Eds.), pp.31-41.

Lewis, Lisa (2000). *Soil Bioengineering an Alternative for Roadside Management: A practical Guide.* San Dimas Technology & Development Centre, San Dimas, California.

Mukhopadhyay, S. C.(1980). *Geomorphology of Subarnarekha*, Publications Officer, University of Brdwan, West Bengal.

Pani, Padmini (2020). *Land Degradation and Socio-Economic Development, Springer Publication, Pp 34-39.*

Singh, B.(1962). Distribution of Cultivable Waste & Possibilities of its Reclamation in Chakia, Banaras, *The Nat. Geog. of India*, Vol.VII, Par-I, pp. 59-72.

Zdruli, P., Pagliai, M., Kapur, S., Faz Cano, A. (2010),'Land Degradation and Desertification: Assessment, Mitigation and Remediation', Springer Publication, Pp 24-29.