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Bank erosion and its affects on sustainable development: A case study on Dihing river basin, Namsai, Arunachal Pradesh.

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Abstract

The sustainable of development means the long term development of a region. It may flourish the possibilities of development and potentiality of varieties of resource and its utilities. River basin may one of such geographical area where uncertainty is one of the most important barriers of development. Due to erosion and different natural hazards the sustainable development of river basin area always faced the challenges. These basin problems are very common in North Eastern hill region of India. Due to slope and siltation, maximum foothill rivers in this region become very dangerous in rainy season. These same problems are also affected on the development in Dihing Basin area of Namsai districts. Bank erosion of the Dihing River caused lots of socio-economic problems at Namsai and Mahadevpur circle. By satellite image observation and morphometric analysis of the study area beside Namsai Region of Dihing river basin, has represented a regular basin erosion and river capturing, which caused a large level erosion and deforestation, flood, landslide in the Kharibari village of Namsai circle in right bank and Philobari, Silapathar, in Mahadevpur circle in the left bank. This region has a long record of flood and that's the main challenge of sustainable development of this region of Namsai.

Keywords

Sustainable Development, Basin Erosion, River capture, Flood, Deforestation, Morphometric.

Introduction

Erosion is a geo-morphic process in which earth materials removed and transport by natural agent. Here river bank erosion also a same geo-morphic process which involves the removal of bank materials from river banks by the fluvial actions like channel head pressure, velocity, discharge, tide etc. and transport it, which created problems to the bank people.

Riverbank erosion is an inevitable natural phenomenon of any floodplain region. The people of India worship the river as a goddess due to guaranteeing rich soils, abundant water supplies and means of water-way transport so, its helps the human settlement, agricultural development, growth-centres and socio-economic development

of bank people. Unfortunately, some of the river banks eroded and cause considerable loss of lives, livelihoods, property, adverse impacts on the economy and people's safety. Therefore, the development near bank floodplains is a very big challenge. The concept of river bank sustainability concerns not only the ecological condition of the river course, but also socioeconomic activities in the river basin region. River bank sustainability is concerned with resource sufficiency, resilience to water-related risks, access to water supply and other services, the productive use of water, and fairness between different users and generations.

North East region in India is a disaster porn area, there are different types of natural disaster create various problems in human life. Bank erosion one of the major problem in this area which effects the sustainable development of this area. In Assam, The Brahmaputra River is main causes of flood and erosion. That's why instability hampers in development and poverty reduction in Assam.

Dihing River in Namsai district, mainly a tributary of Brahmaputra also hampered the sustainable development of Namsai and Mahadevpur block in this district. Kharibari area in Namsai circle and Shilapathar, Philobari area in Mahadevpur circle are badly affected by the erosion and flood of Dihing River.

Objectives

The basic or the core objectives are mentioned here as follows: -

i. To find out the rate of river bank erosion of Dihing River in Namsai,

ii. To figure out the impact of bank erosion of Dihing River on the life of people dwelling near the bank and figuring different dimensions of socio economic impact of river bank erosion of Dihing River in Namsai.

iii. To find out the environment degradation near Dihing river in Namsai.

Methodology

The study is done on the basis of primary data, secondary and tertiary data. The secondary data is collected from different sources like articles, journals, reports, websites, and newspapers and the tertiary data which is relevant with the map source of Indian boundary map, Arunachal Pradesh, Namsai district and circle map which is prepared through the use of QGIS 3.14 pie software in GIS lab of AUS. The satellite images are collect from Google Earth and Google map website and the Indian boundary map collected from DIVAGIS.

Causes of Riverbank Erosion

Rivers are dynamics in nature; they change their flows continuously and naturally, which affects the bank's soil. Stream bank erosion is natural process. The massive erosion takes place in some rivers due to their unstable character, so large scale and high-frequency erosion take place in this river channel and the river are assume a braided pattern consisting of several channels separated by a small island in their course. Extensive overbank spills, bank erosion, and bank-line shifts are to be typical in monsoon time. Due to erosion, the river channels have been swinging between the main valleys.

Riverbank erosion occurs by dually, facts Physical and human. Rivers and streams are dynamic systems as they are constantly changing. The natural process of riverbank erosion can produce favourable outcomes such as the formation of productive floodplains and alluvial terraces. Some stable rivers have a healthy amount of erosion; however, unstable rivers and the erosion taking place on those banks are a cause for concern.

So the main causes of riverbank erosion are divided into two categories A) Physical Factor and B) Human activity.

Physical Factor of the Erosion

The two main physical factors are responsible for the erosion of the river bank. These two factors are a) Bank scour and b) Mass failure. Other physical factors are Geological Shape, Mature Stage of River, and Sedimentation in the River Beds.

a. Bank Scour:- It is the process to direct removal of bank materials by the wave action and the sediment carries by the water. When the river water flow speed increases then the erosive power of the flowing water of the river also increases and scour may occur according to the river bank. The flowing of the river water is increased due to natural or human activity. Due to the undercutting of the river bank the bank tone is a sing of scour processes.

b. Mass Failure:- Mass failure is the various mechanisms process of the riverbank erosion, which is the result in sections of the river bank sliding or toppling into the river. Mass failure is sometimes described as collapse or slumping. Due to the undercutting process of the riverbank, the river material stay as bare and near-vertical banks, or the river areas of slumped bank materials are the signs of these processes. The causes of these types of failures are often difficult to find out but it also includes natural or human factors. Due to the undercutting process the bank toe and slumping suddenly collapse and it is the result of saturation after flooding, it is the example of mass failure.

c. Geological Shape:- Due to the geological shape of the country, the process of riverbank erosion is rapidly increased, and bank erosion also depended on the situation of the river bank. Even the situation of the flat land did not resistant to the hydraulic forces of the river, particularly during the monsoon time when the river water is high flow.

d. Mature Stage of River:- When the rivers enter the mature stage then the river become sluggish and they formed the meander or braid due to decrease the sudden power of the erosion but due to the pressure of the river water, the erosion work of the river continues slowly and during the monsoon season the erosion power of the river increase, this is the cause of the massive erosion of the riverbank.

e. Sedimentation in the Rivers Beds:- In the mature stage, the river deposition is very high then the power of erosion. Whatever the river eroded in the upper portion, the river bring with water and deposited those materials in own channel in the mature stage, that's why during the monsoon time, when the pressure of river water is very high then the water overflowed the bank and that's time flowing speed of the river water is very high so the erosion power of the river is increasing. So sedimentation is another cause of riverbank erosion.

Human Factors of Erosion

a. Deforestation:- The riverbank erosion increased due to deforestation which led to excessive sediment load into the rivers. Trees are important to our society. Trees roots bind the soil together. Forest is the strength of the river bank. Forest controls the riverine morphology. The tree's roots bind the soil of the river bank. It is the trend of the riverbank area continuously collapsing soil in the river channel but presents the forest beside of the bank erosion is decreased. Deforestation refers to cutting down trees and making a forest area into a non-vegetation area. Forest stabilized riverbank by increasing strength of the soil, reducing slope and water velocity of the river bank. But when the trees are cut down, the soil particles become loose and for this reason, the soil of the riverbank can be eroded gradually.

b. Dam and bridge construction:- Dam and Bridge construction on the river is another extensive cause of riverbank erosion. Many river systems of the world have been affected due to the construction of dams and bridges. Sometimes dam and bridge construction on the river are positive benefits of the country but at the same time physically and biologically changes of the river.

The erosion problem is also a serious problem of the river due to the bridge construction. After the construction of the Three Gorges Dam (TGD) on the Yangtze River in China observed that severe erosion has taken place in the Yangtze River channels.

One major cause of increased river erosion after the construction of dams is that all the sediment being carried by the river into the reservoir retains there. Then the water released through the dam is very clean and has no sediment. Clean water causes more erosion than sediment-laden water because it can carry more sediment.

Sometimes the wrong structure of the bridge causes bank erosion. Constructions of bridge piers have some morphological impacts on rivers. Pier scouring occurs when water discharge is suddenly increased and it washes away big amounts of soil materials adjacent to bridge piers Most of the soil particles removed surround the bridge piers by turbidity currents.

Unscientific river boundary: - Due to the unscientific boundary across the river, the natural behaviour of the river has been changed. For readjusting the condition, the river changes its behaviours and possesses a great pressure on those constructional structures ending with collapsing most of it.

Location of Study area

Namsai become the 18th district of Arunachal Pradesh on November 25, 2014 with population 11,582. Geographically, Namsai district is located beside the river basin of Dihing, which is tributary of Brahmaputra River. It is a foothill district of Eastern Himalayan zone. The district is situated at north eastern most part of the country and lies between 27°39'N to 95°52' E coordinator, with a geographical area of about 1587sq km. Namsai is divided into 5 circles. Our study area belong Namsai and Mahadevpur circle besides the Dihing river basin.

Fig No: 1. Satellite image of study area

Location of study area

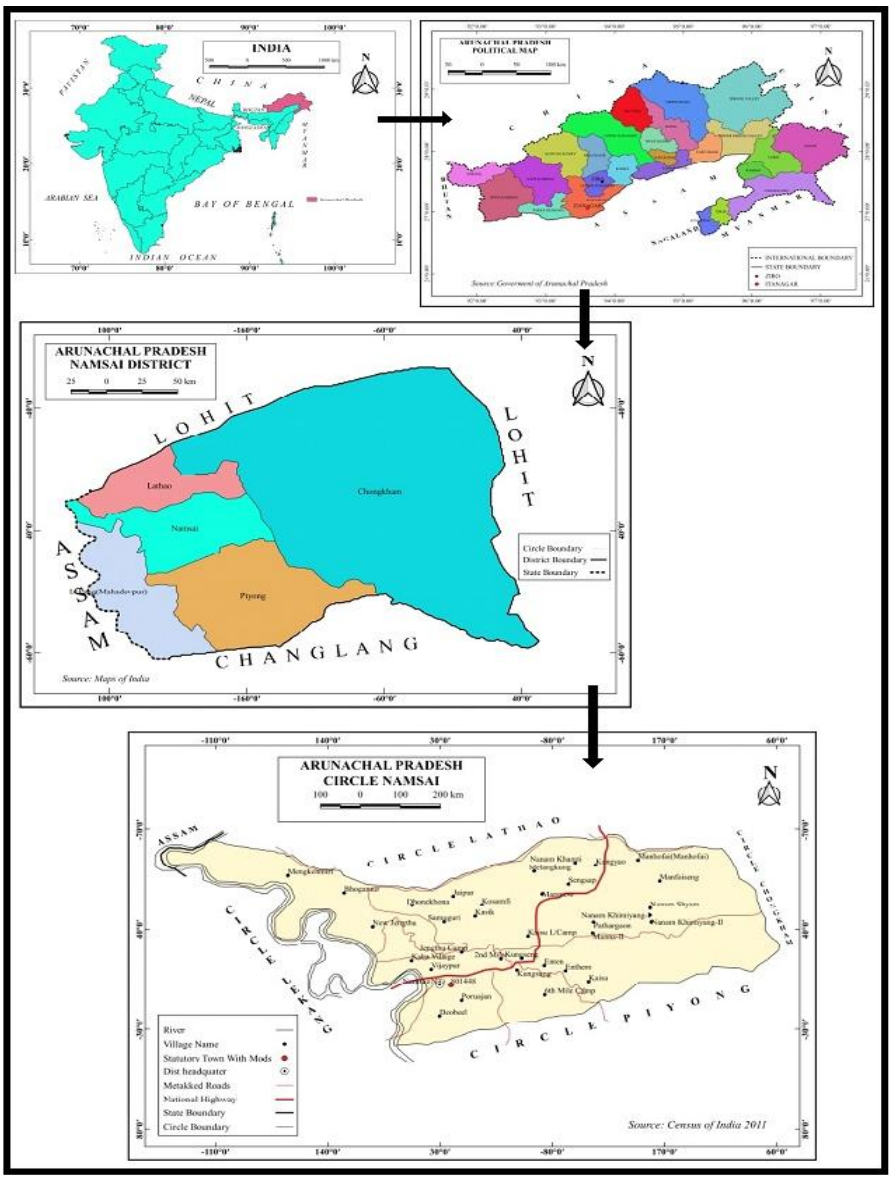

Fig No: 2. showing the Location map of Namsai Circle

Causes of Dihing Riverbank Erosion

Dihing River is a large tributary of Brahmaputra River. It's originated at Naga Patkai hill of Eastern Himalayas in Arunachal Pradesh and flows through Assam and Arunachal Pradesh. Namsai district is situated at the bank of the Dihing River so Namsai is influenced by the Dihing River. Dihing River eroded the Namsai and Mahadevpur circle badly. New Seela -2 and Filobari village in Mahadevpur circle are destroyed 15 years ago due to erosion by the Dihing River and now it's eroded the Kharbari village of Namsai circle.

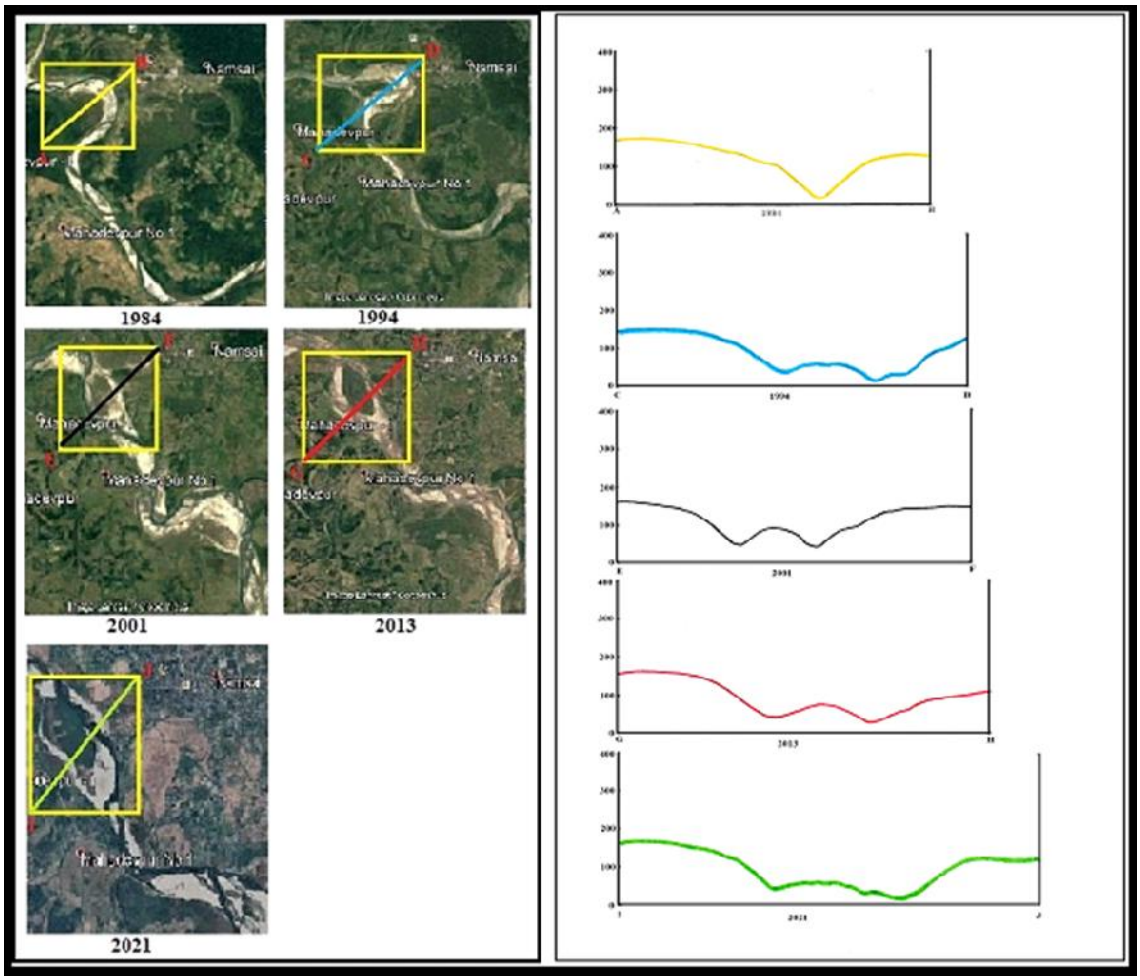

Fig No: 3. Satellite Image and cross profile analysis of Dihing River (Source: Google Earth Pro, 2021)

The Dihing River changes his cross time to time. Due to mature stage of Dihing River near Namsai, the deposition rate of silted material is very high and a small island builds between Namsai and Mahadevpur circle. The satellite image are showing that the change of Dihing from 1984 to 2021. In 1984 the river cross like a 'V' shape but due to deposition of silted material from 1994 a small island formed in the middle of Dihing river cross so, the cross of Dihing river moved near the bank and eroded its own bank and create problem of the dwellers of Namsai and Mahadevpur circle.

So there are various causes of Dihing river erosion. However, the causes are divided into two parts 1. Natural Causes 2. Man-made causes.

Natural Causes

a. Silt Deposition by transported materials from Upper Region

Landslide is a natural phenomenon in Arunachal Pradesh. In the upper course of the Dihing River, it is frequently found. It is very common in rainy seasons. Due to heavy rainfall, the loose materials of the hill come into the river directly by surface runoff and the river water brings this material and deposited it in the middle and lower portion of the river course. Actually, Namsai is situated at the middle course of the Dihing River. So the silted material deposited along the Dihing River between Namsai and Mahadevpur circle which creating problems during the rainy season.

This silted material reduced the depth of the river so during the rainy season when extra water is added to the river then the extra water flooded beside the river basin area. This flooded water also eroded the side portion of the Dihing River; this is the major cause of the Namsai circle.

Fig No: 4. Silt Deposition in Dihing River channel between Mahadevpur and Namsai Circle. Source: Self Click

b. Heavy Rainfall

Namsai belongs to the Sub-tropical humid climatic zone, where annual rainfall is more than 250 cm. March to August facing the maximum rain and average humidity 60%, so such heaviest rainfall in the whole year, create maximum surface level erosion in Namsai region. Due to un-drained connectivity and lack of proper channel in Namsai, the sheet erosion regularly added heavy silted materials like silt, clay, and mud in the basin and the main course of Dihing in Namsai and degrades the depth of the mainstream course. It is the major fact of regular floods in Kharibari, Mahadevpur, and Deobill area.

c. Flood

Flood is the indirect cause of flood river bank erosion of each drainage system. Flood creates a heavy deposited material and its deposition in the river basin and affects the depth of the river and as a result, it's creating the side erosion in the rainy season due to the heavy water. So it creates the side erosion and again it's creating the food on the basin area of the river. So in the case of Dihing river, it's very similar because each year the Dihing creates a flood Namsai and Mahadevpur circle, and these floods added huge deposited material in the river basin area due to its gentle slope. So the causes of deposition on this basin, again it's inspired to river the side erosion inn each year. So due to erosion occurs the flood in Namsai and Mahadevpur circle and also due to Flood River inspire to side erosion. So flood is the cause of erosion and erosion is the cause of the flood. So the fold and erosion have happened through the cyclic process in the Dihing River. Erosion and flood are positively connected to each other; if the erosion is high then it will create a flood in the surrounding area of the river.

So, Due to the massive rainfall of Namsai District the huge water of Namsai block is added to the Dihing river and it also brings the silt material which deposit in the Dihing basin, its causes to decreases the capacity of water, so the water cross the river bank and flood take place in the Namsai block. So this accelerated the riverbank erosion of Namsai.

d. Mature Stage of River

When the rivers enter the mature stage then the river become sluggish and they formed the meander or braid due to decrease the sudden power of the erosion but due to the pressure of the river water, the erosion work of the river continues slowly and during the monsoon season the erosion power of the river increase, this is the cause of the massive erosion of the riverbank.

Namsai is situated on the mature stage of the Dihing River, in this stage, the Dihing River deposits the silted material and there is no power of bottom erosion due to decrease the force of the water but during rainy seasons when the pressure of the water increases then the river eroded the side portion. That's why every year during the rainy season Mahadevpur and Namsai is badly affected.

e. River Meandering

When the rivers enter the mature stages then the river becomes sluggish and the erosion power of the river is declining so the river creates the number meander. In this meander region, the river eroded the most, and the eroded material was deposited in this region. This erosion accelerated during the rainy season; on the other side in mature stages the river eroded the side portion than the bottom portion. In the rainy season when extra water is added to the river than it creates a flood beside the river basin region. The Namsai circle and the Mahadevpur Circle are situated in the mature stage of Dihing River and the Dihing River creates meander in this portion so the river eroded his side in this portion. In Kharibari village of Namsai circle, Dihing River eroded his side portion due to creating the meander. It also creates problems in Namsai circle and creates a flood in this region during the rainy season.

Fig No: 5. Satellite image showing Dihing River Meandering. Source: Google Earth

f. Redirection and acceleration of flow within the channel

Due to the redirection of the river channel intensity of the erosion increase in the river. Due to huge silt deposition of river forcefully change the direction, its change permanently or temporally. This causes erosion to take place in the new place.

The Dihing River changes her channel frequently. So if we analyzed the satellite image the river flow between Namsai and Mahadevpur circle directly, and after bringing the huge contrite of silted material from the upper stage, it is deposited between Namsai and Mahadevpur circle and formed a small island due to silt deposition. So the Dihing River shifted to Namsai circle and increases the side erosion in Kharibari village. In 1984 the river creates a meander and flow than after some years there formed an island. If we see the 2021 satellite image there the Dihing River eroded kharibari village and create a problem for the people.

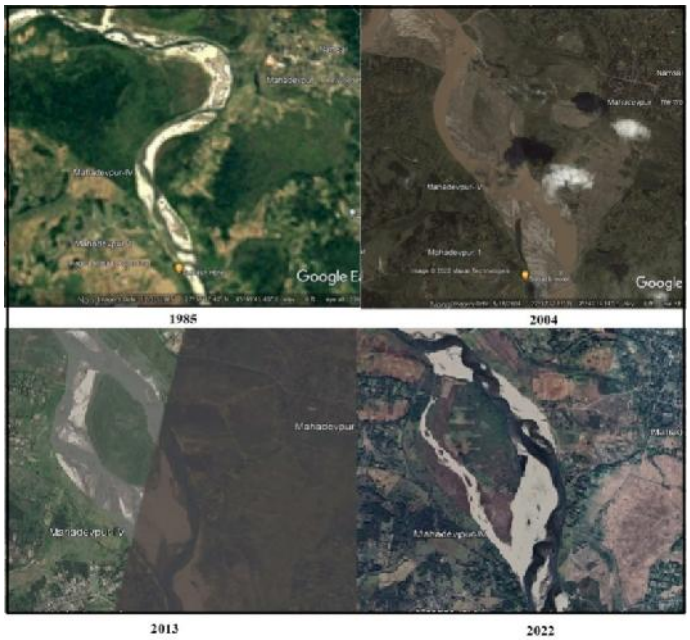

Fig No: 6. Satellite image showing Redirection and acceleration of Dihing River between Namsai and Mahadevpur circle. Source: Google Earth

Man Made Causes

a. Irregular Drainage System

The irregular drainage system is also one of the most impotent causes of riverbank erosion in Namsai area. Due to the regular growth of population and settlement area, Namsai drainage system becomes blocked and in some cases, it totally disappears. In an area where the drainage system is not cleared or blocked there such a type of problem arises during the rainy season. It's happened due to the addition of huge silted materials and the waste materials of the basin area.

Fig No: 7. Block drain in Namsai Circle. Source: Shelf Click

b. Deforestation

Forest stabilized riverbank by increasing strength of the soil, reducing slope and water velocity of the river bank. But when the trees are cut down, the soil particles become loose and for this reason, the soil of the riverbank can be eroded gradually. During the rainy season, the shit erosion is an increase in the open land and there also take place rill and gully erosion. So this eroded material flows with water and is deposited in the drainage basin and this silted material reduced the depth of the river, it's another reason of flood in the river basin and this floodwater eroded the side portion of the river. In the case of Namsai region there the forest area decreases day by day due to the un-scientific growth of the urban area. In the year 2002 to 2020, Namsai lost 37% of the forest cover area. So there the shit erosion is increases during the rainy season. If we see that the kharibari area of Namsai circle including Deobill area there is no big tree, so shit erosion, rill erosion, and gully erosion is taking place in this region. During the rainy season, this process is accelerated by rainwater. So when rainwater is added with the Dihing River then the flood takes place in Namsai and Mahadevpur Circle.

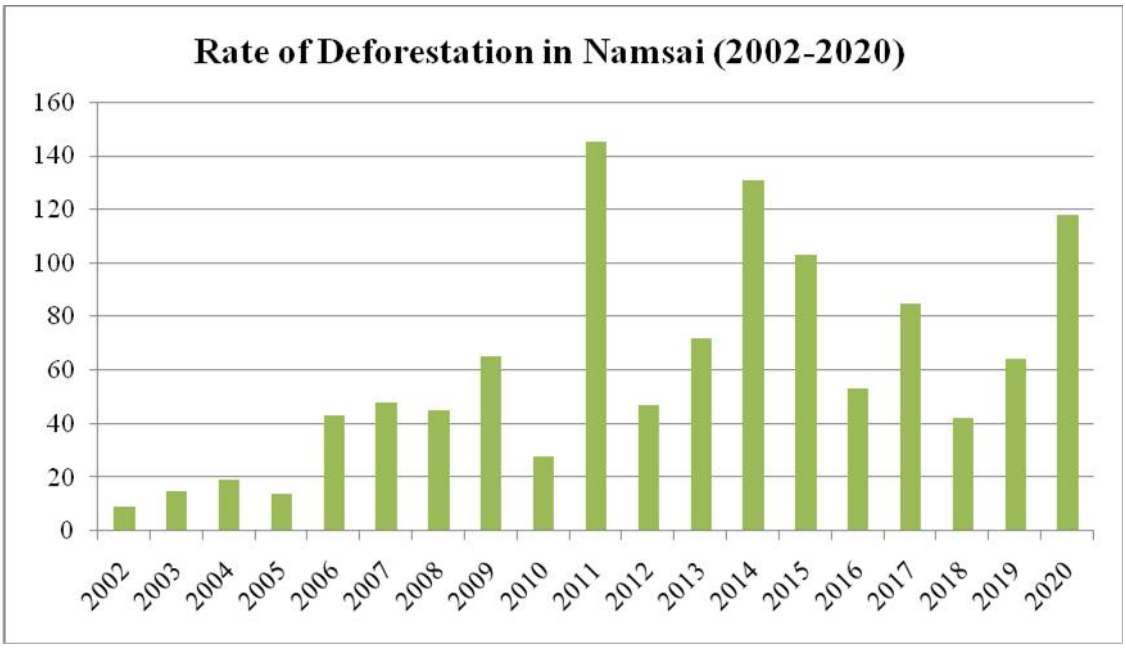

Fig No: 8. Bar Graph Showing Rate of Deforestation in Namsai.
Source: globalforestwatch.org

c. Agricultural land Use

Riverbank erosion is increasing due to changing land-use practices. Clearing of vegetation cover for the purpose of cultivation and regular use of land, change the compactness of soils of Namsai and which eroded easily in rainy seasons. In Namsai, due to unscientific land use, the soil of agricultural land becomes very weak it becomes a cause of sheet erosion. So, in the rainy season, the soil eroded and it washed with the water and deposited at river course of Dihing and reduced the capacity of water when in rainy season extra water added with the Dihing River than the flooded the basin area and it's also cut the bank of the river which most vulnerability of Kharibari village of Namsai.

d. Dam and bridge construction

Dam and Bridge construction on the river is another extensive cause of the riverbank erosion. Many river systems of the world have been affected due to the construction of dams and bridges. Sometimes dam and bridge construction on the river are positive benefits of the country but at the same time physically and biologically changes of the river.

After the built Banka bridge on Dihing River silt deposition are increased between Namsai and Mahadevpur circle, for this reason, there is formed a small island which is submerged during the rainy season. So for this island, the river changes its direction and eroded the agricultural land settlement area of Namsai circle.

Fig No: 9. Showing Bank bridge connected between Namsai and Mahadevpur. Source: Shelf Click

e. Urbanization in Namsai

Increasing urbanization in the river basin is followed by some serious impacts on the river system. Rapidly changing demography the land use and land cover patterns have changed in the rivers basin geography. In past to present the river basin area is an important economic zone in any country, so the rural settlement area was originated in any river bank but in the present day this rural settlement is converted into urban settlement and increase its area unscientifically and it is the problem of river basin area, its causes of the flood and bank erosion of river basin area. Some of the cases cut down the forest area and growth the urban area, so due to cut the forest area there the increases of shit erosion during the rainy season and this eroded material deposited in the river basin and it's the cause of flood and riverbank erosion. Over urbanization and poor management of river basin causes increases the river erosion. Due to the unscientific growth of the urban area of Namsai the shit erosion is increases during the rainy season and the silted material are deposited in the course of Dihing River, this silted material is the cause of the flood in the river basin of Namsai. This silted material also causes the bank erosion of Kharibari village of Namsai.

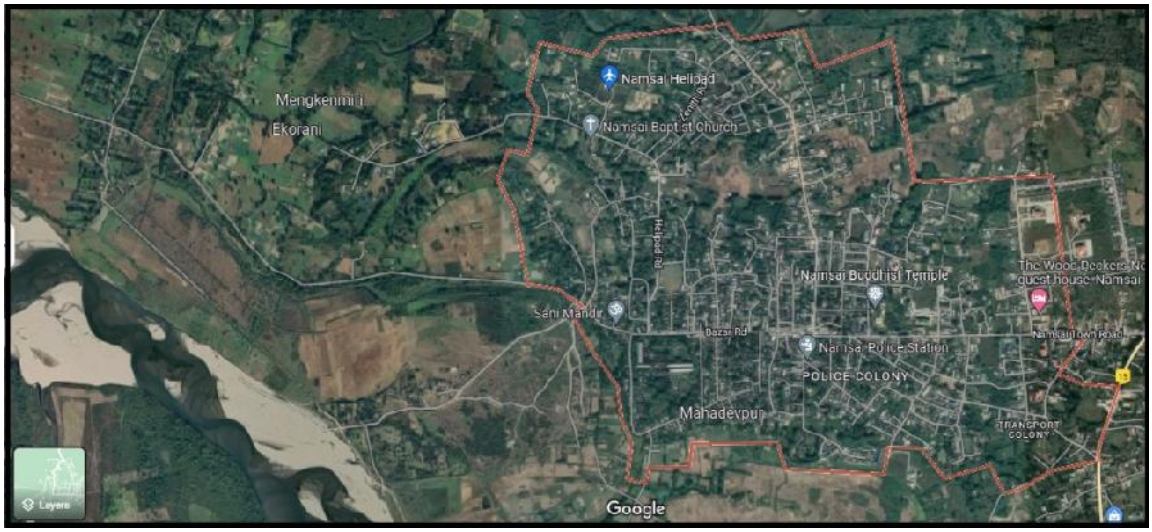

Fig No: 10. Satellite image showing Urbanization in Namsai area. Source: Google Map

Impact of Dihing River erosion

Due to river bank erosion, there are various socio-economic impact face by basin people. River bank erosion is one of the causes of national poverty. The economy impacts of river bank erosion are led to reduction of the agricultural land and decreasing income of people from agricultural. The impact of land loss involves primarily the loss of agricultural land, homestead lands, agricultural productions, crops; livelihood status of people of that area has changed due to the impact of property losses.

1. Homelessness

In Namsai due to flood the riverbank erosion the people shift to another place. The local people told during the survey in every year the bank eroded due to the flood of Dihing River, kharibari village of Namsai circle is badly effect due to erosion and they also told some people are leaving the place. According to the report of The Times of India on 27th July 2016, there are approximately 3,500 houses were completely damaged due to a flood in Namsai District. Due to the flood of the Noa-Dihing River, 53 houses of Lekang circle in Namsai District were damaged due to the flood reported by The Arunachal Times on 12th July 2020.

2. Loss of Agricultural land

Namsai is agricultural based area. The people are dependent in agricultural but due to flood and river bank erosion they are suffering in various sides. Due to flood the crop are damaged and also agricultural land eroded due to flood. Agricultural land of Philobari and Silatoo Village in Mahadevpur circle are totally eroded by Dihing River.

3. Loss of Agricultural Production

In Namsai due to flood the farmers are loss their agricultural production. The people are told that in rainy season the floods are coming due to overflow of the Dihing River. So the agricultural productions are almost damaged due to flood. According to Business Standard report on 2016, around 3,500 hectares agricultural field was damaged by flood water and another report on 2014 the several hectares agricultural field was washed in Mahadevpur.

4. Loss of homestead areas

Due to river bank erosion the homestead land of river basin area are losses. Maximum time the people are expended their saving to rebuild their house again and again. Although they know that the house which they are rebuilding will not exist after one or two years. Due to flood in Kharibari village in Namsai circle the people are rebuild their house in several time. The people are told that they also live their homestead due to erosion. In Philobari village and Silatoo village in Mahadevpur circle the people were totally lived their village due to erosion of Noa-Dihing River.

5. Loss of productive Land

Due to river bank erosion victim people loss there farming land and it is a main cause of economic problem of basin area. Each years in rainy seasons the lower Ganga river Basin of West Bengal, India is suffered by this problem. Also the people of Namsai in Dihing river basin are suffered the same problem. Erosion eroded the productive land and flood damaged the fertility of productive land so the people of Namsai and Mahadevpur Circle are faced the huge problem in every year.

6. Loss of occupation

Due to river bank erosion people lost their job because there working place floating by the flood. Due to they have no job there is a risk to became a poor because they have lost their land, property and human life. In Namsai the people are mainly dependent on agricultural but due to erosion and several flood they changed their job but due to unskilled for other job sometime they are lose their job or when they live their place then they also lost their job.

7. Decreased the family income

Due to river bank erosion and flood the main source of their income has washout. The main source of income of people in Namsai is agricultural but due to erosion and flood the income level of people is decreased. When they left their native place they don't get job easily, so they are unable to earning their satisfactory level.

8. Problems of displacement

Due to bank erosion the people loss their home land, agricultural land other thing, so they are bound to migrated to another place and there the expenditure for new setup is very high and another problems they are not found well place for their living so they suffer their health problem, drinking water problem and security problem. In Namsai some people are migrated to another place due to flood and erosion.

9. Impact on Transport

The Basic problem of the affected region of the riverbank is transport. It is frequently found that after a flood the roadway communication becomes so much hampered that the area becomes paused due to lack of a proper combination system. At that time, the prices of different products start to increase continuously and it creates a socio-economic problem. Due to flood and bank erosion the transport system of Namsai and Mahadevpur circle is interrupted during monsoon season and it creates a socio-economic problem.

River Bank Erosion and Sustainable Development in Namsai

A. Infrastructural losses and River Bank erosion

Riverbank erosion is a perennial problem in India. In the time of monsoon, the rive transporting extreme amounts of sediment from the Himalayan Mountains. These fine soils have no resistance so, it's easily transported and deposited. As a consequence the fine soils deposit in river channel and build the small island which reduced the water capacity of river, this unpredictable behaviour with the permanent risk of riverbank erosion. Riverbank erosion exceeds per year and poses of substantial risk to floodplain dwellers. The loss of land is accompanied by loss of infrastructures such as flood embankments, schools, hospitals, cultural and religious monuments and, of course, agricultural lands and assets.

Due to Dihing River erosion Philobari, silatoo village in Mahadevpur circle and Kharibari village in Namsai circle are badly affected. The Philobari and Silatoo village in Mahadevpur circle are destroy and the people are migrated another region.

B. Deforestation and River Bank erosion

Trees are important agent to stabilize the soil and river bank. Root system of forest can bind the soil from erosion. They are strength of the river bank and its help control the evolution of riverine morphology. When trees root are bind the riverbank, it tends to collapse into the river intermittently, in large blocks, rather than more continuously in smaller pieces. These large blocks disrupt the flow of the river and protect the riverbank against further erosion. If the forest area is reduced from riverbank the rate of erosion is increases.

In Namsai due to human influence the forest area is reduced slowly. So soil erosion is increase during rainy season. Due to deforestation in Namsai beside the Dihing river basin the erosion increases rapidly. From 2002 to 2020, Namsai lost the 37% forest area. So the bank erosion is increase in Namsai and Mahadevpur circle.

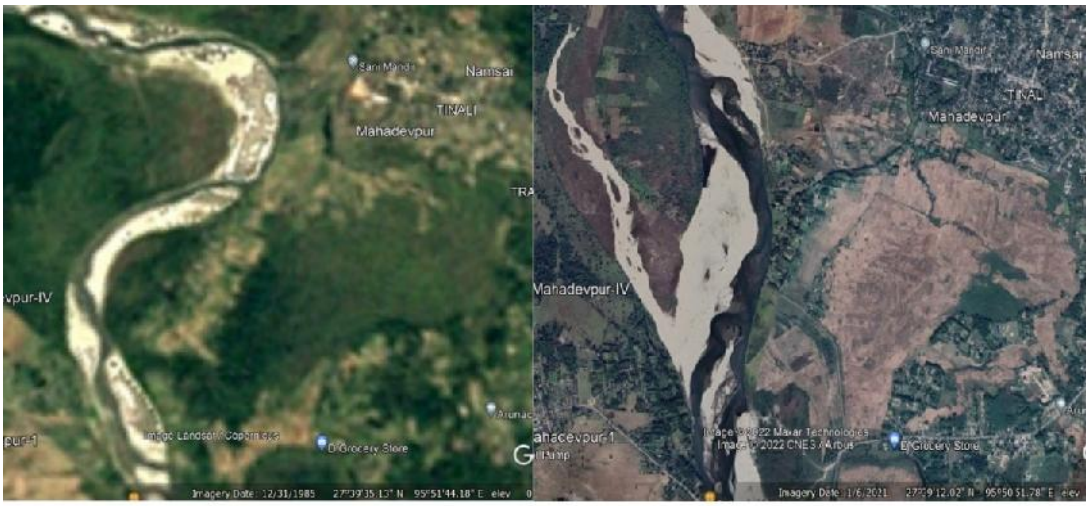

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Fig No: 10. Satellite image of Dihing River which showing deforestation area in Namsai Circle. Source: Google Earth.

C. Soil Erosion and River Bank erosion

Soil erosion is another cause of the river bank erosion. During rainfall the soil erosion is increase in open land and this silted material flow with the water and deposit in the river channel and another cause of soil erosion is irregular soil collecting form river channel.

Namsai belongs to the Sub-tropical humid climatic zone, where annual rainfall is more than 250 cm. March to August facing the maximum rain and average humidity 60%, so such heaviest rainfall in the whole year, create maximum surface level erosion in Namsai region. Due to un-drained connectivity and lack of proper channel in Namsai, the sheet erosion regularly added heavy silted materials like silt, clay, and mud in the basin and the main course of Dihing in Namsai and degrades the depth of the mainstream course. It is the major fact of regular floods in Kharibari, Mahadevpur, and Deobill area.

Fig No: 11. Showing irregular soil collecting form river channel of Dihing in Namsai circle which is the causes of soil erosion. Source: Shelf Click

D. River capture and River Bank erosion

River capture is a natural process which is more active in the youthful stage of the valley development because the streams are actively engaged in head-ward erosion and valley lengthening but river capture also occurs during mature and senile stage of the valley development through the process of lateral erosion and meander inter section. So after erosion the silted material comes in mature and old stage of river where this silted material are deposited, after deposition depth of the river is reduced and side erosion is take place when the rainy season comes.

Namsai is situated at the mature stage of the Dihing river, so after erosion in upper stage and in meandering procession the silted material deposited between Namsai and Mahadevpur area so depth of this portion is reduced and during rainy season when water level is increased then flood take place in Namsai and Mahadevpur area, so due to flood the bank erosion is increased in this area.

Fig No: 12. Satellite Image showing the river captures area in Kharibari village of Namsai Circle. Source: Google Earth

E. Transport problem by Riverbank erosion

Namsai is an unplanned area so there is the maximum situation is developing and going on so the communications system also is not developed. In the Namsai district their normal transport communications depend on NH-52 and some subway it's connected to with the National Highway NH-52 but in the case of rural communication is not metallic. In the riverbank area of Namsai there is the maximum communication system that is totally un-metallic and in the rainy season the road due to the rainwater becomes destroyed and its mud situation creates a huge communication problem in the Kharibari region and it also affects the Deobill area. If the flood situation will come then it creates more trouble because the road becomes flooded and the road becomes dissolved by water. The direct communication of the people of this area becomes more complicated. On this view we can defiantly say that it is the very common matter at the time of the flood in each year march to August, there are maximum people are basically facing of this problem. As per the report of common people of this area, they also face this same problem during the flood by the riverbank erosion of Dihing. If we see that the road of Kharibari area is very down so during flood due to the lateral erosion of Dihing River it's always submerged.

Due to the 2016 flood, the movement of the vehicle was completely suspended on NH-52 reported by The Times of India.

Image No 13: Showing erosion of road of Kharibari village in Namsai Circle. Source: Shelf Click

Conclusion

The results from various analyses in this study revealed that there is a close link between riverbank erosion and Sustainable development. Riverbank erosion creates different forms of socioeconomic and demographic problems such as loss of livelihood, loss of education and falling health condition, loss of homestead land etc. and also the displacement issue are related with the erosion.

The development of any region is related with people but when the people are left the place due to various reasons so the development is posed. Due to river bank erosion when the victim's people are migrated another place the sustainable development in bank area is interrupted. In north eastern part of India due to huge rainfall in monsoon time the rate of river bank erosion is increased and the people are sufferers. So the sustainable development of North-Eastern region is very slow.

After analysis of satellite image and other source in Namsai district the river bank erosion is one of the major briars of sustainable development. So the local government has taken to appropriate bank protection measure immediately for sustainable develop the Dihing river bank. The Main key of sustainable development is to increase the capacity and desire of the local community to reduce their own vulnerabilities. Prime concern was to understand the local people and their problems thus providing solutions in such a way thus the sustainable development come to the Namsai circle.

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