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Changes in The Demographic and Social Profile of The Char Dwellers Due to The Meander Cut-Off in The River Bhagirathi, West Bengal

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Abstract: The world's largest rivers often display meandering features in their middle and lower courses, leading to the formation of oxbow lakes. These meandering rivers frequently change their paths along the floodplain and creating frequent meandering scars and paleochannels. The Bhagirathi River in West Bengal is a prominent example marked by numerous meander loops and oxbow lakes. Over the past decades , it has experienced frequent cut-offs. Consequently, a few villages have suddenly become disconnected from the mainland due to a cut-off, causing physical isolation of certain villages from the mainland. This study explores the socio-economic impacts experienced by the communities residing within these isolated oxbow lakes regions. A household survey was conducted among 102 respondents from Chupi Char (located in the Purbasthali 1 block of Purba Bardhaman district), focusing on demographic profiles and occupation changes before and after the cut-off. Both quantitative and qualitative data were collected through interviews and structured questionnaires. Key findings reveal that the age group between 30-60 years old experienced the most significant impacts, while younger individuals reported minimal effects due to the meander cut-off. Additionally, there has been a shift in occupation, with the majority of people transitioning from primary activities to secondary activities due to land submergence following the cut-off. Land erosion, waterlogging, and crop damage have adversely affected the region. This unfortunate situation has changed significantly due to social development and support in recent times, leading many to flee from hazardous conditions.

Keywords: Meandering River, Oxbow lakes, Bhagirathi River, Char dwellers

I. Introduction

Understanding river dynamics and morphometry with its impact on society has become the study of interest of geology, geomorphology and sociology scholars. With time, this interest has been altered due to concern for the environment (Buffington, 2012). Much research has been carried out previously looking at channel morphometry, river meandering, dam and flood morphometry, etc. Being concerned about the environment is as important as taking into account the natural and social changes around us. The change in the river dynamics causes riverbank erosion and bank failures, which justifies the untold suffering of the local people. At this point, the core phenomenon. that aligns with the broader discourse of geography is environmental displacement, where populations are compelled to recognise and reorganise their social and economic lives. The state of West Bengal is a land of rivers. The notable change is noticed in the course of the lower reach of the Bhagirathi River flowing in a southern direction for approximately 67.30 km between the confluence point of Ajay and Jalangi Rivers in Purba Bardhaman and Nadia district of West Bengal. The dynamic nature of the river produces various geomorphic features such as oxbow lakes, mid-channel bars, paleochannels, meander scars, etc. The meander geometry at the lower course reflects inconsistency, erosion vulnerability and unpredictable behaviour over the years. The migration behaviour and changing nature of the river in human habitation have been analysed throughout the technological progress of remote sensing-based on bank erosion, avulsion and resultant problems (Das et al.,2014; Pal et al., 2016; Rudra, 2014). The Bhagirathi River shows a lateral migration which causes serious problems of sediment load, destruction of the floodplain and land use change. With time, the human habitation along the banks of the river is also changing with their dependency on agricultural land, nature of occupation, economic set-up, and social changes. This behaviour particularly reflects the human-environment interaction where natural process invokes a vulnerable situation among the people.

The present sub-catchment basin of the Bhagirathi River experiences a favourable geomorphic change through riverbank line changing with bank erosion and sinuous meandering. The meanders become an oxbow lake along the side of the river. Oxbow Lake is a small lake located in an abandoned meander loop of a river channel. They are U-shaped or curved bends in a river that are cut off from the main river flow, forming an oxbow lake. Rural communities residing within the Oxbow Lake face a livelihood problem.

Rationale of the Study

The Purbasthali oxbow lake is situated within the dynamic fluvial environment of the Bhagirathi River. This region has become well-known as a destination for birdwatchers and nature enthusiasts. Furthermore, tourism development has achieved considerable popularity among tourists. Employment opportunities were significantly expanded by lake residents, primarily

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue IV, April 2025

during the peak winter season, through the provision of tourist services, including guiding and boat operation. Tourism activities are undertaken in the three villages—Kasthasthali, Purbasthali, and Chupi—situated outside the loop (Roy et al., 2020). Conversely, Indrakpur, situated on the concave shore of the lake, experiences a progressive channel migration, thereby reducing the cultural benefits derived from tourism. The surrounding body of water isolates Indrakpur, geographically separating it from neighbouring villages. Due to its remote location and inadequate infrastructure, the village lacks tourist activities.

Study area

The wetlands of West Bengal are classified into four categories based on the physiographic and hydrological parameters (TARU 2010). They are *Wetlands of North Bengal, Wetlands of Gangetic Alluvial Plain, Wetlands of Rarh Region and Coastal Wetlands*. The Purbasthali oxbow lake, or Chupi beel, is located along the margin between Nadia and Purba Bardhaman Districts of West Bengal. It extends between 88º19’45” E to 88º21’54” E longitudes and 23º25’54” N to 23º27’54” N latitudes. This wetland is located on the right bank of the river Bhagirathi, which was formed due to the shifting of the river channel during 1989-1991 (Bandyopadhyay et al., 2014; Mandal et al., 2018). The Bhagirathi-Hooghly River is dynamic in this region, shifting its channel, causing river meanders at a lower stage. Selection of villages has been done in such a way that it covers both the villages located inside and outside of the crescent loop (Purbasthali oxbow lake).

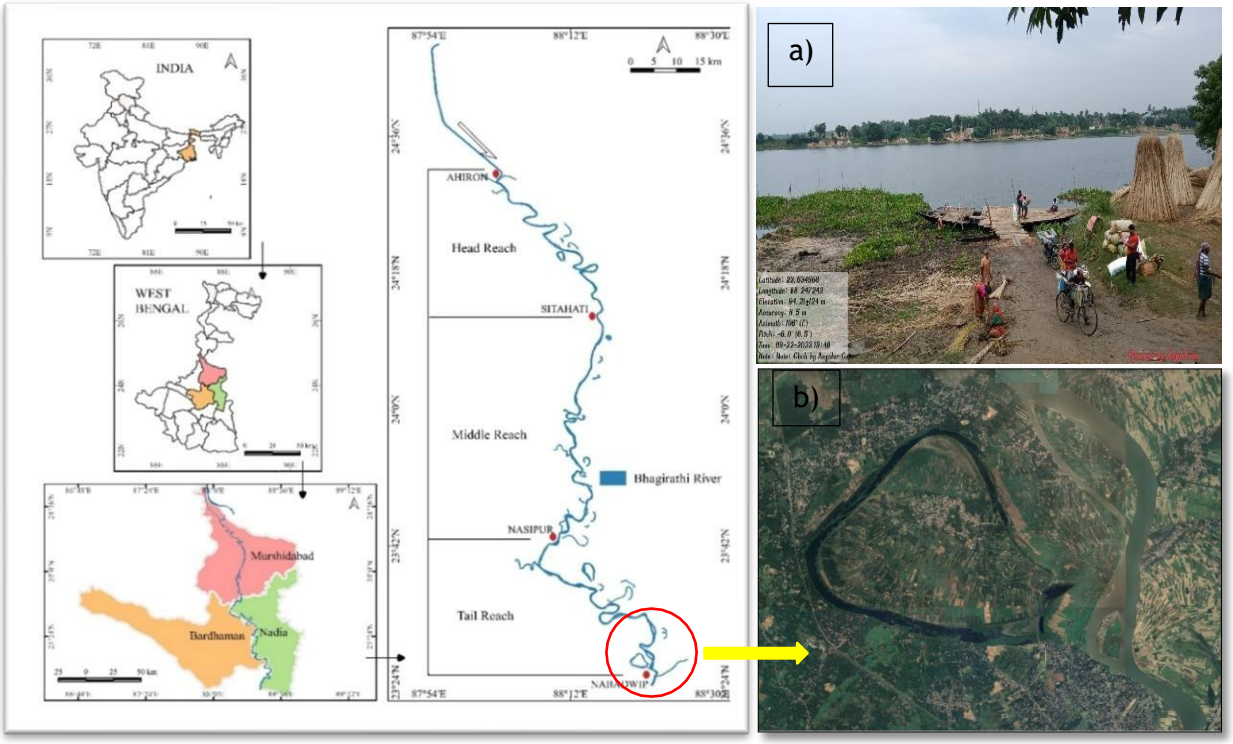


Fig1. Location of the Purbasthali Oxbow Lake. a) The people on the boat are dependent on navigation. b) Satellite Image of the Oxbow lake

Research Objectives

1. To identify the meandering cutoffs along the channel and the formation of an oxbow lake.

2. To explore the demographic and occupational structure of the community.

Database and Methodology

Research methodology is a way to solve the research problem systematically so that the research work can be carried out easily. Methodological design refers to the entire process of planning the research work to follow the proper stages of data collection, analysis of data and find out the reality and problem associated with.

Primary data sources: Primary data has been collected directly from the field through direct field survey methods like household surveys, Interview method and Focus Group discussion (FGD). For a collection of respondents’ details and socio-economic structure, pre-planned open-ended questionnaires have been conducted.

Secondary data sources: Secondary data is collected from different organisations, offices and other related research publications. The collection of data from primary and secondary sources is tabulated in Ms-Excel. The preparation of map on the shifting of Bhagirathi River has been accomplished using QGIS 3.28.4 and ArcGIS 10.5 software.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue IV, April 2025

II. Results and Discussion

Meandering Dynamics of the River Bhagirathi

Historically, the alluvial channel of the River Bhagirathi has changed its course several times owing to various endogenetic and exogenetic forces, where maximum change is found in the southern portion of the river rather than the middle part near Berhampur town. This flow of river is modified by the construction of dams, barrages, weirs, reservoirs, canals and open pits on the riverbed. According to the World Commission on Dams (IIED, 2001), half of the world's large rivers are affected by the construction of dams and barrages. The Farakka Barrage Project (FBP) was constructed in 1975 by the Government of India to revive Kolkata Port by providing a saline-free environment and fresh water to the inhabitants of Kolkata. But the construction of this project has impacted the hydraulic regime, especially in post- Farakka. The problem of siltation and sand bar formation (Islam et al., 2010), flood, bank erosion and channel oscillation (Rudra, 2010) as well as ecological and environmental impact (Parua, 2009) are common. Oscillation and meandering behaviours have been noticed more in the lower reach of the river Bhagirathi. Over the years, the lateral migration of the Bhagirathi River has caused a serious problem because of the destruction of flood floodplain, land use change, bank erosion, etc. On the other hand, it had also given birth to various geomorphic features such as ox-bow lakes, sand bars, and wetlands.

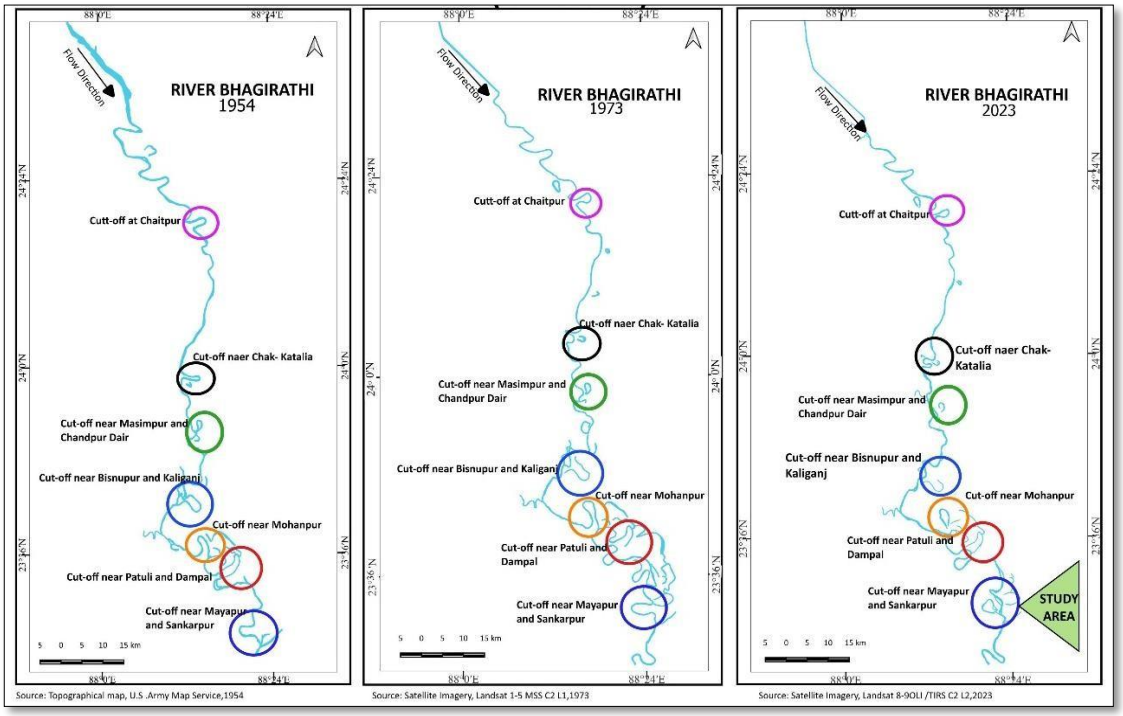


Fig 2. Meandering Loops are created due to the Oscillation of the River Bhagirathi (1954 - 2023)

Demographic Profile and Socio-Economic Characteristics

The socio-economic condition of the people provides critical insights into the condition and the development status of the people, along with their population structure, living conditions and wellbeing status.

Characteristics of the Respondent	Category	Frequency	Percentage (%)
Age (in years)	Below 30	22	21.57
	30-60	38	37.25
	60-80	22	21.57
	Above 80	20	19.61
Education	Illiterate	51	50.00
	Primary School	30	29.41
	Secondary School	16	15.69
	Higher Secondary	4	3.92

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue IV, April 2025

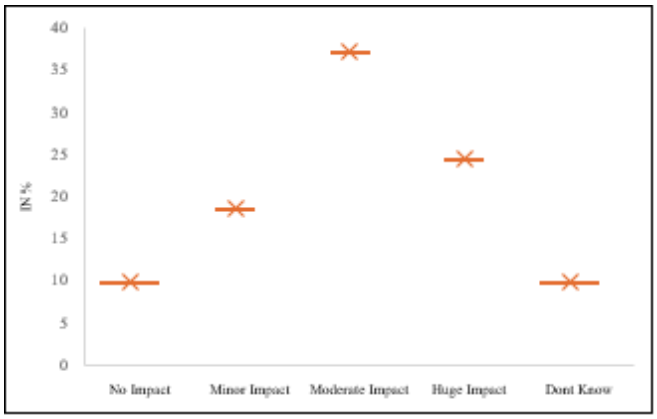
	Graduate and above	1	0.98
Monthly Income (in Rs)	<5000	40	39.22
	5001-10000	47	46.08
	10001- 15000	14	13.73
	15001-20000	1	0.98
	>20000	0	0.00

The Demographic Data has been collected from a total of 102 households. The table reveals that the majority (37.25%) of the respondents are in the age group of 30-60 years, and 41% are aged above 60, indicating a possible ageing community and fewer younger individuals staying in this area. It is true that due to fewer opportunities in this village, the younger working population moves out to get a better future. The education levels are quite low, as the majority of the people have not gone to any formal school. Further, most of the respondent (39.22%) has a monthly income of less than Rs.5000, which shows the economic condition of the people and possibly a subsistence level of livelihood.

Witnessing Cut-off and Its Impacts

The meander cut-offs are a dynamic geomorphic process that impacts different age groups in distinct ways. These sudden landform changes not only impact the physical assets but are also closely linked to the psychological aspects of life. In the case of this village, the people also experienced severe consequences by losing their plot of land, and a change in their income sources.

As shown in (Fig. 3a), 37.25% of respondents reported experiencing a moderate impact due to the cutoff, indicating it is the effects are noticeable but not overwhelming. Middle-aged individuals (i.e., within the age group 30-60) perceived that the cut-off had a significant impact on their village. In contrast, respondents in the age group above 70 exhibited limited recall of the events that occurred around 1985 and had a moderate impact on their daily lives. Only 9.80 % of people, primarily those under 30 years of age, felt that the cutoff had no discernible effect on them.



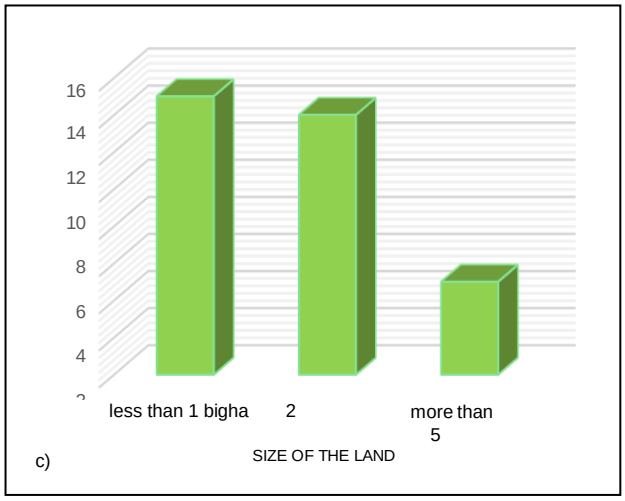


Fig.3(a): Impact of people of different age groups. Fig.3(b) and (c): Size of the land loss and present status of land gained

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue IV, April 2025

There is a sharp increase in the landless households due to the cutoff. Prior to the cutoff, the water flow in the Bhagirathi River created frequent floods and land submergence, making it difficult to sustain crops. However, post-cutoff stabilised the flow of water facilitated by sediment deposition, improving the fertility of the soil, enabling a resurgence of farming in this region.

The net land loss remained below 2 bigha because most of the people have reclaimed their land after the cut-off, which was once submerged in the water (Fig.3 b). Very few people have lost their land which are >5 bighas, primarily where land remained permanently underwater.

The significant position of the surveyed people has their land below 1 bigha, likely to hold small to marginal plots, suggesting that people value place on landownership and complete reliance on land-based activities. A large group of people are engaged in sharecropping and have farmland below 2 bighas (Fig. 3c). Very few individuals have a farm plot of more than 5 bighas, indicating a shrinkage of the actual size of the land after cutoff.

Occupational Structure

The occupational structure of the char dwellers is largely determined by the surrounding environment. A high degree of dependency on natural resources sometimes creates an opportunity for the best utilisation of this resources. However, during the monsoon season, many households operate on insecure income generation by engaging in insecure activities. Farming is the most dominant occupation (40.54%), followed by Animal husbandry, grocery, farm labour and other informal jobs (builders) as shown in (Fig. 4a). Most of the farmers practice a market-oriented agricultural system, where farmers prioritise cash-generating crops (jute, sugarcane) and staple food for subsistence and sale. The cultivation of pulses and oilseeds is less due to poor storage infrastructure and high risks (Fig. 4 b).

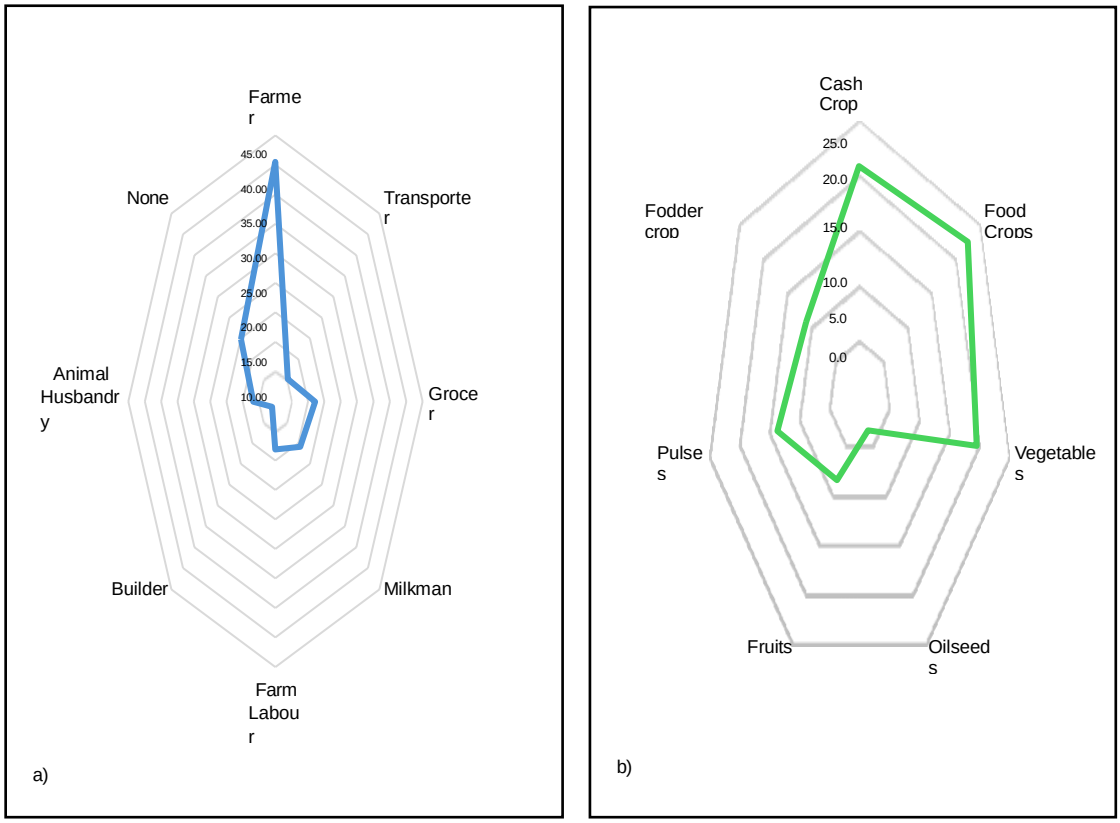


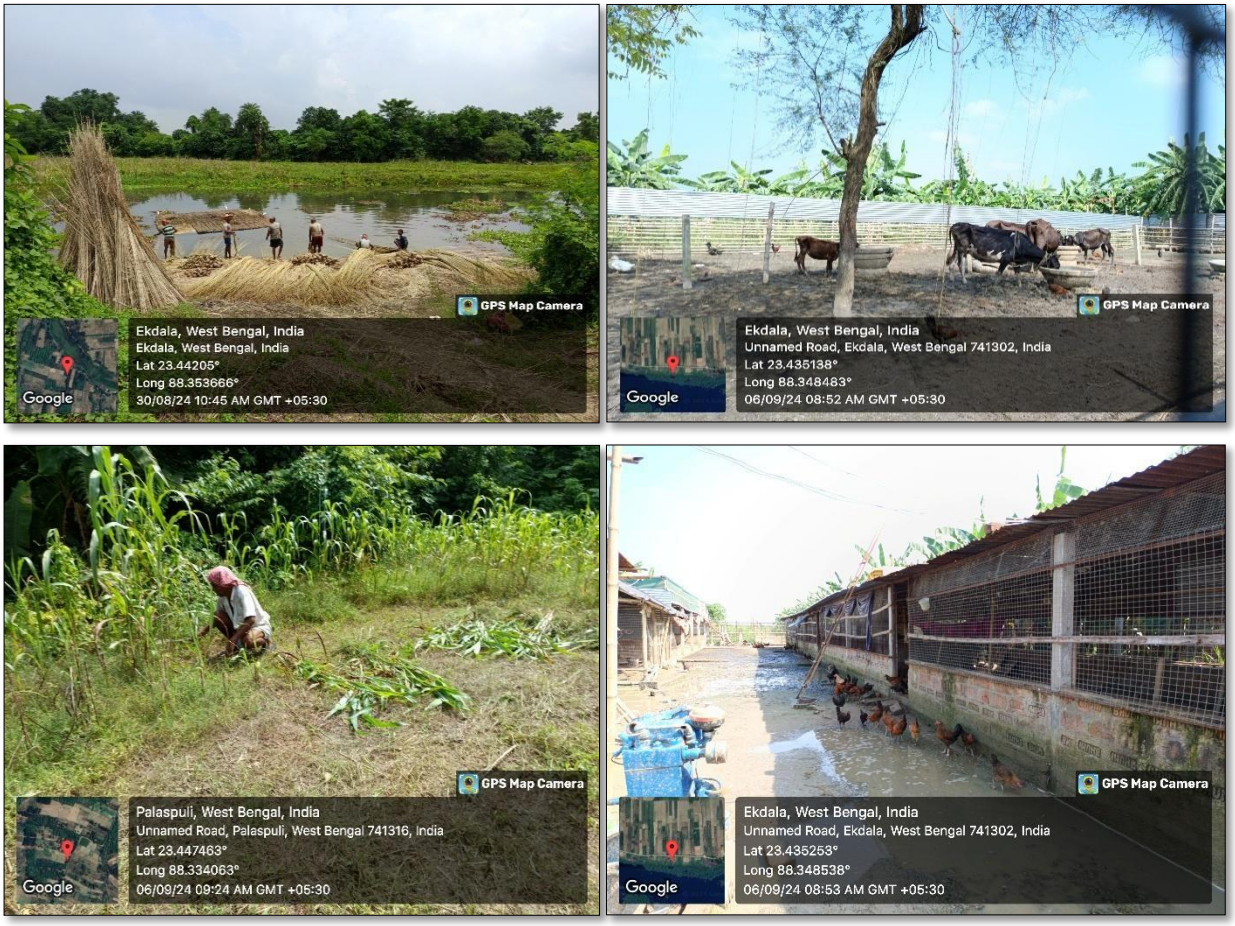
Fig. 4a and b: Occupation and Primary Crops grown by the people.

Similarly, the predominance of individuals in farming activities justifies the lower engagement in secondary occupations such as transport or construction work be due to low education or poor access to credit facilities and huge land attachment reflecting limited livelihood diversification.

The following study has been conducted in a unique geographical location where long-term policies must focus on integrated management into national river basins and early warning systems. Moreover, the development of roads, secure financial stability and better connectivity should be institutionalised, engaging local perspectives. Similar riverine and deltaic regions of Asia, such as the Brahmaputra floodplains, the Kosi belt of Bihar, exhibit parallel dynamics and has adopted various smart initiatives and participatory management techniques.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue IV, April 2025

A glimpse. of the people engaged in the activities.



III. Conclusion

The impact of meander cut-off on the social and economic life of the char dwellers is multifaceted, which often reshapes the lifestyle of the people. Economically, the problems faced by the char dwellers are caused due to meander cut-offs, leading to an emphasis on changing the economic policies and investments in the development of the villages, which have brought new opportunities and increased the support network. Overall, the study has tried to emphasise more on the livelihood conditions of the people and their adaptation strategies concerning all natural processes that have occurred before and in recent times, therefore.

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