CHAPTER II

Physical and Socioeconomic Landscapes

2.1 Introduction

Natural resources include soil, water, biodiversity, genetic resources, biomass resources, forests, livestock, fisheries, and wild animals. The natural resources, namely soil and water, are finite and frequently exist in a fragile ecological equilibrium. The significance of natural resources to the inhabitants of arid regions is multifaceted. To begin with, natural resources are crucial for supplying vital items necessary to fulfill basic demands at both the household and communal levels. Furthermore, these resources contribute to economic growth and job creation in rural areas. Additionally, natural resources provide sustenance and environmental stability, which are crucial for on-going food production and ensuring the well-being of future generations.

The analysis is grounded on the physical and social landscape, encompassing the physical resource base, economic activity, and sociocultural viewpoint. Understanding these limits of livelihood is crucial for this study. The physical resource base represents the capacity for resource development in a rural environment, which serves as the fundamental basis for the livelihood of rural inhabitants in this region. The economic profile of an area is determined by more than just its potential resources. It is shaped by the activities that create resources, the level of skill among the labour force, and the overall economic success of the region in terms of resources, technology, and culture. Once again, economic activity and sociocultural processes are interconnected. Economic activities determine the level of sociocultural development. The cultural component or inertia simultaneously impacts the future economic potential of a town or area. Therefore, it is essential to consider the physical-social environment when interpreting the limits on the livelihoods of an area.

2.2 Physical landscape

In order to understand the resource base of the study area concerning rural livelihood, it is crucial to examine the overall landscape of the *Jangal Mahal* districts and then

focus on the specific region. This investigation includes a detailed description of the physical (landform, climate, soil, and water bodies) as well as socioeconomic landscapes of the study area.

2.2.1 Geographic features

Physical and cultural aspects are recognized as the geographic attributes of any given place. In geography, physical characteristics pertain to the natural features of a location without any influence from human activities. Image 2.1 shows the physical setup of the study area**.** The predominant physical constituents encompass geology, topography, hydrology, climate, vegetation, and other similar factors. Cultural or human qualities can be noticed in any location's demographics, population, economy, and social activities in *Jangal Mahal*. The alluvial plain of the east with recent deposits, Rahr Plain with lateritic uplands in the middle, and Chhotonagpur Flanks with hills, mounds, and rolling lands in the west are the three main geomorphological divisions of Paschim Medinipur district. Although it forms low basins to the southeast and east, it is steep to the northwest (Development & Planning Department, 2011a).

Image 2.1 shows physical setup of the Study Area

2.2.2 Geology

In Purulia, the principal rock types are Cambrian rocks and Gondwana sediments; in Bankura, they are the Laterite and Alluvium formation; and in Paschim Medinipur District, it is the Laterite formation (Gaz. Pur. 1985). The majority of the Purulia district comprises rocks from the Cambrian period. These rocks are found along the Damodar River and are part of the Gondwana Formation. The alluvium formation covers the region's eastern part, while the laterite formation covers most of the western part, including the CDBs of Khatra, Ranibandh, and Sarenga. Bankura has a gentle slope that goes from west to east. The primary rock type in the Paschim Medinipur District is laterite.

From a geological perspective, the studied region is one of India's earliest formations. The area consists of pre-Cambrian igneous intrusions and a small number of sedimentary and metamorphic rocks from later eras. The region is characterized by a shallow layer of dirt that has accumulated relatively recently. The granite-gneiss of the Archaean era is visible, except in areas where it is covered by metamorphic rocks from the Dharwar period (2500 to 2100 million years old), as stated in the Gazetteer (Gaz. Pur, 1985). The crystalline gneisses and sedimentary Dharwars are among the earliest formations documented in India. Their appearance disrupted these systems and has undergone significant modifications since their initial forms (Gaz. Pur., 1985). The Bundwan Block in Purulia is adjacent to the Dalma trap, which consists of hardened chloritic schists from the Dharwar era. Epidiorite is present in arid and semi-arid regions worldwide. The area has distinct attributes: soils, climate, fauna, flora, natural resources, customary governance, and human activities. The Dalma trap that borders Bundwan Block in Purulia is interspersed with hardened chloritic schists from the Dharwar era. Epidiorite is present in many locations within this area. Epidiorite is a type of igneous rock that changes the movement of the Earth after it is formed. The principal change is converting the mineral 'augite' into the mineral 'hornblende' (Gaz. Pur., 1985). The description and its concentration are depicted in Table 2.1. The predominant geological composition of Bundwan consists of epidiorite, meta-basalt, meta-gabbro, and ophiolite. The remaining section of the Block consists of schist, phyllite, and quartzite (Fig. 2.1).

In studying ancient habitation and culture, knowing the geology of a place has become essential. Ancient tools implements and other materials not amenable to isotopic age determinations must be geologically linked to the rock types or sediments from which they were recovered (Nandy *et al*. 2014). The western portion of West Bengal represents the east of the Precambrian Shield, which has a stable cratonic mass. This area of Archaean–Proterozoic rocks becomes Chhotonagpur's eastern continuation plateau. The para-schists and para-gneisses—phyllite, carbon-phyllite, garnetiferous quartz sillimanite schist, talchlorite-tremolite schist, etc.—are the oldest rocks that are accessible here. These comprise the basement, which is covered by hornblende gneiss, calc granulite, pyroxine granulite, and para-amphibolite.

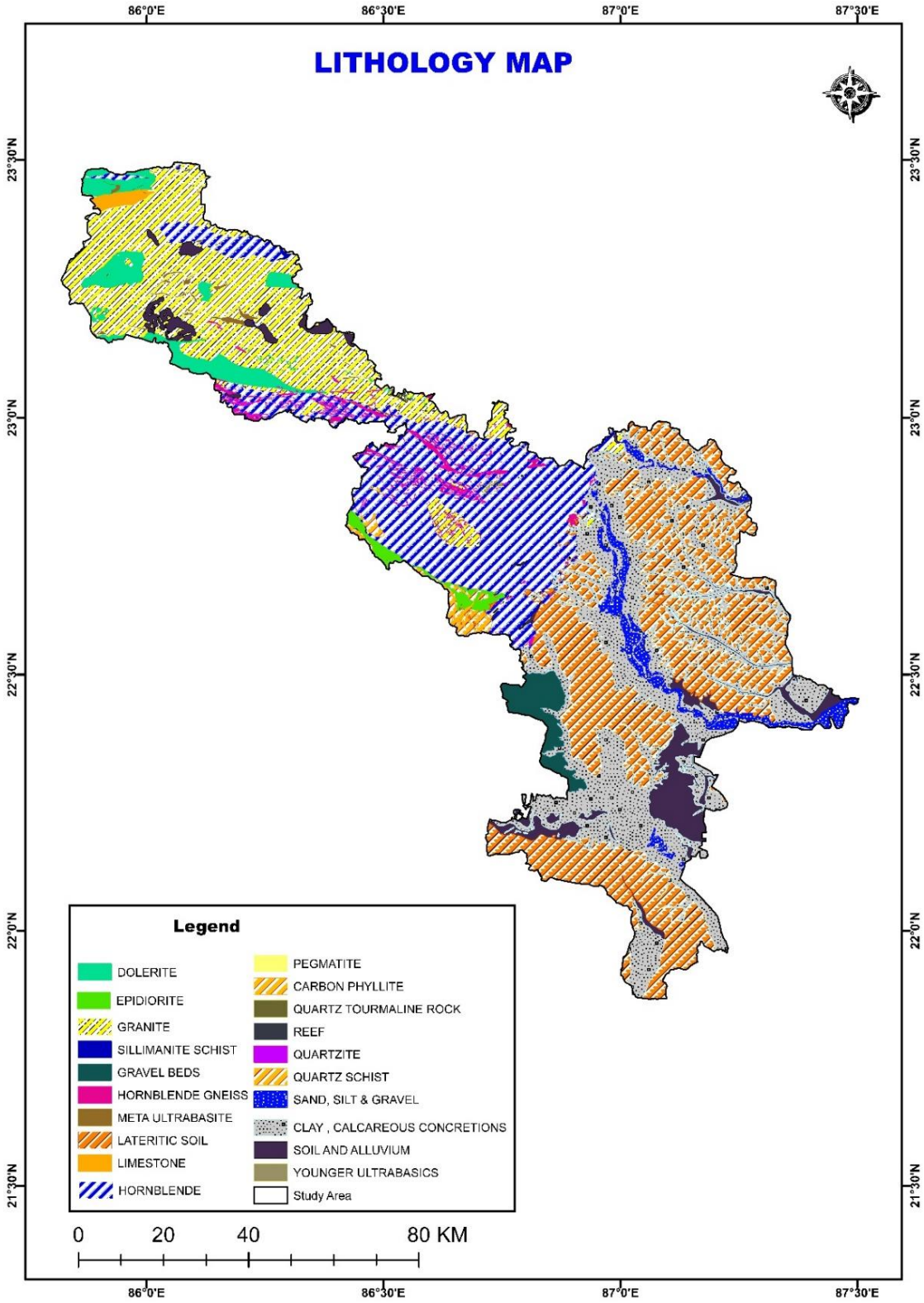


Fig. 2.1 shows lithology map of the study area

Prepared by the Author

Source: Geological Survey of India

These rocks are primarily found in the southern portion of Purulia District, a southwest portion of Bankura, and the western and north-western portions of Medinipur District (Fig. 2.1). The study of geochemical weathering in different weathering Crusts are subject of great geomorphological interest because these are essential sources of information on the condition of landscape evolution, especially in humid tropical areas. The weathering profile of granite gneiss sampled approximately 6 km southeast of Bandwan, Purulia, provides a complete weathering sequence from fresh to complete weathered rock. This exposure is a part of the Chhotanagpur gneissic complex, which consists of granite gneiss with quartz veins and mica schist (Dolui *et al*. 2014).

Table 2.1: Concentration of Different Lithological Features

Type of Lithology	Length (Sq.km)
Hornblende schist, amphibolite, meta ultrabasite	53.346
Graphite sillimanite schist	3.511
Pegmatite	3.553
Limestone, impure marble, calc silicate rocks	38.735
Granite / gangpur granite	1551.363
Quartz vein/reef	2.259
Unclassified soil and alluvium	478.009
Dolerite	260.127
Hornblende gneiss	92.940
Quartzite, cherty quartzite	12.964
Quartz tourmaline rock	0.255
Phyllite/carbon phyllite/mica schist	79.231
Quartzite, quartz schist	7.445
Epidiorite, hornblende schist	61.900
Lateritic soil	2156.305
Sand, silt, clay, calcareous concretions	1729.420
Sand, silt & gravel	185.963
Younger ultrabasics	1.811
Mica schist with hornblende schist	1613.961
Gravel beds	154.172

Source: Geological Survey of India

- **The initial zone encompasses**

i) The elevated areas of Ajodhya, Panchet, and Bundwan.

ii) The second zone, which comprises approximately one-third of the study area, encompasses the whole Purulia district and the western portions of the Bankura and Paschim Medinipur districts.

iii) The third zone of the plateau region encompasses the whole of Rahr Bengal, stretching to Jhargram, Garhbeta, Raipur, and CDBs.

iv) The fourth geographic zone of the eroded plain is located on the eastern edge of the research area in Bankura. It also covers a significant chunk of the Paschim Medinipur District around the Damodar, Rupnarayan, and Kansai rivers. As a part of the Chhotonagpur plateau, the area's general slope stretches east to southeast, as shown in Fig 2.2. The highest point in the northwest is more than 250 meters, while the lowest points in the southeast and along the river valley are less than 50 meters.

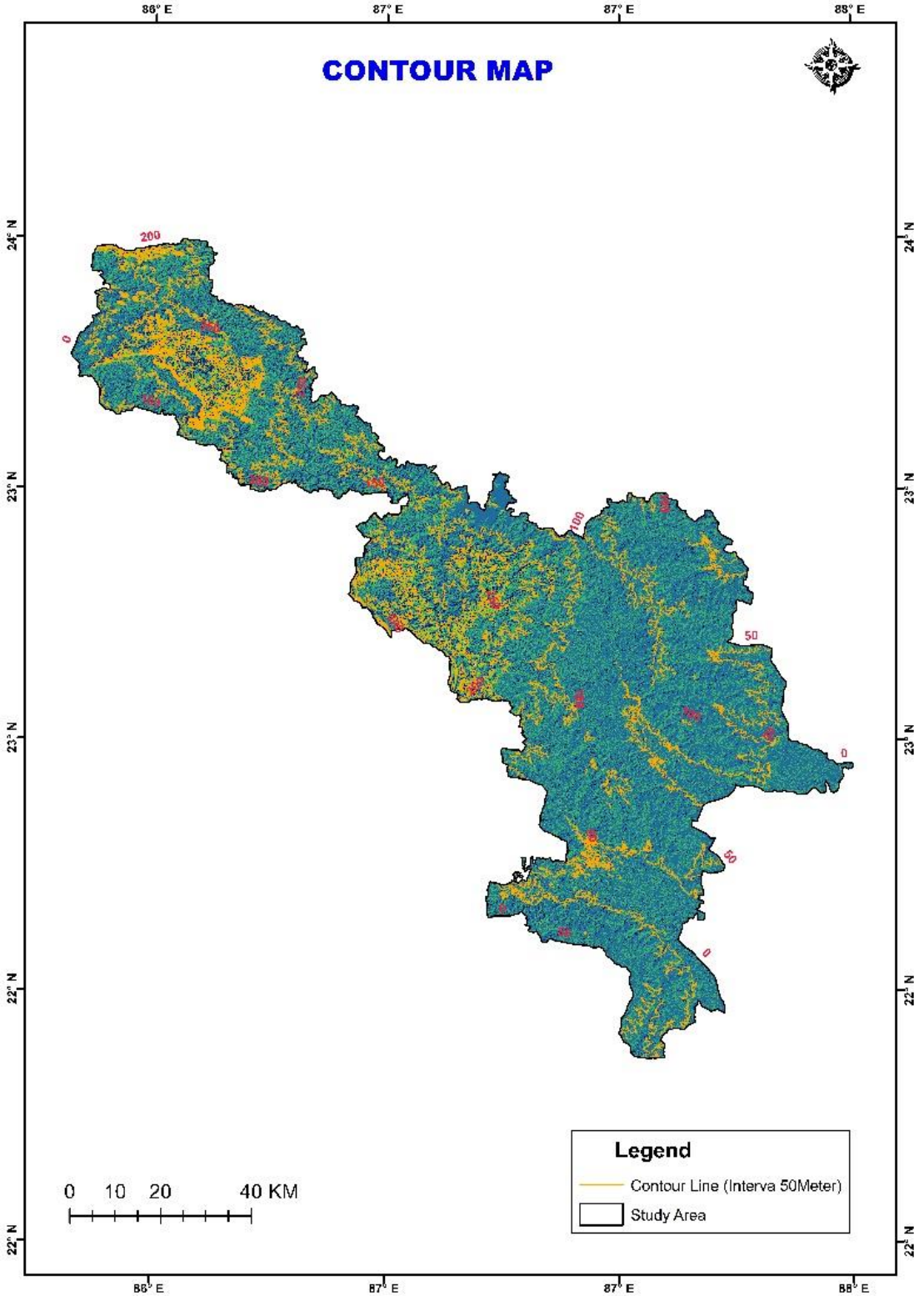


Fig. 2.2 shows contour map of the Study Area

Prepared by the Author

Source: Shuttle Radar Topography Mission (SRTM) DEM USGS NASA

2.2.3 Hydrology

The hydrology of the research region includes the flow, distribution, and management of water resources and the water cycle. The region's run-off water is influenced by the physiographic features of a steep slope, with hills on the west and an alluvial tract on the east. As a result, water typically flows from west to east, causing a consistent water shortage in Purulia and western Bankura. According to Rudra *et al*. (2010), the average annual precipitation for Bankura, Purulia, and Paschim Medinipur is approximately 154 cm, 151 cm, and 166 cm, respectively. The capacity to store water resources in the research area has been provided. The data in the table show that Paschim Medinipur has the most significant potential for total internal water resources. The table includes all water sources, including river outflow and runoff from other states.

The Bankura District possesses the most extraordinary capacity for water resources in terms of the combined sources of rainfall and runoff from the upper catchment area. The distribution and availability of water sources in this area may be categorized as follows−

i) Surface water

It refers to water on Earth's surface, such as in rivers, lakes, and oceans. Primary hydrological features include *jhor* (springs), rivers, tributaries, lakes, and tanks. The geographical region under investigation comprises the source waters of numerous rivers (Fig. 2.3), such as Rupnarayan, Kansai, Kumari, Nangasai, Subarnarekha, Silabati, Gobai, and Dwarakeswar Kangsabati.

ii) Groundwater

The research region's subsurface water is of concern due to the presence of an impermeable crystalline foundation. During summer, the water table depth varies between 3 and 15 meters beneath the surface. The research region is characterized by riparian zones that offer advantageous circumstances for groundwater resources. On the contrary, the indigenous communities located on the western periphery face a scarcity of significant subterranean water resources (Figs 2.3 and 2.4) and experience

the annual drying up of numerous tube wells, excavated wells, and riverbeds during the summer season (Gaz. Pur., 1985). Folding, faulting, and fracturing are categorized as lineaments in hydrogeology. In regions with rugged rock formations, the geological element known as lineaments is critical in regulating groundwater storage and passage. A lineament density exceeding 0.3 indicates enhanced transmission of groundwater.

However, the majority of the locations in the study area of Purulia fall under the low lineage density zone, with values below 0.15 (Das *et al*., 2018).

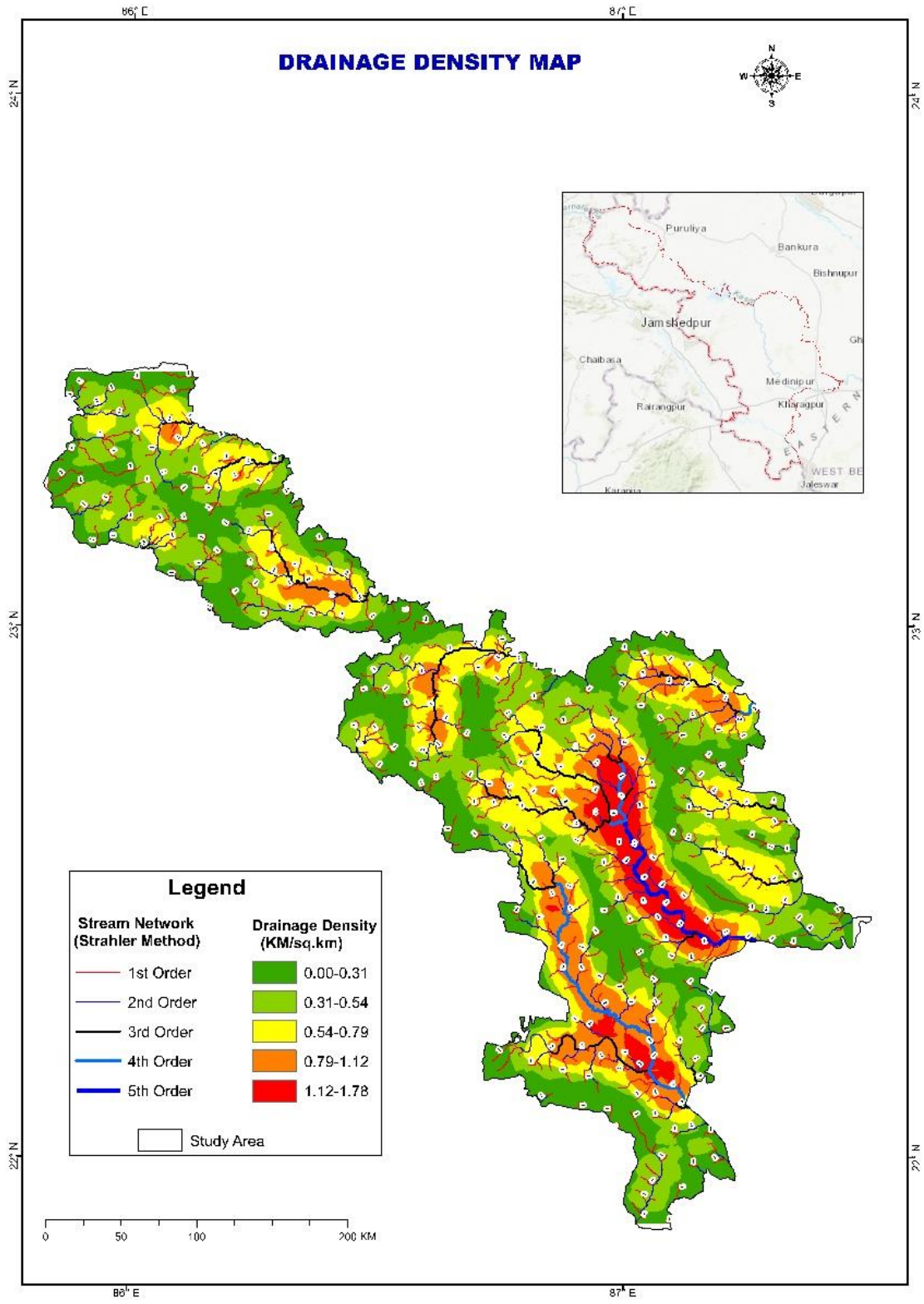


Fig. 2.3 shows drainage map of the Study Area
Prepared by the Author
Source: European Space Agency

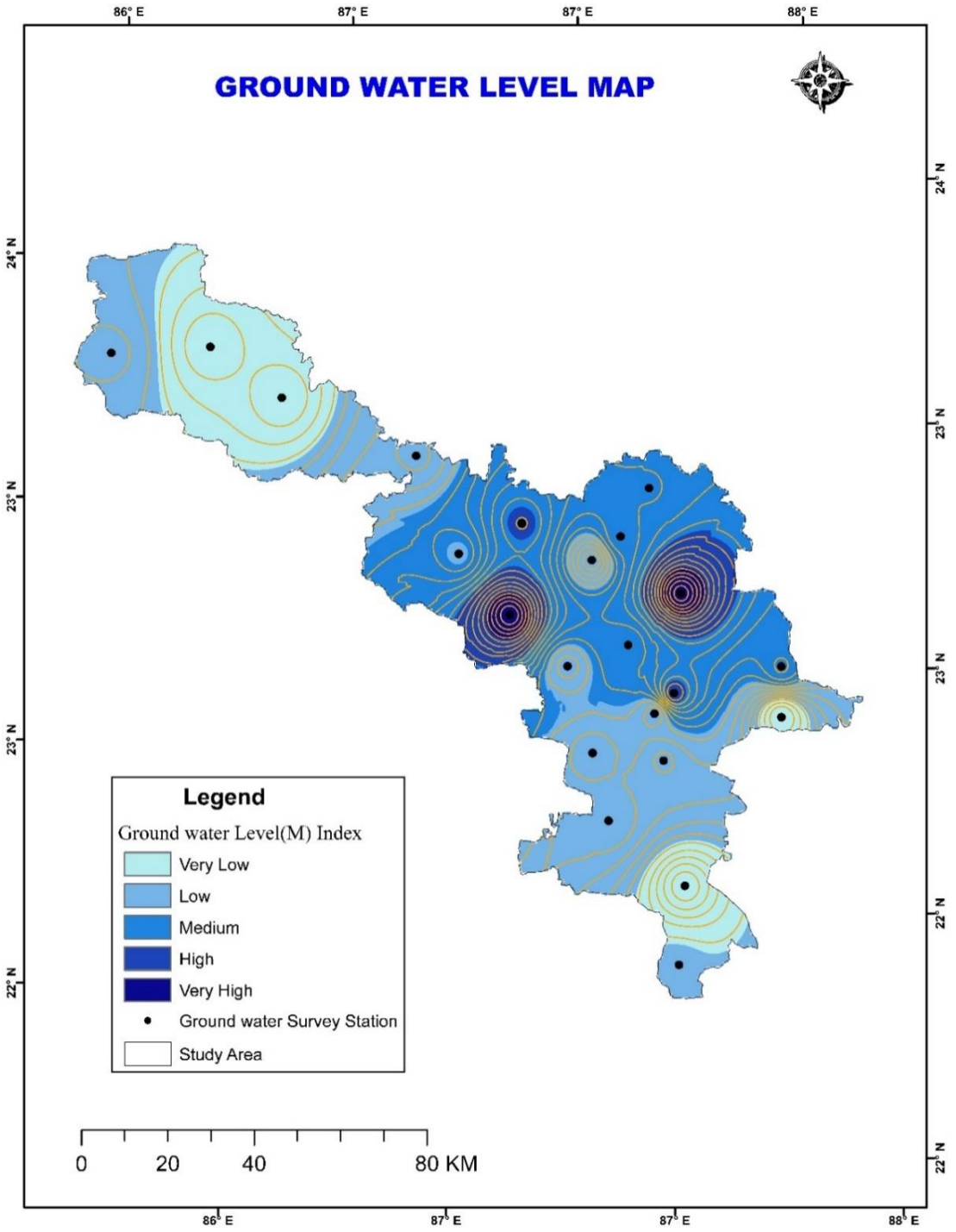


Fig 2.4 shows groundwater level map of the study area

Prepared by the Author

Source: India-WRIS

2.2.4 Soil

In the District Gazetteer of Purulia from 1985, the soils of the area were classified as gneissic soil, Gondwana soil, and sedimentary soil (Fig. 2.5). Bankura is distinguished in the northern regions of Sonamukhi, Indas, and Kotulpur by its loamy soil. Other areas of this region are primarily composed of lateritic soils. In Paschim Medinipur, the soil composition is alluvium, while in Jhargram, laterite predominates. The predominant soil composition in the area is loamy soil, which encompasses a range of particle sizes from fine to coarse. In Fig. 2.3, gravel and sand are observed in restricted quantities in isolated sections along the Damodar, Kansai, and Dwarakeshwar rivers, which flow through the study area.

The research region is classified as being in the red and laterite zone according to the 2012 National Agricultural Research Project classification, as determined by the Government of India. The soil map in Fig. 2.5 and the soil concentration (Table 2.2) presented below illustrate that the western portion of the study area comprises water stressed regions. In contrast, the eastern plain area does not display any notable water-stress challenges. Hence, regarding agricultural yield, the blocks situated in the eastern plain region, which are not under the dominion of the communities, enjoy a more advantageous position. In contrast, the western plateau areas, where the populations are located, have uncertainties in agriculture and significantly lower crop yield.

Table 2.2: Soil concentration in the Study Area

Type	Sq.km
Silt Soil	1750.30
Loamy Soil	2164.88
Sandy Soil	4494.99
Clay Soil	416.57
Fine Loamy Soil	27.25
Mountainous Soil	94.98

Source: European Soil Data Centre (ESDAC)

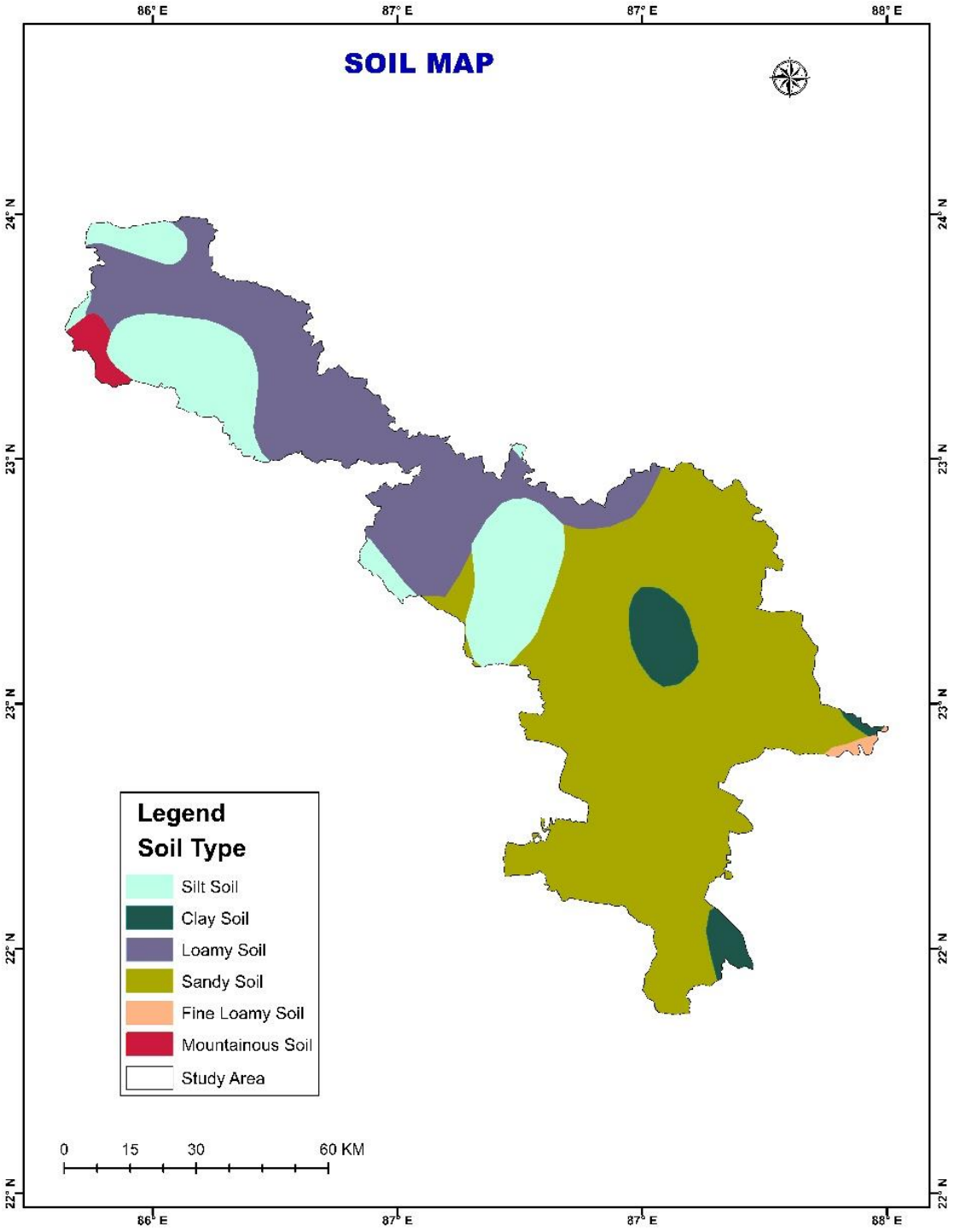


Fig. 2.5 shows soil map of the Study Area

Prepared by the Author

Source: European Soil Data Centre (ESDAC)

2.2.5 Climate

The region under consideration experiences intense summer temperatures and intermittent precipitation during the southwest monsoon season. From 1901 to 2011, climate data have been analyzed for more than a century. The region under investigation receives an average annual precipitation of 1300 to 1450 mm and an average annual temperature spanning from 24°C to 26°C, according to Gaz. Pur. (1985), Gaz. Bank (1995), and O'Malley (1911). The four discrete seasons are as follows: December through February constitutes the cold season, March through May denotes the hot season, June through September is the monsoon season, and October and November comprise the post-monsoon season. The entire studied region is characterized by a dry and wet sub-humid tropical climate, which, according to the Koppen classification system (Spate and Learmonth, 1954), falls specifically under the 'Aw' category. The southwest monsoon regime's influence characterizes the selected area's climate.

2.2.6 Temperature

The highest and lowest recorded temperatures for Purulia, Bankura, and Paschim Medinipur from 2008 to 2012 are 46ºC and 6ºC, 46ºC and 6ºC, and 45ºC and 8ºC, respectively. The decadal data from 1901 to 2011 shows that the highest recorded annual average temperature in the study region was 25.92°C in Bankura in 1951, while the lowest recorded temperature was 22.33°C in Paschim Medinipur in 1911. The average yearly temperature is around 24°C, with an annual variation of only 3.5°C. There is a prevailing hot climate from March to September, but a dominant cold climate is found from October to February. The area has scorching summers, freezing winters, and mild autumns.

2.2.7 Precipitation

The decadal rainfall data from 1901 to 2020 for Purulia, Bankura, and Paschim Medinipur indicates that the greatest and minimum rainfall values are as follows: Purulia - 1781 mm and 1027 mm, Bankura - 1910 mm and 1043 mm, and Paschim Medinipur - 2269 mm and 1130 mm. The mean precipitation in Purulia, Bankura, and Paschim Medinipur is 1258 mm, 1358 mm, and 1507 mm (District Statistical Handbook), respectively. The annual rainfall varies between 1214mm and 1429mm (NBSSLUP, 1992).

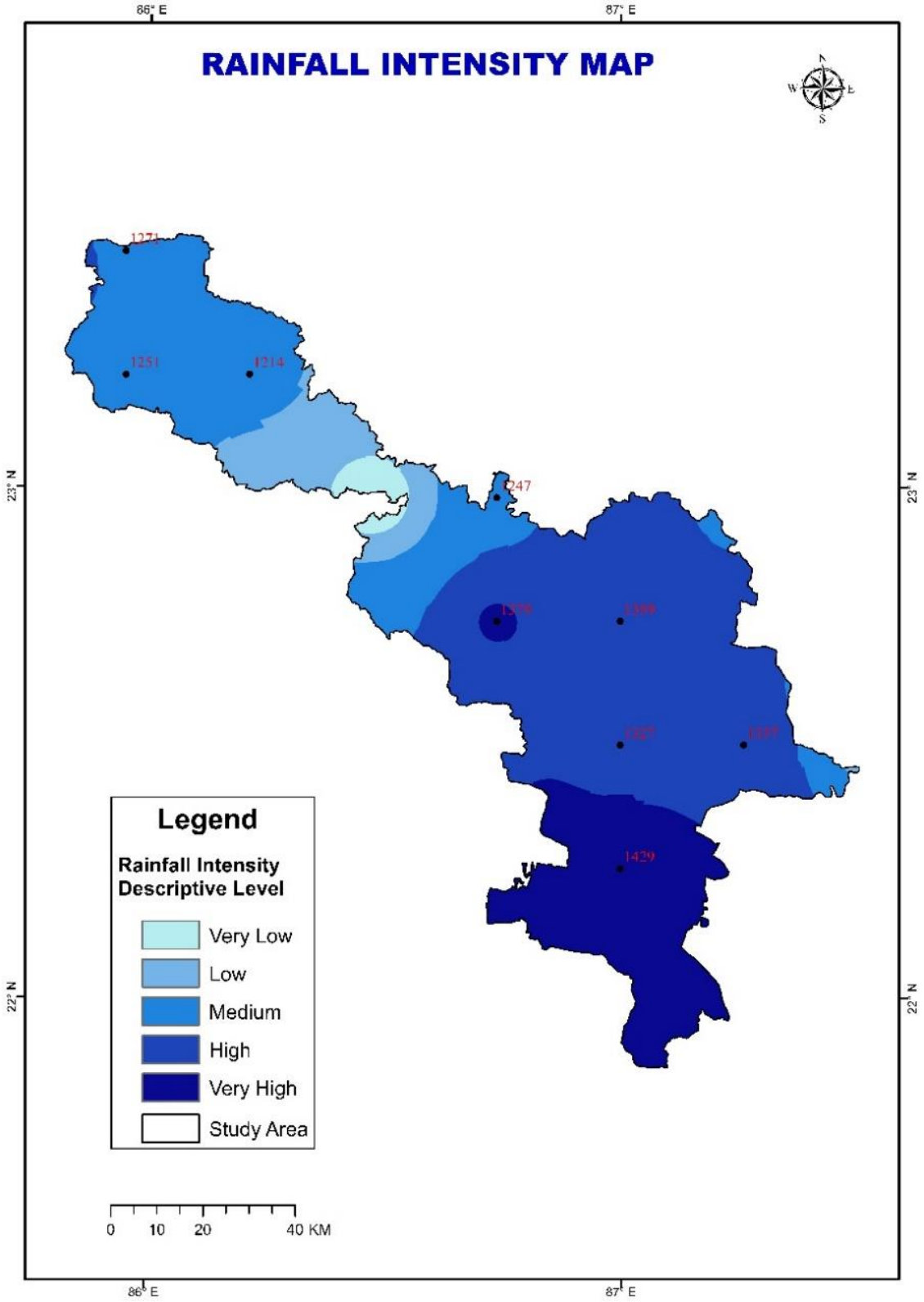


Fig. 2.6 shows rainfall intensity map of the Study Area

Prepared by the Author

Source: Indian Meteorological Department

2.2.8 Geography and topography

The geography of a region plays a crucial role in determining how resources are used. It assesses the characteristics of evenness, gradient, runoff, and infiltration. They can impact the agricultural output of the soil. Three main geographical features distinguish the *Jangal Mahal* region−

i) To the west, a plateau and mountainous region,

ii) To the far right, an alluvial plain area, and

iii) To the transitory zone situated between the plateau and the plain.

The dry semi-arid region possesses valuable natural resources, namely soil and water, and is in a fragile ecological equilibrium. The significance of natural resources to the inhabitants of arid regions is multifaceted. To begin with, natural resources supply indispensable items necessary to fulfill the fundamental requirements at both the individual and communal levels. Furthermore, these resources contribute to rural areas' economic growth and job creation. Additionally, natural resources provide sustenance and environmental stability, which are crucial for on-going food production and ensuring the well-being of future generations.

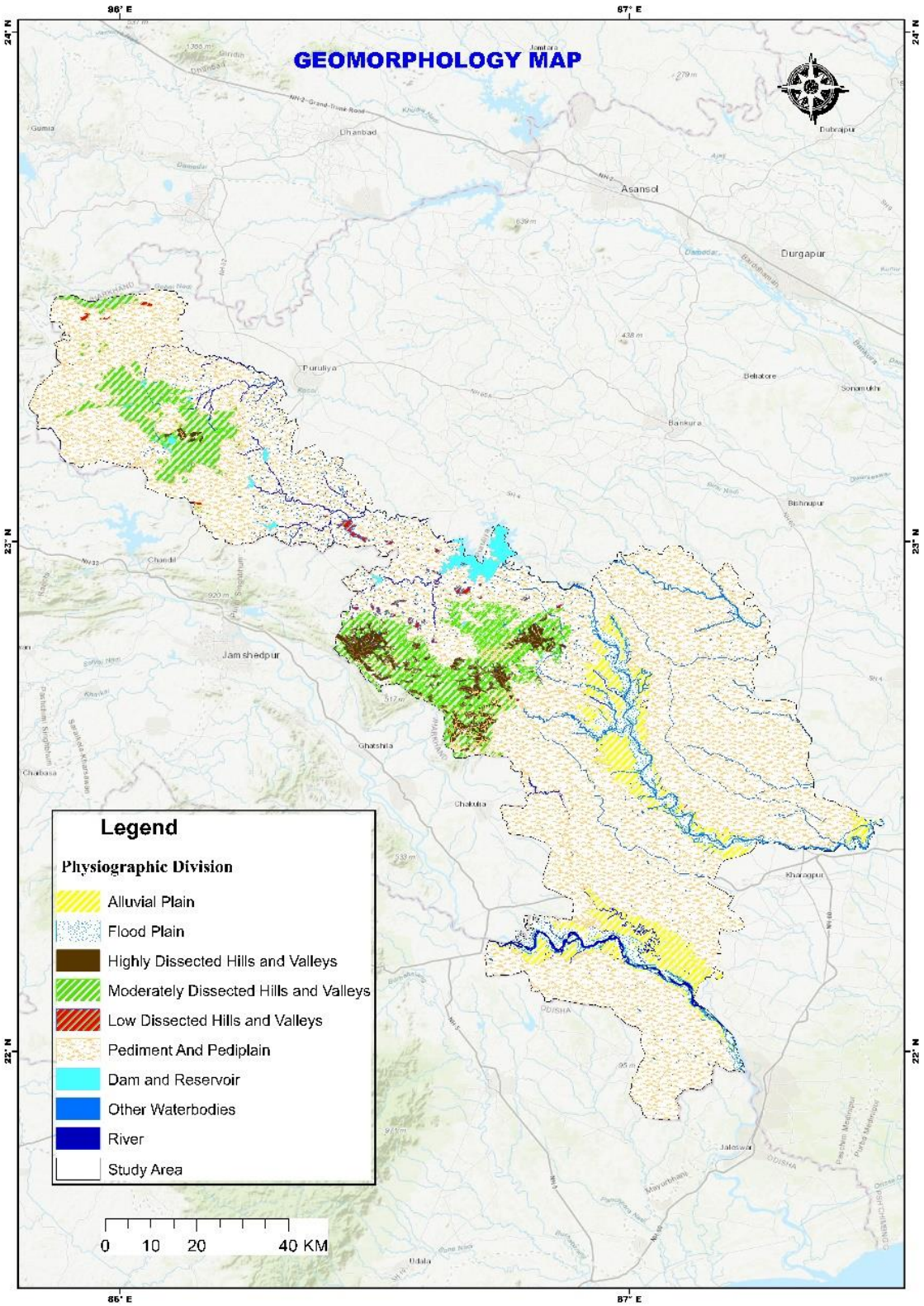


Fig. 2.7 shows geomorphology map of the Study Area

Prepared by the Author

Source: Geological Survey of India

2.2.8.1 Flora

The forests in the region serve as crucial components of the natural habitats for indigenous populations. They are used to using forest edge ecotones, which are areas where forests meet meadows, pastures, croplands, and other open habitats (Odum, 1959). They create scattered small plots of forest edge ecotones adjacent to these open areas.

They have been linked to forest ecosystems since the earliest days of their settlements. The presence of humans in both developed and undeveloped ecosystems is significant in this particular setting. In a mature ecosystem, the amount of energy acquired is equal to the amount of energy lost. However, immature ecosystems are characterized by an excess of energy. Coastal locations, river valleys, and other similar regions are nascent ecosystems that provide the ideal conditions for human civilization's first development and prosperity. Therefore, nomadic herders transitioned into pastoralists and subsequently engaged in shifting agriculture before ultimately settling as stationary cultivators (Biswas, 1987). These marginal communities of people that opt to reside in well-developed ecosystems of wooded areas and a scarcity of excess energy constrain their population expansion. The imminent risk of extinction has compelled them to become environmental preservationists.

North West and middle parts of the area like Baghmundi, Bundwan, and Binpur-II. The total areas covered by the natural forests are primarily dense forest, which is 2245.1 sq. km. The mixed forests are 1554.3 sq. km. The most important trees are Sal Forest mixed with miscellaneous species like palash, kusum, mahua, neem, and kendo, which are significant sources of timber, poles, small wood, firewood, and medicinal plants to local people. Farmers of the area have developed an interest in vegetable and fruit growing and dairy due to demand from the area. The total area of Jangalmahal is about 8635 sq. km. Out of which 1208.9 sq. km. Areas are built up area, and the water body covers 172.7 sq. km. There are three significant rivers: Kansaboti, Silai, and Dulung. Maximum seasons are covered in sand except for the rainy season, and the total area of sand is 86.35 sq. km (Mondal *et al*., 2019).

The biotic resources of nature serve as nurturing guardians for any human society. Settled agriculturalists prioritize the reproduction of biotic resources, whereas traditional communities adopt a mixed strategy involving limited production and environmental extraction to meet their survival needs (Siddique, 1996). The marginals of the southwestern plateau region of West Bengal chose this location as their habitat because of the abundant biotic resources in the wet deciduous woods, including a wide variety of plant Images 2. 1 shows dense forest in the study area and Fig 2.8 shows the forest coverage. In our study area forestry play a crucial role to support the livelihood of *Jangal Mahal* people. Images 2.2 and 2.3 a, b show fuel wood for selling. This choice was also influenced by social marginalization.

Forestry as a source of livelihood

Image 2.2 shows fuel wood for selling

Images 2.3 a and b show leaves made plates for selling

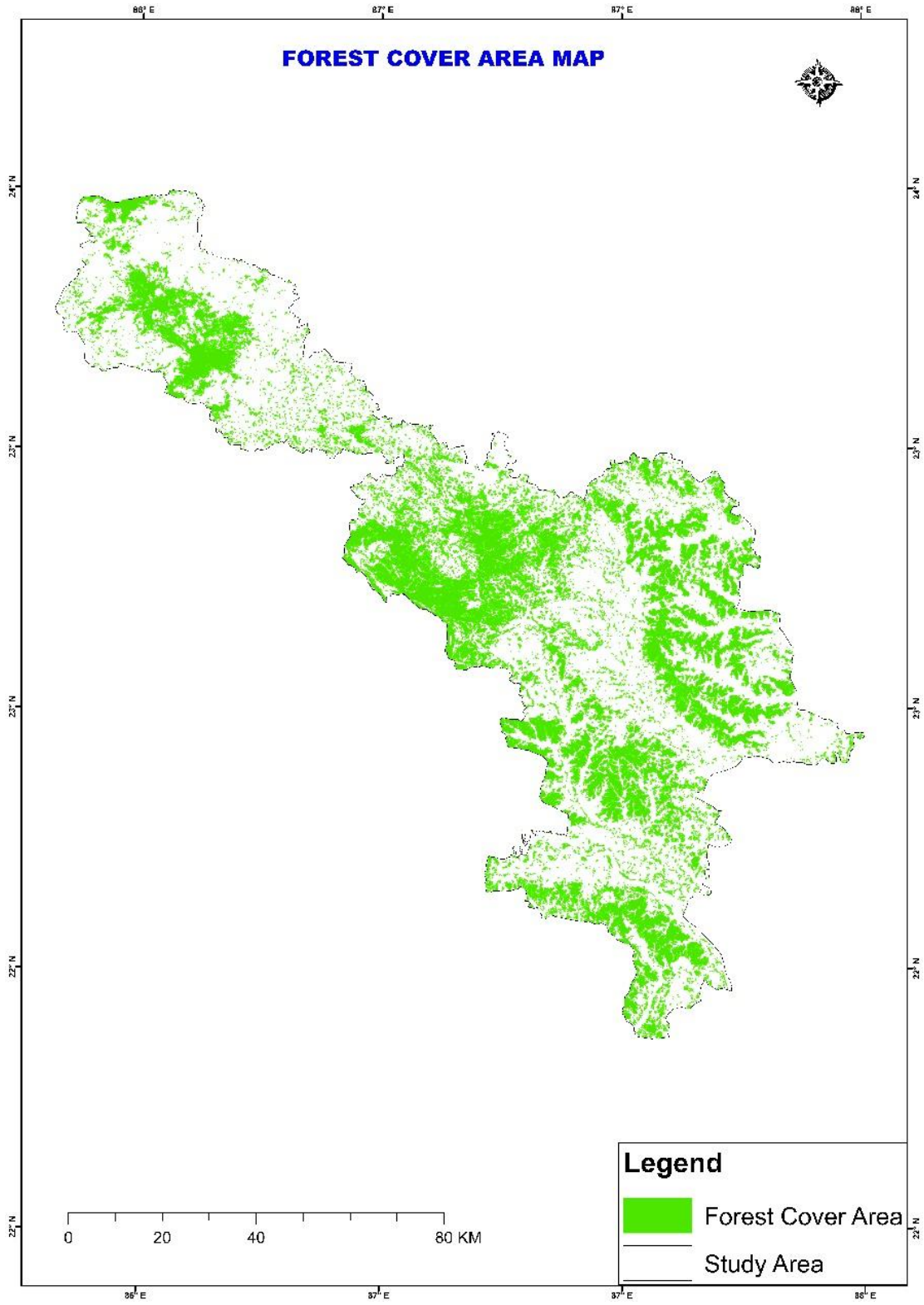


Fig. 2.8 shows forest cover map of the study area

Prepared by the Author

Source: Landsat-8 (USGS Earth Explorer)

2.3 Socioeconomic landscape

2.3.1 Agriculture

For the Kharif crops, we considered satellite images from April 2022 to September 2022, while for the Ravi crops, we used satellite images from March 2022 to October 2022 in Fig. 2.8a. The peak NDVI (Normalized Difference Vegetation Index) of Kharif crops time series data set was higher than 0.52, while the minimum was between 0.18 and 0.34. The peak NDVI was identified as more than 0.52, and it reached the highest growth during the Kharif season. Similarly, for the Ravi season, the peak NDVI was identified as more than 0.68, and the minimum was between 0.26 and 0.41. Hence, in the Ravi season, the peak NDVI heading toward 0.68 indicated the highest growth stage of Ravi crops.

2.3.2 Arable land resources

The total area of our current study area is about 8487 sq. km. From Table 2.2a, it can see that the percentage coverage of the water body is being very less, only 0.883%, the densely forested area is about ~29 % (2439 sq. km) along with ~18.31 % (1554.3 sq.km.) is the mixed forested area and ~27 % (2331.45 sq. km) agriculture land area. However, the agricultural land along with the current fallow is 38.26%. However, the cultivable land is only 20.673% of the total studied area. Therefore, Table 2.2a shows situation of agriculture based livelihood dependency of the residents. Image 2.4a and 2.4b show the traditional way of collecting and storing crops during the dry months.

Table 2.2a: Land use and land cover

Class	Total Area Coverage (sq. km)	Total Area Coverage (in %)
Waterbody	75.09	0.883
Sand bar	34.98	0.411
Builtup area	1542.34	18.172
Vegetation	2439.2653	28.740
Agricultural/ current fallow	3247.40	38.264
Cultivated land	1754.76	20.673

Source: Compiled by the author

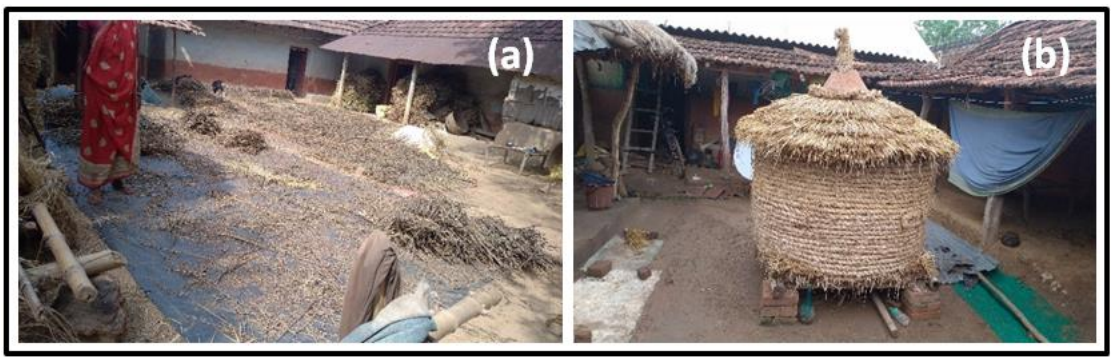
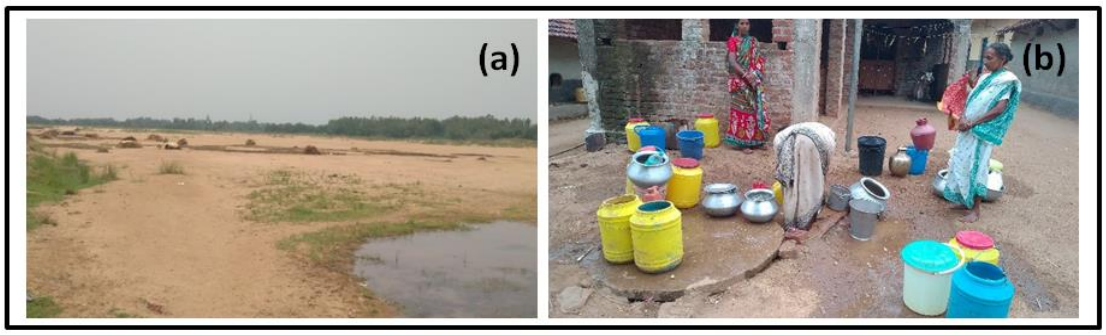


Image 2.4a shows thrashing oilseed in Jhargram **Image 2.4b** shows paddy storage in rural area

2.3.3 Scope of irrigation

Groundwater management in this area is crucial in promoting sustainable agricultural development for the region. To ensure resilience against drought in the future, the construction of water harvesting structures of varying sizes tailored to different land conditions can be considered (Mondal *et al*., 2018).



Images 2.5a and b show water crisis during dry months.

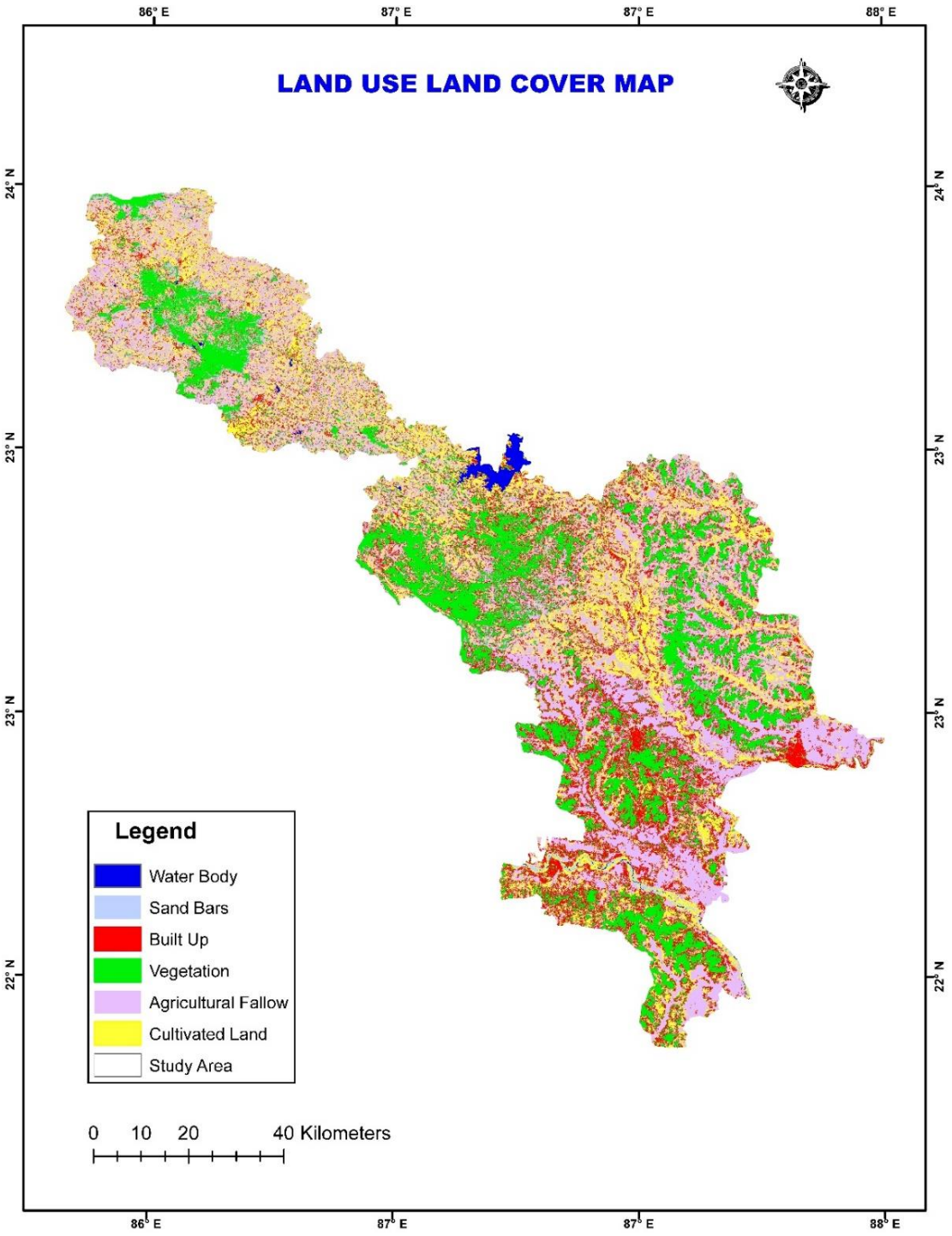


Fig. 2.8a shows land use and land cover map

Prepared by the Author

Source: Landsat-8 (USGS Earth Explorer)

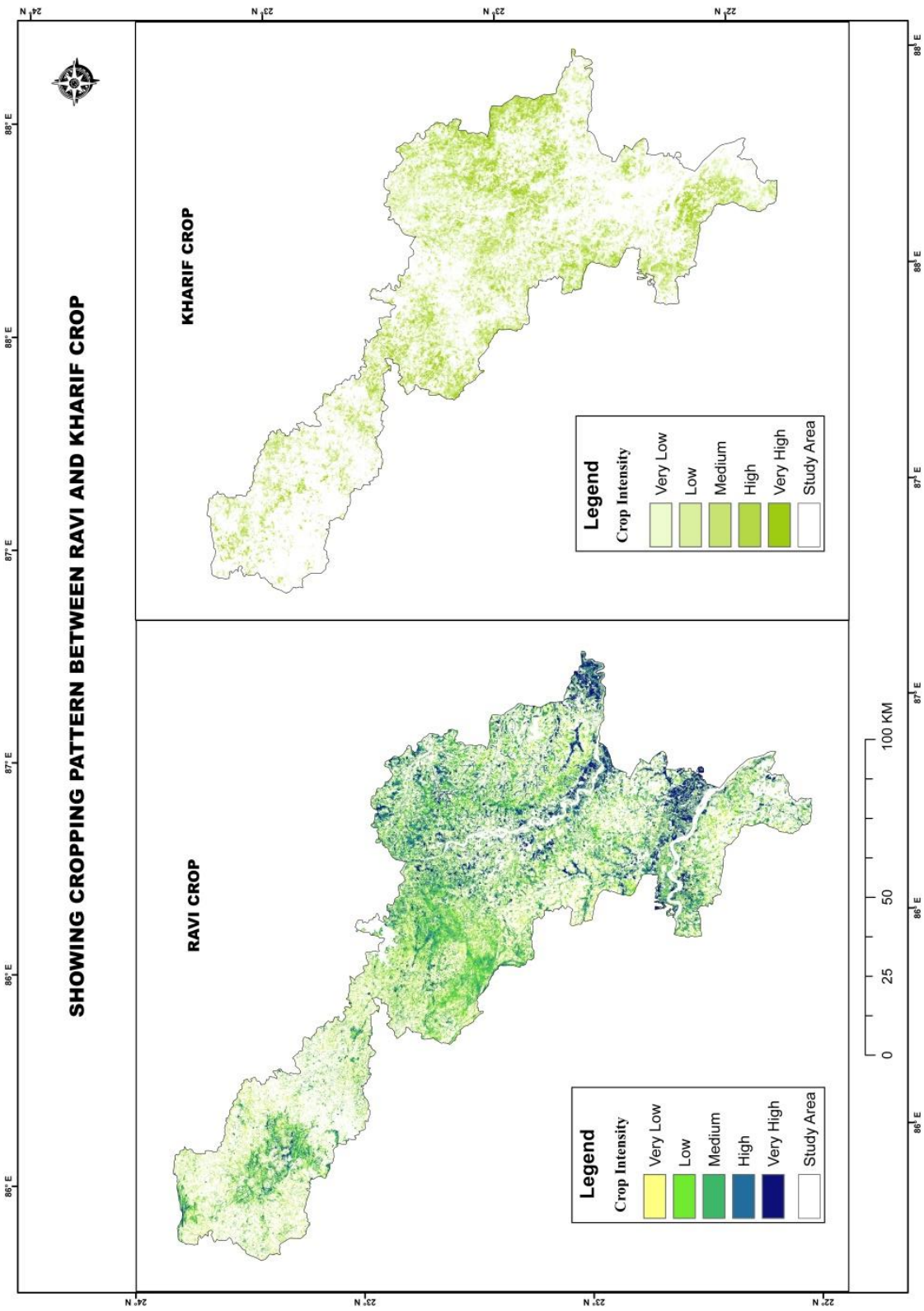


Fig. 2.8b shows cropping of two different seasons

Prepared by the Author

Source: Landsat-8 (USGS Earth Explorer)

2.4 Cultural landscape

2.4.1 Opportunity of work

Workers and non-workers are people who can do work and people who cannot do work. There are two more types of workers: major and minor. People who have more than 180 days of full-time work are called "main workers," and people who have less than 180 days of work are called "marginal workers" (World Bank, 2011).

Based on the 2011 Census statistics, the economic base of the study area was considered at the CDB level during the field investigation. So, this unit can be seen as a miniature version of the study area as a whole. The whole workforce includes key workers, minor workers, and people who do not work.

2.4.2 Livelihood sources

The way people make a living and the economy of a place or country are greatly affected by the kinds of businesses they run. The Census of India says that there are four main types of jobs. There are cultivators, laborers, household workers, and other workers in this group, which was chosen for the present research. These people are actively involved in primary economic activities, from the images 2.6a, b and c. The images 2.7a and b show their houses and housing materials. This study looks at 12 CDBs from four districts inhabited by a mainly marginal population (Table 2.3 and 2.4), with a concentration in these pockets of the state. It focuses on both primary and minor workers. After looking at the main workers by their communities, this study will discuss the marginal workers from the selected area.

Images 2.6 a, b, and c show rural artisans

Table 2.3: Population Composition

Districts	SCs (%)	STs (%)	Rural (%)	Urban (%)
Bankura	32.7	10.3	91.67	8.33
Purulia	19.38	18.45	87.26	12.74
Jhargram	20.11	29.37	96.52	3.48
Paschim Medinipur	19.08	14.88	87.78	12.22

Source: Census of India Abstract, 2011

Table 2.4: Concentration of Marginal Population

CD Blocks	SCs (%)	STs (%)
Jhargram	14.83	22.71
Binpur -I	25.02	28.15
Binpur-II	15.77	39.95
Bandwan	5.93	51.86
Jhalda-I	12.39	11.38
Baghmundi	10.36	25.11
Raipur	21.86	27.66
Ranibandh	11.45	47.07
Sarenga	29.21	19.11
Garhbeta-II	26.48	19.99
Salboni	18.61	17.38
MDP Sadar	19.53	17.67

Source: Census of India Abstract, 2011

Images 2.7 a and, b show Houses in Bandwan and Ranibandh.

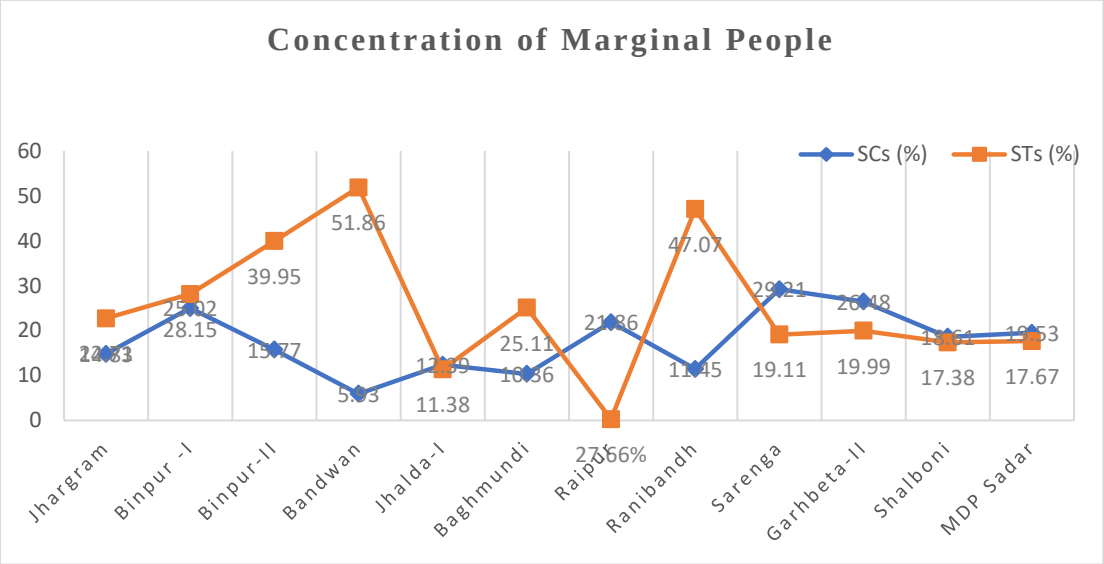
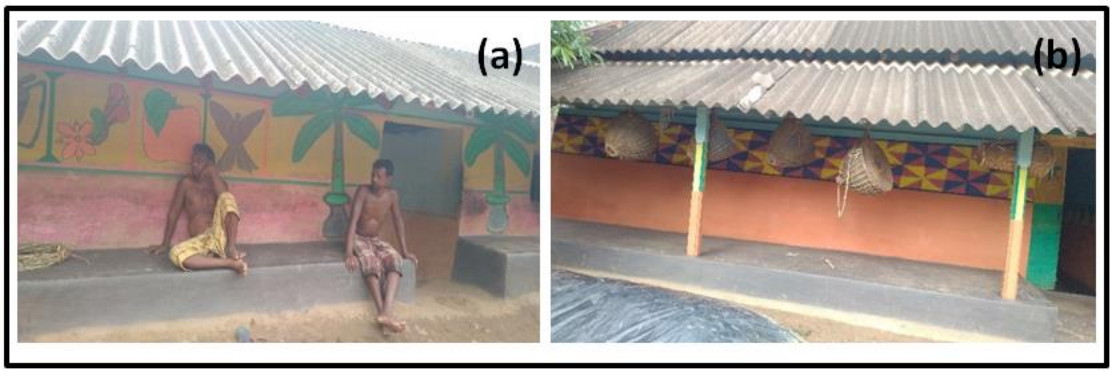


Fig. 2.9 shows the concentration of marginal population in the study area.

Based on the figures on fringe workers, the "agricultural laborers" category has the most workers, while the other three groups have very few. All people are involved in agriculture-based activities in the study region. The weak state of the marginal economies is further supported by the types of economic activities listed above. Image 2.8a and 2.b; 2.9a and 2.9b reflect the existing sociocultural setup of the area. People live together in a world where different cultures interact and depend on each other.



Images 2.8 and b show the folk art of Purulia.

Image 2.9a shows the economic bases of the study area.

Each area has its own cultural landscape, which shows how closely the people there have interacted with their natural surroundings for a long time (Lieber and Weisberg, 2002). Ethnic people still depend on their traditions in many parts of West Bengal. Traditions and cultural norms are passed down from one family to the next through oral stories. A lot of different cultural settings are mixed with new ideas. Because of their shared cultural history, these show an unbreakable bond. People sing and dance different types of old and traditional folk songs and dances in *Jangal Mahal*, such as *Kirtan, Bhadu, Tusu,* and *Baul*. These cultural events are significant to the group's people and their identity. Many cultural materials are closely linked to a person's life and way of living (Dey, 2012).

To understand handicrafts and country industries, you need to look at how they fit into systems that firms do not control. Crafts production used to be based on the needs of farming, which usually meant making things for people to use at home. The production area was close to the farm and happened at a specific time during the slow, dry season. The limitations and opportunities of farming affected what people made, where they made it, and when they did it (Gough and Rigg, 2012).

Image 2.9 b shows handicrafts from Baghmundi

2.5 Conclusion

This chapter discussed typical physical and socioeconomic setups in the studied area. Some information about the temperature, geology, vegetation, and local inhabitants has been given, including population, employment patterns, etc. This chapter mainly depicted the livelihood of the marginal households, the crisis, and related vulnerability due to unfavorable climatic conditions and geographical location. These features made the region underprivileged. As a result, the area experiences a significant water crisis, with the exception of the monsoonal months. In this context, the people depend on multiple livelihood sources. The rural households are engaged in the preparation of handicrafts and artisan products. In addition to agriculture and related primary sector activities, rural households engage in daily work as agricultural laborers and in stone quarrying. Agroforestry, plantations, livestock ranching, and fishing are among the diverse sources of income.