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Microlevel Socio-economic and Environmental Disparities in Ballavpur, Sriniketan (West Bengal), India

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ABSTRACT

Ballavpur village, part of Tagore's historical Sriniketan, focuses on rural upliftment by promoting self-reliance and addressing financial disparities in agriculture, crafts, and migration. It highlights cultural aspects and educational challenges while revealing income inequalities and differences in access to resources. This situation contrasts Tagore's ideals with the realities of modern rural life. Collaborative micro-level studies using Geographic Information Systems and modern tools are rarely conducted. This investigation represents a micro-level analysis covering the art, architecture, economics, and culture of the area through GIS studies and field visits. The study has assessed the shortfalls and environmental deterioration caused by urbanisation and anthropogenic stressors, including issues related to eco-health, urban development, waste disposal, and deforestation. The findings of this extensive study call for immediate attention to address environmental deterioration in line with the recommendations from the Green Tribunal and the West Bengal Pollution Control Board, as well as to improve the socio-economic standards of the residents of Ballavpur Village.

Keywords: *Ballavpur, Sriniketan, Bolpur, Kopai River.*

Introduction

The physical environment includes the natural surroundings of an area, encompassing aspects such as relief, climate, soil, natural vegetation, wildlife, and resources like energy and minerals. The geographical location and geoenvironmental factors of any place significantly impact human lives and activities. The Physical aspects are primarily gifts of nature and not manmade. However, humans can exploit these physical surroundings to meet their needs [1]. Examining how various physical factors affect the socio-economic conditions of people in a specific area is particularly intriguing. Furthermore, an aspiring geographer can validate their theoretical knowledge through practical observations gathered during fieldwork. Empirical studies can offer insights into theoretical concepts [2].

The Santiniketan area, located along the banks of the Kopai River, is known for producing remarkable pottery. It is also the birthplace of Nobel laureate and educational reformer Rabindranath Tagore. This region is celebrated for its panoramic natural beauty and commitment to holistic rural development [3]. Sriniketan was established to assist the rural community around Santiniketan and the Kopai River. Within a radius of 3 to 4 km from the Visva Bharati Central Office, there are about 16 larger and smaller Santal tribal villages [4]. The outskirts of the Ballavpur area encompass the Maharshi's educational institutions, like Palli Samgathana Vibhag (Institute of Rural Reconstruction), Palli Siksha Bhavana (Institute of Agricultural Science) and Siksha Satra (Institute of Primary, Secondary & Higher Secondary Education) at Sriniketan [5].

However, the district faces several challenges, including frequent flooding, an unhealthy surface and groundwater system, heavy rainfall, anthropogenic interventions, and significant sedimentation in the drainage system. The area is struggling with groundwater pollution, primarily due to $CO3^{2-}$ contamination, stone crushing, sand mining, Micro, Small, and Medium Enterprises (MSMEs), and the proliferation of brick kilns. The river meanders in a semi-circular arc[6];[7];[8];[9].

Objectives of the Study

Ballabhpur mouza has been selected as the study area for the following reasons: (1) The agricultural village, Ballavpur have pleasant weather during Autumn, and the connectivity between Ballabhpur and Kolkata is good. (2) The tourist hub has well-equipped hotels and is considered an educational centre for the last 200years. The Kopai River, a tributary of the Mayurakhi, flows gracefully around the village of Ballavpur. The farmers of Ballavpur is excellent in art, architecture, terracotta crafts, and breathtaking views. However, the urbanisation of the village has negatively impacted the economy and the peaceful environment. This situation has been studied in depth, and suggestions for improvement have been offered.

Methodology

The information on surface topography, altitude, drainage, natural vegetation, communication, and settlement patterns of Ballabhpur mouza is obtained from the topographic maps of Survey of India sheets (SOI) and other sources from Government reports (National atlas map, Meteorological office (Alipore) data), and literature like the District Gazetteers and Census Handbook of Birbhum. A door-to-door field survey and an engineering survey were performed for a socio-economic survey for insights into the mouza's profile. Photographs and sketches supplemented the findings. Statistical and cartographic techniques were employed for data analysis.

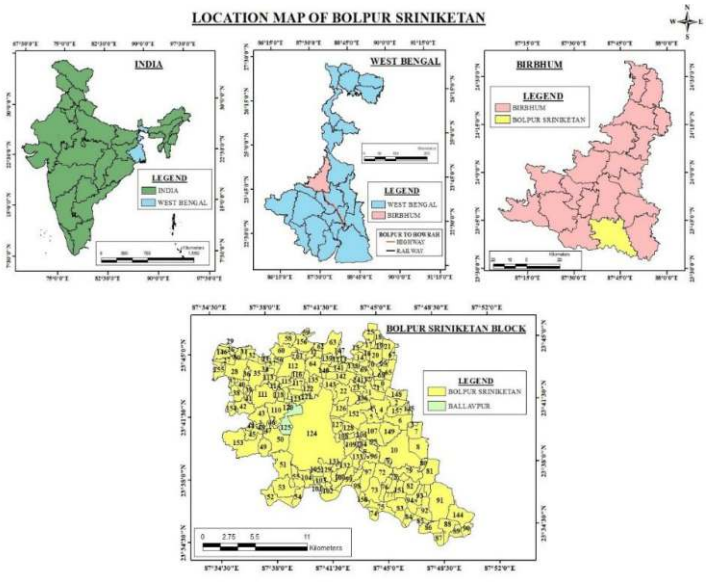
The field report was prepared after analysing and representing this data, aiming to connect the physical and cultural aspects of the mouza of Ballabhpur & Bolpur Sriniketan Block.
The help of the geographical information system, considered to be the present innovative tool for gaining knowledge about the physical characteristics of the area by constructing the maps related to elevation, geology, soil, Stream order, and village maps using the software Arc GIS, Q-GIS, Remote Sensing, ERDAS imaging and Snap software.

Physical Background

The spiritual retreat at Shantiniketan was established by Debendranath Tagore in 1863. Gurudev Rabindranath Tagore turned Santiniketan into a trailblazing centre for internationalism, education, and the arts. The Bengal's culture, society, and environment became the background and transformed to inspired Santiniketan's values for about 160 years for increasing creativity, efficiency and fiscal support. Later, the Bolpur-Sriniketan block was located in the extreme south of Birbhum district. It lies between 23° 34m to 23° 46m 15s North latitude and 87° 36m 15s East to 87° 47m East longitude. (Fig-1(a and b)

Territorial Division and Administrative Setup:

The block covers an area of 334.58 km^2, measuring 21.10 km north-south and 19.44 km east-west. Santiniketan block is bordered by Sainthia, Labpur CD Block to the north, Nanoor CD Block to the east, Illambazar CD Block to the west, and the Ajay River and Burdwan District to the south. Sriniketan was established in 1921 after Rabindranath Tagore purchased land 3 km west of Surul. Leonard Knight Elmhirst initiated an agro-project there, promoting Tagore's principle of self-reliance through cooperative efforts, focusing on rural development through handicrafts and agronomic training.
According to the 2011 District Census Handbook [10], there are 156 inhabited villages in the Bolpur Sriniketan CD Block, along with 1 panchayat samity and 9 Gram panchayats. The gram panchayats are Sattore, Kasba, Ruppur, Kankalitala, Sian, Raipur-Supur, Singhi, Bahiri, and Sarpalihana. Bolpur police station serves the block, with the headquarters located in Sriniketan. (Fig-2.1) [11]



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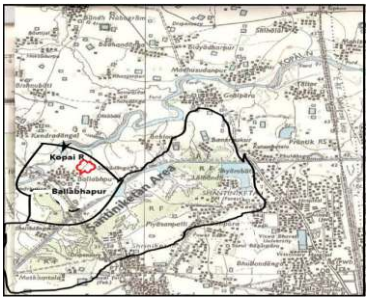

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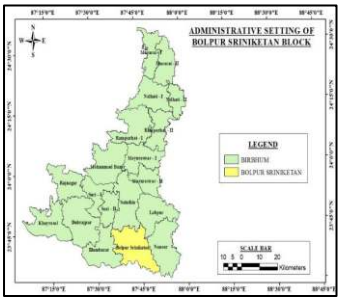

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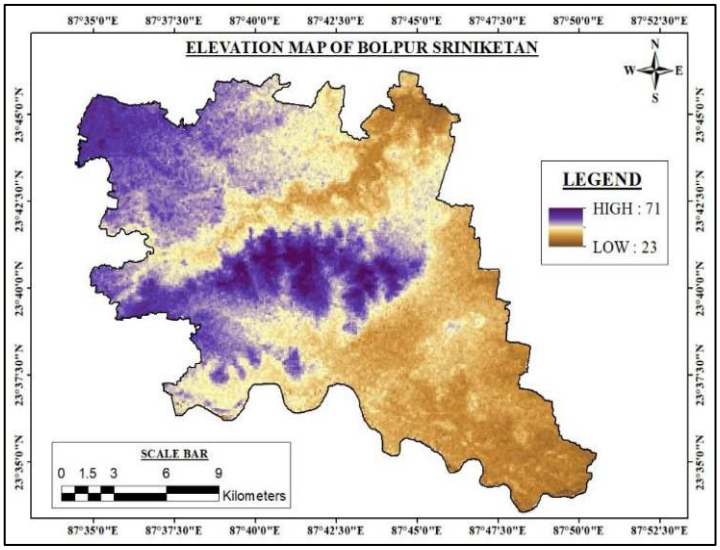
Fig 1(a to c): (a) The index map of the study area (b) The SOI map of Ballabhpur (c) The block map of the Bolpur Sriniketan in Birbhum district.

Relief:

Bolpur Sriniketan CD Block is part of the Suri-Bolpur Plain, one of the four sub-micro physiographic regions of Birbhum district. It covers the interfluves of the Mayurakshi and Ajay rivers in the south-eastern part of the district. Geographically, it is referred to as the part of the ancient 'Rarh', which is characterised by undulating plains with old alluvium and lateritic soil. The bedrock beneath the plain lies at a depth of 150 to 750 mt. below the surface. The landscape of the entire block appears to be a rolling plain with an average elevation of less than 50 mt. This area exhibits slopes from north-west to south-east, which is less than 10 metres/km. (Fig-3.1)



A

Fig-3.2Fig 2 (a): The topographic (DEM) map of the Bolpur pf Sriniketan CD block.

The northwest part of Bolpur, Sriniketan, is located at a height of 71m, while the southeast zone is situated at 23m. An elevation profile, shown in Fig 2(b), was surveyed at Sonajhuri Haat, Santiniketan (23°69'20"N, 87°66'98"E) at BM 40, near the Khoai River. This area features a floodplain and gently sloping land formed by sediment deposition, resulting in a dynamic landscape at point E, making it suitable for agriculture.

Demographic Profile Survey: In West Bengal, there are two Ballavpur locations: a census town in Bardhaman district and a village in Birbhum district with a population of 2,525, consisting mostly of the Santhal community (50.22%). The village has a literacy rate of 77.68%, slightly above the state's 76.26%. It consists of 590 families and 253 children (ages 0-6), making up 10.02% of the population. The sex ratio is 1,043, which is above the state average of 950, with a child sex ratio of 977 compared to the state average of 956. Male literacy stands at 86.91%, while female literacy is at 68.90%.

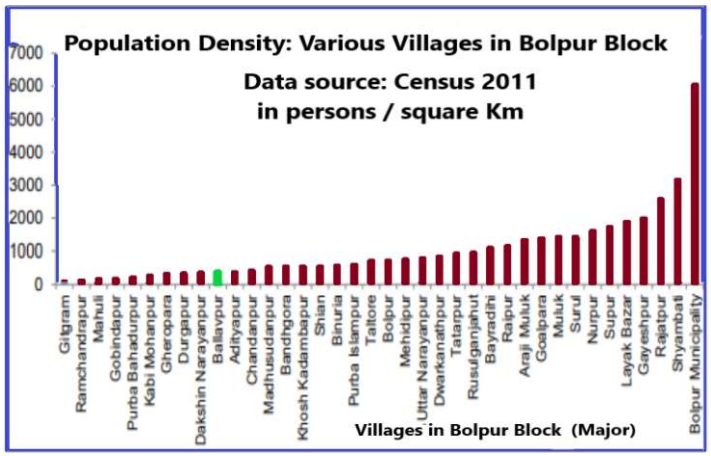


Fig 3: The population density of prominent villages in Bolepur Block, West Bengal

Geology:

The block is nested in the Rarh region of the Lower Gangetic Plains, in the fringe areas of the Chhottanagpur plateau. The unique landscape is covered with laterites and latosol of older and younger formations (Rills and Gulley erosion) mixed with alluvium, and underlying Gondwana formations [12]. Gully erosion and its impact on regional development: A case study of Bolpur-Sriniketan lateritic patch. Three successive major faults are housed at Chhottanagpur Foot-hill, Medinipur-Farakka and at the Damodar Fault of NS trend spread for inconstant distances into the overlain Cretaceous-Palaeocene sequences. They are of the western Tectonic Shelf from the Bengal Basin, and the Lower Gangetic landforms of the Bengal Basin had been formed due to reactivation of these faults [13].

Stratigraphy:

The land is interspersed with small hillocks, natural water bodies, and patches of forested areas, giving it a picturesque rural charm. Seasonal streams and rivulets flow through the region, replenished during the monsoon season. The geological formation of this block is found to be Vindhyan alluvium of the tertiary period, covered with river-borne younger alluvium or deposits of clay and silt. The block has an older alluvium with laterite (towards west), b) Newer alluvium (near the river banks), c) Older alluvium (the Bolpur including Ballavpur area). t a) Older alluvium with laterite b) Newer alluvium c) Older alluvium. The upper reaches near Bolpur are of granite-gneiss of the Proterozoic era, whereas the mid and the lower end of the Kopai River basin comprises recent and old alluvium. (Fig. 5.1, [8], [14].

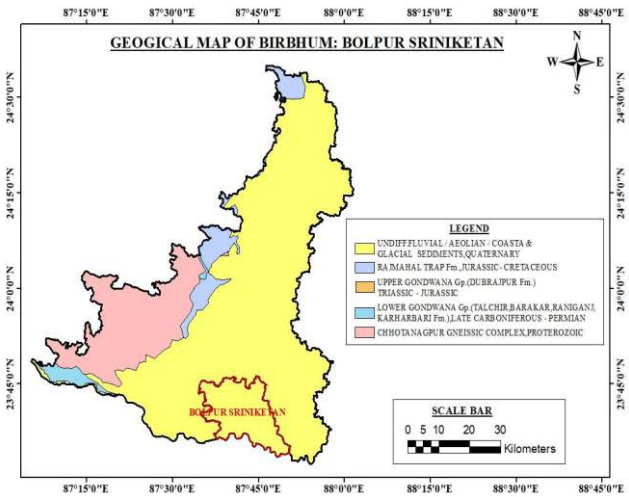


Fig 4: The geological map of Birbhum District, Bolpur Sriniketan, West Bengal

The laterite terrains of Ballavpur, Bolpur (also known as "Khoai" Badlands), including rills, gullies, and drains, are extensive and dynamic erosional features**.** These common formations are dense due to high runoff and soil erosion. The drainage system of the area is ephemeral, as sturdily protracted by long-term seasonal rainfall, anthropogenic, and the unique two-tier lateritic landscape [15]; [6].

Soil:

The primary soil types in Bolpur are old alluvium and red latosols. Alluvial soils are loamy and contain a moderate amount of organic matter, phosphate, and a high level of potash, with a pH ranging from 5 to 6.5. On the other hand, red lateritic soils are characterised by their light, porous, and gravelly texture, which is low in organic matter and has a pH range of 4.8 to 6.0. Although red soils have low fertility, they can support crops such as rice and wheat when irrigated. However, heavy rainfall and the presence of impervious rocks lead to rapid runoff and soil erosion, particularly in regions like Khoai. (Fig-5.3)

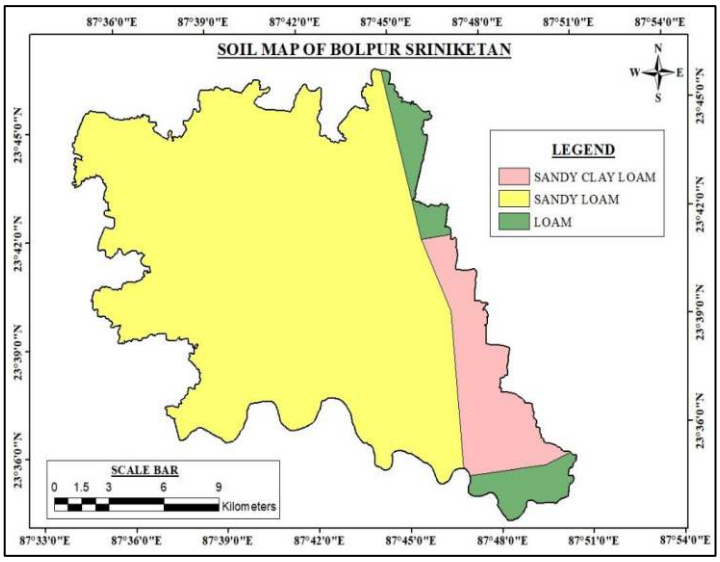


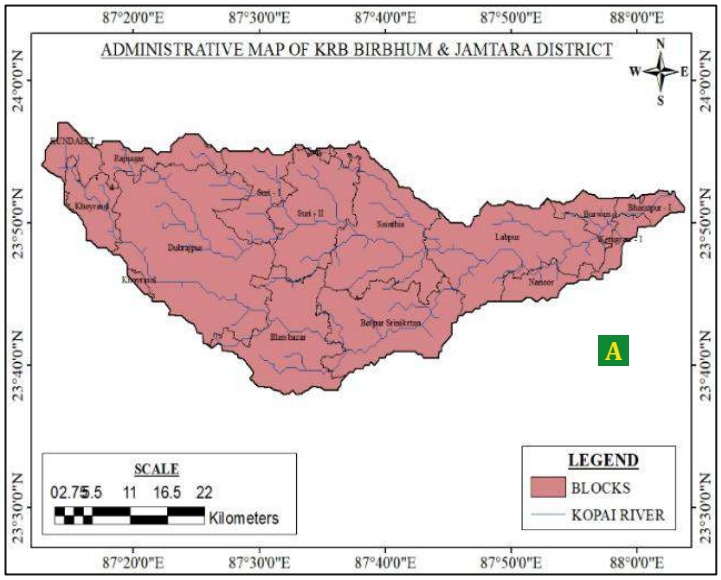
Fig 5: The soil map of the Bole areas in Sriniketan, in West Bengal

Groundwater Hydrology:

In this block, water table contours lie below 16 mt. Aquifers with secondary intergranular porosity and fractures exist. So, tube-well and well irrigation have become prevalent all over the block. (Fig-3.2). The groundwater in the area has pH values ranging from 6.5 to 8.5, which are considered safe for use and irrigation. However, it contains unsafe levels of fluoride ions. The permissible limit for fluoride in the village is 1.5 mg/l, which is deemed safe for use throughout the year. [16].

Drainage and Waterbodies:

River Ajay originates in the Chota Nagpur Plateau and flows from west to east, forming the southern boundary of the Bolpur Sriniketan block, demarcating the Burdwan and Birbhum districts. The Kopai River flows across this block from west to East. They are mainly perennial but partly ephemeral rivers. During the dry season, the flow of the river has lean flow, but during the rains it is flooded. The Ajoy River provides irrigation to both sides. Several tanks exist scattered, covering the entire block [17]. The rivulet is the Kopai River (~176.4km out of which 151.6km is perennial and the rest is ephemeral). The Kopai River dries up in summer near the Sri-Niketan area, joins the Bakreswar River adjacent to Hasuli Bank at Labpur village, and later as the Kuya River. Fig 4(a and b).



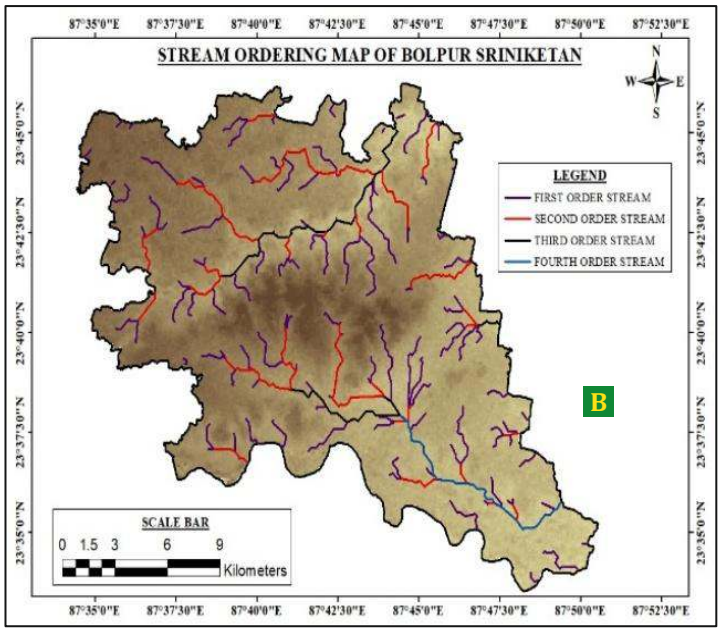


Fig. 4(a and b): (a) The Administrative blocks in Birbhum (b). The Kopai R. stream order map

Natural Vegetation

The Bolpur block is home to the Ballavpur Wildlife Sanctuary, a 202-hectare area of dry deciduous forest that shelters Blackbucks and Spotted deer, along with vegetation such as Sal, Acacia, and cashew plantations. The sanctuary hosts jackals, birds, and small mammals amidst lateritic soil and sparse forests. It includes three large waterbodies and attracts both native and migratory birds such as Rollers and Kingfishers. Birbhum district's total forest area is about 159.26 sq.km, just 3.5% of the district's land, with the Bolpur Sriniketan block containing only 2.83%. Much of the natural vegetation has been lost to agriculture, leaving isolated forest patches. The sanctuary includes a plantation from 1954-55, primarily featuring Sal and Cashew, with additional enrichment planting in the northeastern part. Currently, only 80 hectares are used for wildlife management, while the remaining area remains unutilized.

Bolpur is situated in three agro-climatic zones: (1) the Gangetic Alluvial Zone, (2) the Vindhyan Alluvial Zone, and (3) the Undulating Red and Laterite Zone. The Gangetic Alluvial Zone consists of both young and old alluvial soil. This alluvial soil is characterised by its deep, medium-fine to medium texture. It has a pH level that ranges from neutral to mildly alkaline, with significant calcareousness in many areas. The base saturation is moderately high, while the nitrogen (N) and phosphorus (P) levels are medium to medium-low. The potassium (K) status in this zone is medium to high. https://birbhum.gov.in/agriculture

Climate:

The general climate is a hot summer, characterised by high humidity, monsoon rainfall and moderate winter. May is the hottest month with a minimum temperature of 40°C. January is the coldest month when the minimum temperature drops to 5°C. Sriniketan has a tropical wet-and-dry climate featured by hot summers, a humid monsoon season, and cool, dry winters. January, like late January 2026, typically features cool nights (around 11∘ C13∘C) and warm, sunny days (about 25 ∘ C - 28∘ C)

Table 1: The monthly normal temperature data of IMD of the Birbhum district (1901 – 2020)

Months	Mean Monthly Maximum Temp (°C)	Mean Monthly Minimum Temp (°C)	Average Temp (°C)	Average Temp in °F	Scale: 1 cm = 10°F Average Temp	Relative Humidity (%)	Scale: 1 cm = 10% Relative Humidity
Jan	24.7	11.1	17.9	64.22	6.42 cm	69.5	6.95 cm
Feb	28.5	14.6	21.55	70.79	7.07 cm	61.5	6.15 cm
Mar	33.6	19.4	26.5	79.7	7.97cm	53.5	5.35 cm
Apr	36.5	23.5	30	86	8.6 cm	58.5	5.85 cm
May	36.7	25.1	30.9	87.62	8.76 cm	65.5	6.55 cm
Jun	35.4	26.1	30.75	87.35	8.73 cm	76.5	7.65 cm
Jul	33.1	26.1	29.6	85.28	8.52 cm	83.5	8.35 cm
Aug	32.8	26.1	29.45	85.01	8.50 cm	83.5	8.35 cm
Sep	32.8	25.5	29.15	84.47	8.44 cm	84	8.4 cm
Oct	31.9	22.5	27.2	80.96	8.09 cm	81	8.1 cm
Nov	29.7	17.3	23.5	74.3	7.43 cm	73.5	7.35 cm
Dec	26.1	12.7	19.4	66.92	6.69 cm	72	7.2 cm

In summer as well as in winter, the range of temperature is high, and it lies between 10 °C and 15 °C. Most of the rainfall takes place during June and September (south West Monsoon). The average annual rainfall is 150 cm. Sometimes winter rainfall is caused by western disturbances. The climatic data collected from the Meteorological Observatory at Sriniketan for the year 2018 shows that relative humidity (RH) is highest (85.39%) in the rainy season, i.e., in July, and it is lowest in April. Sriniketan's temperature data of 2018 shows deviations of maximum and minimum temperature from the average temperature for 12 months of the year. The Climo graph drawn based on the climatic data of 2018 shows that Ballabhpur acquired a position between a muggy and scorching type of climate. (Fig-6.3)

A Salient Overview of Ballabhpur Village

The Ballabhpur village with Census code 317784 is located in the Bolpur Sriniketan subdivision of Birbhum district. in West Bengal, India. It is situated 6.5km away from the sub-district headquarters (HQ) Sriniketan (Tehsildar's office) and 30.2 km away from the district headquarters Suri. As per the 2009 status, Ruppur is the gram panchayat of Ballabhpur village. The total geographical area of the village is 583.95 hectares, accommodating 2,525 people, out of which the male population ratio is 959:1000. The literacy rate is 69.90%, out of which 77.91% males and 62.22% females are literate. There are about 590 houses in Ballabhpur village, which comes under the Bolpur assembly & parliamentary constituency. Bolpur is the nearest town to Ballabhpur village (lat. of 23.68°N and long. of 87.72°E) for all major economic activities, approximately 7 km away. Ballabhpur mouza is surrounded by Sattor gram panchayat in the north-west, Sarpalihana gram panchayat in the north, Kankalitala gram panchayat in the north-east, Bolpur Municipality in the east, and Raipur-Supur GP in the south.

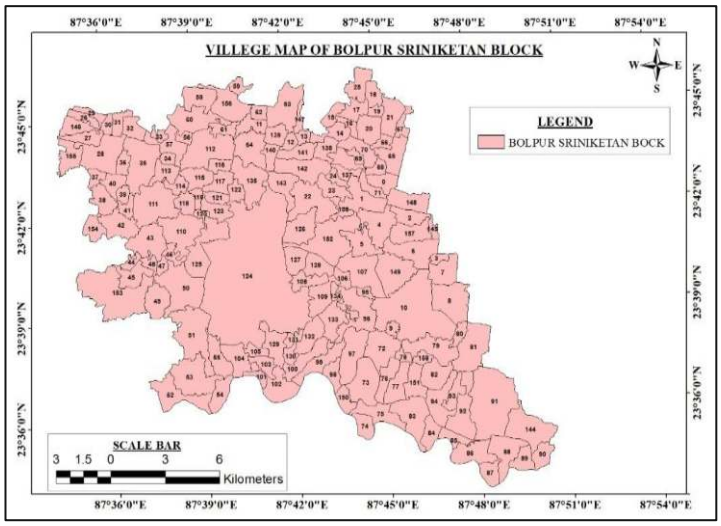


Fig 4: The village map of the Bolpur-Sriniketan Block in West Bengal

Agriculture:

Agriculture is the primary livelihood of the local population. The main crops include rice, wheat, mustard, and vegetables. The fertile alluvial soil, supplemented by irrigation from local water bodies, supports farming activities, although traditional methods are predominantly used.

Culture and Economy:

The village economy is closely tied to Shantiniketan and the Visva-Bharati University, with many residents engaged in handicrafts, pottery, and tourism-related activities. Ballabhpur is also known for its weekly haat (market), where locals trade goods and produce.

Connectivity:

Ballabhpur is well-connected by road to Bolpur and Shantiniketan. Bolpur Railway Station, located about 5 kilometres away, connects the area to major cities like Kolkata and Howrah. The village's proximity to Shantiniketan makes it accessible for tourists and students visiting the region.

Socio-Economics of Ballabhpur Mauza

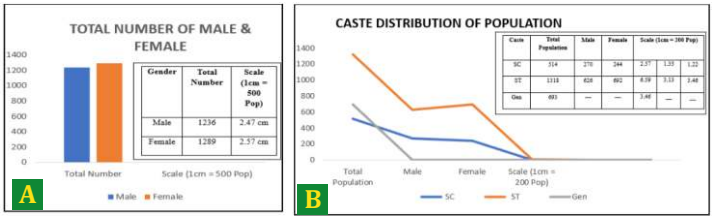


Fig 4 (a and b): The demographic statistics of Ballavpur Village in Bolpur block, WB.

Demography

Ballabhpur village had a population of 2,525 in 2011, with 1,236 males and 1,289 females, indicating a female majority. Covering an area of 583.95 hectares (5.8395 sq. km), the population density is 432 persons per sq km. The village has a significant scheduled tribe population (1,318) and a smaller scheduled caste population (514), while the general caste is only 693. Brahmins and Kayasths are higher Hindu castes, Sod Gopes are middle castes, and Bagdis, Chamar, and Koras are either SC or ST, respectively.

Literacy

The literacy rate of Birbhum district in West Bengal was 70.68% as per the 2011 census. It is noted that the literacy rate (69.90%) of Ballabhpur village is a little bit lower than that of the District.

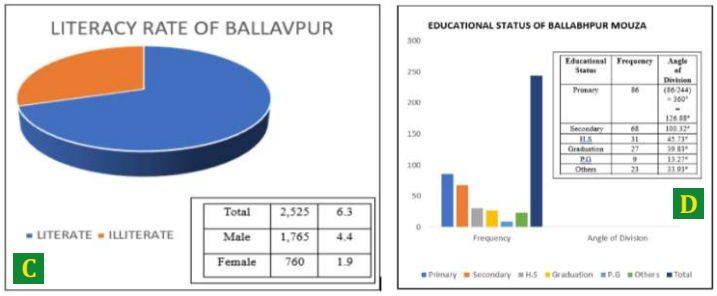


Fig 4 (c and d): The educational status of Ballavpur Mouza in Bolpur Block, WB

Here, the total literate population is 1,765 out of the total population of 2,525, while the total illiterate population is only 760. The educational status of this village is shown through a pie diagram. Here, we can see that primary education is maximum in this village, while the number of people completing Secondary, Higher Secondary, Graduation, Post Graduation, etc. is gradually decreasing. (Fig-7.3)

Categories of workers: It is noticed from the data that the non-working population is maximum (1,398) compared to the total working population (1,127). The percentage of marginal workers (only 4%) is negligible compared to that of the main worker (1,076) in Ballabhpur village. Agricultural labourers (636) are predominant in the group of main workers. The functional pattern of Ballabhpur Mauza reveals a dominance of primary workers since agriculture is the mainstay of people in this area. (Fig

Land Use: a) Agricultural Land Classification: Ballabhpur is predominantly an agricultural village. The agricultural land of this village has been classified into different types: a) Shali, b) Suna, c) Do, d) Danga and e) orchard. Shali lands are lowlands, moderately drained to under-drained. Suna lands are moderately elevated lands that are over-drained to moderately drained. 'Do' lands are irrigated lands where double cropping is done utilising irrigation water. According to the settlement office record, the 'do' land in this village is scattered over a few patches in this village (Fig 5).

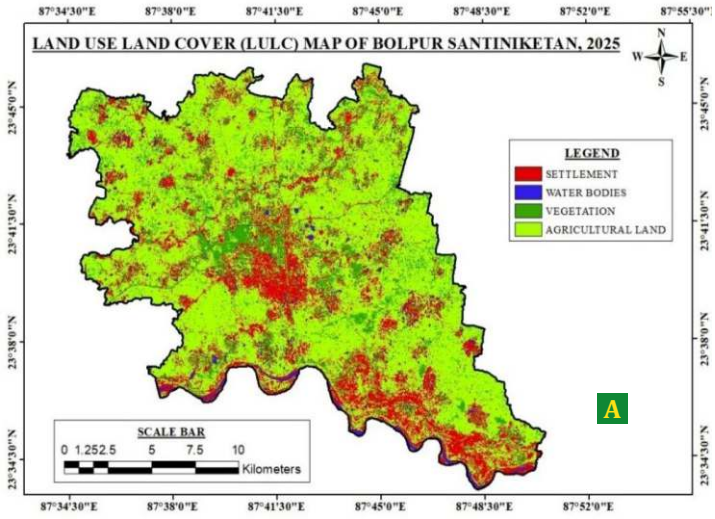


Fig 8.1Fig 5 (a): The LULC map of the Ballavpur Mouza in Bolpur Block in West Bengal.

b) Plot-wise distribution of land use

A plot-to-plot survey of different land uses of Ballabhpur mauza records that the maximum number of plots are used as agricultural land, which are located in the central portion of the village. Most of the agricultural plots are single-cropped. Residential plots were located in the southern portion of the mauza. Several ponds or water bodies are scattered all over the mouza. A single metalled road passes through the village from South to North on the Western side of the mouza, and earthen roads are used by the villagers.

c) Land holding pattern

Land holding pattern is an important factor in determining the level of agricultural development. In Ballabhpur mouza, different classes of farmers according to the different sizes of land holding are found based on a house-to-house socio-economic survey. The size classes include big farmers (more than 30 bighas), medium farmers (22.52 - 30 bighas), and lower medium farmers (15 to 22.5 bighas), which are not observed in the village. Small farmers (7.5 to 15 bighas) and marginal farmers (less than 7.5 bighas) are 11 and 22, and Landless labourers are 37 out of the survey sample of 70, that depecits the economic status of the villagers. The following table gives the size class distribution of agricultural households:

d) Use of Fertiliser and Seeds

Both organic and chemical fertilisers are used for the crops in this village. Chemical fertilisers mainly include urea, potash, etc., while organic manures consist of cow dung or compost manure. Two types of seeds - high-yielding varieties (HYV) and traditional varieties are used in the village. High-yielding varieties of paddy seeds like Joya, Ratna, Padma, etc. are common. Small and marginal farmers use traditional varieties of seeds. Some of the HYV seeds used by the villagers are Ranibahar for sugarcane and Jyoti for potato.

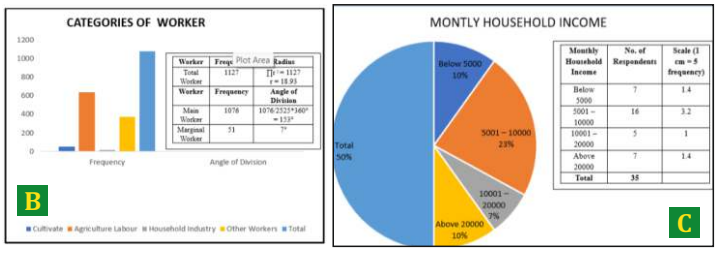


Fig 5(b and c): The workers categories and the monthly Household income in Ballavpur Mouza f)

Use of pesticides and machinery

The application of pesticides is limited in Ballabhpur village. Only the small farmers use very small amounts of pesticides in their plots, whereas marginal farmers are unable to buy and apply costly pesticides. The farmers in Ballabhpur mauza use different agricultural machinery like wooden ploughs, sickles and bullocks. All these are made and repaired locally. The fragmentation of land holding often stands as a problem in using modern farm machinery because its use demands extensive tracts of cultivated plots. Financial incapacity of farmers is another major problem against the use of modern farm machinery.

g) Infrastructure Facilities

i) Sources of drinking water - The majority of the inhabitants of Ballabhpur mauza collect their drinking water from tube wells, and a very few of the inhabitants depend on well-water for drinking purposes.

ii) Other infrastructural facilities - Villagers of this mauza attend primary school, secondary school in the neighbouring Bolpur Municipal area. Primary Health Centre is located at Bolpur, while the village dispensary serves the people of this mauza. A hospital is located at Bolpur near Sriniketan. Post and Telegraph offices are situated at Bolpur and Adityapur. Bolpur serves as the police station headquarters for this mouza. The villagers use bicycles, tuk-tuk, auto, etc. as their modes of transportation.

iii) Types of houses and building materials -Most of the people live in pucca type of houses. From the village survey 3 house types become prominent. These are - single-storied house with thatched roof, double-storied mud-built houses with thatched roof, double-storied brick-built house with a combination of tin-roof and thatched roof. Building materials include mud from the river, bamboo and thatch, tin, brick, etc.

h) Secondary and tertiary activities

Ballabhpur Mauza lacks in the development of secondary and tertiary activities because the mauza is mainly agriculture-based, and most of the workers are directly and indirectly involved in the primary sectors. A very few people are engaged in manufacturing industries and handicrafts. Villagers are engaged in different types of activities like teaching, worshipping, business, hair-cutting, shop-keeping, etc.

Sources of livelihood: (Market Area Analysis)

Out of a 2525 population spread over 28.34Km^2 in Ballavpur Mouza, major households earn between 5,000 and 10,000, primarily from handicrafts, filigrees, Terracotta and weaving (fig 6 e and f)). Daily markets along with the weekly Jonu haat, and Sanjhuri hat in the banks of the Khoai River, offering clothes, bags, toys, jewellery, and crafts. Sellers face challenges such as seasonal fluctuations, competition from online marketplaces, and transportation issues during the monsoon season. While they receive some government aid, they need extra support in the form of financial assistance, skill training, improved infrastructure, and permanent stalls. It is surveyed that out of 1131 workers, 1076 are main workers and 51 are marginal workers, and four are begging alms for their livelihoods. Fig 6 (a to d)

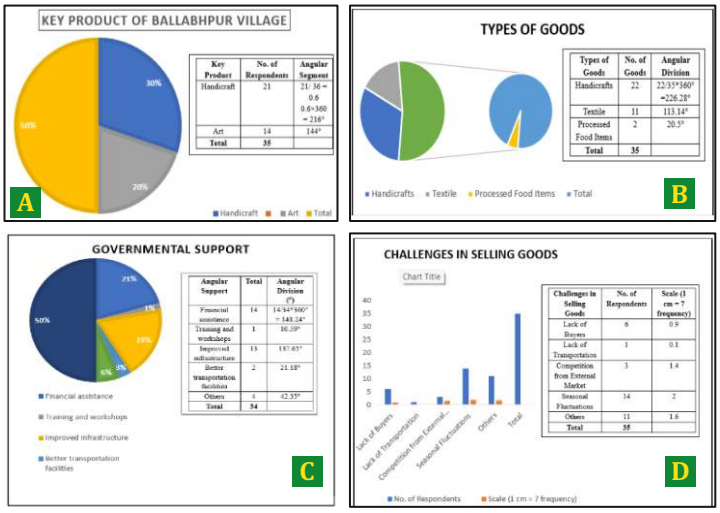


Fig 6 (a to f): (a) The goods and products, (b) The types of goods used as livelihood (c and d) the government assistance and the challenges in the market (g and h) the filigree products sold in Sonajhuri Hat in Ballavpur Village, Bolpur Block. (Fig 6 (a-f)

Tourism:

Shriniketan is a culturally and naturally rich tourist destination in India, attracting visitors primarily for leisure. Most tourists visit 2–5 times and typically stay in hotels, arriving by personal vehicles or train. They express satisfaction with transport facilities, services, and food quality 6(a and b) and Fig 7 (a-d) [18].

Fig 7 (a – d): (a) The rills, gulleys and drains in laterite copings of Sonajhuri forest, (b) The deer in the Ballavpur Sanctuary, (c) The migratory birds in the large water body in the Ballavpur Sanctuary, (d)

The confluence of the Mayurakhi and the Kopai River.

Tourists are drawn to local handicrafts, preferring to shop at markets rather than online, and express a desire for permanent stalls, better sanitation, and electricity. To summarise, handicraft is the key product of Ballavpur village. The market is directly proportional to tourism. The market is one of the highlights of the entire area.

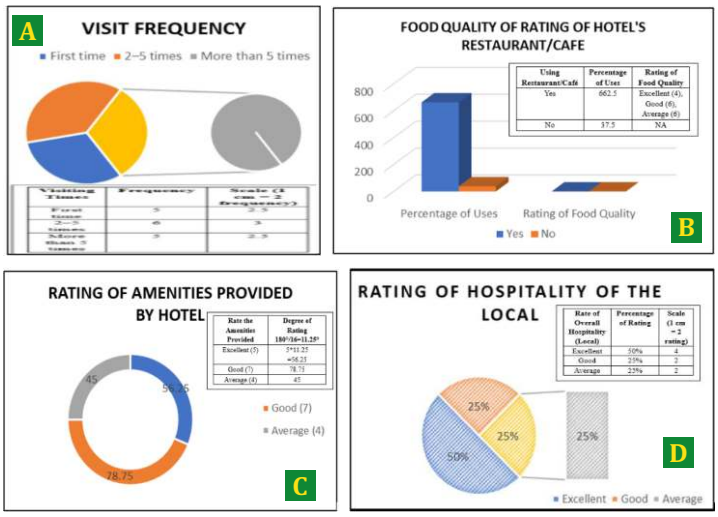


Fig 8 (a to g): The frequency of visit (b), Food and lodging quality of visitors (c), Rating of amenities; (d) Hospitality in Hotels at Ballavpur, Sriniketan; (d) Types of staying (e) Satisfaction Level and (f) Purpose of visit to Sriniketan area

Induced literacy from Sriniketan:

Sriniketan, located near Bolpur in West Bengal, celebrates the legacy of Guru Rabindranath Tagore and serves as the second campus of Visva-Bharati University. Established in 1922, the Institute of Rural Reconstruction, comprising the Palli Samgathana Vibhag (Department of Rural Reconstruction) and Palli Siksha Bhavana (Institute of Rural Education), focuses on village education, health, agriculture, and local crafts. The area is renowned for its cultural heritage, traditional arts, and peaceful environment, reflecting Tagore's vision of community development and sustainable practices [19].

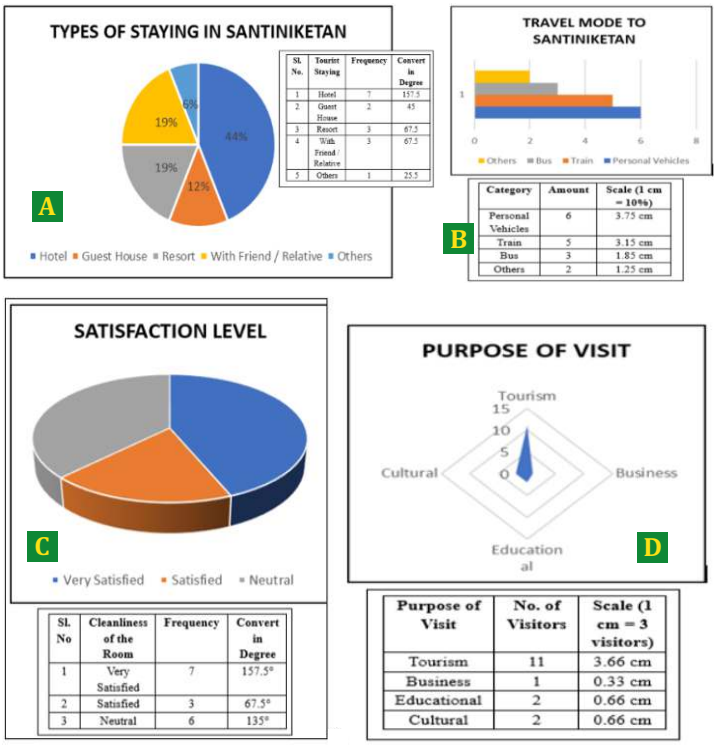
The art and architecture

This area is significant as the residence of Nobel Laureate Rabindranath Tagore and the site of Visva-Bharati University, the most visited location, followed by Rabindra Bhavan Museum, Amra Kutir, Khoai Mela, and Ballavpur Sanctuary. Sonajhuri Haat is particularly popular among tourists, who appreciate the hospitality of the locals. However, the increase in tourism has led to environmental issues like pollution and waste disposal. Tourist surveys provide valuable insights into their preferences and concerns [20].

Fig 9 (a and d); The mesh of Handicrafts sold in Ballavpur Haat, Bolepur, WB.

Transportation and conveyance:

The various modes to visit the Sriniketan and Ballavpur village are personal vehicles, Private /government buses, trains, personal vehicles and other sources (Banerjee et al, 2020).



Sl. No.	Tourist Staying	Frequency	Convert in Degree
1	Hotel	7	157.5
2	Guest House	2	45
3	Resort	3	67.5
4	With Friend / Relative	3	67.5
5	Others	1	22.5

Category	Amount	Scale (1 cm = 10%)
Personal Vehicles	6	3.75 cm
Train	5	3.15 cm
Bus	3	1.85 cm
Others	2	1.25 cm

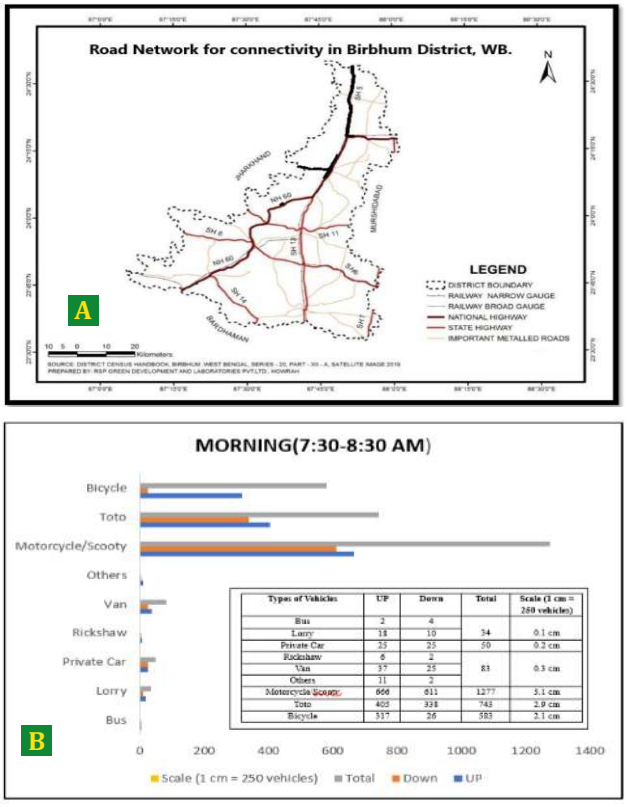
Sl. No	Cleanliness of the Room	Frequency	Convert in Degree
1	Very Satisfied	7	157.5°
2	Satisfied	3	67.5°
3	Neutral	6	135°

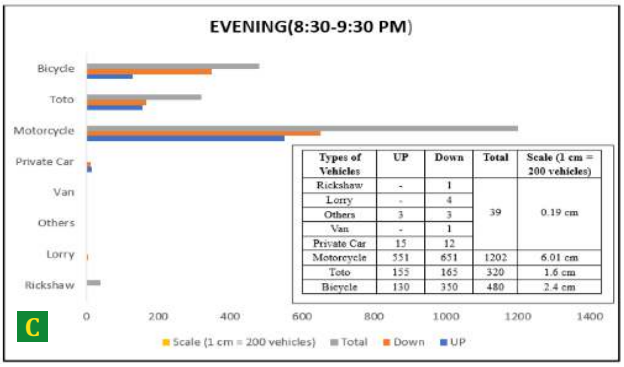
Purpose of Visit	No. of Visitors	Scale (1 cm = 3 visitors)
Tourism	11	3.66 cm
Business	1	0.33 cm
Educational	2	0.66 cm
Cultural	2	0.66 cm

Fig 10(a and d): The purpose and mode of visit to the Sriniketan and Ballavpur

Transport Survey

Ballavpur village is connected to Sriniketan by road and is linked to Suri. It is located 220 km from Kolkata, 90 km from Durgapur, 34 km from Bolpur, 55 km from Andal, and 19 km from Sainthia, along the Panagarh–Morgram Highway (NH 60). Suri is accessible from Ahmadpur station via Purandarpur and Kondaipur. The transport system mainly consists of government and private bus services. A traffic survey was conducted during the morning 7.30 to 8.30 AM, and Evening 830 to9.30PM. (up vehicles 1421numbers and down vehicles 1196numbers) on October 9th 2024 and statistics of the vehicles are in Fig 9(a) and 9(b) [21].





Types of Vehicles	UP	Down	Total	Scale (1 cm = 200 vehicles)
Rickshaw	-	1	39	0.19 cm
Lorry	-	4		
Others	3	3		
Van	-	1		
Private Car	15	12		
Motorcycle	551	651	1202	6.01 cm
Toto	155	165	320	1.6 cm
Bicycle	130	350	480	2.4 cm

Fig 11: Traffic survey in Sriniketan during (a) morning and (b) Evening session, (c): Major communication network in Birbhum district, West Bengal.

Traffic Survey

A traffic survey was done at Bolpur Chou Rasta in the morning from 7:30 am–8:30 am and from 8:30 pm to 9:30 pm on vehicles. It was observed that the flow of both the passenger and goods vehicles was extremely high in the morning, whereas the flow was quite low in the evening. The percentage of rickshaw, lorry, van was less compared to motorcycle, toto, bicycle and private cars. In the morning, the traffic density of passenger vehicles was high towards Bolpur, and in the evening, the traffic density was towards Bolpur station. But, in the case of goods vehicle the highest traffic density was towards the Bolpur station both in day & night. More motorcycles were found to be plying in this area. (Fig 11(d)

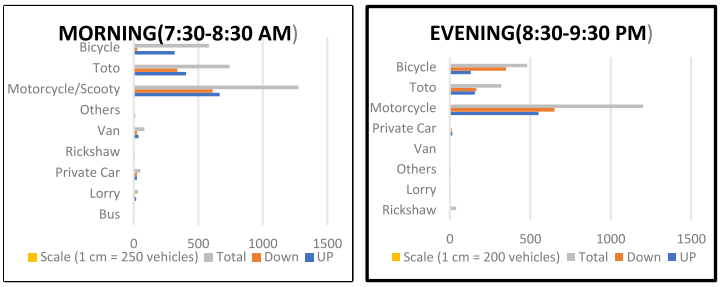
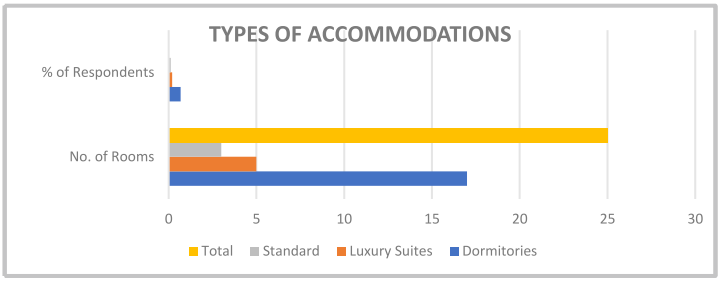


Fig 11(d): The traffic survey data of the area from Ballavpur to Sriniketan

Hotel Survey: A hotel survey identifies areas for improvement in guest experiences from data collected across 16 hotels targeting tourists, corporate travellers, and families. Guests come from various regions, including local districts, other states, and countries like Bangladesh and the USA. Hotels see spikes in guests during events such as Sonajhuri haat and Poush mela. Amenities offered include free Wi-Fi, in-room dining, and parking, with discounts for different customer types. Most hotels lack eco-friendly practices beyond waste management. Many faced significant losses during COVID-19 and now struggle with staff shortages and the closure of Vishwa Bharati to tourists. They plan upgrades like solar panels, CCTV, room maintenance, and improved service.



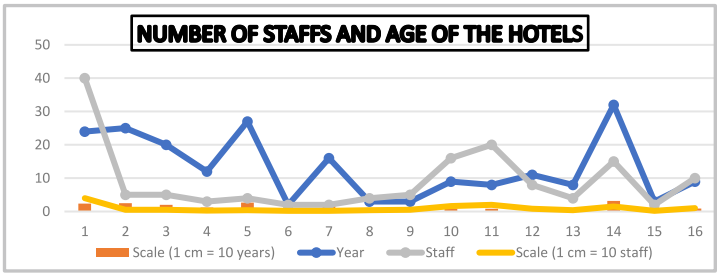


Fig 12 (a and b): Various accommodations, numbers of beds, staffs and hotel life in Sriniketan

The list of Hotels in Ballavpur with respective numbers of beds is (Hotel Royal Bengal (32beds), Sri Sri Mahananda Sevasram (16 beds), Hotel Emblie (22beds), Lodge Godbuli (15beds), Parabasi Lodge (16beds), Dreamland Guest House (7beds), Sonar Kella Lodge (10beds), Raj Mandir (15beds), Hotel Royal Palace (28beds), Green Chilli (22beds), Lodge Ashribad (35beds), Sanai Lodge (23 beds), Udayan Lodge (7 beds), Rangamati Hotel (24 beds), Shantanibai Hotel (15beds) Bolpur Lodge (25beds) and many other Hotels in and around Ballavpur area. The other list of hotels is:

Table 2: The number of Hotels and Guest Houses in the Sriniketan area in Ballavpur and Kabimohanpur

#	Name of the unit	Address	Sl No	Name of the Unit	
1	Shakuntala Vil. Resort	Kabimohanpur. Municipality ward 1; P.O. & P.S.- Santiniketan, Birbhun-73 1235	9	Baul hut vil. resort	Kabimohanpur, Bolpur Municipality ward no. I, PO. & PS.- Shantiniketan, Birbhum- 731235
2	Ram Shyam Resort		10	Roshnai Vil. Resort	
3	The Cristallo Resort		11	Sonajhuri Atithi Nivwas	
4	Palash Boni Resort		12	Mukta Dhara Guest House	
5	Krishna Utsab Resort		13	Bono Lota Bagan Bari	
6	Sonajhuri Bagan Bari	Ballavpur, Ruppur GP, P.O.- Sriniketan. P.S.- Santiniketan, Birbhum-73 1236	14	Resort Sanjhabati	
7	Sanchari Restaurant (Unit of Udayan)		15	Resort Titili	
8	Maharshi Niwas	Ballavpur-Rupur GP, Sriniketan. Birbhum -73 1236	16	Tanubithi Resort	

ENVIRONMENT SURVEY

Environmental surveys and various sources of pollution are conducted to identify the current state of an area's environment for the identification of potential environmental issues. Shriniketan was famous as a clean place. According to residents, water pollution has surged, and wastes from the overuse of plastic and anthropogenic waste are the main causes of water pollution. Transportation is the prime source of air pollution, followed by open burning.

Grid-supplied electricity is the primary source of energy in the area. There is no systematic waste management of the main solid and liquid waste management plants before disposal. There is no plastic-free zone in the region. Bolpur municipality has two separate units of biodegradable and non-biodegradable waste collection chambers. It can be concluded that Shantiniketan is generally clean with a focus on preserving the natural beauty of the area.nd Guest House (7beds), Sonar Kella Lodge (10beds), Raj Mandir (15beds), Hotel Royal Palace (28beds), Green Chilli (22beds), Lodge Ashribad (35beds), Sanai Lodge (23 beds), Udayan Lodge (7 beds), Rangamati Hotel (24 beds), Shantanibai Hotel (15beds) Bolpur Lodge (25beds) and many other Hotels in and around Ballavpur area. The other list of hotels is:

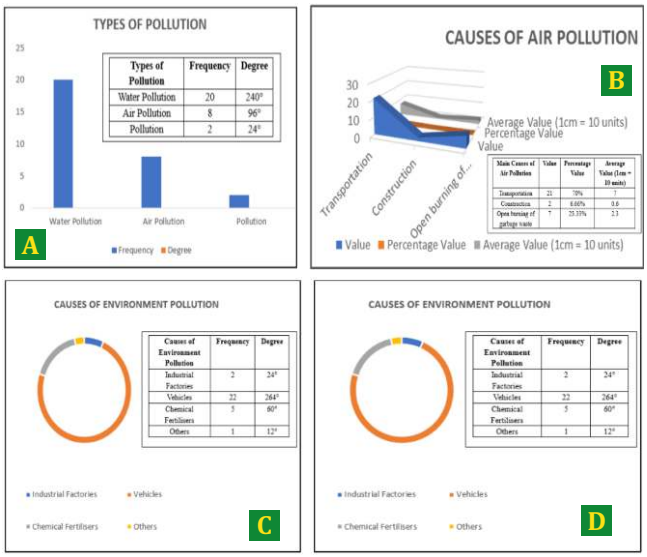


Fig 13(a to d): Various types of pollution and their causes in the Ballavpur area, Sriniketan

Waste management in the Ballavpur area

The local Gram Panchayat (GP) or nearby Bolpur Municipality manages daily door-to-door waste collection, promoting segregation of wet (decomposable) and dry (paper, plastic, metals, glass) waste at source. West Bengal Waste Management Ltd (WBWML) handles hazardous, biomedical, and municipal solid waste. Visva-Bharati University and local NGOs run awareness programs to encourage community participation in waste segregation and reduction.

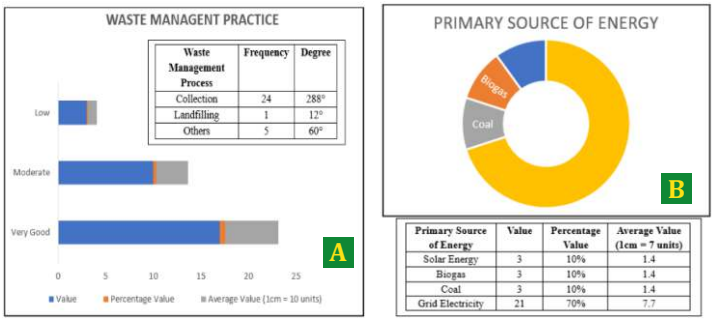


Fig 14 (a and b): (a) The waste management practices; (b) The primary sources of energy in Ballavpur

Discussion

The microlevel investigation of an agglomerating village and urban areas is warranted, but is gradually deteriorating due to the Sun-Earth geometry, anthropogenic stresses and over-exploitation of energy and resources. It is essential to study hydro-morphology, societal impact, human-induced factors, climate change, geohazards, and anthropogenic stresses. The use of big data, cloud platforms, and GIS technology, along with hyperspectral imagery, has facilitated the investigation process.

On a visit to the site, the following discrepancies were observed.

a. Hotels, guesthouses, resorts and lodges have surged up in the Ballavpur area, which is deteriorating the region's solitude, particularly inside the Sonajhuri forest.

b. These unplanned settlements, hotels and lodges have accorded the GP's approval but not at par with Municipal Laws.

c. As per local people's statement, the Ballavpur GP's Haat, though scheduled for two days, Monday and Tuesday a week, is organised for 6days/week except on Wednesday. Whereas the shops are open and gatherings are held during the six days, generating huge municipality waste.

d. The wastes are dumped and accumulated within the premises of the Sonajhuri Haat area, and there is no scope for solid waste management.
e. No parking management and littered without proper disposal of solid, liquid and sewage disposal, rather scattered the plastics and alcohol bottles.
f. Unauthorisedly, the Sonajhuri forest is deforested and used by the public as firewood.
g. The panoramic area should be maintained with Green Field Theory (or somewhere the concept of Brown Field Theory

Recommendations:
The following recommendations are suggested by the
1) None of the hotels/resorts/guest houses visited during inspections possess Consent to Operate of WBPCB, but they are all found operational. However, for the operation of such hotels/resorts/guest houses, Consent to Operate of WBPCB is mandatory.
2) The Birbhum District Administration and Birbhum Forest Division may decide regarding frequency of occurrence of Sonajhuri Haat and allied parking of motor vehicles in Sonajhuri Forest.
3) The concerned local authority should develop a proper solid waste management plan for the Sonajhuri Forest area [22].
4) Birbhum Forest Division should look after the upkeep of trees in Sonajhuri Forest area and see that there is no illegal felling of trees and unauthorised use of wood & logs.
5) Pally Sangathans and Mahadal (Self Help Group), in Sriniketan, should be actively involved in tribal development. Visva Bharati should promote free coaching in sports, education, and culture.
6) Immediate restoration of the drainage system is essential for sediment, fish, and groundwater to achieve Sustainable Development Goals (SDGs). This data is vital for sustainable management of the Kopai River, supporting the region's cultural heritage and ecological balance.
7) At Poush Mela, Magh Mela, and in Ananda Bazar, requires higher participation of SCs and STs [23].

CONCLUSION
It can be concluded from the socio-economic profile of the Ballabhpur mouza that the urban impact of Bolpur town has played a role in the overall development of the mouza. Apart from providing certain infrastructural facilities like market, post office, hospital, bank or police station, etc., the town has not particularly played an important role in the employment generation in the mouza as well as in strengthening its economic base. The villagers often prefer to buy consumer goods or enjoy entertainment, medical, educational and other infrastructural facilities in Bolpur town.
It is not surprising that manifestations of rural-urban linkages are rarely noticed in the case of the socio-economic development of Ballabhpur Mauza, lying in the vicinity of a fast-developing township in Bolpur.

References

1. Wang C, Zhang W, Gao Y, Sun J. The Impact of Geographical Location of Households' Residences on the Livelihoods of Households Surrounding Protected Areas: An Empirical Analysis of Seven Nature Reserves Across Three Provinces in China. Land. 2025; 14(6):1231. https://doi.org/10.3390/land14061231
2. Chen L, Wang X, Cai X, Yang C, Lu X. RETRACTED: Combined Effects of Artificial Surface and Urban Blue-Green Space on Land Surface Temperature in 28 Major Cities in China. Remote Sensing. 2022; 14(3):448. https://doi.org/10.3390/rs14030448
3. Sarkar S., Barman P. (2023). The Cultural Heritage, Abode of Peace and an Institution of National Importance with Special Reference to Tagore's Visva-Bharati, Santiniketan. IJCRT, 11(7), 405-411.
4. Samanta RK. 2017. Influence of Visva Bharati, Santiniketan and Sriniketan over the surrounding Villages.
5. Mishra, SP., Mondal, A., Mondal, T. (2025). Unveiling Societal Hydro-Morphology of the Lower Kopai River, West Bengal, India. AJEE, 24 (7):244-62, doi.org/10.9734/ajee/2025/v24i7766
6. Das P., Saha TK., Mandal I., Debanshi S., Pal Swadesh. Evolution of rills and gullies in the lateritic Badlands region of the Indian Rarh tract. J. Earth Syst. Sci. (2023) 132:7 Indian Academy of Sciences https://doi.org/10.1007/s12040-022-02009-6
7. Ghosal J (2022). Ethnographic Study of Potters: A Case Study on Kopai River Valley, Birbhum District, West Bengal. Heritage: Journal of Multidisciplinary Studies in Archaeology 10 (2022-23): 715-736
8. Ghosh, S., Islam, A., Quesada-Román, A., Reza Md. A, Islam, T., Subodh Chandra Pal SC., Das BC., (2023): Taxonomic approach and potential anthropic indices to understanding cross-sectional morphology and landscape modification of a Tropical River Basin, India, Physical Geogra., DOI:10.1080/02723646
9. Mishra D.P., Mishra S.P., Cottage Industry and Handicrafts Sectors in Eastern India: Ticking the Right Boxes for Socio-economic Development. Purvodaya, The rise of Opportunities, (2023), Institute of Social and Cultural Studies, India, 3(5), 5-8
10. Census (2011) Government of India. http://censusindia.gov.in
11. Mondal J. (2025). Geological characteristics and their influences on the topography: A case study on Santiniketan and its surroundings, Int. J. of Geogr., Geology and Env. 7(6): 05-13
12. Ghosh S. (2018). Gully Erosion and Its Impact on Regional Development: A Case Study of Bolpur-Sriniketan Lateritic Patch. 0-55, doi:10.13140/RG.2.2.31405.14567
13. Mishra, SP., Roy, R., Mishra, S. 2025. "Cataclysmic Morpho Dynamics of the Lower Damodar River Basin, India. Journal of Geography, Environment and Earth Science International 29 (5):140-65. https://doi.org/10.9734/jgeesi/2025/v29i5899
14. Biswas B., Sharma KK. (2025): Development of infrastructure and its impact on Sustainable livelihood resilience in the rural areas of the Rarh region in India, Asia Geographer, 1-30. DOI: 10.1080/10225706.2025.2453141
15. Jha VC., Ghosh S. (2022). Environmental Risk Assessment: A Geomorphic Investigation over the Bolpur-Santiniketan-Illambazar Lateritic Patch of Birbhum District, West Bengal, India. National Geographical Journal of India 66(2):94-110, DOI: 10.48008/ngji.1733
16. Chakrabarti S., Patra PK., (2016). Chemical Analysis of Ground Water of Bolpur Block, Birbhum, West Bengal, India. 9(4), 627 – 633,
17. Mishra, SP.; Padhi, S.; Shuvamjeet Manna, Ayan Mondal, and Tanushree Mondal. 2025. "Fluvio-Geomorphologic Analysis of Lower Ajoy River, West Bengal, India. CJAST; 44(4):66-90. https://doi.org/10.9734/cjast/2025/v44i44516.
18. Banerjee, S. & Khanna, D. (2021). "Mass Tourism: Its Challenges and Sustainability: A Study on Santiniketan and Its Surroundings." Indian Cartography. 7(1) 2021 IJARIIE-219-223

19. Chakrabory P., Rana PB., Biswas R., (2024). Visva-Bharati-Santiniketan, A UNESCO WHS: A Role Model of Deeply-Rooted Education, Andre-Connecting Culture. EdA -IJAE (Rome), 11 (1): pp. 52-67
20. UNESCO (2023): Santiniketan as World Heritage Site, Retrieved from: https:// whc. unesco.org/en/list/1375.
21. Mishra SP., Mondal A., Mondal T. (2025). Geospatial-analysis-of-Socio-Economic-Health-Gnathang-Valley-and-Sikkim-Himalayas. Env. Reports: an Int. J., 7(2):199-212, DOI: 10.51470/ER.2025.7.2.199
22. The National Green Tribunal No Report 2. Eastern Zone Bench, Kolkata, (2025). Original Application No. 79/2025/EZ, Subhas Dutta vs the state of West Bengal and others
23. Roy S. (2024). Balancing Tradition and Modernity: The Brand Personality of Santiniketan as a Tourist Destination. 13(3), https://doi.org/10.1177/2277977924129526

Data from various links used

- www.natmo.gov.in
- National Geographical Department 'Vol XXXI'
- India Meteorological Department (IMD)
- https://mausam.imd.gov.in
- West Bengal Tourism Development Corporation Ltd. 2021. Popular Tourist Destinations. Available from: https://wbtourism.gov.in/properties-department
- Yatra Online Private Limited. 2021. Santiniketan Tourist Lodge. Available from: www.yatra.com/hotels/hotels
- District Information System for Education (DISE), 2017.