

The Regional Development and Planning in Sundarbans: A Comprehensive Analysis of South 24 Pargana's District; West Bengal, India

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Abstract: *The Sundarbans, a vast mangrove delta straddling the border of India and Bangladesh, stands as one of the world's most ecologically sensitive and economically significant regions. This research delves into the intricate dynamics of regional development and planning in the Sundarbans, examining the interplay between environmental conservation, economic growth, and social well-being. By synthesizing existing literature, statistical data, and on-the-ground case studies, this research aims to provide a comprehensive overview of current regional development strategies in the Sundarbans. It evaluates the effectiveness of policies implemented by both India and Bangladesh in fostering sustainable growth while preserving the fragile ecosystem. This study can help to identify and understand key regional challenges, formulate effective strategies, and promote sustainable development to enhance the overall quality of life in the region and develop policies for better planning. The scope of studying regional development and planning in the Indian Sundarbans is vast and multidimensional. It encompasses ecological sustainability, economic growth, social welfare, and effective governance. Key aspects include biodiversity conservation, community livelihoods, disaster resilience, and the impact of climate change. Understanding the unique challenges of this region can contribute to the formulation of holistic strategies for balanced and inclusive development. The nature of this study is interdisciplinary, drawing from fields like economics, geography, sociology, and environmental science.*

Keywords: Sundarbans, Multidimensional, Regional Development, Sustainability, Planning

1. Introduction

In the present time, Region - based study is the most considerable theme in geography. Because proper regional development and planning can only reveal a better life quality and valuable lifestyle for humanity. Study area The Indian Sundarbans region is part of the largest and most active Delta of the World Ganges Delta. As per the research conducted it is believed that the Sundarbans have soaked in 4.5 crore tons of carbon dioxide. The study area Indian Sundarbans comprises the extreme limit of the state of West Bengal and the boundary is demarcated by the river Hooghly on the West, the Bay of Bengal on the South, the Ichamati - kalindi - raimangal rivers on the east and by an imaginary line (Dampier & Hodge line) in the North (Banerjee 1998). Historically, the entire extent of Indian Sundarbans used to be under dense mangrove forests. Over the years, 54 islands were reclaimed for human settlement and the present extent of mangroves only extends to the remaining islands encompassing an area of 2155 sq. Km (Forest Survey of India in 2011). Most of the study area falls within the territory of an active Delta which still undergoes natural erosion and accretion under the influence of numerous tidal creeks and channels. A network of nearly 4000 km of earthen embankment essentially serves as the key to survival for many of these extremely low - lying islands. The region is also severely threatened by relative sea level rise. Officials reports suggest that the relative sea level rise in the region is about 5.22 mm/ year at the Diamond Harbor Gauge station situated in the Western part of the Indian Sundarbans

(INCA2010). Indian Sundarbans are spread across 19 coastal development blocks (CBD); where 13 are in the district of South 24 Parganas and 6 are in the district of North 24 Parganas in West Bengal. From the demographic perspective, the study area hosts a predominantly rural population of nearly 4.37 million with a staggering density of 957/sq. km; most of which thrive on coastal agriculture. Our study paper primarily focuses on the regional development and planning strategy of Sundarbans and the impact of regional development indicators (Social, economic, and environmental) on human life.

2. Study Area

Indian Sundarbans are unique in all aspects. The area is Geographically confined between 21°32" N to 22°40" North latitude and 88°05" E to 89°00" East longitude and the boundary is demarcated by the river Hooghly on the West, the Bay of Bengal on the South, the Ichamati - Kalindi - Raimangal rivers on the east and by an imaginary line (Dampier & Hodge line) in the North (Banerjee 1998). The Indian Sundarbans comprises 19 blocks (6 blocks from North 24 Parganas and 13 blocks from South 24 Parganas). But in the present study, we have taken only South 24 Parganas districts which consist of 13 blocks. Sundarbans of India cover parts of North and South 24 Parganas of West Bengal with an area of 9630 sq. Km. It contains 120 islands of which only 54 islands are inhabited (Mandal, A. K. et al.1989).

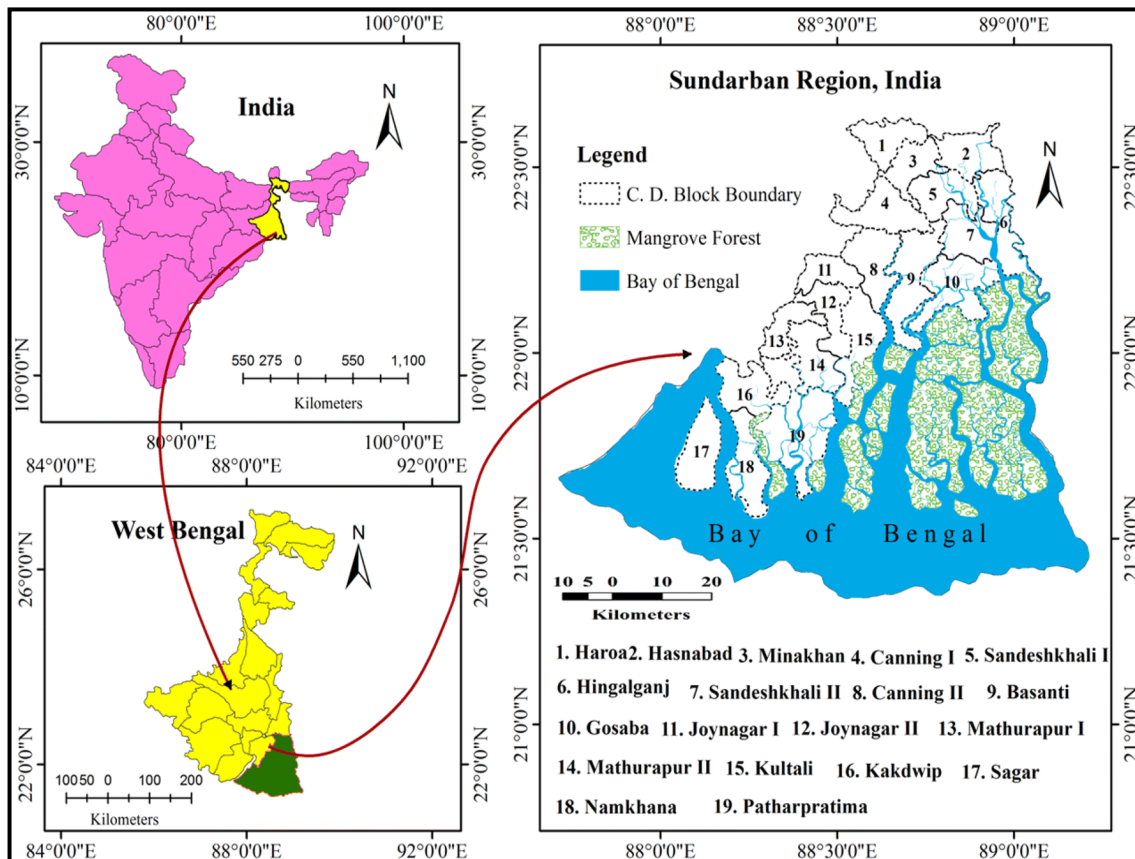


Figure 1: Location map of the Study Region

3. Objectives of the study

- 1) Compare, analyze, and understand variations in several regional elements.
- 2) Planning and implementing regional infrastructure projects to facilitate economic activities and improve connectivity within the region.
- 3) Focusing on long - term sustainability by considering several regional development factors in the planning process.
- 4) Assessing and mitigating potential risks and vulnerabilities that may impact regional development.

4. Review of Earlier Literature

For preparing our paper we used several pieces of literature and several writers' and geographer's thoughts, opinion, and data that and used several important parts of their papers. Lots of research papers or works have been done on this topic by several writers and Geographers, such as "Sundarbans Mangrove of India" (Chakrabarti, K.1987). "Sundarbans: A Socio - Bio - Ecological study" (Mandal, A. K and Ghosh, R. K 1989). "Assessing socio - economic vulnerability to climate change - induced disasters: Evidence from Sundarbans Biosphere Reserve, India: this paper focuses on several socioeconomic infrastructures with

climate change written by Maheeb Sahana, safari Rehman, Ashish Kumar Paul, and Haroon Sajid. " Spatial analysis of land use and land cover changes and its impact on the ecosystem of Indian Sundarbans" by A. Mukhopadhyay, et al. (2018) in the Journal of Environmental Management. The Sundarbans region has been inhabited since at least the 4th century BC (Mandal, 2003). The modern identification of land use started with the trading posts of the English East India Company in the 18th century and continued under the rule of India by a Governor - General appointed by the British in the 19th century (Gupta, 1962). The first reference to the concept of infrastructure was made by Hirschman (1958). Social overhead capital (SOC) according to him, comprises' those basic services without which primary, secondary and tertiary productive activities cannot function (Hirschman, 1958). Evidence of human ingress, in the Sundarban region in the form of proto - urban settlement, back to the Mauryan period (Pandit 2013). In Mauryan period (321 - 226 BC) emphasized forest management. However, during the Gupta Dynasty (AD 320 - 415), extensive tracts of land were created and converted into agricultural land. After this period, started pre - Mughal era, during this time, the region was known to be inhabited by the Hindi Bengali caste of Pod in the West and Chandals in the east, who practiced fishing as a livelihood. Then in 1584s, formed many villages in the Sundarban region. While some distribute to Portuguese and native pirate incursions, narratives on the shift in the river course, leading to increased salinity of the agricultural land, are also present (Chakrabarti 2009). Thus, forms the Indian Sundarban region.

5. Research materials and methods

The present analysis has been carried out in the South 24 Parganas (13 blocks). The nature of the achievement in different sectors of basic regional infrastructure has been discussed both at district and sub - district levels. These 13 blocks have been treated as micro - level units for this study. Data have been collected from various sectors, like the Census of India, the Bureau of Applied Economics and Statistics, the Government of West Bengal, the Indian Railways, the lead bank office, the Baruipur subdivision, etc. Certain basic parameters from each broad sector of the infrastructure have been selected. The intention is to make a more comprehensive study across the C. D. blocks of the districts in terms of regional infrastructural development. The methodology of this calculation has been discussed in detail later in the related sectors.

6. Database and Methodology

Data was collected from several secondary and primary sources, that were already discussed in the methodology. The study sample consisted of 300 male and female population from 28 age groups of 12 to 32 years from different areas of South 24 Parganas District. For each age group, more than 20 subjective were surveyed. Out of 300 respondents, 200 were married whereas 100 were unmarried. Out of

these 80 are students, 110 are housewives, 90 are workers and more than 20 are government service men. Tools commonly used for the study of regional development and planning include Geographic Information Systems (GIS), Statistical software for data analysis, Remote sensing technology, economic modeling tools, and stakeholder engagement techniques. These tools help analyze spatial data, assess infrastructure needs, and involve communities in the planning process. A random survey was conducted in several blocks of Sundarbans (Indian parts), wherein subjects were personally interrogated about their prior concern, and all the information was noted in the questionnaire. A questionnaire was mainly divided into several parts, namely general profile, family details, marital details, health and education details, etc. obtained through information about the respondents.

7. Result and Discussion

7.1 Agriculture:

Agriculture traditionally acts as a major source of income and employment for South 24 Parganas, though recently there has occurred a large - scale decline in the share of agricultural workforce. Its contribution to income generation has also been falling. Agriculture in this district has remained largely traditional in nature. South 24 Parganas concentrates on the cultivation of food crops mainly. The area under food crops was more than three - fourths of the total cultivated area in 2010 - 11. Till now there has been an overwhelming preponderance of paddy cultivation, especially the monsoonal variety. The area under rice was more than 70 percent of the total cultivated area in 2010 - 11. Other food crops include pulses, wheat, barley, and maize mainly. Major non - food crops are oilseeds, potatoes, chilies (dry), ginger, jute and sugarcane. The yield of most of these principal crops was lower in South 24 Parganas than in West Bengal in 2010 - 11 (Table 2). Both fruit and vegetable production increased in this district during the last decade. Fruit production grew by 67.49 percent and vegetable production by 34.92 percent.

Between 1983 - 84 and 2010 - 11 all the blocks in Region I, except Bishnupur II, and six blocks in Region II registered an increase in agricultural productivity. However, such an increase was marginal in most of the cases. Falta, Kulpi, and Mandirbazar in Region II demand special mention. In Region III productivity increased only in five out of thirteen blocks. These were Gosaba, Jaynagar I, Mathurapur I, Kultali and Namkhana. However, there was a decline in the average agricultural performances of C. D. Blocks between 2001 and 2011, especially in Mandirbazar, Mathurapur II Canning II, Gosaba, Patharpratima, Kakdwip and Namkhana. The cyclone 'Aila' in 2010 badly affected the productive capacity of the area. This should be treated as an area of concern, as these are the rural and largely agricultural parts of the district. The status of the availability of two basic inputs has been discussed in this context.

Table 1: Yield rate of principal crops in South 24 Parganas and West Bengal (1980 - 2011)

Crops	Production, Kilograms/ hectare							
	1980 - 81		1990 - 91		2000 - 01		2010 - 11	
	South 24 Parganas	West Bengal	South 24 Parganas	West Bengal	South 24 Parganas	West Bengal	South 24 Parganas	West Bengal
Rice	1280	1442	1220	1795	2036	2287	2302	2576
Wheat	2224	1672	1860	1970	1746	2485	2557	2760
Pulses	495	454	262	616	791	800	921	1031
Oilseeds	462	1133	1133	884	704	953	1309	962
Jute	1487	1310	2264	1978	1863	2182	2088	2576
Sugarcane	Na	6057	5953	7069	64315	67821	81190	75518
Potato	12500	17057	13474	23046	20521	25606	25558	32831
Chilies (Dry)	618	702	736	764	524	894	2259	1512
Ginger	1236	300	300	1696	400	2026	1504	2157

Source: Statistical Abstract, West Bengal, 2005; District Statistical Handbook, South 24 Parganas, 2010 - 2011 (Combined); Statistical Handbook, West Bengal, 2011, Bureau of Applied Economics and Statistics.

7.1.1 Agricultural area per agricultural worker:

Table 2: Broad pattern of land utilization in South 24 Parganas and West Bengal

year	Proportion of area, %					
	Cultivable Land		Area not Available for cultivation		Forest land	
	South 24 Parganas	West Bengal	South 24 Parganas	West Bengal	South 24 Parganas	West Bengal
1995 - 96	42.36	67.53	13.52	18.89	44.12	13.58
2000 - 01	41.61	67.95	14.27	18.35	44.12	13.70
2005 - 06	40.73	66.28	14.31	20.19	44.96	13.53
2010 - 11	39.95	65.30	15.11	21.20	44.94	13.50

Source: Statistical Abstract, West Bengal, 2005; District Statistical Handbook, South 24 Parganas, 2010 - 2011 (Combined), Bureau of Applied Economics and Statistics.

7.1.2 Irrigation System:

The irrigation system is of tremendous importance to the agricultural sector in countries with monsoonal climates, like India. Though the share of the total cultivated area with irrigation facilities increased during last two decades, less than one - third of net sown area was irrigated even in 2010 - 11 (Table 3). Government canals remained by far the most dominant source of irrigation in this district in terms of area covered. C. D. Blocks within Region I and Region II had a much better status in terms of the availability of irrigation facilities than the blocks of Region III in 2010 - - 11. Falta, Bishnupur I had more than 80 percent of the net sown area under irrigation, while Bhangar I and Diamond Harbour II had more than 60 percent area under this facility. In Region

III achievement was very poor in Gosaba, Basanti, Jaynagar I and II, Kultali, and Patharpratima having less than one - tenth of the net sown area under irrigation. Lack of adequate irrigation facilities is a major constraint resulting in low cropping intensity, less crop diversification, and limited agricultural commercialization. The mono - cropping pattern of cultivation is followed largely because of poor irrigation facilities and high soil salinity. The main causes for the slowdown in the expansion of irrigation are:

- a) deceleration in capital formation in the public and private sectors after 1996 - 97,
- b) decline in the availability of electric power to agriculture, and
- c) stress on water resources (Chand et al., 2011).

Table 3: Agricultural area under irrigation in South 24 Parganas (1990 - 2011)

Year	1990 - 91	1995 - 96	2000 - 01	2005 - 06	2010 - 11
Irrigated area in ' (000 hectares)	53.327	83.91	71.036	109.54	106.39
Irrigated area (as Percentage of net sown area)	13.35	21.08	18.78	29.58	29.68

Source: Developed by the author based on data available at the Bureau of Applied Economics and Statistics

Government canals remained by far the most dominant source of irrigation in this district in terms of area covered. In 2010 - 11, Falta, Bishnupur - 1 had more than 80% of the net sown area under irrigation, while Bhangar - 1 and

Diamond Harbour - 2 had more than 60% area under this facility.

7.2 Literacy rate and education

Year	Teachers in educational institutes/1000 students						
	Primary schools	High schools	Higher secondary schools	Total schools	Degree colleges	Technical schools	Technical colleges
1991	16	86	64	19	38	226	24
2001	14	25	24	18	15	98	45
2011	12	17	16	19	18	47	104

Literacy status is generally considered one of the most influential elements of human development. Literacy rate positively influences the rate of participation in gainful work, quality of workers, and level of productivity. South 24 Parganas improved continuously in terms of literacy status (Table 5). In 2011, with a total literacy rate of 67.77 percent, it ranked ninth among the districts of West Ben gal. Rural literacy increased more rapidly, by 43.44 percent points, than urban literacy (21.67 percent points) during the last six decades Out of twenty - nine C. D. Blocks, the literacy rate was over 70 percent in nine blocks and more than 60 percent in seventeen blocks as per the latest census of 2011. All C. D. Blocks in the north - western part nearing Kolkata, except Bishnupur I, had literacy rates over 70 percent. In C. D. Blocks in the central and southern part of the district was it more than 60 percent. There were some exceptions. The four most remote blocks within or around the Sundar bans, namely Namkhana, Sagar, Patharpratima and Gosaba, performed better than many others. These blocks had literacy rates over 70 percent. On the other hand, in Canning II, Basanti, and Kultali the literacy rate was between 50 percent and 60 percent. However, the highest literacy was always found in areas closer to Kolkata, while the lowest literacy rate in distant parts. For instance, in 2011 Sonarpur had the highest literacy rate (78.80 percent) and the lowest rate was in Canning II (55.07 percent). One more good observation is that the literacy differential between rural and urban areas has been decreasing with time. The urban literacy rate remained higher than the rural rate in most of the blocks. There has been a continuous rise in both male and female literacy rates in this district with a simultaneous decline in gender disparity since 1951. Male and female

literacy rates were 72.91 percent and 62.39 percent respectively in 2011.

7.2.1 Status of major educational parameters:

Table 4: Selected educational parameters of South 24 Parganas (1991 - 2011)

Crude literacy rate, %			
Year	Total literacy rate	Rural Literacy rate	Urban Literacy rate
1951	23.58	22.20	52.32
1961	28.64	27.30	46.40
1971	30.46	28.58	49.83
1981	37.00	34.56	54.90
1991	44.63	41.93	62.26
2001	58.89	56.62	71.07
2011	67.77	65.64	73.99year

Source: Computed by the author from District Statistical Handbook, South 24 Parganas,

7.3 Healthcare System

The number of medical facilities in South 24 Parganas has grown over time, with a decline observed between 2003 and 2005. There were 188 private healthcare systems, 100 public healthcare systems, 1 institute managed by local government, and 1 central government undertaking institute in the districts in 2010–11. Since 2006, there has been a relative drop in the accessibility of the public healthcare system, as well as a surge in private healthcare institutions, according to detailed data on medical infrastructure that has been accessible since 2003.

Table 5: Status of selected medical parameters in South 24 Parganas and West Bengal (1991 - 2011)

year	Hospitals/100000 population		Total medical institutions/ 100000 population		Beds/100000 population		Doctors/100000 population	
	South 24 Parganas	West Bengal	South 24 Parganas	West Bengal	South 24 Parganas	West Bengal	South 24 Parganas....	West Bengal
1991	0.31	0.58	2	5	32	98	NA	72
2001	0.26	0.54	3	12	23	89	3	56
2011	0.22	+2.53	4	+15	61	+118	10	NA

Explanation: NA= data not available Source: *

District Statistical Handbook, South 24 Parganas, 1995, 2002 and 2010 - 2011 (Combined), Bureau of Applied Economics and Statistics; # Statistical Abstract, West Bengal, 2002 - 03, Bureau of Applied Economics and Statistics; + Economic Review, Statistical Appendix, West Bengal, 2011 - 12, Bureau of Applied Economics and Statistics

Explanation: NA= data not available Source: *

District Statistical Handbook, South 24 Parganas, 1995, 2002 and 2010 - 2011 (Combined), Bureau of Applied Economics and Statistics; # Statistical Abstract, West Bengal, 2002 - 03, Bureau of Applied Economics and Statistics; + Economic Review, Statistical Appendix, West Bengal, 2011 - 12, Bureau of Applied Economics and Statistics

7.4 Transport facilities

Mainly in the Indian Sundarbans region, there are two principal components of transport infrastructure, namely roadways and railways, and some parts are carried out by waterways. These are -

7.4.1 Roadways:

Between 1993–1994 and 2010–11, the total road length expanded by about nine times, from 4, 000.80 kilometers to 35, 028 kilometers. By the end of the 1990s, road length had increased dramatically. From 2, 702.71 kilometers in 1993–1994 to 14, 175.15 kilometers in 2010–11, the length of metaled roads expanded practically constantly, representing

an increase of just over five times. Unmetered roads, on the other hand, had a growth throughout this time of over seventeen times, or from 1225.06 kilometers to 20853.23 kilometers.

7.4.2 Railways:

The extent of railway construction in the Sundarbans has been restricted. The densities of railways are lowest in Jaynagar 2, Namjhana, Mathurapur 1 and 2, Canning 1, and highest in Budge Budge 1, Baruipur, and Diamond Harbour 1.

Table 6: Length and density of railways in South 24 Parganas, 2020 - 21

C. D Blocks	Railway length, Km	Railway density, km/100 sq km
Canning 1	8	4.26
Baruipur	36	15.30
Sonarpur	11	6.25
Magrahat 2	12	8.76
Magrahat 1	9	7.56
Diamond harbour 1	8	10.15
Joynagar 1	13	9.92
Mathurapur 1	8	5.43
Mandirbazar	6	5.08
Kulpi	16	7.59
Kakdwip	17	6.73
Namkhana	8	2.16
Budge budge 1	8	18.14
Mahestala	9	8.39
Jaynagar 2	2	1.05

Explanation: * – Approximate lengths, Source: Eastern Railways, Sealdah Sub - division

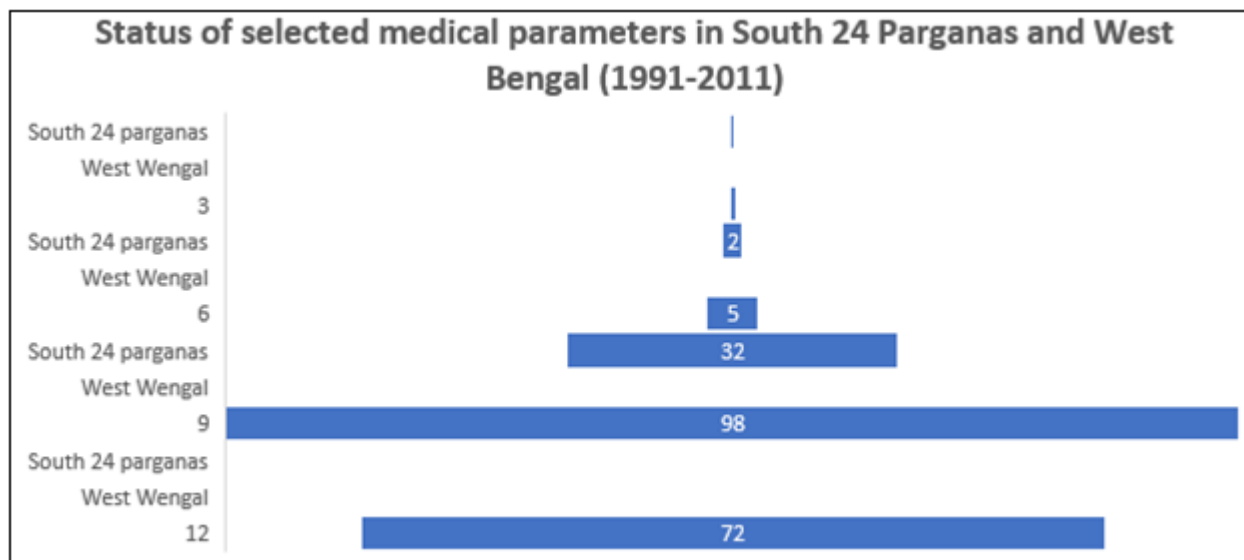
The total highest road density is in Jayanagar 1 (25.29 km/sq), and the lowest density was in Basanti (2.41 km/ sq), preceded by Kultali (2.82 km/sq).

7.5 Electrification

Over the past 20 years, the overall power consumption in the Indian Sundarbans has climbed significantly, rising from 59721 KWH in 1990–1991 to 673700 KWH in 2010–2011. In the 1990s, consumption was 257.58%, and in the most recent ten years, it was 215.48 percent. Between 1990–1991 and 2010–2011, its proportion of total consumption rose from 43.80 percent to 61.24 percent. In 1981, 42.23 percent of urban homes and 4.35 percent of rural households had electricity. Thakurpukur Maheshtalahad the highest percentage of households in 2011 (93.50 percent), followed by Sonarpur, Budge Budge 1 (83.63 percent), and Baruipur (65.30 percent). There have been some railway buildings in the Sundarbans. Railway concentrations are highest in Budge Budge 1, Baruipur, and Diamond Harbour 1, and lowest in Jaynagar 2, Namjhana, Mathurapur 1 and 2, and Canning 1.

7.6 Financial services

The Indian Sundarbans region offers two types of financial services: cooperative societies and banks. However, due to the remote location and underdeveloped environment that contribute to the labor force's growing marginalization, the percentage of workers with part - time, irregular, and less secure job returns has been rising quickly.



7.7 Household amenities

Drinking water and sanitary facilities are the two home utilities in the Sundarbans area.2011 saw Sonarpur come in second place with the best accomplishment coming from Bhangar 2 (39.78 percent). More than 20% of drinking water facilities were available in ThakurpukurMaheshtala, Budge Budge 1 and 2, and Bishnupur. Nonetheless, there were still wide variations in household access to sanitary services at the C. D. Blocks level.

7.8 Environmental Characteristics

The Sundarbans is one of the largest mangrove forests in the World and takes its name from the dominant mangrove

species, Heritiera fomes, locally known as the Sundari tree. Mangrove forests are biologically productive ecosystems and Sundarbans, too, is home to a very rich floral and faunal diversity. The region encompasses 85% of mangrove habitat in India with 63 to 69 mangrove species found in the country (Danda et al.2011). The algal flora of Sundarbans has not been examined in detail, however, a total of 150 species has been identified in a recent study in the Indian part of Sundarbans (Naskar et al.2004).

A total number of 1434 faunal species has been recorded, despite a fragmented record of most faunal groups in the region (Das and Nandi 1999). The rich estuarine and coastal marine life on the Indian side of the forest consists of 165 species, which include Hilsa (Tenualosailisha), spotted

javelin fish (*Pomadasys hasta*), and others (Sanyal 1999). Seven amphibian and 59 reptile species are also present including king cobra, Indian spectacled cobra, Indian python, olive ridley turtle, green turtle, and others (Naskar et al.2004). Several species of kingfisher, white - bellied sea eagles, herons, egrets, storks, sandpipers, etc., are the waterfowl common in the region. Forest birds like woodpeckers, barbets, shrikes, drongos, and others are also abundantly found. The Sundarbans support one of the largest populations of tiger (*Panthera Tigris*), spotted deer, and wild boar that occur in large numbers and form the principal prey of the tiger (Gopal and Chauhan 2006).

8. Planning Initiatives

Several governmental and non - governmental programs were implemented for the goals of regional development and planning. These programs include: A core area of the 1973 - created Sundarbans Tiger Reserve is part of the Sundarbans National Park, which was named a UNESCO World Heritage Site in 1987. The park was formed in 1984. In January 2019, the Ramsar Conservation designated India's Sundarbans Wetland as a Wetland of International Importance. The system faces several significant obstacles, including the susceptibility to climate change, resource development, conflicts between humans and wildlife, and human activity. The Mangrove Mission was designed to both preserve the local ecology and shield Kolkata from the destructive power of cyclonic storms. The MGNREGA program is being administered by the Forest Department in South 24 Parganas and involves the local populations, particularly women. From

9. Conclusions

The overall performance of the Sundarbans in terms of regional infrastructure is, at the very least, sub - urban regions were determined to have a superior standing than their rural counterparts in the majority of circumstances. Therefore, when it comes to the overall development of these less - developed West Bengal districts, a more balanced regional development acquires essential relevance.

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