Assessing the Ecotourism Potential of Indian Sundarbans for Sustainable Development

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CERTIFICATE FROM THE SUPERVISOR (S)

This is to certify that the thesis entitled **"Assessing the Ecotourism Potential of Indian Sundarbans for Sustainable Development"** submitted by Sri Soumik Sarkar who got his name registered on 1st August, 2014 for the award of Ph. D. (Science) degree of Jadavpur University, is absolutely based upon his own work under our joint supervision and that neither this thesis nor any part of it has been submitted for either any degree / diploma or any other academic award anywhere before.

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Abstract

The Indian Sundarbans consists of 102 islands. People live on 52 of these islands. The total area of Indian Sundarbans is 9630 sq km. The Sundarbans is a symbol of beauty. Green forests full of different species of mangrove trees, rivers, animals, birds, flowers, fruits, fish etc. attract tourists again and again. Eco-friendly tourism gives pleasure to tourists. The Sundarbans tourism industry plays a vital role in the development of the Indian economy, because Sundarbans tourism is the world's largest sector, which generates revenue and foreign currency for the country. Indian Sundarbans has potentiality of tourism and resources that can help in economic growth.

The main purpose of this research is to assess potential ecotourism sites in the Indian Sundarbans by the three bottom lines (social-economics-environment), Geographic Information System (GIS) and Energy Performance Index (EPI). This is based on the ecosystem of the Sundarbans, its ecological and bio-physical properties, and the socio-economic data. All data were gathered through field visits, interviews and secondary data collected from different literature sources.

Chapter I outlines the objectives of the study as follows:

(i) To conduct the landuse/landcover analysis of the study areas.

(ii) To understand the socio-economic profiles of tourists in the study areas.

(iii) To assess the socio-economic, cultural and environmental impacts of tourism in the study areas.

(iv) To assess the physical, economic and socio-cultural impact of tourism.

(v) To assess the environmental performance of the hospitality sub-sector through their Energy Performance Index.

(vi) To make a comparative assessment of the effects of tourism on the environment of the study areas.

(vii) To propose Ecotourism strategies for the Indian Sundarbans.

Five study areas were selected to for the research. These are – Sagar Island, Bakkhali, Jharkhali, Pakhiralaya and Dayapur. Face to face interviews, discussions, field verification and observations and grass root data collection were the primary sources of information. All collected data have been compiled, tabulated, analyzed, processed and presented using excels, GIS and statistical software.

In chapter II, literature reviews are described in five sections: concept of ecotourism, ecotourism vs. sustainable development, ecotourism assessment indicators, individual studies pertaining to ecological footprint, energy efficiency and carbon footprint and studies on coastal regulation zone.

In chapter III, landuse/landcover (LULC) time-series analysis was conducted over four decades of 1986, 1996, 2006 and 2014 using multi-temporal Landsat satellite data under eleven categories – agricultural land, mangrove, settlement with vegetation, creek, mudflat, water body, aquacultural farm, other vegetation, marshy land, beach and open space. Land use / land cover analysis shows that for all five sites the amount of agricultural land has decreased and settlement has increased.

In chapter IV, tourist traffic flow, accommodation facilities and hotel tariff, socio, economic and environmental perception of the domestic and foreign tourists of study areas were studied. The tourist traffic flow shows that the number of tourists in each study area is increasing every year.

In chapter V, energy consumption and the corresponding carbon emission of hotels and lodges were assessed. Energy Performance Index values were quantified in terms of kWh/m^2/year and carbon emission values were quantified in terms of KgC/ m^2/year. The Bakkhali region has the highest level of carbon emissions among the study areas.

In chapter VI, the demographic profiles of the study areas have been studied. Restrictions on irrigation and agricultural facilities have pushed the majority of the population into extreme poverty and paved the way for the development of tourism in certain areas, which is considered to be conducive to local livelihoods. Research has shown local involvement in inter-island boat trips, food / raw material supply, working as a tourist guide, selling non-timber forest products (NTFP), etc. Tourism in the region has benefited financially. In the process, the chapter introduces the population profiles of the five study

areas, maps the growth of tourism on these islands in terms of the hospitality sector and how local people perceive this growth in terms of their employment opportunities, livelihood options and increasing income levels. Although mixed reactions were found during the study, most of the opinions were found to be largely favorable for tourism.

In chapter VII, a comparative summary of the study areas have been presented. The results show that Sagar Island has the highest number of beds (2804), compared to the number of beds (368) in the Jharkhali tourism area. Again, it is seen that Bakkhali hotels consume more energy and emit more carbon than the other four study areas.

In chapter VIII, several strategies have been adopted to make these five tourist sites healthy and environmentally friendly. The importance of these strategies is immense in developing countries and coastal tourism regions.

In chapter IX, the concluding remarks of this research and future avenues of the work have been presented. Major research findings have been given below:

i. With the growth in tourism sector, land use/land cover planning is an important factor as it is seen that the development of tourist sites are taking place by destroying mangroves in Jharkhali and converting agricultural land to fair ground in the Sagar Island.
ii. The number of ‘over night stay tourists’ is higher than the number of ‘day trippers’.
iii. The impact of tourism on the local socio-economy is positive and there is a lot of interest in the community for further development of tourism in the study areas (e.g. home stay tourism).
iv. Ecotourism therefore, can be a tool for environmental protection, local empowerment, poverty alleviation.
v. The carbon footprint check is an essential element of ecotourism, as the level of carbon emissions in this region must be regulated to be not more than the sustainable level to protect the environment.
vi. Local cultural heritage gets encouragement through eco-tourism practices, heritage tourism centering on archaeological sites can also be promoted.

This study demonstrates that the random growth and rapid expansion of tourism and the process of tourism industry with unfavorable geographical conditions have put

tremendous pressure on these five tourist centers. But the great economic potential, limited flow of tourists, decentralization of tourism activities, restructuring of tourism policy, proper zoning, expansion of capacity building of infrastructure, prudent use of resources and its management, involvement of local people and seasonal character of tourism have been put forward on the basis of sustainable development policy, which will help sustain the industry in the long run.

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List of Abbreviations

CREST - Center for Responsible Travel

CRZ – Coastal Regulation Zone

EC - Energy Conservation

EDC - Eco-Development Committee

EF – Ecological Footprint

EPI - Energy Performance Index

ET – Eco-Tourism

FPC - Forest Protection Committee

GPS - Global Positioning System

GSM - Ganga Sagar Mela

IUCN - International Union for the Conservation of Nature

LULC – Landuse/Landcover

NMEEE - National Mission for Enhanced Energy Efficiency

NTFP - Non-Timber Forest Products

SBR - Sundarbans Biosphere Reserve

SOI - Survey of India

STP - Sewage Treatment Plant

STR - Sundarban Tiger Reserve

SWAP - Sundarban Wild Animal's Park

TEF - Touristic Ecological Footprint

TIES - The International Ecotourism Society

UNEP - United Nations Environment Programme

UNESCO - United Nations Educational, Scientific and Cultural Organization

USGS - United States Geological Survey

WCED - World Commission on Environment and Development

WTO - World Tourism Organization

Chapter I:

Introduction

1.1. Introduction:

Ecotourism is a from of tourism, where tourists in visit undisturbed nature-based areas. Ecotourism is nature-based tourism which aims to defend the natural environment and cultural resources through local people involvement as well as generates source of revenue for local people. Consistent with the fundamental definition of “ECOTOURISM” proposed by The International Ecotourism Society (TIES, 1990), it defines Ecotourism as: "Responsible travel to natural areas that conserves the environment and improves the welfare of local people". Ecotourism is nature-friendly, ecologically sustainable and economically beneficial to the local community.

Ecotourism is a shape of tourism that is recommended for its “potential to simultaneously support conservation and the sustainable development of local communities” (Ross and Wall, 1999).

Tourism has already achieved unplanned extraordinary growth in response to population demand and advert-hoc way in Sundarbans Biosphere Reserve which is a unique mangrove ecosystem in the World. “The tourism sector is also in serious discord with the fragile coastal ecology of the Sundarbans” (Bardhan et al., 2010). Currently, the Sundarbans face a serious threat due to these unplanned development and tourism activities. The ultimate result of this unplanned tourism are land use change, increasing deforestation and biodiversity losses (Rahman, 2010). But there are no proper ecotourism guidelines for Sundarbans. Therefore, an estimation of ecotourism potential in this region is required for its sustainable development. So the research found that the land use of the Sundarbans suffered considerable changes along with simultaneous decline in the density of forest.

Ecotourism is time and again perceived as an exquisite device for sustainable development within growing countries, consisting of India, Bangladesh etc. Protection of the natural environment, mangrove ecosystem, erosion of river embankment and beach area, and also protection of wild animals and socio-economic benefits for local peoples, as a vision of ecotourism (Buchsbaum, 2004).

Measurement of the ecotourism carrying capacity for sundarbans is essential as there is hardly any literature on this topic. The main theme of the research paper is assessing the ecotourism potential of Indian Sundarban (developing countries) for sustainable development.

1.2. Problem Statement:

Ecotourism is a new concept to the world. Initially, many studies were done in different countries of the world on issues related to ecotourism. Major research on ecotourism in India has been done in Kerala, Assam, Madhya Pradesh etc. However, the Sundarbans region of West Bengal is also looking for this growth recently and is developing ecotourism destinations.

The main theme of my research is that the Sundarbans face some serious sustainability challenges due to unplanned development and tourism activities, including undesirable land use change, increasing deforestation and biodiversity losses. Since there are no proper ecotourism guidelines for the Sundarbans, a study on the ecotourism potential of this region was felt necessary for sustainable development.

1.3. Aims and Objectives:

Aim of the study: To understand the potential and capacity of the Indian Sundarbans regions in supporting ecotourism and suggest a sustainable roadmap for ecotourism in the region.

Objectives of the Study:

The main objectives of this study are as follows:

1) To assess the growth and development of tourism in the selected areas of the Sundarbans along with changes in landuse/landcover.
2) To assess the socio-economic profiles and role of tourists in the study areas.
3) To assess energy performance and carbon foot print of the hospitality sub-sector in the study areas.
4) To suggest some strategic options based on the above research findings to encourage ecotourism in the Sundarbans.

1.4. Scope and Limitations:

Scope of the work: There are three main factors important for the development of ecotourism, namely hospitality, food and local travel. Again, the three main components of hospitality are energy, waste and water. In my thesis, I have put more emphasis on energy and waste. Local food and local transport are based on the preferences of tourists.

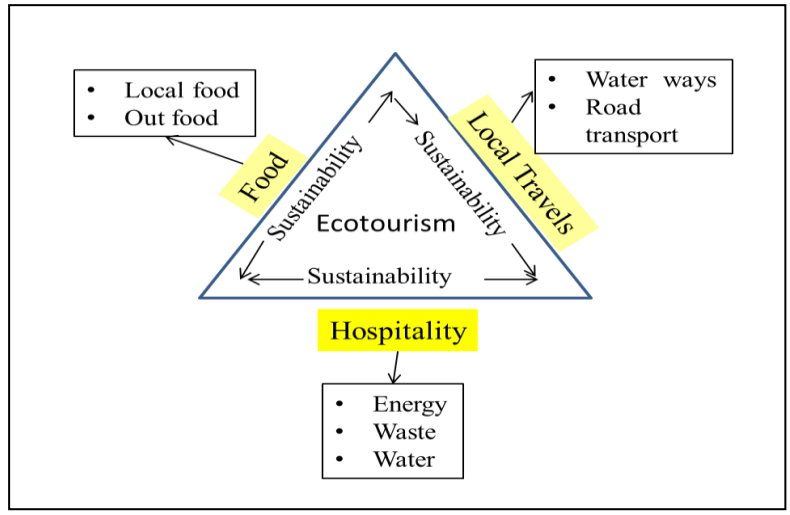


Figure 1.1 The three aspects of ecotourism sustainability

Limitations:

i. There is no detailed research on ecotourism in the Sundarbans in terms of data collection due to lack of time.

ii. The information must be preliminary data which requires extensive field work and requires interviews with all stakeholders, including all concerned officials, people, the local community and tourists themselves.

iii. The province has limited recorded data on Sundarbans's tourism.

iv. At the time of the interview it seemed that some of the respondents had a lot of information but they did not easily help my work.

v. Access to study areas for COVID-19 pandemic situations is not at all easy.

vi. There was no data bank related to ecotourism.

vii. Time and cost constraints for access and prolonged field studies.

1.5. Research Methodology:

1.5.1. Data used:

The study provides an analysis of the tourism industry in the Sundarbans, focusing on ecotourism. The method used in this research is descriptive and observation methods. The information is collected through primary and secondary data. Primary data, such as hotel survey data, tourist data and household survey data were collected from the five selected tourist centers and secondary data collection from different web sites, diverse organizations and magazines and gathered fabric consists of annual files along with statistical data from the district statistical hand book.

First of all, the primary facts amassed from the discipline survey through questionnaires and interviews. This thesis is based on data from a total of 102 hotels in the five selected tourist centers, 138 household data and 138 sample-size responses from five selected centers that were selected for the purpose of the study. In addition, a worldwide Positioning device (GPS) tool became used within the field survey for the collection of actual place point of surveyed accommodations; natural attraction locations and so forth, in different study areas. The majority of the secondary data was collected from Department of Tourism, Government of West Bengal, satellite TV for PC information was downloaded from the U.S. Geological Survey (USGS), and a topographical sheet was collected from Survey of India (SOI). The population census data of 2011 was collected from Census of India.

Table 1.1 List of data used and their original sources

Data	Source
Primary data (Tourist interviews , hotel survey and household survey data)	Field survey
Tourist footfall data	Department of Tourism, Government of West Bengal
Demographic data	Census of India, 2011
Digital Satellite Imagery	Downloaded from USGS
Topographical sheet	Collected from Survey of India

1.5.2. Software used for data management:

Studies strategies include having statistics collection and a discipline statistical records, statistical analysis using various equipment and techniques. Microsoft word was used for the write-up of the thesis record and Microsoft excel software became used for multi-criteria statistics evaluation. Arc GIS 10.1 was used to create a land use/land cover map in different studyareas.

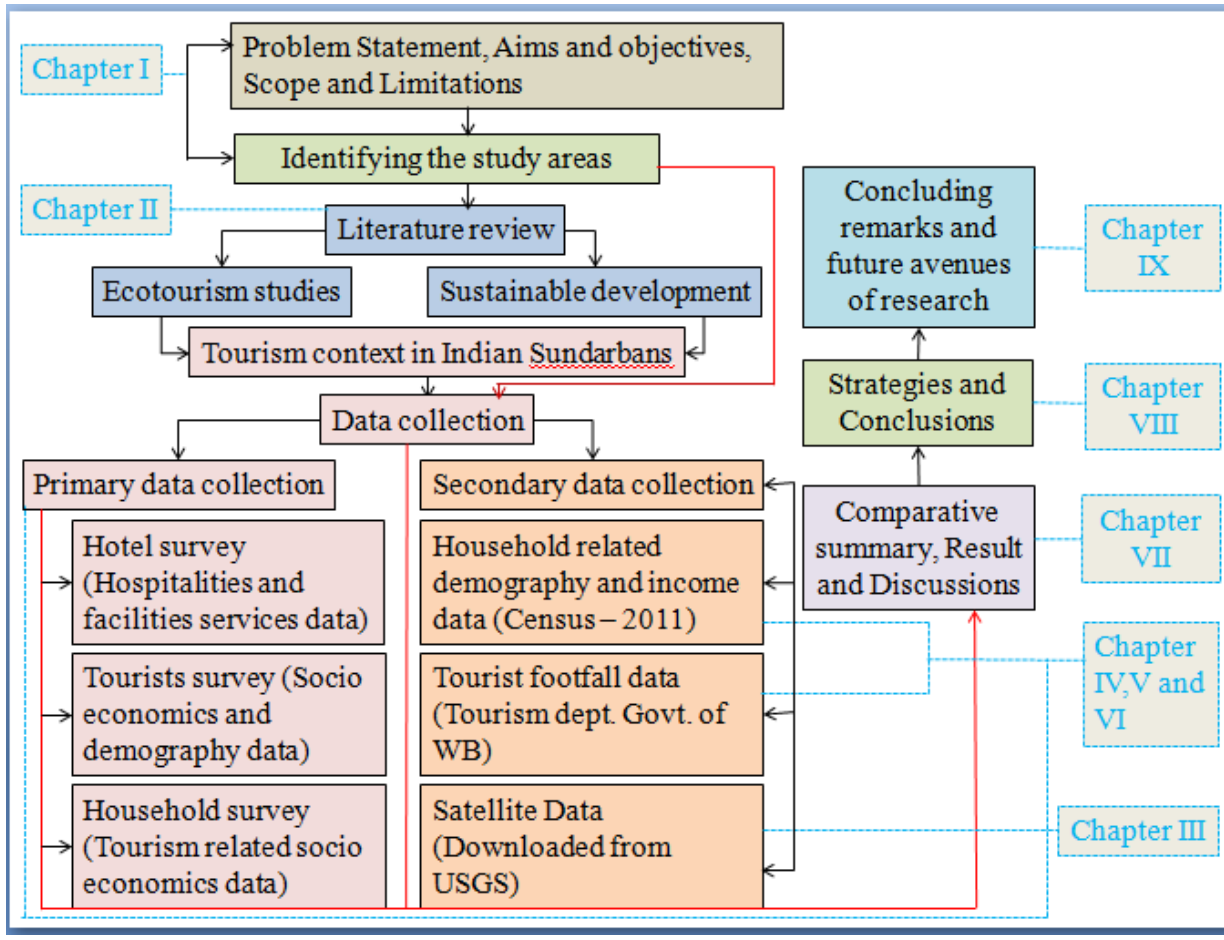


Figure 1.2 Conceptual framework of the study

1.6. Identifying the study areas:

The Sundarbans of Bangladesh and India are the single biggest mangrove bite of the globe, spread inside the range 21˚30'N-22˚40'N and the longitude between 88° 05¢ E – 89° 55¢ E (Curtis, 1933) ; the total place of Indian Sundarbans forests unfold over South 24-Parganas and North 24-Parganas districts is 4260 km2. It's part of the world's well-known Sundarbans Biosphere Reserve, which is also a global heritage website online. The full region of the Sundarbans Biosphere Reserve (SBR) is 9360 km2 (source: South 24 Parganas

Human development Report, 2009, govt. of West Bengal) which includes Bangladesh, and it is the second biosphere reserve of the country other than the Nilgiri Biosphere Reserve, that is part of the global network of biosphere reserve. Sundarbans has become listed as a world background website online due to the fact that it was 1987. This mangrove sector is the habitat for the highest bio-diversity, precise thrilling flora and fauna; meanwhile, floral successions in the Sundarbans are unique with the highest number of species diversity.

The Sundarbans may be very mighty for its renewable herbal sources and this mangrove forest can also protect the coastal West Bengal from frequent tidal flooding, surges springing up from the bay and the pressure of cyclones, which often arise and are concentrated in the Bay of Bengal. Earlier, Ganges used to flow through the area where Sundarban is now. During the 12th to 16th centuries, because of some natural causes, the Bengal Basin slanted towards the east and the Ganges changed its course and followed the tract of Padma in Bangladesh. For this reason, Sundarban has taken its shape like this.

The Sundarbans received its official recognition in 1830 after Prinsp completed the northern boundary. William Dampier was the commissioner of the Sundarbans Commission at the time and Lt. Hodges changed into the surveyor. Because of their joint efforts, the northern boundary of the Sundarbans is marked by the Dampier Hodges line.

The present study focuses on the Indian Sundarbans part, based on potential ecotourism and sustainable development within the Indian Sundarbans with socio-economic and local participation. Two major tourist spots in western Sundarbans are at Sagar and Bakkhali and three of eastern Sundarbans, namely Jharkhali, Pakhiralay and Dayapur. These locations had been selected to conduct the research.

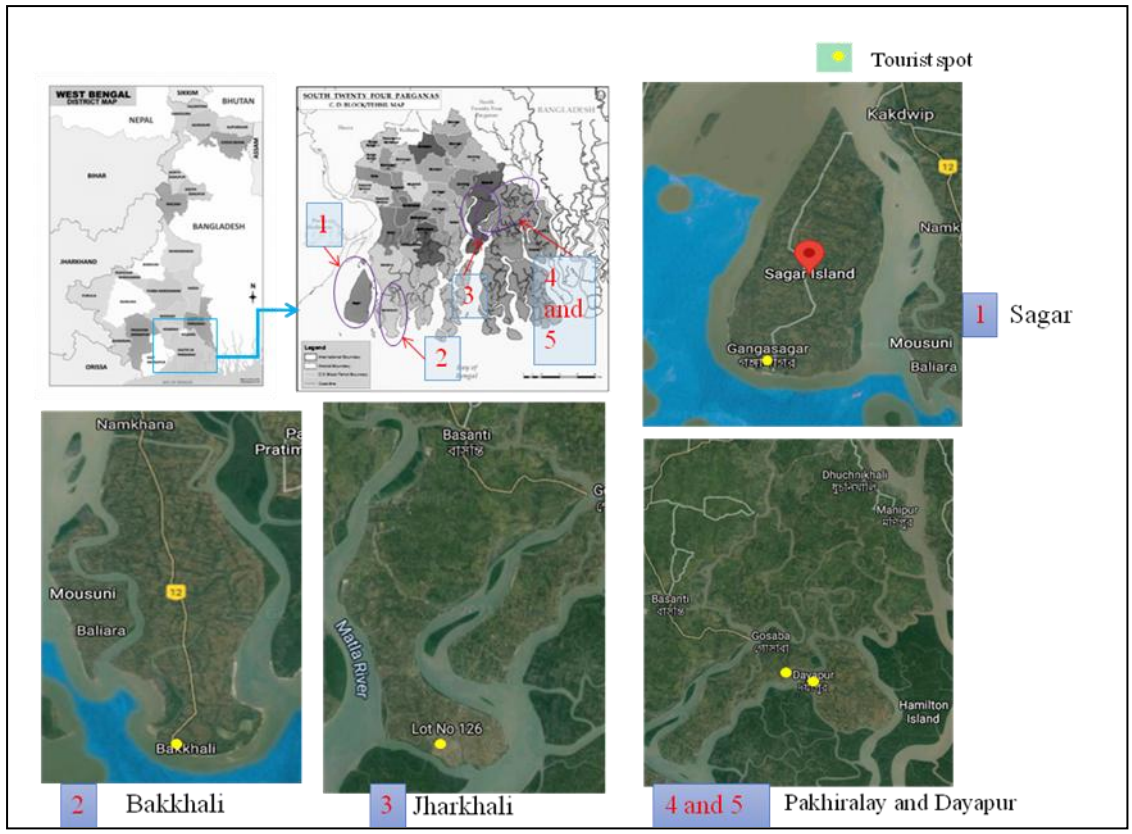


Figure 1.3 Identifying the study areas Source: Google earth image

Sagar Island:

Sagar Island is a sea-facing island and it is considered as the lower estuarine of the Hoogly River. Sagar Island, which is situated at 21˚37'21" to 21˚52'28" N and 88˚2'17" to 88˚10'25" E (Hajra et al. 2014). Sagar Island is situated in the western part of the Sundarbans. From Kolkata via Harwood Point via Diamond Harbour road (NH – 117) to Kakdwip about 90 km south, where a ferry travels to Kachuberia at the north end of the island around 3.5 km, crossing a distributary of the Ganga river and also travels 32 km on the road to the pilgrimage site at Gangasagar (Mandal, 2016). Gangasagar fair and Kapil Muni temple are the main attractions of Sagar Island.

Bakkhali:

Bakkhali is the last inhabited island on the eastern sea -facing island and it is on the border with Bangladesh . Bakkhali (latitude 21˚35’ N, longitude 88˚15’ E) is situated in the lower reaches of South 24 Parganas along the coastal tract of west. It is about 132km south of Kolkata. Bakkhali is the second most popular sea resort in West Bengal. The sea beach is the main attraction of Bakkhali Island. A crocodile park and Bishalaxmi temple are other attractions on this island.

Jharkhali:

"Jharkhali Island is located in the Basanti block of South 24 Praganas district in West Bengal. The island is considered a mid-walled region and is located in the center of the Sundarbans Biosphere Reserve. Jharkhali, which is situated at 21˚59'34.25" to 22˚13'23.98" N and 88˚37'23.96" to 88˚48'38.88" E" (Samanta et al. 2012). It is located about 115 km from Kolkata. The main attractions of Jharkhali Island are the tiger rescue center, a watch tower, a butterfly garden and natural beauty. With the rivers Matla on the west and the Bidyadhari River to the east, and the Herobhanga to the south, the village is called Lot Number 126 of major tourist centers.

Pakhiralaya:

Pakhiralaya is a massive village positioned beneath Gosaba block in the South 24 Parganas district in West Bengal. This island is taken into consideration as a mid estuarine region and is positioned at a distance of approximately ninety-six km. from south of Kolkata. It may be accessed from the south of Kolkata via Baruipur- Canning Street and SH-3 and crossing a river known as Bidhyadhari. Pakhiralaya is famous for being the home of birds.

Dayapur:

Dayapur is a village in the Gosaba block in the Parganas district, 24 south of West Bengal. The Dayapur location is located on the opposite side of Sajnekhali and is positioned at a distance of about 98 km from the south of Kolkata. It can be reached from the south of Kolkata via Baruipur – Canning Street and crosses two rivers, known as Bidyadhari, from Godkhali to Gosaba and Gomor River, from Pakhiralay to Dayapur bazar.

1.7. Structure of the Thesis:

The structure of this thesis consists of nine chapters. The first chapter presents the background information of the study area, problem statement, aims and objectives, scope of work, research limitations and research methodology of thesis study. The second chapter includes a literature review about concept of tourism, ecotourism and sustainable development. The third chapter describes the changes of landuse/landcover (LULC) pattern in different study areas. The fourth chapter highlights the tourism scenario of the study areas, tourism infrastructure and tourist profile. The fifth chapter focuses on energy performance and carbon foot-print, specifically describing the environmental impact of selected study areas. The sixth chapter focuses on local community perception of different study areas. The seventh chapter highlights the comparative summary of the study areas. The eighth chapter

focuses on proposed strategies for study areas. Finally, the last chapter focuses on the concluding remarks and future avenues of research.

Chapter II:

Literature Review

The literature review on various aspects of ecotourism is completely extensive. A quick review of existing literature on unique factors of ecotourism has been made in this chapter.

2.1. Studies on Ecotourism:

The Oxford dictionary defines tourism as a "commercial organization and operation of holidays' while a tourist is a 'holiday-maker'. The web dictionary explains ecotourism as that 'directed towards exotic, often threatened, natural environments, intended to support conservation efforts and observe wildlife". Thus, a paradigm shift in the concept of ecotourism versus tourism is observable here- the motive is inclined towards conservation in the former as opposed to simply holidaying as in the case of the latter, and similarly, it is ecologically oriented instead of being commercial. Seen against the backdrop of the sustainable development goals outlined by the Brundtland Commission, famously known as the World Commission on Environment and Development (WCED) in 1987, it seems of "Sustainable Development' as one 'that meets the needs of the present without compromising the ability of future generations to meet their own needs.", ecotourism seem to be perfectly befitting this notion with its ecological conservation framework. The economy, environment and environment were presented as the three pillars of development where sustainability stood the common ground between all the three aspects, which is also termed as the triple bottom-line. Some also like to describe these three pillars as profit, people and the planet, condensing it as the 3-P approach.

Seen via records, the term ecotourism was coined by the Mexican environmentalist Héctor Ceballos-Lascuráinin in the early 1980s, wherein the idea revolved around visiting relatively undisturbed areas for their scenic beauty and culture (Green Global Travel). This later figured in his book titled "Tourism, Ecotourism, and Protected Areas" (1996) using the global Union for the Conservation of Nature (IUCN).

Megan Epler Wood, another proponent of the formative year's ecotourism concept, added the very important aspect of 'local well-being for conservation of natural areas' and started The International Ecotourism Society (TIES), which in 1990 well defined ecotourism as the "responsible travel to natural areas that conserves the environment and improves the we1l-being of local people". It's interesting to note that the evolution of ecotourism from mere enjoyment of pristine nature to encompassing community-cum-nature conservation benefits reflects the sustainable development goals as recommended by WCED.

TIES promoted ecotourism as a viable device for conservation, safety of the bio-cultural range, and sustainable community improvement. Dr. Martha Honey, author of 'Ecotourism and Sustainable improvement: Who Owns Paradise?' (1999) and successor of Epler timber in TIES from 2003 to 2006, took it forward and eventually founded the middle for accountable journey (CREST) in Washington, DC. She had framed the salient functions of ecotourism as "tour to fragile, pristine, and generally covered areas that try to be low effect and (typically) small scale. It facilitates training the travellers, offers funds for conservation, immediately benefits the monetary improvement and political empowerment of neighborhood communities and fosters appreciation for exceptional cultures and for human rights." Thus, it is seen that the concept of ecotourism drew and grew with several semi-synonyms like sustainable tourism, responsible tourism; nature tourism and so on, that essentially harped on the principle of triple bottom-line.

This chapter suggests some studies on tourism and ecotourism. In this review, this chapter will now examine how individual researchers approached and theorized the concept of ecotourism. The table below chronologically lists some of the significant observations in ecotourism studies:

Sl.	**Year**	**Authors**	**Theories proposed/ study content**
1	1987	Randall	Increased income levels of tourists are linked with greater demand for the environment
2	1989	Ziffer, K.	Ecotourism has been defined as "a form of tourism inspired primarily by the natural history of an area, including its indigenous cultures". The author ascribes certain responsibilities to the ecotourists such as 'participation, sensitivity, non-consumptive use of wildlife / natural resources' and contributory through 'labour or financial means' towards conservation as well as 'economic well-being of the local residents'.
3	1990	Wiedner and Kerlinger	Estimated the per head spending of birdwatchers in 1988 at $1,852/year as a part of ecotourism activity
4	1992	Eadington and Smith	Considered ecotourism to be a 'low impact alternative to traditional tourism'

5	1992	Quammen	Estimated ecotourism expenditures at $12 billion in 1990
6	1993	US Fish and Wildlife Service	Supplied an account of ecotourism charges incurred by means of approximately three million human beings in the U.S.A. where they spent $222 million on 'watching, photographing, and feeding natural world'- all considered as part of ecotourism.
7	1995	Luzar et al	Participation in ecotourism is associated with positive socio-economic characteristics like earnings, gender, race and environmental mindset.
8	1995	Luzar et al.	Expressed ecotourism activities as "traveling to relatively undisturbed areas with the specific objective of studying, admiring, and enjoying the scenery and its wild plants and animals [or] existing cultural manifestations found in the areas."
9	1996	Whiteman	Suggested that the purpose of ecotourism is to make tourists aware of nature and environment
10	1996	Brandon, K.	Defined ecotourism as "environmentally responsible travel and visitation to relatively undisturbed natural areas, in order to enjoy and appreciate nature that promotes conservation, has low negative visitor impact, and provides for beneficially active socio-economic involvement of local populations"
11	1997	Newberry	Deliberated on energy-intensive activities like tourist submarines and underwater hotels
12	1998	Ecotourism Society in Wheat	Defined ecotourism as "responsible travel that conserves natural environments and sustains the wellbeing of local cultures"
13	1998	Sirakaya and McLellan	Advisory for ecotourism to lessen the bad influences of human moves on nature thru voluntary restraint of over- intake.
14	1998	Roxe	Recommended an extremely light footprint of the ecotourism activities on nature
15	1998	Meric and Hunt	Suggested low-impact activities like hiking, wetland trails
16	1998	Leones et al	Assessed expenditures of nature tourists of Arizona

17	1998	Chi and Luzar	Opined that an average eco-tourist rides high on education and income as well as recreational choice parameters, such as participation in wildlife photography
18	1998	Nord et al.	The aforementioned frequency of participation in ecotourism is moderately associated with environmental behavior, but weakly associated with environmental challenges.
19	1998	Hawkins and Khan	Articulated the triple backside-line idea in barely exceptional phrases in which 'respect for the integrity of ecosystems', 'nearby participation' and 'economic opportunities for the area people' cause 'eco-improvement'.
20	1998	Wong, P. P.	Studied the impacts of coastal tourism in south-east Asia and reported not only unplanned development of coastal resorts, but also the resort developers' ignorance of the physical environment, even that affected their resorts.
21	1999	Ross and Wall	Advocated ecotourism to be 'nature-friendly, ecologically sustainable as well as economically beneficial to the local community' and highlighted its 'capacity to simultaneously assist conservation and the sustainable improvement of nearby communities'
22	1999	Swarbrooke	Presented a diagram showing the notion of sustainable tourism, encompassing the triple bottom-line principle i.e. environmental conservation, economic efficiency and social equity, keeping the tourists as part of the over-all sustainable development.
23	1999	Weaver, D. B.	"Interest in ecotourism, now widespread among tourism planners and marketers, is rationalized by a number of popular assumptions regarding the sector's potential economic, environmental, and socio-cultural benefits."

In this new millennium, proponents of ecotourism have reiterated its role as an effective way to sustainable development, especially in countries with developing economies. Priskin, J. (2001) sheds light on nature-dependent ecotourism in his study paper "evaluation

of herbal assets for nature – based tourism: The case of the imperative Coast area of Western Australia". Various techniques have been used to frame an assessment structure for the development of nature-based tourism. Protection of the natural environment, mangrove ecosystem, river embankment, beach area and wild animals and enhancement of socio-economic benefits for local peoples are necessary for ecotourism (Buchsbaum, 2004).

According to Raju, S.A.J. (2007), the concept of ecotourism and eco-restoration are gaining momentum throughout the world. These two sub-disciplines of ecology refer to sustainable development. Collectively, ecotourism, eco-restoration and sustainable development have prominent roles in nourishing the economy of any nation in general and India in particular. This book puts together different topics in relation to the three subject areas, providing detailed information. Mirsanjari Mir M. et al. (2007) in their observation on 'significance of Lake capability for improvement of Ecotourism in Pune District' – centered on special parameters of Environmental impact evaluation of human development and mainly offers a relationship between environmental parameters. The paper mainly stressed the assessment of the potential of ecotourism in Pune district.

Ramanathan, AL. et al. (2010) in their book ' Control and Sustainable improvement of Coastal region Environments' focuses on all affected parties global on degrading surroundings and increasing man-marine conflicts and offers some demanding situations for the production of safe coastal groundwater that allows you to take suitable steps in the path of efficient innovation. Witt de L. et al (2011) in their article 'An Ecotourism Model for African National Parks' identifies the key aspects of an ecotourism model in South Africa. Factors like engaging the local community, pro-environment practices, responsible ecotourism ethics, food, activities and policies were considered to create the model. Mehrdad, R. and Mahmoud, R. (2011) in their paper 'GIS Based Process Used to Determine the Locations of Ecotourism Sites Based on Climatic Variables' conditions, focused on identifying suitable regions of environmental conditions for ecotourism activities. Three types of suitable regions like ecotourism sites have been classified in the paper: suitable, semi-suitable and unsuitable. The analysis used the GIS-based technique.

Oladi, J. & Otghsara, F. T. (2012) said in their study, "Feasibility study on ecotourism potential areas using remote sensing and geographic information system (case study: abbasabad forest area, Veresk, Iran)" the available bio-environmental units were obtained by measuring. This paper shows the Soil map, vegetation density map and Landuse/Landcover

map using remote sensing and GIS application and classified the Ecotourism potential as – class I mass ecotourism, magnificence II mass ecotourism, magnificence I opportunity ecotourism land use and class II alternative ecotourism land use.

Joshi, V. M., (2014) in her paper 'Eco-Tourism – A key to Guarding the biodiversity in Maharashtra' defined the key aspects of eco-tourism for protection of biodiversity in Maharashtra. It is a detailed study to investigate the pressure and negative impacts on biodiversity.

In India, the Annual Report (2011 – 2012) of the Ministry of Tourism, Government of India, is seen to be following the TIES's definition of ecotourism. The Ministry recognizes the following key principles for developing ecotourism:

i. Involvement of local community leading to the region's overall economic development.
ii. Minimize conflicts between resource needed for ecotourism and local life.
iii. Compatibility of the sort and scale of ecotourism development with the environment and neighborhood socio-cultural characteristics.
iv. Be used as typical vicinity improvement approach, with an included land-use plan making sure sectoral coherence and corresponding growth of public offerings.

The hospitality region has additionally been mandated with sure recommendations via the Ministry of Tourism and lodges at the venture level itself are required to plot for Sewage remedy Plant (STP), rain water harvesting device, and waste control structures and so on.

Bardhan et al (2010) observed serious discord of the hospitality sector with the fragile coastal mangrove ecosystem of the Indian Sundarban and suggested environmental retrofits to achieve ecotourism goals and comply with government guidelines. Ecotourism principles are absolutely essential in natural reserves like the Sundarban Biosphere Reserve, in which tourism is already growing in an unplanned and advert-hoc way, responding to the popular demand. Currently, Sundarban faces a serious threat due to these unplanned development and tourism activities. The ultimate result of this unplanned tourism are land use change, increasing deforestation and biodiversity losses (Rahman, 2010). GIS application is capable of supporting decision making for tourism planning, impact assessment and visitor flow

management. The study found that the land use of Sundarban underwent considerable changes alongwith simultaneous decline in the density of forest.

Guha I. & Ghosh S. (2007) in their study "Does Tourism Contribute to Local Livelihoods? A Case Study of Tourism, Poverty and Conservation in the Indian Sundarbans" points out the contribution of tourism towards improving the local livelihoods in the villages of the Indian Sundarbans. This paper also recommends coverage on nature primarily based on tourism with greater room for nearby participation. Carrying Capacity assessment is a part of this paper.

Banerjee, M. (2014) in her paper 'Ecotourism in Sundarbans…A Life Line For Local People and Ecology' has identified different issues related to ecotourism which will sell nearby the economy, socio-cultural adjustments and as existence the fashion of the people settled in and across the tourist locations, challenges, possibilities and weak spot of ecotourism as well its impact on improvement of socio-monetary circumstance of the socially challenged regions.

Hossain, E. (2014) in his studies article 'Eco-tourism in the Sundarbans, West Bengal, India' severely analyses the ecotourism projects in Sundarban from its strengths, issues, and related remedial measures.

Mandal et al. (2013) discussed the growth of coastal tourism in West Bengal in places other than the Indian Sundarbans and listed their impacts on the environment. In a comprehensive list, they have provided an account of the popular seaside destinations with their main natural attractions alongside the resulting degradation, including vanishing beaches, deforestation of Casuarina forests and wind erosion of sand dunes, flooding & inundation and anthropogenic pollution due to the boom in hotel construction and allied infrastructure in these areas.

"As referred to earlier, the discourse of ecotourism additionally consists of its semi-synonym 'Sustainable tourism'- a term used to denote the adoption of the principles of sustainable improvement by means of the tourism region" (Fennel, 2002). In this sense, one can argue "sustainable tourism refers to assembling the desires and rights of present travelers and host groups and regions, even as defensive and enhancing possibilities for destiny"

(Bendell & Font, 2004, p. 25). Consistent with Toth (2002), ecotourism refers to "sustainable tourism as a balance among social, environmental, cultural and financial pastimes" (p.75).

Sustainable tourism is an approach that looks at a long-term scenario and holds the local ecological as well as socio-cultural capitalist-its very centre. Sustainable tourism has to be responsible for tourism, generating more livelihood opportunities and income. Sustainable tourism needs to be planned and managed suitably. Eco India travel portal believes that sustainable improvement of tourism is most effective if it follows some of the hints and concepts (http://www.ecoindia.com/sustainable-tourism/):

i. Tourism has to be initiated with the assist of neighborhood network. This enables retaining the appropriateness of the tourism development.
ii. The area people have to meet the direct advantage of flourishing tourism in their region. The link among local business and tourism permits neighborhood network to advantage economically.
iii. To cause massive boom in sustainable development, there is want that codes, ethics and some honest suggestions be appointed.
iv. So that you can heighten the significance of background and herbal sources, and manage them better, schooling and schooling programme need to be instituted.

Eco India also attempts to characterize sustainable tourism as follows:

a) Sustainable tourism shall preserve local culture and culture.

b) Sustainable Tourism is informatory, as it doesn't simplest let visitor understand about the locations but also it allows local knowing about the way of life and civilization of visitor.

c) This sort of tourism is aimed to conserve the assets of locations wherein one is travelling too.

d) Sustainable Tourism seeks deeper involvement of locals that would growth their livelihood opportunity and assist earn their dwelling.

Moving beyond defining ecotourism as a concept, Blamey (1997) questioned how its definition might be applied for market research purposes and argued that "a distinction between intentions and outcomes is required". He further infers that different applications in

market research studies “may require different approaches and that any one application may require a combination of different measurement approaches”.

According to Blamey (2001), the concept of sustainable tourism covers mass tourism as well as ecotourism. He identified ten key aspects of sustainable tourism, as follows:

i. The use of resources sustainably
ii. Decreasing over- consumption and waste
iii. Maintaining Biodiversity
iv. Integrating tourism into making plans
v. Assisting neighborhood economies
vi. Involving neighborhood groups
vii. Consulting stakeholders and the public
viii. Training group of workers
ix. Marketing tourism responsibly
x. Undertaking research

Earth Summit (1992) endorsed ecotourism as a prospective tactic for sustainable development while sustainable tourism was a pro-environment economic activity (Gray, 2003). Parker, S., & Khare, A., (2008, Dec 22) in their paper ‘Understanding Success Factors for Ensuring Sustainability in Ecotourism Development in Southern Africa’, has highlighted three critical factors: (i) Environmental (environmental great, website limitations, water & opportunity costs), (ii) community (network partnerships, network definition, community dialogue, poverty & social inclusion) and (iii) financial (national political environment, good enough legal systems and security, infrastructure & government policy).

Bhuiyan et al (2012) expressed ecotourism development, sharing space with regional development with both as sub-sets of sustainable development. This is interesting as an ecotourist destination is seen in the context of the larger region and is, therefore, more holistic. He lists the components of the triple bottom-line as (i) Social (public facilities, local culture, infrastructure, people’s attitude and lifestyle), (ii) Economic (employment, revenue & tax, social welfare, equitableness and income), (iii) Environmental (transportation, traffic, preserving natural areas and biodiversity). On the other hand, regional development includes policies & initiatives, conservation efforts, ecosystem maintenance, innovation & knowledge

transfer, public-private partnerships, community-based organization, improved lifestyle and equitable development.

2.1.1. Impact of Ecotourism:

Ecotourism, with this kind of wide variety of products, and the power to drive people's movements on an international scale, inevitably has a variety of implications, each positive and bad, in a number of arena's aspects. It consists of social, environmental and economic systems.

"Today the tourism industry bears innumerable expectations, on its capacity role as a motor for poverty comfort, improvement, sustainable aid-use, or for powerful conservation" (Ashley et al., 2000; Binns & Nel, 2002; Burger, 2000). "The gigantic length of the tourism enterprise has attracted the attention of many 1/3 global nations as an ability gateway closer to financial improvement" (Brown and hall, 2008). "The list of terrible impacts entailed by means of relying on traditional tourism for improvement is big. Broadly regarded examples consist of elements along with immoderate foreign dependency, exacerbation of socioeconomic inequalities, environmental degradation, and cultural alienation" (Brohman, 1996; Binns & Nel, 2002 ; Gössling, 2002).

2.1.1.1. Economic Impacts:

Scheyvens (1999) provided a sensible notion that when questioning whether or no longer a network has been given economic freedom by means of an ecotourism commercial enterprise, it's miles essential to consider opportunities, which have been derived from both casual and formal zone employment and business possibilities.

2.1.1.2. Environmental Impacts :

Cater (1994) defined that humans have ended up more and more aware of the unfavorable sociocultural and environmental consequences of limitless mass tourism. The merging of the term 'eco' implies that ecotourism has to be an environmentally accountable shape of tourism. In point of fact, if it does now not act consistently with this requirement, then the herbal sights will experience degradation so that the vacationers will now not go to. the level of those ecotourism activities indirectly states that comparatively fewer travelers will arrive. As a result, the assistance centers may be kept up to a minimum and can be less

intrusive. It's more important to comprehend that any human activity counting on the usage of a large amount of ecological resources use like ecotourism cannot be sustained, usually if the consequential doctrine does not give any guide to its business enterprise. Coccossis (1996) agreed that environmental problems in rural regions are not always due to abandonment and lack of knowledge. Harsh problems of environmental degradation are also positioned all the way down to over utilization of assets integrated with the lack of resource management.

Growing Coastal Tourism and its Impact Environment in Coastal West Bengal

Destination		Period of Emergence	Site and Situation	Tourist Carrying Capacity at present	Impact
Digha	Old	Late 1950s	Water front	250H, 21 HH & many no. of houses cum guest house are there.	Shore line water table Changes, sea beach Vanishing, Failure sea guard wall structure, flooding and inundation and anthropogenic pollution etc.
	New	Mid 1980s	Back shore	155H & 30 HH & Other houses cum guest house.	Built up Dune surface but erode sand dunes by wind action due to remove casuarinas forest in large scale for converting the land into urban habitat.
Sankarpur		1990s and onward	Low land behind the Dune Barrier	8H	Reduced beach width and erode dune in massive scale. Geo-Tube concept failure so storm tide caused flood and salty and marshy land formed damage agricultural land.
Tajpur-Mandarmoni		2003 and onward	Back shore	More than 13H	Built up dune Surface but erode sand dunes by wind and storm wave action due to remove casuarinas forest in large scale for converting the land into urban habitat.
Fresergunge		Early 1950s	Beach-Dune complex	0B and 3R (Under fishery Dept. of WB. Govt.)	Damaged by erosion and cyclone waves in different times.
Bakkhali		Mid 1960s	Mangrove forest belt with sandy shore line.	25-30 H/L	Inundation beach erosion, loss of mangrove and casuarinas forest.
Sagar Island		Mid 1980s	Reclaimed sand bar areas in the mouth of Ganga and previously mangrove forest belt.	1H, 2YH, 7GH, 5A, 1P and temporary Tourist habitat at the time of famous fair.	Bank eroded, marshy land reduced, flooding and inundation.

Source: Mandal, M., Dandapath, P. K. & Shukla, J., Vol. 2, No. 1, January 2013

2.1.1.3. Social Impacts:

According to Mansperger, M.C. (1995), social empowerment means that a community's feeling of solidarity has been proved or made extra effective with the aid of an interest like ecotourism. Social empowerment can occur whilst visitor sports involve crime, begging, tourist discovery or prostitution, forcing local citizens to travel out of their homes and dropping a true sense of vicinity. Coccossis (1996) argued that the consequences of tourism could also be favorable. Because of supplying accommodation for the advent of a large quantity of tourists and visitors, local citizens have the benefit of getting entry to upgraded infrastructure, facilities and offerings, including shipping, wastewater control and so forth, for that reason, improving environmental nice.

2.1.1.4. Socio-cultural Impacts:

Weaver (1998) found that in most locations, the degree to which tourism's negative socio-cultural consequences depends on numerous situations, which include paramount divergence in monetary popularity among vacationers and the host community, huge cultural and racial variations between vacationers and the host society, strong dreams of travelers to stick to their very own cultural norms. In the meantime, the rapid growth of the tourism industry within the destination, the involvement of the judiciary and the visitor-centered factors, the high quantity of tourists depending on the local population, greater tourism beyond the vacation spot economy and external manipulation over the most important phase of the tourism enterprise can influence socio-cultural issues. Through Weaver's (1998) findings, the socio-cultural charges are attributable to the monetary costs; even certain reporters from the guide group have recommended that the socio-cultural effects be expected because of effects of the chronic economic advantages. In Erisman's (1983) view, the actual sociocultural fees generated through the defined variables can be categorized into several interblended genres based totally on research versions. Cole (1997) observed that the power of anthropologists needs to be noted in increasing sustainable tourism in growing countries. Virtually, particularly, in nature-primarily based tourism, the position of the hosts has to be in the middle of the sustainable tourism development procedure. To provide them with this central position, it is crucial to have a clear comprehension of their way of life.

2.2. Ecotourism vs. Sustainable Development:

"Sustainable tourism is a time period used to indicate the adoption of the concepts of sustainable development through the tourism zone" (Fennel, 2002). From this experience, we can argue that "sustainable tourism refers to meeting the needs and rights of current tourists and host communities and regions, protecting and enhancing future opportunities" (Bendell & Font, 2004, p. 25). According to Toth (2002), "sustainable tourism is about creating a balance between social, environmental, cultural and economic interests" (p.75).

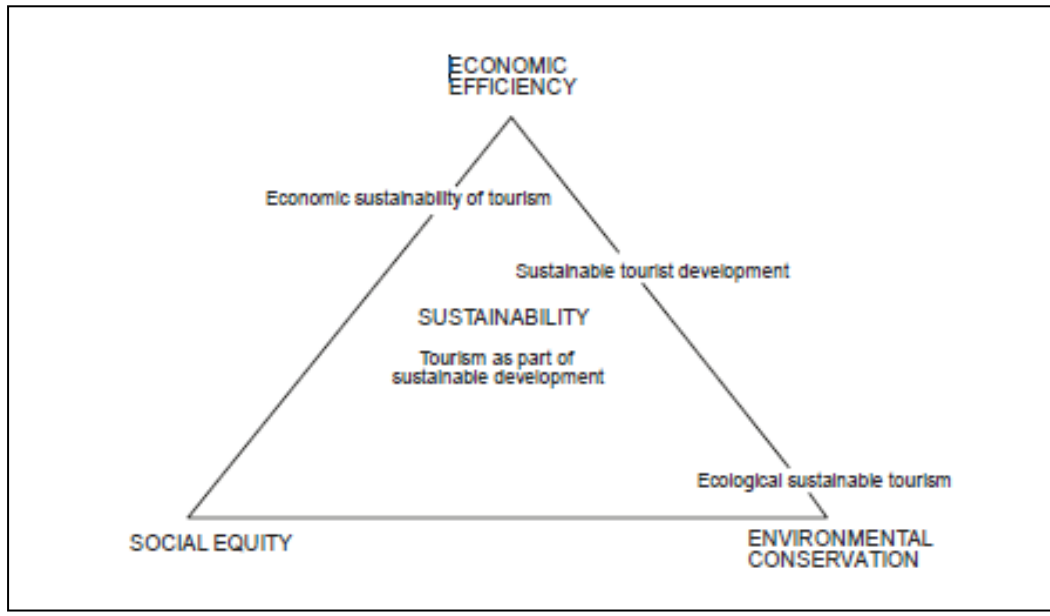


Figure 2.1 The three aspects of tourism sustainability (Source: Swarbrooke, 1999)

The above displayed diagram displays the state of sustainable tourism. As a result, it encompasses 3 dimensions, namely environmental conservation, economic performance and social fairness.

Sustainable tourism is a type of tourism meant to make the development of tourism environmentally supportable within the long term. The very significance of sustainable tourism lies in the motives of conserving, increasing the assets and increasing the value of local subculture and subculture. Sustainable tourism is an accountable tourism intending to generate employment and earnings on the side of alleviating any deeper impact on the environment and local lifestyle.

As a result of the expanded number of vacationers, it is vital that tourism, like other sectors, be properly planned and controlled. Sustainable improvement of tourism is feasible and it is simplest if it follows some of the hints and ideas:

- Tourism ought to be initiated in any area with the help of nearby networks. The involvement of neighborhood networks allows maintaining the precise tourism development.
- The local community has to fulfill the direct benefit of flourishing tourism in their place. The hyperlink between local business and tourism enables local people to take advantage of it economically.
- Sustainable development requires the deployment of codes, ethics and some sound hints for extra increases.
- Education and training sports must be added to increase the significance of the historical past and natural resources and to control them higher.
- The traits of sustainable tourism are as follows:
- Sustainable Tourism attempts its utmost to hold the importance of local culture and lifestyle.
- Sustainable Tourism, as it isn't the simplest, lets travellers realize approximately the locations, but it also enables them to know approximately the culture and civilization of the traveler.
- This type of tourism is aimed at preserving the sources of destinations where one is traveling to?
- Sustainable Tourism seeks deeper involvement of locals, which provides local humans an opportunity to make their living.

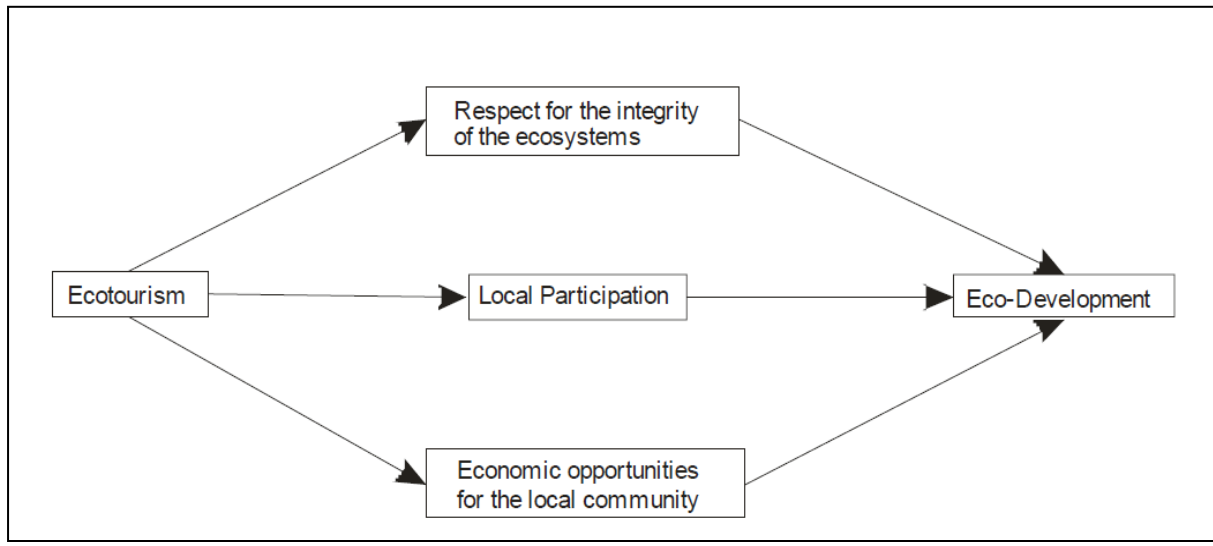


Figure 2.2 The three concepts for viable ecotourism development (Source: Hawkins & Khan, 1998)

Above the diagram displaying the particular tick list is based on 3 predominant standards that cover the three aspect of tourism sustainability.

"The concept of sustainable tourism, which has existed for decades, encompasses mass tourism as well as ecotourism" (Blamey, 2001). He listed some principles for sustainable tourism. These principles are follows:

1. Using resources sustainably	The conservation and sustainable use of resources -- natural, social, cultural, -- is important and makes long-time period commercial enterprise sense.
2. Reducing over consumption and waste	Reduction of over-consumption and waste avoids the expenses of restoring long-term environmental damage and contributes to the first-rate of tourism.
3. Maintaining Biodiversity	Retaining and promoting natural, social, and cultural range is vital for lengthy-term sustainable tourism, and creates a resilient base for the enterprise.
4. Integrating tourism into planning	Tourism development that is incorporated right into a national and local strategic planning framework and which undertakes environmental effect exams, boom the long-time period viability of tourism.
5. Supporting local economies	Tourism that supports a huge range of nearby monetary sports and which takes environmental fees and values under consideration, both protects those economies and avoids environmental harm
6. Involving local communities	The total involvement of local groups inside the tourism quarter not handiest benefits them and the environment however also improves the great of the tourism challenge
7. Consulting stakeholders and the public	Consultation between the tourism industry and neighborhood communities organizations and institutions is vital if they're to paintings alongside each different and remedy potential conflicts of interest
8. Training Staff	Personnel education which integrates sustainable tourism into paintings practices, along with recruitment of personnel in any respect ranges, improves the best of the tourism product.
9. Marketing tourism responsibly	Advertising that gives travelers with full and accountable records will increase recognize for the herbal, social and cultural environments of vacation spot regions and complements consumer delight.
10. Undertaking research	Ongoing studies and tracking through the industry the use of effective information series and evaluation is vital to assist remedy troubles and convey advantages to locations, the industry and consumers industry and consumers.

Source: (Buchsbaum, D. B., May 3, 2004).

Parker S. and Khare A., (2008, 22 Dec). in their paper "information success factors for ensuring Sustainability in Ecotourism improvement in Southern Africa", has been cited

the paper affords a method of evaluation for the 3 foremost classes of important successes factors, which includes i) Environmental (environmental first-class, website online barriers, water and possibility prices), ii) Network (network partnerships, community definition, network talk, and poverty & social inclusion) iii) Economic (countrywide political environment, good enough criminal structures and protection, infrastructure and authorities coverage).

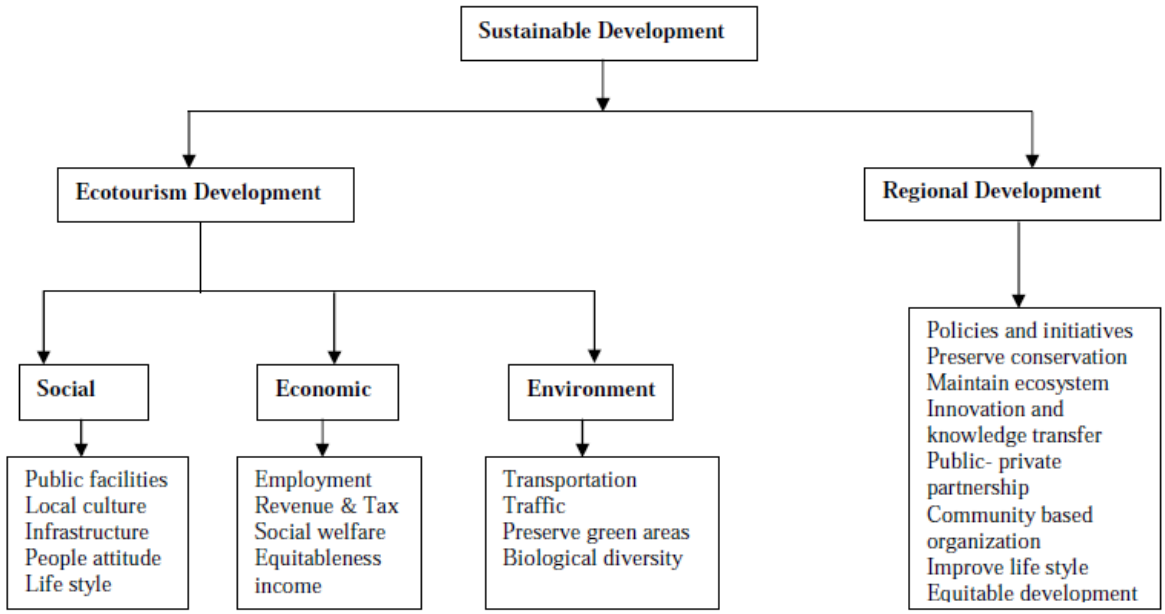


Figure 2.3 Aspects of sustainable development (Source: Bhuiyan et al. / OIDA International Journal of Sustainable Development 03: 09, 2012)

2.3. Ecotourism Assessment Indicators:

Studies under this stage have found three major tracks– one that suggests different methodologies to assess the Ecotourism potential sites; secondly, works that suggest formula for assessing the carrying capacity of these sites and finally, ecological foot-print as a measure of the impact of tourism activity in the site. Thus there seem to be a two-level hierarchical approach to operationalize the ecotourism theory in specific contexts:

i. Identify potential sites fit for ecotourism
ii. Assess carrying capacity of those identified sites and, therefore, ensure that the environmental impact is indeed low in order to justify ecotourism.

Potential Ecotourism Sites:

Banerjee, U. K. et al. (2002) in their study on 'Remote Sensing and GIS based ecotourism planning: A case study for Western Midnapore, West Bengal, India' highlighted the challenges of ecotourism planning and also presented an Ecotourism Potential Map. It has used the following formulation to discover the 'Ecotourism capability' sites:

EPi = S(VDi + LU/LCi + SPi)

Where i = 1,2,-------n

VD = Vegetation Density

LU/LC = Land use/Land Cover

SP = Soil Productivity

The White Paper on Eco-Tourism policy (2006) via middle for Conservation Governance and policy, Ashoka considers Ecology and the environment for studies (ATREE) and develops a scoring system by identifying a set of criteria with their respective indicators for assessment and monitoring of Eco-Tourism (ET). Their Monitoring and Evaluation of an ET model is given by:

Score of any indicator = Value x Weightage

Value: Value is the degree of influence on the numerous parameters in the version based on observations and calculations. Right here, values are taken from -3 to a few. These values are of different importance depending on the direct environment and operating conditions and can be weighted appropriately.

Weightage: it's miles website in particular; fashions compared here belong to distinctive websites and a, for this reason, are not weighted. But weightage is vital, while any effect can have intense consequences; water pollutants from houseboats can be heavier than the use of imported materials in boat building.

A few categorised standards and signs are (i) Ecological indicators (topography, air nice, noise, water best, solid waste control, aquatic flora and fauna), (ii) Socio cultural indicators

(layout, nearby art forms, neighborhood handicrafts, way of life, training and awareness of guest, employment, multiplier impact on local financial system and proportion of domestic tourists to foreign visitors), and (iii) Economic indicators (profit, occupancy, living standards and competition). Tables 1, 2 and 3 show how the model works.

Table 2.1 Sample scoring of Ecological indicators (source: ATREE)

Criteria	Indicators	Un weighted score across models			
		Homestay	Public Sector	Co-managed	Community Owned
Ecological	Topography	0	0	0	-1
	Air quality	-1	-1	-1	-1
	Noise	-1	-2	0	-1
	Water quantity	-1	-1	-1	-1
	Water quality	0	-1	0	0
	Solid waste management	2	1	-2	0
	Terrestrial flora	-1	-1	-1	-1
	Terrestrial fauna	-1	-2	0	0
	Aquatic flora & fauna	0	-1	0	0
	Conservation efforts	1	1	2	1
	Total	-2	-7	-3	-1

Table 2.2 Sample scoring of Socio-Cultural indicators (source: ATREE)

Criteria	Indicators	Un weighted score across models			
		Homestay	Public Sector	Co-managed	Community Owned
Socio/ Cultural	Design	2	0	2	2
	Local art form	0	0	1	0
	Local handicrafts	1	0	0	0
	Local cuisine	0	0	0	1
	Culture	1	0	1	1
	Education/Awareness	2	1	1	1
	Employment	1	3	2	1
	Leakages	-1	-2	3	2
	Multiplier effect on local economy	0	1	1	1
	Equity in benefit sharing	0	0	2	0
	Domestic tourist	1	1	1	2
	Total	7	4	14	11

Table 2.3 Sample scoring of Economic indicators (source: ATREE)

Criteria	Indicators	Un weighted score across models			
		Homestay	Public Sector	Co-managed	Community Owned
Economic	Profit	1	3	2	2
	Gestation period	2	1	1	2
	Occupancy	1	3	2	1
	Living standards	1	1	2	1
	Competition	0	1	2	0
	Total	5	9	9	6

Rankings for the 3 standards may be compared between any web page or enterprise or model. The choice at the reduce-off level of relative to every criteria and the significance of any of the criteria for you decide on a project would be decided via involved stakeholders within the precise context. Table 4 shows the results of the demonstration.

Table 2.4 Sample of consolidated scores under the three criteria (source: ATREE)

Criteria	Homestatys	Public Sector	Co-managed	Community
Ecological	-2	-7	-3	-4
Socio-cultural	7	4	14	11
Economic	5	9	9	6
Total	10	6	20	13

The Draft policy additionally suggests that the function of financial criterion is most effective in ensuring that ET is not a loss making enterprise. As soon as this is confirmed, this criterion does no longer need to be useful in deciding between a corporation and a model.

Kumari, S. et al. (2010) in their paper ‘Identification of potential ecotourism sites in West District, Sikkim using Geospatial Tools’ have suggested five indices: ‘Ecological Value Index’ (EVI), ‘Wildlife Distribution Index’ (WDI), ‘Ecotourism Attractivity Index’ (EAI), ‘Ecotourism Diversity Index’ (EDI) ‘Environmental Resiliency Index’ (ERI). Based on primary and secondary data, these five indices may be used to become aware of and prioritize the potential Ecotourism web sites (PES). Those indices encompass and account for the subsequent sub-parameters:

i. WDI – mammal, avifauna and butterfly
ii. EVI – Species diversity, ecosystem uniqueness, biosphere reserve

iii. EAI- Vegetation canopy and topographic attractivity, religious attraction, accessibility, lake

iv. ERI- vegetation cover, soil, slope, seismic hazard

v. EDI- viewshed between 1, 2.5 and 5 km – view shed map

The ecotourism potential is then calculated using the following equation:

EP = {wti (WDI) + wtj(EVI) + wtk (EAI) + wtl(ERI) + wtm(EDI) }

Wherein, EP - level of Ecotourism capability and wti, wtj, wtk, wtl and wtm are weights. The bad weights of the 4 signs consisting of WDI, EAI, ERI, EDI and EVI have been decided to be the proportional weights to reap PES.

2.4. Carrying Capacity:

Carrying capacity is "the maximum level of visitor use an area can accommodate with high levels of satisfaction for visitors and few negative impacts on resources" (McNeely & Thorsell, 1987). Hunter (1995) has mentioned four different types of carrying capacity: physical, psychological (or perceptual), social and economic carrying capacity.

The concept of capacity has emerged from the need to understanding the ability of certain fragile ecosystems to sustain an ever increasing anthropogenic load. This is particularly relevant to coastal environments and the swelling of coastal populations, considering that the carrying capacity of the world's coast is finite and thus forming the basis of several coastal management initiatives (UNEP, 1996).

$$\text{Carrying Capacity} = \frac{\text{Area used by tourists}}{\text{Average Individual Standard}}$$

The World Tourism Organization (WTO) defines the idea of carrying power as follows: "The maximum number of people can visit a tourist destination at the same time without destroying the physical, economic and socio-cultural environment and reducing the unacceptable quality of visitors' satisfaction" (cited in PAP/RAC 1997).

Weaver, D. B. (1999) defines the carrying capacity as "a major environmental expense is the possibility that local carrying capacity will be difficult to perceive due to it's

complexity, unknowingly surpassed in the long run by activities involving ecotourism, especially in cases where the sector It is growing rapidly".

Quicoy, A. R. & Briones, N. D. (2009, December) in their study titled 'Beach Carrying Capacity Assessment of Coastal Ecotourism in Calatagan, Batangas, Phlippines', showed the carrying capacity assessment for swimming areas by using different standards. The formula to estimate the tourism carrying capacity was follows:

$$\text{Carrying Capacity} = \frac{\text{Area used by tourists(i.e. swimming area)}}{\text{Average Individual Standard}}$$

$$\text{Rotation Coefficient} = \frac{\text{No. of daily hours are open to tourists}}{\text{Average time of visit}}$$

The full wide variety of authorized day by day visits is then calculated with the aid of:

Total Daily Visit = Carrying Capacity * Rotation Coefficient

Zacarias, D. A. et al. (2011) "Recreation carrying capacity estimations to support beach management at Praia de Faro, Portugal' attempts to focus on the 'physico-ecological carrying capacity of 1385 and 2628 visitors / day with maximum impact acceptance curve 305 and 608 local tourists (e.g. For people and tourists) '. This study suggests that the physico-ecological carrying capacity to be applied for ecosystem management whiles the socio-cultural carrying capacity addresses the tourists and beach users".

Quicoy & Briones (2009) presents 'Carrying capacity' as a tool for ecotourism whose interdependent stakeholders are tourism industry, community/local authorities and environmental supporters.

2.5. Ecological Footprint:

Ecological footprint is a well-recognized measure of sustainability (Wackernagel et al., 1996), which analyses human demand for eco-systems with certain productivity and services, and converts the usage of strength, biomass (meals, fiber), water, constructing

materials and our bodies into a commonplace measure of land region called the ‘worldwide hectare’ (gha). It does this through comparing the biologically effective land and marine areas to generate the quantity of resources that the public consumes and the related wastes that are used in the current era. Originally, called the ‘appropriated carrying capacity’, it was altered to ecological footprint to make the idea easily comprehendible. According to this theory, earth’s carrying capacity, expressed in terms of global hectare hectares, was estimated to be 100 GJ/ha/year.

It is considered to be a valuable technique for creating a quantitative evaluation of both national and international sporting capacities (Ferguson, 1998, 1999).This approach can be implemented to a degree and manipulate the usage of resources at some stage in the financial system and hence, is also applicable to assessing the effectiveness of ecotourism initiatives. Although not without its share of criticisms and counter arguments, the ecological footprint may be complemented by other indicators and rationalized in a given context (Lenzen, et al., 2001).

Cole et al (2002) applied ecological footprint analysis in the tourism sector by estimating the ecological footprint of Manali, India based on land use, goods & services and population data. Its EF was found to be 25 times greater than its size, indicating increasing reliance on external ecosystems and moving down the sustainability scale.

In yet another study, Hunter (2002) argued in favour of linking sustainable tourism with ecological footprint, thinking through 'touristic ecological footprint' (TEF) and its calculations of individual tourism products, throughout the product's life-cycle.

Gossling S. et al (2002) used ecological footprint analysis to assess tourism sustainability in their paper. It provides a methodological framework for calculating the ecological footprint of tourism, based on the example of the Seychelles, and discusses its strengths and weaknesses.

Several studies, even quite recently, have applied this tool in diverse geographical contexts, like Italy (Castellani V. et al., 2008), Canada (Jahnson, 2016) and China (Chen, et al., 2017).

Torres-Delgado et. al (2018) proposes a method for studying tourism sustainability on the local stage and proposes the ISOST index defining the threshold of sustainable tourism for a given region to assess its level of sustainability. They considered this method to be an effective device for assessing and defining tourism strategies for destination.

2.6. Potential Ecotourism:

"The potential of ecotourism as a strategy for sustainable development was recognized during the Earth Summit in 1992, when sustainable tourism was considered an environmentally friendly economic activity" (Gray, 2003).

"As the world's population increases and, in many cases, incomes rise, the demand for travel and tourism is increasing. In 1990, an estimated 425 million international travelers spent $230 billion. It is purported to be the fastest-growing industry on earth, experiencing a 9% annual growth rate. International arrivals are expected to increase to 702 million in 2000 and 1.6 billion in 2010. Receipts are forecast to reach $ 621 billion in 2000 and $ 1,550 billion in 2010" (Eadington & Smith, 1992). "Although these figures may be open to debate (A good trip? Ecotourism, 1997), tourism is clearly a large international industry with the potential for development. Rising incomes have also increased the demand for environmental facilities" (Randall, 1987). "An apparent combination of increased demand for travel and increased demand for environmental quality is the growth of ecotourism. Identified as a low-impact alternative to traditional tourism" (Eadington & Smith 1992; Roxe, 1998). Ecotourism is called "responsible travel that preserves the natural environment and preserves the well-being of the local culture" (Wheat, 1998). "The stated functions of ecotourism are to elevate the general public's consciousness of the surroundings, to sensitize vacationers to nature and its procedures" (Whiteman, 1996), and to lessen the poor effect of human pastime in natural regions (Sirakaya & McLellan, 1998). Practitioners of ecotourism, if now not, frequently follow moral standards that promotion of voluntary restraint of human use, the development of less impactful activities, and the sharing of economic benefits amongst nearby human beings.

Unfortunately, the time period "ecotourism" is incredibly difficult to understand. This inequality can make a contribution to a huge variation in estimating and reaching ecotourism spending from $ 12 billion in 1990 to $ 388 billion in 1988 and $ 416 billion in 1994

(Ecotourism Society, unpublished statistics). that is the broader goal of a huge range of power-intensive activities which includes wetland trails (Meric & Hunt, 1998) to power-in depth sports together with visitor submarines and underwater lodges (Newberry, 1997). For the sake of clarity, ecotourism is defined here as "a relatively indomitable ... travel and travel with a specific purpose to enjoy the scenery and its wild flora and fauna and the cultural expressions that exist in the [or] regions" (Luzar et al., 1995).

This definition consists of hiking, canoeing, camping, images, natural world remark, and various activities that do not involve the collection of fish and flora and fauna. Exclusion of looking and fishing isn't depreciation in their ability to contribute to habitat conservation, but an acknowledgment of the difference between hunting and what is commonly considered a rubric of ecotourism. In 1991, 3, 160,000 humans inside the U.S.A. spent $222 million staring at, photographing, and feeding flora and fauna (U.S. Fish and natural world service 1993). Total costs for birdwatchers by myself, typically greater than the ones of other ecotourists, totaled $20 million in 1981. In line with per capita expenditure by means of birdwatchers in 1988, it turned into envisioned at $ 1,852 / yr (Wiedner & Kerlinger, 1990; Leones et al., 1998). The ordinary ecotourist is tremendously educated and has high-quality profits (Chi & Luzar, 1998). Age varies with the nature of the activity (Wiedner & Kerlinger, 1990; Boxall & McFarlane, 1993 ; Wight, 1996 ; Meric & Hunt, 1998). Participation in ecotourism is associated with such socio-economic traits as earnings, gender, race, and environmental mindset (Luzar et al., 1995), as well as leisure choice parameters, inclusive of the range of preceding visits to public land and participation in flora and fauna photography (Chi and Luzar, 1998). Frequency of participation is fairly related to environmental conduct but most effective weakly to environmental issue (Nord et al. 1998). Operation of the Polar endures (Thalarctos maritimus) - observations of groups in Churchill, Manitoba, Canada (nameless 1998) and the Antarctic tour expedition (Montieath, 1997) and many factors in between prove that nature travel actually leads from one end of the world to the other.

2.6.1. The potential positive and negative impacts of ecotourism on local people's livelihood:

"As there is no consensus approximately, which means of ecotourism, the term is used loosely and in some advertising and marketing campaigns, opportunistically" (Goodwin, 1996). At the same time, the impact of ecotourism on the host network and the host environment can be both high quality and low quality. In particular, there is a capacity

for both advantage to and destruction of the surroundings, the subculture, and the prevailing social order. This section of the chapter aims to explore the impact on a neighborhood population's livelihood and the surrounding environment while initiating ecotourism in specific locations.

"It has been established that the capability charges and blessings of ecotourism are seen within the form of its financial, environmental, and socio-cultural aspects" (Weaver, 1998). The table below summarizes the subtle individual and negative impacts.

The Impact of Ecotourism on a Local Community

	Economic	Environmental	Socio-cultural
Positive Impact	➢ Local revenue from ecotourists ➢ Establishment of local employment ➢ Indicate revenue (multiplier effects) ➢ Stimulates peripheral rural economy	➢ Encouragement to care for environment ➢ Ecotourists'assistance with habitat enhancement ➢ Education in protected areas	➢ Aesthetic/spiritual experiences ➢ Fosters awareness among residents and ecotourists
Negative Impact	➢ Start off the costs ➢ In progress charge ➢ Doubtful revenue ➢ Damage to crops by wildlife	➢ Accomplishment = rapid growth ➢ Tourism causes damage and stress ➢ Financial value on nature	➢ Intrusion on local ➢ Cultural influence ➢ Displacement of local culture due to parks

Source: Adapted from Weaver (1998)

Fundamental factors of points illustrated by desk will now be discussed in addition, regarding the paintings of authors aside from Weaver as properly.

2.6.2. Potential positive economic impacts:

Concerning its doubtlessly high-quality financial impact, Weaver (1998) mentioned that ecotourism can offer monetary benefit in terms of profits and employment.

A prime example of this is the work of Harrison and Schipani (2007), which outlines the contribution of the call Ha ecotourism to the livelihoods of local human beings via the boom of social and human capital. In reality, such tourism no longer plays an important role in foreign currency exchange. However, it additionally offers employment which improves the livelihoods of the poor neighborhoods in Laos. In particular, there are about 2,000 rural people in eight separate villages outside and inside the Nam Ha Ecotourism website; most of them offer travelers neighborhood meals and lodging, manual services and domestically made handicrafts and, as a end result, their groups get hold of significant direct monetary blessings. The Nam Ha Eco-guide service, which includes tracking and river tours, had general revenue of US$ 34400 from October 2000 to February 2002. Therefore, income from ecotourism accounted for up to 40% of the village's total profits. Much of this income was spent on essential remedies, rice, apparel, and household objects.

Additionally, in Weinberg, B. & Ekster‘s (2002) research in Costa Rica, ecotourism was found to have added to a spread of fantastic modifications which increased extra jobs and increased earnings, improving the livelihoods of nearby people. Gould (2004) additionally provided a case observation of ecotourism in Uganda, Africa in which he suggested that ecotourism delivered employment and profits to the local people. Substantially, he noted that nearby people had grown to be employed as countrywide park officers, excursion-guides, campground operators, craft and meals manufacturers.

Further, Lindberg, Enliquez, & Sproule (1996) studied ecotourism in Belize and concluded that it achieved 3 sources: the promotion of local economic benefits, the technology of monetary resources to manipulate protected regions, and the era of nearby resources for conservation. As an end result, in their examination of economic effects, the 4 groups studied (San Pedro, Caye Caulker, Gales point and Maya center) noted both direct and indirect local blessings. According to their survey, more than 50% of the population benefited directly from local ecotourism, even though 70% of non-tourism jobs were perceived to be dependent on tourism.

2.6.3. Potential positive environmental impacts:

In relation to the ability to have a positive impact on the environment, Weaver (2006) referred to that ecology plays a critical function in maximizing environmental benefits. He

attributed this to its important role in providing an immediate economic incentive for the protection of surprisingly undisturbed countrywide habitats. It indirectly initiates the protection of reservoirs and normal quality of water. Further, Lindberg (2000) claims that ecotourism plays a critical position in financing the status quo and upkeep of covered regions. As an example, White & Dobias (1991), as noted in Lindberg, Enriquez & Sproule, 1996) using a Filipino case study, identified the following:

Tubbataha [National Marine Park in the Philippines] is a clean case of tourism contributing to marine conservation and useful resource control. It seems viable that if there had been no tourism at the site, it'd no longer be considered a countrywide park or a countrywide basis would countrywide for its protection.

Also, Fang's (2002) takes a look at ecotourism in Sichuan, China and shows that ecology plays a crucial position in protecting the natural surroundings there. Managers within the affected areas took steps to efficiently control logging, increase the use of noise energy, and implement vacationer ration rules, resulting in a boom of 6.7 million hectares underneath flowers in about 90% of the forests.

Further, Stone and Wall (2004) studied ecotourism and community improvement in Hainan, China. Their principal goal was to assess the current popularity of ecotourism in two areas in which it has turned into being promoted as a strategy for balancing the local monetary boom and conservation goals. Consistent with their study, most community residents usually favored conservation and were convinced that the tourism boom would benefit the local people.

2.6.4. Potential positive socio-cultural impacts:

Concerning any probably high-quality effect on socio-cultural situations, Weaver (1998) shows that ecotourism plays an important position in building the self-assurance of nearby human beings, encouraging neighborhood possession and instilling a sense of pleasure and wonderful self-picture. In addition, ecotourism is now not the hardest thing. Increasing the knowledge and information of vacationers enhances the level of locals as nicely. Moreover, Gould (2004) said that ecotourism can create possibilities for community empowerment. The idea changed. He, without a doubt echoed by way of Scheyvens (1999),

observed the opportunities of community empowerment. He claimed that a hit neighborhood-based total ecotourism assignment should result in the empowerment of local people, which encompasses economic, social, political and mental factors.

Such social and cultural blessings are intimately connected with enhancements in monetary conditions, specifically in terms of improvements to the public infrastructure and improvements in the social welfare of the network as an entire. That is pleasant supplied by means of Nelson (2004), who studied network-based total ecotourism in Northern Tanzania and discovered it performed a vital role in improving rural livelihoods and conservation there. While the neighborhood economies were firmly based totally on pastoralist livelihood production, tourism came to make a contribution as an essential and growing source of diversification. Nelson defined the consequent improvement of men's women's households and the community's social infrastructure as proper, stating that village sales had increased unexpectedly over the five years previous to the time of the study, and for that reason, the village budget had multiplied more than 20-fold at some point of that time, that leads to numerous socio-financial benefits.

2.6.5. Potential negative economic impact:

In addition to its ability to fine-tune, ecotourism can also have a negative impact on neighboring areas and populations. Weaver (1998) identifies domestically initiated costs, ongoing prices, unsure sales, and lack of nearby vegetation by using covered flora and fauna as the principal financial for environmental conservation. In particular, the maximum obvious direct value is the financial outlay necessary for launching a possible and suitable operation. This includes the purchase of land for setting up protected areas, improving prices, improvement of appropriate management plans and other necessary regulatory strategies, training and environmental promotion of local staff, and promotion and marketing as ecotourism destinations. “In addition, the construction of both the superstructure—such as accommodation and an interpretation centre —and the infrastructure—such as roads, car park, trails, waste-disposal units, and energy systems—must be financed. Subsequently, costs are incurred on an ongoing basis for the maintenance of these facilities, upgrading of skills, habitat protection, and the enhancement and continued promotion of the site. Also, compensation must be provided for local farmers who experience crop and livestock predation by wildlife ranging far from their protected-area sanctuaries” (Weaver, 1998).

"Research by Stone and Wall (2004) documented these types of negative economic consequences to an area surrounding the ecotourism site at Hainan, China. Results from their survey indicated that 25% or more of the local residents who participated responded that the park has had either no effect at all, or only a negative effect on their lives, mainly due to lost jobs and land" (Stone & Wall, 2004).

2.6.6. Potential negative environmental impacts:

Paradoxically, the environmental results of ecotourism may be poor as well. Weaver (2006) suggested environmental expenses resulting in particular from the removal of local flora in the course of the construction of an eco-lodge, mediating sights, trails, and different footprint facilities. Archer and Cooper (2001, as referred to in Gould, 2004) describe every other component of the negative environmental effect of ecotourism. They pointed out numerous varieties of direct environmental damage, together with pollution, littering and waste, soil erosion, and impairment of flowers and animals because of the established order and operation of ecotourism projects. Further, Weinberg, Bellows and Ekster (2002) analysed case studies in Costa Rica and determined that ecotourism created pollution and infection in terms of waste, site visitors, and noise degree (especially because of a boom in the presence of bikes, cars, and vehicles).

Oram (1995) stated some exciting claims regarding ecotourism—mainly whilst he referred to it as a 'huge commercial enterprise'. Even as it could provide a possibility for foreign currency trading and economic reward and consequently contribute to the upkeep of natural systems and the natural world, according to Oram, it is true that:

Ecotourism can also damage the resources that depend on it. For example, tour boats dump trash in the waters off Antarctica, insects in the photo harass the flora and fauna of parks throughout the state, and hordes trample in vulnerable areas. This desperate interest threatens the efficiency of herbal devices. In many cases, we seem to love the lack of nature.

In addition, the purchase of safe crafts by Kenya's ecotourism project has led to the extinction of anomalous plant species. Mowforth and Munt (1998) noted that when tourism improvement exceeds the carrying capability of neighborhood communities, it reasons for a variety of poor outcomes. These outcomes, together with the displacement of

indigenous/nearby people, nearby cultural degradation, distortion of nearby economies, erosion of social systems, environmental degradation, diversion of scarce resources on which locals depend, and disorder outbreaks were observed around the arena. Nowak (2001) provided a concrete instance of this from his observations on extremely good East African ecotourism, where he witnessed how ecologists brought animal assist cash and advanced the dwelling requirements of the local community, whilst also exposing the animals to human disease. Further, whale watchers were linked to a huge kind of behavioural modifications in centered cetaceans, because of the density of the presence of boats (Higham & success, 2002).

2.6.7. Potential negative socio-cultural impacts:

Negative socio-cultural significance of ecotourism have additionally been widespread. Scheyvens (1999) said that the entice of visitor greenbacks might also make a contribution to escalating competitiveness within or among nearby populations, as well as feeding a number of social troubles together with resentment, jealousy, dating breakdown, social inequality, lack of admiration for elders, and intensifying the problems of deprived businesses. In addition, two Costa Rican case research by way of Weinberg, Bellows and Ekster (2002) illustrated methods wherein the increase in ecotourism has caused large demanding situations. Expanding ecotourism development in Costa Rica has created urbanisation, and with it has come a lack of nearby customs, values, and the small-town, community feeling that once characterized the locale. Researchers highlighted developing issues concerning cultural change, social inequality, and out of control population increase (Weinberg, Bellows, & Ekster, 2002). One network leader commented:

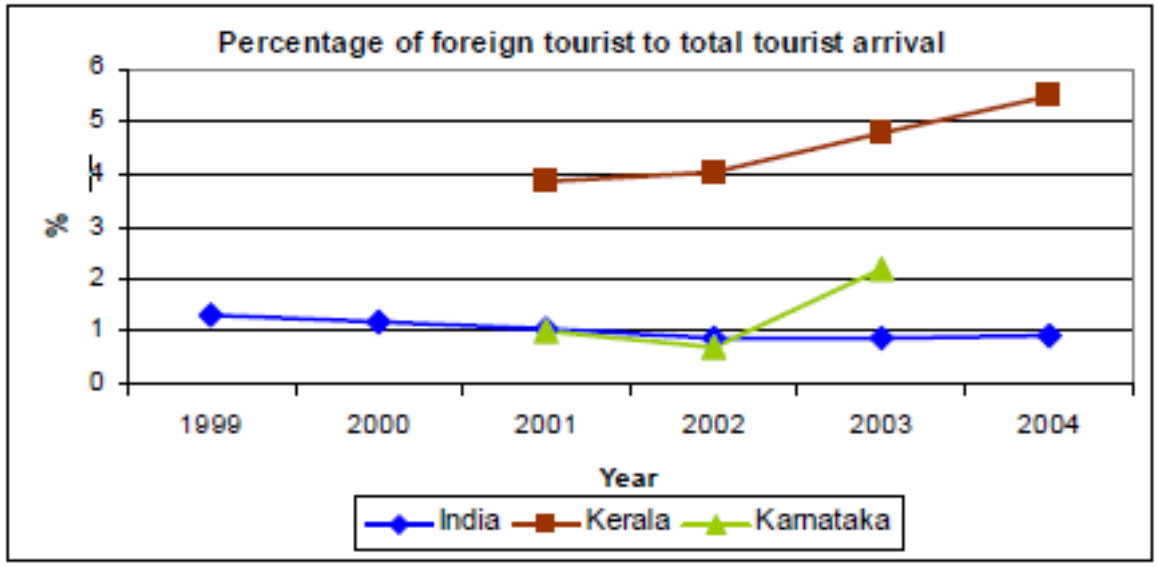
Loads of individuals who labored inside the cheese manufacturing facility started out to depart work in resorts, and so more people came from outside have been introduced to paintings. The idea of a small metropolitan community of friendship and relationships has changed.

Another probably bad socio-cultural effect of ecotourism is cultural intrusion that can arise via tourists getting into near touch with local workers. In a few cases, this ends in native employees realising they can acquire a better fashion of dwelling in an industrialised United

States of America, and considering the opportunity of vacationers going directly to their personal U.S.A. of foundation in their very own United States of America (Schluter, 2001).

2.7. Studies on Ecotourism Policy:

The White Paper on Eco-Tourism policy (2006, April), center for Conservation Governance and coverage, Ashoka believes for research in Ecology and the environment (ATREE), outlines the policy desires of the ecotourism region in India. This area associated with policy planners, manufacturers and implementers inside the middle and the States.



Source: White Paper on Eco-Tourism Policy (Draft, April 2006, ATREE)

Table 2.5: Status of existing policy initiatives in the Ecotourism sector, India

	India	Karnataka	Kerala		
	Ecotourism in India: Policy and Guidelines 1998	Wilderness Tourism Policy 2003	Kerala Tourism Eco initiative 2004	Conservation and Preservation of Areas Act 2005	Participatory Ecotourism programme of Forest Dept 2005
Objectives	Same as general tourism; to be a unifying force, preserving natural and cultural heritage	Opening up forest areas for ecotourism	Eco-Certification Scheme to make each sub-sector within the tourism sector to be eco-friendly	Avoid unsustainable tourism	Promotes participatory Ecotourism programme through EDC/VSS
Strengths	Identified key players in Ecotourism	A beginning	One of the first standards issued by a state, intends to cover all sectors of tourism	Regulates unplanned growth of tourism	Inter-departmental cooperation, financial assistance for establishing community ecotourism
Weakness	No institutional set-up, fiscal incentives or community ownership.	Public sector gets priority/Monopolized access to forest areas	Less stress on socio-cultural aspects including local employment, insufficient incentives for achieving the standards	In conflict with the expected powers and rights of 'panchayathi raj' institutions	Difficult procedural formalities involving many sanctioning authorities

	Sikkim	Madhya Pradesh	Himachal Pradesh
	Sikkim wildlife (Regulation of Trekking) Rules, 2005	Eco & Adventure Tourism Policy 2002	Policy on Development of Ecotourism 2001
Objectives	To regulate trekking activities in the state	Opening up forest areas for eco/adventure	Opening up of forest areas for community based ecotourism
Strengths	Details penalties for offences and rewards for reporting offences	A beginning	Community involvement, well detailed institutional set up
Weakness	Confines only to trekking activities	Stresses on adventure tourism and private sector. Lack of community involvement	Too much stress on trekking and less on other ecotourism activities

Source: White Paper on Eco-Tourism Policy (Draft, April 2006, ATREE)

Motive of this comparative desk (desk 5) is to show the want for wide comparability of regulations throughout states, even consider the context to determine this to a brilliant extent (Mountains, Coast, wildlife rich and so on).

West Bengal funding and commercial coverage (document - 2013), the government has described West Bengal, West Bengal as the only country inside the USA. Which has herbal beauty and variety from the snowy hills of Darjeeling to the seashores of Digha and the mangrove forests of the Sundarbans to the forests of North Bengal. development of eco-tourism hub for sightseeing of towers protecting a place of about one hundred ten acres, together with stilettos, canopy walks, boats, arts and cultural villages, interpretation centers, reservoirs - estimated investment: Rs 50-70 crores (nine.47-13.26 million $) for Sundarban Tourism hub.

2.8. Studies on Coastal Regulation Zone (CRZ):

Coastal Regulation Zone 1991 and subsequence modification: Stormy restricts the establishment of further tourist resorts. Most of the places within 50 meters from highest high tide line need to be utilized as no development zone.

A comprehensive understanding from the above literature review will have to be developed for delineating the research gaps, especially in Indian context. This would help to fine-tune the direction of the proposed thesis.

Chapter III:

Landuse/Landcover analysis of study areas

3.1. General Information:

Among the coastal states of India, the lower Gangetic plains of West Bengal and the deep saline forests formed by the Bay of Bengal and with which the large islands and human settlements are merged together are known as the Sundarbans. Based on various differences, it is believed that the name "Sundarbans" comes from the name of Climax tree "sundari" (Heritiera fomes). This Sundarbans Island was formed as a result of the sediment flowing into the Ganges and Brahmaputra rivers. It is the largest pro-grading delta in the world, with a total area of 25500 km2. (Indian Bangladesh Sundarban) and in India it is 9630 km2. The Sundarbans are comprised of 102 islands, of which 54 have human settlements. The total area of these 54 islands is 5366 km2. The remaining 48 islands are still jungle, with an area of 4264 km2. There are a total of 19 blocks in the Sundarbans region, of which 13 are falling within South 24 Parganas district. The border of the Sundarbans of India can be stated to be the Bay of Bengal to the south and the Dampier Hodges line to the north (extending from Kakdwip to Hasnabad). The Sundarbans are located between the 21° 32´N to 22° 40´ N latitude and the 88°05′E to the 89°01′ Elongitude line. The Sundarbans islands are thus located in the North and South 24 Parganas districts of West Bengal.

In 1973, the Sundarbans Development Board was formed with a 9630 km2 area and it was declared a World Heritage site by UNESCO in 1987. Just two years later, the area was declared as the Sundarbans Biosphere Reserve.

Tourist centers have been set up in various places in the region for nature-loving travelers, and new avenues have been created for local people to earn money by focusing on those tourist destinations. Notable tourist destinations are Sajnekhali, Sudhanyakhali, Dobanki, Netidhopani, Bakkhali, Frasergunj, Henry Island, Pakhiralay, Jharkhali and Ganga Sagar etc.

3.2. Physical Aspects:

3.2.1. Terrain Characteristics:

The lower Gangetic plain, where the Sundarbans mangrove forests reside, was formed by gravel, pebbles, sand, and sediment carried from the Himalayas. Before the Sundarbans were formed, it represented a continental shelf-slope locality, eventually filled with thick layers, mainly late Pleistocene deposits and other particles (Wadia, 1973). Two major river systems, number one Ganga (2492 km) and Brahmaputra (2988 km) along with their

tributaries and distributaries took an active part in filling up the basin. Also, sediment accumulation and distribution were further facilitated by tidal currents from the sea and major rivers.

Ghosh (1940) commented that the ruins of the huge mangrove are lying beneath the surface of the present Sundarbans. Using the C-1 dating method, Mukherjee (1972) analyzed that, around 3,000 - 5,000 years ago Kolkata's metropolitan area was covered by delta mangroves and the present Sundarbans region was below sea level only 6,000 – 7,000 years ago. The process of formation of the Sundarbans delta is both rapid and dynamic. Naskar & Guha Bakshi (1987) described in their report that the landforms in the western and southeast of the Sundarbans are constantly changing as sea currents and tidal forces operate in this area. The erosional processes are prominent along the outer estuaries and depositional processes along the banks of inner estuarine waterways. Sanyal and Ball (1986) describe that erosion processes in the Sundarbans region are characterized by external sedimentation and exit processes along the inner estuarine waterways.

According to S. C. Deb (1956), it is described that the morphological nature of the Sundarbans is apparently the same and the average elevation is from 5 to 8 meters above mean sea level. The southwestern Sundarbans is comparatively higher than the southeastern part of the Sundarbans.

3.2.2. Drainage System:

The rivers of the Sundarbans are spreading like nets. The numbers of 102 islands of Sundarbans are located along these numerous rivers. Twice a day, the rivers are flooded and water flows downstream. There are numerous small rivers associated with some large rivers in the Sundarbans region. W.W. Hunter states in his "A Statistical Account of Bengal" in the context of Sundarbans' river – "The whole country is one network of rivers and watercourses. The great trunk channels enter the Sundarbans from the north and are connected by innumerable distributaries, which after endless bifurcation and interlacing, unite into large estuaries into the Bay of Bengal" (Hunter, 1875). The major rivers in the region are Muri Ganga, Saptamukhi, Thakuran, Matla, Vidyadhari, Raimangal, Kalindi etc. Raimangal is a wide and open river and it indicates the boundaries between India and Bangladesh. However, all the rivers have fallen into the Bay of Bengal.

Except for the above-mentioned major rivers, the smaller rivers are Ichamati, Gomor, Hogal, Hatania-Doania, Satbanki, Piyali, etc. Many rivers and canals connect these rivers in the Sundarbans.

In the 16th century, the Ganges flowed and joined the Bay of Bengal with the name Bhagirathi-Hooghly channel and another branch with the name Padma entered Bangladesh (Morgan and Mclntire, 1959). This led to an inadequate supply of fresh water to the Indian Sundarbans. The western part of the Indian Sundarbans has recovered some fresh water through the Bhagirathi-Hooghly channel but the eastern part, designated as the "Tiger Reserve", has been completely isolated from the river's freshwater sources in the last 500 years (Sanyal and Ball, 1986). However, the eastern boundary of Sundarban Tiger Reserve (STR) bounded by Kalindi and Raimangal rivers supplies fresh water.

3.2.3. Climate Characteristics:

The climate of the Sundarbans region is the nature of the sub-tropical climate. The climate of the Sundarbans region has been identified as a sub-tropical climate based on the climatic classification by Koppen. The climate of this region is controlled by the climate of the Bay of Bengal. The prominence of the three seasons is particularly noticeable – i) Summer season (March to June), ii) Rainy season (June to September), iii) Winter season (November to February). The average annual rainfall is 1550 to 2300 millimeters. The maximum rainfall is here during the monsoon (about 80 percent). The winters here are dry. The maximum heat during summer is about 35 degrees Celsius and the lowest is 18 degrees Celsius. The maximum temperature in winter is about 30 degrees Celsius and the minimum is 10 degrees Celsius. Natural disasters are more prevalent due to their location in the coastal areas. The wind speed here is high and during the summer there is often a torrential downpour in the afternoon, which is known locally as "Kal Baisakhi". The average wind speed here is about 60 to 80 km and the maximum is about 170 km.

3.2.4. Soil Characteristics:

The Sundarbans region is made up of newly formed clay soil. The river formed the island region by depositing in the lowland areas such as gravel, pebbles, silt, sand, etc., which flows from the hills to the lowland. The Sundarbans region is very saline, because of the coastline; the area has a high salt content. So the soil is usually alkaline in nature because of the high amount of salt in the soil. The main minerals in this soil are chlorides, sodium,

magnesium, calcium, etc. Based on soil quality, the soil in this region has been divided into 5 main, such as – i) Clay soil ii) Sandy soil iii) Sandy loam iv) Heavy soil and v) Salty soil. In widespread, the soil of the Sundarbans is deep and poorly tired. The pinnacle horizon is the size of the clayey, overlain by a thin layer of fresh shoots distributed in the monsoon floods each year. Below this, alternate horizons of clay and sand are present (Choudhury, 1962). The following table analyzes the major soil type and volumes of the study area.

Table 3.1: Soil type of study area blocks, Indian Sundarbans, South 24 Parganas

Name of the study area	Name of the Blocks	Major soil type	Covered by percentage of block area	Other soil type	Covered by percentage of block area
Jharkhali	Basanti	Saline Alkaline	80	Saline	20
Pakhiralay & Dayapur	Gosaba	Saline Alkaline	90	Saline	10
Bakkhali	Namkhana	Saline Alkaline	90	Saline	10
Ganga Sagar	Sagar	Saline Alkaline	90	Saline	10

Source: Central Soil Salinity Research Institute, Canning

3.2.5. Ecosystem Characteristics:

Billions of years ago, the world has been protecting its own ecosystem in a natural way since the birth of its creation. But since the creation of man on earth and the changing of the civilization era with civilization, the change in the ecosystem has begun. Biologist A.G. Tansley first used the term "ecosystem" in 1935. The ecosystem of that region is developed on the basis of these two factors, both lively and lifeless.

The ecological features of the Sundarbans are - There are mainly two types of ecosystems in this area, namely the forest ecosystem and the aquatic ecosystem. In each ecosystem, there is a relationship between the producer and the food. So the ecosystem is dependent on the relationship between producer and food. The forest ecosystem of the Sundarbans is a variety of plants, shrubs, grasses, etc. in the forests of that region and in the forest; there are different species of wildlife, such as deer that live by eating grass. Deer is the tiger's food. In this way, a food chain is protected on the basis of its relation to the food chain. But now the forest ecosystem of Sundarbans is about to collapse due to various natural disasters and various human activities. On the other hand, in the aquatic ecosystem, small fish

live by eating aquatic plants, these small fish are eaters of medium fish and medium fish live as food for big fish, sharks, crocodiles, etc. In the same way, aquatic ecosystems like the forest ecosystem are also protected.

3.2.6. Biodiversity Characteristics:

Sundarbans have been created in their own way of nature. Due to the accumulation of sediment, gravel, etc. in the estuary of the Ganges and Brahmaputra rivers, the largest delta of the world has been created by the "Sundarbans delta". In order to balance nature, the island itself was decorated with greenery and was home to wildlife. The island was home to several species of birds. Currently, 54 of the 102 islands are home to human beings, which in addition to destroying forests are destroying the biosphere to some extent.

Sundarbans Biosphere Reserve stands on a natural balance with the history of different species of trees, rivers, wildlife, and people of different times. The wildlife and the environment inhabiting this forest are in danger today. Nearly half of the forests for livelihood and human habitation are almost finished. Some trees and wildlife are on the way to extinction today. The waters of the rivers of the region are polluted today due to indiscriminate use and oppression of the people. On the other hand, the natural biodiversity of the Sundarbans is also being destroyed due to repeated natural disasters. So, today the Sundarbans biosphere was created to keep the "Sundarbans Biosphere" on March 28th, 1989. The Sundarbans is one of the biggest biospheres in the world. The size of the biosphere in India is 9630 square kilometers. The Biodiversity Conservation Act was enacted in 2002 for the purpose of keeping biodiversity, and on February 1st, 2019, the Indian Sundarbans declared a Ramsar site (Sundarbans Wetland). The Sundarbans Wetland extends over an area of 4230 sq km. The Sundarbans has been declared a Ramsar site for the purpose of saving the wetland (“List of Ramsar Site in India”, 2020).

Various species of mangrove trees, shrubs, etc. are found in the Sundarbans region. Animals, on the other hand, are notable, such as tigers, deer, pigs, monkeys, crocodiles, snakes of various species, and various types of birds. This is all about the Sundarbans biosphere. But now, due to natural causes and various activities of human beings, the biodiversity is slowly eroding; even today some species are almost extinct. The possibility of a loss of biodiversity continues to increase due to deforestation, use of chemical fertilizers,

use of plastics, and disposal of waste everywhere. Simultaneously, uncontrolled populations indirectly produce misery. So, we all have a responsibility to preserve this biodiversity.

3.2.6.1. Flora:

Sundarbans mangroves (along with Bangladesh) form the largest contiguous mangrove chunk on the globe. The most diverse famous mangrove forests of the world have been developed in the water and soil mixed with salt in the rivers, canals, creeks, and coastal areas of the Sundarbans. Soil and tropical climates in the region are conducive to mangrove plant growth. Many species of plants have grown simultaneously in this land. The Sundari tree is a mangrove species, in whose name in India is known as "Sundarbans", but now it is almost extinct in Indian Sundarbans. Notable species of mangrove trees in this forest are – Heritiera Fomes (Sundari), Aegialitis Rotundtfolia (Tora), Sonneratia Apetala (Keura), Phonerix Paludosa (Hental), Nypa Fruticans (golpata) and Acanthus Volubilis (Lota Horgos), etc.

3.2.6.2. Fauna:

There were many wildlife habitats in the dense forests of the Sundarbans, but now the wildlife in the Sundarbans is declining greatly due to the destruction of the forest and the increase of human habitat. Yet there is still much wildlife gathering in this forest. Among the wildlife, the Royal Bengal Tiger (Panthera Tigris Tigris) lives in these mangrove forests forming the only mangrove tiger land on the globe. In addition, various species of turtles, crocodiles, Sharks, different types of snakes, wild pigs, monkeys, deer, etc., roam the area. There are many gharial (Gavialis gangeticus), crabs, and different types of fish notable in rivers and creeks. Different species of birds are also found in the Sundarbans region, worth mentioning – copper smith barbet (Megalaima Haemacephala), collared kingfisher (Coryle Rudis), common sandpiper (Actitis hypoleucos), spotted owl (Athene brama) and Asian openbill (Anastomus oscitant) etc.

3.2.7. Heritage Assets:

The history property of the state originates from numerous centuries of the records of Bengal. In ancient and medieval instances the area became ruled by using Hindu Kings, Buddhist Kings, and later Sultan Nawabs. The wealthy heritage of Bengal is reminiscent of Hindu, Muslim, Buddhist, Vaishnava, and Christian cultures.

In 1987, UNESCO declared the Sundarbans place as an international history web page. The heritage site of Sundarbans covers an area of 10,000 km² of land and water inside the Ganga delta. It consists of the world's biggest region of mangrove forests. That is the house of some rare or endangered species consisting of tigers, aquatic mammals, birds, and reptiles.

3.2.8. Sundarbans Ramsar Site:

The Ramsar Conference was held in Iran in 1971 to conserve wetlands. However, it is not only a wetland restoration or conservation project, it also plays an important role in mangrove forest conservation, forest conservation, biodiversity conservation, etc. Therefore, in order to save the Sundarbans wetlands, the Sundarbans wetlands have been declared as Ramsar sites on February 1, 2019, with an area of 4230 sq km. (Zaved, 2019 ; "List of Ramsar Site in India", 2020 ; Ramsar Sites Information Service, 2020).

3.2.9. Demography:

One of the most popular proverbs - "Crocodile in the water and a tiger on the land" - is about the Sundarbans. Today, out of 102 islands, people have gradually evolved into 54 islands. As a result, the Sundarbans is one of the most populous regions of West Bengal.

The Sundarbans were previously identified as part of the 24 Parganas district and consisted of 15 police stations. The district is now divided into two separate districts and is divided into 19 blocks, 13 of which are in the South 24 Parganas districts and six in the North 24 Parganas districts. Currently, Sundarbans is made up of 19 blocks. According to the 1991 census, the total population of the Sundarbans region was 3154890 which increased to 3757356 in 2001 (growth rate is 19.09 percent) and in 2011 the population increased to 4426259 (growth rate of 17.80 percent), according to 2011 census data. According to 2011 data, the total number of males in the Sundarbans area is 2264133 (51.15 percent) and the total number of females is 2162126 (48.85 percent). The number of women per 1000 males is about 955. Total literacy is 2846061 people (64.30 percent), of which male literacy is 1592227 (70.32 percent) and female literacy is 1253843 (57.99 percent). The total working population in this area is 162433 people, of which the total number of working men is 1268092 and the total number of working women is 394341 - according to 2011 census data. The total population is 1573859 (35.58 percent) in the Scheduled Castes and 211927 (4.79 percent) in the Scheduled Tribes.

Table 3.2 Comparison between different census years of Indian Sundarbans

YEAR	1991	2001	2011
Total population	3154890	3757356	4426259
Male	1624432	1932401	2264133
Female	1530458	1824955	2162126
Male (Percentage)	51.49	51.43	51.15
Female (Percentage)	48.51	48.57	48.85
Scheduled Castes	1277367	1396648	1573859
Scheduled Tribes	159084	180429	211927
Scheduled Castes (Percentage)	40.49	37.17	35.58
Scheduled Tribes (Percentage)	5.04	5.22	4.79
Total literacy	1207794	2028208	2846061
Male literacy	817692	1228518	1592227
Female literacy	390102	799690	1253843
Total literacy	38.28	53.98	64.30
Male literacy (Percentage)	50.34	63.57	70.32
Female literacy (Percentage)	25.49	43.82	57.99
Total working population	842429	1302919	162433
Total male working population	792107	1009166	1268092
Total female working population	50322	293753	394341

Source: Sundarbaner Itihas, Kanailal Sarkar

Looking at the population of the Sundarbans region, it is seen that a large proportion of the people living in the region are people belonging to the indigenous people of the tribes who are economically backward compared to others. Therefore, it is hoped that the development of these regions can improve their socio-economic infrastructure.

3.2.10. Economic Activities:

Human settlements have been established in 54 of the 102 islands of the Sundarbans. Aboriginal and working people from different places have started living on these islands. The discussion here is about the livelihood of the people living in the Sundarbans and their economic role. About 80 to 85 percent of the total population of the Sundarbans is dependent on agriculture, which usually cultivates a single crop of paddy a year. They are usually followed by the stages of small farmers and landless farmers. In 1975, the survey report of

the Tagore Society for Rural Development showed that the average land area is less than one hectare (Kanjilal, 2000). In the category of economic activities, most of the people here are covered under the primary activities, because agriculture, marine fisheries harvesting, wood climbing, wax and honey collection from forests, fisheries, and livestock are the main livelihoods. Aush (Pre-monsoon paddy), Amon (monsoon paddy), and Boro (winter paddy) are the main three types of crop cultivated, among which Aman is predominant. About 40 percent of the people are landless farmers. As a result, they have to move from village to city for work all year long. So the unemployment populations are high and upward. Apart from these, the people have adopted other livelihoods, such as handloom, making furniture in wood, bamboo work, mat weaving, etc. With the development of the tourism industry in different areas of the Sundarbans at present, the local people have associated themselves with the industry in various activities. As a result, a portion of their income is earned from this enterprise. The development of the tourism industry has made the local people of these places all associated with the work: tour guides, tour operators, boat operators, cooks, forest guards,s and small shops (tea shops, food hotels, small toy shops, local fruit sales, etc.).

3.3. Change of Landuse Pattern in different study areas:

Here are the changes in landuse/landcover (LULC) over the four decades (1986, 1996, 2006 & 2014) in the four tourist areas (Jharkhali in Basanti, Pakhiralaya & Dayapur in Gosaba, Sagar Island in Sagar, and Bakkhali in Namkhana) of the Sundarbans. This study shows the classification of LULC and also imagines the most probable algorithm in software ERDAS using the supervised classification method. The image classification resulted in ten LULC classes: Agriculture Land (AL), Aquaculture Farm (AF), Creek (C), Mangrove (M), Marshy Land (ML), Mudflat (Mf), Open Space (OS), Other Vegetation (OV), Settlement with Vegetation (SV) and Water Body (WB). During the study period from 1986-2014, the region underwent numerous development-related activities. Settlement growth, redistribution of forest land for settlements, settlements, and agriculture, construction of roads for communication and increase of tourism, change of landforms for tourism development, etc.

3.3.1. SAGAR ISLAND:

The Sagar Island LULC four-decade map is presented in Figure 3.1, Figure 3.3, Figure 3.5 and Figure 3.7. Table 3.7 shows that the LULC mapping of the Sagar Island study area for four decades indicates a steady increase in the built-up area that consists of the built-in land use. It is observed that Sagar Island was 254.42 km2 in 1986, but due to land

degradation it decreased to 239.47 km2 in 1996 and 236.18 km2 in 2006 but very little (237.19 km2) land area increased in 2014. Table 3.7 shows that in 1986, the area of agricultural land was 118.64 km2 and the settlement with vegetation area was 73.16 km2. Land use analysis of the last four decades proves that the amount of agricultural land is declining and the area inhabited by it is increasing. In other words, in 2014, the amount of agricultural land decreased to 89.21 km2, while the settlement with vegetation increased to 101.02 km2.

Figures 3.2, 3.4, 3.6, and 3.8 show the decreasing and increasing percentages of each class of land use over four decades on Sagar Island. It is observed (Fig. 3.10) that while some land uses like agriculture, mangrove, mudflat, and water bodies fluctuate in these four decades, two land uses that record a steady rise are i) Aquaculture farm and ii) settlement with vegetation. The analysis also points out that there has been an increase in the overall Island area by 1 km2 during the same period, after land loss due to erosion in the previous decades indicating a negative trend in Island area reduced, as given in figure 3.11 Table 3.8 analyses the location of these events.

Most of the study area is agriculture, and there are some settlements with more or less linear vegetation along both sides of the road. You can see some botanical and artificial waters scattered throughout this cloth.

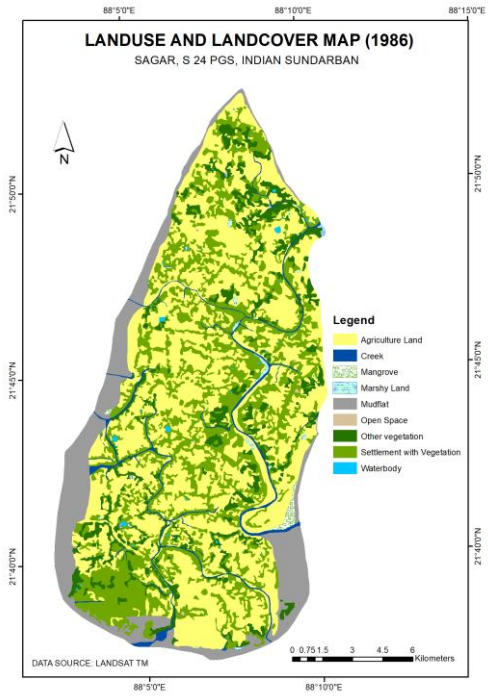


Figure 3.1 LULC Map, 1986

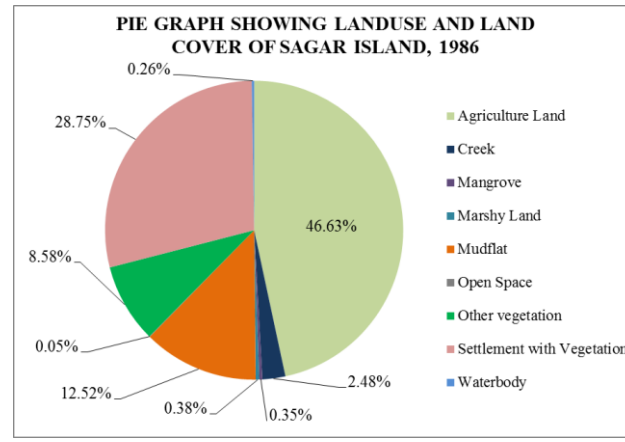
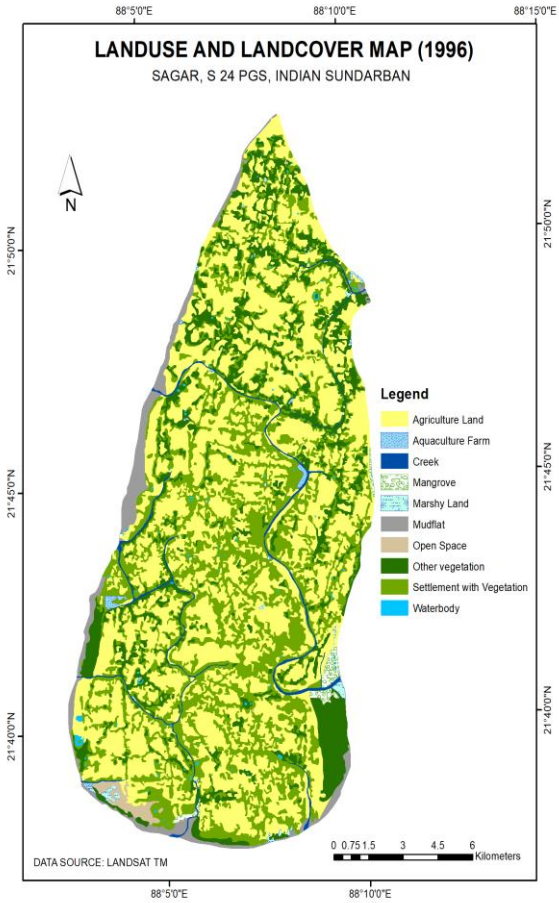


Figure 3.2 Percentage occurrence of difference LULC.s, 1986

Table 3.3 Landuse/Landcover Classes and Area in Km^2 of Sagar Island (1986)

Sl No.	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	118.64	46.63
2	Aquaculture Farm	0	0
3	Creek	6.32	2.48
4	Mangrove	0.89	0.35
5	Marshy Land	0.96	0.38
6	Mudflat	31.85	12.52
7	Open Space	0.14	0.05
8	Other vegetation	21.83	8.58
9	Settlement with Vegetation	73.16	28.75
10	Water body	0.65	0.26
	Total	**254.42**	**100**



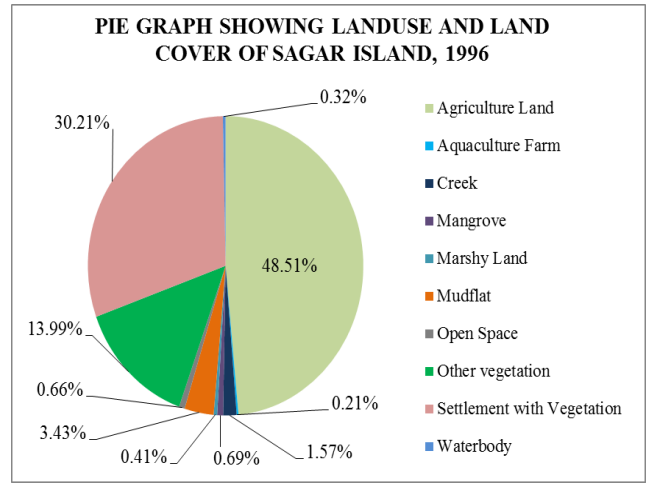


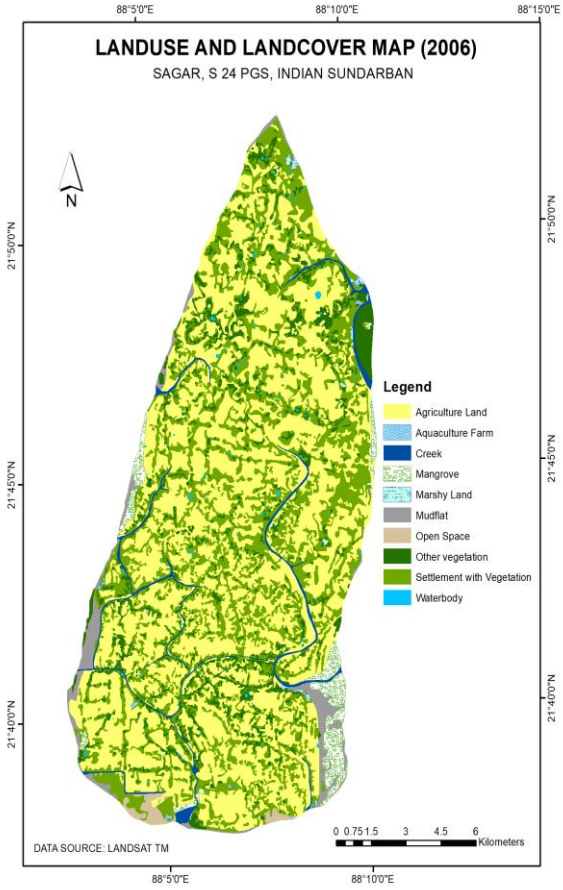
Figure 3.4 Percentage occurrence of difference LULC.s, 1996

Figure 3.3 LULC Map, 1996

Table 3.4 Landuse/Landcover Classes and Area in Km^2 of Sagar Island (1996)

Sl No.	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	116.16	48.51
2	Aquaculture Farm	0.51	0.21
3	Creek	3.76	1.57
4	Mangrove	1.65	0.69
5	Marshy Land	0.98	0.41

6	Mudflat	8.21	3.43
7	Open Space	1.59	0.66
8	Other vegetation	33.50	13.99
9	Settlement with Vegetation	72.34	30.21
10	Water body	0.77	0.32
	Total	**239.47**	**100**



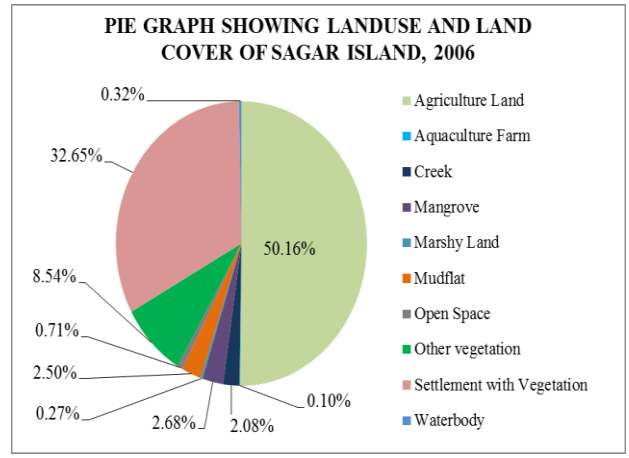


Figure 3.6 Percentage occurrence of difference LULC.s, 2006

Figure 3.5 LULC Map, 2006

Table 3.5 Landuse/Landcover Classes and Area in Km^2 of Sagar Island (2006)

Sl No.	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	118.46	50.16
2	Aquaculture Farm	0.22	0.10
3	Creek	4.92	2.08
4	Mangrove	6.33	2.68
5	Marshy Land	0.63	0.27
6	Mudflat	5.91	2.50
7	Open Space	1.67	0.71
8	Other vegetation	20.17	8.54
9	Settlement with Vegetation	77.11	32.65
10	Water body	0.75	0.32
	Total	236.18	100

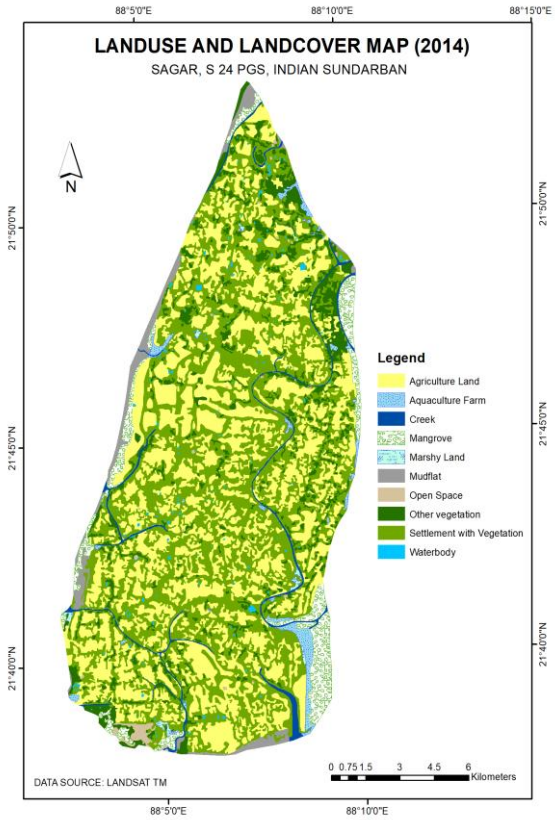


Figure 3.7 LULC Map, 2014

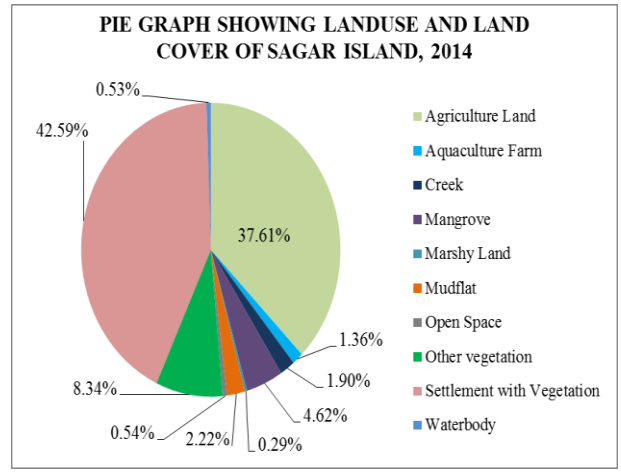


Figure 3.8 Percentage occurrence of difference LULC.s, 2014

Table 3.6 Landuse/Landcover Classes and Area in Km^2 of Sagar Island (2014)

Sl No.	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	89.21	37.61
2	Aquaculture Farm	3.23	1.36
3	Creek	4.49	1.90
4	Mangrove	10.96	4.62
5	Marshy Land	0.68	0.29
6	Mudflat	5.27	2.22
7	Open Space	1.28	0.54
8	Other vegetation	19.79	8.34
9	Settlement with Vegetation	101.02	42.59
10	Water body	1.25	0.53
	Total	**237.19**	**100**

Table 3.7 Comparison between classified Landuse/Landcover during the year 1986, 1996, 2006 and 2014

Sl No.	LULC Type	1986		1996		2006		2014	
		Area in km^2	Percentage (%)	Area in km^2	Percentage (%)	Area in km^2	Percentage (%)	Area in km^2	Percentage (%)
1	Agriculture Land	118.64	46.63	116.16	48.51	118.46	50.16	89.21	37.61
2	Aquaculture Farm	0	0	0.51	0.21	0.22	0.10	3.23	1.36
3	Creek	6.32	2.48	3.76	1.57	4.92	2.08	4.49	1.90
4	Mangrove	0.89	0.35	1.65	0.69	6.33	2.68	10.96	4.62
5	Marshy Land	0.96	0.38	0.98	0.41	0.63	0.27	0.68	0.29
6	Mudflat	31.85	12.52	8.21	3.43	5.91	2.50	5.27	2.22
7	Open Space	0.14	0.05	1.59	0.66	1.67	0.71	1.28	0.54
8	Other vegetation	21.83	8.58	33.50	13.99	20.17	8.54	19.79	8.34
9	Settlement with vegetation	73.16	28.75	72.34	30.21	77.11	32.65	101.02	42.59
10	Water body	0.65	0.26	0.77	0.32	0.75	0.32	1.25	0.53
	TOTAL	**254.42**		**239.47**		**236.18**		**237.19**	

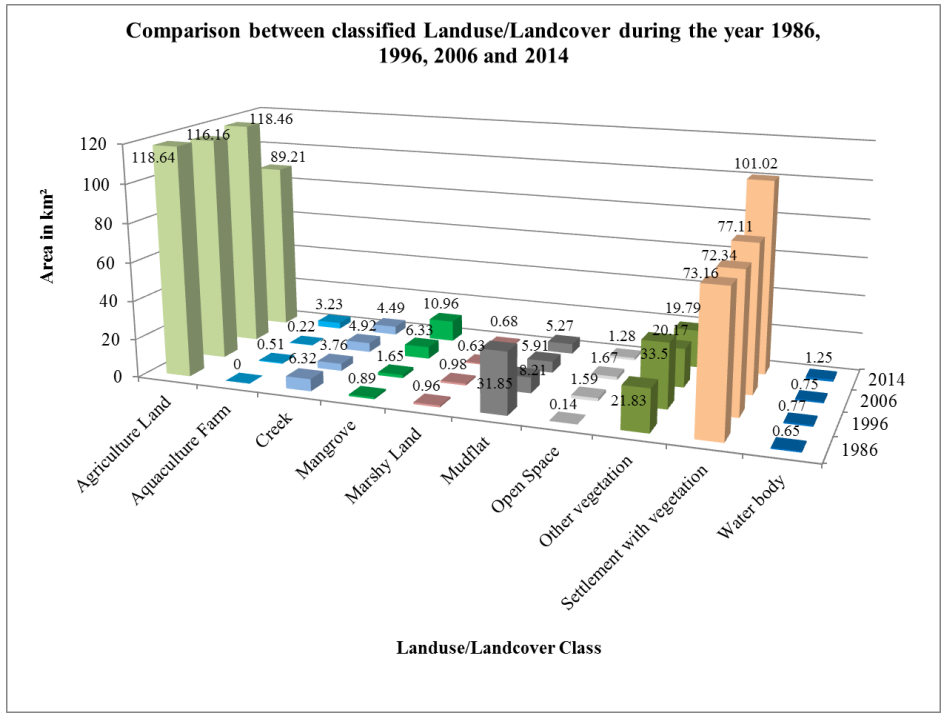


Figure 3.9 Change dynamics of LULC.s over four decades (1986-2014)

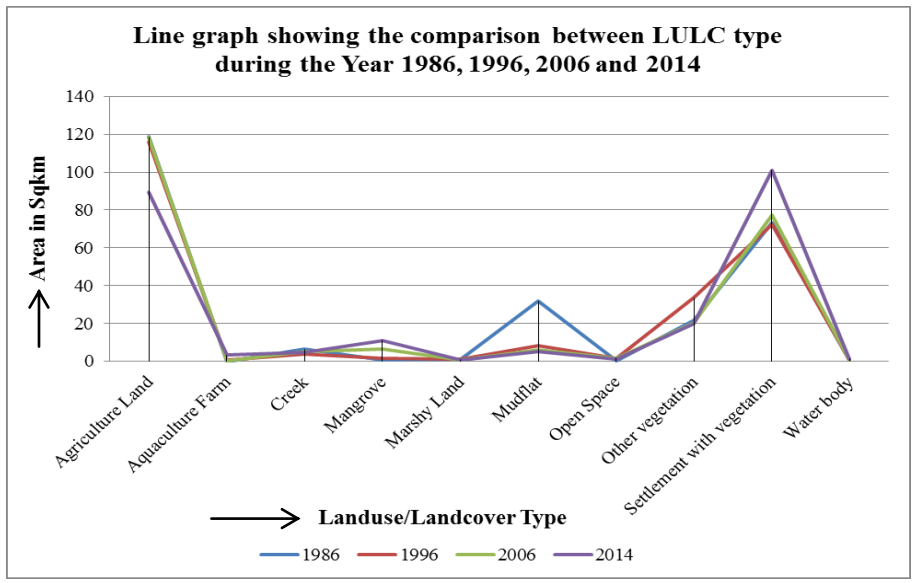


Figure 3.10 Change dynamics of LULC.s over four decades (1986-2014) in line graph

Table 3.8 Decadal change in Island area due to erosion and accretion from 1986-2014

YEAR	Total area in km^2	Percentage of Erosion loss and Accretion gain	Result
1986	254.42		
1996	239.47	-5.88	Land erosion
2006	236.18	-1.37	Land erosion
2014	237.19	0.43	Land accretion

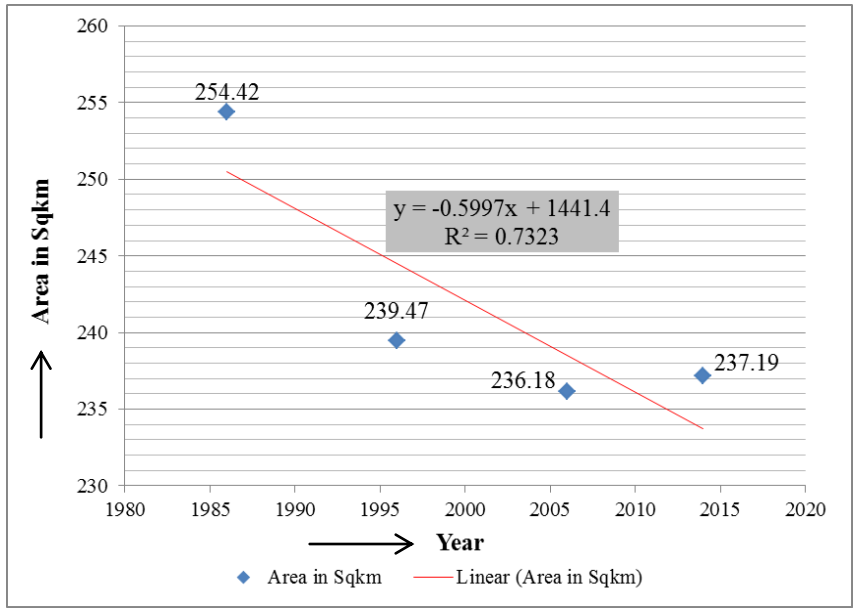


Figure 3.11 Trend (decreasing) analysis of Island area dynamics due to erosion & accretion

Table 3.9 Showing the area of Landuse/Landcover transformations matrix of the study area from 1986 to 1996 (in hectare)

Land Class		Land Class 1996										
		Agriculture Land	Aquaculture Farm	Creek	Mangrove	Marshy Land	Mudflat	Open Space	Other Vegetation	Settlement with Vegetation	Water body	Grand Total
Land Class 1986	Agriculture Land	8382.63	17.64	72.06	13.43	19.51	82.45	11.84	10.12	3339.94	17.06	11966.68
	Creek	96.35	12.79	197.98	5.30	5.40	33.64	2.94	-	251.86	3.15	609.40
	Mangrove	6.90	-	3.83	65.59	-	1.30	-	-	7.36	2.72	87.70
	Marshy Land	37.69	13.68	3.46	-	0.64	5.66	-	-	27.39	0.14	88.67
	Mudflat	251.15	0.62	19.93	47.95	22.62	676.70	29.78	-	721.64	16.90	1787.29
	Open Space	7.96	-	-	-	-	-	0.02	-	5.89	-	13.87
	Other Vegetation	269.04	-	2.06	19.28	0.95	3.08	-	7.87	356.29	0.66	659.23
	Settlement with Vegetation	2689.15	6.38	81.77	0.53	48.61	28.49	114.96	1.74	5945.05	26.51	8943.20
	Water body	9.92	0.52	0.05	-	0.95	0.07	1.69	-	41.82	10.97	65.99
	Grand Total	**11750.79**	**51.63**	**381.14**	**152.07**	**98.68**	**831.40**	**161.23**	**19.74**	**10697.24**	**78.11**	**24222.03**

Table 3.10 Showing the area of Landuse/Landcover transformations matrix of the study area from 1996 to 2006 (in hectare)

Land Class		Land Class 2006										
		Agriculture Land	Aquaculture Farm	Creek	Mangrove	Marshy Land	Mudflat	Open Space	Other Vegetation	Settlement with Vegetation	Water body	Grand Total
Land Class 1996	Agriculture Land	7144.89	5.38	122.89	34.67	8.66	138.13	31.10	11.55	4116.35	23.86	11637.48
	Aquaculture Farm	19.27	-	4.36	-	-	-	-	-	27.06	0.44	51.12
	Creek	120.13	1.16	45.54	21.00	0.98	5.21	0.95	1.03	172.85	0.90	369.75
	Mangrove	22.16	-	8.67	111.02	-	0.12	-	-	8.98	-	150.94
	Marshy Land	8.76	-	6.43	11.15	1.63	4.91	3.72	-	39.16	0.23	75.99
	Mudflat	48.76	5.42	38.18	153.41	4.57	149.73	27.40	0.25	111.83	0.70	540.25
	Open Space	34.53	-	15.91	-	1.52	0.72	28.62	-	79.92	-	161.23

	Other Vegetation	2.87	-	-	-	-	-	-	-	14.82	2.05	19.74
	Settlement with Vegetation	4560.58	10.39	226.04	271.90	44.55	276.39	36.52	11.37	5043.62	45.96	10527.32
	Water body	31.43	0.36	0.87	3.37	1.18	2.77	0.69	0.46	33.80	2.03	76.97
	Grand Total	**11993.37**	**22.71**	**468.91**	**606.50**	**63.10**	**577.98**	**129.00**	**24.66**	**9648.38**	**76.18**	**23610.80**

Table 3.11 Showing the area of Landuse/Landcover transformations matrix of the study area from 2006 to 2014 (in hectare)

Land Class		**Land Class 2014**										
		Agriculture Land	**Aquaculture Farm**	**Creek**	**Mangrove**	**Marshy land**	**Mudflat**	**Open Space**	**Other Vegetation**	**Settlement with Vegetation**	**Water body**	**Grand Total**
Land Class 2006	**Agriculture Land**	4689.40	122.51	183.29	160.34	31.72	64.31	50.80	115.05	6125.79	63.34	11606.55
	Aquaculture Farm	5.50	-	-	2.69	-	0.32	-	--	4.83	-	13.34
	Creek	149.25	10.80	10.71	34.59	1.26	6.38	3.85	1.73	215.20	4.76	438.54
	Mangrove	88.31	6.75	15.22	187.11	-	3.07	1.14	-	61.97	0.39	363.96
	Marshy Land	6.02	5.21	1.41	4.58	0.06	1.98	0.71	0.39	20.58	0.00	40.94
	Mudflat	134.57	40.72	4.76	137.01	-	9.01	1.56	-	145.76	2.64	476.04
	Open Space	4.91	-	0.53	7.12	-	0.04	19.62	4.55	28.87	0.86	66.52
	Other Vegetation	9.31	-	-	2.21	-	0.07	-	0.68	9.04	-	21.30
	Settlement with Vegetation	3518.60	115.27	188.82	279.22	25.88	58.69	52.14	121.66	4837.05	45.57	9242.92
	Water body	29.05	0.68	1.17	2.32	-	-	0.16	1.59	38.69	0.33	73.99
	Grand Total	**8634.92**	**301.94**	**405.92**	**817.19**	**58.93**	**143.85**	**129.98**	**245.66**	**11487.79**	**117.90**	**22344.09**

3.3.2. BAKKHALI

The Bakkhali LULC four-decade map is presented in Figure 3.3.12, Figure 3.14, Figure 3.16 and Figure 3.18. Table 3.16 shows that the LULC mapping of the Island study area for four decades indicates a steady increase in the built-up area that consists of the built-in land use. It is observed that Bakkhali Island was 156.54 km^2 in 1986, but due to land degradation it decreased to 147.47 km^2 in 1996 and 145.17 km^2 in 2006 but very little (146.46 km^2) land area increased in 2014. Table 3.16 shows that in 1986, the area of agricultural land was 68.40 km^2 and the settlement with vegetation area was 44.16 km^2. Land use analysis of the last four decades proves that the amount of agricultural land is declining and the area

inhabited by it is increasing. In other words, in 2014, the amount of agricultural land decreased to 48.20 km^2, while the settlement with vegetation increased to 68.46 km^2.

Figures 3.13, 3.15, 3.17 and 3.19 show the decreasing and increasing percentages of each class of land use over four decades on Bakkhali. It is observed (Fig. 3.21) that while some land uses like agriculture, mangrove, mudflat and water bodies fluctuate in these four decades, two land uses that record steady rise are i) Aquaculture farm and ii) settlement with vegetation. The analysis also points out that there has been an increase in the overall Island area by 1.29 km^2 during the same period, after land loss due to erosion in the previous decades indicating a negative trend in Island area reduced, as given in figure 3.22 Table 3.17 analyses the location of these events the most important study area is beneath agricultural and there are some settlements with more or less linear vegetation along both sides of the roads in more or fewer liner patterns. Some natural and man-made water bodies are found scattered with in this fabric.

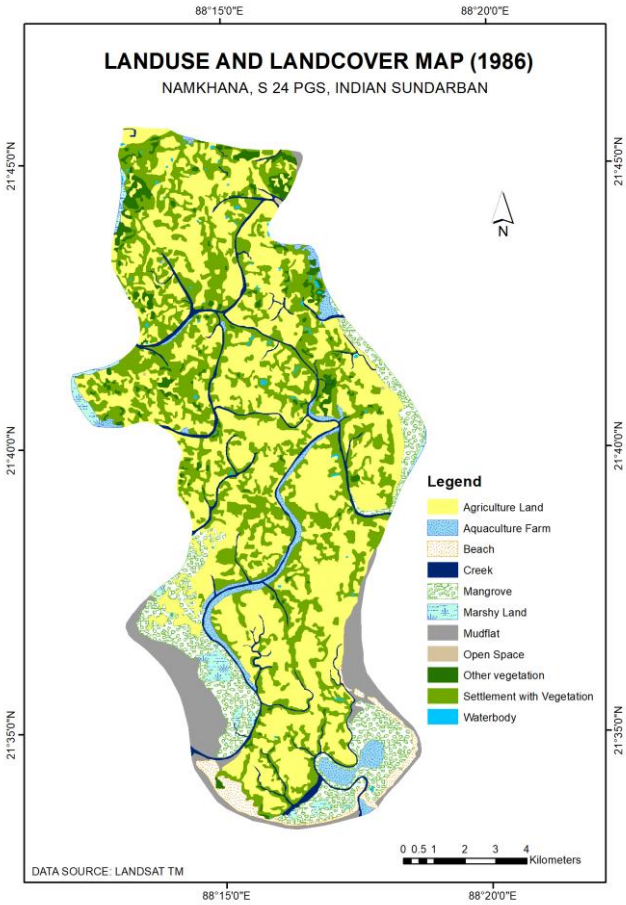


Figure 3.12 LULC Map, 1986

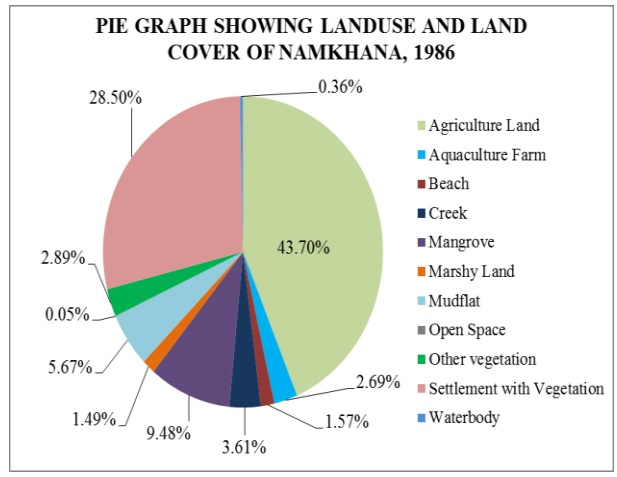


Figure 3.13 Percentage occurrence of difference LULC.s, 1986

Table 3.12 Landuse/Landcover Classes and Area in Km^2 of Namkhana (1986)

Sl No	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	68.40	43.70
2	Aquaculture Farm	4.22	2.69
3	Beach	2.45	1.57
4	Creek	5.65	3.61
5	Mangrove	14.84	9.48
6	Marshy Land	2.34	1.49
7	Mudflat	8.88	5.67
8	Open Space	0.08	0.05
9	Other vegetation	4.52	2.89
10	Settlement with Vegetation	44.61	28.50
11	Water body	0.56	0.36
	Total	**156.54**	**100**

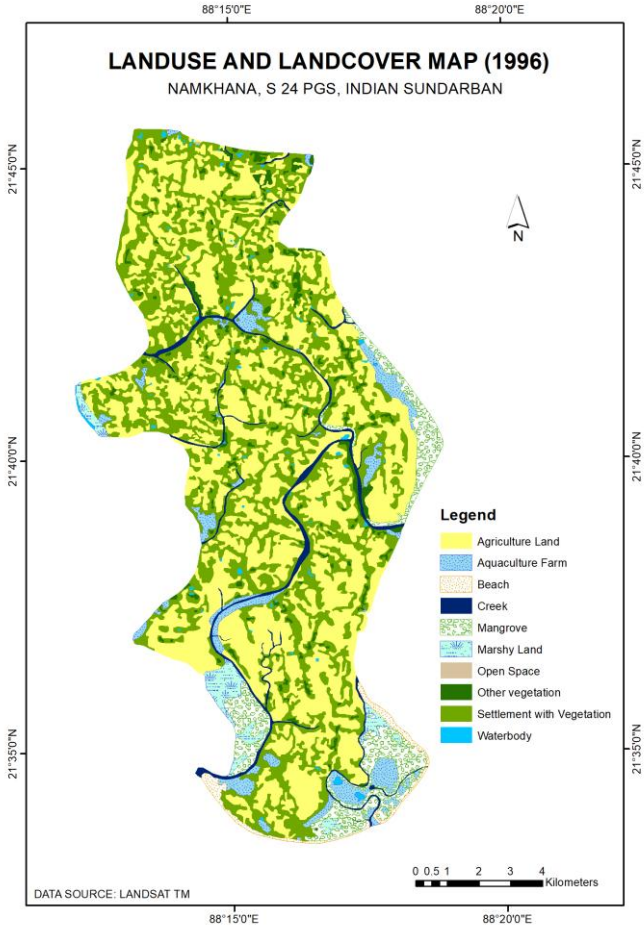


Figure 3.14 LULC Map, 1996

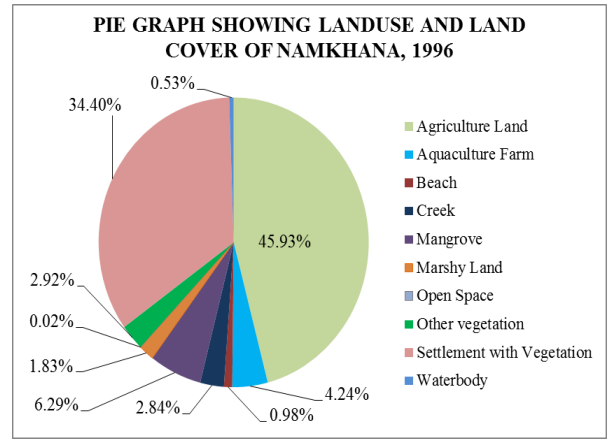


Figure 3.15 Percentage occurrence of difference LULC.s, 1996

Table 3.13 Landuse/Landcover Classes and Area in Km^2 of Namkhana (1996)

Sl No	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	67.73	45.93
2	Aquaculture Farm	6.25	4.24
3	Beach	1.45	0.98
4	Creek	4.19	2.84
5	Mangrove	9.27	6.29
6	Marshy Land	2.70	1.83
7	Mudflat	0	0
8	Open Space	0.03	0.02
9	Other vegetation	4.31	2.92
10	Settlement with Vegetation	50.74	34.40
11	Water body	0.79	0.53
	Total	**147.47**	**100**

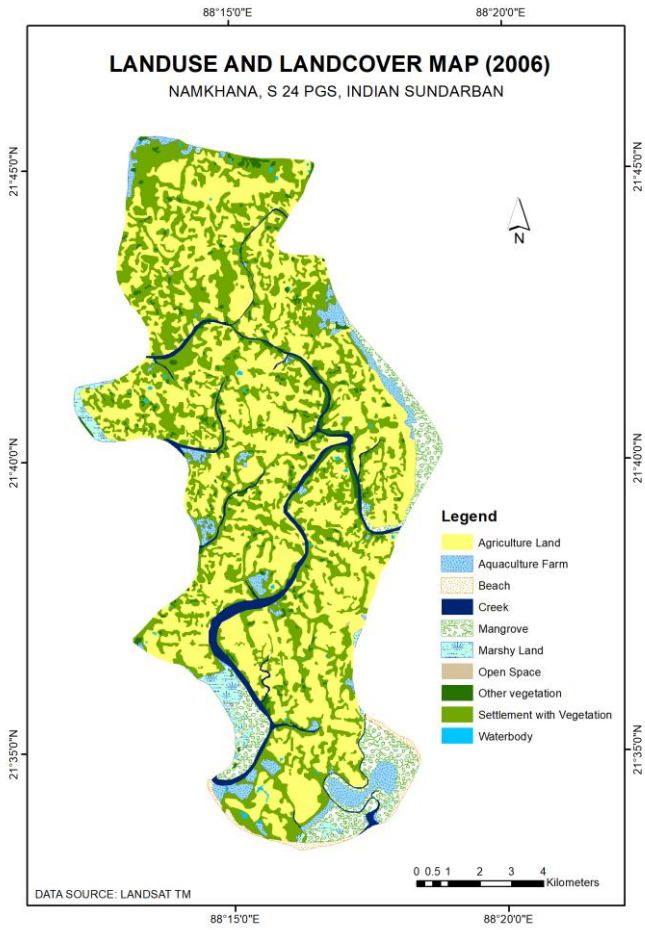


Figure 3.16 LULC Map, 2006

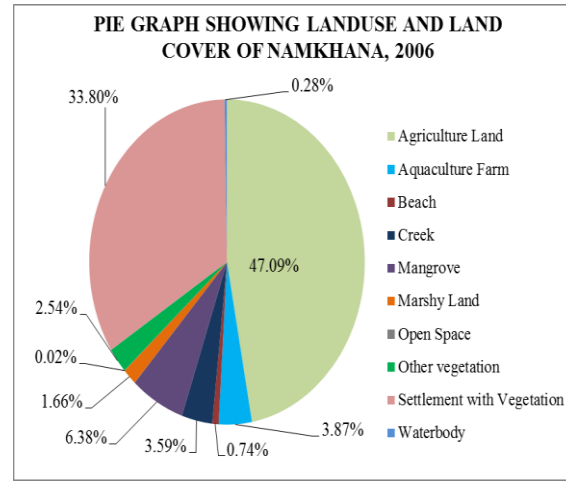


Figure 3.17 Percentage occurrence of difference LULC.s, 2006

Table 3.14 Landuse/Landcover Classes and Area in Km^2 of Namkhana (2006)

Sl No	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	68.36	47.09
2	Aquaculture Farm	5.62	3.87
3	Beach	1.08	0.74
4	Creek	5.22	3.59
5	Mangrove	9.27	6.38
6	Marshy Land	2.41	1.66
7	Mudflat	0	0
8	Open Space	0.03	0.02
9	Other vegetation	3.69	2.54
10	Settlement with Vegetation	49.07	33.80
11	Water body	0.41	0.28
	Total	**145.17**	**100**

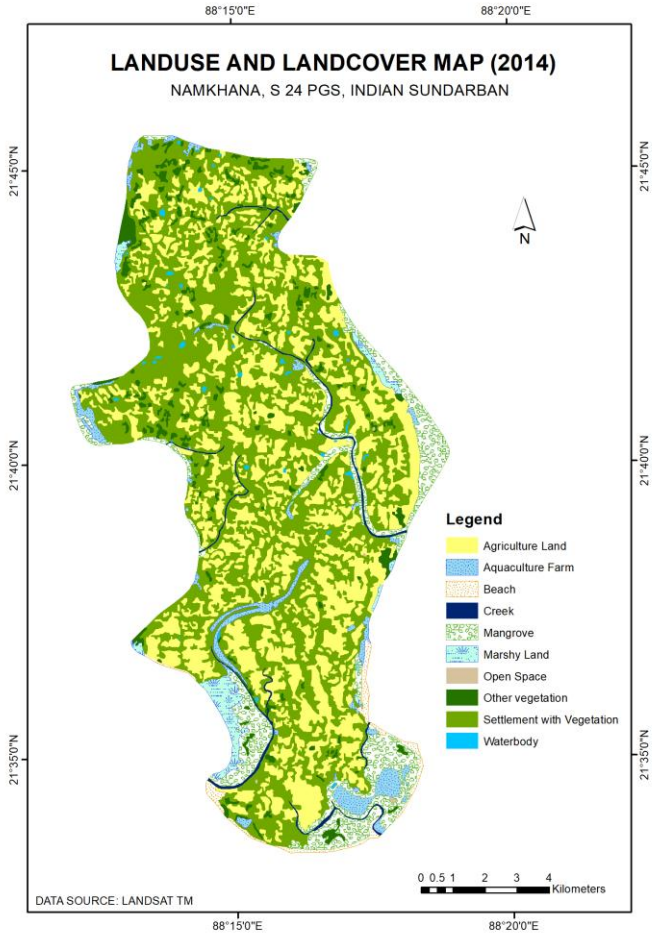


Figure 3.18 LULC Map, 2014

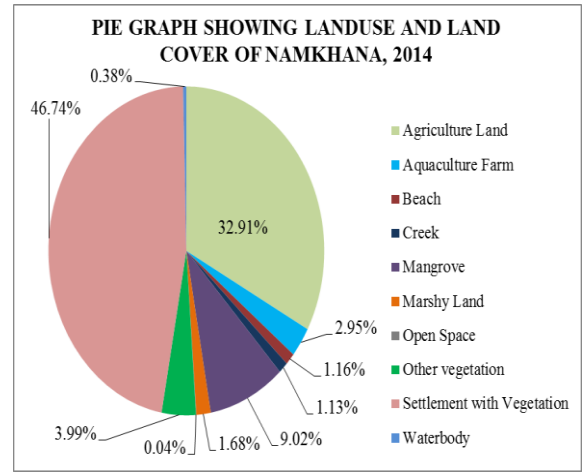


Figure 3.19 Percentage occurrence of difference LULC.s, 2014

Table 3.15 Landuse/Landcover Classes and Area in Km^2 of Namkhana (2014)

Sl No	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	48.20	32.91
2	Aquaculture Farm	4.31	2.95
3	Beach	1.70	1.16
4	Creek	1.65	1.13
5	Mangrove	13.21	9.02
6	Marshy Land	2.46	1.68
7	Mudflat	0	0
8	Open Space	0.06	0.04
9	Other vegetation	5.85	3.99
10	Settlement with Vegetation	68.46	46.74
11	Waterbody	0.55	0.38
	Total	**146.46**	**100**

Table 3.16 Comparison between classified Landuse/Landcover during the year 1986, 1996, 2006 and 2014

Sl No.	**LULC Type**	**1986**		**1996**		**2006**		**2014**	
		Area in km^2	**Percentage (%)**	**Area in km^2**	**Percentage (%)**	**Area in km^2**	**Percentage (%)**	**Area in km^2**	**Percentage (%)**
1	Agriculture Land	68.40	43.70	67.73	45.93	68.36	47.09	48.20	32.91
2	Aquaculture Farm	4.22	2.69	6.25	4.24	5.62	3.87	4.31	2.95
3	Beach	2.45	1.57	1.45	0.98	1.08	0.74	1.70	1.16
4	Creek	5.65	3.61	4.19	2.84	5.22	3.59	1.65	1.13
5	Mangrove	14.84	9.48	9.27	6.29	9.27	6.38	13.21	9.02
6	Marshy Land	2.34	1.49	2.70	1.83	2.41	1.66	2.46	1.68
7	Mudflat	8.88	5.67	0	0	0	0	0	0
8	Open Space	0.08	0.05	0.03	0.02	0.03	0.02	0.06	0.04
9	Other vegetation	4.52	2.89	4.31	2.92	3.69	2.54	5.85	3.99
10	Settlement with vegetation	44.61	28.50	50.74	34.40	49.07	33.80	68.46	46.74
11	Water body	0.56	0.36	0.79	0.53	0.41	0.28	0.55	0.38
	TOTAL	**156.54**		**147.47**		**145.17**		**146.46**	

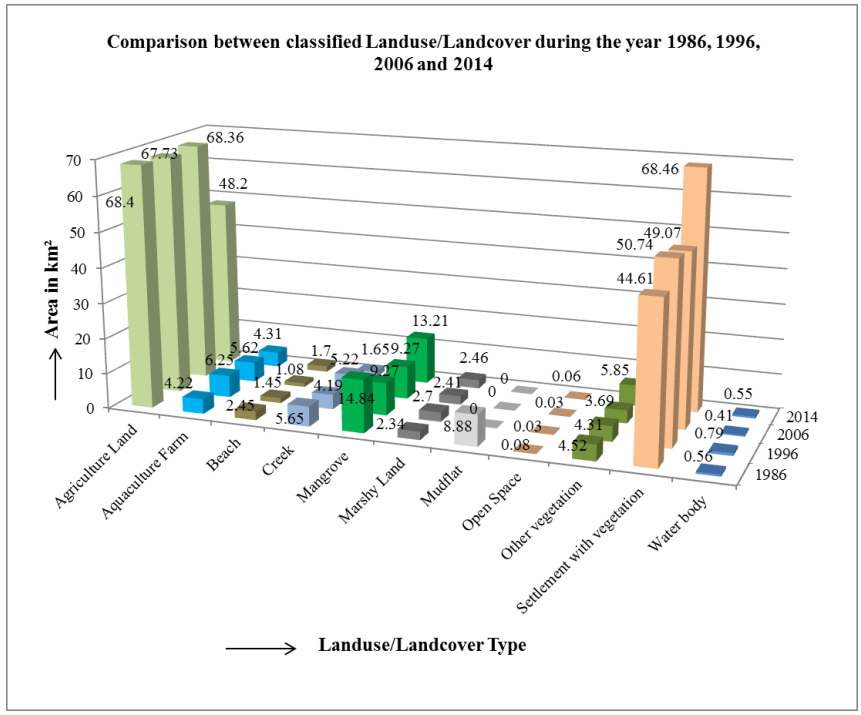


Figure 3.20 Change dynamics of LULC.s over four decades (1986-2014)

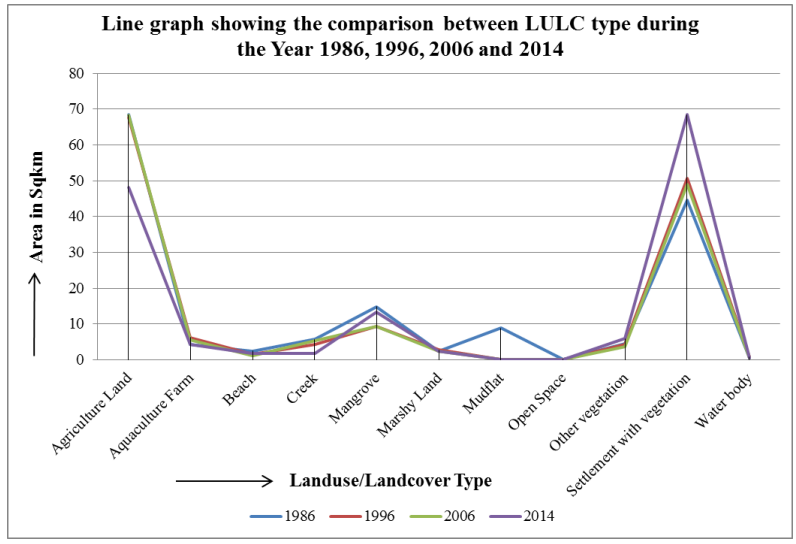


Figure 3.21 Change dynamics of LULC.s over four decades (1986-2014) in line graph

Table 3.17 Decadal change in Island area due to erosion and accretion from 1986-2014

YEAR	Total area in Sqkm	Percentage of Erosion loss and Accretion gain	Result
1986	156.54		
1996	147.47	-6.15	Land erosion
2006	145.17	-1.58	Land erosion
2014	146.46	0.88	Land accretion

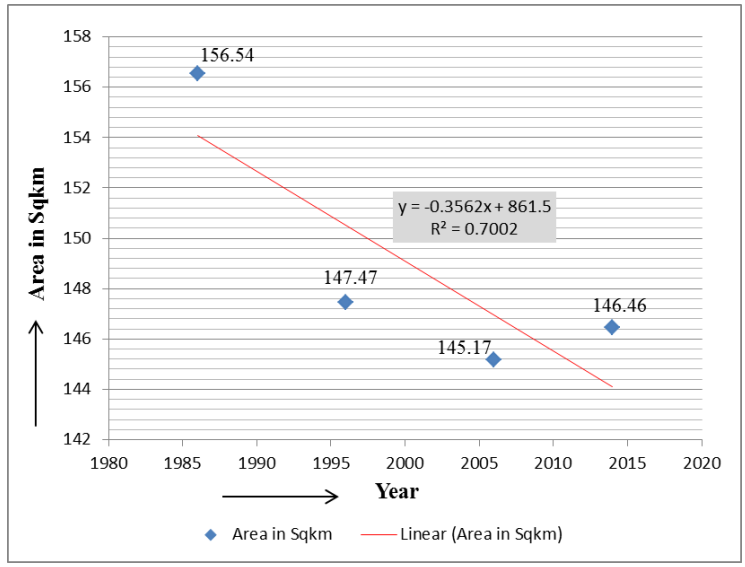


Figure 3.22 Trend (decreasing) analysis of Island area dynamics due to erosion & accretion

Table 3.18 Showing the area of Landuse/Landcover transformations matrix of the study area from 1986 to 1996 (in hectare)

Land Class		Land Class 1996										
		Agriculture Land	**Aquaculture Farm**	**Beach**	**Creek**	**Mangrove**	**Marshy Land**	**Open Space**	**Other vegetation**	**Settlement with vegetation**	**Water body**	**Grand Total**
Land Class 1986	**Agriculture Land**	4662.95	213.68		44.90	5.71	6.47	0.75	55.80	1778.28	23.92	6792.46
	Aquaculture Farm	85.77	167.30		78.89	17.24	0.51	0.67	4.61	44.57	10.81	410.37
	Beach	27.47	13.43	78.93	0.75	10.35	6.87			38.05		175.85
	Creek	105.92	42.92	2.07	170.89	23.50	3.53		20.18	182.86	6.07	557.93
	Mangrove	223.52	88.27	27.68	29.44	780.48	94.38		14.60	153.04	6.30	1417.70
	Marshy Land	13.17	4.71	0.40	0.17	31.94	137.96		0.75	19.17	8.74	217.02
	Mudflat	30.04	27.65	33.25	16.17	5.12	17.90		2.18	19.16		151.47
	Open Space	3.34	0.96		1.24			1.08		0.71	0.64	7.97
	Other vegetation	170.72	1.13	1.77	2.67	0.57			58.25	214.91	0.28	450.30
	Settlement with vegetation	1417.42	60.79	0.58	71.75	11.31	2.66	0.15	266.32	2585.76	19.09	4435.84
	Water body	20.10	1.98	0.40	0.82	0.71			2.51	24.46	2.91	53.89
	Grand Total	**6760.42**	**622.83**	**145.08**	**417.68**	**886.91**	**270.29**	**2.65**	**425.19**	**5060.97**	**78.77**	**14670.79**

Table 3.19 Showing the area of Landuse/Landcover transformations matrix of the study area from 1996 to 2006 (in hectare)

Land Class		Land Class 2006										
		Agriculture land	Aquaculture Farm	Beach	Creek	Mangrove	Marshy land	Open Space	Other vegetation	Settlement with vegetation	Water body	Grand Total
land Class 1996	Agriculture Land	4294.18	125.11	0.03	78.38	22.17	16.53	0.68	106.94	2024.77	15.64	6684.42
	Aquaculture Farm	102.62	226.98	7.21	83.98	70.74	3.00		5.97	104.61	2.19	607.31
	Beach	1.34	17.46	20.60	7.41	9.65	0.88			20.33	0.73	78.39
	Creek	72.20	12.18	0.54	139.23	45.11			26.36	100.18	0.59	396.38
	Mangrove	21.68	24.70	24.16	32.13	680.31	40.90		5.99	6.74		836.61
	Marshy Land	12.43		8.45	10.92	63.26	129.05		1.60	12.51		238.22
	Open Space	0.05					0.08			0.79	0.32	1.24
	Other vegetation	134.41	8.49		26.14	4.38	1.02		37.41	196.06	1.42	409.33
	Settlement with vegetation	2134.39	124.91	0.45	129.28	13.94	13.04	2.45	176.48	2363.77	20.23	4978.94
	Water body	24.12	13.30		2.66	4.81	8.04		1.78	19.78	0.19	74.67
	Grand Total	**6797.41**	**553.12**	**61.44**	**510.14**	**914.37**	**212.53**	**3.13**	**362.53**	**4849.52**	**41.32**	**14305.51**

Table 3.20 Showing the area of Landuse/Landcover transformations matrix of the study area from 2006 to 2014 (in hectare)

Land Class		Land Class 2014										
		Agriculture land	Aquaculture Farm	Beach	Creek	Mangrove	Marshy land	Open Space	Other vegetation	Settlement with vegetation	Water body	Grand Total
Land Class 2006	Agriculture land	2531.88	103.86	30.68	69.95	276.22	45.97	1.51	202.17	3327.75	24.07	6614.06
	Aquaculture Farm	108.24	80.86	9.25	6.33	156.39	9.00	3.24	26.39	139.58	2.45	541.73
	Beach		0.64	15.36		6.02			2.86	7.00		31.88
	Creek	175.68	24.16	0.94	9.74	29.16	0.49		11.57	252.77	1.84	506.34
	Mangrove	19.24	56.44	39.16	26.80	438.07	0.84	1.01	28.50	68.82	1.15	680.04
	Marshy land	7.52	21.21	10.87	1.83	98.42	42.71		7.81	30.12		220.48

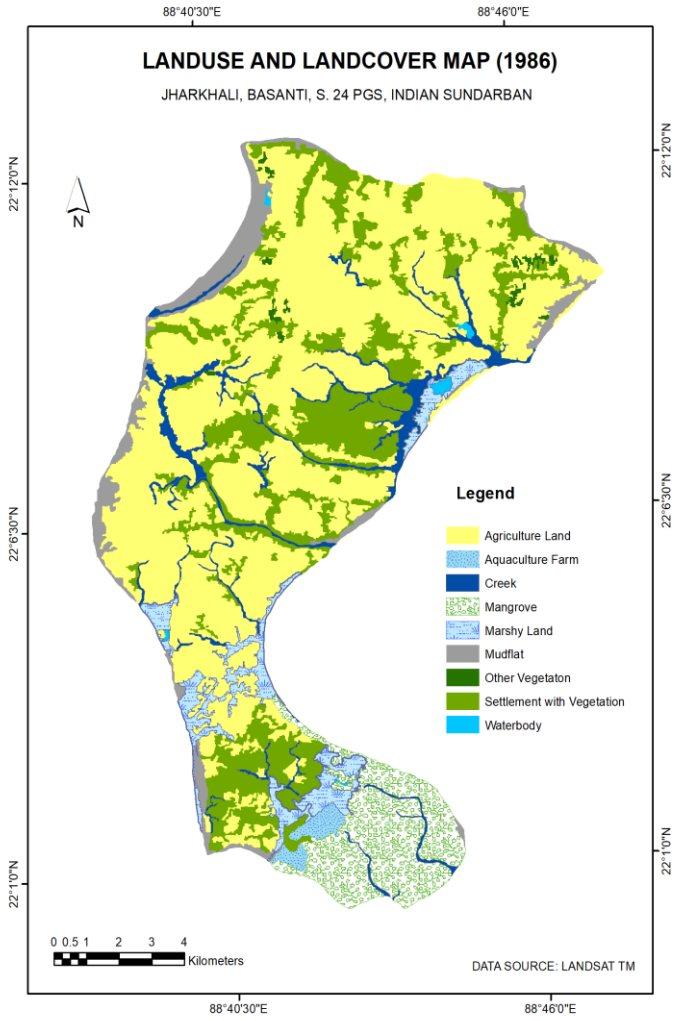
	Open Space	0.28	0.01							2.83	0.00	3.13
	Other vegetation	125.62	5.90	0.43	7.58	17.20	1.58		18.29	183.17	1.55	361.33
	Settlement with vegetation	1772.70	76.75	28.94	36.39	167.19	34.46	0.69	174.53	2457.70	18.49	4767.84
	Water body	12.78	0.72		0.57	2.68			4.03	18.40	0.19	39.36
	Grand Total	**4753.93**	**370.55**	**135.62**	**159.19**	**1191.36**	**135.06**	**6.46**	**476.14**	**6488.15**	**49.74**	**13766.19**

3.3.3. Jharkhali:

The Jharkhali LULC four-decade map is presented in Figure 3.23, Figure 3.25, Figure 3.27 and Figure 3.29. Table 3.25 shows that the LULC mapping of the Jharkhali Island study area for four decades indicates a steady increase in the built-up area that consists of the built-in land use. It is observed that Jharkhali Island was 163.307 km^2 in 1986, but due to land degradation it decreased to 161.206 km^2 in 1996 and 160.847 km^2 in 2006 but very little (165.2 km^2) land area increased in 2014. Table 3.25 shows that in 1986, the area of agricultural land was 88.407 km^2 and the settlement with vegetation area was 32.815 km^2. Land use analysis of the last four decades proves that the amount of agricultural land is declining and the area inhabited by it is increasing. In other words, in 2014, the amount of agricultural land decreased to 77.08 km^2, while the settlement with vegetation increased to 58.54 km^2.

Figures 3.24, 3.26, 3.28 and 3.30 show the decreasing and increasing percentages of each class of land use over four decades on Jharkhali Island. It is observed (Fig. 3.25) that while some land uses like agriculture, mangrove, mudflat and water bodies fluctuate in these four decades, two land uses that record steady rise are i) Aquaculture farm and ii) settlement with vegetation. The analysis also points out that there has been an increase in the overall Island area by 4.35 km^2 during the same period, after land loss due to erosion in the previous decades indicating a positive trend in Island area enlargement, as given in figure 3.33. Table 3.26 analyses the location of these events.

The main part of the observation area is for agricultural purposes, with some settlements along both sides of the road where more or less vegetation is concentrated. The fabric is dotted with several natural and artificial bodies of water.



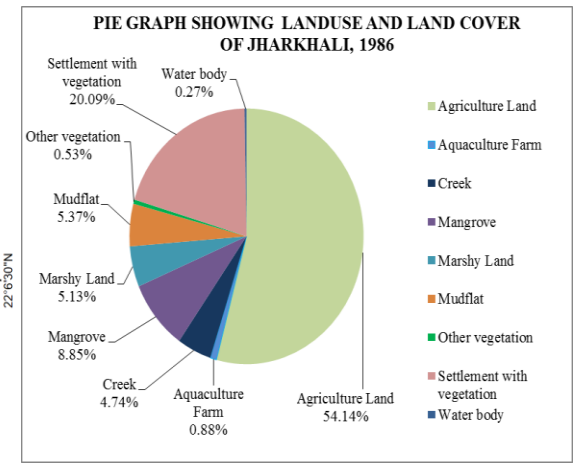


Figure 3.24 Percentage occurrence of difference LULC.s, 1986

Figure 3.23 LULC Map, 1986

Table 3.21 Landuse/Landcover Classes and Area in Km^2 of Jharkhali Island (1986)

Sl No	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	88.407	54.14
2	Aquaculture Farm	1.435	0.88
3	Creek	7.752	4.74
4	Mangrove	14.448	8.85
5	Marshy Land	8.381	5.13
6	Mudflat	8.764	5.37
7	Other vegetation	0.871	0.53
8	Settlement with vegetation	32.815	20.09
9	Water body	0.434	0.27
	Total area	**163.307**	**100**

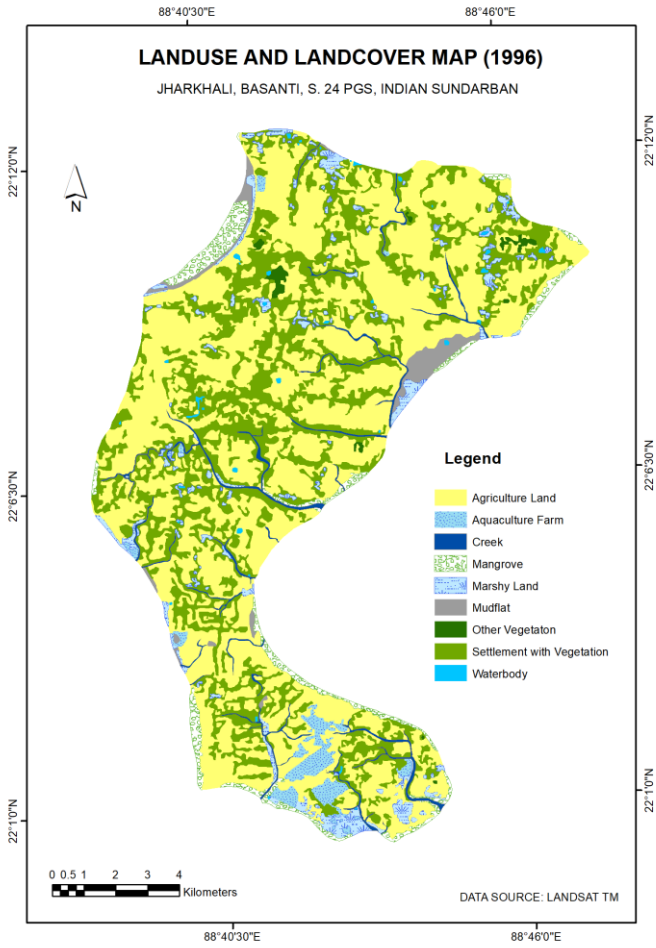


Figure 3.25 LULC Map, 1996

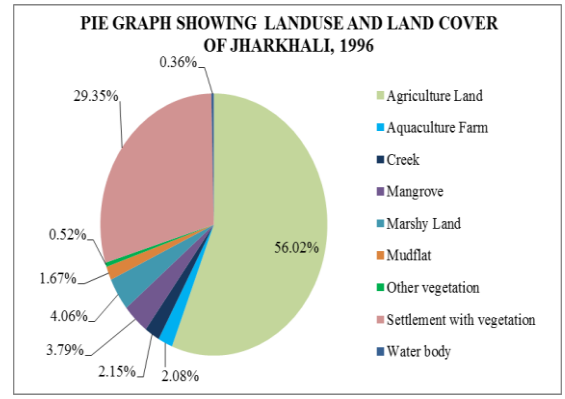


Figure 3.26 Percentage occurrence of difference LULC.s, 1996

Table 3.22 Landuse/Landcover Classes and Area in Km^2 of Jharkhali Island (1996)

Sl No	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	90.303	56.02
2	Aquaculture Farm	3.355	2.08
3	Creek	3.467	2.15
4	Mangrove	6.102	3.79
5	Marshy Land	6.544	4.06
6	Mudflat	2.703	1.67
7	Other vegetation	0.845	0.52
8	Settlement with vegetation	47.306	29.35
9	Water body	0.581	0.36
	Total area	**161.206**	**100**

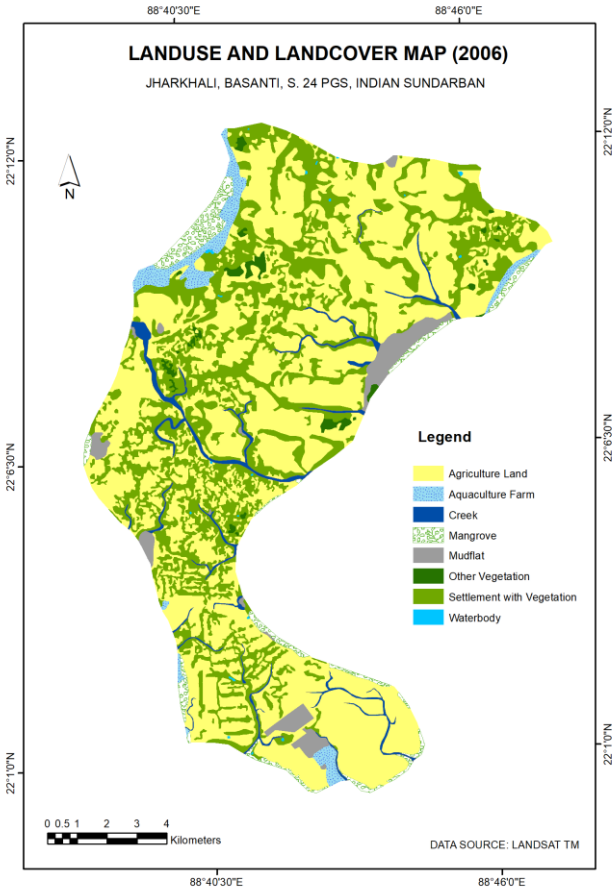


Figure 3.27 LULC Map, 1996

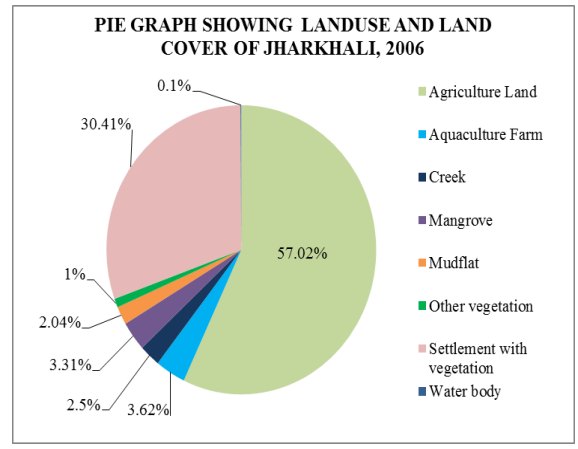


Figure 3.28 Percentage occurrence of difference LULC.s, 2006

Table 3.23 Landuse/Landcover Classes and Area in Km^2 of Jharkhali Island (2006)

Sl No.	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	91.715	57.02
2	Aquaculture Farm	5.837	3.62
3	Creek	4.014	2.50
4	Mangrove	5.32	3.31
5	Mudflat	3.286	2.04
6	Other vegetation	1.597	1.00
7	Settlement with vegetation	48.913	30.41
8	Water body	0.165	0.10
	Total area	**160.847**	**100.00**

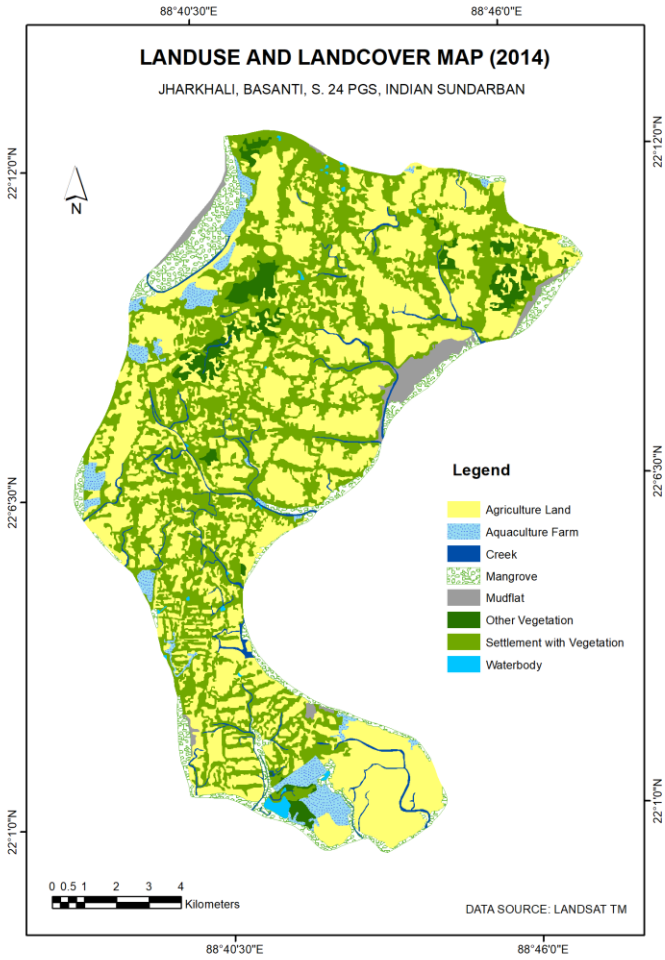


Figure 3.29 LULC Map, 2014

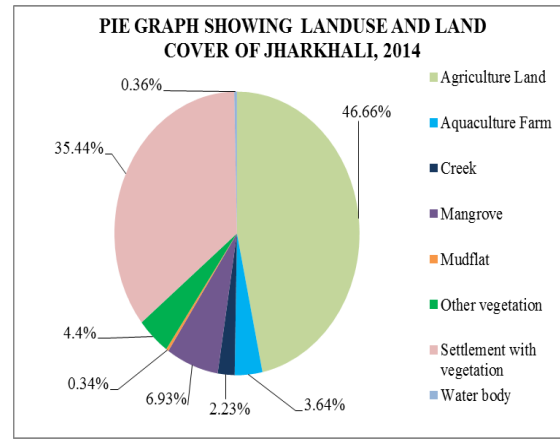


Figure 3.30 Percentage occurrence of difference LULC.s, 2014

Table 3.24 Landuse/Landcover Classes and Area in Km^2 of Jharkhali Island (2014)

Sl No.	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	77.08	46.66
2	Aquaculture Farm	6.01	3.64
3	Creek	3.68	2.23
4	Mangrove	11.45	6.93
5	Mudflat	0.56	0.34
6	Other vegetation	7.28	4.4
7	Settlement with vegetation	58.54	35.44
8	Water body	0.6	0.36
	Total area	**165.2**	**100**

Table 3.25 Comparison between classified Landuse/Landcover during the year 1986, 1996, 2006 and 2014

Sl No.	LULC Type	1986		1996		2006		2014	
		Area in km^2	Percentage (%)	Area in km^2	Percentage (%)	Area in km^2	Percentage (%)	Area in km^2	Percentage (%)
1	Agriculture Land	88.407	54.14	90.303	56.02	91.715	57.02	77.08	46.66
2	Aquaculture Farm	1.435	0.88	3.355	2.08	5.837	3.62	6.01	3.64
3	Creek	7.752	4.74	3.467	2.15	4.014	2.5	3.68	2.23
4	Mangrove	14.448	8.85	6.102	3.79	5.32	3.31	11.45	6.93
5	Marshy Land	8.381	5.13	6.544	4.06				
6	Mudflat	8.764	5.37	2.703	1.67	3.286	2.04	0.56	0.34
7	Other vegetation	0.871	0.53	0.845	0.52	1.597	1	7.28	4.4
8	Settlement with vegetation	32.815	20.09	47.306	29.35	48.913	30.41	58.54	35.44
9	Water body	0.434	0.27	0.581	0.36	0.165	0.1	0.6	0.36
	TOTAL	**163.307**		**161.206**		**160.847**		**165.2**	

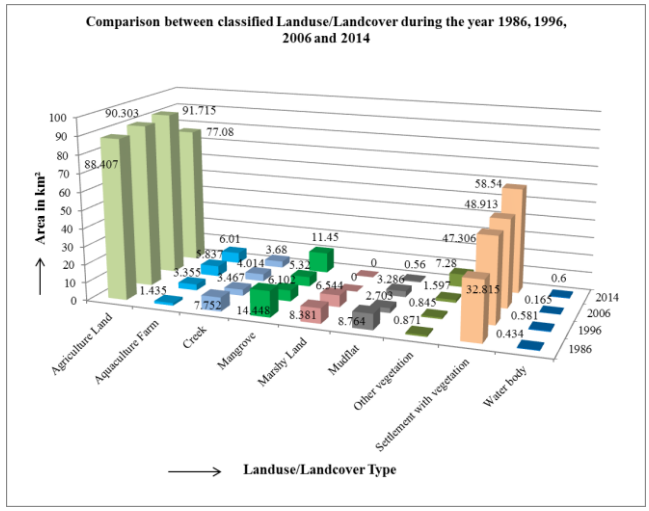


Figure 3.31 Change dynamics of LULC.s over four decades (1986-2014)

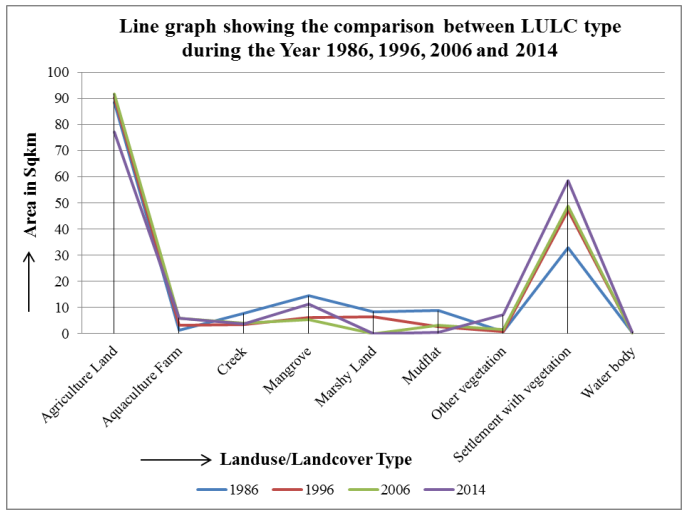


Figure 3.32 Change dynamics of LULC.s over four decades (1986-2014) in line graph

Table 3.26 Decadal change in Island area due to erosion and accretion from 1986-2014

YEAR	Total area in km^2	Percentage of Erosion loss and Accretion gain	Result
1986	163.307		
1996	161.206	-1.29	Land erosion
2006	160.847	-0.22	Land erosion
2014	165.2	2.71	Land accretion

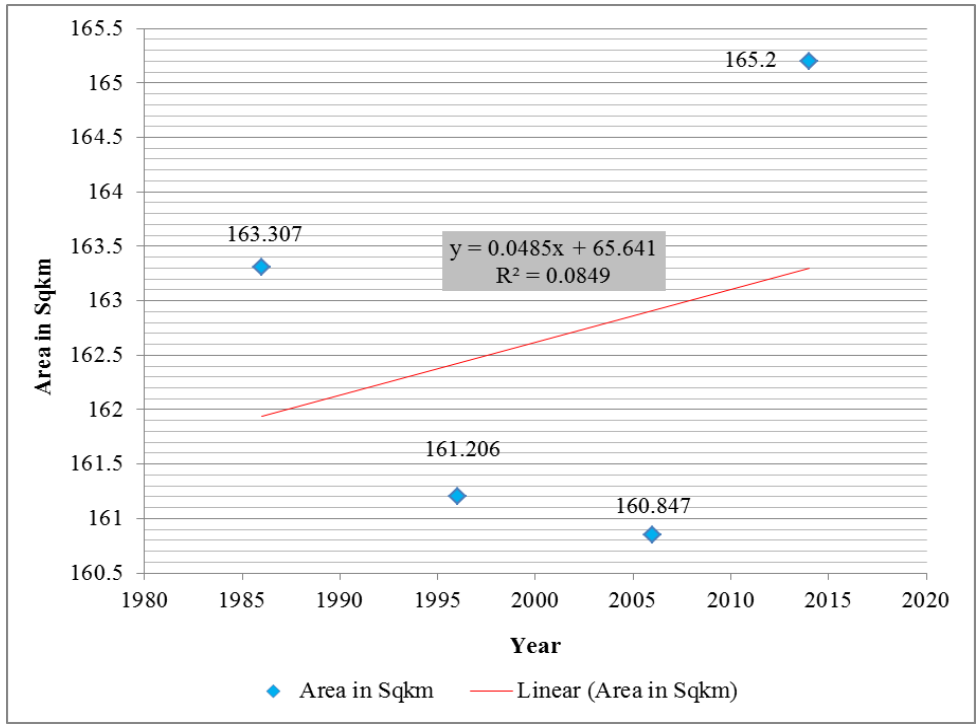


Figure 3.33 Trend (increasing) analysis of Island area dynamics due to erosion & accretion

Table 3.27 Showing the area of Landuse/Landcover transformations matrix of the study area from 1986 to 1996 (in hectare)

Land Class		Land Class 1996									
		Agriculture Land	Aquaculture Farm	Creek	Mangrove	Marshy Land	Mudflat	Other Vegetation	Settlement with Vegetation	Water body	Grand Total
Land Class 1986	Agriculture Land	5500.45	23.73	155.76	69.27	168.75	40.70	56.73	2653.61	28.81	8697.80
	Aquaculture Farm	34.46	77.77	0.47	15.75	4.67	-	-	-	0.45	133.57
	Creek	426.80	10.35	29.43	9.75	33.41	37.07	1.15	185.57	2.72	736.24
	Mangrove	629.16	105.34	62.80	63.41	154.63	-	1.23	293.22	2.02	1311.81

	Marshy Land	352.17	90.24	21.47	23.66	59.14	98.02	-	70.15	0.21	715.07
	Mudflat	203.35	5.52	3.01	229.15	36.72	58.85	-	111.48	3.42	651.49
	Other Vegetation	35.91	-	-	-	7.54	1.48	8.81	31.91	1.32	86.97
	Settlement with Vegetation	1674.65	21.94	70.45	44.25	135.87	4.60	15.76	1264.53	13.66	3245.71
	Water body	15.26	0.74	1.12	-	1.44	19.75	-	2.85	-	41.16
	Grand Total	**8872.21**	**335.62**	**344.52**	**455.23**	**602.17**	**260.47**	**83.68**	**4613.32**	**52.60**	**15619.83**

Table 3.28 Showing the area of Landuse/Landcover transformations matrix of the study area from 1996 to 2006 (in hectare)

Land Class		**Land Class 2006**								
		Agriculture Land	**Aquaculture Land**	**Creek**	**Mangrove**	**Mudflat**	**Other Vegetation**	**Settlement with Vegetation**	**Water body**	**Grand Total**
Land Class 1996	**Agriculture Land**	6586.20	210.29	170.17	26.14	104.47	81.24	1792.90	4.42	8975.85
	Aquaculture Farm	182.46	7.51	5.75	0.90	116.16	-	22.76	-	335.54
	Creek	114.92	2.65	86.72	5.96	14.34	-	119.33	0.50	344.41
	Mangrove	75.91	59.69	9.40	321.04	14.66	-	73.93	0.31	554.93
	Marshy Land	217.65	66.00	13.41	9.60	42.72	8.52	272.74	0.89	631.54
	Mudflat	39.81	43.82	0.88	30.43	130.63	-	13.47	-	259.04
	Other Vegetation	27.82	-	-	-	-	28.24	28.49	-	84.55
	Settlement with Vegetation	1888.94	35.34	141.97	10.09	32.59	35.17	2520.80	10.22	4675.12
	Water body	22.95	3.90	2.10	0.59	1.32	0.06	24.87	0.16	55.96
	Grand Total	**9156.66**	**429.20**	**430.40**	**404.73**	**456.90**	**153.23**	**4869.30**	**16.51**	**15916.93**

Table 3.29 Showing the area of Landuse/Landcover transformations matrix of the study area from 2006 to 2014 (in hectare)

Land Class		Land Class 2014								
		Agriculture Land	**Aquaculture Farm**	**Creek**	**Mangrove**	**Mud flat**	**Other Vegetation**	**Settlement with Vegetation**	**Water body**	**Grand Total**
Land Class 2006	**Agriculture Land**	4792.31	139.94	186.79	259.00	0.46	238.08	3044.57	28.24	8689.39
	Aquaculture Land	165.38	62.33	8.92	54.59	-	11.03	112.50	-	414.75
	Creek	191.86	12.07	23.95	11.97	-	5.80	151.55	3.65	400.85
	Mangrove	105.62	75.11	15.86	103.66	-	1.78	28.06	3.93	334.03
	Mudflat	151.22	94.70	4.69	89.96	-	5.02	42.27	4.61	392.47
	Other Vegetation	51.31	2.07	2.28	4.97	-	32.51	45.68	-	138.82
	Settlement with Vegetation	1998.23	51.69	98.41	112.33	3.22	230.47	2107.72	16.50	4618.56
	Water body	6.03	0.05	0.60	1.26	-	0.55	6.30	0.50	15.30
	Grand Total	**7461.96**	**437.96**	**341.51**	**637.75**	**3.68**	**525.23**	**5538.66**	**57.43**	**15004.17**

3.3.4. GOSABA:

The Gosaba LULC four-decade map is presented in Figure 3.34, Figure 3.36, Figure 3.38 and Figure 3.40. Table 3.34 shows that the LULC mapping of the Gosaba Island study area for four decades indicates a steady increase in the built-up area that consists of the built-in land use. It is observed that Gosaba Island was 328.90 km^2 in 1986, but due to land degradation it decreased to 337.14 km^2 in 1996 and 324.89 km^2 in 2006 but in 2014, there was no increase or decrease in landforms. In other words, there was no change in the land between 2006 and 2014 on the basis of size. Table 3.34 shows that in 1986, the area of agricultural land was 218.53 km^2 and the settlement with vegetation area was 64.98 km^2. Land use analysis of the last four decades proves that the amount of agricultural land is declining and the area inhabited by it is increasing. In other words, in 2014, the amount of agricultural land decreased to 166.70 km^2, while the settlement with vegetation increased to 97.65 km^2.

Figures 3.35, 3.37, 3.39 and 3.41 show the decreasing and increasing percentages of each class of land use over four decades on Gosaba Island. It is observed (Fig. 3.36) that while some land uses like agriculture, mangrove, mudflat and water bodies fluctuate in these

four decades, two land uses that record steady rise are i) Aquaculture farm and ii) settlement with vegetation. The analysis also points out that there has been more or less stable in the overall Island during the same period, after land loss due to erosion in the previous decades indicating a negative trend in Island area reduced, as given in figure 3.44. Table 3.35 analyses the location of these events.

The principal area of the examined region is agriculture makes use of some settlers with flowers which are focused along with each facet of the roads in greater or fewer liner styles. Some herbal and man-made water our bodies are found scattered with on this fabric.

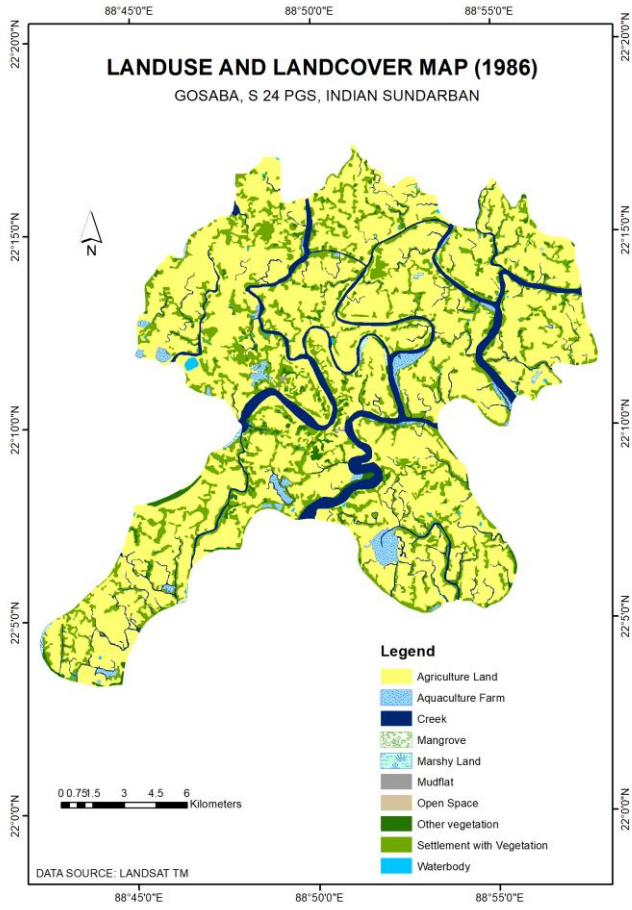


Figure 3.34 LULC Map, 1986

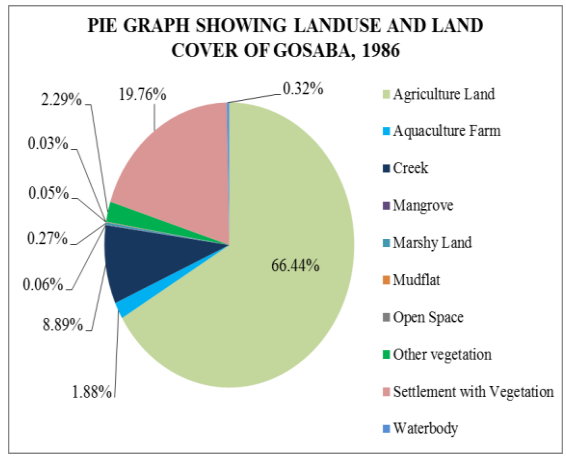


Figure 3.35 Percentage occurrence of difference LULC.s, 1986

Table 3.30 Landuse/Landcover Classes and Area in Km^2 of Gosaba (1986)

Sl No	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	218.53	66.44
2	Aquaculture Farm	6.19	1.88
3	Creek	29.25	8.89
4	Mangrove	0.20	0.06
5	Marshy Land	0.88	0.27
6	Mudflat	0.16	0.05

7	Open Space	0.10	0.03
8	Other vegetation	7.53	2.29
9	Settlement with Vegetation	64.98	19.76
10	Water body	1.07	0.32
	Total area	**328.90**	**100**

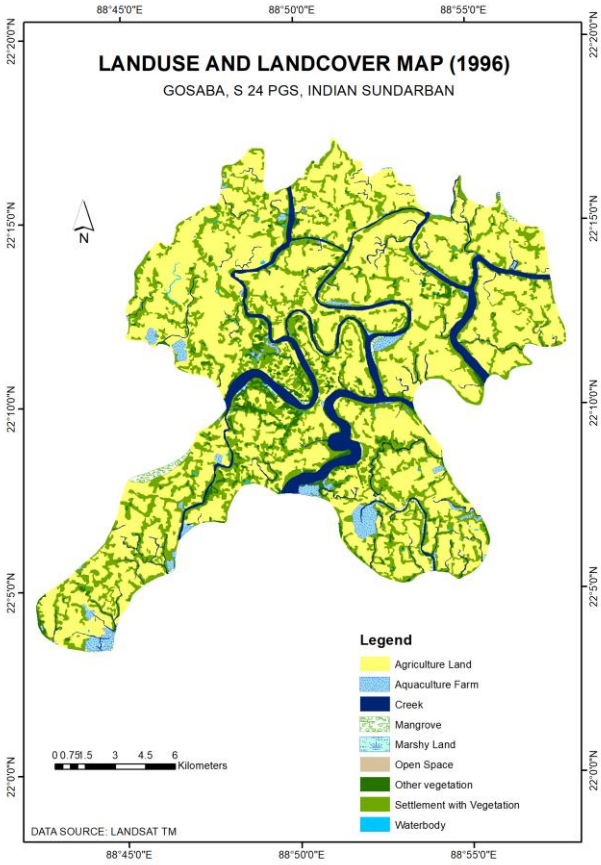


Figure 3.36 LULC Map, 1996

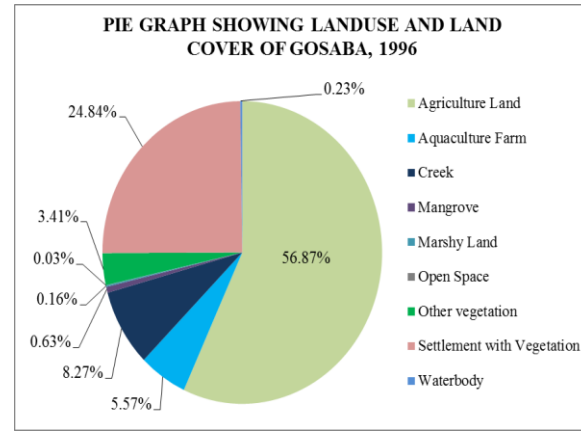


Figure 3.37 Percentage occurrence of difference LULC.s, 1996

Table 3.31 Landuse/Landcover Classes and Area in km^2 of Gosaba (1996)

Sl No	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	191.72	56.87
2	Aquaculture Farm	18.77	5.57
3	Creek	27.89	8.27
4	Mangrove	2.14	0.63
5	Marshy Land	0.53	0.16
6	Mudflat	0	0
7	Open Space	0.10	0.03
8	Other vegetation	11.49	3.41
9	Settlement with Vegetation	83.73	24.84
10	Waterbody	0.77	0.23
	Total area	**337.14**	**100**

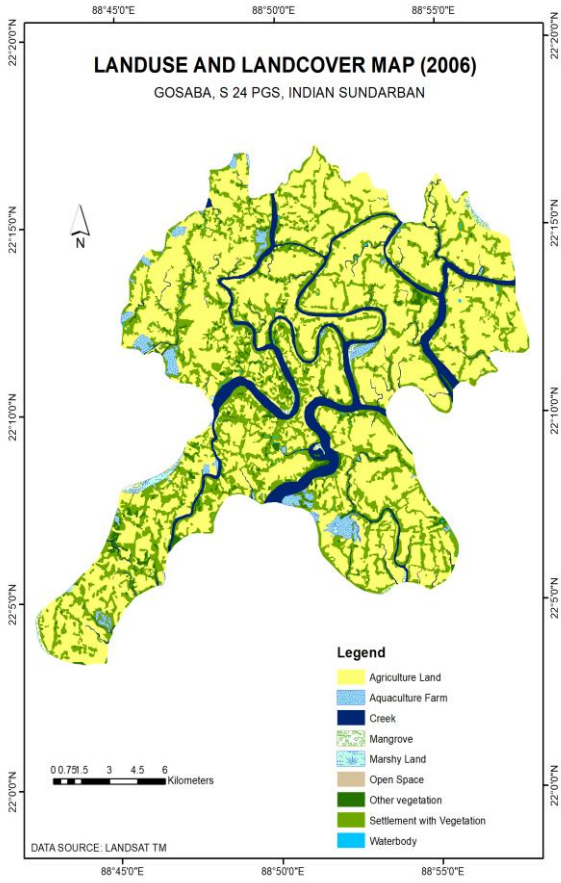


Figure 3.38 LULC Map, 2006

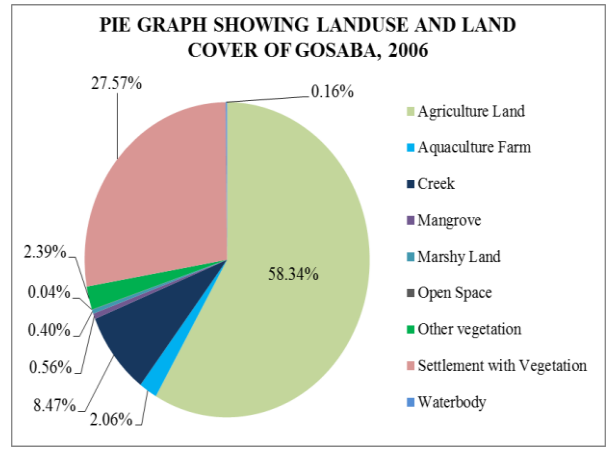


Figure 3.39 Percentage occurrence of difference LULC.s, 2006

Table 3.32 Landuse/Landcover Classes and Area in km^2 of Gosaba (2006)

Sl No	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	189.54	58.34
2	Aquaculture Farm	6.71	2.06
3	Creek	27.53	8.47
4	Mangrove	1.82	0.56
5	Marshy Land	1.31	0.40
6	Mudflat	0	0
7	Open Space	0.12	0.04
8	Other vegetation	7.76	2.39
9	Settlement with Vegetation	89.58	27.57
10	Waterbody	0.53	0.16
	Total area	**324.89**	**100**

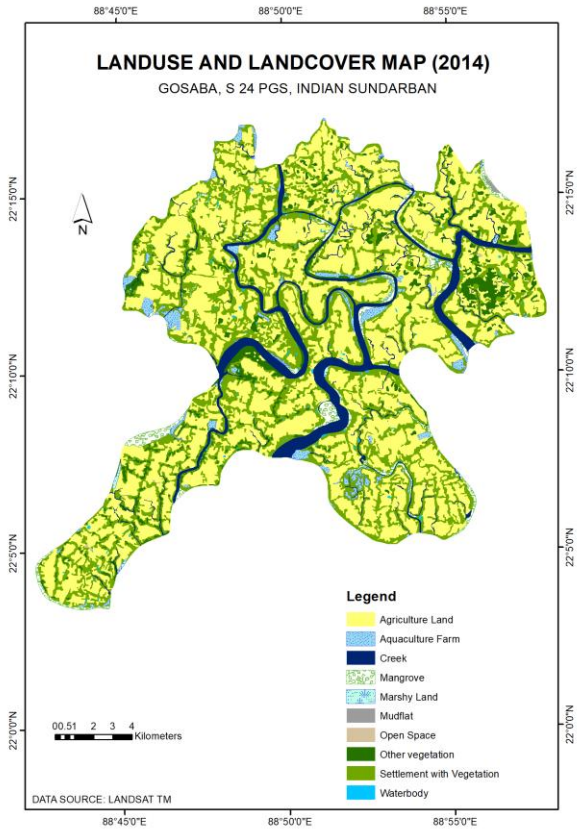


Figure 3.40 LULC Map, 2006

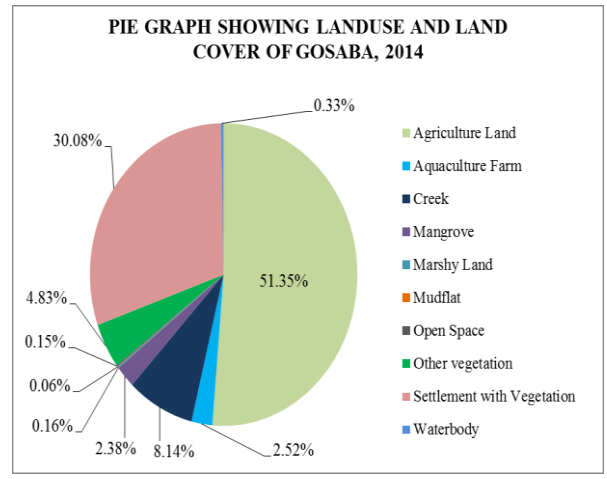


Figure 3.41 Percentage occurrence of difference LULC.s, 2006

Table 3.33 Landuse/Landcover Classes and Area in Km^2 of Gosaba (2014)

Sl No	LULC Type	Area in km^2	Percentage of Area in km^2
1	Agriculture Land	166.70	51.35
2	Aquaculture Farm	8.17	2.52
3	Creek	26.44	8.14
4	Mangrove	7.74	2.38
5	Marshy Land	0.52	0.16
6	Mudflat	0.19	0.06
7	Open Space	0.48	0.15
8	Other vegetation	15.68	4.83
9	Settlement with Vegetation	97.65	30.08
10	Water body	1.08	0.33
	Total area	**324.66**	**100**

Table 3.34: Comparison between classified Landuse/Landcover during the year 1986, 1996, 2006 and 2014

Sl No	LULC Type	1986		1996		2006		2014	
		Area in KM^2	Percentage (%)	Area in km^2	Percentage (%)	Area in km^2	Percentage (%)	Area in km^2	Percentage (%)
1	Agriculture Land	218.53	66.44	191.72	56.87	189.54	58.34	166.70	51.35
2	Aquaculture Farm	6.19	1.88	18.77	5.57	6.71	2.06	8.17	2.52
3	Creek	29.25	8.89	27.89	8.27	27.53	8.47	26.44	8.14
4	Mangrove	0.20	0.06	2.14	0.63	1.82	0.56	7.74	2.38
5	Marshy Land	0.88	0.27	0.53	0.16	1.31	0.40	0.52	0.16
6	Mudflat	0.16	0.05	0	0	0	0	0.19	0.06
7	Open Space	0.10	0.03	0.10	0.03	0.12	0.04	0.48	0.15
8	Other vegetation	7.53	2.29	11.49	3.41	7.76	2.39	15.68	4.83
9	Settlement with vegetation	64.98	19.76	83.73	24.84	89.58	27.57	97.65	30.08
10	Water body	1.07	0.32	0.77	0.23	0.53	0.16	1.08	0.33
	TOTAL	**328.90**		**337.14**		**324.89**		**324.66**	

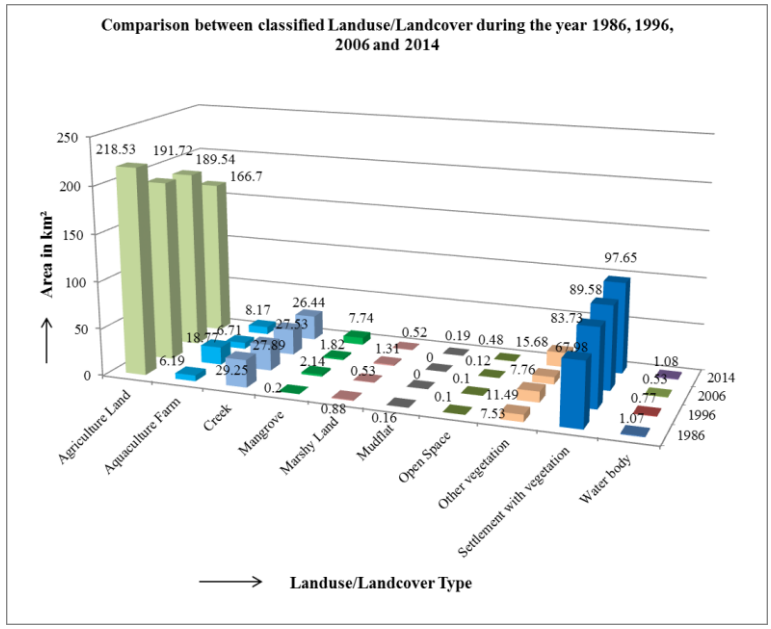


Figure 3.42 Change dynamics of LULC.s over four decades (1986-2014)

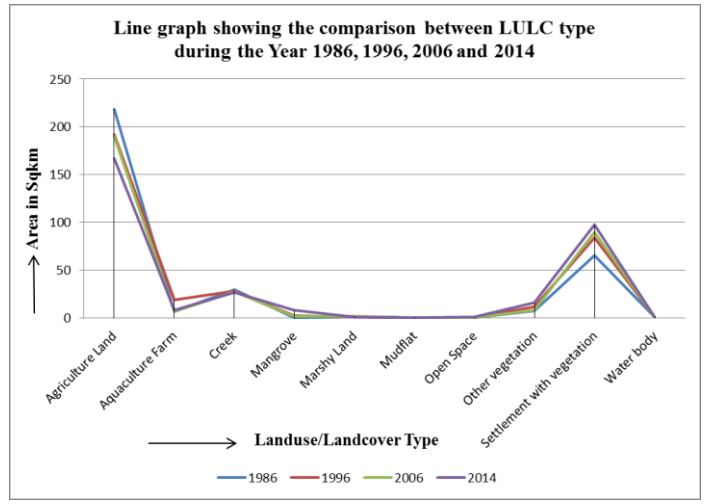


Figure 3.43 Change dynamics of LULC.s over four decades (1986-2014) in line graph

Table 3.35 Decadal change in Island area due to erosion and accretion from 1986-2014

YEAR	Total area in km^2	Percentage of Erosion loss and Accretion gain	Result
1986	328.90		
1996	337.14	2.50	Land accretion
2006	324.89	-3.63	Land erosion
2014	324.66	-0.07	More or less stable

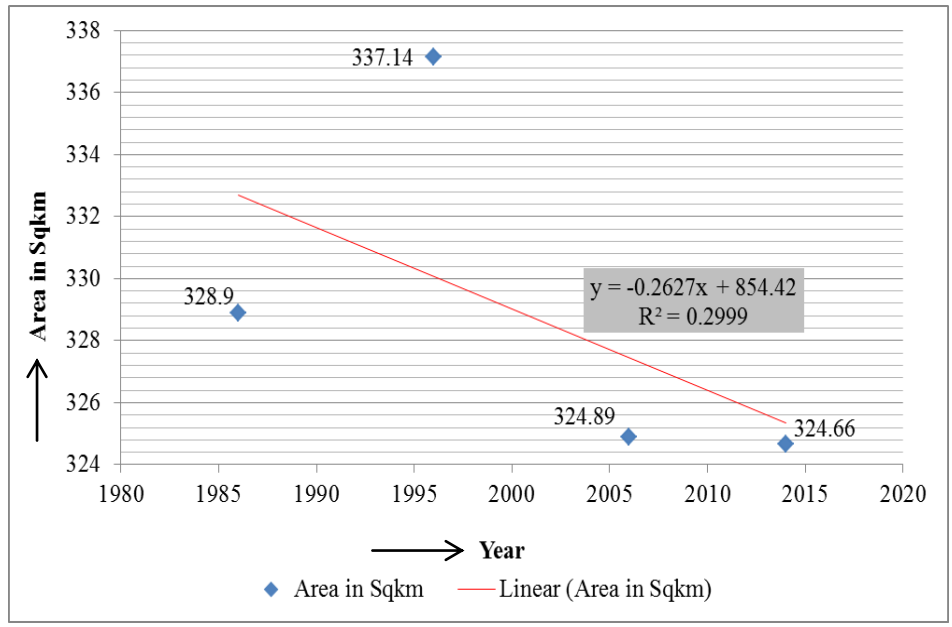


Figure 3.44 Trend (decreasing) analysis of Island area dynamics due to erosion & accretion

Table 3.36 Showing the area of Landuse/Landcover transformations matrix of the study area from 1986 to 1996 (in hectare)

Land Class		Land Class 1996									
		Agriculture land	Aquaculture Farm	Creek	Mangrove	Marshy land	Open Space	Other vegetation	Settlement with vegetation	Water body	Grand Total
Land Class 1986	Agriculture land	17313.22	347.45	338.36	35.61	28.78	4.63	280.11	3235.87	31.97	21616.00
	Aquaculture Farm	135.19	277.76	26.58	18.81	8.06	0.04	20.27	125.35	3.72	615.78
	Creek	282.13	16.31	2158.38	12.73	1.67	0.37	41.65	377.43	9.62	2900.29
	Mangrove	0.26	1.10	3.24	2.67			8.20	0.58		16.04
	Marshy land	39.31	1.56	2.76			0.55	15.09	18.08		77.36
	Mudflat	5.39		2.15				0.77	7.98		16.30
	Open Space	3.11		0.98		0.92	0.96	0.81	2.53	0.63	9.93
	Other vegetation	59.60	5.13	30.96	72.60	0.62	0.14	209.81	330.46	2.39	711.72
	Settlement with vegetation	1278.34	41.50	212.42	29.11	10.45	2.69	562.62	4197.95	24.31	6359.39
	Water body	28.17	32.03	1.50	0.07	0.66	0.14	6.85	33.23	3.88	106.53
	Grand Total	**19144.73**	**722.85**	**2777.33**	**171.60**	**51.15**	**9.52**	**1146.19**	**8329.45**	**76.53**	**32429.33**

Table 3.37 Showing the area of Landuse/Landcover transformations matrix of the study area from 1996 to 2006 (in hectare)

Land Class		Land Class 2006									
		Agriculture land	Aquaculture Farm	Creek	Mangrove	Marshy land	Open Space	Other vegetation	Settlement with vegetation	Water body	Grand Total
Land Class 1996	Agriculture land	15358.37	244.99	242.42	9.25	33.53	5.46	180.97	2937.02	18.58	19030.60
	Aquaculture Farm	239.70	296.84	22.00	5.99	12.49		26.76	112.56	1.67	717.99
	Creek	262.52	16.85	1946.96	25.64	2.22		64.40	436.10	2.13	2756.82
	Mangrove	19.46		8.64	78.20	55.60		22.64	15.24	0.46	200.23
	Marshy land	23.91	0.11	9.11	1.63			0.36	11.48	0.17	46.77
	Open Space	2.13	0.09	0.36			0.13		5.93	0.10	8.75

	Other vegetation	194.02	8.95	81.52	20.98	3.57	2.10	168.32	646.34	4.31	1130.11
	Settlement with vegetation	2640.96	97.93	413.30	15.50	14.14	4.33	294.58	4675.61	23.91	8180.26
	Water body	32.88	2.59	4.75			0.29	3.33	30.69	1.17	75.69
	Grand Total	**18773.94**	**668.34**	**2729.06**	**157.20**	**121.55**	**12.31**	**761.36**	**8870.95**	**52.50**	**32147.21**

Table 3.38 Showing the area of Landuse/Landcover transformations matrix of the study area from 2006 to 2014 (in hectare)

Land Class		**Land class 2014**										
		Agriculture land	**Aquaculture Farm**	**Creek**	**Mangrove**	**Marshy land**	**Mudflat**	**Open Space**	**Other vegetation**	**Settlement with vegetation**	**Water body**	**Grand Total**
Land class 2006	**Agriculture land**	10166.73	295.26	1060.71	275.49	3.85	7.57	25.26	912.44	5358.98	59.64	18165.92
	Aquaculture Farm	235.34	120.93	42.99	11.41	3.05			28.16	214.48	1.78	658.14
	Creek	890.29	97.42	708.46	98.28	10.14		5.26	114.47	739.67	15.05	2679.03
	Mangrove	48.37	13.83	15.28	31.79		4.09		3.50	21.51	0.55	138.93
	Marshy land	27.33	9.86	5.17	11.87				8.90	49.19	0.13	112.46
	Open Space	5.30	0.51	1.01					0.01	5.43		12.27
	Other vegetation	323.49	18.07	76.24	30.02	0.77		2.08	36.96	233.55	1.88	723.06
	Settlement with vegetation	4525.20	134.07	705.74	152.50	9.64	7.45	14.09	394.85	2564.41	23.98	8531.93
	Water body	21.79		3.87	1.33			0.28	2.79	16.77	0.32	47.14
	Grand Total	**16243.84**	**689.95**	**2619.48**	**612.68**	**27.45**	**19.11**	**46.97**	**1502.08**	**9204.00**	**103.33**	**31068.89**

3.4. Conclusion:

It is quite clear from the above analysis that in order to convert tourist destinations into potential eco-tourism destinations, land-use/land cover analysis is required. This is because the number of hotels is increasing due to the increasing number of tourists rapidly, not only the number of hotels has increased but also the area of the market. As a result, forest cover is declining and biodiversity is declining. Therefore, tourist centers should be built in proper away so that the environment is not polluted and biodiversity is not destroyed.

Chapter IV:

Tourism scenario of the study areas

4.1. Tourism scenario:

Tourism is an activity that entertains people, relaxes, leisurely and experiences culture and nature. According to the definition of the World Tourism Organization - "Tourism is the carrier of the personal and collective fulfillment of the people". Therefore, tourism is not only a common phenomenon; it is the collection of knowledge related to mutual tolerance and cultural diversity.

Sundarbans is one of the largest mangrove forests in the world. The area is known as the Sundarbans, surrounded by green forests consisting of numerous islands, rivers and creeks. Different species of mangrove trees, wild animals and different types of birds with their own characteristics, all of which make this Sundarbans region a natural fit.

Sundarbans are the largest mangrove forests of India; hence many places have been identified as attractive places for thirsty travelers. Therefore, not only domestic tourists, many foreign tourists gather in this area. The following figures show that in the Sundarbans region, the tourism industry is developing at a rapid pace.

Table 4.1 Year-wise statement of tourists' inflow in West Bengal

Year	Number of Indian tourist	Number of Foreign tourist	Total tourist
2016	74443650	1528700	75972350
2017	79630345	1574915	81205260
2018	85657365	1617105	87274470

Source: Dept. of tourism, Govt. of West Bengal

Table 4.2 Year-wise statement of tourists' inflow in Sundarbans

Year	Number of Indian tourist	Number of Foreign tourist	Total tourist
2016	3141810	18384	3160194
2017	3764957	20916	3785873
2018	4162150	22612	4184762

Source: Dept. of tourism, Govt. of West Bengal

Table 4.3 Comparison between West Bengal tourist and Sundarbans tourist

Year	Number of tourist in West Bengal		Number of tourist in Sundarbans		Percentage of Indian tourist		Percentage of foreign tourist		Total number of tourist in West Bengal	Total number of tourist in Sundarbans
	Indian tourist (A)	Foreign tourist (B)	Indian tourist (C)	Foreign tourist (D)	Indian tourist in West Bengal	Indian tourist in Sundarbans	Foreign tourist in West Bengal	Foreign tourist in Sundarbans	E = (A+B)	F = (C+D)
2016	74443650	1528700	3141810	18384	95.95	4.05	98.81	1.19	75972350 (96.01%)	3160194 (3.99%)

2017	79630345	1574915	3764957	20916	95.49	4.51	98.69	1.31	81205260 (95.55%)	3785873 (4.45%)
2018	85657365	1617105	4162150	22612	95.37	4.63	98.62	1.38	87274470 (95.42%)	4184762 (4.58%)

Source: Dept. of tourism, Govt. of West Bengal

The above table show that in West Bengal, only 4.05 percent of Indian tourists are arriving and 1.19 percent of foreign tourists are visiting in Sundarbans tourism hub. The weaknesses of both the statistics are - 1) the information that is allowed to enter places in the Sundarbans region, only the information is documented and 2) since all places do not have permission to travel, it is impossible to get accurate information. Since Sundarbans are very important as tourist centers, the number of tourists' here is increasing every year.

4.2. History of tourism in study areas:

Sagar Island:

The Ganga Sagar is one of the most famous pilgrimage sites in India. The Kapil Muni Ashram here is very famous. Today, pilgrims from different parts of India come to Sagar Island. Every year millions of pilgrims from different parts of India come to bathe in Makar Sankranti (also known is Ganga Sagar Mela). The Ganga Sagar Tourist Center is the oldest tourist attraction in the Sundarbans.

Today, the Ganga Sagar is not only famous as a pilgrimage site, but also as a tourist destination. Improved transportation, public and private accommodation, and quality food have boosted the morale of tourists. Although Kapil Muni Ashram attracts special attention of tourists, the beach, Tapoban, Beguakhali lamp post etc. attract the attention of tourists.

Bakkhali:

Bakkhali tourist center is under Namkhana block. Bakkhali is one of the most popular tourist spot in the Sundarbans. This tourist center is situated at a distance of only 132 km from Kolkata. Preliminary studies and analysis of various data have revealed that the first hotel in the region was built about 50 years ago today (Table 4.8). Weekly holidays or two-three day holidays are crowded with tourists. With the increase in the number of tourists, a lot of public and private hotels have sprung up, which are discussed below. Bakkhali beautiful beach is very attractive to tourists as it has vast beaches, red crabs, motor boat trips to Jambu Island, Frazerganj Fisheries Port and Henry Island attract tourists.

Jharkhali:

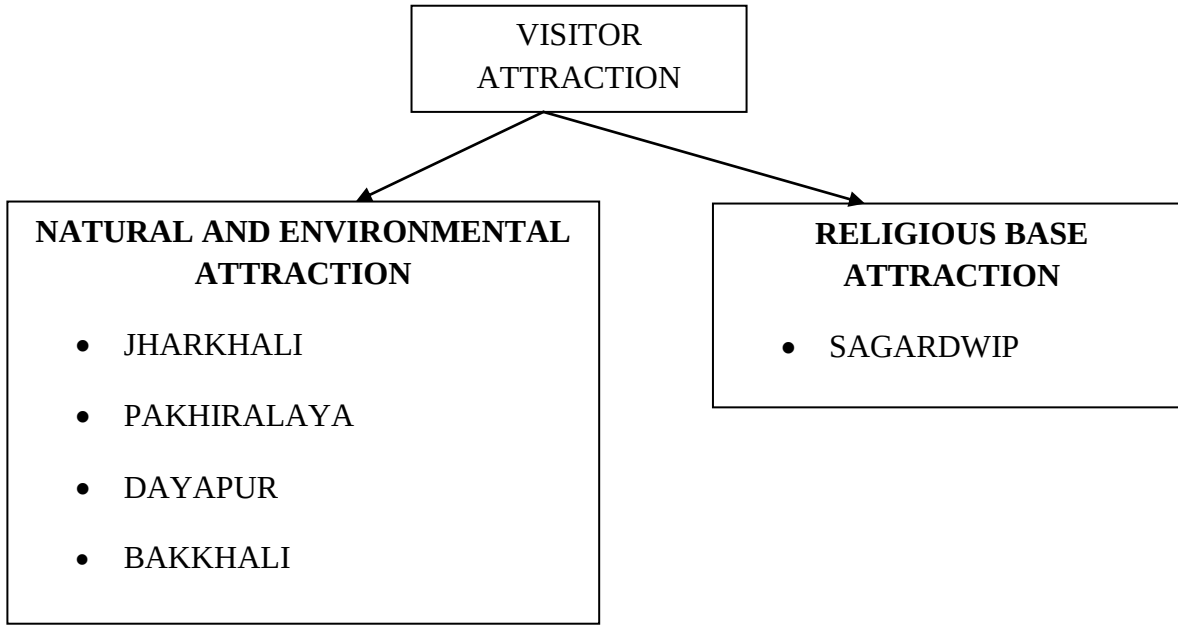
"Jharkhali Island is located at Basanti Block of South 24 Parganas district in West Bengal. This Island considered as mid estuarine region and is situated at the heart of Sundarban Biosphere Reserve. One watch tower, Sundarban Wild Animals' Park (SWAP), butterfly garden, mangrove park and general scenic beauty are the main tourist attractions of the Jharkhali Island. With the rivers Bidyadhari on the east, Matla on the west and Choto Herobhanga on the south, the village named Lot No. 126 is the main tourism hub along-with its neighboring village named Garanbose" (Sarkar, et al., 2019).

Pakhiralay & Dayapur (Gosaba):

There is nothing to attract tourists in Pakhirala and Dayapur in Gosaba. However, in fact, many hotels have sprung up in these two regions to accommodate those who visit the Sundarbans for two to three nights. Initially, the survey revealed that no hotel had been built in the area before 2000 (Table 4.12). However, due to the current favorable conditions, many tourists come to Sandarban every year. The Sajanekhali Reserve Forest (SRF) is located just opposite Pakhiralaya and Dayapur, and other places are easily accessible from here. That is why tourists like these places.

4.3 . Tourist attractions:

Attraction plays a major role as a specific space visit. The attraction of visitors always depends on some factors such as natural causes, cultural reasons, religious reasons, historical reasons etc. However, visitors to the Sundarbans mainly come for two reasons, namely natural reasons and the other is religious reasons. In the Sagardwip region alone, the number of visitors is based on religious reasons.



Animals, plants, rivers, creeks, and protected forests of the Sundarbans National Sanctuary - all together form an attractive tourist destination in the world. Sundarbans is an attractive tourist destination for all those who love nature and want to see wildlife. Currently, the main attraction of the Sundarbans is the tiger project. The Royal Bengal Tiger is found only in this forested area. So Sundarbans is a particularly attractive place for tourists. Tourist centers have been built up in several places in the Sundarbans for the tourists. Watchtowers have been built up at places like Sajnekhali, Sudhanyakhali, Jhingekhali, Netidhopani, Burirdabari, Haldibari, etc. - which attracts a large number of tourists. Various species of birds gather in the forest areas preserved in the Sundarbans. Also noticeable are mangrove trees of various species along the banks of rivers and creeks (such as Heritiera fomes, Excoecaria agallocha, Nypa fruticans, Sonneratia apetala and Avicennia officinalis etc.).

Once again, the first thing that catches the attention of tourists when they enter the Sundarbans from Namkhana is the Bhagabatpur Crocodile Project. Public and private initiatives have been taken to save the natural resources and for the socio-economic development of the local people, which attracts the attention of tourists.

Table 4.4 Name of the tourist attractions of the different tourist spots

Sl. No	Name of the tourist spot	Name of the tourist attractions
1	Sagar	i. Kapil Muni temple ii. Ganga Sagar beach iii. Sagar lighthouse iv. Bharat Sebashram Sangha

2	Bakkhali	i. Bakkhali beach ii. Bakkhali watch tower iii. Crocodile Breeding Centre iv. Jambu Dwip v. Henry Island watch tower vi. Frasergunj fishing harbor vii. Scenic beauty
3	Jharkhali	i. Mangrove Eco-garden ii. Watch tower iii. Boat riding iv. Home stay v. Bird watching vi. Scenic beauty vii. Tiger rescue centre Viii Natural environment
4	Gosaba (Pakhiraloy & Dayapur)	i. Travel to different watch tower (Sajnekhali, Sudhanyakhali, Jhingekhali, Netidhopani, Burirdabari, Haldibari watch tower) ii. Wildlife of Sundarbans iii. Sundarbans National Park iv. Sajnekhali bird Sanctuary v. Sudhanyakhali tiger reserve vi. Sundarban tiger camp vii. Scenic beauty viii. Natural environment ix. Boat riding

Source: Primary data (Field survey)

4.4. Hospitality services and facilities:

4.4.1. Ganga Sagar:

Table 4.5 Basic data structure of hotels at Ganga Sagar

Sl No.	Name of the hotel	Year of establishment	Geographical location		Built-up area (m^2)	Floor height (m) & No. of floors	Total built up area (m^2)	No. of beds	Cumulative beds	Built up area / bed (m^2)	Tariff – average per head per night (RS)	Ownership
			Latitude	Longitude								
					A	B	C = (A x No. of floors)	D	∑ D	E = C / D		
1	Calcutta Vastra Vyavsayi Seva Samiti Dharma Sala	1901	21°38’31.84”N	88° 4’51.01”E	1600	3 m & Two storied	3200	660	660	4.85	Only donation	Private
2	Shri Shri Shankarachariya Ashram	1903	21°38'11.37"N	88° 4'46.84"E	40	2.8 m & One storied	40	6	666	6.67	Only donation	Private
3	Kapil Kuthi Sangkhyayog Ashram	1905	21°38'16.86"N	88° 4'48.72"E	700	3 m & Two storied	1400	256	922	5.47	600	Private
4	Ganga Sagar Vavan (Shri Shri Kapil Muni Charitable Trust)	1905	21°38'38.70"N	88° 4'51.92"E	280	3 m & Three storied	840	120	1042	7	Only donation	Private
5	Manab Seva Samiti	1920	21°38'39.99"N	88° 4'51.79"E	1216	2.9 m & Two storied	2432	180	1222	13.51	Only donation	Private
6	Shri Guru Sangha	1933	21°38'40.69"N	88° 4'51.66"E	145	2.8 m & One storied	145	25	1247	5.8	Only donation	Private

7	Kapil KalpaTaru Ashram	1945	21°38'25.62"N	88° 4'49.74"E	300	2.7 m & One storied	300	76	1323	3.95	500	Private
8	Arya Wrishi Ashram	1953	21°38'26.88"N	88° 4'49.26"E	140	2.8 m & One storied	140	36	1359	3.89	Only donation	Private
9	Gouriya Ashram	1953	21°38'32.70"N	88° 4'41.40"E	70	2.7 m & One storied	70	15	1374	4.67	Only donation	Private
10	Hindu Sanatan Dharma Prachar Ashram Sangha	1957	21°38'31.27"N	88° 4'49.67"E	400	2.9 m & Two storied	800	90	1464	8.89	Only donation	Private
11	Ganga Sagar Shri Shri Nigamananda Seba-Ashram	1965	21°38'28.02"N	88° 4'49.50"E	73.79	2.8 m & one storied	73.79	12	1476	6.15	Only donation	Private
12	Ganga Sagar Shankar Dham Ashram	1969	21°38'31.62"N	88° 4'46.47"E	100	2.9 m & One storied	100	30	1506	3.33	Only donation	Private
13	Kapil Muni Dharma Sala	1972	21°38'14.34"N	88° 4'47.70"E	200	2.9 m & One storeyed	200	45	1551	4.44	Only donation	Private
14	Bharat Sevashram	1979	21°38'21.39"N	88° 4'46.56"E	1500	3 m & Three storied	4500	330	1881	15	Only donation	Private
15	Basudebananda Tatsangha Ashram	1980	21°38'28.92"N	88° 4'51.54"E	125	2.9 m & Two storied	250	100	1981	2.5	400	Private
16	Purnashram	1980	21°38'38.15"N	88° 4'51.38"E	115	2.8 m & One storied	115	32	2013	3.59	Only donation	Private
17	Sankhoya Yogashram	1981	21°38'27.90"N	88° 4'49.98"E	150	2.9 m & One storeyed	150	56	2069	2.68	500	Private

18	Ganga Sagar Youth Hostel	1984	21°38'19.70"N	88° 4'30.39"E	790	3 m & Two storied	1580	76	2145	20.79	500	W.B GOVT
19	Vishwa Hindu Parisad (Madhab Ashram)	1985	21°38'38.08"N	88° 4'53.24"E	600	3 m & Two storied	1200	70	2215	17.14	Only donation	Private
20	Swami Debananda Ashram	1987	21°38'37.92"N	88° 4'35.28"E	60	2.7 m & One storied	120	12	2227	10	Only donation	Private
21	Sanatan Bhramcharya Seva Ashram Sanga	1988	21°38'28.86"N	88° 4'49.68"E	73	2.9 m & One storied	73	20	2247	3.65	Only donation	Private
22	Ganga Sagar Tourist Lodge	1993	21°38'23.35"N	88° 4'24.45"E	640	3 m & Three storied	1920	36	2283	53.33	1000	W.B GOVT
23	Loknath Mission	1993	21°38'33.66"N	88° 4'44.82"E	352	2.9 m & One storied	352	24	2307	14.67	Only donation	Private
24	Jogendra Math	1994	21°38'5.21"N	88° 4'41.69"E	384	2.9 m & Two storied	768	24	2331	32	500	Private
25	Bishalaxmi Hanuman Mandir Dharma Sala	1996	21°38'3.84"N	88° 4'39.85"E	105	2.8 m & One storied	105	12	2343	8.75	400	Private
26	Ganga Sagar Ananda Ashram	1997	21°38'34.08"N	88° 4'45.84"E	230	2.8 m & One storied	230	15	2358	15.33	Only donation	Private
27	Hariyana Charitable Society	2003	21°38'38.42"N	88° 4'43.82"E	900	2.9 m & Two storied	1800	60	2418	30	400	Private

28	Kapil Muni Dharma Sala, Nat Mandir	2006	21°38'15.61"N	88° 4'30.05"E	750	2.8 m & One storied	750	320	2738	2.34	Only donation	Private
29	Howrah Bharatiya Sahu Samaj	2006	21°38'38.29"N	88° 4'44.73"E	452	2.9 m & Two storied	904	30	2768	30.13	Only donation	Private
30	Ramkrishna Mission Ashram	2008	21°38'33.00"N	88° 4'42.96"E	245	2.9 m & Two storied	490	36	2804	13.61	Only donation	Private
	TOTAL							**2804**				

Primary data source: 2018 – 2019

4.4.1.1. Total number of hotels:

The first hotel was built in 1901 on the Ganga Sagar. The region attracts more pilgrims than ordinary tourists. So it has been seen that there are more ashrams than hotels in this place. At present, the preliminary survey shows that there are a total of 30 ashrams and hotels in the Ganga Sagar.

4.4.1.2. Location of hotels:

The Kapil Muni temple is located 0.5 km from the beach in the Ganga Sagar. On the other hand, the Kapil Muni temple is located within 1 km from the Ganga Sagar bus stop. The ashrams and hotels are located along with road site within a 1 km buffer towards the land center centered on this Kapil Muni temple (Plate 4.1).

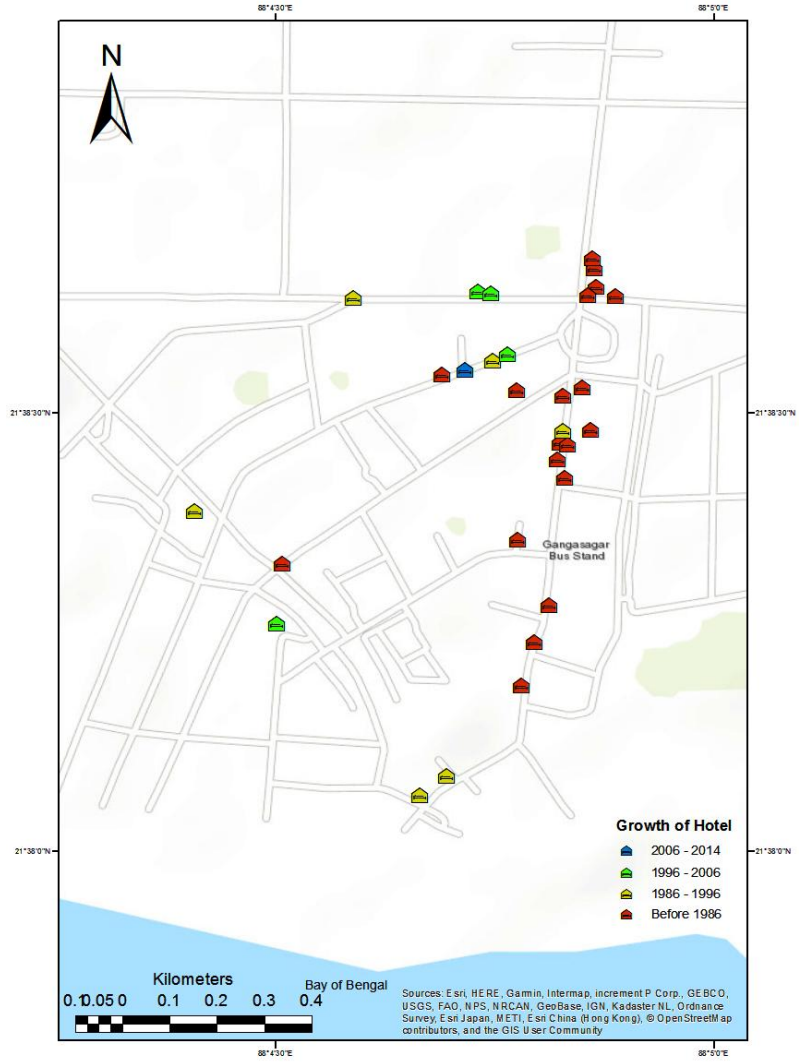


Plate 4.1 GPS locations of lodging facilities with complete information studies till date

4.4.1.3. Categorization of hotel:

Table 4.7 shows that the hotels/ashram in Ganga Sagar has been divided into four sections on the basis of hotel/ashram charges. Namely i) low budget hotel (less than 500 rupees per bed per night); ii) middle budget hotel (501 to 1000 rupees per bed per night); iii) high budget hotel (more than 1000 rupees per bed per night) and iv) only donation. It is clear from the following table that the number of hotels in the second category i.e. middle budget is more (17%) than the other two categories. However, most of the hotels (70%) are run by donations.

4.4.1.4. Accommodation facilities:

The total accommodation capacity of the hotels located in the Ganga Sagar Tourism Area of Sagar has been judged entirely on the basis of preliminary information obtained from the hotels/ashram. At present the total number of hotels/ashram in this place is 30, with a total bed capacity of 2804 (Table 4.5). Considering this, the average bed capacity of the hotel has been calculated as 93.47 beds. Based on the bed capacity, 57% of the hotels have less than 50 bed capacity (Fig. 4.1).

Table 4.6 Classification on accommodation facilities of hotel based

Category	No. of Beds	No. of Hotels	% of Hotels
I	< 50	17	57%
II	50 – 100	7	23%
III	>100	6	20%
Total		30	

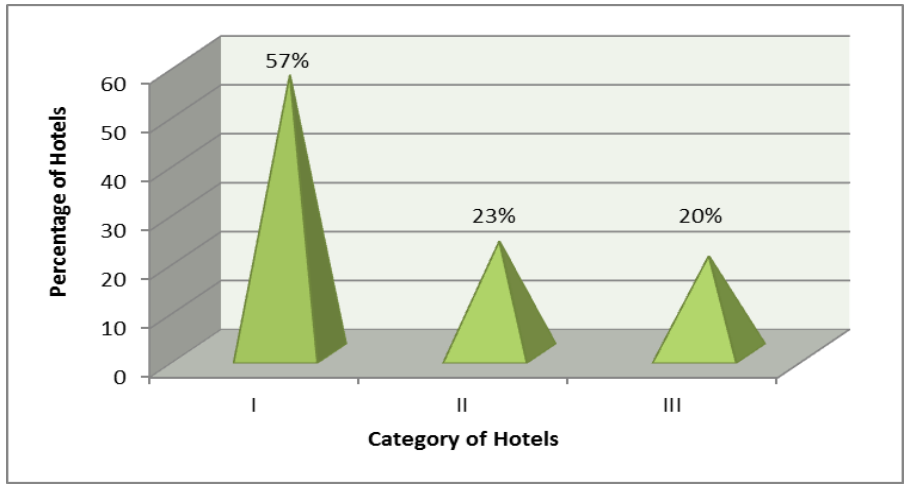


Figure 4.1 Classification on accommodation facilities of hotel based

4.4.1.5. Hotel tariff range:

The price range of hotels/ashram in the tourist area of Ganga Sagar varies between peak season and off-season. According to preliminary survey estimates, most hotels/ashram typically spends about 20% to 30% off in the off-season. However, the discount varies according to the status of the hotels and the business policy. Looking at the table 4.7 and figure 4.2, it is understood that 17% of the hotels whose rent is 500 to 1000 rupees in Indian currency. As the Ganga Sagar is a holy land, there are more ashrams than private hotels. Analysis of the data from the preliminary survey has shown that the ashrams are running on the basis of donations. Figure 4.2 shows that 70% of the hotels / ashrams are run on full donations.

Table 4.7 Classification of hotel Based on tariff range

Category	Tariff Range (INR)	No. of Hotels	% of Hotels
I	< 500	3	10%
II	501 – 1000	5	17%
III	>1000	1	3%
IV	Only Donation	21	70%
Total		30	

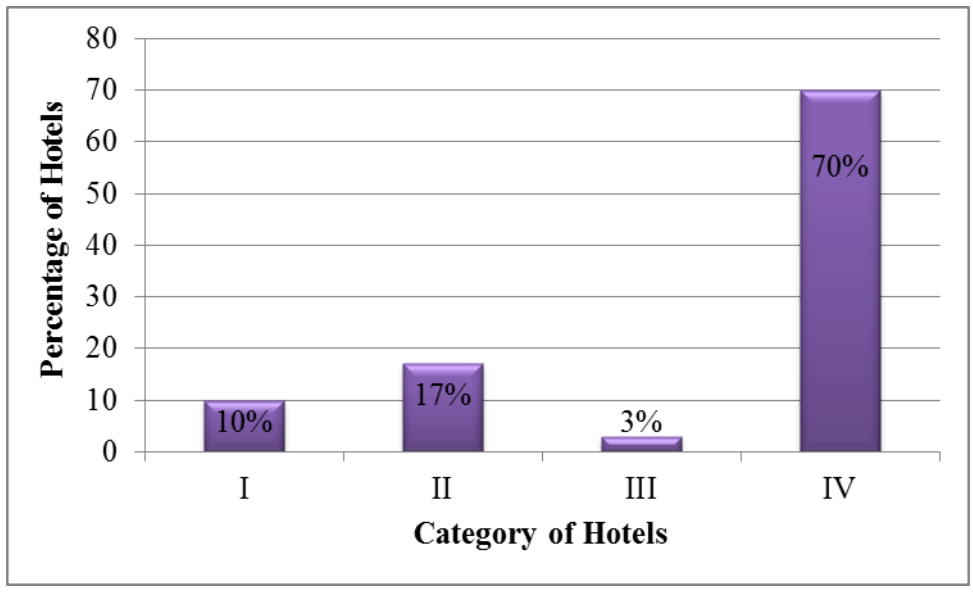


Figure 4.2 Classification of hotel Based tariff range

4.4.1.6. Ownership of the hotels:

The private sector has always played an influential role in the Ganga Sagar tourism industry. A preliminary survey has shown that a Dharamshala was first built in the Ganges Sea in 1901 and since then 30 hotels/ashrams have been built to date (Table 4.5).

The hotel survey analysis reveals another important aspect of ownership, in which 93% of hotels/ashrams are private against 7% of West Bengal Govt. undertaking (Fig. 4.3).

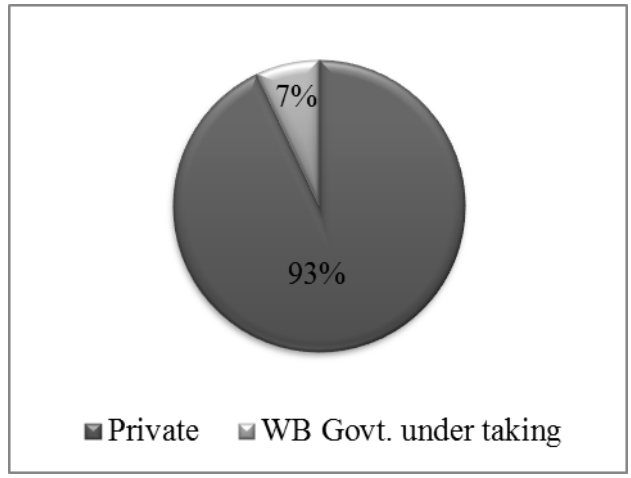


Figure 4.3 Nature of hotel ownership

4.4.1.7. Hotel occupancy:

Hotel occupancy in the tourist areas of the Sundarbans is highly influenced by the seasonal character. Typically the peak season (only January) has been observed with 100% occupancy while the off-season 10% to 20% (February to December) occupancy has been observed depending on the hoteliers' ability to manage.

4.4.2. Bakkhali:

Table 4.8 Basic data structure of hotels at Bakkhali

Sl No.	Name of the hotel	Year of establishment	Geographical location		Built-up area (m^2)	Floor height (m) & No. of floors	Total built up area (m^2)	No. of beds	Cumulative beds	Built up area / bed (m^2)	Tariff – average per head per night (RS)	Ownership
			Latitude	Longitude								
					A	B	C = (A x No. of floors)	D	∑ D	E = C / D		
1	Balaka Lodge	1970	21°33'49.02"N	88°15'59.24"E	397	2.9 m & Three storied	1191	120	120	9.93	1200	Private (Non-residential owner)
2	Sahana Tourist Lodge	1979	21°33'49.27"N	88°15'54.00"E	100	2.8 m & Three storied	300	30	150	10.00	1000	Private (Non-residential owner)
3	Bakkhali Tourist Lodge	1980	21°33'39.57"N	88°16'6.46"E	496	2.8 m & One storied	496	36	186	13.78	2200	W.B GOVT.
4	Narayani Lodge	1980	21°33'49.56"N	88°15'58.09"E	186	2.8 m & Three storied	558	54	240	10.33	1000	Private (Residential owner)
5	Hotel Bay View	1987	21°33'49.59"N	88°15'56.24"E	659	2.8 m & Two storied	1318	70	310	18.83	1550	Private (Non-residential owner)
6	Samabay Sasthya Unnayan Sanstha	1988	21°33'50.49"N	88°15'48.72"E	124	2.9 m & Two storied	248	64	374	3.88	500	Co-operative Private LTD

7	Bakkhali Beach Banglow	1990	21°33'49.80"N	88°16'00.00"E	260	2.9 m & Two storied	520	36	410	14.44	3000	Private (Residential owner)
8	Hotel Samanta	1990	21°33'47.83"N	88°16'1.32"E	151	2.8 m & Three storied	453	50	460	9.06	1250	Private (Residential owner)
9	Hotel Hansaraj	1994	21°33'51.37"N	88°15'54.61"E	70	2.9 m & Two storied	140	20	480	7.00	800	Private (Residential owner)
10	Hotel Sagarika	1998	21°33'50.31"N	88°16'3.32"E	219	2.8 m & Three storied	657	60	540	10.95	600	Private (Residential owner)
11	Bijaya Tourist Lodge	1999	21°33'49.34"N	88°15'57.75"E	156	2.9 m & Three storied	468	60	600	7.80	800	Private (Residential owner)
12	Hotel Babylon	2000	21°33'49.58"N	88°15'57.33"E	232	2.8 m & Two storied	464	30	630	15.47	1000	Private (Non-residential owner)
13	Hotel Apanjan	2000	21°33'47.70"N	88°15'50.51"E	96	2.9 m & Three storeyed	200	60	690	3.33	1050	Private (Non-residential owner)
14	Hotel Amarabati	2000	21°33'50.13"N	88°15'52.72"E	219	3 m & Three storied	288	150	840	1.92	1300	Private (Non-residential owner)
15	Hotel Sea View	2000	21°33'55.82"N	88°15'41.24"E	614	2.9 m & Three storied	1842	90	930	20.47	800	Private (Non-residential owner)
16	Hotel Moumita	2000	21°33'52.67"N	88°15'46.52"E	230	2.8 m & Two storied	460	30	960	15.33	600	Private (Residential owner)

17	Hotel Rainbow	2005	21°33'52.51"N	88°15'43.87"E	70.9	2.9 m & Three storeyed	212.7	60	1020	3.55	500	Private (Residential owner)
18	Hotel Bhorer Allo	2005	21°33'53.10"N	88°15'53.67"E	160	2.8 m & Three storied	480	60	1080	8.00	1000	Private (Residential owner)
19	Hotel Joyguru	2007	21°33'50.54"N	88°15'58.30"E	226	2.8 m & Four storied	904	100	1180	9.04	1200	Private (Residential owner)
20	Hotel Triva	2008	21°33'53.25"N	88°15'50.79"E	69.4	2.8 m & Two storied	138.8	30	1210	4.63	1000	Private (Residential owner)
21	Hotel Meghalaya	2009	21°33'50.17"N	88°15'58.54"E	217	2.8 m & Three storied	651	100	1310	6.51	1200	Private (Non Residential owner)
22	Hotel Amantran	2010	21°33'51.07"N	88°16'3.69"E	217	2.9 m & Three storied	651	50	1360	13.02	1000	Private (Residential owner)
23	Hotel Samudra Nill	2010	21°33'50.25"N	88°15'53.92"E	497	2.9 m & Three storied	1491	100	1460	14.91	1200	Private (Non Residential owner)
24	Hotel Chhuti	2010	21°33'51.98"N	88°15'50.24"E	70	2.8 m & Three storied	210	45	1505	4.67	1000	Private (Non-residential Owner)
25	Hotel Pinki	2012	21°33'52.74"N	88°15'49.62"E	163	2.9 m & Two storied	326	70	1575	4.66	500	Private (Residential owner)
26	Beach Resort	2012	21°33'52.95"N	88°15'44.71"E	222	2.8 m & Two storied	444	40	1615	11.10	1200	Private (Non-residential owner)

27	Hotel Sanjog	2014	21°33'52.39"N	88°15'52.82"E	160	2.8 m & Four storied	640	90	1705	7.11	1000	Private (Non-residential owner)
	TOTAL							**1705**				

Primary data source: 2018 – 2019

4.4.2.1. Total number of hotels:

Table 4.8 shows that the total number of hotels in Bakkhali is now 27. The first hotel was built in Bakkhali in 1960 and since then it has grown to a total of 27 hotels.

4.4.2.2. Location of hotels:

The main direct route from Kolkata to Bakkhali is National Highway 117. The number of hotels that have been built in Bakkhali tourist center is about National Highway 117. Plate 4.2 shows that the hotels in Bakkhali are grouped along with linear patterns.

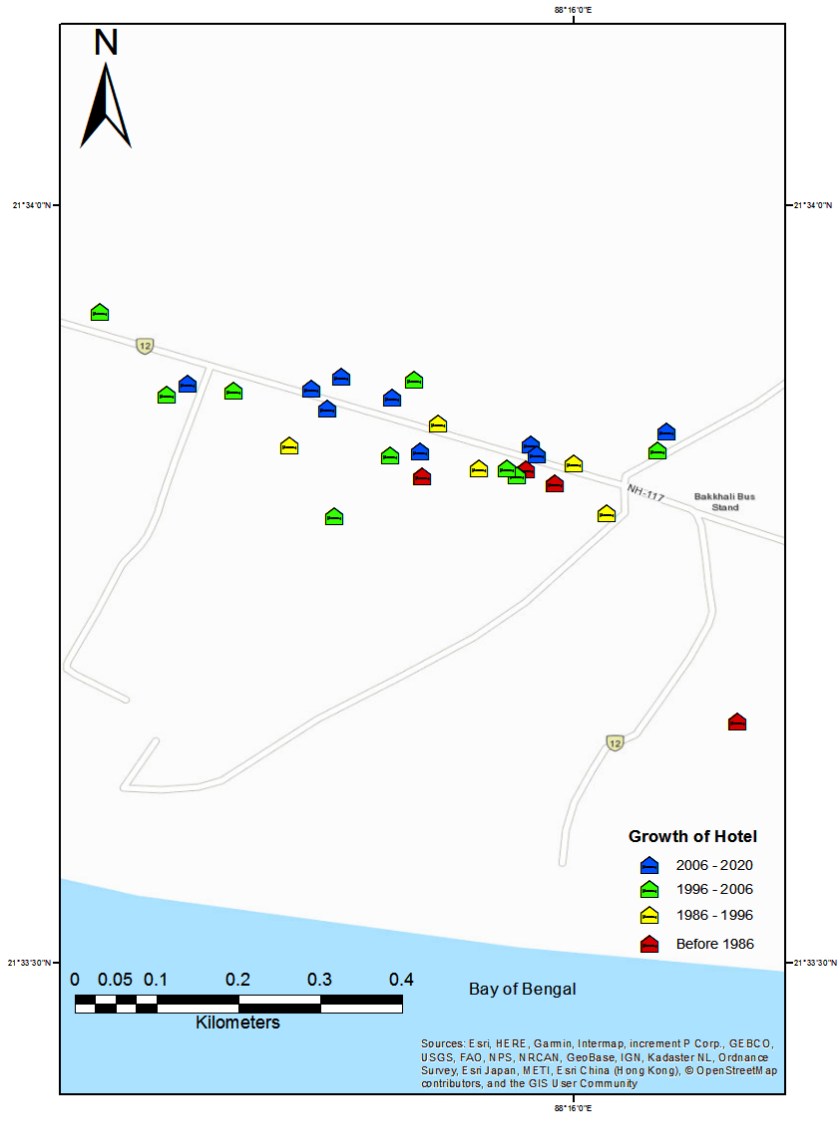


Plate 4.2 GPS locations of lodging facilities with complete information studies till date

4.4.2.3. Categorization of hotel:

Table 4.10 shows that the hotels in Bakkhali have been divided into three sections on the basis of hotel charges. Namely i) low budget hotel (less than 800 rupees per bed per

night) ii) middle budget hotel (801 to 1600 rupees per bed per night) and iii) high budget hotel (more than 1600 rupees per bed per night). It is clear from the following table that the number of hotels in the second category i.e. middle budget is more (56%) than the other two categories.

4.4.2.4. Accommodation facilities:

The total accommodation capacity of the hotels located in the Bakkhali Tourism Area of Namkhana has been judged entirely on the basis of preliminary information obtained from the hotels. At present the total number of hotels in this place is 27, with a total bed capacity of 1705 (Table 4.8). Considering this, the average bed capacity of the hotel has been calculated as 81.19 beds. Based on the bed capacity, 30% of the hotels have less than 40 bed capacity (Fig. 4.4).

Table 4.9 Classification on accommodation facilities of hotel based

Category	No. of Beds	No. of Hotels	% of Hotels
I	< 40	8	30%
II	40 – 80	12	44%
III	>80	7	26%
Total		27	

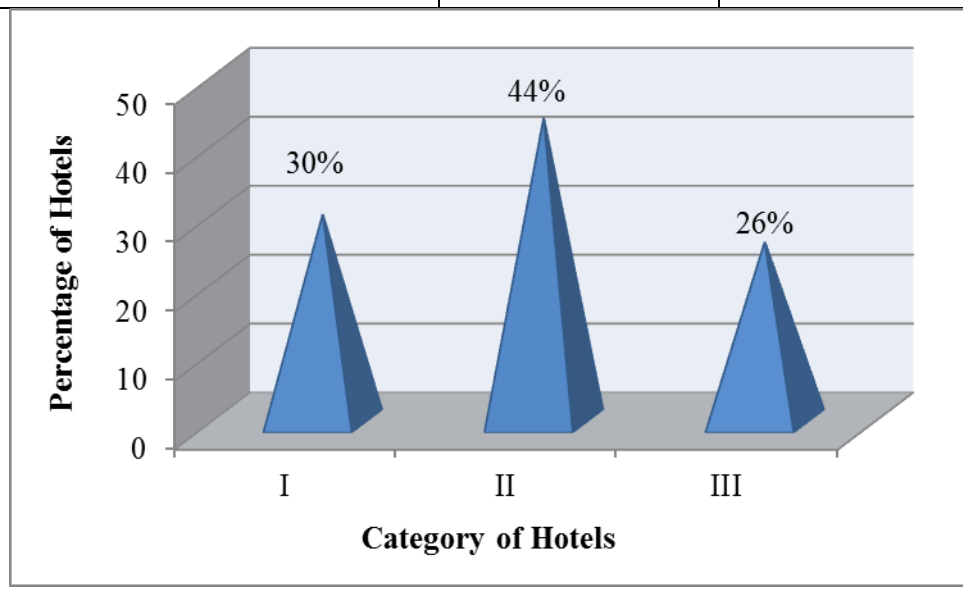


Figure 4.4 Classification on accommodation facilities of hotel based

4.4.2.5. Hotel tariff range:

The price range of hotels in the tourist area of Bakkhali no varies between peak season and off-season, because more or fewer tourists are seen throughout the year.

According to preliminary survey estimates, most hotels typically spend about 10% to 15% off in throughout the year. However, the discount varies according to the status of the hotels and the business policy. Looking at table 4.10 and figure 4.5, it is understood that 63% of the hotels whose rent is 801 to 1600 rupees in Indian currency. It turns out that middle budget hotels are more. Only two hotels in the region have been identified with rents of more than Rs 1,600 per bed per night in Indian currency.

Table 4.10 Classification of hotel based on tariff range

Category	Tariff Range (INR)	No. of Hotels	% of Hotels
I	< 800	8	30%
II	801 – 1600	17	63%
III	>1600	2	7%
Total		27	

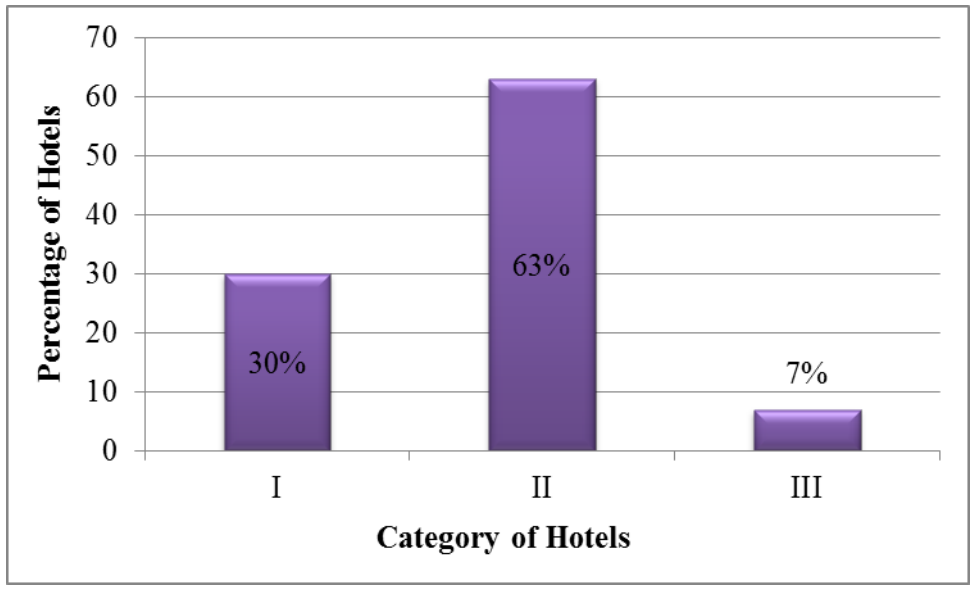


Figure 4.5 Classification of hotel based tariff range

4.4.2.6. Ownership of the hotels:

The private sector has always played an influential role in the Bakkhali tourism industry as it is Sundarbans tourism sector. Table No 4.8 shows that no hotel was built here before 1970, but in 1970 a dimension hotel was built in the area. At present, according to the preliminary survey, there are a total of 27 hotels in Bakkhali. Except for only two hotels, all

the others have been developed by private enterprises. Most of the hotels are run by a single entrepreneur or joint venture.

The hotel survey analysis reveals another important aspect of ownership, which 48% residential hotel ownership against 44% of non-residential hotel owners (Fig 4.6).

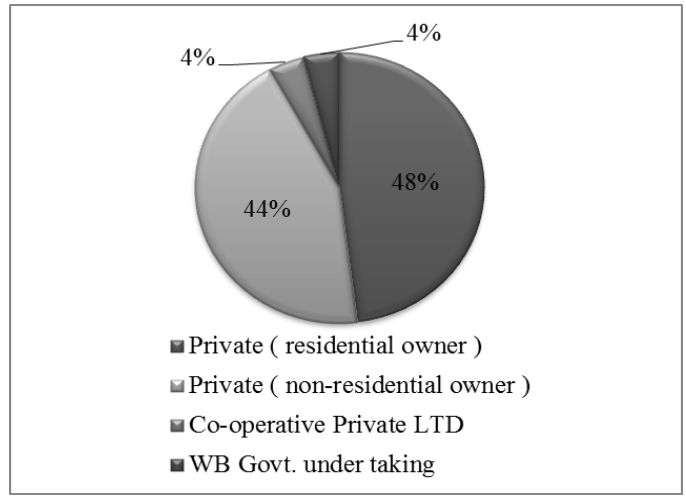


Figure 4.6 Nature of hotel ownership

4.4.2.7. Hotel Occupancy:

Hotel occupancy in the tourist areas of the Sundarbans are highly influenced by the seasonal character. But in the case of Bakkhali, tourist arrivals occur throughout the year, but 100% occupancy is observed during Pujo and winter season.

4.4.3. Jharkhali:

Table 4.11 Basic data structure of hotels at Jharkhali

Sl No.	Name of the hotel	Year of establishment	Geographical location		Built-up area (m^2)	Floor height (m) & No. of floors	Total built-up area (m^2)	No. of beds	Cumulative beds	Built up area / bed (m^2)	Tariff – average per head per night (RS)	Ownershp
			Latitude	Longitude								
					A	B	C = (A x No. of floors)	D	∑ D	E = C / D		
1	Jharbanglow	1983	22° 1'16.06"N	88°41'5.98" E	79.37	2.8 m & one storied	79.37	14	14	5.67	400	Tourism Dept. Govt. Of WB
2	Banalata Lodge	2005	22° 1'37.12"N	88°41'16.03 "E	135.06	2.8 m & Two storied	270.12	36	50	7.50	450	Private (residential owner)
3	Mangrove Wild Resort	2008	22° 1'24.43"N	88°41'28.49 "E	286.52	2.6 m & One storied	286.52	37	87	7.74	600	Private (non- residential owner)
4	Billabasi Lodge	2013	22° 1'27.25"N	88°41'19.53 "E	96.95	2.6 m & One storied	96.95	25	112	3.88	400	Private (residential owner)
5	Jani Hotel	2013	22° 1'48.60"N	88°41'25.01 "E	55.2	2.7 m & One storied	55.2	11	123	5.02	400	Private (residential owner)

6	Royal Sundarban Wild Resort	2013	22° 1'53.77"N	88°41'14.36 "E	500	3.3 m & One storied	500	80	203	6.25	1000	Private (non-residential owner)
7	Sarkar Tiger Camp Lodge	2013	22° 1'26.28"N	88°41'27.45 "E	94.55	2.9 m & One storied	94.55	10	213	9.46	500	Private (non-residential owner)
8	Sundar Resort	2013	22° 1'31.04"N	88°41'33.85 "E	161.94	2.8 m & One storied	161.94	6	219	26.99	600	Private (residential owner)
9	Swabhumi Guest House	2013	22° 1'34.82"N	88°41'19.57 "E	227.75	2.9 m & Two storied	455.5	28	247	16.27	900	Private (non-residential owner)
10	Akash Guest House	2014	22° 1'26.95"N	88°41'22.31 "E	42.35	2.9 m & One storeyed	42.35	8	255	5.29	600	Private (residential owner)
11	Kali Adber Hotel	2014	22° 1'27.28"N	88°41'19.99 "E	73.79	2.8 m & one storied	73.79	8	263	9.22	500	Private (residential owner)
12	Maa Tara Guest House	2014	22° 1'41.08"N	88°41'16.23 "E	157.7	2.9 m & Two storied	315.4	36	299	8.76	650	Private (non-residential owner)
13	Aronnok Home Stay	2017	22° 1'24.43"N	88°41'30.23 "E	74.79	2.9 m & One storeyed	74.79	12	311	6.23	850	Private (residential owner)
14	Dream Land Home Stay	2017	22° 1'33.54"N	88°41'22.14 "E	64	2.8 m & One storied	64	9	320	7.11	700	Private (residential owner)

15	Ekanta Apan	2017	22° 1'41.10"N	88°41'27.82 "E	330.89	2.9 m & Two storied	661.78	28	348	23.64	900	Private (non-residential owner)
16	Sundarban Natural Home Stay	2018	22° 1'45.34"N	88°41'14.47 "E	83.52	2.8 m & Two storied	167.04	20	368	8.35	800	Private (residential owner)
	TOTAL							**368**				

Primary data source: 2018 – 2019

4.4.3.1. Total number of hotels:

The first hotel was established in Jharkhali in 1983 under the Government of West Bengal, which had only 14 seats. Then in 2005 the first private venture hotel was built in Jharkhali and since then a growing number of hotels have been built to handle the tourist crowd. Today, a total of 16 hotels have been set up in the Jharkhali Tourism Hub (Table 4.11).

4.4.3.2. Location of hotels:

Plate 4.3 shows that all the hotels that have been built in the Jharkhali Tourism Area are located on road sites. Jharkhali Samabay Moor is a car parking zone in the area, so the hotels are located along with the road site. The main tourist attraction is the Sundarbans Wild Animal Park (SWAP), located just 1 km from the Jharkhali Samabay Moor.

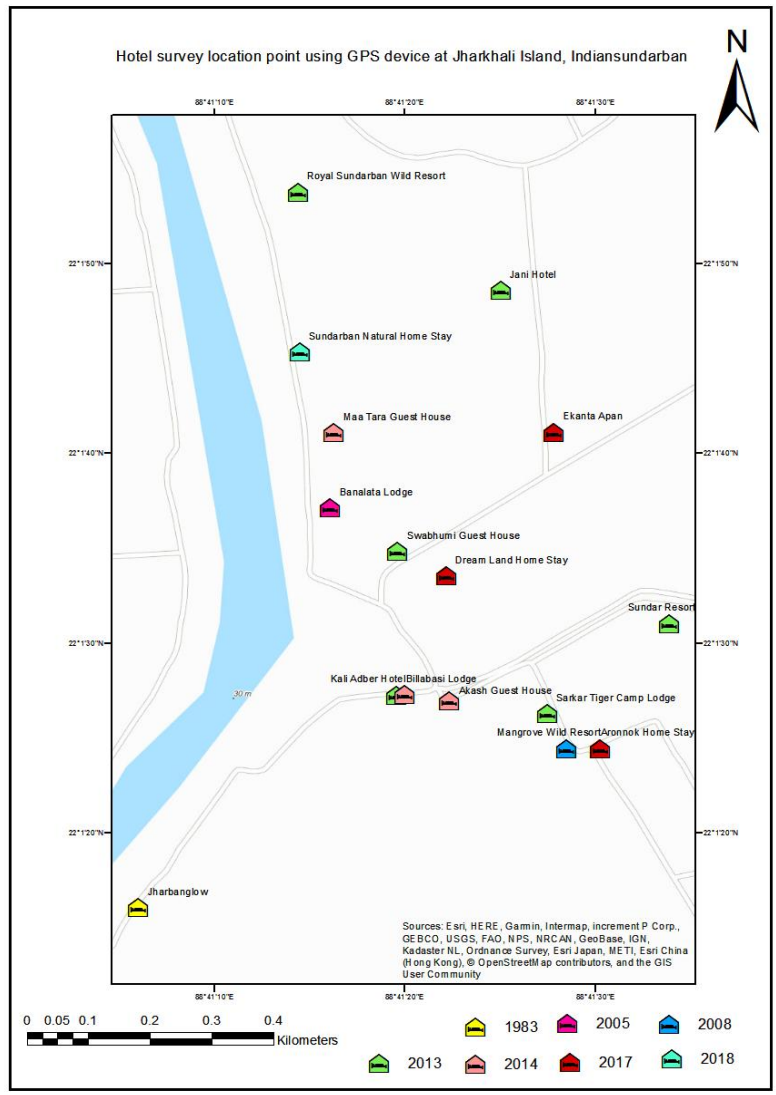


Plate 4.3 GPS locations of lodging facilities with complete information studies till date

4.4.3.3. Categorization of hotel:

Table 4.13 shows that the hotels in Jharkhali have been divided into three sections on the basis of hotel charges. Namely i) low budget hotel (less than 400 rupees per bed per night) ii) middle budget hotel (401 to 800 rupees per bed per night) and iii) high budget hotel (more than 800 rupees per bed per night). It is clear from the following table that the number of hotels in the second category i.e. middle budget is more (56%) than the other two categories.

4.4.3.4. Accommodation facilities:

The total accommodation capacity of the hotels located in the Jharkhali Tourism Area of Basanti has been judged entirely on the basis of preliminary information obtained from the hotels. At present the total number of hotels in this place is 16, with a total bed capacity of 368 (Table 4.11). Considering this, the average bed capacity of the hotel has been calculated as 23 beds. Based on the bed capacity, 56% of the hotels have less than 20 bed capacity (Fig. 4.7).

Table 4.12 Classification on accommodation facilities of hotel based

Category	No. of Beds	No. of Hotels	% of Hotels
I	< 20	9	56%
II	20 – 40	6	38%
III	>40	1	6%
Total		16	

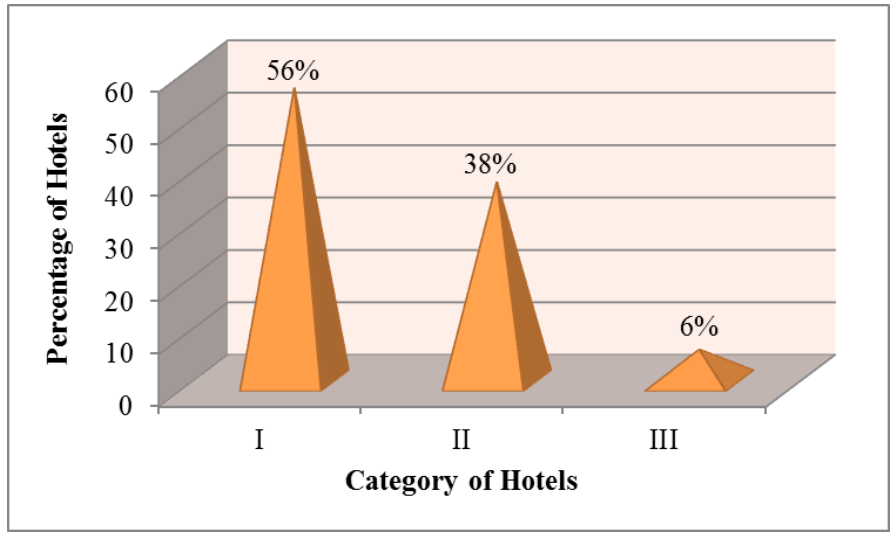


Figure 4.7 Classification on accommodation facilities of hotel based

4.4.3.5. Hotel tariff range:

The price range of hotels in the tourist area of Jharkhali varies between peak season and off-season. According to preliminary survey estimates, most hotels typically spend about 20% to 30% off in the off-season. However, the discount varies according to the status of the hotels and the business policy. Looking at table 4.13 and figure 4.8, it is understood that 56% of the hotels whose rent is 400 to 800 rupees in Indian currency.

Table 4.13 Classification of hotel based on tariff range

Category	Tariff Range (INR)	No. of Hotels	% of Hotels
I	< 400	3	19%
II	401 – 800	9	56%
III	>800	4	25%
Total		16	

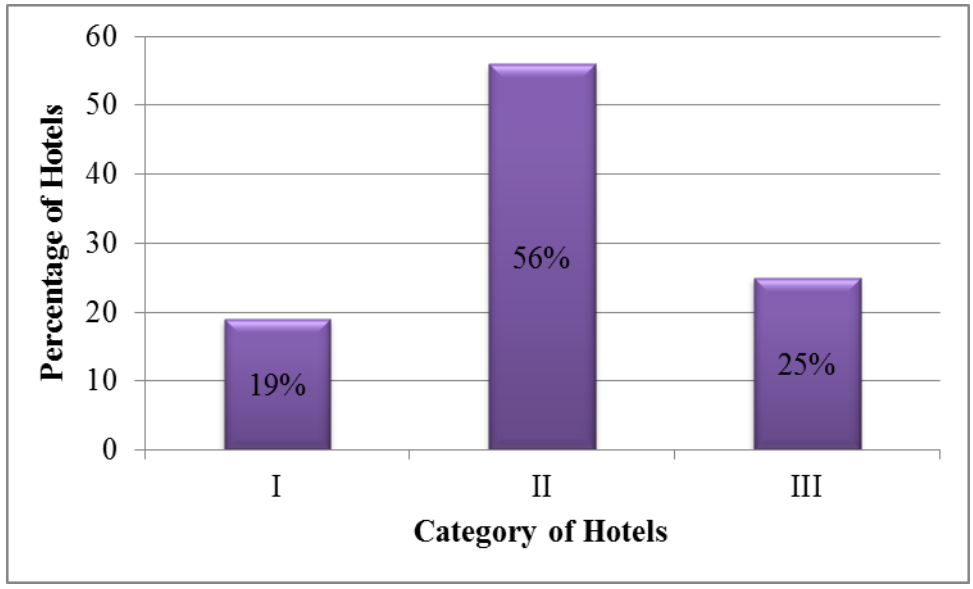


Figure 4.8 Classification of hotel based tariff range

4.4.3.6. Ownership of the hotels:

The private sector has always played an influential role in the Jharkhali tourism industry. However, the first bungalow was built in 1983 at the initiative of the West Bengal Tourism Department. According to the preliminary survey, there were no hotels except Jharbanglow from 1983 to 2005, but since 2005, a number of privately owned hotels have been built. Most of the hotels are run by a single entrepreneur or joint venture.

The hotel survey analysis reveals another important aspect of ownership, which is 56% of residential hotel ownership against 38% of non-residential hotel owners (Fig. 4.9).

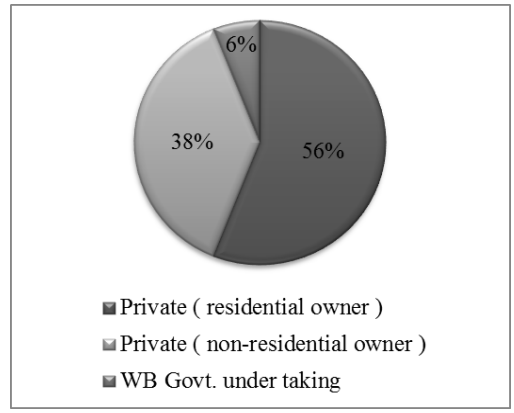


Figure 4.9 Nature of hotel ownership

4.4.3.7. Hotel Occupancy:

Hotel occupancy in the tourist areas of the Sundarbans are highly influenced by the seasonal character. Typically the peak season (November to the end of February) has been observed 100% occupancy while the off-season 10% to 20% (March to October) occupancy has been observed depending on the hoteliers' ability to manage.

4.4.4. Pakhiralay (Gosaba block)

Table 4.14 Basic data structure of hotels at Pakhiralay

Sl No.	Name of the hotel	Year of establishment	Geographical location		Built-up area (m^2)	Floor height (m) & No. of floors	Total built up area (m^2)	No. of beds	Cumulative beds	Built up area / bed (m^2)	Tariff – average per head per night (RS)	Ownership
			Latitude	Longitude								
					A	B	C = (A x No. of floors)	D	∑ D	E = C / D		
1	Sanaha Guest House	1990	22°07'40.21"N	88°49'13.71"E	270	2.9 m & Two storied	540	50	50	10.80	2000	WB Govt. (Jela Parishad BAnglow)
2	Mangroves Hotel	2001	22°07'53.97"N	88°49'24.54"E	160	3 m & One storied	160	32	82	5.00	1200	Private (Residential owner)
3	Aram Hotel	2001	22°07'45.97"N	88°49'16.86"E	90	2.9 m & Two storied	180	30	112	6.00	1000	Private (Residential owner)
4	Hemonta Lodge	2002	22°08'07.53"N	88°49'40.20"E	350	2.8 m & One storied	350	12	124	29.17	1000	Private (Non-residential owner)
5	Hotel Mouchak	2008	22°08'12.17"N	88°49'41.95"E	210	2.8 m & Two storied	420	42	166	10.00	1200	Private (Non-residential owner)
6	Hotel Mainak	2010	22°07'52.35"N	88°49'21.72"E	185	2.8 m & Two storied	370	32	198	11.56	1200	Private (Non-residential owner)
7	Sundarban Home Stay	2012	22°08'04.06"N	88°49'33.10"E	100	2.9 m & Two storied	200	20	218	10.00	800	Private (Residential owner)

8	Dalphin Hotel	2012	22°08'03.35"N	88°49'32.04"E	130	2.8 m & One storied	130	19	237	6.84	1500	Private (Residential owner)
9	Hotel Sreya	2013	22°07'48.60"N	88°49'18.82"E	440	2.8 m & Two storied	880	72	309	12.22	1200	Private (Non-residential owner)
10	S2 Hotel	2014	22°08'10.51"N	88°49'48.32"E	700	2.9 m & Three storied	2100	54	363	38.89	2400	Private (Non-residential owner)
11	Sanartari Eco Resort	2014	22°08'10.34"N	88°49'43.78"E	270	2.8 m & one storied	270	20	383	13.50	900	Private (Residential owner)
12	Apanjan Resort (New)	2014	22°07'51.56"N	88°49'24.34"E	700	2.9 m & One storied	700	80	463	8.75	1200	Private (Non-residential owner)
13	Avinandan Cottage	2014	22°07'58.58"N	88°49'27.11"E	210	2.9 m & One storied	210	45	508	4.67	1000	Private (Residential owner)
14	Sundari Lodge	2014	22°07'55.36"N	88°49'25.38"E	200	3 m & Three storied	600	36	544	16.67	800	Private (Non-residential owner)
15	Madhuban Hotel	2015	22°07'53.40"N	88°49'25.00"E	150	2.9 m & Two storied	300	28	572	10.71	1000	Private (Residential owner)
16	Apanjan Hotel	2015	22°07'48.60"N	88°49'17.69"E	424	2.9 m & Three storied	1272	52	624	24.46	1400	Private (Non-residential owner)
17	Spandan Guest House	2015	22°07'40.58"N	88°49'12.15"E	180	2.9 m & One storied	180	12	636	15.00	1400	Private (Residential owner)

18	Lodge Chital	2015	22°07'42.04"N	88°49'07.94"E	350	2.9 m & One storied	350	32	668	10.94	1100	Private (Non Residential owner)
19	Banaful Hotel	2015	22°08'8.27N	88°49'45.19"E	120	2.8 m & Two storied	240	32	700	7.50	800	Private (Residential owner)
20	Hotel Promila	2017	22°08'7.47"N	88°49'43.22"E	160	2.9 m & Three storied	480	57	757	8.42	1000	Private (Residential owner)
21	Maa Taruvila	2017	22°08'08.95"N	88°49'41.98"E	160	2.9 m & Two storied	480	48	805	110.00	1200	Private (Residential owner)
	TOTAL							**805**				

Primary data source: 2018 – 2019

4.4.4.1. Total number of hotels:

Pakhiralay is one of the tourist destinations for Sundarbans travel. The first hotel was built in the region in 1990, under the government of West Bengal. Since then, due to the increasing pressure of tourists, a total of 21 hotels have been set up in the area on private initiative. Table 4.14 shows that a total of 21 hotels have been built in Pakhiralay.

4.4.4.2. Location of hotels:

Plate number 4.4 shows that the tourism in Gosaba is based on the hotels lined up along the road. The main tourist attraction is the Sajnekhali Reserve Forest.

Plate 4.4 shows that the hotels are linearly located on the road site in Pakhiralay.

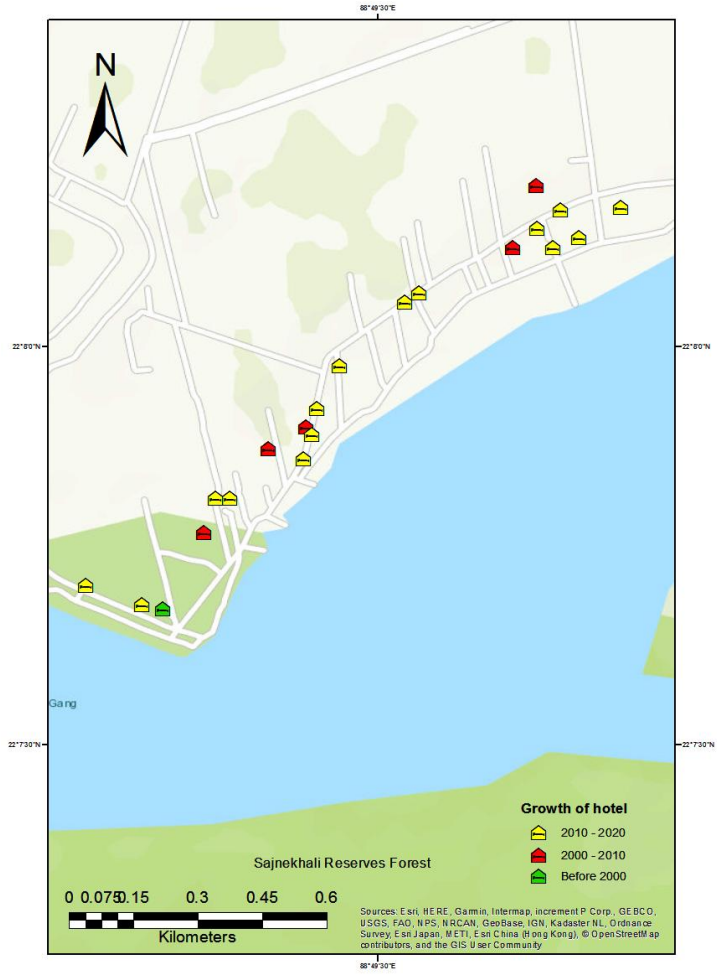


Plate 4.4 GPS locations of lodging facilities with complete information studies till date

4.4.4.3. Categorization of hotel:

Table 4.16 shows that the hotels in Pakhiralaya (under Gosaba block) have been divided into three sections on the basis of hotel charges. Namely i) low budget hotel (less than 800 rupees per bed per night) ii) middle budget hotel (801 to 1600 rupees per bed per

night) and iii) high budget hotel (more than 1600 rupees per bed per night). It is clear from the following table that the number of hotels in the second category i.e. middle budget is more (56%) than the other two categories.

4.4.4.4. Accommodation facilities:

The total accommodation capacity of the hotels located in the Pakhiralaya Tourism Area of Gosaba has been judged entirely on the basis of preliminary information obtained from the hotels. At present the total number of hotels in this place is 21, with a total bed capacity of 805 (Table 4.14). Considering this, the average bed capacity of the hotel has been calculated as 38.33 beds. Based on the bed capacity, 24% of the hotels have less than 20 bed capacity while 43% of the hotels have more than 40 bed capacity (Fig. 4.10).

Table 4.15 Classification on accommodation facilities of hotel based

Category	No. of beds	No. of hotels	Percentage of hotels
I	< 20	5	24%
II	20 – 40	7	33%
III	>40	9	43%
Total		21	

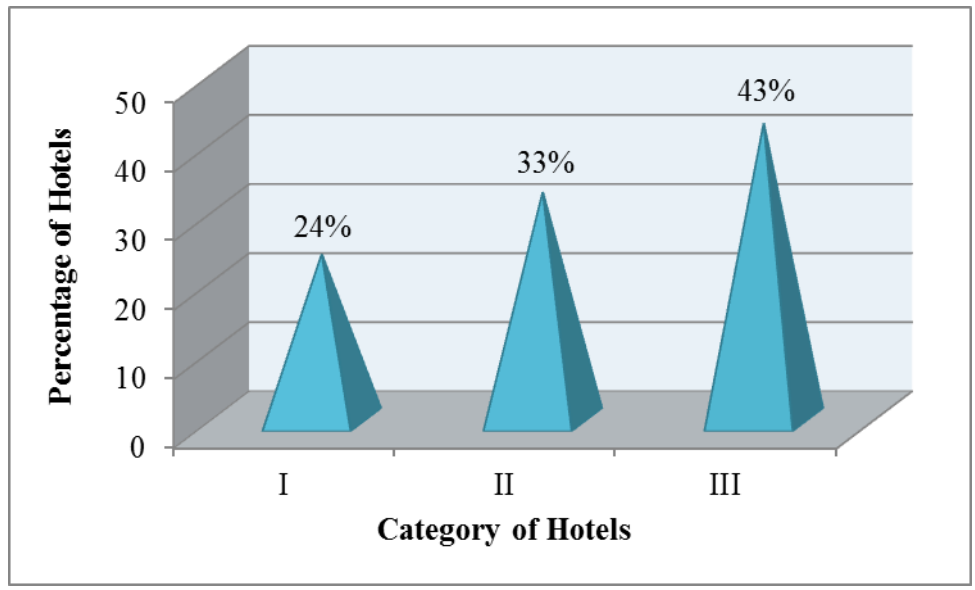


Figure 4.10 Classification on accommodation facilities of hotel based

4.4.4.5. Hotel tariff range:

The price range of hotels in the tourist area of Pakhiralaya varies between peak season and off-season. According to preliminary survey estimates, most hotels typically spend about 10% to 30% off in the off-season. However, the discount varies according to the status of the

hotels and the business policy. Looking at the table 4.16 and figure 4.11, it is understood that 56% of the hotels whose rent is 801 to 1600 rupees in Indian currency. It turns out that middle budget hotels are more.

Table 4.16 Classification of Hotel Based on Tariff Range

Category	Tariff range (INR)	No. of hotels	Percentage of hotels
I	< 800	3	19%
II	801 – 1600	16	56%
III	>1600	2	25%
Total		21	

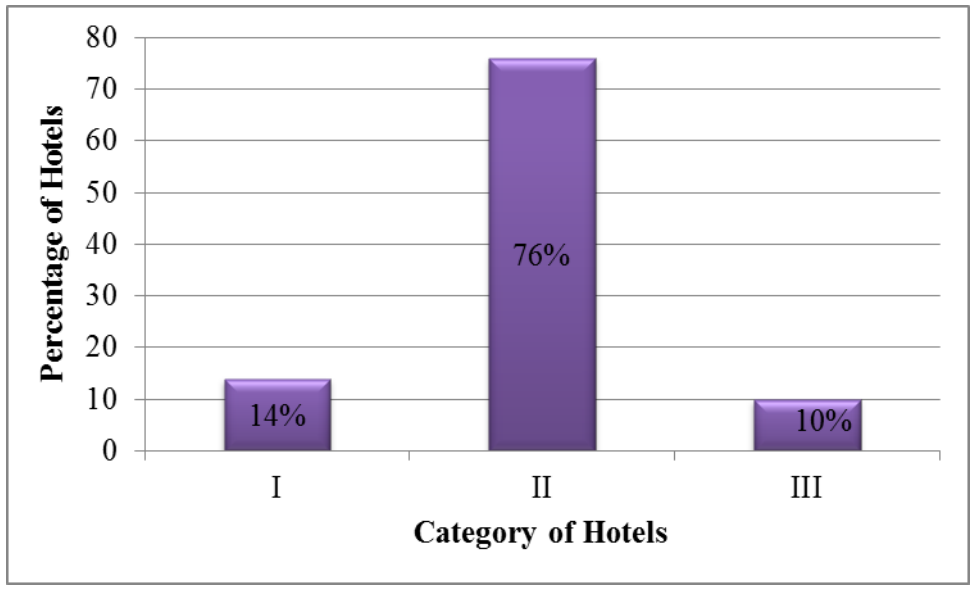


Figure 4.11 Classification of Hotel Based Tariff Range

4.4.4.6. Ownership of the hotels:

The private sector has always played an influential role in the Pakhiralaya tourism industry as it is Sundarbans tourism sector. Table No 4.14 shows that no hotel was built here before 1990, but in 1990 a dimension hotel was built in the area, the Zila Parishad Bungalow of the Government of West Bengal. Since then, a total of 21 hotels have been built from 2001 to present time. Except for only one hotel, all the others have been developed by private enterprises. Most of the hotels are run by a single entrepreneur or joint venture.

The hotel survey analysis reveals another important aspect of ownership, which 52% residential hotel ownership against 43% of non-residential hotel owners (Fig.4.12).

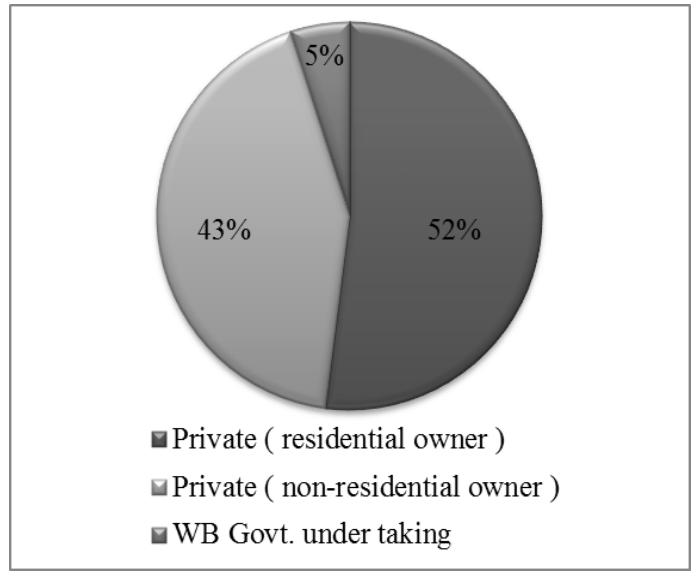


Figure 4.12 Nature of hotel ownership

4.4.4.7. Hotel Occupancy:

Hotel occupancy in the tourist areas of the Sundarbans are highly influenced by the seasonal character. Typically the peak season (November to the end of February) has been observed 100% occupancy while the off-season 20% to 30% (March to October) occupancy has been observed depending on the hoteliers' ability to manage.

4.4.5. Dayapur (Gosaba block):

Table 4.17 Basic data structure of hotels at Dayapur

Sl No.	Name of the hotel	Year of establishment	Geographical location		Built-up area (m^2)	Floor height (m) & No. of floors	Total built up area (m^2)	No. of beds	Cumulative beds	Built up area / bed (m^2)	Tariff – average per head per night (RS)	Ownership
			Latitude	Longitude								
					A	B	C = (A x No. of floors)	D	∑ D	E = C / D		
1	Sundarban Green House	2000	22° 7’37.00”N	88°49’58.00”E	300	2.74 m & Two storied	600	42	42	10.80	2000	Private (residential owner)
2	Tiger View Point	2004	22° 7’ 31”N	88° 50’ 26”E	320	2.8 m & Two storied	640	50	92	5.00	1200	Private (non-residential owner)
3	Sundarban Tiger Camp	2004	22° 7’ 24”N	88° 50’ 46”E	400	2.8 m & One storied	400	21	113	6.00	1000	Private (non-residential owner)
4	New Suranjana Resort	2007	22° 7’ 34”N	88° 50’ 22”E	1200	2.9 m & Two storied	2400	100	213	29.17	1000	Private (non-residential owner)

5	Royel Bengal Resort	2009	22° 7’ 36”N	88° 50’ 6”E	660	3 m & Two storied	1320	60	273	10.00	1200	Private (non-residential owner)
6	Sundarban Monisha Resort	2011	22° 7’36.74”N	88°49’58.51”E	334	2.9 m & Two storied	668	40	313	11.56	1200	Private (non-residential owner)
7	Cottage Banobas	2012	22° 7’37.00”N	88°50’0.00”E	220	2.8 m & One storied	220	21	334	10.00	800	Private (non- residential owner)
8	Sundarban Riverside Holiday Resort	2013	22° 7’ 10”N	88° 50’ 56”E	1400	2.9 m & Two storied	2800	74	408	6.84	1500	Private (non-residential owner)
	TOTAL							**408**				

Primary data source: 2018 – 2019

4.4.5.1. Total number of hotels:

A total of eight hotels have been set up along the road adjacent to the river embankment in the riverside area of Dayapur village under Gosaba block. Table 4.17 shows that there were no hotels here before 2000, hotels have started to be built here since 2000 and now there are 8 hotels in total.

4.4.5.2. Location of hotels:

The hotels are located linearly along the river embankment road at Dayapur village, just opposite the Sajanekhali Reserves Forest.

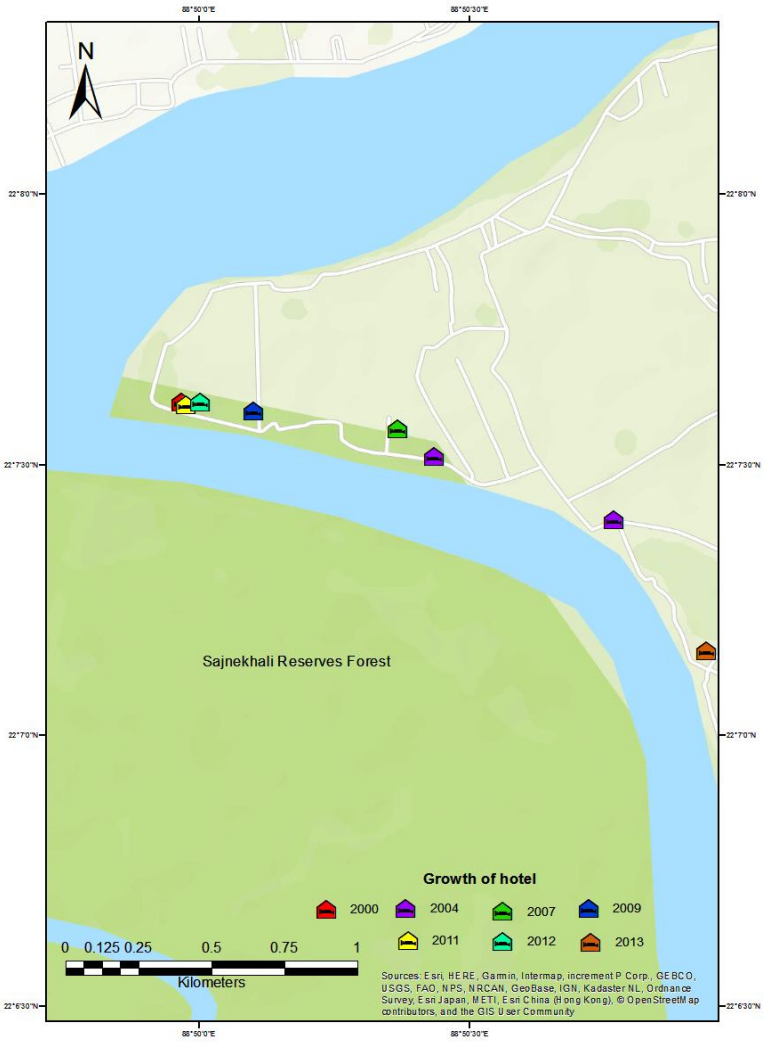


Plate 4.5 GPS locations of lodging facilities with complete information studies till date

4.4.5.3. Categorization of hotel:

Table 4.19 shows that the hotels in Dayapur (under Gosaba block) have been divided into three sections on the basis of hotel charges. Namely i) low budget hotel (less than 800 rupees per bed per night) ii) middle budget hotel (801 to 1600 rupees per bed per night) and iii) high budget hotel (more

than 1600 rupees per bed per night). It is clear from the following table that the number of hotels in the second category i.e. middle budget is more (56%) than the other two categories.

4.4.5.4. Accommodation facilities:

The total accommodation capacity of the hotels located in the Dayapur Tourism Area of Gosaba has been judged entirely on the basis of preliminary information obtained from the hotels. At present the total number of hotels in this place is 8, with a total bed capacity of 408 (Table 4.17). Considering this, the average bed capacity of the hotel has been calculated as 51 beds. Based on the bed capacity, 25% of the hotels have less than 30 bed capacity while 50% of the hotels have been more than 30 to 60 bed capacity (Fig. 4.13).

Table 4.18 Classification on accommodation facilities of hotel based

Category	No. of beds	No. of hotels	Percentage of hotels
I	< 30	2	25%
II	30 – 60	4	50%
III	>60	2	25%
Total		8	

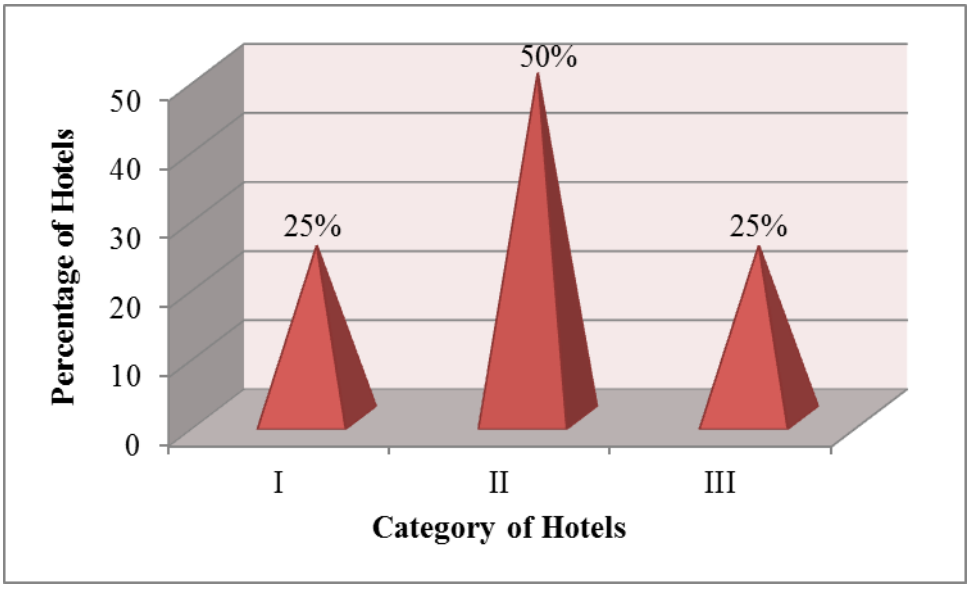


Figure 4.13 Classification on accommodation facilities of hotel based

4.4.5.5. Hotel tariff range:

The price range of hotels in the tourist area of Dayapur varies between peak season and off-season. According to preliminary survey estimates, most hotels typically spend about 10% to 20% off in the off-season. However, the discount varies according to the status of the hotels and the business

policy. Looking at table 4.19 and figure 4.14, it is understood that 56% of the hotels whose rent is 801 to 1600 rupees in Indian currency. It turns out that middle budget hotels are more. Only one hotel in the region has been identified with rents of more than Rs 1,600 per bed per night in Indian currency.

Table 4.19 Classification of hotel based on tariff range

Category	Tariff range (INR)	No. of Hotels	Percentage of Hotels
I	< 800	1	19%
II	801 – 1600	6	56%
III	>1600	1	25%
Total		8	

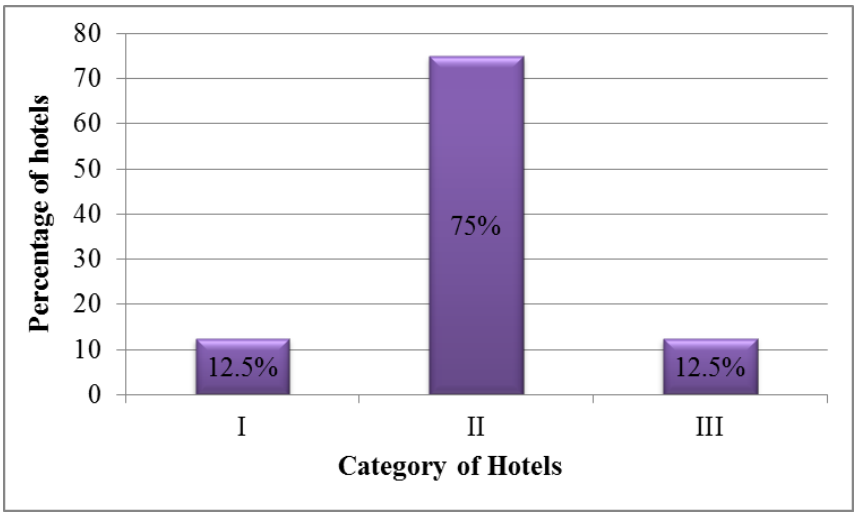


Figure 4.14 Classification of hotel based tariff range

4.4.5.6. Ownership of the hotels:

The private sector has always played an influential role in the Dayapur tourism industry as it is Sundarbans tourism sector. Table No 4.17 shows that no hotel was built here before 2000. Since, a total of 8 hotels have been built from 2000 to present time. All hotels have been developed by private enterprises. Most of the hotels are run by a single entrepreneur or joint venture.

The hotel survey analysis reveals another important aspect of ownership, which 12.5% residential hotel ownership against 87.5% of non-residential hotel owners (Fig. 4.15).

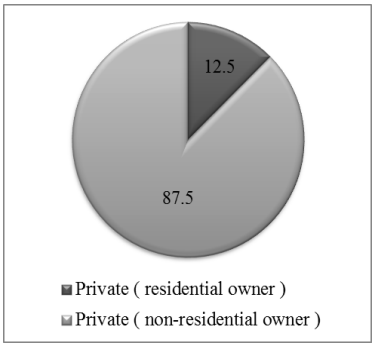


Figure 4.15 Nature of hotel ownership

4.4.5.7. Hotel occupancy:

Hotel occupancy in the tourist areas of the Sundarbans is highly influenced by the seasonal character. Typically the peak season (November to the end of February) has been observed with 100% occupancy while the off-season 10% to 20% (March to October) occupancy has been observed depending on the hoteliers' ability to manage.

4.5. Accessibility Analysis:

The Namkhana and Canning is the main entrance to the Sundarbans. Although Sundarbans are recognized as backward areas for transport and communication, today, communication and transportation systems are changing based on the number of tourists started arriving. For the transport of Sundarbans, only 12 km of railway, 250 km of metalled roads, and roughly 170 km of unpaved roads are present (Sharma, 1994; Kanjilal, 2000). The only means of transportation from the outskirts of Kolkata to Sundarbans are roads and railways, where the waterways are transported from one island to another. However, the construction of bridges on several rivers currently has a lot of benefits to the transport system (eg Matla, Hogal and Hatania Doania, bridges built on these three rivers), which no longer simplest benefit the human beings of the vicinity, however additionally assist in the development of tourism enterprise in Sundarbans.

Airport: Netaji Subhas Chandra Bose International Airport in Kolkata connects the state capital with the major cities and towns of the country and also connects the rest of the world. The distance from Kolkata Airport to Sundarbans is 112 km.

Road: Road transportation is more accessible from Kolkata to Namkhana (105 km.), but this road extended up to Bakkhali (126 km.), Sonakhali (73 km.), Jharkhali (100 km.), Gadkhali (84 km.) and Canning (56 km.), which are all near the Sundarbans.

Railways: In the Sundarbans, railways are limited to one level. The main gateway to the Sundarbans is Namkhana and Canning, and rail transport is located from Sealdah to Canning and Namkhana.

Waterways: For traveling in the Sundarbans are more approachable only by riverine waterways. Motor launch facilities are available from Lot No. 8 to Kachukhali, Gadkhali to Gosaba, Namkhana to Bhagabatpur crocodile project – Sagar Island – Jambu Dwip; from Hajnekhali – Sudhanyakhali – Burirdabri – Netidhopani – Holiday Island, etc.

4.6 Tourist profile:

4.6.1 Sagar Island

4.6.1.1. Tourists profile of Sagar:

Another place of interest in the Sundarbans is Sagar Island. Millions of people visit Kapil Muni's temple on Sagar Island during the Poush Sankranti (mid of January). The Ganga Sagar has been a place of pilgrimage since time immemorial, so the number of pilgrims visiting this region has increased. Analysis of the following three years (2016, 2017, and 2018) data and figures shows that the highest crowds were observed in January. Almost all those who come at this time are pilgrims. A preliminary survey has shown that pilgrims gathered on the occasion of Ganga Sagar Mela (GSM) in January. The remaining 11 months (February to December) are the arrival of ordinary tourists. The analysis of the images shows that the number of tourists visiting these 11 months is much less than the month of January, where the month January is a pillar. In the case of foreign tourists, they have arrived in the four months of July, August, and September, including January.

Table 4.20 Number of tourists (Indian with Foreign) in Sagar Island during 2016 - 2018

Year	Ganga Sagar					
	Number of Indian tourists (in Thousands)	Rate of growth (%)	Number of Foreign tourists (in Thousands)	Rate of growth (%)	Number of total tourists (in Thousands)	Overall growth rate (%)
	A	a	B	b	C = (A + B)	D
2016	1665.7		3.05		1668.75	
2017	2000.1	**20.08**	4.675	**53.28**	2004.775	**20.14**
2018	2261.4	**13.04**	5.125	**9.63**	2266.525	**13.06**

Source: Dept. of Tourism, Govt. of West Bengal

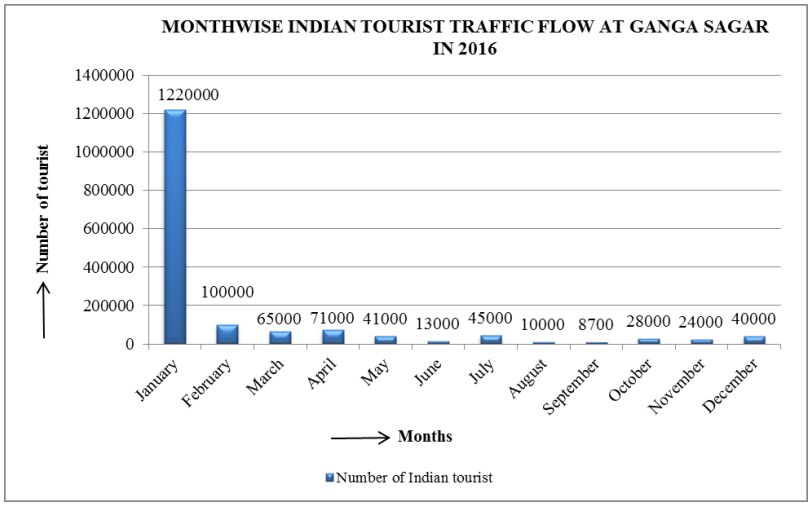


Figure 4.16a. Domestic Tourist Traffic flow in Sagar Island in 2016

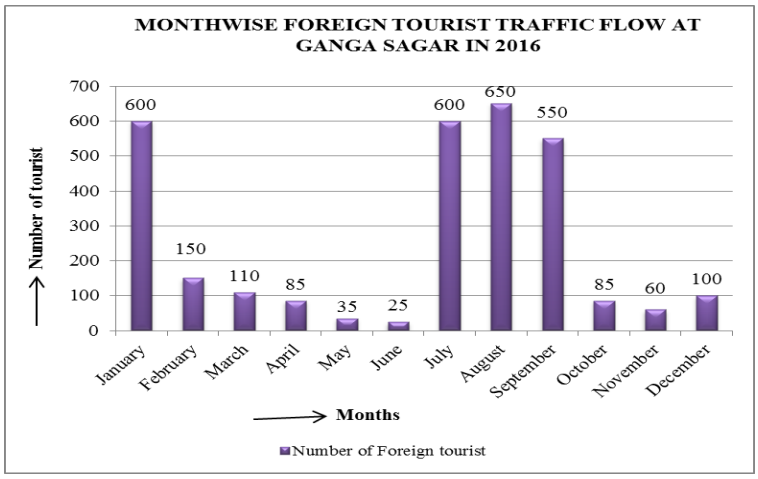


Figure 4.16b. Foreign Tourist Traffic flow in Sagar Island in 2016

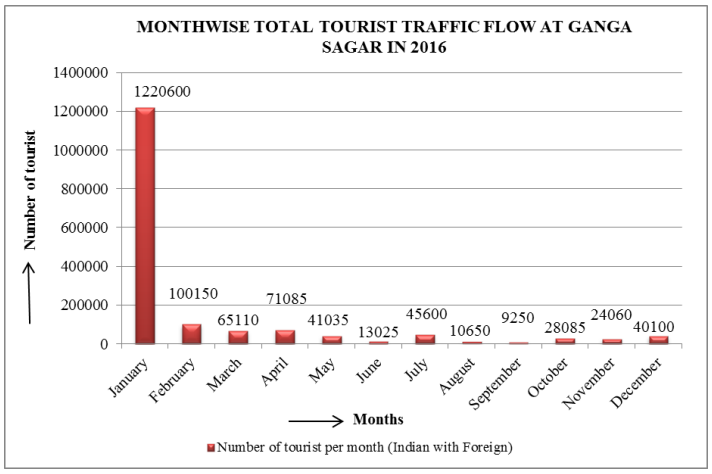


Figure 4.16c. Total Tourist Traffic flow in Sagar Island in 2016

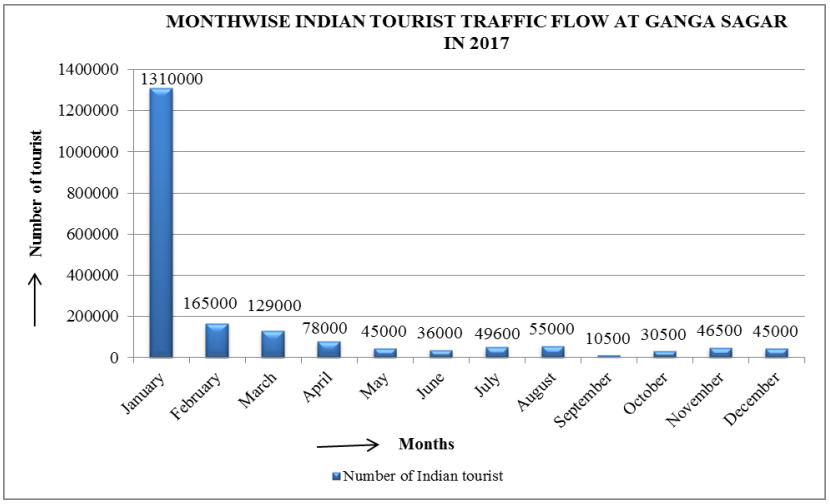


Figure 4.17a. Domestic Tourist Traffic flow in Sagar Island in 2017

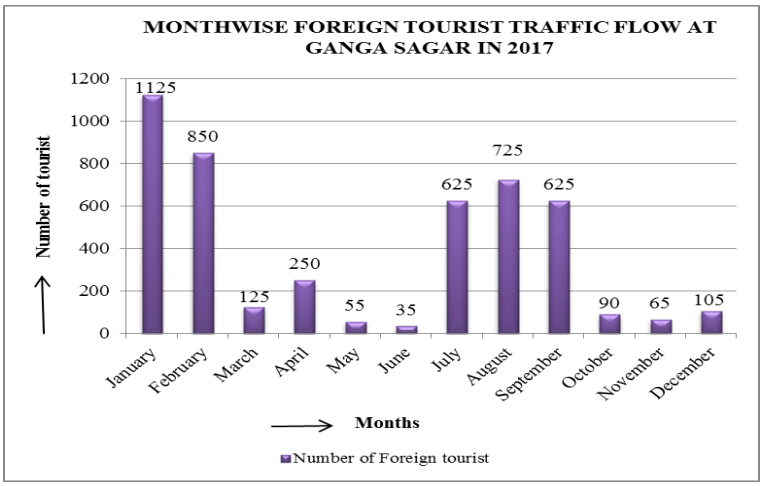


Figure 4.17b. Foreign Tourist Traffic flow in Sagar Island in 2017

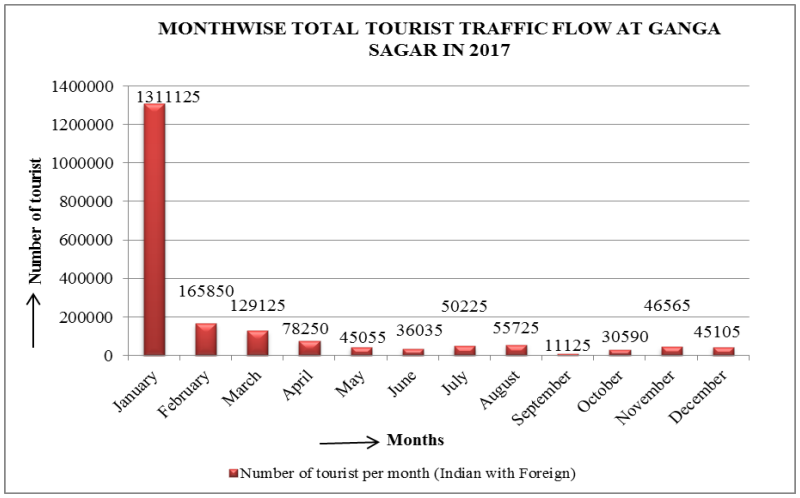


Figure 4.17c. Total Tourist Traffic flow in Sagar Island in 2017

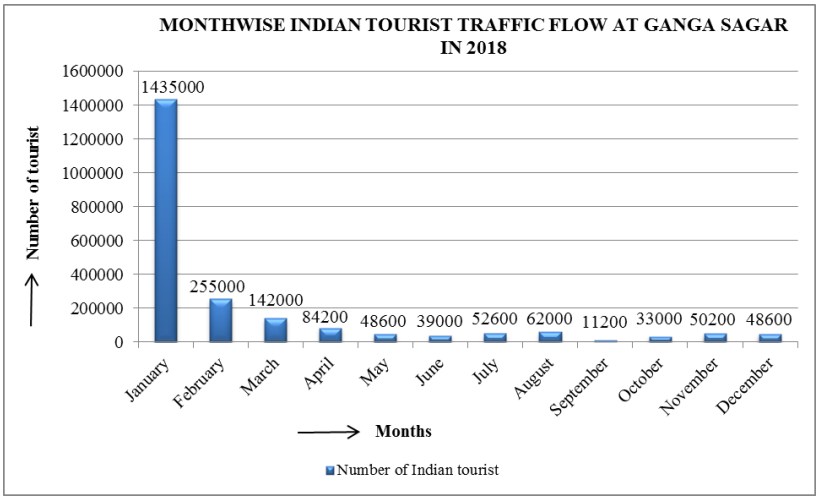


Figure 4.18a. Domestic Tourist Traffic flow in Sagar Island in 2018

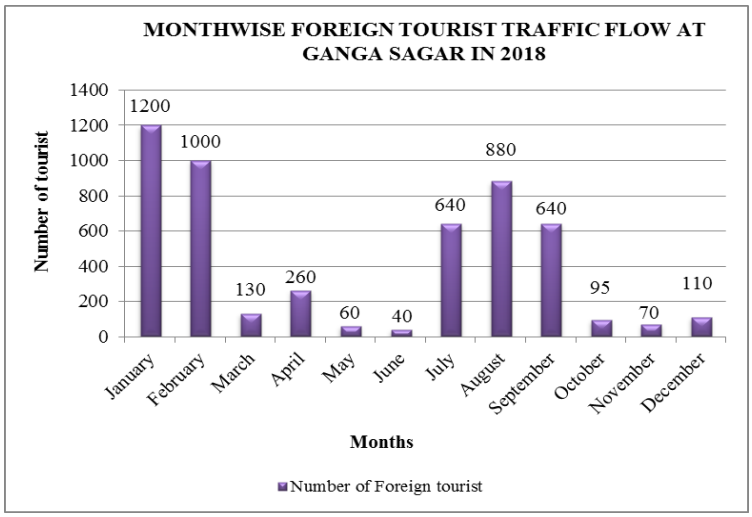


Figure 4.18b. Foreign Tourist Traffic flow in Sagar Island in 2018

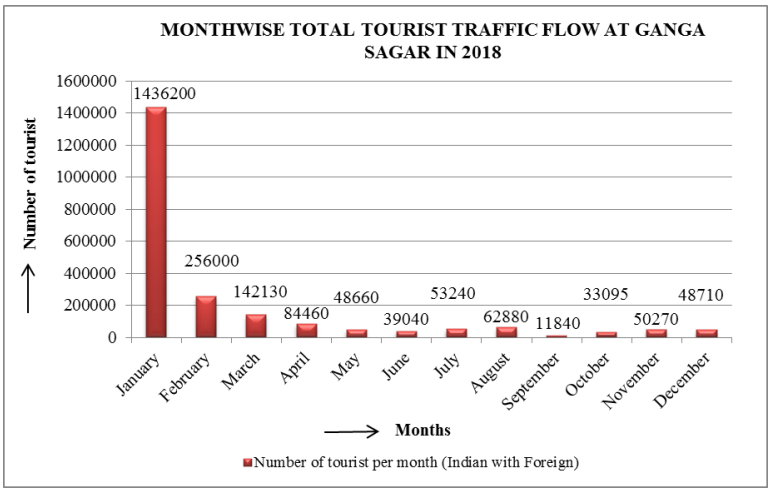


Figure 4.18c. Total Tourist Traffic flow in Sagar Island in 2018

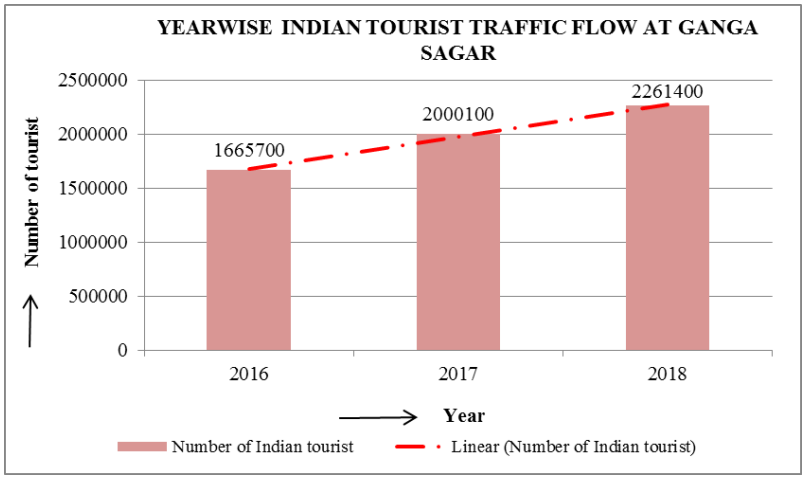


Figure 4.19a. Domestic Tourist Traffic trend in Sagar Island between 2016-2018

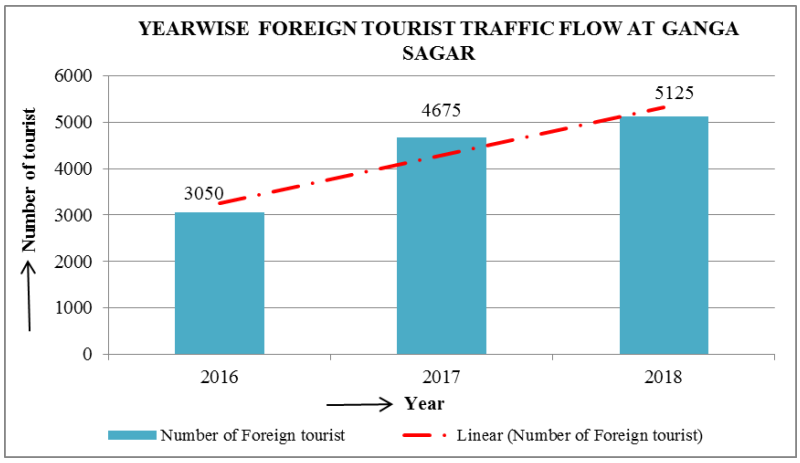


Figure 4.19b. Foreign Tourist Traffic trend in Sagar Island between 2016-2018

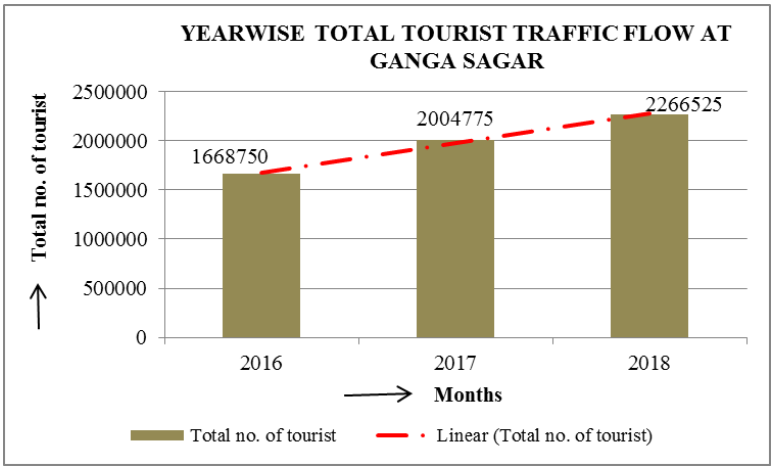


Figure 4.19c. Total Tourist Traffic trend in Sagar Island between 2016-2018

As given in table 4.20 and visually presented in figure series 4.19, there has been a rise of 20% in 2017 compared to 2016, followed by a much higher rise of 13% in 2018 compared to 2017 in total tourist

traffic volume visiting the Sagar Dwip, clearly indicating the rise in popularity of the touristic charestaristics of the area.

4.6.1.2. Demographic, Educational and Economic Profile of the Tourists:

(i) State wise tourists' inflow:

The analysis found that about 30.43% of the tourists surveyed came from Uttar Pradesh, because of proximity and the coincidence of the survey period with the winter season and most vital time for 'Makarsankranti' or Ganga Sagar Mela (GSM), therefore, many devotees from different parts of India gather. In terms of inflow Uttar Pradesh has been followed by Bihar, Uttarakhand, West Bengal, Maharastra, Orisa, Himachal Pradesh etc. (Figure 4.20a).

(ii) Age-sex composition:

Age groups are categorised as per age of tourist and examine the nature of tourist as per gender wise and interested age categorised population. Among the surveyed male tourists population, 75.45% are belonging to 40 to 60 age group followed by more than 60 (20.00%) and 20 to 40 (4.55%). Among the surveyed female tourist population about 75.00% due to age group the 40 to 60, followed by more than 60 (21.43%) and 20 to 40 (3.57%). There is a predominance of all groups between the ages of 40 to 60 which may be due to the preferred attitude of tourists to travel with their aged family members (Figure 4.20b).

Table 4.21 District-wise percentage (%) shear of the surveyed tourist in Sagar Island

SL No.	State	Percentage (%) of tourist
1	Assam	2.90
2	Bihar	13.04
3	Chhattisgarh	4.35
4	Gujarat	0.72
5	Himachal Pradesh	6.52
6	Jharkhand	3.62
7	Madhya Pradesh	2.17
8	Maharastra	6.52
9	Odisha	6.52
10	Rajasthan	3.62
11	Uttar Pradesh	30.43
12	Uttrakhand	12.32
13	West Bengal	7.25

Source: Primary surveyed data

Table 4.22 Gender composition of the surveyed tourist in Sagar Island

Age group	Percentage (%) of male	Percentage (%) of female
>60	20.00	21.43
40 – 60	75.45	75.00
20 – 40	4.55	3.57
<20	0.00	0.00

Source: Primary surveyed data

(iii) The male-female ratio of the tourists surveyed in Sagar was about 112:26, that is 56:13 almost 4:1 though there was a large dominance of male tourists.

(iv) Marital status:

Regarding the marital status of the surveyed tourists, it has been found that about 94.93% of them were married and the rest (5.07%) are unmarried (Figure 4.20c).

Table 4.23 Marital status of the surveyed tourist in Sagar Island

Marital status	Male	Female	Total	Percentage (%) of tourists
Married	105	26	131	94.93
Unmarried	7	0	7	5.07

Source: Primary surveyed data

(v) Educational profile:

The educational status of the tourists shows a larger spectrum ranging from secondary level to graduate to postgraduate to technical education. Among the tourists 30.43% & 31.88% were found as both below secondary level and secondary level while 22.46% were higher secondary level; 15.22% were having graduated (Figure 4.20d).

Table 4.24 Educational status of the surveyed tourist in Sagar Island

Educational status	Male	Female	Total	Percentage (%) of tourists
Below Secondary level	22	20	42	30.43
Secondary level	41	3	44	31.88
Higher Secondary level	30	1	31	22.46
Graduate	19	2	21	15.22
Post Graduate	0	0	0	0.00
Technical	0	0	0	0.00

Source: Primary surveyed data

(vi) Employment status:

Among the tourists surveyed, it was about 25.36% were Business person; followed by House-wife (18.12%); Self-employee (18.12%); Unemployed (11.59%); Govt. Employee (10.87%) and Retired person (4.35%) (Figure 4.20e).

Table 4.25 Employment status of the surveyed tourist in Sagar Island

Employment status	Total No.	Percentage (%) of tourist
Business	35	25.36
Farmer	0	0.00
Govt. Employee	15	10.87
House Wife	25	18.12
Private Employee	16	11.59
Retired	6	4.35
Self - Employee	25	18.12
Student	0	0.00
Unemployed	16	11.59

Source: Primary surveyed data

(vii) Economic Profile:

On the basis of monthly income of tourists are again classified onto 5 groups (Table 4.33) in which the dominance of lower-middle income group people has been found (Figure 4.20f).

Table 4.26 Economic profile of the surveyed tourist in Sagar Island

Range of Income (INR)	Total no.	Percentage (%) of tourist
<5000	0	0.00
5000 – 10,000	6	4.35
10,000 – 15,000	63	45.65
15,000 – 20,000	52	37.68
>20,000	17	12.32

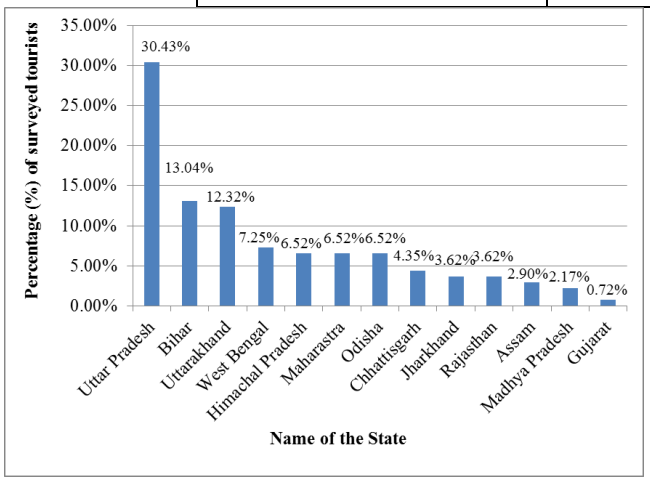


Figure 4.20a. District-wise arrival tourists in Sagar Island

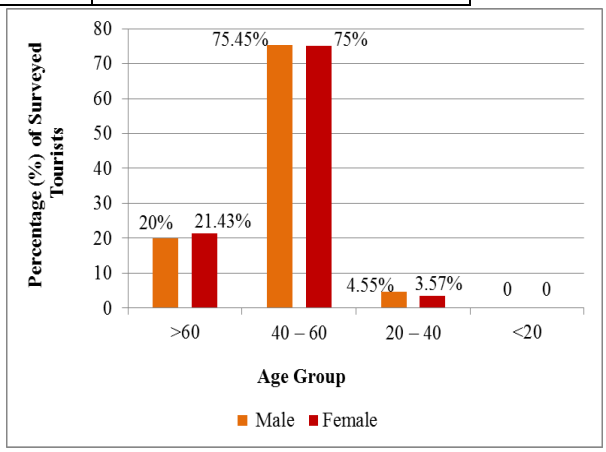


Figure 4.20b. Age-sex composition of tourists in Sagar Island

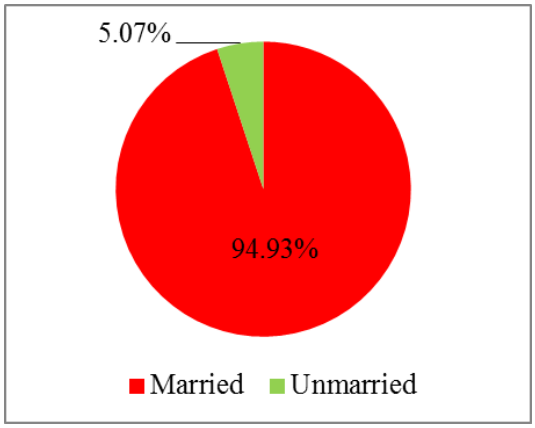


Figure 4.20c. Marital status of tourists in Sagar Island

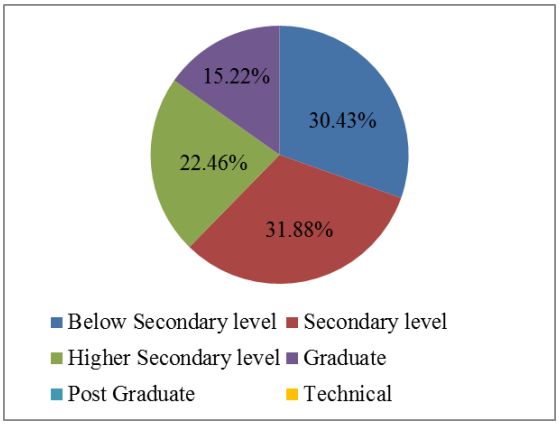


Figure 4.20d. Educational status of tourists in Sagar

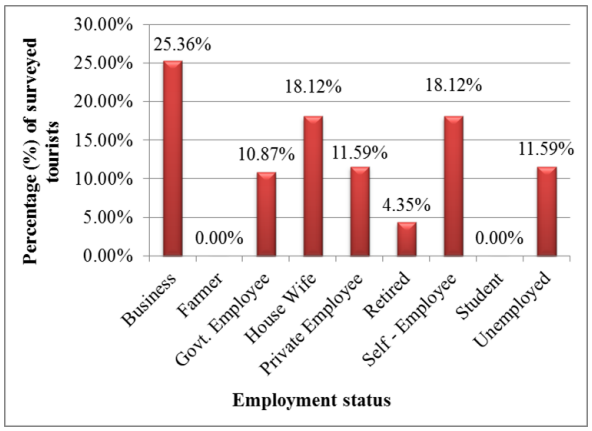


Figure 4.20e. Employment status of tourists in Sagar Island

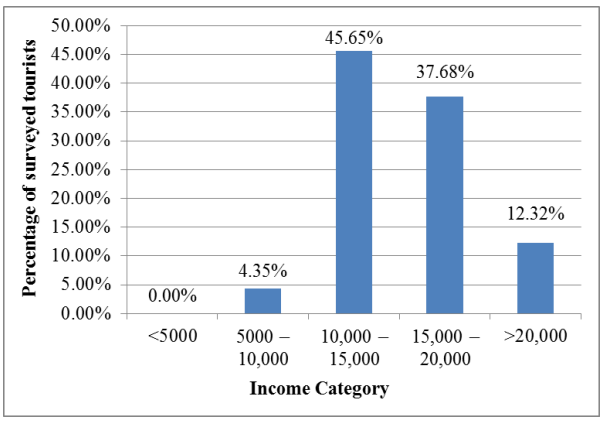


Figure 4.20f. Economic status of tourists in Sagar Island

4.6.1.3. Particulars about the tour

(i) Out of the tourists visiting Ganga Sagar, it has been found that about 73% of them are coming directly from their hometown while only 27% are coming via other tourist sports.

(ii) About 44.20% of the tourists has been organised their tours by themselves starting from tour planning, and hotel booking to sightseeing while 55.80% had come on a package tour, Which means it comes through a tour operator or travel agency (Table 4.27).

Table 4.27 Tour organization of the surveyed tourist in Sagar Island

Tour organised	Percentage (%) of tourist
Self-organised	44.20
Tour operator/Travel Agency	55.80

Source: Primary surveyed data

(iii) Regarding the factors for preferring of tourist spots; it has been found that Religious reasons (Table 4.28) is the dominant factor followed by Sea beach (12.32%), Scenic beauty (5.80%), Bio-diversity enriched spot (4.35) and Rest & relaxation (3.62) etc. (Figure 4.21a).

Table 4.28 Factors for preferring of the surveyed tourist in Sagar Island

Causes of visit	Percentage (%) of tourist
Rest & relaxation	3.62
Local socio economic cultural	0.00
Home stay	0.00
Sports & recreation	0.00
Biodiversity enriched spot	4.35
Sea beach	12.32
Scenic beauty	5.80
Religious reasons	73.91
Boat riding	0.00
Wild Animal Park	0.00

Source: Primary surveyed data

(iv) Among the tourists surveyed, it was about 72.46% were visited less than two times; followed by 2 to 3 times (23.19%) and more than three times about 4.35% (Figure 4.21b).

Table 4.29 Frequency of visit of the surveyed tourist in Sagar Island

Frequency of visit	Percentage (%) of tourist
<2	72.46
2 - 3	23.19
>3	4.35

Source: Primary surveyed data

(v) Regarding the length of stay, it has been seen that most of the tourists prefer to stay maximum for one night in Ganga Sagar (Table 4.30 & Figure 4.21c).

Table 4.30 Duration of stay for the surveyed tourist in Sagar Island

No. of days	Percentage (%) of tourist
One night	67.39
Two night	32.61
Three night	0.00

Source: Primary surveyed data

(vi) Regarding the mode of journey it has been found that about 70% tourists/pilgrims travelled by private car, bus, Tata Sumo and other transport while 30% tourists used by public transport.

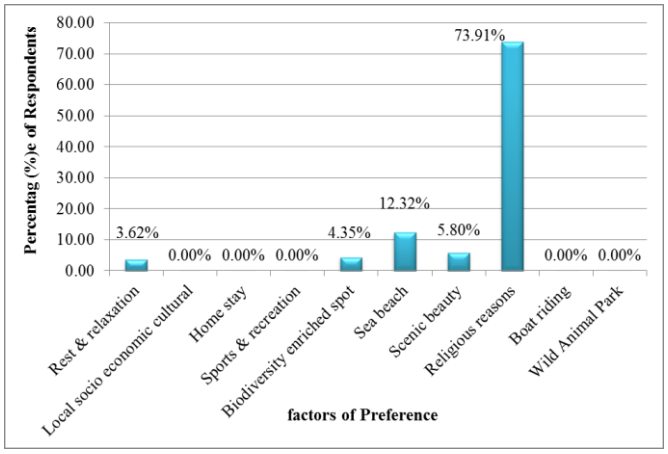


Figure 4.21a. Factors of preference for Sagar Island

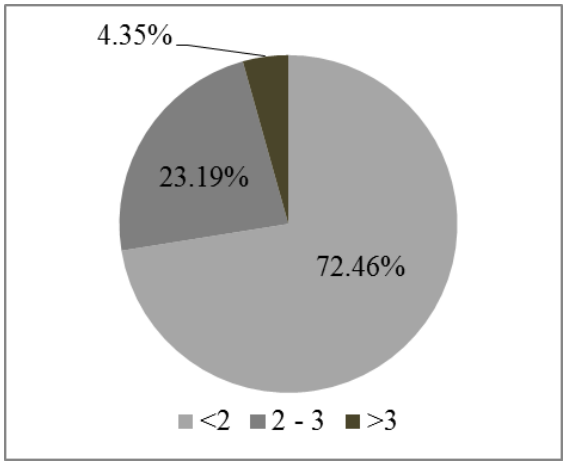


Figure 4.21b. Frequency of visit of tourists in Sagar Island

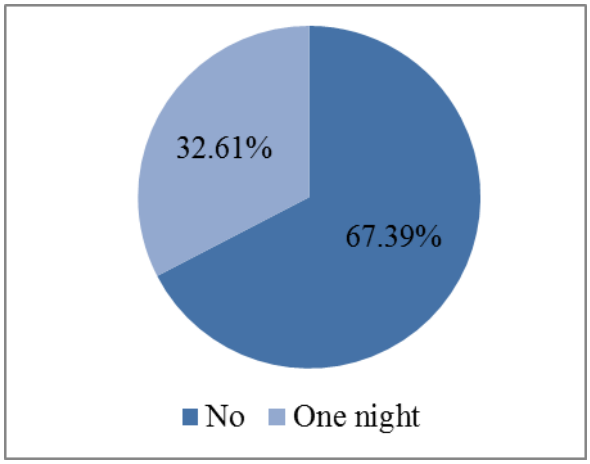


Figure 4.21c. Duration of stay of tourists in Sagar Island

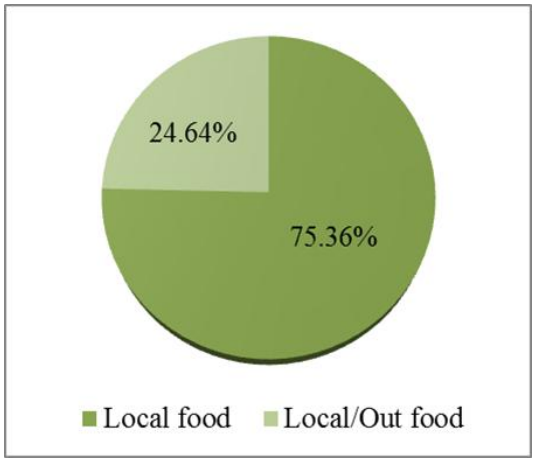


Figure 4.21d. Food preference of tourists in Sagar

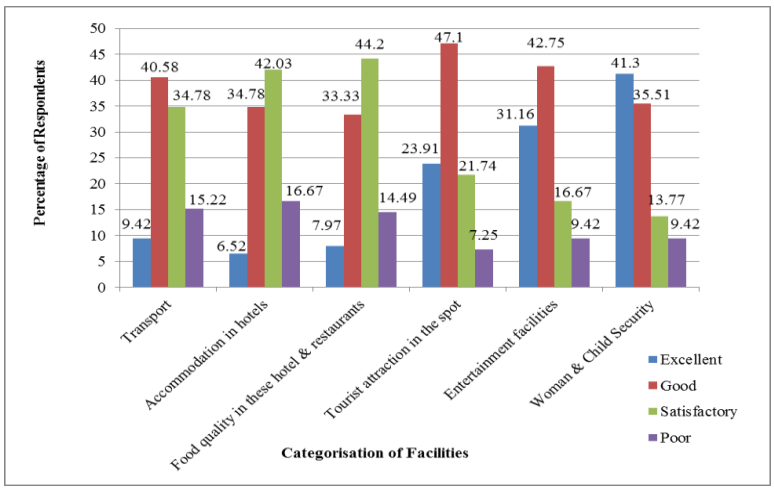


Figure 4.21e. Categorisation of facilities level of satisfaction

(vii) According to 40.58% of the surveyed tourists/pilgrims, the condition of the road is good, 34.78% said satisfactory and only 15.22% said that the road condition is poor. While 9.42% said that the transport condition is excellent (Figure 4.21e).

(viii) Regarding the accommodation in hotel and homestay, 42.03% of surveyed tourists the condition of accommodation is satisfactory, 34.78% said good and only 16.67% of tourists said that the hotel accommodation is poor, while 6.52% of tourists/pilgrims said that the accommodation condition is excellent (Figure 4.21e).

(ix) About the hotels they were staying in have opined differently regarding the standard of food, water, and sanitation, etc. 44.20% surveyed tourists/pilgrims said that is satisfactory whereas almost 33.33% & 14.49% of tourists/pilgrims said good and poor. But the little volume of tourists (7.97%) said that the food quality is excellent (Figure 4.21e).

(x) Regarding the tourist attraction in the spot, 47.10% of tourists replied that is good, 23.91% and 21.74% of surveyed tourists/pilgrims said that is excellent and satisfactory. While only 7.25% of tourists/pilgrims said that is poor (Figure 4.21e).

(xi) About the 42.75% of surveyed tourists/pilgrims said that the entertainment facilities are good, whereas 9.42% of tourists said that it is poor (Figure 4.21e).

(xii) About the 41.30% and 35.51% of surveyed tourists clearly feedback that woman & child security is excellent and good in the Ganga Sagar region. While only 9.42% of tourists/pilgrims said that is poor (Figure 4.21e).

Table 4.31 Facilities analysis on the level of satisfaction

Facilities	Satisfaction level (%)			
	Excellent	Good	Satisfactory	Poor
Transport	9.42	40.58	34.78	15.22
Accommodation in hotels	6.52	34.78	42.03	16.67
Food quality in these hotel & restaurants	7.97	33.33	44.20	14.49
Tourist attraction in the spot	23.91	47.10	21.74	7.25
Entertainment facilities	31.16	42.75	16.67	9.42
Woman & Child Security	41.30	35.51	13.77	9.42

Source: Primary surveyed data

Table 4.32 Food preference of surveyed tourist in Sagar Island

Food Preference	Percentage (%) of Tourist
Local food	75.36
Local food & out food	24.64
Out food	0.00

Source: Primary surveyed data

(xiii) Regarding the types of food, almost 75.36% tourists preferred local food. While only 24.64% surveyed tourists/pilgrims said that they are liked both local & out food (Fig. 4.21d).

4.6.2. Bakkhali:

4.6.2.1. Tourists profile of Bakkhali:

Bakkhali is a beautiful beach in West Bengal, which attracts tourists in a special way. Frazerganj and Henry Island, which are adjacent to Bakkhali, are also part of Bakkhali Tourism and many local as well as foreign tourists, flock to enjoy the beautiful view of the sea from each place. It is clear from the following figures that domestic tourists have been flocking to almost all the months of the year. However, the highest number of tourists is seen in July because in the tropical monsoon climate, domestic tourists flock to enjoy the beauty of the sea from the coast during the rainy season. But usually the influx of foreign tourists is seen in July, August and September, these three months of the year. May and June are the two months when foreign tourists do not come.

Table 4.33 Number of Tourists (Indian with Foreign) in Bakkhali during 2016 - 2018

Year	Bakkhali					
	Number of Indian tourists (in Thousands)	Rate of growth (%)	Number of Foreign tourists (in Thousands)	Rate of growth (%)	Number of total tourists (in Thousands)	Overall growth rate (%)
	A	a	B	b	C = (A + B)	D
2016	203.8		1.01		204.81	
2017	239.6	**17.57**	1.23	**21.78**	240.83	**17.59**
2018	258.4	**7.85**	1.296	**5.37**	259.696	**7.83**

Source: Dept. of Tourism, Govt. of West Bengal

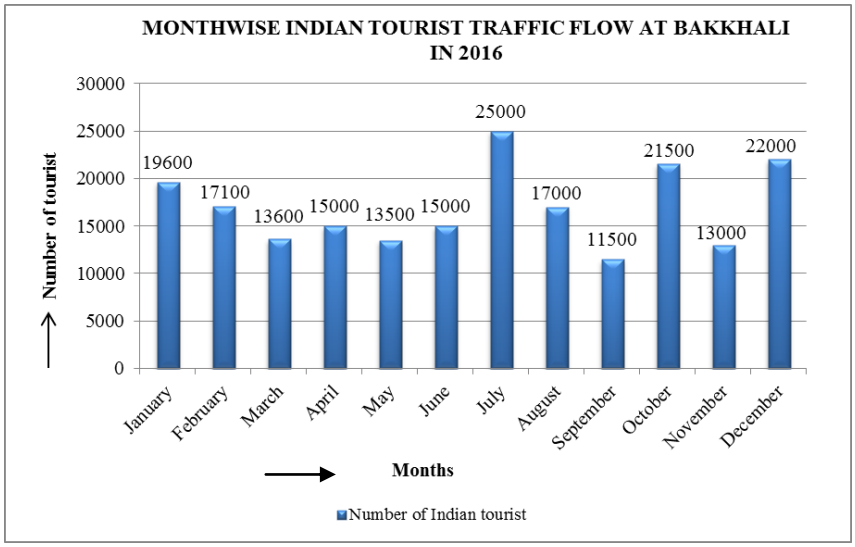


Figure 4.22a. Domestic Tourist Traffic flow in Bakkhali in 2016

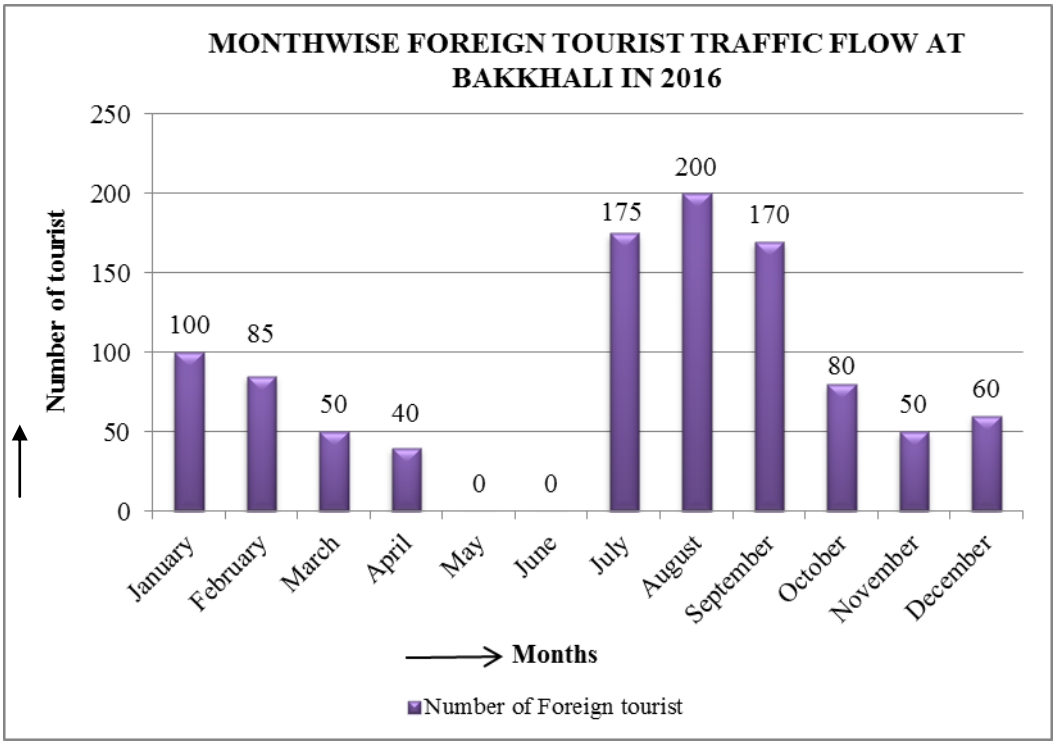


Figure 4.22b. Foreign Tourist Traffic flow in Bakkhali in 2016

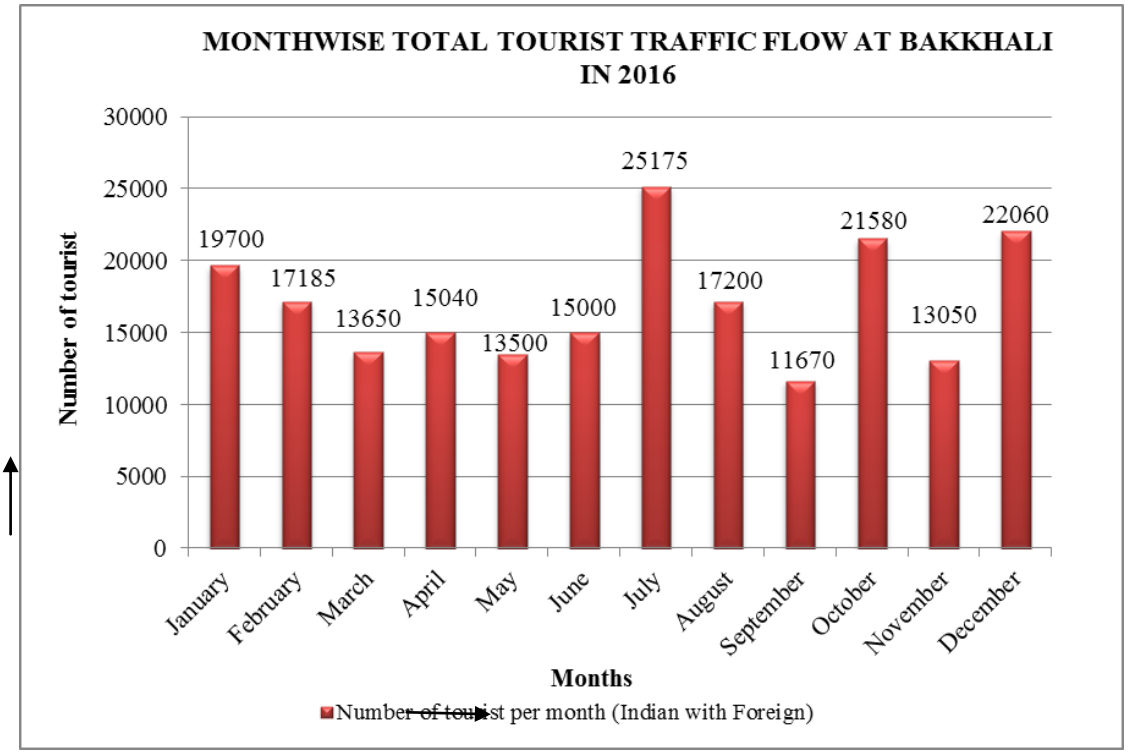


Figure 4.22c. Total Tourist Traffic flow in Bakkhali in 2016

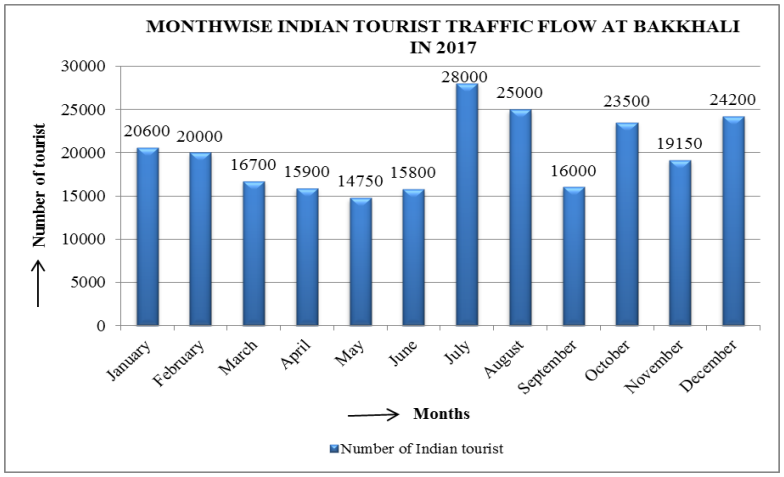


Figure 4.23a. Domestic Tourist Traffic flow in Bakkhali in 2017

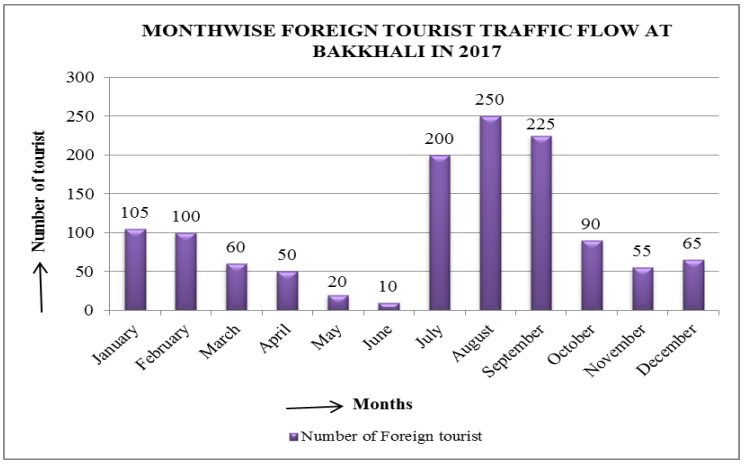


Figure 4.23b. Foreign Tourist Traffic flow in Bakkhali in 2017

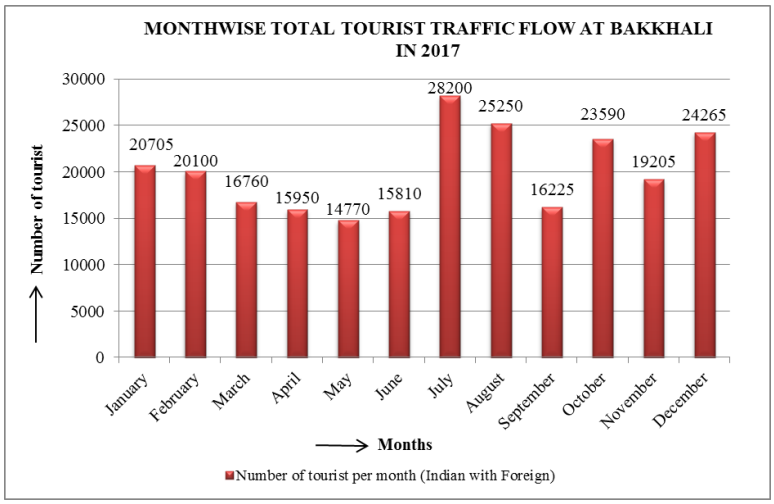


Figure 4.23c. Total Tourist Traffic flow in Bakkhali in 2017

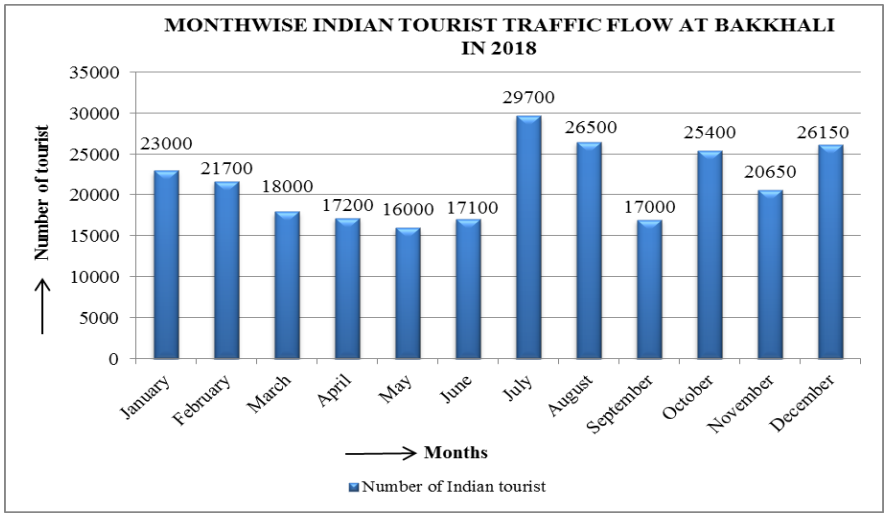


Figure 4.24a. Domestic Tourist Traffic flow in Bakkhali in 2018

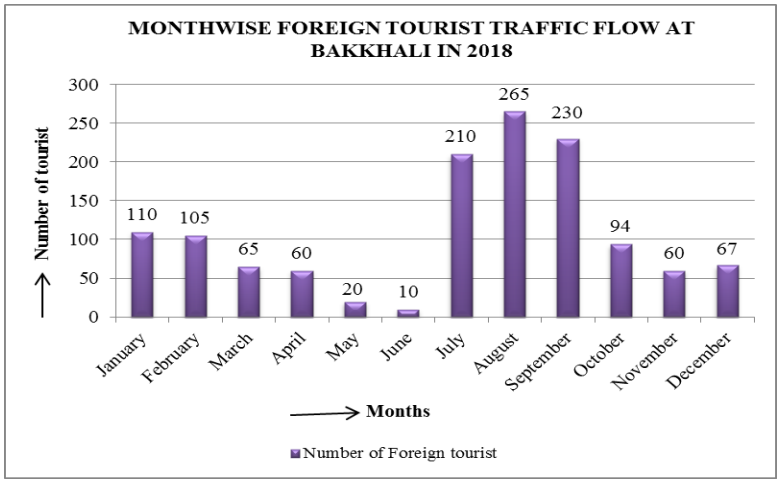


Figure 4.24b. Foreign Tourist Traffic flow in Bakkhali in 2018

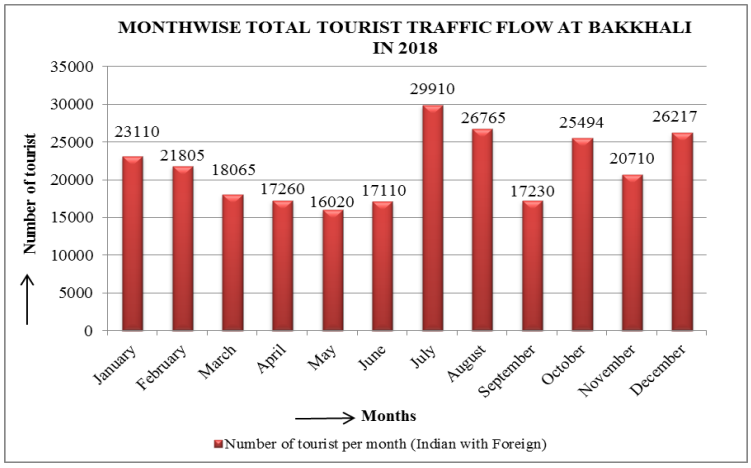


Figure 4.24c. Total Tourist Traffic flow in Bakkhali in 2018

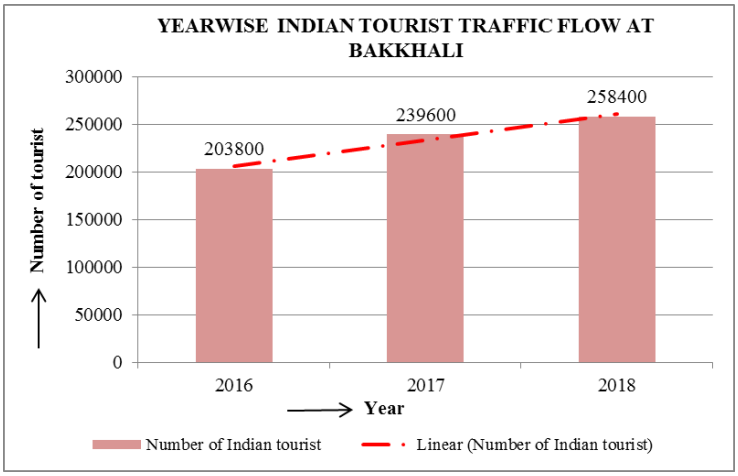


Figure 4.25a. Domestic Tourist Traffic trend in Bakkhali between 2016-2018

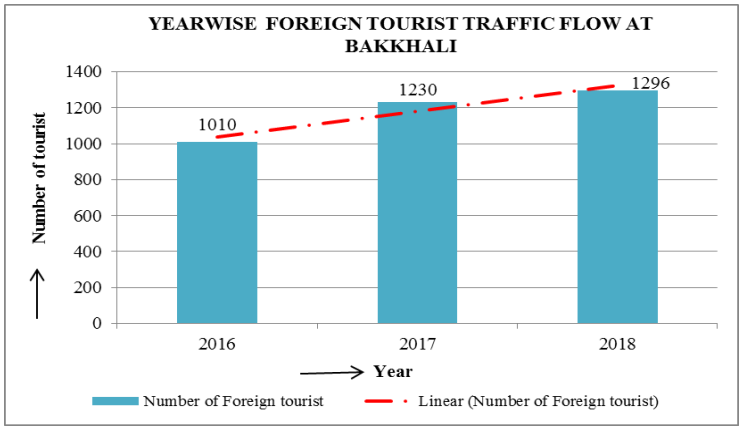


Figure 4.25b. ForeignTourist Traffic trend in Bakkhali between 2016-2018

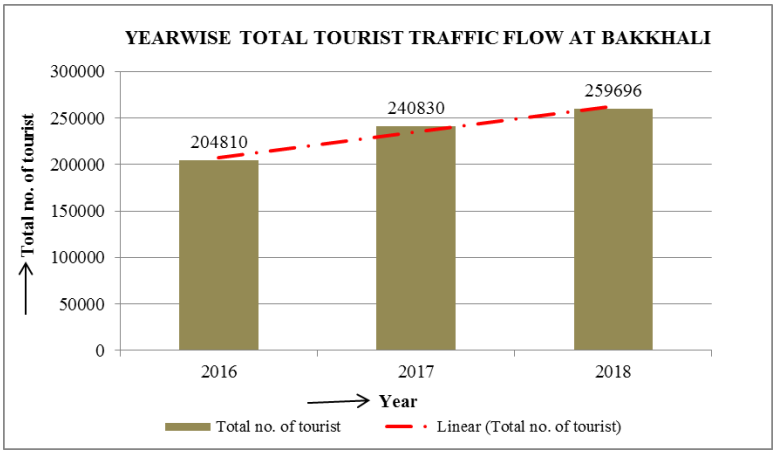


Figure 4.25c. Total Tourist Traffic trend in Bakkhali between 2016-2018

As given in Table 4.33 and visually presented in figure series 4.25, there has been a rise of 17.59% in 2017 compared to 2016, followed by a much higher rise of 7.83% in 2018 compared to 2017 in total tourist traffic volume visiting the Gosaba block, clearly indicating the rise in popularity of the touristic characteristics of the area.

4.6.2.2. Demographic, Educational, and Economic Profile of the Tourists:

(i) District-wise tourists' inflow:

The analysis found that about 26.81% of the tourists surveyed came from Kolkata and 16.67% of tourists came from South Twenty-four Parganas, as comfortable travel takes place in a very short time and short distances. In terms of inflow Kolkata and South 24 Parganas have been followed by Howrah, North 24 Parganas, Purba Medinipur, Hooghly, Paschim Medinipur, Malda, Murshidabad, Nadia, Birbhum, Puruliya, Purba Bardhaman, Paschim Bardhaman, and Bankura are much lesser in number might be explained by the distance decay factor (Figure 4.26a).

(ii) Age-sex composition:

Age groups are categorised as per age of tourist and examine the nature of tourist as per gender-wise and interested age categorised population. Among the surveyed male tourists population, 77.55% are belonging to the 20 to 40 age group followed by 40 to 60 (18.37%) and more than 60 (4.08%). Among the surveyed female tourist population about 70.00% due to the age group 20 to 40, followed by 40 to 60 (30.00%). There is a predominance of all groups between the ages of 20 and 40 which may be due to the preferred attitude of tourists to travel with their whole family (Figure 4.26b).

Table 4.34 District-wise percentage (%) shear of the surveyed tourist in Bakkhali

SL. No	District	Percentage (%) of tourist
1	Bankura	0.72
2	Birbhum	2.90
3	Hoogly	5.07
4	Howrah	13.04
5	Kolkata	26.81
6	Malda	3.62
7	Murshidabad	3.62
8	Nadia	3.62
9	North 24 Parganas	6.52
10	Paschim Bardhaman	2.17
11	Paschim Medinipur	4.35
12	Purba Bardhaman	2.17
13	Purba Medinipur	6.52
14	Purulia	2.17
15	South 24 Parganas	16.67

Source: Primary surveyed data

Table 4.35 Gender composition of the surveyed tourist in Bakkhali

Age group	Percentage (%) of male	Percentage (%) of female
>60	4.08	0.00
40 – 60	18.37	30.00
20 – 40	77.55	70.00
<20	0.00	0.00

Source: Primary surveyed data

(iii) The male-female ratio of the tourists surveyed in Bakkhali was about 98:40, that is 49:20 almost 2:1 though there was a little dominance of male tourists.

(iv) Marital status:

Regarding the marital status of the surveyed tourists, it has been found that about 57.25% of them were married and the rest (42.75%) are unmarried (Figure 2.26c).

Table 4.36 Marital status of the surveyed tourist in Bakkhali

Marital status	Male	Female	Total	Percentage (%) of tourists
Married	52	27	79	57.25
Unmarried	46	13	59	42.75

Source: Primary surveyed data

(v) Educational profile:

Educational status of the tourists shows that a larger spectrum ranging from secondary level to graduate to post graduate to technical education. Among the tourists 27.54% & 26.09% were found as both graduate and post graduate level while 23.19% were higher secondary level; 18.84% were having secondary level and only 4.35% were having technical education (Figure 4.26d).

Table 4.37 Educational status of the surveyed tourist in Bakkhali

Educational status	Male	Female	Total	Percentage (%) of tourists
Secondary level	19	7	26	18.84
Higher Secondary level	17	15	32	23.19
Graduate	30	8	38	27.54
Post Graduate	27	9	36	26.09
Technical	5	1	6	4.35

Source: Primary surveyed data

(vi) Employment status:

Among the tourists surveyed, it was about 23.91% were Private-employee; followed by Unemployed (18.84%); Govt. employee (15.22%); House-wife (13.04%); Self-employee (11.59%); Student (9.42%); Business (5.80%) and Retired person (2.17%) (Figure 4.26e).

Table 4.38 Employment status of the surveyed tourist in Bakkhali

Employment status	Total no.	Percentage (%) of tourist
Business	8	5.80
Farmer	0	0.00
Govt. Employee	21	15.22
House Wife	18	13.04
Private Employee	33	23.91
Retired	3	2.17
Self - Employee	16	11.59

Student	13	9.42
Unemployed	26	18.84

Source: Primary surveyed data

(vii) Economic Profile:

On the basis of monthly income of tourists are again classified onto 5 groups (Table 4.39) in which the dominance of lower-middle income group people has been found (Figure 4.26f).

Table 4.39 Economic profile of the surveyed tourist in Bakkhali

Range of Income (INR)	Total no.	Percentage (%) of tourist
<5000	0	0.00
5000 – 10,000	11	7.97
10,000 – 15,000	37	26.81
15,000 – 20,000	65	47.10
>20,000	25	18.12

Source: Primary surveyed data

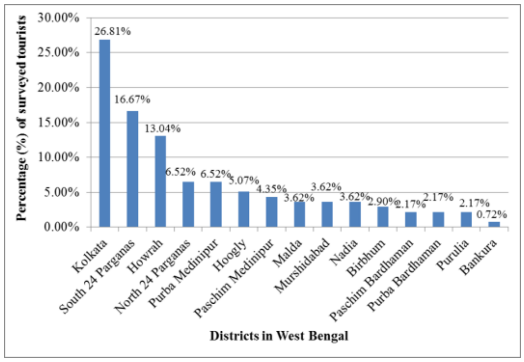


Figure 4.26a. District-wise arrival tourists in Bakkhali

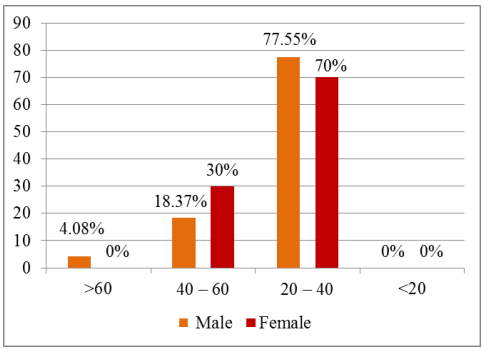


Figure 4.26b. Age-sex composition of tourists in Bakkhali

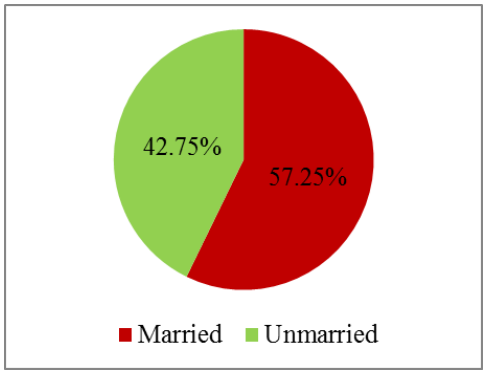


Figure 4.26c. Marital status of tourists in Bakkhali

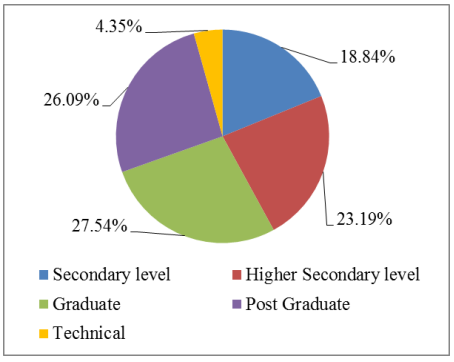


Figure 4.26d. Educational status of tourists in Bakkhali

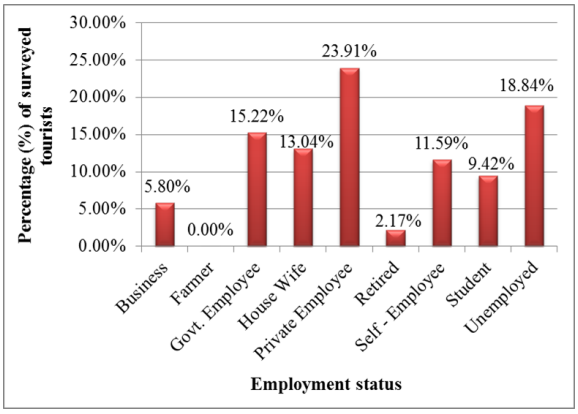


Figure 4.26e. Employment status of tourists in Bakkhali

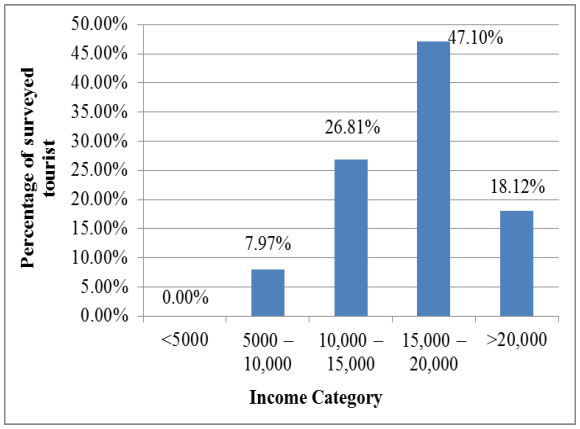


Figure 4.26f. Economic status of tourists in Bakkhali

4.6.2 3. Particulars about the tour:

(i) Out of the tourists visiting Bakkhali, it has been found that about 93% of them are coming directly from their hometown while only 7% are coming via other tourist sports.

(ii) About 36.96% of the tourists has been organized their tours by themselves starting from tour planning, and hotel booking to sightseeing while 63.04% had come on a package tour, Which means it comes through a tour operator or travel agency (Table 4.40).

Table 4.40 Tour Organization of the surveyed tourist in Bakkhali

Tour organised	Percentage (%) of tourist
Self-organised	36.96
Tour operator/Travel Agency	63.04

Source: Primary surveyed data

(iii) Regarding the factors for preferring Bakkhali as a tourist spots; it has been found that Sea beach (Table 4.41) is the dominant factor followed by Rest & relaxation (19.57%), Scenic beauty (18.84%), Wild Animal Park (10.14%) etc. (Figure 4.27a).

Table 4.41 Factors for preferring of the surveyed tourist in Bakkhali

Causes of Visit	Percentage (%) of Tourist
Rest & relaxation	19.57
Local socio economic cultural	3.62
Home stay	0.00
Sports & recreation	6.52
Biodiversity enriched spot	6.52
Sea beach	27.54
Scenic beauty	18.84

Religious reasons	0.00
Boat riding	7.25
Wild Animal Park	10.14

Source: Primary surveyed data

(iv) Among the tourists surveyed, it was about 50.00% were visited less than two times; followed by 2 to 3 times (22.46%) and more than three times about 27.54% (Figure 4.27b).

Table 4.42 Frequency of visit of the surveyed tourist in Bakkhali

Frequency of Visit	Percentage (%) of Tourist
<2	50.00
2 - 3	22.46
>3	27.54

Source: Primary surveyed data

(v) Regarding the length of stay, it has been seen that most of the tourists prefer to stay maximum for one night or two nights in Bakkhali tourism hub (Table 4.43 & Figure 4.27c).

Table 4.43 Duration of stay for the surveyed tourist in Bakkhali

No. of days	Percentage (%) of tourist
One night	49.28
Two night	42.03
Three night	8.70

Source: Primary surveyed data

(vi) Regarding the mode of journey it has been found that about 60% tourists travelled by private car, bike, Bus and other transport while 40% tourists used by public transport.

(vii) According to 44.20% of the surveyed tourists the condition of the road is good, 33.33% said excellent and only 16.67% said that the road condition is satisfactory, while 5.80% said that the transport condition is poor (Figure 4.27e).

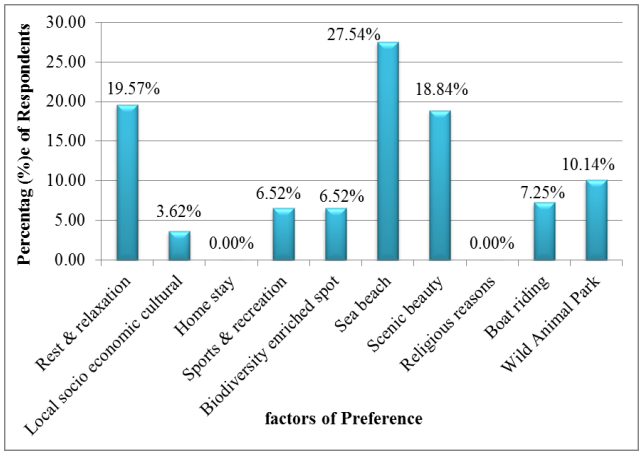


Figure 4.27a. Factors of preference for Bakkhali

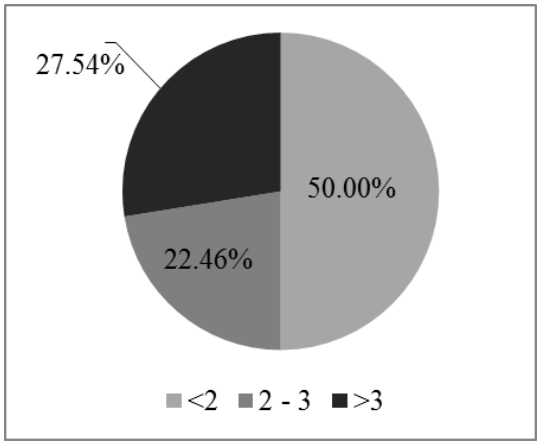


Figure 4.27b. Frequency of visit of tourists in Bakkhali

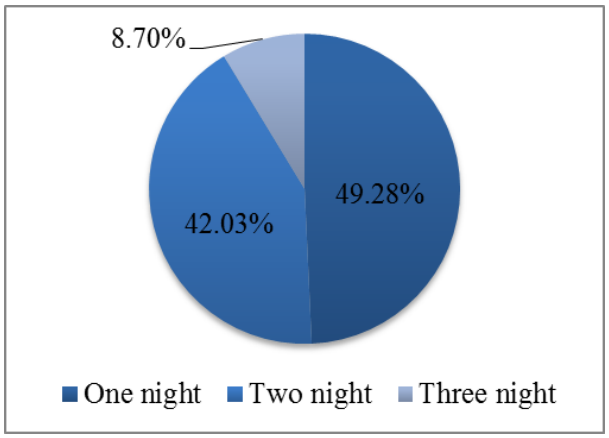


Figure 4.27c. Duration of stay of tourists in Bakkhali

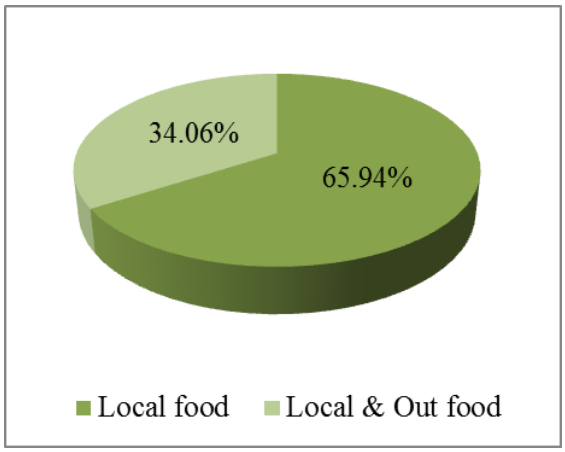


Figure 4.27d. Food preference of tourists in Bakkhali

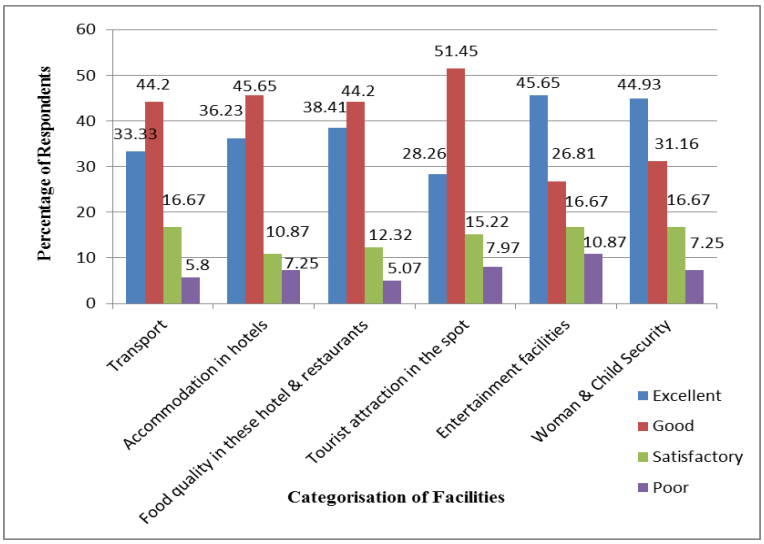


Figure 4.27e. Categorisation of facilities level of satisfaction

(viii) Regarding the accommodation in hotels and homestays, 45.65% of surveyed tourists the condition of accommodation is good, 36.23% said excellent and only 10.87% of tourists said that the hotel accommodation is satisfactory, while 7.25% said that the accommodation condition is poor (Figure 4.27e).

(ix) About the hotels they were staying in have opined differently regarding the standard of food, water, sanitation, etc. 44.20% of surveyed tourists said that is good whereas almost 38.41% and 12.32% tourists said excellent and satisfactory. But the little volume of tourists (5.07%) said that the food quality is poor (Figure 4.27e).

(x) Regarding the tourist attraction in the spot, 51.45% of tourists replied that is good, 28.26% and 15.22% of surveyed tourists said that is excellent and satisfactory. While 7.97% of tourists said that is poor (Figure 4.27e).

(xi) About 45.65% of surveyed tourists said that the entertainment facilities are excellent, whereas 10.87% of tourists said that it is poor (Figure 4.27e).

(xii) About the 44.93% and 31.16% of surveyed tourists clearly feedback that woman & child security is excellent and good in Bakkhali tourist spot. While only 7.25% of tourists said that is poor (Figure 4.27e).

Table 4.44 Facilities analysis on the level of satisfaction

Facilities	Satisfaction level (%)			
	Excellent	Good	Satisfactory	Poor
Transport	33.33	44.20	16.67	5.80
Accommodation in hotels	36.23	45.65	10.87	7.25
Food quality in these hotel & restaurants	38.41	44.20	12.32	5.07
Tourist attraction in the spot	28.26	51.45	15.22	7.97
Entertainment facilities	45.65	26.81	16.67	10.87
Woman & Child Security	44.93	31.16	16.67	7.25

Source: Primary surveyed data

Table 4.45 Food preference of surveyed tourist in Bakkhali

Food Preference	Percentage (%) of Tourist
Local food	65.94
Local food & out food	34.06
Out food	0.00

Source: Primary surveyed data

(xiii) Regarding the types of food, almost 65.94% tourists preferred local food and only 34.06% of tourists liked both local food & out food (Figure 4.27d).

4.6.3. Jharkhali:

4.6.3.1. Tourists profile of Jharkhali:

The following flow diagrams for 2016, 2017 and 2018 show that both domestic and foreign tourists visit this place. These three months of December, January and February attract more domestic tourists. This is because winter prevails in the tropical monsoon climate region, which is ideal for visiting the Sundarbans. On the other hand, December, January and February are the three months, and again in March of any year, there is a crowd of foreign tourists. During the rest of the year, due to the scorching heat of summer and heavy rains and storms during the monsoon season, the number of tourists, both domestic and foreign, gradually decreases.

Table 4.46 Number of Tourists (Indian with Foreign) in Jharkhali during 2016 - 2018

Year	Jharkhali					
	Number of Indian tourists (in Thousands)	Rate of growth (%)	Number of Foreign tourists (in Thousands)	Rate of growth (%)	Number of total tourists (in Thousands)	Overall growth rate (%)
	A	a	B	b	C = (A + B)	D
2016	52.260		.084		52.344	
2017	56.007	**7.17**	.096	**14.29**	56.103	**7.18**
2018	63.510	**13.4**	.119	**23.96**	63.629	**13.41**

Source: Dept. of Tourism, Govt. of West Bengal

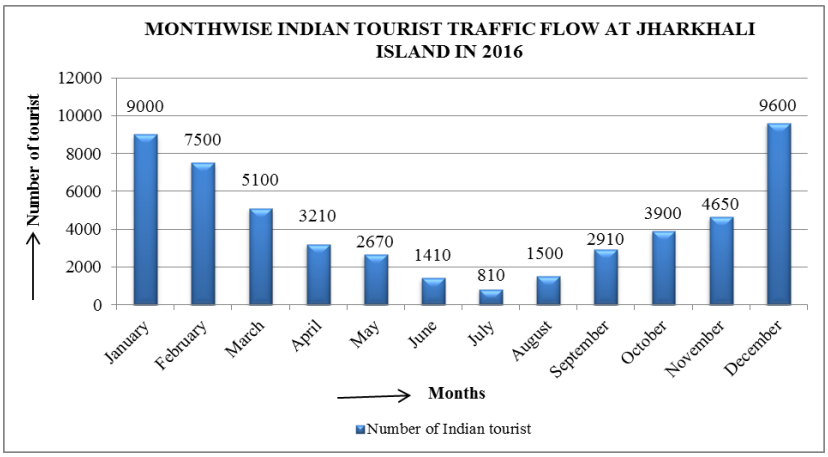


Figure 4.28a. Domestic Tourist Traffic flow in jharkhali in 2016

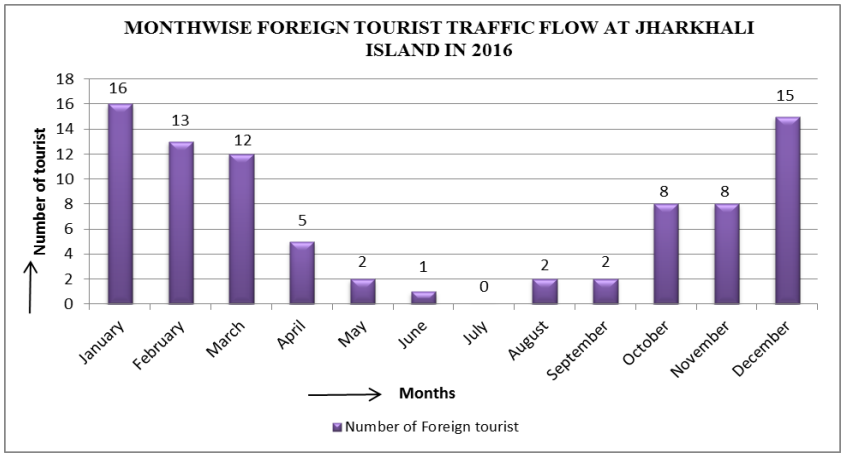


Figure 4.28b. Foreign Tourist Traffic flow in jharkhali in 2016

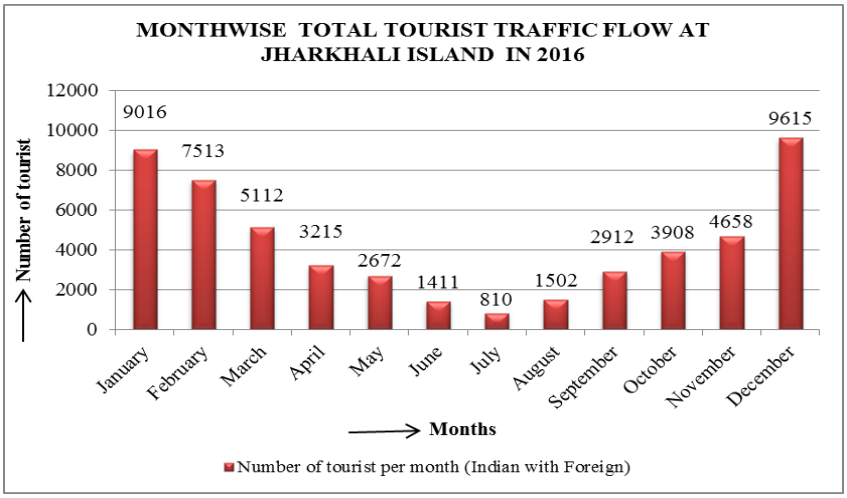


Figure 4.28c. Total Tourist Traffic flow in jharkhali in 2016

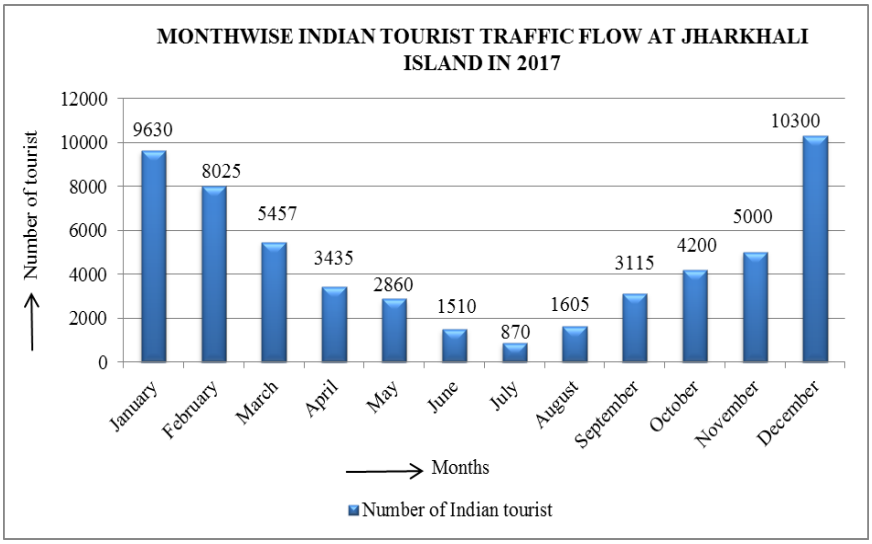


Figure 4.29a. Domestic Tourist Traffic flow in jharkhali in 2017

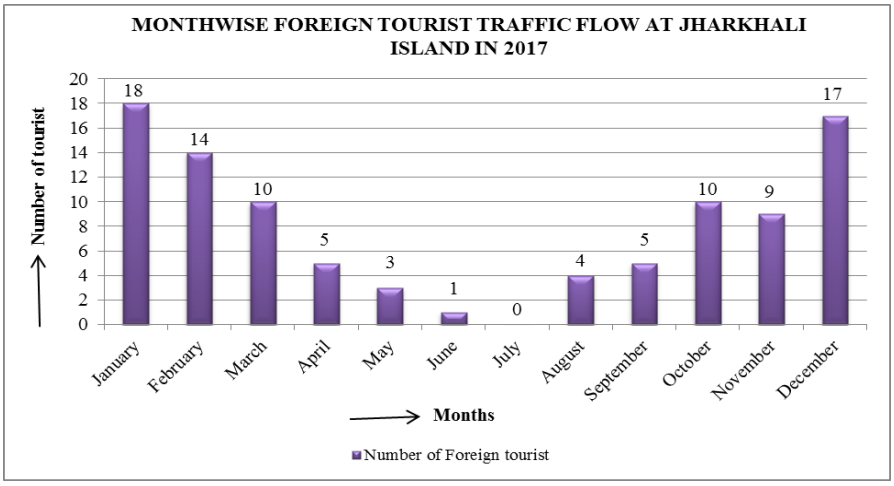


Figure 4.29b. Foreign Tourist Traffic flow in jharkhali in 2017

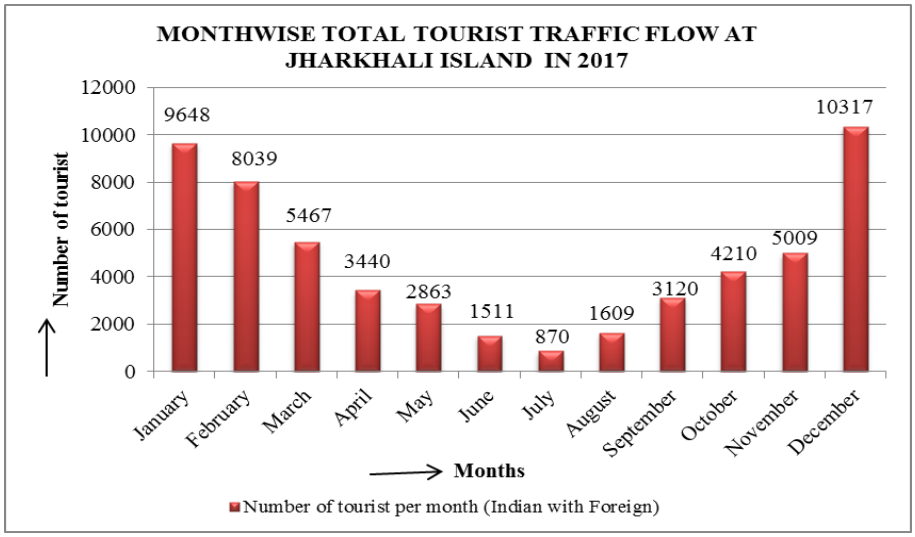


Figure 4.29c. Total Tourist Traffic flow in jharkhali in 2017

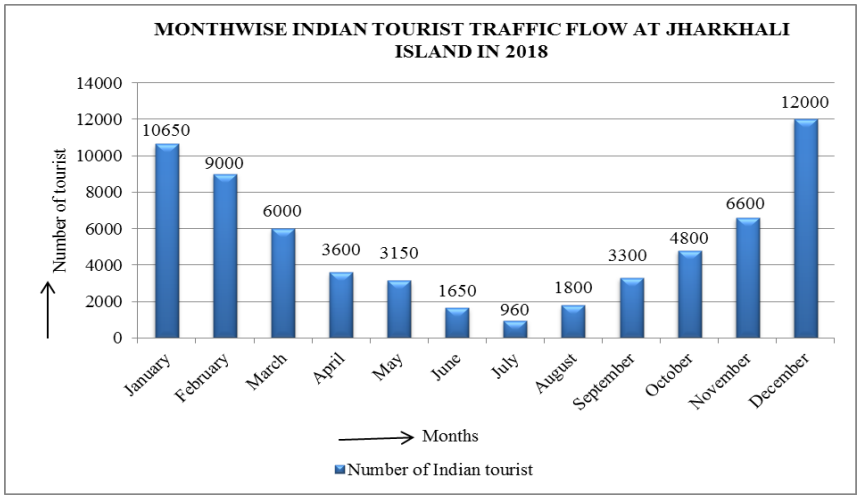


Figure 4.30a. Domestic Tourist Traffic flow in jharkhali in 2018

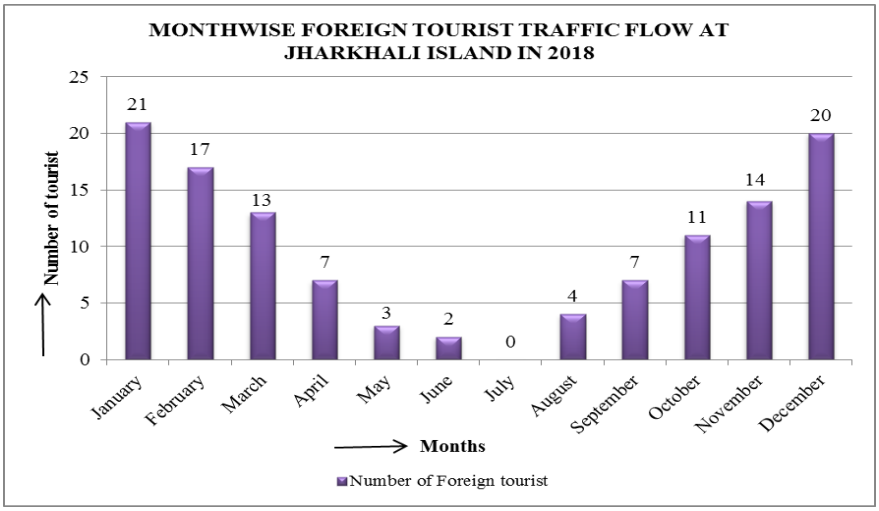


Figure 4.30b. Foreign Tourist Traffic flow in jharkhali in 2018

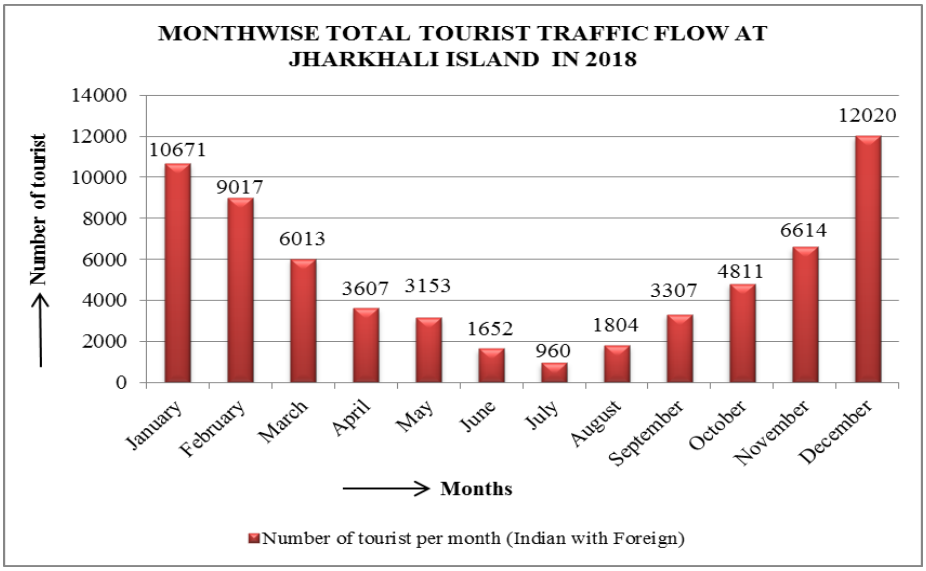


Figure 4.30c. Total Tourist Traffic flow in jharkhali in 2018

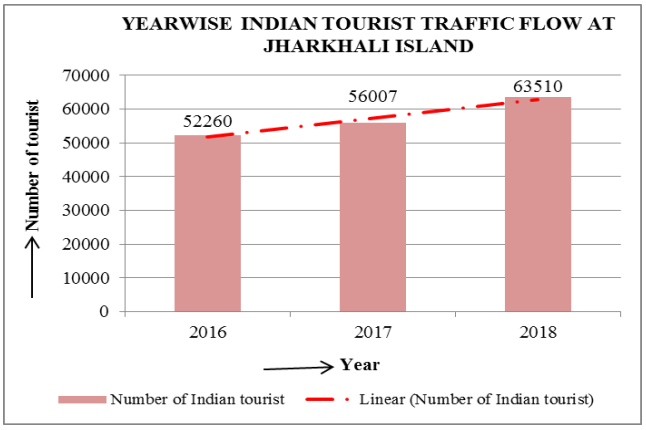


Figure 4.31a. Domestic Tourist Traffic trend in jharkhali between 2016-2018

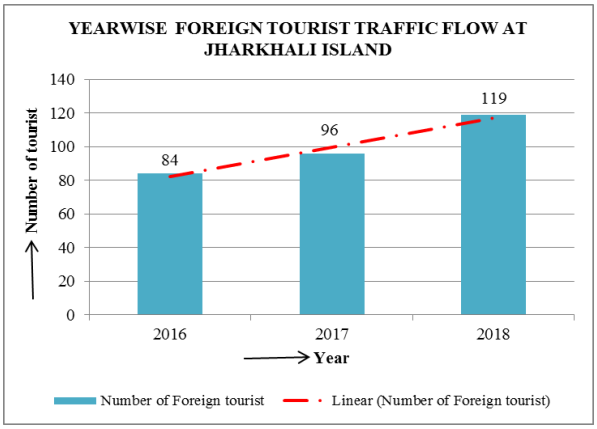


Figure 4.31b. Foreign Tourist Traffic trend in jharkhali between 2016-2018

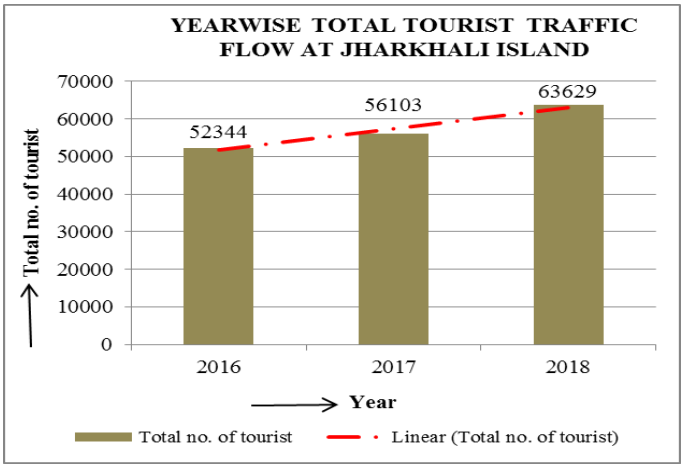


Figure 4.31c. Total Tourist Traffic trend in jharkhali between 2016-2018

As given in table 4.46 and visually presented in figure series 4.31, there has been a rise of 7.2% in 2017 compared to 2016, followed by a much higher rise of 13% in 2018 compared to 2017 in total tourist traffic volume visiting the island, clearly indicating the rise in popularity of the touristic charestaristics of the area.

4.6.3.2. Demographic, Educational and Economic Profile of the Tourists:

(i) District wise tourists' inflow:

The analysis found that about 25% of the tourists surveyed came from Kolkata and the South Twenty-four Parganas, as comfortable travel takes place in very short time and short distances. In terms of inflow Kolkata and South 24 Parganas have been followed by Howrah, North 24 Parganas, Purba Bardhaman, Nadia, Hoogly, Birbhum, Malda, Murshidabad, Paschim Bardhaman, Paschim Medinipur and Bankura are much lesser in number might be explained by the distance decay factor (Fig. 4.32a).

Table 4.47 District-wise percentage (%) shear of the surveyed tourist in Jharkhali

SL No	District	Percentage (%) of Tourists
1	Bankura	0.72%
2	Birbhum	2.90%
3	Hoogly	5.07%
4	Howrah	13.77%
5	Kolkata	24.64%
6	Malda	2.90%
7	Murshidabad	2.17%
8	Nadia	5.07%
9	North 24 Parganas	9.42%
10	Paschim Burdhaman	1.45%
11	Paschim Medinipur	1.45%
12	Purba Bardhaman	6.52%
13	South 24 Parganas	23.91%

Source: Primary surveyed data

(ii) Age-sex composition:

Age groups are categorised as per age of tourist and examine the nature of tourist as per gender wise and interested age categorised population. Among the surveyed male tourists population, 79.46% are belonging to the 20 to 40 age group followed by 40 to 60 (14.29%); more than 60 (5.36% and less than 20 (0.89%). Among the surveyed female tourist population about 84.62% due to age group 20 to 40, followed by 40 to 60 (15.38%). There is a predominance of all groups between the ages of 20 and 40 which may be due to the preferred attitude of tourists to travel with their whole family (Fig. 4.32b).

Table 4.48 Gender composition of the surveyed tourist in Jharkhali

Age Group	Percentage (%) of Male	Percentage (%) of Female
>60	5.36	0.00
40 – 60	14.29	15.38
20 – 40	79.46	84.62
<20	0.89	0.00

Source: Primary surveyed data

(iii) The male-female ratio of the tourists surveyed in Jharkhali was about 112:26, that is 56:13 almost 4:1 though there was a large dominance of male tourists.

(iv) Marital Status:

Regarding the marital status of the surveyed tourists, it has been found that about 52.90% of them were married and the rest (47.10%) are unmarried (Fig. 4.32c).

Table 4.49 Marital status of the surveyed tourist in Jharkhali

Marital Status	Male	Female	Total	Percentage (%) of Tourists
Married	57	16	73	52.90
Unmarried	55	10	65	47.10

(v) Educational Profile:

The educational status of the tourists shows a larger spectrum ranging from secondary level to graduate to postgraduate to technical education. Among the tourists 25.36% were found to both secondary level and graduate while 22.46% were higher secondary level; 17.39% were having post graduated and only 9.42% were having technical education (Fig.4.32d).

Table 4.50 Educational status of the surveyed tourist in Jharkhali

Educational Status	Male	Female	Total	Percentage (%) of Tourists
Secondary level	25	10	35	25.36
Higher Secondary level	27	4	31	22.46
Graduate	28	7	35	25.36
Post Graduate	19	5	24	17.39
Technical	13	0	13	9.42

(vi) Employment status:

Among the tourists surveyed, it was about 24.64% were Govt. employee; followed by Private-employee (17.39%); Unemployed (15.94%); Self-employee (15.22%); Student (11.59%); House-wife (7.25%); Business (3.62%); Farmer (2.17%) and Retired persion (2.17%) (Fig. 4.32e).

Table 4.51 Employment status of the surveyed tourist in Jharkhali

Employment status	Total No.	Percentage (%) of Tourist
Business	5	3.62
Farmer	3	2.17
Govt. Employee	34	24.64
House Wife	10	7.25
Private Employee	24	17.39
Retired	3	2.17
Self - Employee	21	15.22
Student	16	11.59
Unemployed	22	15.94

(vii) Economic Profile:

On the basis of monthly income of tourists are again classified onto 5 groups (Table 4.52) in which the dominance of lower-middle income group people has been found (Fig. 4.32f).

Table 4.52 Economic profile of the surveyed tourist in Jharkhali

Range of Income (INR)	Total No.	Percentage (%) of Tourist
<5000	2	1.45
5000 – 10,000	16	11.59
10,000 – 15,000	47	34.06
15,000 – 20,000	62	44.93
>20,000	11	7.97

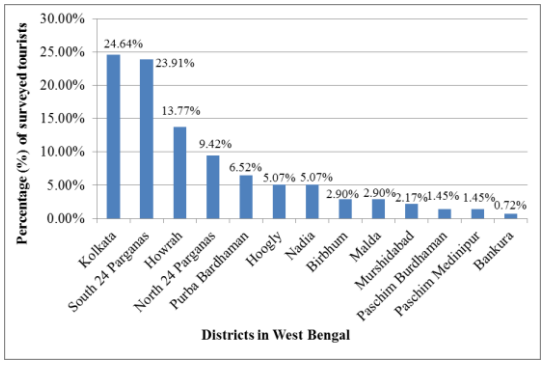


Figure 4.32a. District-wise arrival tourists in Jharkhali

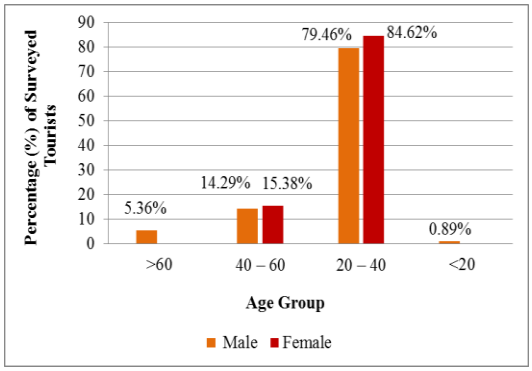


Figure 4.32b. Age-sex composition of tourists in Jharkhali

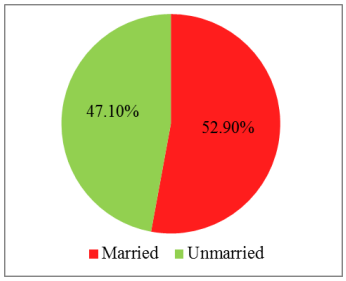


Figure 4.32c. Marital status of tourists in Jharkhali

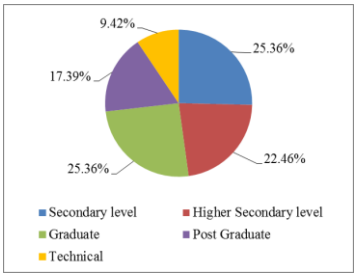


Figure 4.32d. Educational status of tourists in Jharkhali

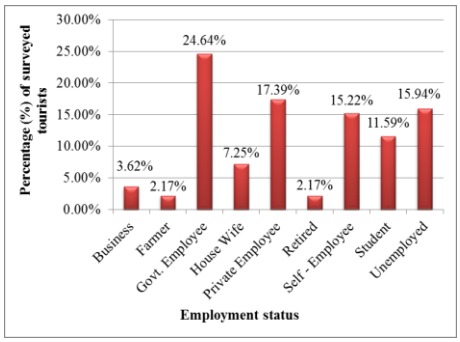


Figure 4.32e. Employment status of tourists Jharkhali

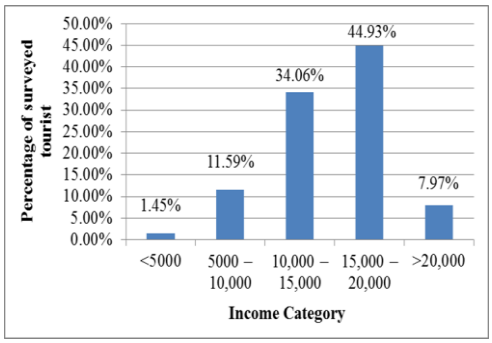


Figure 4.32f. Economic status of tourists in in Jharkhali

4.6.3.3. Particulars about the tour:

(i) Out of the tourists visiting Jharkhali, it has been found that about 27% of them are coming directly from their hometown while only 73% are coming via other tourist sports.

(ii) About 42.03% of the tourists has been organised their tours by themselves starting from tour planning, and hotel booking to sightseeing while 57.97% had come in a package tour, Which means it comes through a tour operator or travel agency (Table 4.53).

Table 4.53 Tour Organization of the surveyed tourist in Jharkhali

Tour Organised	Percentage (%) of Tourist
Self-Organised	42.03
Tour Operator/Travel Agency	57.97

(iii) Regarding the factors for preferring Jharkhali as a tourist spots; it has been found that Wild Animal Park (Table 4.54) is the dominant factor followed by Scenic beauty (18.84%), Boat riding, Biodiversity enriched spot, Rest & relaxation etc (Fig. 4.33a).

Table 4.54 Factors for preferring of the surveyed tourist in Jharkhali

Causes of Visit (Factor)	Percentage (%) of Tourist
Rest & relaxation	9.42
Local socio economic cultural	6.52
Home stay	5.07
Sports & recreation	5.07
Biodiversity enriched spot	10.87
Sea beach	0.00
Scenic beauty	18.84
Religious reasons	0.00
Boat riding	16.67
Wild Animal Park	27.54

(iv) Among the tourists surveyed, it was about 61.59% were visited less than two times; followed by 2 to 3 times (36.96%) and more than three times about 1.45% (Fig. 4.33b).

Table 4.55 Frequency of visit of the surveyed tourist in Jharkhali

Frequency of Visit	Percentage (%) of Tourist
<2	61.59
2 - 3	36.96
>3	1.45

(v) Regarding the length of stay, it has been seen that most of the tourists prefer to stay maximum for one night in Jharkhali tourism hub (Table 4.56 & Fig. 4.33c).

Table 4.56 Duration of stay for the surveyed tourist in Jharkhali

No. of Days	Percentage (%) of Tourist
No	36.96
One night	45.65
Two night	17.39

(vi) Regarding the mode of journey it has been found that about 51% tourists travelled by private car, bike, auto and other transport while 49% tourists used by public transport.

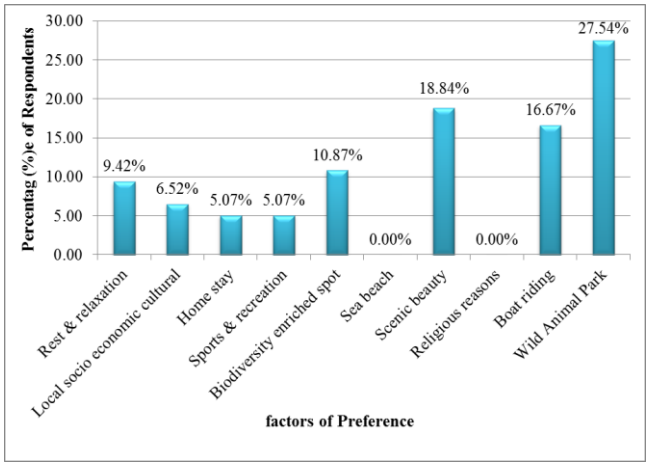


Figure 4.33a. Factors of preference for Jharkhali

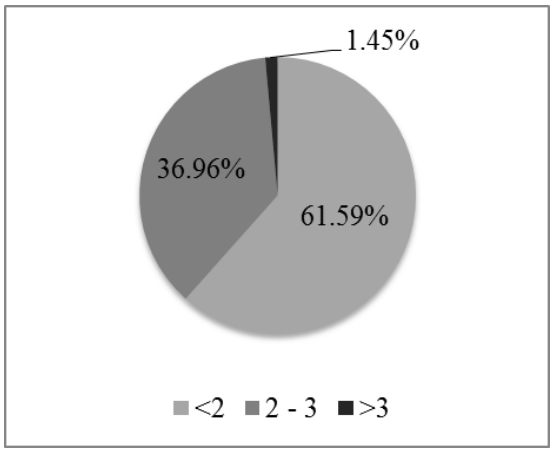


Figure 4.33b. Frequency of visit of tourists in Jharkhali

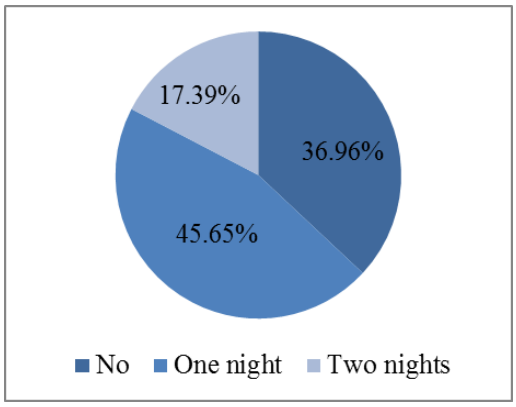


Figure 4.33c. Duration of stay of tourists in Jharkhali

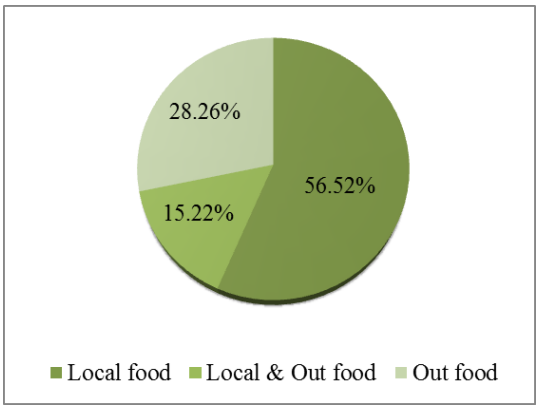


Figure 4.33d. Food preference of tourists in Jharkhali

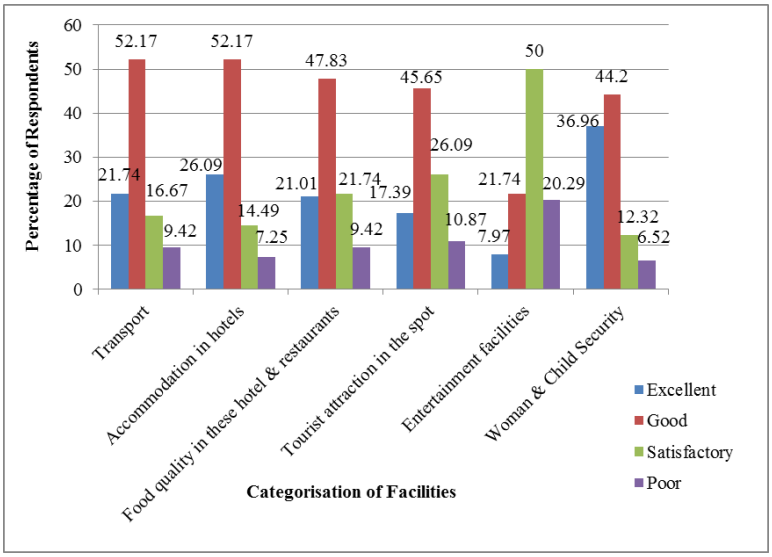


Figure 4.33e. Categorisation of facilities level of satisfaction

(vii) According to 52.17% of the surveyed tourists the condition of the road is good, 21.74% said excellent and only 16.67% said that the road condition is satisfactory, while 9.42% said that the transport condition is poor (Fig. 4.33e).

(viii) Regarding the accommodation in hotel and homestay, 52.17% of surveyed tourists the condition of accommodation is good, 26.09% said excellent and only 14.49% of tourists said that the hotel accommodation is satisfactory, while 7.25% said that the accommodation condition is poor (Fig. 4.33e).

(ix) About the hotels they were staying in have opined differently regarding the standard of food, water, sanitation, etc. 47.83% of surveyed tourists said that is good whereas almost 21% to 22% of tourists said excellent and satisfactory. But the little volume of tourists (9.42%) said that the food quality is poor (Fig. 4.33e).

(x) Regarding the tourist attraction in the spot, 26.09% of tourists replied that is satisfied, 45.65% and 17.39% of surveyed tourists said that is good and excellent. While 10.87% of tourists said that is poor (Fig. 4.33e).

(xi) About the 50.00% of surveyed tourists said that the entertainment facilities are satisfactory, whereas 20.29% of tourists said that it is poor (Fig. 4.33e). (xii) About the 44.20% and 36.96% surveyed tourists clearly feedback that woman & child security is very good and excellent in Jharkhali tourist spot. While only 6.52% tourists said that is poor (Fig. 4.33e).

Table 4.57 Facilities analysis on the level of satisfaction

Facilities	Satisfaction level (%)			
	Excellent	Good	Satisfactory	Poor
Transport	21.74	52.17	16.67	9.42
Accommodation in hotels	26.09	52.17	14.49	7.25
Food quality in these hotel & restaurants	21.01	47.83	21.74	9.42
Tourist attraction in the spot	17.39	45.65	26.09	10.87
Entertainment facilities	7.97	21.74	50.00	20.29
Woman & Child Security	36.96	44.20	12.32	6.52

Table 4.58 Food preference of surveyed tourist in Jharkhali

Food Preference	Percentage (%) of Tourist
Local food	56.52
Local food & out food	15.22
Out food	28.26

(xiii) Regarding the types of food, almost 56.52% of tourists preferred local food, and only 28.26% of tourists liked our food. While 15.22% of surveyed tourists said that they are liked both local & our food (Fig. 4.33d).

4.6.4. Gosaba (Pakhiralay and Dayapur):

4.6.4.1. Tourists profile of Gosaba:

The figure for tourist flow in the Gosaba region is similar to that in the Jharkhali region because these areas belong to the same climatic zone. The following flow diagrams for 2016, 2017, and 2018 show that both domestic and foreign tourists visit this place. These three months of December, January, and February attract more domestic tourists. This is because winter prevails in the tropical monsoon climate region, which is ideal for visiting the Sundarbans. On the other hand, December, January, and February are the three months, and again in March of any year, there is a crowd of foreign tourists. The following flow diagrams for 2016, 2017, and 2018 show that both domestic and foreign tourists visit this place. These three months of December, January, and February attract more domestic tourists. This is because winter prevails in the tropical monsoon climate region, which is ideal for visiting the Sundarbans. On the other hand, December, January, and February are the three months, and again in March of any year, there is a crowd of foreign tourists. During the rest of the year, due to the scorching heat of summer and heavy rains and storms during the monsoon season, the number of tourists, both domestic and foreign, gradually decreases.

Table 4.59 Number of Tourists (Indian with Foreign) in Sajnekhali/Sundarban during 2016 - 2018

Year	Sajnekhali/Sundarban					
	Number of Indian tourists (in Thousands)	Rate of growth (%)	Number of Foreign tourists (in Thousands)	Rate of growth (%)	Number of total tourists (in Thousands)	Overall growth rate (%)
	A	a	B	b	C = (A + B)	D
2016	296.9		8.65		305.55	
2017	334.45	**12.65**	8.304	**-4.00**	342.754	**12.18**
2018	362.77	**8.47**	9.745	**17.35**	372.515	**8.68**

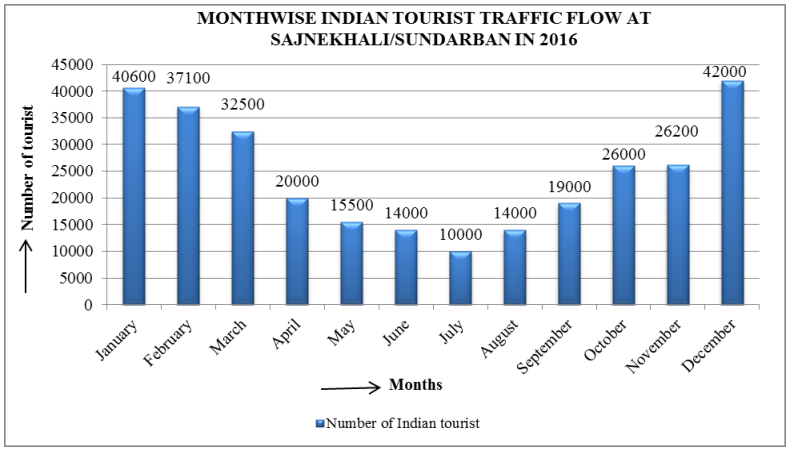


Figure 4.34a. Domestic Tourist Traffic flow in Gosaba in 2016

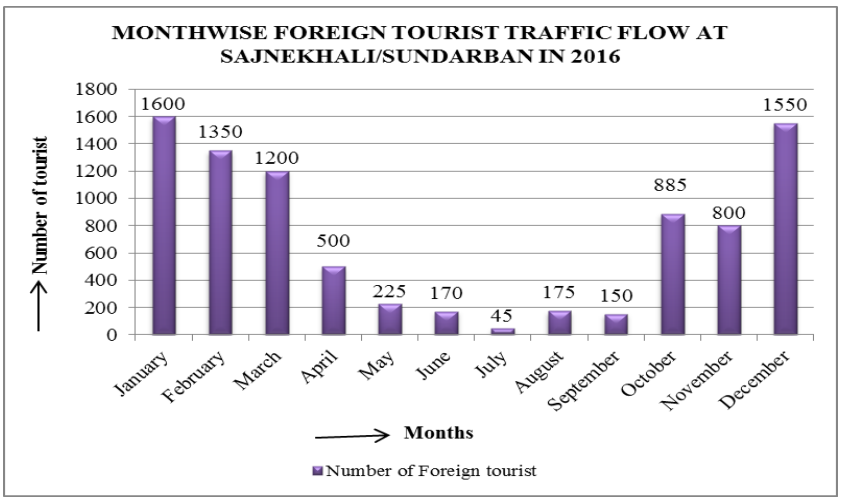


Figure 4.34b.Foreign Tourist Traffic flow in Gosaba in 2016

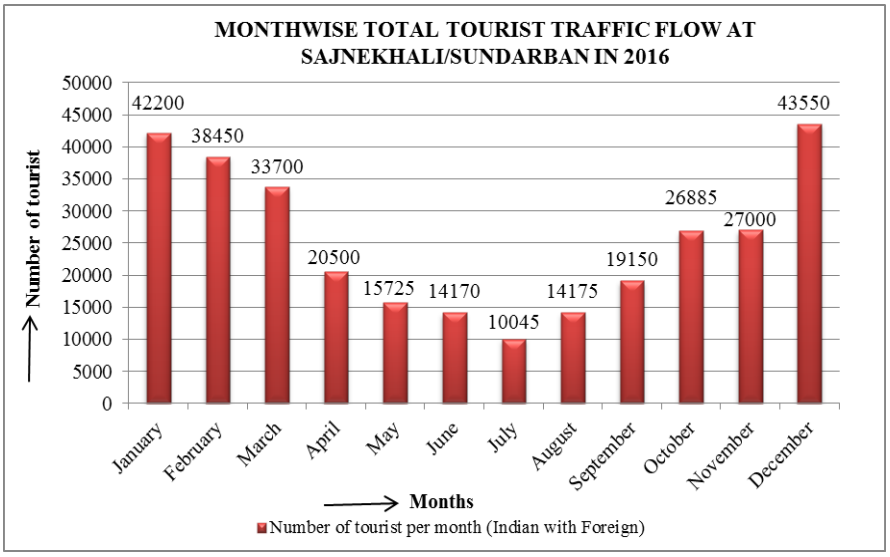


Figure 4.34c.Total Tourist Traffic flow in Gosaba in 2016

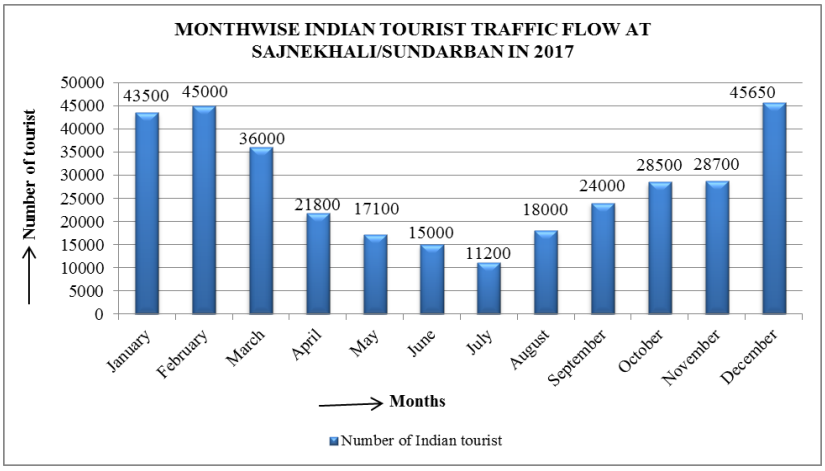


Figure 4.35a. Domestic Tourist Traffic flow in Gosaba in 2017

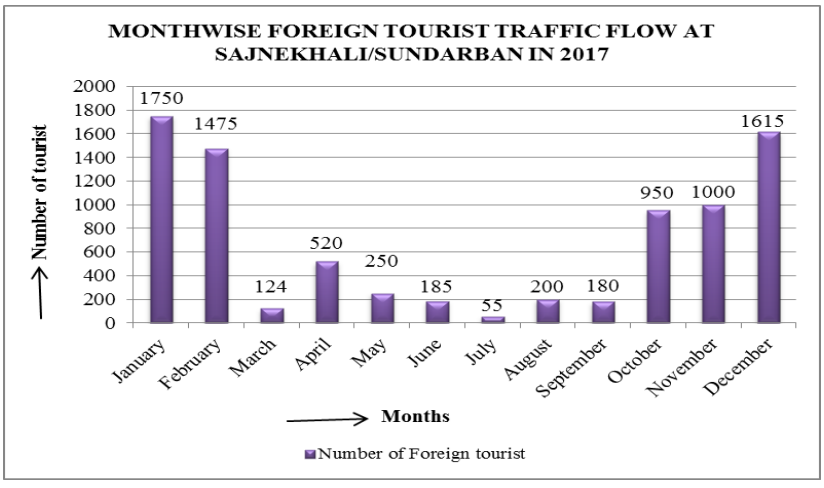


Figure 4.35b.Foreign Tourist Traffic flow in Gosaba in 2017

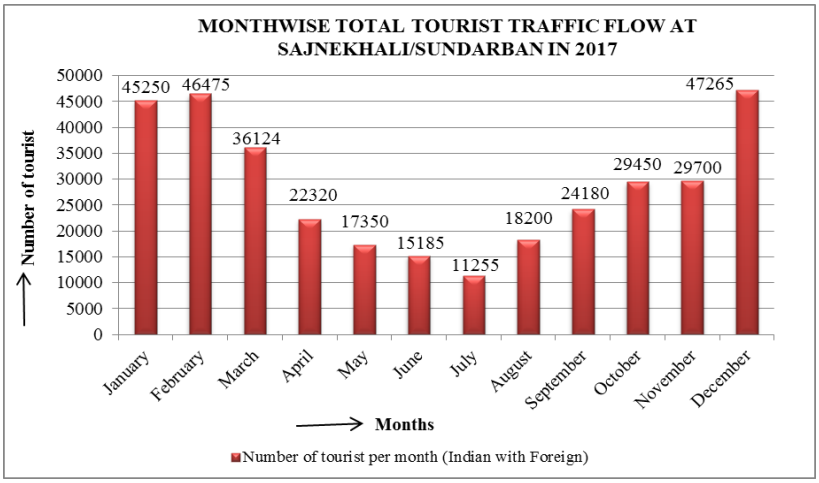


Figure 4.35c.Total Tourist Traffic flow in Gosaba in 2017

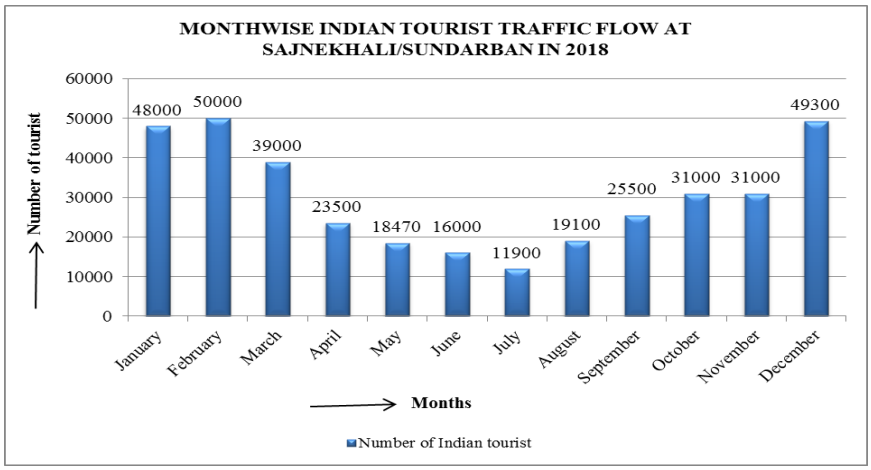


Figure 4.36a. Domestic Tourist Traffic flow in Gosaba in 2018

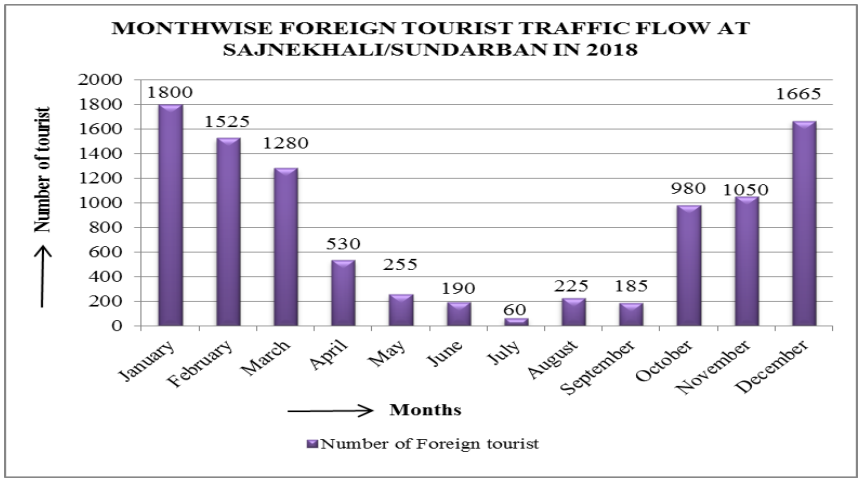


Figure 4.36b.Foreign Tourist Traffic flow in Gosaba in 2018

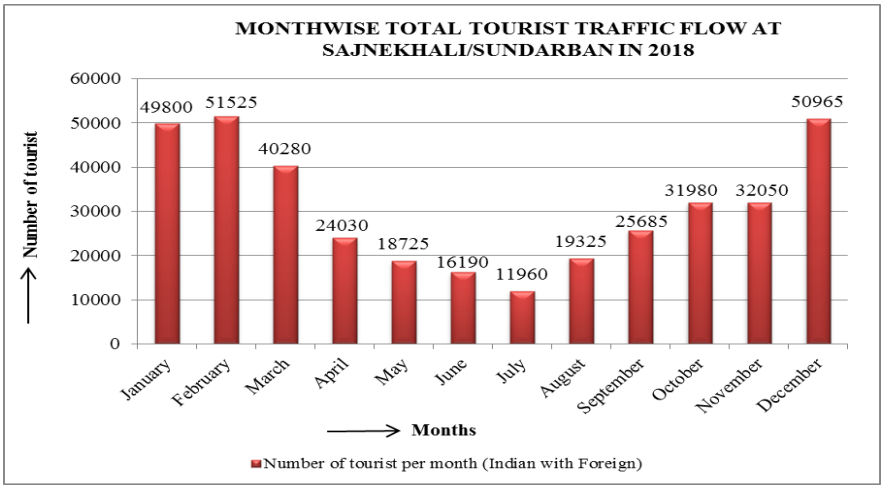


Figure 4.36c.Total Tourist Traffic flow in Gosaba in 2018

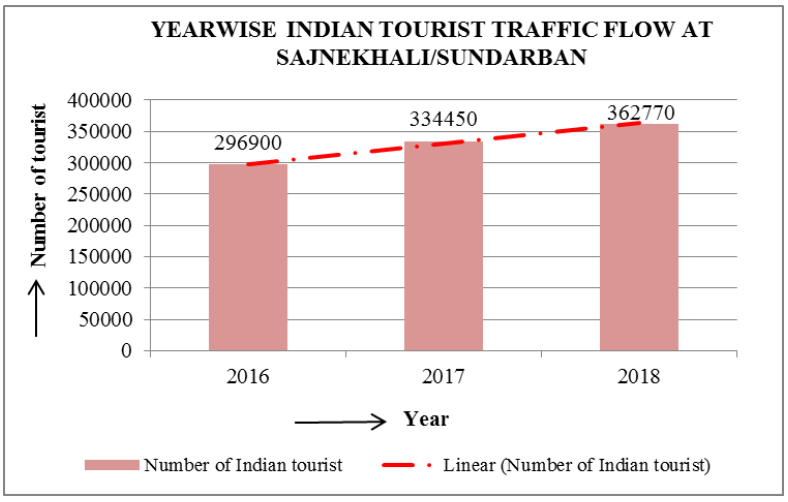


Figure 4.37a. Domestic Tourist Traffic trend in Gosaba between 2016-2018

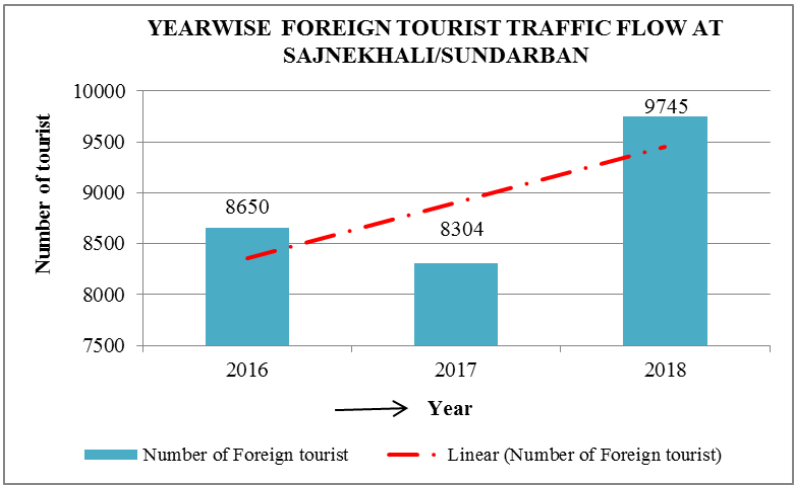


Figure 4.37b. Foreign Tourist Traffic trend in Gosaba between 2016-2018

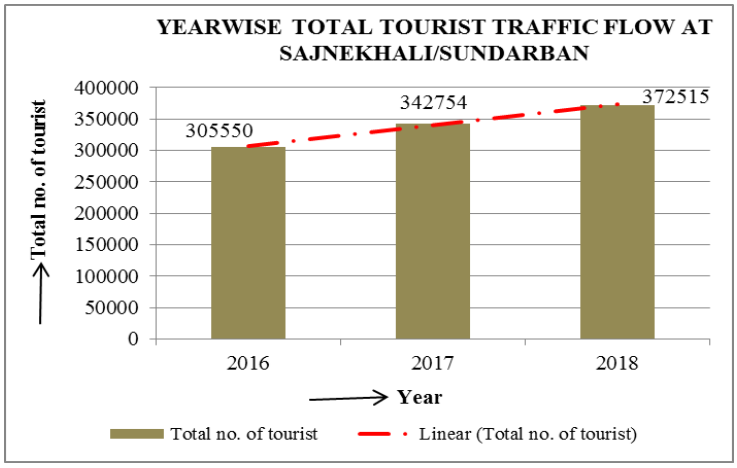


Figure 4.37c. Total Tourist Traffic trend in Gosaba between 2016-2018

As given in Table 4.59 and visually presented in figure series 4.37, there has been a rise of 12% in 2017 compared to 2016, followed by a much higher rise of 9% in 2018 compared to 2017 in total tourist traffic volume visiting the Gosaba block, clearly indicating the rise in popularity of the touristic characteristics of the area.

4.6.4.2. Demographic, Educational, and Economic Profile of the Tourists:

(i) District wise tourists' inflow:

The analysis found that about 24% of the tourists surveyed came from Kolkata and the South Twenty-four Parganas, as comfortable travel takes place in a very short time and short distances. In terms of inflow Kolkata and South 24 Parganas have been followed by Howrah, North 24 Parganas, Purba Medinipur, Birbhum, Puruliya, Malda, Murshidabad, Paschim Medinipur, Hooghly, Cooch Behar, Bankura, Alipurduar, Purba Bardhaman and Jhargram are much lesser in number might be explained by the distance decay factor (Fig. 4.11a).

(ii) Age-sex composition:

Age groups are categorised as per age of tourist and examine the nature of tourist as per gender-wise and interested age categorised population. Among the surveyed male tourists population, 75.00% are belonging to the 20 to 40 age group followed by 40 to 60 (22.00%) and more than 60 (3.00%). Among the surveyed female tourist population about 81.58% due to age group 20 to 40, followed by 40 to 60 (15.79%) and more than 60 (2.63%). There is a predominance of all groups between the ages of 20 and 40 which may be due to the preferred attitude of tourists to travel with their whole family (Fig. 4.11b).

Table 4.60 District-wise percentage (%) shear of the surveyed tourist in Gosaba

SL No.	District	Percentage (%) of Tourist
1	Alipurduar	1.45
2	Bankura	1.45
3	Birbhum	2.90
4	cooch behar	2.1
5	Hooghly	2.17
6	Howrah	11.59
7	Jhargram	0.72
8	Kolkata	23.91
9	Malda	2.90
10	Murshidabad	2.90
11	Nadia	2.17
12	North 24 Parganas	9.42
13	Paschim Bardhaman	0.72
14	Paschim Medinipur	2.17
15	Purba Bardhaman	1.45
16	Purba Medinipur	6.52
17	Purulia	2.90
18	South 24 Parganas	22.46

Table 4.61 Gender composition of the surveyed tourist in Gosaba

Age Group	Percentage (%) of Male	Percentage (%) of Female
>60	3.00	2.63
40 – 60	22.00	15.79
20 – 40	75.00	81.58
<20	0.00	0.00

(iii) The male-female ratio of the tourists surveyed in Gosaba was about 100:38, that is 50:19 almost 3:1 though there was a little dominance of male tourists.

(iv) Marital Status:

Regarding the marital status of the surveyed tourists, it has been found that about 55.80% of them were married and the rest (44.20%) are unmarried (Fig. 4.11c).

Table 4.62 Marital status of the surveyed tourist in Gosaba

Marital Status	Male	Female	Total	Percentage (%) of Tourists
Married	46	31	77	55.80
Unmarried	54	7	61	44.20

(v) Educational Profile:

The educational status of the tourists shows a larger spectrum ranging from secondary level to graduate to postgraduate to technical education. Among the tourists 14.49% & 13.04% were found as both secondary level and post graduate while 24.64% were higher secondary level; 41.30% were having graduated and only 6.52% were having technical education (Fig.4.11d).

Table 4.63 Educational status of the surveyed tourist in Gosaba

Educational Status	Male	Female	Total	Percentage (%) of Tourists
Secondary level	14	6	20	14.49
Higher Secondary level	25	9	34	24.64
Graduate	39	18	57	41.30
Post Graduate	15	3	18	13.04
Technical	7	2	9	6.52

(vi) Employment status:

Among the tourists surveyed, it was about 33.33% were Private-employee; followed by Unemployed (20.29%); House-wife (17.39%); Govt. employee (10.14%); Self-employee (6.52%); Student (6.52%); Business (4.35%) and Retired person (1.45%) (Fig. 4.11e).

Table 4.64 Employment status of the surveyed tourist in Gosaba

Employment status	Total No.	Percentage (%) of Tourist
Business	6	4.35
Farmer	0	0.00
Govt. Employee	14	10.14
House Wife	24	17.39
Private Employee	46	33.33
Retired	2	1.45
Self - Employee	9	6.52
Student	9	6.52
Unemployed	28	20.29

(vii) Economic Profile:

On the basis of monthly income of tourists are again classified onto 5 groups (Table 4.20) in which the dominance of lower-middle income group people has been found (Fig. 4.11f).

Table 4.65 Economic profile of the surveyed tourist in Gosaba

Range of Income (INR)	Total No.	Percentage (%) of Tourist
<5000	0	0.00

5000 – 10,000	19	13.77
10,000 – 15,000	40	28.99
15,000 – 20,000	58	42.03
>20,000	21	15.22

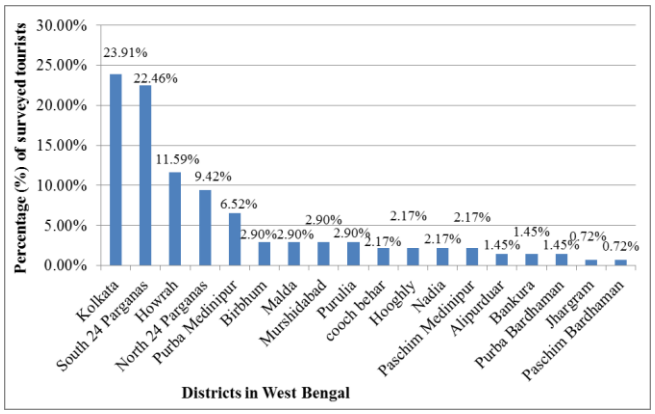


Figure 4.38a. District-wise arrival tourists in Gosaba

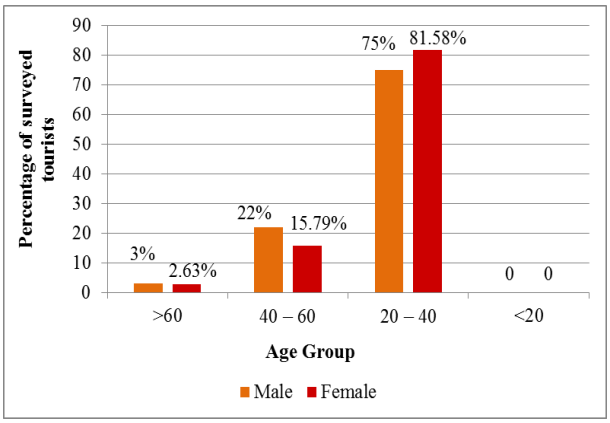


Figure 4.38b. Age-sex composition of tourists in Gosaba

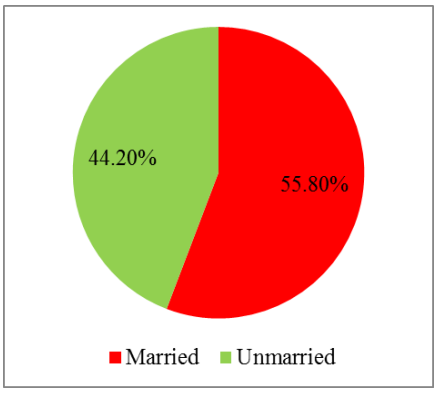


Figure 4.38c. Marital status of tourists in Gosaba

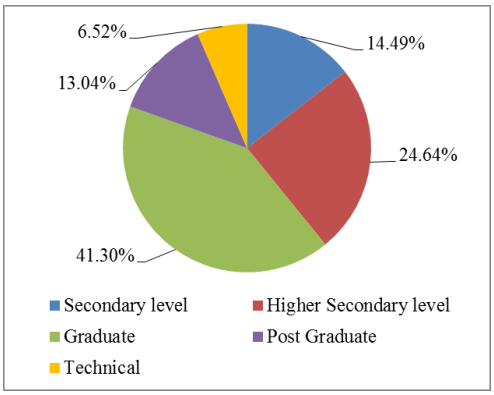


Figure 4.38d. Educational status of tourists in Gosaba

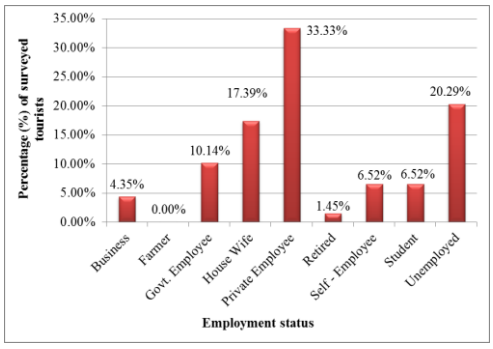


Figure 4.38e. Employment status of tourists Gosaba

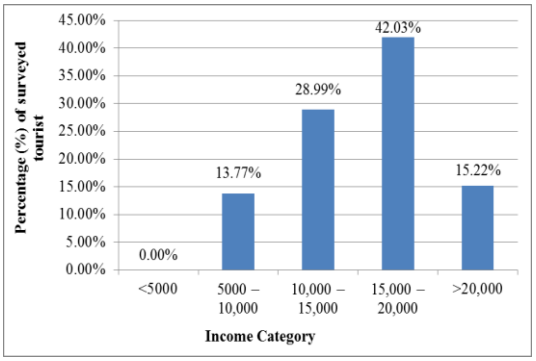


Figure 4.38f. Economic status of tourists in in Gosaba

4.6.4.3. Particulars about the tour:

(i) Out of the tourists visiting Pakhiralaya and Satjelia at Gosaba block, it has been found that about 80% of them are coming directly from their hometown while only 20% are coming via other tourist sports.

(ii) About 20.29% of the tourists has been organised their tours by themselves starting from tour planning, and hotel booking to sightseeing while 79.71% had come on a package tour, Which means it comes through a tour operator or travel agency (Table 4.66).

Table 4.66 Tour Organization of the surveyed tourist in Gosaba

Tour Organised	Percentage (%) of Tourist
Self-Organised	20.29
Tour Operator/Travel Agency	79.71

(iii) Regarding the factors for preferring of tourist spots; it has been found that Biodiversity enriched spot (Table 4.67) is the dominant factor followed by Scenic beauty (24.64%), Boat riding (16.67%), Rest & relaxation etc (Fig. 4.39a).

Table 4.67 Factors for preferring of the surveyed tourist in Gosaba

Causes of Visit	Percentage (%) of Tourist
Rest & relaxation	7.97
Local socio economic cultural	6.52
Home stay	5.07
Sports & recreation	3.62
Biodiversity enriched spot	35.51
Sea beach	0.00
Scenic beauty	24.64
Religious reasons	0.00
Boat riding	16.67
Wild Animal Park	0.00

(iv) Among the tourists surveyed, it was about 74.64% were visited less than two times; followed by 2 to 3 times (18.84%) and more than three times about 6.52% (Fig. 4.39b).

Table 4.68 Frequency of visit of the surveyed tourist in Gosaba

Frequency of Visit	Percentage (%) of Tourist
<2	74.64
2 - 3	18.84
>3	6.52

(v) Regarding the length of stay, it has been seen that most of the tourists prefer to stay maximum for three nights in Pakhiralaya & Satjelia at Gosaba block (Table 4.69 & Fig. 4.39c).

Table 4.69 Duration of stay for the surveyed tourist in Gosaba

No. of Days	Percentage (%) of Tourist
One night	28.99
Two night	21.74
Three night	49.28

(vi) Regarding the mode of journey it has been found that about 67% tourists travelled by private car, bike, auto and other transport while 33% tourists used by public transport.

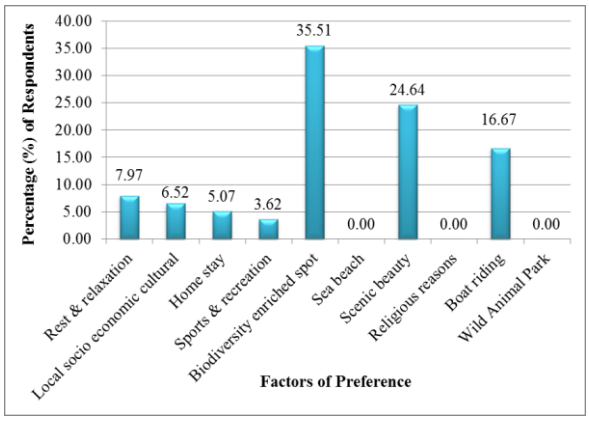


Figure 4.39a. Factors of preference for Gosaba

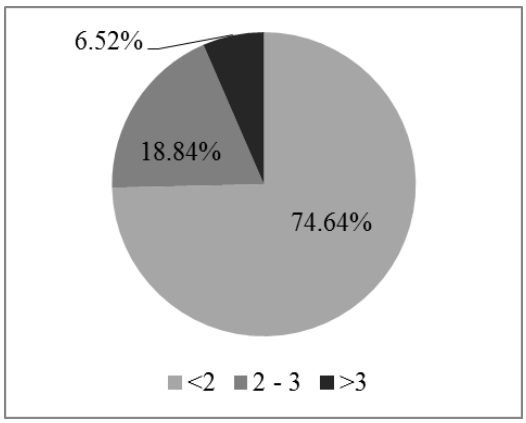


Figure 4.39b. Frequency of visit of tourists in Gosaba

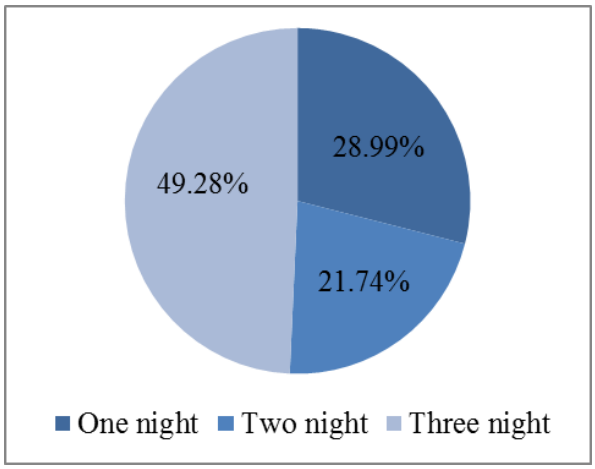


Figure 4.39c. Duration of stay of tourists in Gosaba

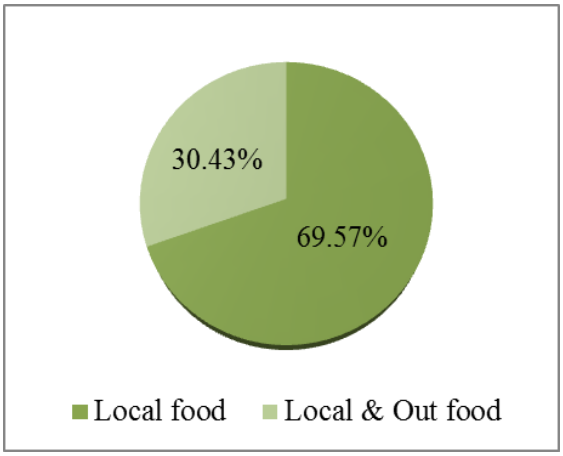


Figure 4.39d. Food preference of tourists in Gosaba

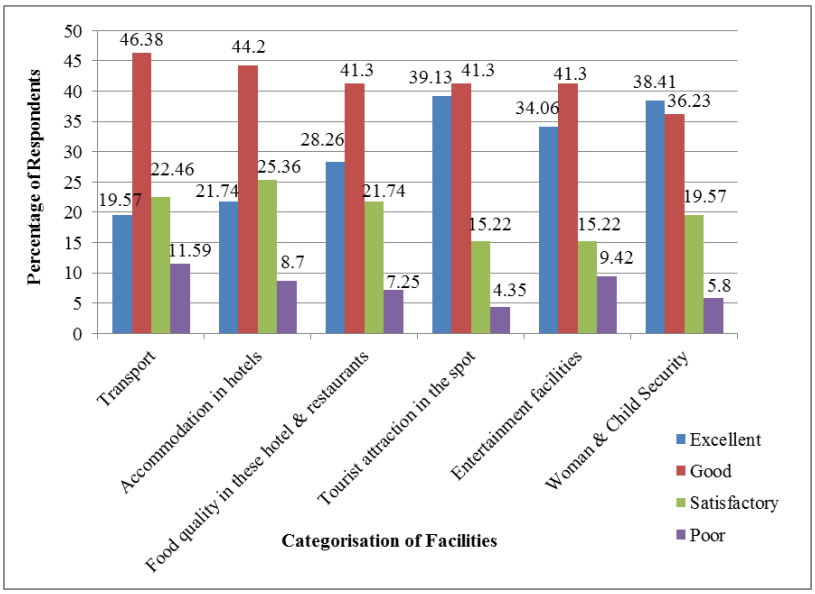


Figure 4.39e. Categorisation of facilities level of satisfaction

(vii) According to 46.38% of the surveyed tourists, the condition of the road is good, 19.57% said excellent and only 22.46% said that the road condition is satisfactory, while 11.59% said that the transport condition is poor (Fig. 4.39e.).

(viii) Regarding the accommodation in hotel and homestay, 44.20% of surveyed tourists the condition of accommodation is good, 21.74% said excellent and only 25.36% of tourists said that the hotel accommodation is satisfactory, while 8.70% said that the accommodation condition is poor (Fig. 4.39e.).

(ix) About the hotels they were staying in have opined differently regarding the standard of food, water, sanitation, etc. 41.30% of surveyed tourists said that is good whereas almost 28.26% to 21.74% tourists said excellent and satisfactory. But the little volume of tourists (7.25%) said that the food quality is poor (Fig. 4.39e.).

(x) Regarding the tourist attraction in the spot, 15.22% of tourists replied that is satisfied, 41.30% and 39.13% of surveyed tourists said that is good and excellent. While only 4.35% of tourists said that is poor (Fig. 4.39e.).

(xi) About the 41.30% of surveyed tourists said that the entertainment facilities are satisfactory, whereas 9.42% of tourists said that it is poor (Fig. 4.39e.).

(xii) About the 38.41% and 36.23% of surveyed tourists clearly feedback that woman & child security is excellent and good in Gosaba. While only 5.80% of tourists said that is poor (Fig. 4.39e.).

Table 4.70 Facilities analysis on the level of satisfaction

Facilities	Satisfaction level (%)			
	Excellent	Good	Satisfactory	Poor
Transport	19.57	46.38	22.46	11.59
Accommodation in hotels	21.74	44.20	25.36	8.70
Food quality in these hotel & restaurants	28.26	41.30	21.74	7.25
Tourist attraction in the spot	39.13	41.30	15.22	4.35
Entertainment facilities	34.06	41.30	15.22	9.42
Woman & Child Security	38.41	36.23	19.57	5.80

Table 4.71 Food preference of surveyed tourist in Gosaba

Food Preference	Percentage (%) of Tourist
Local food	69.57
Local food & out food	30.43
Out food	0.00

(xiii) Regarding the types of food, almost 69.57% tourists preferred local food. While 30.43% surveyed tourists said that they are liked both local & out food (Fig. 4.39d.).

4.7. Conclusion:

This chapter analyzes the profiles of tourists visiting the four tourist areas of the Sundarbans (Jharkhali, Gosaba, Sagar Island and Bakkhali). Here is an analysis of the growing rate of tourists as well as the reasons and preferences for them to come through the infrastructure. Tourists visiting these places have been given a picture of the level of infrastructure to the satisfaction of tourists, which has helped in identifying the problems in the development of the Sundarbans tourism industry.

CHAPTER V:

Environmental performance of the Hospitality sub-sector

5.1. Hospitality sub-sector in the regions:

The hospitality sector is integral to tourism, providing one of the four 'A'.s i.e. Accommodation, as mentioned before. It is important that these lodging facilities conform to the sustainable development goals and are conscious of various ecological and environmental aspects including visual impact (Blangy et al, 2006). The thirty lodges and ashrams currently present at Sagar, twenty-seven lodges currently present at Bakkhali, sixteen lodges currently present at Jharkhali, twenty-one lodges currently present at Pakhiralaya, and eight lodges currently present at Dayapur are suited to all budgets and mostly comprise of the conventional system of providing thermal comfort to guests without much concern about the natural resources. Hence, it is important to assess each of these tourist lodges in terms of their energy consumption, water consumption, and waste generation.

The lodges are connected to the electrical grid for their energy needs. However, disruptions occur due to bad weather conditions, when the lodge switches over to diesel generators to substitute the grid supply, implying considerable use of fossil fuels, thus contributing to air pollution. The emissions have proven records of deteriorating an environment, destroying the ecological balance, and also negatively affecting human health.

Degenerated and degraded environment in the long run effect tourism prospects negatively, especially if it is nature-based tourism, and finally undergoes economic collapse as it gets robbed of its main values.

5.2. Energy Performance Index (EPI) of the study areas:

'Energy efficiency is using an era that requires less electricity to perform the identical function and 'carbon footprint' is a greenhouse gas emission associated with a pastime, group of activities or a product (GRIHA for Affordable Housing: v.1., 2017). The Energy Conservation (EC) Act of 2001 furnished the framework for performance constraints in India, observed with the aid of the National Mission for Enhanced Energy Efficiency (NMEEE) in 2008. The Energy Performance Index (EPI) is a range that shows the overall energy performance of a building. EPI can be used to measure the performance of a construction (ICEEB, 2015).Carbon footprint is defined as the total carbon dioxide equivalent (CO2E) released from energy use in a development / city / village / state / country / sector. The purpose is to reduce energy use, reduce the use of motorized vehicles on-site, and take up clean energy on-site, in the development proposed by the analysis and thus involved in green construction practice (GRIHA LD, 2015). The Energy Performance Index (EPI) was compiled by combining data collected under three categories. Since electricity is the main source of energy used in

hotel management and quarterly energy bills can be taken from hotel management, EPI was evaluated based on the top-down method (Boemi et al, 2011). The power units consumed every three months were extrapolated for the year and then divided by the total built-up area of the facility to reach the EPI, i.e. the annual energy consumed per unit area of that facility. The extra load due to the functionality of the Diesel Generator (DG) sets was also factorized by adding two components as both are fossil-fuel-based. Thus this EPI assessment study includes (i) grid electricity and (ii) power consumption through DG services. The objective is to analyze the annual energy per capita and annual CO_2 emissions per capita of the proposed development in tourist centers, such as Sagar, Bakkhali, Jharkhali, and Gosaba. The determining two factors for this assessment will include: i) Annual recurring (in terms of Building operation energy) and Annual recurring (in terms of waste generate energy); ii) Annual recurring (in terms of total CO_2 Emission from Building operation energy).

$$\textbf{Energy Performance Index} = \frac{\textbf{Annual average grid electricity usage + Annual average diesel}}{\textbf{Total buildup area of the hotel}}$$

Carbon foot print = Annual recurring (in terms of building operation energy) X 0.9 (coal based fossil fuel) or 0.85 (oil based fossil fuel)

The EPI is the measure of the annual operational energy consumption of any building towards meeting the thermal comfort of the occupants and is given in kWh per unit area of the building and Carbon footprint is the measure of the annual recurring (in terms of building operation energy and is given in KgC per unit area of the building. It is mostly the electrical energy consumption by the building for its day-to-day operations. The raw data collected in this regard for the year 2019-2020 is attached in the Annexure. The findings are given in table 5.3.

Table 5.1 Energy source of materials & carbon emission

Sl. No.	Energy source/ material	Carbon emission
1	One Unit of Electricity: Coal based	900 gmC/kWh
2	One Unit of Electricity: Oil-based	850gmC/kWh
3	Gas combined	400gmC/kWh
4	Bio-mass (fuel wood)	45gmC/kWh
5	Photovoltaic: Crystallised	37gmC/kWh
6	Photovoltaic: Cadmium	18gmC/kWh
7	Nuclear Power	40gmC/kWh
8	Wind	11gmC/kWh

Source: IEEE Spectrum (WWW.SPECTRUM.IEEE.ORG) (Institute of Electrical and Electronic Engineers) Issue: Feb 2008, Vol.-45, No.2, Pg 56

Table 5.2 Resource parameters section criteria

Section	Resource Parameter
Energy	Net kWh required from the utility grid & Diesel Generator
Solid Waste	Total organic waste generated from hotels

5.3. About the study areas:

Sundarbans is the biggest delta in the World. Sundarbans delta is a Ganga – Brahmaputra – Meghna basin in Asia. The total area of the Sundarbans region in India is 9630 km^2. Sundarbans was declared National Park in 1984 and announced World Heritage Site and Sundarbans Biosphere Reserve respectively in the year 1989. Sundarbans mangrove forest, Sajnekhali Wildlife Sanctuary, Sundarbans National Park, Haliday Wildlife Sanctuary, and Lothian Island Wildlife Sanctuary are the main attractions of tourists, which helps to build the development of Sundarbans tourism. Today, tourism has rapidly grown in the Sundarbans region, because tourist pressure is continuing to increase (both domestic and international tourists) on the basis of the above-mentioned tourist attractions. Approximately tourism has grown up at a 3% rate per year. So, our lives are increasingly being pressed against the negative impacts of growing environmental problems. Buildings contribute to these problems at different stages. That allows you to reduce the environmental effect, homes should be useful resource green, electrical efficient and with water green qualities and pollute much less & do not have an adverse effect on human health. Our study has estimated the Hotel's Carbon Footprint in order to find out the Energy Performance Index (EPI) for different types of hotels in the study area sustainably in Indian Sundarbans. EPI values were calculated in terms of kWh/m^2/year and correlated with different influencing factors, such as actually built-up area, the average occupancy rate in a year, energy consumption in a year; waste generation from hotels (organic and inorganic waste) and water consumption per year. Carbon footprint measurement is another factor to protect the natural environment. Carbon emission values were calculated in terms of KgC/m^2/year. As a result, one hotel's annual energy consumption is 21.9 kWh/m^2/year and annual CO_2 Emission is 18.25 kg/m^2/year, and another hotel's annual energy consumption is 29.2 kWh/m^2/year and annual CO2 Emission is 25.55 KgC/m^2/year, both data being different, due to difference in built-up areas.

Table 5.3 Summary of the annual recurring of total energy & total co_2 emission of the five study areas

Sl No	SAGAR ISLAND	
1	Total numbers of hotel building	30
2	Total built-up area (all storeys)	23555.79 m^2
3	Total annual working days	365
4	Annual recurring (in terms of total energy)	1591.751 kWh/m^2/year
5	Annual recurring (in terms of total CO_2 Emission)	227.766 KgC/ m^2/year
6	Mean value (in terms of total energy)	53.06 kWh/m^2/year
7	Mean value (in terms of total CO_2 Emission)	7.59 KgC/ m^2/year
Sl No	BAKKHALI	
1	Total numbers of hotel building	27
2	Total built-up area (all storeys)	16574.5 m^2
3	Total annual working days	365
4	Annual recurring (in terms of total energy)	2822.244 kWh/m^2/year
5	Annual recurring (in terms of total CO_2 Emission)	1598.163 KgC/ m^2/year
6	Mean value (in terms of total energy)	104.528 kWh/m^2/year
7	Mean value (in terms of total CO_2 Emission)	59.191 KgC/ m^2/year
Sl No	JHARKHALI	
1	Total numbers of hotel building	16
2	Total built-up area (all storeys)	3399.3 m^2
3	Total annual working days	365
4	Annual recurring (in terms of total energy)	921.955 kWh/m^2/year
5	Annual recurring (in terms of total CO_2 Emission)	269.562 KgC/ m^2/year
6	Mean value (in terms of total energy)	57.622 kWh/m^2/year
7	Mean value (in terms of total CO_2 Emission)	16.848 KgC/ m^2/year

Sl No	PAKHIRALAYA	
1	Total numbers of hotel building	21
2	Total built-up area (all storeys)	10052 m^2
3	Total annual working days	365
4	Annual recurring (in terms of total energy)	893.856 kWh/m^2/year
5	Annual recurring (in terms of total CO_2 Emission)	223.275 KgC/ m^2/year
6	Mean value (in terms of total energy)	42.565 kWh/m^2/year
7	Mean value (in terms of total CO_2 Emission)	10.632 KgC/ m^2/year
Sl No	DAYAPUR	
1	Total numbers of hotel building	8
2	Total built-up area (all storeys)	9048 m^2
3	Total annual working days	365
4	Annual recurring (in terms of total energy)	609.058 kWh/m^2/year
5	Annual recurring (in terms of total CO_2 Emission)	397.415 KgC/ m^2/year
6	Mean value (in terms of total energy)	76.132 kWh/m^2/year
7	Mean value (in terms of total CO_2 Emission)	49.68 KgC/ m^2/year

Table 5.4 Type of Building and Energy use in the lodging facilities studies at Sagar Island

Sl No.	Name of the Hotel	Built-up area (m^2)	No. of storeys	No. of Beds	DG Service & Power (KVA)		No. of AC/NON AC Room		Power Grid Energy consume per Month (kWh)	Waste (Solid Waste) generated/kg/bed/day
					YES	NO	AC	NON AC		
1	Calcutta Vastra Vyavsayi Seva Samiti Dharma Sala	1600	Two	660	Yes (10 KVA)	-	10	40	500	0.15
2	Shri Shri Shankarachariya Ashram	40	One	6	-	No	-	2	22.73	0.15
3	Kapil Kuthi Sangkhyayog Ashram	700	Two	256	-	No	-	66	909.09	0.15

4	Ganga Sagar Vavan (Shri Shri Kapil Muni Charitable Trust)	280	Three	120	-	No	1	15	227.27	0.175
5	Manab Seva Samiti	500	Two	180	-	No	-	36	454.55	0.15
6	Shri Guru Sangha	145	One	25	-	No	-	5	54.55	0.2
7	Kapil KalpaTaru Ashram	300	One	76	-	No	-	23	281.82	0.17
8	Arya Wrishi Ashram	140	One	36	-	No	-	12	136.36	0.15
9	Gouriya Ashram	70	One	15	-	No	-	5	45.45	0.15
10	Hindu Sanatan Dharma Prachar Ashram Sangha	400	Two	90	-	No	-	16	212.09	0.15
11	Ganga Sagar Shri Shri Nigamananda Seba-Ashram	73.79	One	12	-	No	-	3	27.27	0.2
12	Ganga Sagar Shankar Dham Ashram	100	One	30	-	No	-	6	77.27	0.175
13	Kapil Muni Dharma Sala	200	One	45	-	No	-	15	195	0.15
14	Bharat Sevashram	1500	Three	330	Yes (125 KVA)	-	-	103	1000	0.15
15	Basudebanan da Tatsangha Ashram	125	Two	100	-	No	-	14	280	0.2
16	Purnashram	115	One	32	-	No	-	8	90.91	0.2
17	Sankhoya Yogashram	150	One	56	-	No	-	8	109.90	0.175
18	Ganga Sagar Youth Hostel	790	Two	76	-	No	3	13	500	0.2
19	Vishwa Hindu Parisad (Madhab Ashram)	600	Two	70	-	No	-	10	130	0.15

20	Swami Debananda Ashram	60	One	12	-	No	-	4	45.45	0.2
21	Sanatan Bhramcharya Seva Ashram Sanga	73	One	20	-	No	-	5	63.64	0.15
22	Ganga Sagar Tourist Lodge	640	Three	36	-	No	2	16	272.72	0.17
23	Loknath Mission	352	One	24	-	No	-	12	136.36	0.2
24	Jogendra Math	384	Two	24	-	No	-	12	181.82	0.2
25	Bishalaxmi Hanuman Mandir Dharma Sala	105	One	12	-	No	-	4	63.63	0.175
26	Ganga Sagar Ananda Ashram	230	One	15	-	No	-	5	45.45	0.2
27	Hariyana Charitable Society	900	Two	60	-	No	-	20	260	0.2
28	Kapil Muni Dharma Sala, Nat Mandir	750	One	320	-	No	-	32	545.45	0.15
29	Howrah Bharatiya Sahu Samaj	452	Two	30	-	No	-	10	130	0.2
30	Ramkrishna Mission Ashram	245	Two	36	-	No	-	12	163.64	0.15

Source: Primary data source (Field survey)

Table 5.5 Comprehensive Assessment of Energy Consumption & Co_2 Emission in Building Operation for 30th Hotels at Sagar Island (2019 – 2020)

SL NO.	Hotel's Name	Annual recurring (in terms Building operation energy), 2019-2020	Annual recurring CO_2 Emission, 2019-2020	Annual recurring (in terms waste generate energy), 2019-2020	Annual recurring CO_2 Emission, 2019-2020	Annual recurring (in terms of total energy), 2019-2020	Annual recurring (in terms of total CO_2 Emission), 2019-2020
		kWh/m^2/Yr	KgC/m^2/Yr	kWh/m^2/Yr	KgC/m^2/Yr	kWh/m^2/Yr	KgC/ m^2/Yr
		A	B = (A x 0.85*)	C	D = (C x 0.045**)	A + C	B + D
1	Calcutta Vastra Vyavsayi Seva Samiti Dharma Sala	2.172	1.944	50.005	2.19	52.177	4.134
2	Shri Shri Shankarachariya Ashram	6.816	6.132	36.135	1.46	42.951	7.592
3	Kapil Kuthi Sangkhyayog Ashram	7.788	7.008	44.165	1.83	51.953	8.838
4	Ganga Sagar Vavan (Shri Shri Kapil Muni Charitable Trust)	3.252	2.928	40.515	1.83	43.767	4.758
5	Manab Seva Samiti	5.46	4.908	43.435	1.83	48.895	6.738
6	Shri Guru Sangha	4.512	4.068	55.48	2.19	59.992	6.258
7	Kapil KalpaTaru Ashram	11.268	10.14	69.35	3.285	80.618	13.425
8	Arya Wrishi Ashram	11.688	10.644	62.05	2.92	73.738	13.564
9	Gouriya Ashram	7.788	7.008	51.83	2.19	59.618	9.198
10	Hindu Sanatan Dharma Prachar Ashram Sangha	3.18	2.868	27.375	1.095	30.555	3.963
11	Ganga Sagar Shri Shri Nigamananda Seba-Ashram	4.44	3.996	52.56	2.19	57	6.186
12	Ganga Sagar Shankar Dham Ashram	9.276	8.34	84.68	3.65	93.956	11.99
13	Kapil Muni Dharma Sala	11.7	10.536	54.385	2.555	66.085	13.091
14	Bharat Sevashram	2.832	2.544	17.885	0.73	20.717	3.274

15	Basudebananda Tatsangha Ashram	13.44	12.096	129.21	5.84	142.65	17.936
16	Purnashram	9.492	8.532	89.79	4.015	99.282	12.547
17	Sankhoya Yogashram	8.796	7.908	105.485	4.745	114.281	12.653
18	Ganga Sagar Youth Hostel	3.792	3.42	15.695	0.73	19.487	4.15
19	Vishwa Hindu Parisad (Madhab Ashram)	1.296	1.176	14.235	0.73	15.531	1.906
20	Swami Debananda Ashram	9.096	8.184	64.605	2.92	73.701	11.104
21	Sanatan Bhramcharya Seva Ashram Sanga	10.464	9.42	66.43	2.92	76.894	12.34
22	Ganga Sagar Tourist Lodge	1.704	1.536	5.11	0.365	6.814	1.901
23	Loknath Mission	4.644	4.188	21.9	1.095	26.544	5.283
24	Jogendra Math	2.844	2.556	10.22	0.365	13.064	2.921
25	Bishalaxmi Hanuman Mandir Dharma Sala	7.272	6.54	32.12	1.46	39.392	8
26	Ganga Sagar Ananda Ashram	2.376	2.136	21.17	1.095	23.546	3.231
27	Hariyana Charitable Society	1.728	1.56	10.585	0.365	12.313	1.925
28	Kapil Muni Dharma Sala, Nat Mandir	8.724	7.86	103.30	4.745	112.024	12.605
29	Howrah Bharatiya Sahu Samaj	1.728	1.548	10.585	0.365	12.313	1.913
30	Ramkrishna Mission Ashram	4.008	3.612	17.885	0.73	21.893	4.342

* Greenhouse gas emission is 850 grams per kilowatt-hour of CO_2 Equivalent for oil-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

**Greenhouse gas emission is 45 grams per Kilowatt-hour of CO_2 Equivalent for bio-mass based fossil fuel form of energy supply i.e. (75.92 x 45) = 3416.4 gms C = 3.416 KgC [IEEE Spectrum, Issue: Feb 2008, Vol. -45, No. 2, Pg 56].

Table 5.6 Comparative Environmental Impact of the no. of 30th Hotels at Sagar Island (2019 – 2020)

SL NO.	Name of the Hotel	Annual energy consumption, 2019 - 2020		Annual recurring CO_2 Emission, 2019-2020	
		kWh/m²/year		KgC/m^2/year	
		****Sustainable EPI benchmark 183.33 kWh/m²/year [GRIHA, 2015]**		*****Sustainable CO_2-foot-print 2.363**	
1	Calcutta Vastra Vyavsayi Seva Samiti Dharma Sala	52.177	72% lower	4.134	2 times larger and more intensive than the sustainable threshold
2	Shri Shri Shankarachariya Ashram	42.951	77% lower	7.592	3 times larger and more intensive than the sustainable threshold
3	Kapil Kuthi Sangkhyayog Ashram	51.953	72% lower	8.838	4 times larger and more intensive than the sustainable threshold
4	Ganga Sagar Vavan (Shri Shri Kapil Muni Charitable Trust)	43.767	77% lower	4.758	2 times larger and more intensive than the sustainable threshold
5	Manab Seva Samiti	48.895	73% lower	6.738	3 times larger and more intensive than the sustainable threshold
6	Shri Guru Sangha	59.992	67% lower	6.258	3 times larger and more intensive than the sustainable threshold

7	Kapil KalpaTaru Ashram	80.618	56% lower	13.425	6 times larger and more intensive than the sustainable threshold
8	Arya Wrishi Ashram	73.738	60% lower	13.564	6 times larger and more intensive than the sustainable threshold
9	Gouriya Ashram	59.618	67% lower	9.198	4 times larger and more intensive than the sustainable threshold
10	Hindu Sanatan Dharma Prachar Ashram Sangha	30.555	83% lower	3.963	2 times larger and more intensive than the sustainable threshold
11	Ganga Sagar Shri Shri Nigamananda Seba-Ashram	57	69% lower	6.186	3 times larger and more intensive than the sustainable threshold
12	Ganga Sagar Shankar Dham Ashram	93.956	49% lower	11.99	5 times larger and more intensive than the sustainable threshold
13	Kapil Muni Dharma Sala	66.085	64% lower	13.091	6 times larger and more intensive than the sustainable threshold
14	Bharat Sevashram	20.717	89% lower	3.274	1 times larger and more intensive than the sustainable threshold
15	Basudebananda Tatsangha Ashram	142.65	22% lower	17.936	8 times larger and more intensive than the sustainable threshold
16	Purnashram	99.282	46% lower	12.547	5 times larger and more intensive than the sustainable threshold

17	Sankhoya Yogashram	114.281	38% lower	12.653	5 times larger and more intensive than the sustainable threshold
18	Ganga Sagar Youth Hostel	19.487	89% lower	4.15	2 times larger and more intensive than the sustainable threshold
19	Vishwa Hindu Parisad (Madhab Ashram)	15.531	92% lower	1.906	1 times larger and more intensive than the sustainable threshold
20	Swami Debananda Ashram	73.701	60% lower	11.104	5 times larger and more intensive than the sustainable threshold
21	Sanatan Bhramcharya Seva Ashram Sanga	76.894	58% lower	12.34	5 times larger and more intensive than the sustainable threshold
22	Ganga Sagar Tourist Lodge	6.814	96% lower	1.901	1 times larger and more intensive than the sustainable threshold
23	Loknath Mission	26.544	86% lower	5.283	2 times larger and more intensive than the sustainable threshold
24	Jogendra Math	13.064	93% lower	2.921	1 times larger and more intensive than the sustainable threshold
25	Bishalaxmi Hanuman Mandir Dharma Sala	39.392	79% lower	8	3 times larger and more intensive than the sustainable threshold

26	Ganga Sagar Ananda Ashram	23.546	87% lower	3.231	1 times larger and more intensive than the sustainable threshold
27	Hariyana Charitable Society	12.313	93% lower	1.925	1 times larger and more intensive than the sustainable threshold
28	Kapil Muni Dharma Sala, Nat Mandir	112.024	39% lower	12.605	5 times larger and more intensive than the sustainable threshold
29	Howrah Bharatiya Sahu Samaj	12.313	93% lower	1.913	1 times larger and more intensive than the sustainable threshold
30	Ramkrishna Mission Ashram	21.893	88% lower	4.342	2 times larger and more intensive than the sustainable threshold

**The Energy Performance Index are compared with the 'Green Rating for Integrated Habitat Assessment (GRIHA)' prescribed threshold of 275 kWh/m^2/year (GRIHA, 2019). Considering river or sea-side activities at Sundarbans tourism spots for eight hours and indoor space usage for 16 hours, the benchmark comes down to [275 x (16/24)] = 183.33 kWh/m^2/year (GRIHA, 2015).

***One Joule = 2.78 x 10^{-7} kWh; 100 GJ = 100 x 10^9 Joule = (100 x 10^9) x (2.78 x 10^{-7}) kWh = 27800kWh

One Hectare = 10,000Sqm; if sustainable capacity of 1 Ha is 100 GJ or 27800 kWh, then (27,800/10,000) = 2.78 kWh is that of one Sqm.

For oil-based energy supply, this amounts to (2.78 x 0.85) Kg or 2.363 Kg of CO_2 released to the atmosphere. It is to be noted that for coal based energy supply (i.e. thermal power stations), the same will be (2.78 x 0.9) = 2.5 Kg CO_2 equivalent Green House Gases (GHGs) emitted to the atmosphere.

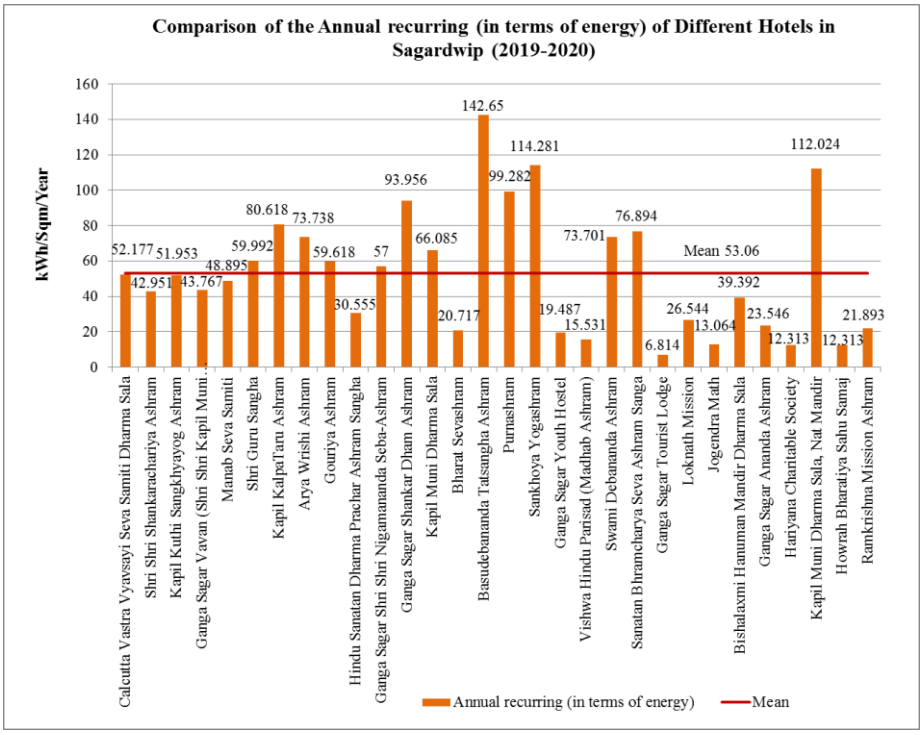


Figure 5.1 Energy Performance Index (EPI) of the different hotels in Sagar Island (2019-20)

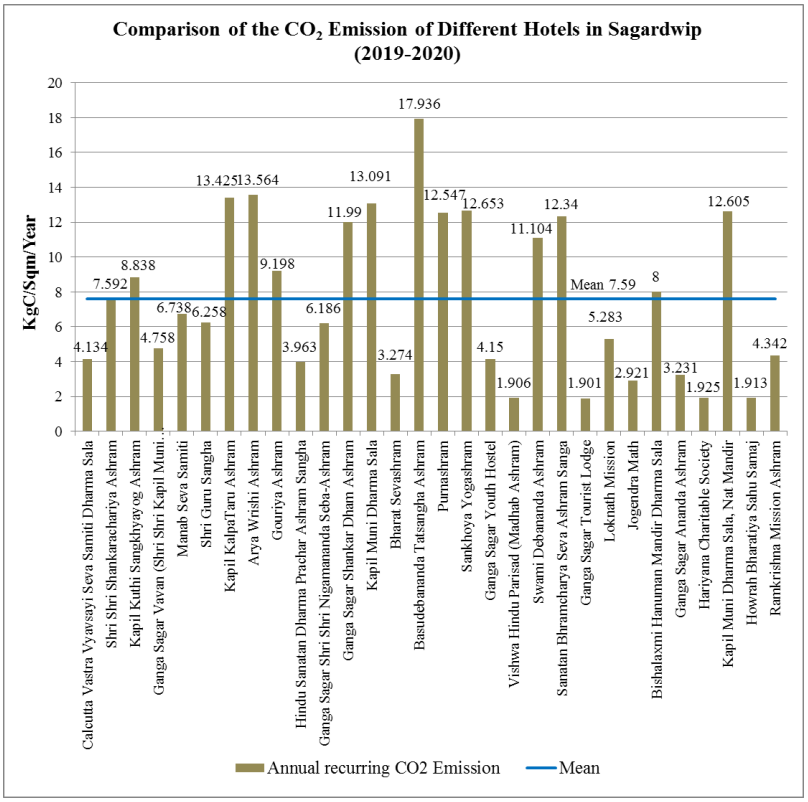


Figure 5.2 CO_2 Emission of the different hotels in Sagar Island (2019-20)

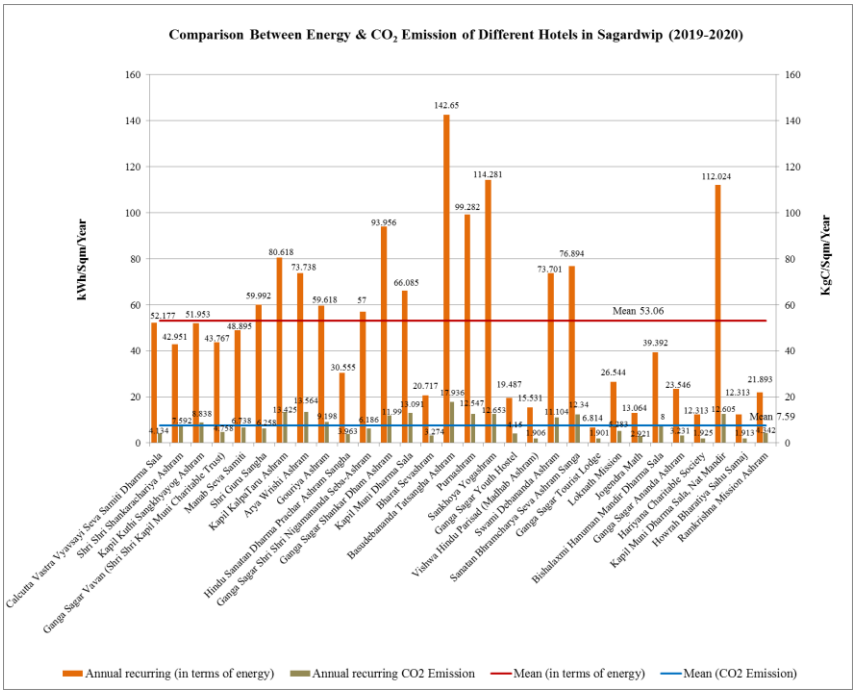


Figure 5.3 Comparison between Energy & CO_2 Emission of the different hotels in Sagar Island (2019-20)

Table 5.7 Type of Building and Energy use in the lodging facilities studies at Bakkhali

Sl No.	Name of the Hotel	Built-up area (m^2)	No. of storeys	No. of Beds	DG Service & Power (KVA)		No. of AC/NON AC Room		Power Grid Energy consume per Month (kWh)	Waste (Solid Waste) generated/kg/bed/day
					YES	NO	AC	NON AC		
1	Balaka Lodge	397	Three	120	Yes (80 KVA)	-	44	-	4545.45	0.2
2	Sahana Tourist Lodge	100	Three	30	Yes (10 KVA)	-	3	5	454.55	0.2
3	Bakkhali Tourist Lodge	496	One	36	Yes (160 KVA)	-	12	-	7272.73	0.22
4	Narayani Lodge	186	Three	54	Yes (10 KVA)	-	8	19	7272.73	0.2
5	Hotel Bay View	659	Two	70	Yes (82 KVA)	-	17	13	3636.36	0.225
6	Samabay Sasthya Unnayan Sanstha	124	Two	64	Yes (5 KVA)	-	-	16	227.27	0.2
7	Bakkhali Beach Banglow	260	Two	36	Yes (10 KVA)	-	4	8	3181.82	0.2
8	Hotel Samanta	151	Three	50	Yes (7.5 KVA)	-	8	10	909.09	0.18
9	Hotel Hansaraj	253	Two	20	Yes (3.5 KVA)	-	-	6	272.73	0.17
10	Hotel Sagarika	219	Three	60	Yes (102 KVA)	-	3	19	757.57	0.2
11	Bijaya Tourist Lodge	156	Three	60	Yes (6 KVA)	-	-	18	909.09	0.17
12	Hotel Babylon	232	Two	30	Yes (30 KVA)	-	10	-	3181.82	0.2
13	Hotel Apanjan	96	Three	60	Yes (60 KVA)	-	5	15	2727.27	0.18
14	Hotel Amarabati	219	Three	150	Yes (162 KVA)	-	45	-	9090.91	0.2
15	Hotel Sea View	614	Three	90	Yes (102 KVA)	-	17	13	4090.91	0.2

16	Hotel Moumita	230	Two	30	Yes (5 KVA)	-	-	10	909.09	0.2
17	Hotel Rainbow	70.9	Three	60	Yes (30 KVA)	-	10	10	1181.82	0.22
18	Hotel Bhorer Allo	160	Three	60	Yes (10 KVA)	-	7	13	1636.36	0.2
19	Hotel Joyguru	226	Four	100	Yes (10 KVA)	-	3	28	909.09	0.19
20	Hotel Triva	69.4	Two	30	Yes (7.5 KVA)	-	3	7	545.45	0.18
21	Hotel Meghalaya	217	Three	100	Yes (15 KVA)	-	13	15	1363.64	0.2
22	Hotel Amantran	217	Three	50	Yes (5 KVA)	-	4	16	909.09	0.17
23	Hotel Samudra Nill	497	Three	100	Yes (60 KVA)	-	12	18	5000	0.2
24	Hotel Chhuti	70	Three	45	Yes (10 KVA)	-	10	4	909.09	0.18
25	Hotel Pinki	163	Two	70	Yes (10 KVA)	-	4	13	545.45	0.2
26	Beach Resort	222	Two	40	Yes (7.5 KVA)	-	3	9	909.09	0.2
27	Hotel Sanjog	160	Four	90	Yes (62 KVA)	-	19	11	2727.27	0.2

Source: Primary data source (Field survey)

Table 5.8 Comprehensive Assessment of Energy Consumption & Co_2 Emission in Building Operation for 27th Hotels at Bakkhali (2019 – 2020)

SL NO.	Hotel's Name	Annual recurring (in terms Building operation energy), 2019-2020	Annual recurring CO_2 Emission, 2019-2020	Annual recurring (in terms waste generate energy), 2019-2020	Annual recurring CO_2 Emission, 2019-2020	Annual recurring (in terms of total energy), 2019-2020	Annual recurring (in terms of total CO_2 Emission), 2019-2020
		kWh/m^2/Yr	KgC/m^2/Yr	kWh/m^2/Yr	KgC/m^2/Yr	kWh/m^2/Yr	KgC/ m^2/Yr
		A	B = (A x 0.85*)	C	D = (C x 0.045**)	A + C	B + D
1	Balaka Lodge	61.92	54.924	32.485	1.46	94.405	56.384
2	Sahana Tourist Lodge	23.94	21.264	32.12	1.46	56.06	22.724
3	Bakkhali Tourist Lodge	253.368	224.16	25.915	1.095	279.283	225.255
4	Narayani Lodge	159.84	143.688	31.39	1.46	191.23	145.148
5	Hotel Bay View	46.248	40.968	19.345	0.73	65.593	41.698
6	Samabay Sasthya Unnayan Sanstha	13.32	11.868	83.22	3.65	96.54	15.518
7	Bakkhali Beach Banglow	77.124	69.228	22.265	1.095	99.389	70.323
8	Hotel Samanta	26.46	23.7	32.12	1.46	58.58	25.16
9	Hotel Hansaraj	7.392	6.612	10.95	0.365	18.342	6.977
10	Hotel Sagarika	43.644	37.788	29.565	1.46	73.209	39.248
11	Bijaya Tourist Lodge	25.152	22.548	35.04	1.46	60.192	24.008
12	Hotel Babylon	94.704	84.612	20.805	1.095	115.509	85.707
13	Hotel Apanjan	161.64	143.076	60.59	2.555	222.23	145.631
14	Hotel Amarabati	208.656	185.652	73.73	3.285	282.386	188.937
15	Hotel Sea View	38.34	33.924	15.695	0.73	54.035	34.654
16	Hotel Moumita	25.176	22.584	21.17	1.095	46.346	23.679
17	Hotel Rainbow	86.988	77.268	100.01	4.38	186.998	81.648

18	Hotel Bhorer Allo	44.112	39.54	40.515	1.825	84.627	41.365
19	Hotel Joyguru	13.656	12.216	33.945	1.46	47.601	13.676
20	Hotel Triva	54.42	48.612	62.78	2.92	117.2	51.532
21	Hotel Meghalaya	28.896	25.824	49.64	2.19	78.536	28.014
22	Hotel Amantran	18.012	16.152	21.17	1.095	39.182	17.247
23	Hotel Samudra Nill	47.964	42.78	21.535	1.095	69.499	43.875
24	Hotel Chhuti	59.724	53.364	62.05	2.92	121.774	56.284
25	Hotel Pinki	24.492	21.828	69.35	3.285	93.842	25.113
26	Beach Resort	27.324	24.456	29.2	1.46	56.524	25.916
27	Hotel Sanjog	67.872	60.252	45.26	2.19	113.132	62.442

* Greenhouse gas emission is 850 grams per kilowatt-hour of CO_2 Equivalent for oil-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

**Greenhouse gas emission is 45 grams per Kilowatt-hour of CO_2 Equivalent for bio-mass based fossil fuel form of energy supply i.e. (75.92 x 45) = 3416.4 gms C = 3.416 KgC [IEEE Spectrum, Issue: Feb 2008, Vol. -45, No. 2, Pg 56].

Table 5.9 Comparative Environmental Impact of the no. of 27th Hotels at Bakkhali (2019 – 2020)

SL NO.	Name of the Hotel			Annual recurring CO_2 Emission, 2019-2020	
		kWh/m²/year		KgC/m^2/year	
		****Sustainable EPI benchmark 183.33 kWh/m²/year [GRIHA, 2015]**		*****Sustainable CO_2-foot-print 2.363**	
1	Balaka Lodge	94.405	49% lower	56.384	24 times larger and more intensive than the sustainable threshold
2	Sahana Tourist Lodge	56.06	69% lower	22.724	10 times larger and more intensive than the sustainable threshold
3	Bakkhali Tourist Lodge	279.283	52% higher	225.255	95 times larger and more intensive than the sustainable threshold
4	Narayani Lodge	191.23	4% higher	145.148	61 times larger and more intensive than the sustainable threshold

5	Hotel Bay View	65.593	64% lower	41.698	18 times larger and more intensive than the sustainable threshold
6	Samabay Sasthya Unnayan Sanstha	96.54	47% lower	15.518	7 times larger and more intensive than the sustainable threshold
7	Bakkhali Beach Banglow	99.389	46% lower	70.323	30 times larger and more intensive than the sustainable threshold
8	Hotel Samanta	58.58	68% lower	25.16	11 times larger and more intensive than the sustainable threshold
9	Hotel Hansaraj	18.342	90% lower	6.977	3 times larger and more intensive than the sustainable threshold
10	Hotel Sagarika	73.209	60% lower	39.248	17 times larger and more intensive than the sustainable threshold
11	Bijaya Tourist Lodge	60.192	67% lower	24.008	10 times larger and more intensive than the sustainable threshold
12	Hotel Babylon	115.509	37% lower	85.707	36 times larger and more intensive than the sustainable threshold
13	Hotel Apanjan	222.23	21% higher	145.631	62 times larger and more intensive than the sustainable threshold
14	Hotel Amarabati	282.386	54% higher	188.937	80 times larger and more intensive than the sustainable threshold
15	Hotel Sea View	54.035	70% lower	34.654	15 times larger and more intensive than the sustainable threshold
16	Hotel Moumita	46.346	74% lower	23.679	10 times larger and more intensive than the sustainable threshold

17	Hotel Rainbow	186.998	2% higher	81.648	35 times larger and more intensive than the sustainable threshold
18	Hotel Bhorer Allo	84.627	54% lower	41.365	18 times larger and more intensive than the sustainable threshold
19	Hotel Joyguru	47.601	74% lower	13.676	6 times larger and more intensive than the sustainable threshold
20	Hotel Triva	117.2	36% lower	51.532	22 times larger and more intensive than the sustainable threshold
21	Hotel Meghalaya	78.536	57% lower	28.014	12 times larger and more intensive than the sustainable threshold
22	Hotel Amantran	39.182	79% lower	17.247	7 times larger and more intensive than the sustainable threshold
23	Hotel Samudra Nill	69.499	62% lower	43.875	19 times larger and more intensive than the sustainable threshold
24	Hotel Chhuti	121.774	34% lower	56.284	24 times larger and more intensive than the sustainable threshold
25	Hotel Pinki	93.842	49% lower	25.113	11 times larger and more intensive than the sustainable threshold
26	Beach Resort	56.524	69% lower	25.916	11 times larger and more intensive than the sustainable threshold
27	Hotel Sanjog	113.132	38% lower	62.442	26 times larger and more intensive than the sustainable threshold

**The Energy Performance Index are compared with the 'Green Rating for Integrated Habitat Assessment (GRIHA)' prescribed threshold of 275 kWh/m^2/year (GRIHA, 2019). Considering river or sea-side activities at Sundarbans tourism spots for eight hours and indoor space usage for 16 hours, the benchmark comes down to [275 x (16/24)] = 183.33 kWh/m^2/year (GRIHA, 2015).

***One Joule = 2.78 x 10^{-7} kWh; 100 GJ = 100 x 10^9 Joule = (100 x 10^9) x (2.78 x 10^{-7}) kWh = 27800kWh

One Hectare = 10,000Sqm; if sustainable capacity of 1 Ha is 100 GJ or 27800 kWh, then (27,800/10,000) = 2.78 kWh is that of one Sqm.

For oil-based energy supply, this amounts to (2.78 x 0.85) Kg or 2.363 Kg of CO_2 released to the atmosphere. It is to be noted that for coal based energy supply (i.e. thermal power stations), the same will be (2.78 x 0.9) = 2.5 Kg CO_2 equivalent Green House Gases (GHGs) emitted to the atmosphere.

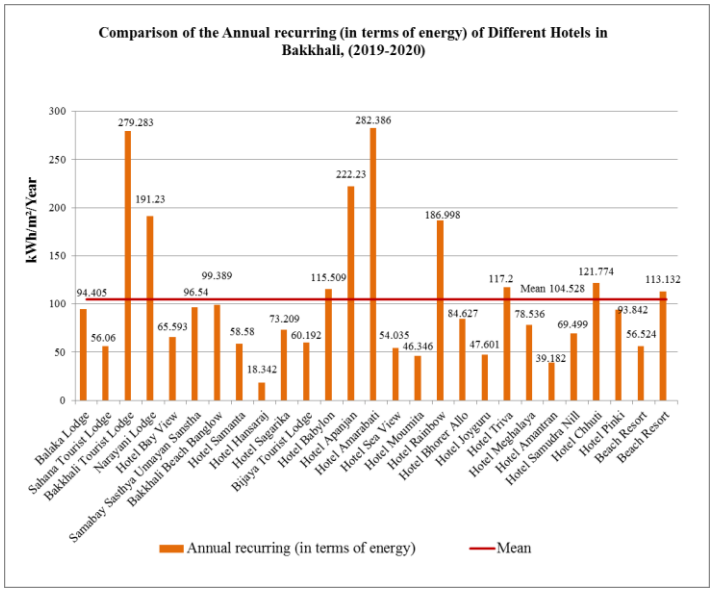


Figure 5.4 Energy Performance Index (EPI) of the different hotels in Bakkhali (2019-20)

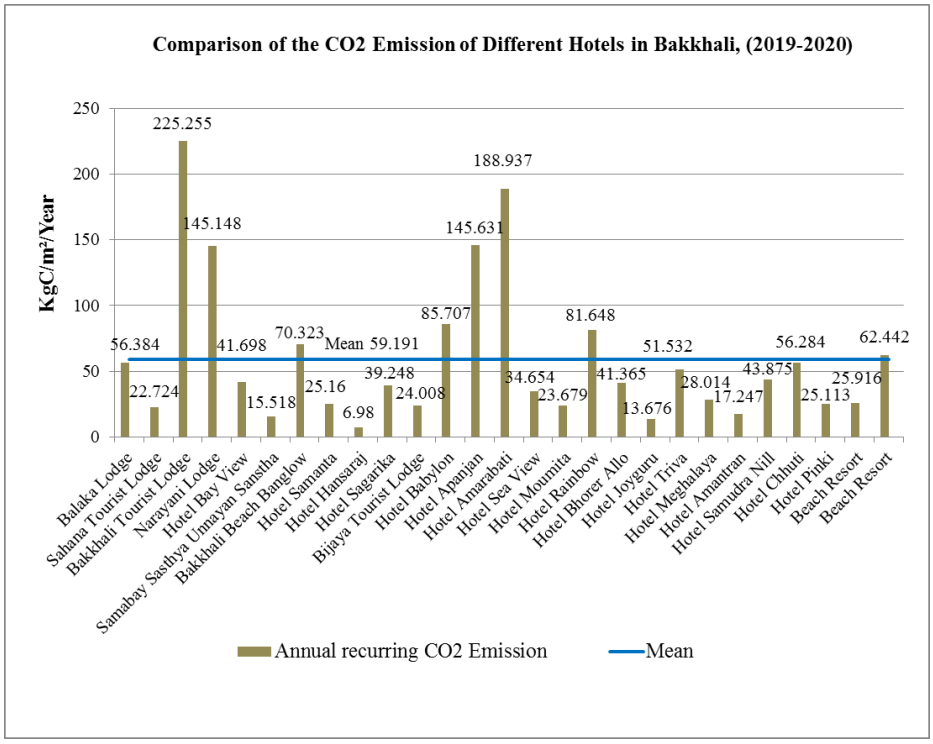


Figure 5.5 CO_2 Emission of the different hotels in Bakkhali (2019-20)

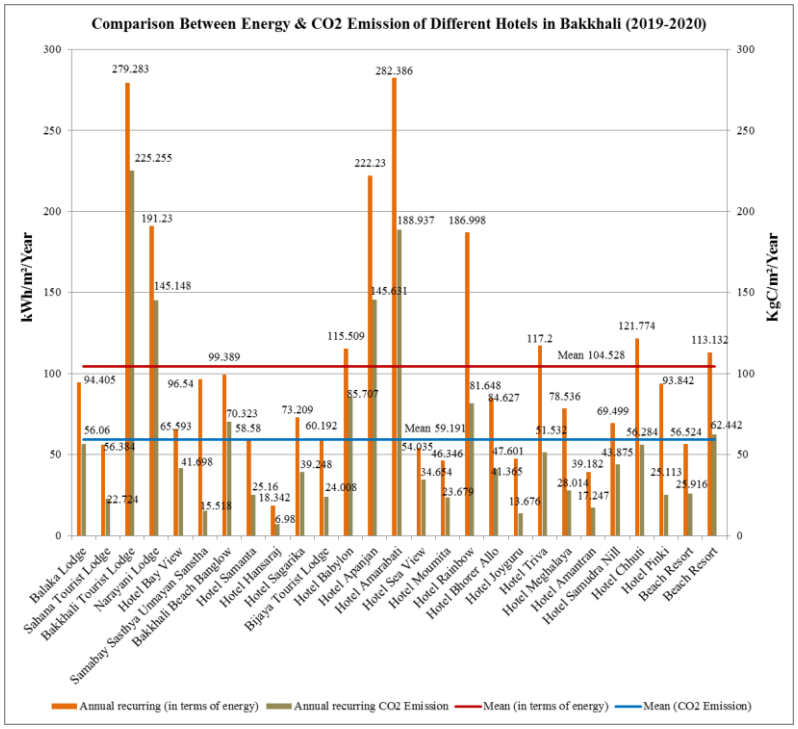


Figure 5.6 Comparison between Energy & CO_2 Emission of the different hotels in Bakkhali (2019-20)

Table 5.10 Type of Building and Energy use in the lodging facilities studies at Jharkhali

Sl No.	Name of the Hotel	Built-up area (m^2)	No. of storeys	No. of Beds	DG Service & Power (KVA)		No. of AC/NON AC Room		Power Grid Energy consume per Month (kWh)	Waste (Solid Waste) generated/kg/bed/day
					YES	NO	AC	NON AC		
1	Jharbanglow	79.37	One	14	-	No	-	3	136.36	0.2
2	Banalata Lodge	135.06	Two	36	Yes (2.5 KVA)	-	-	9	121.21	0.17
3	Mangrove Wild Resort	286.52	One	37	Yes (5 KVA)	-	4	10	606.09	0.25
4	Billabasi Lodge	96.95	One	25	-	No	-	6	90.91	0.17
5	Jani Hotel	55.2	One	11	Yes (2.5 KVA)	-	-	4	90.91	0.175
6	Royal Sundarban Wild Resort	500	One	80	Yes (10 KVA)	-	15	5	545.45	0.15
7	Sarkar Tiger Camp Lodge	94.55	One	10	-	No	-	5	181.82	0.15
8	Sundar Resort	161.94	One	6	-	No	-	3	106.09	0.2
9	Swabhumi Guest House	227.75	Two	28	Yes (10 KVA)	-	4	9	417.64	0.2
10	Akash Guest House	42.35	One	8	Yes (2.5 KVA)	-	-	5	121	0.25
11	Kali Adber Hotel	73.79	One	8	-	No	-	4	136.36	0.2
12	Maa Tara Guest House	157.7	Two	36	-	No	-	12	95.45	0.2
13	Aronnok Home Stay	74.79	One	12	-	No	-	3	137	0.2
14	Dream Land Home Stay	64	One	9	Yes (5 KVA)	-	-	3	43.18	0.15
15	Ekanta Apan	330.89	Two	28	Yes (7.5 KVA)	-	3	8	272.73	0.2
16	Sundarban Natural Home Stay	83.52	Two	20	Yes (2.5 KVA)	-	-	8	170.45	0.2

Source: Primary data source (Field survey)

Table 5.11 Comprehensive Assessment of Energy Consumption & Co_2 Emission in Building Operation for 16th Hotels at Jharkhali (2019 – 2020)

SL NO.	Hotel's Name	Annual recurring (in terms Building operation energy), 2019-2020	Annual recurring CO_2 Emission, 2019-2020	Annual recurring (in terms waste generate energy), 2019-2020	Annual recurring CO_2 Emission, 2019-2020	Annual recurring (in terms of total energy), 2019-2020	Annual recurring (in terms of total CO_2 Emission), 2019-2020
		$kWh/m^2/Yr$	$KgC/m^2/Yr$	$kWh/m^2/Yr$	$KgC/m^2/Yr$	$kWh/m^2/Yr$	$KgC/ m^2/Yr$
		A	B = (A x 0.85*)	C	D = (C x 0.045**)	A + C	B + D
1	Jharbanglow	20.616	18.552	56.94	2.555	77.556	21.107
2	Banalata Lodge	6.276	5.604	36.5	1.46	42.776	7.064
3	Mangrove Wild Resort	27.396	24.552	51.83	2.19	79.226	26.742

4	Billabasi Lodge	11.256	10.128	70.81	2.92	82.066	13.048
5	Jani Hotel	22.368	20.004	54.75	2.19	77.118	22.194
6	Royal Sundarban Wild Resort	14.628	13.092	38.69	1.83	53.318	14.922
7	Sarkar Tiger Camp Lodge	23.076	20.772	25.55	1.095	48.626	21.867
8	Sundar Resort	7.86	7.08	11.68	0.365	19.54	7.445
9	Swabhumi Guest House	13.116	11.688	19.71	0.73	32.826	12.418
10	Akash Guest House	39.384	35.196	75.92	3.285	115.304	38.481
11	Kali Adber Hotel	22.176	19.956	35.04	1.46	57.216	21.416
12	Maa Tara Guest House	3.636	3.264	36.865	1.825	40.501	5.089
13	Aronnok Home Stay	21.984	19.776	51.83	2.19	73.814	21.966
14	Dream Land Home Stay	15.6	13.656	33.945	1.46	49.545	15.116
15	Ekanta Apan	6.36	5.652	13.505	0.73	19.865	6.382
16	Sundarban Natural Home Stay	13.968	12.48	38.69	1.825	52.658	14.305

* Greenhouse gas emission is 850 grams per kilowatt-hour of CO_2 Equivalent for oil-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

**Greenhouse gas emission is 45 grams per Kilowatt-hour of CO_2 Equivalent for bio-mass based fossil fuel form of energy supply i.e. (75.92 x 45) = 3416.4 gms C = 3.416 KgC [IEEE Spectrum, Issue: Feb 2008, Vol. -45, No. 2, Pg 56].

Table 5.12 Comparative Environmental Impact of the no. of 16th Hotels at Jharkhali (2019 – 2020)

SL NO.	Name of the Hotel			Annual recurring CO_2 Emission, 2019-2020	
		kWh/m²/year		KgC/m^2/Year	
		****Sustainable EPI benchmark 183.33 kWh/m²/Year [GRIHA, 2015]**		*****Sustainable CO_2-foot-print 2.363**	
1	Jharbanglow	77.556	58% lower	21.107	9 times larger and more intensive than the sustainable threshold
2	Banalata Lodge	42.776	77% lower	7.064	3 times larger and more intensive than the sustainable threshold
3	Mangrove Wild Resort	79.226	57% lower	26.742	11 times larger and more intensive than the sustainable threshold
4	Billabasi Lodge	82.066	55% lower	13.048	6 times larger and more intensive than the sustainable threshold
5	Jani Hotel	77.118	58% lower	22.194	9 times larger and more intensive than the sustainable threshold
6	Royal Sundarban Wild Resort	53.318	71% lower	14.922	6 times larger and more intensive than the sustainable threshold
7	Sarkar Tiger Camp Lodge	48.626	73% lower	21.867	9 times larger and more intensive than the sustainable threshold
8	Sundar Resort	19.54	89% lower	7.445	3 times larger and more intensive than the sustainable threshold

9	Swabhumi Guest House	32.826	82% lower	12.418	5 times larger and more intensive than the sustainable threshold
10	Akash Guest House	115.304	37% lower	38.481	16 times larger and more intensive than the sustainable threshold
11	Kali Adber Hotel	57.216	68% lower	21.416	9 times larger and more intensive than the sustainable threshold
12	Maa Tara Guest House	40.501	78% lower	5.089	2 times larger and more intensive than the sustainable threshold
13	Aronnok Home Stay	73.814	60% lower	21.966	9 times larger and more intensive than the sustainable threshold
14	Dream Land Home Stay	49.545	73% lower	15.116	6 times larger and more intensive than the sustainable threshold
15	Ekanta Apan	19.865	89% lower	6.382	3 times larger and more intensive than the sustainable threshold
16	Sundarban Natural Home Stay	52.658	71% lower	14.305	6 times larger and more intensive than the sustainable threshold

**The Energy Performance Index are compared with the 'Green Rating for Integrated Habitat Assessment (GRIHA)' prescribed threshold of 275 kWh/m^2/year (GRIHA, 2019). Considering river or sea-side activities at Sundarbans tourism spots for eight hours and indoor space usage for 16 hours, the benchmark comes down to [275 x (16/24)] = 183.33 kWh/m^2/year (GRIHA, 2015).

***One Joule = 2.78 x 10^{-7} kWh; 100 GJ = 100 x 10^9 Joule = (100 x 10^9) x (2.78 x 10^{-7}) kWh = 27800kWh

One Hectare = 10,000Sqm; if sustainable capacity of 1 Ha is 100 GJ or 27800 kWh, then (27,800/10,000) = 2.78 kWh is that of one Sqm.

For oil-based energy supply, this amounts to (2.78 x 0.85) Kg or 2.363 Kg of CO_2 released to the atmosphere. It is to be noted that for coal based energy supply (i.e. thermal power stations), the same will be (2.78 x 0.9) = 2.5 Kg CO_2 equivalent Green House Gases (GHGs) emitted to the atmosphere.

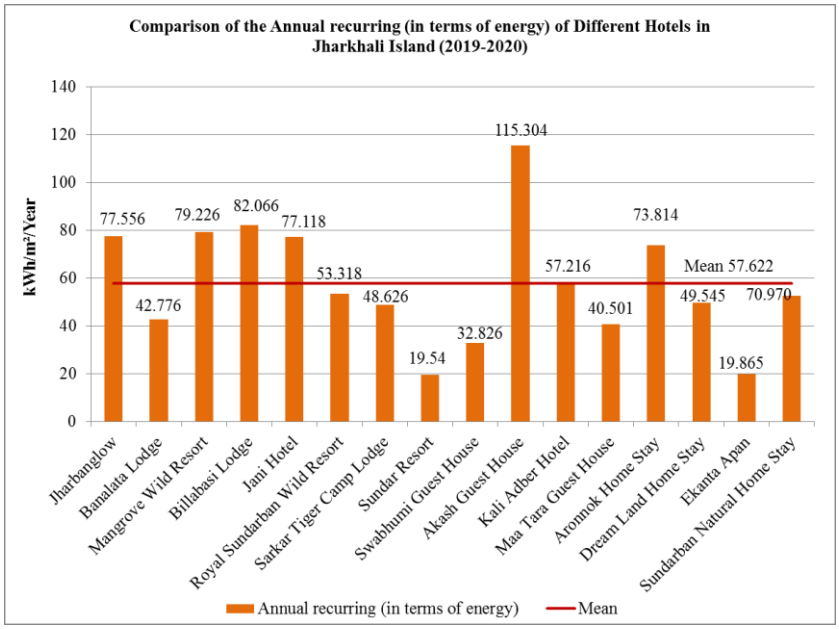


Figure 5.7 Energy Performance Index (EPI) of the different hotels in Jharkhali (2019-20)

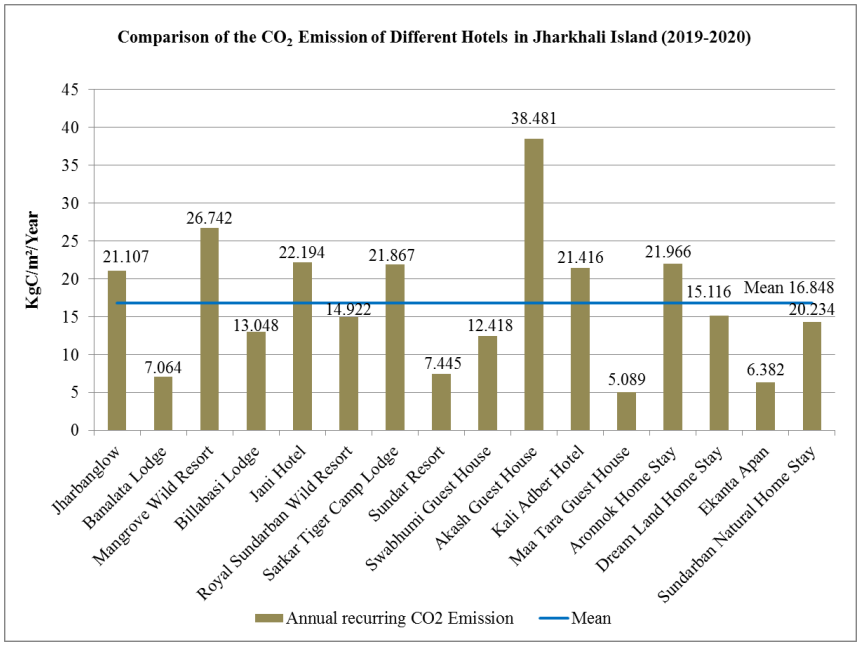


Figure 5.8 CO_2 Emission of the different hotels in Jharkhali (2019-20)

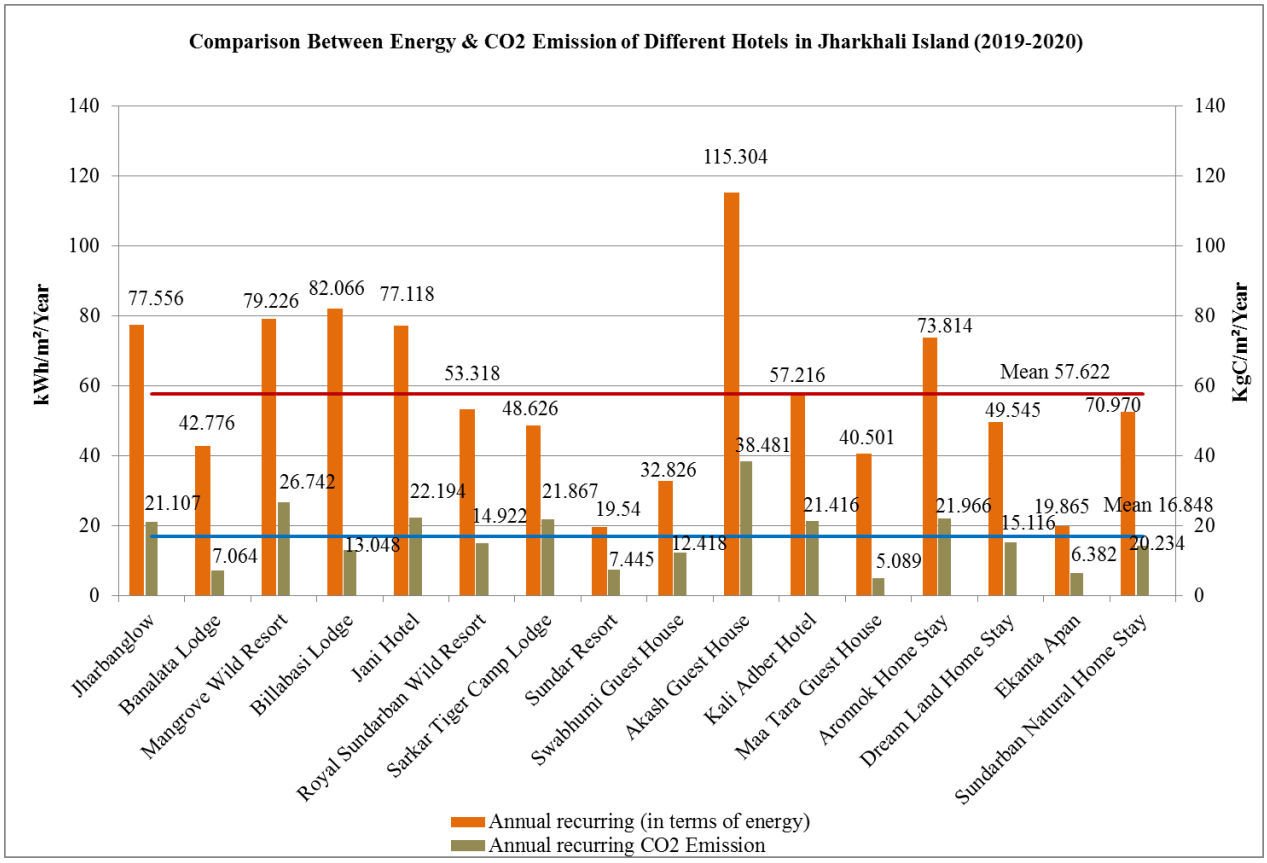


Figure 5.9 Comparison between Energy & CO_2 Emission of the different hotels in Jharkhali (2019-20)

Table 5.13 Type of Building and Energy use in the lodging facilities studies at Pakhiralaya (Gosaba)

Sl No.	Name of the Hotel	Built-up area (m^2)	No. of storeys	No. of Beds	DG Service & Power (KVA)		No. of AC/NON AC Room		Power Grid Energy consume per Month (kWh)	Waste (Solid Waste) generated/kg/bed/day
					YES	NO	AC	NON AC		
1	Sanaha Guest House	270	Two	50	Yes (7.5 KVA)	-	2	8	363.64	0.2
2	Mangroves Hotel	160	One	32	-	No	-	4	63.64	0.18
3	Aram Home Stay	90	Two	30	-	No	-	10	109.09	0.2
4	Hemonta Lodge	350	One	12	Yes (5 KVA)	-	-	6	90.91	0.2
5	Hotel Mouchak	210	Two	42	Yes (5 KVA)	-	-	21	242.42	0.17
6	Hotel Mainak	185	Two	32	Yes (5 KVA)	-	-	8	121.21	0.18
7	Sundarban Home Stay	100	Two	20	Yes (7.5 KVA)	-	-	10	127.27	0.18
8	Dalphin Hotel	130	One	19	Yes (5 KVA)	-	-	9	106.06	0.2

9	Hotel Sreya	440	Two	72	Yes (10 KVA)	-	-	18	363.64	0.17
10	S2 Hotel	700	Three	54	Yes (10 KVA)	-	25	2	545.45	0.2
11	Sanartari Eco Resort	270	One	20	Yes (7.5 KVA)	-	6	4	181.82	0.175
12	Apanjan Resort (New)	700	One	80	Yes (10 KVA)	-	-	20	303.03	0.2
13	Avinandan Cottage	210	One	45	Yes (7.5 KVA)	-	-	15	454.55	0.2
14	Sundari Lodge	200	Two	36	Yes (10 KVA)	-	-	12	409.091	0.2
15	Madhuban Hotel	150	Two	28	Yes (7.5 KVA)	-	10	4	303.03	0.2
16	Apanjan Hotel	424	Three	52	Yes (10 KVA)	-	4	22	454.55	0.2
17	Spandan Guest House	180	One	12	Yes (5 KVA)	-	-	6	121.21	0.18
18	Lodge Chital	350	One	32	Yes (7.5 KVA)	-	-	10	151.52	0.2
19	Banaful Hotel	120	Two	32	Yes (5 KVA)	-	-	8	196.97	0.18
20	Hotel Promila	160	Three	57	Yes (7.5 KVA)	-	-	19	363.64	0.2
21	Maa Taruvila	160	Two	48	Yes (7.5 KVA)	-	-	12	272.73	0.17

Source: Primary data source (Field survey)

Table 5.14 Comprehensive Assessment of Energy Consumption & Co_2 Emission in Building Operation for 21st Hotels at Pakhiralaya, Gosaba (2019 – 2020)

SL NO.	Hotel's Name	Annual recurring (in terms Building operation energy), 2019-2020	Annual recurring CO_2 Emission, 2019-2020	Annual recurring (in terms waste generate energy), 2019-2020	Annual recurring CO_2 Emission, 2019-2020	Annual recurring (in terms of total energy), 2019-2020	Annual recurring (in terms of total CO_2 Emission), 2019-2020
		$kWh/m^2/Yr$	$KgC/m^2/Yr$	$kWh/m^2/Yr$	$KgC/m^2/Yr$	$kWh/m^2/Yr$	$KgC/ m^2/Yr$
		A	B = (A x 0.85*)	C	D = (C x 0.045**)	A + C	B + D
1	Sanaha Guest House	10.08	8.976	29.93	1.46	40.01	10.436
2	Mangroves Hotel	4.776	4.296	58.035	2.555	62.811	6.851
3	Aram Home Stay	7.272	6.54	53.655	2.555	60.927	9.095
4	Hemonta Lodge	4.488	3.972	10.95	0.365	15.438	4.337
5	Hotel Mouchak	8.292	7.404	27.375	1.095	35.667	8.499
6	Hotel Mainak	5.88	5.196	25.185	1.095	31.065	6.291

7	Sundarban Home Stay	13.032	11.46	29.2	1.46	42.232	12.92
8	Dalphin Hotel	13.488	11.952	47.085	2.19	60.573	14.142
9	Hotel Sreya	6.924	6.132	22.265	1.095	29.189	7.227
10	S2 Hotel	3.66	3.276	8.395	0.365	12.055	3.641
11	Sanartari Eco Resort	10.752	9.54	20.805	1.095	31.557	10.635
12	Apanjan Resort (New)	7.248	6.42	36.865	1.825	44.113	8.245
13	Avinandan Cottage	29.4	26.292	68.985	3.285	98.385	29.577
14	Sundari Lodge	14.436	12.876	29.2	1.46	43.636	14.336
15	Madhuban Hotel	15.72	13.968	30.295	1.46	46.015	15.428
16	Apanjan Hotel	5.796	5.148	13.14	0.73	18.936	5.878
17	Spandan Guest House	10.752	9.54	19.35	0.73	30.102	10.27
18	Lodge Chital	7.248	6.42	29.565	1.46	36.813	7.88
19	Banaful Hotel	12.252	10.908	38.69	1.825	50.942	12.733
20	Hotel Promila	11.34	10.092	38.325	1.825	49.665	11.917
21	Maa Taruvila	12.48	11.112	41.245	1.825	53.725	12.937

* Greenhouse gas emission is 850 grams per kilowatt-hour of CO_2 Equivalent for oil-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

**Greenhouse gas emission is 45 grams per Kilowatt-hour of CO_2 Equivalent for bio-mass based fossil fuel form of energy supply i.e. (75.92 x 45) = 3416.4 gms C = 3.416 KgC [IEEE Spectrum, Issue: Feb 2008, Vol. -45, No. 2, Pg 56].

Table 5.15 Comparative Environmental Impact of the no. of 21st Hotels at Pakhiralaya, Gosaba (2019 – 2020)

SL NO.	Name of the Hotel			Annual recurring CO_2 Emission, 2019-2020	
				KgC/m^2/Year	
		****Sustainable EUI benchmark 183.33 kWh/m²/Year [GRIHA, 2015]**		*****Sustainable CO_2-foot-print 2.363**	
1	Sanaha Guest House	40.01	78% lower	10.436	4 times larger and more intensive than the sustainable threshold

2	Mangroves Hotel	62.811	66% lower	6.851	3 times larger and more intensive than the sustainable threshold
3	Aram Home Stay	60.927	67% lower	9.095	4 times larger and more intensive than the sustainable threshold
4	Hemonta Lodge	15.438	92% lower	4.337	2 times larger and more intensive than the sustainable threshold
5	Hotel Mouchak	35.667	81% lower	8.499	4 times larger and more intensive than the sustainable threshold
6	Hotel Mainak	31.065	83% lower	6.291	3 times larger and more intensive than the sustainable threshold
7	Sundarban Home Stay	42.232	77% lower	12.92	5 times larger and more intensive than the sustainable threshold
8	Dalphin Hotel	60.573	67% lower	14.142	6 times larger and more intensive than the sustainable threshold
9	Hotel Sreya	29.189	84% lower	7.23	3 times larger and more intensive than the sustainable threshold
10	S2 Hotel	12.055	93% lower	3.641	2 times larger and more intensive than the sustainable threshold
11	Sanartari Eco Resort	31.557	83% lower	10.635	5 times larger and more intensive than the sustainable threshold
12	Apanjan Resort (New)	44.113	76% lower	8.245	3 times larger and more intensive than the sustainable threshold
13	Avinandan Cottage	98.385	46% lower	29.577	13 times larger and more intensive than the sustainable threshold

14	Sundari Lodge	43.636	76% lower	14.336	6 times larger and more intensive than the sustainable threshold
15	Madhuban Hotel	46.015	75% lower	15.428	7 times larger and more intensive than the sustainable threshold
16	Apanjan Hotel	18.936	90% lower	5.878	2 times larger and more intensive than the sustainable threshold
17	Spandan Guest House	30.102	84% lower	10.27	4 times larger and more intensive than the sustainable threshold
18	Lodge Chital	36.813	80% lower	7.88	3 times larger and more intensive than the sustainable threshold
19	Banaful Hotel	50.942	72% lower	12.733	5 times larger and more intensive than the sustainable threshold
20	Hotel Promila	49.665	73% lower	11.917	5 times larger and more intensive than the sustainable threshold
21	Maa Taruvila	53.725	71% lower	12.937	5 times larger and more intensive than the sustainable threshold

**The Energy Performance Index are compared with the 'Green Rating for Integrated Habitat Assessment (GRIHA)' prescribed threshold of 275 kWh/m^2/year (GRIHA, 2019). Considering river or sea-side activities at Sundarbans tourism spots for eight hours and indoor space usage for 16 hours, the benchmark comes down to [275 x (16/24)] = 183.33 kWh/m^2/year (GRIHA, 2015).

***One Joule = 2.78 x 10^{-7} kWh; 100 GJ = 100 x 10^9 Joule = (100 x 10^9) x (2.78 x 10^{-7}) kWh = 27800kWh

One Hectare = 10,000Sqm; if sustainable capacity of 1 Ha is 100 GJ or 27800 kWh, then (27,800/10,000) = 2.78 kWh is that of one Sqm.

For oil-based energy supply, this amounts to (2.78 x 0.85) Kg or 2.363 Kg of CO_2 released to the atmosphere. It is to be noted that for coal based energy supply (i.e. thermal power stations), the same will be (2.78 x 0.9) = 2.5 Kg CO_2 equivalent Green House Gases (GHGs) emitted to the atmosphere.

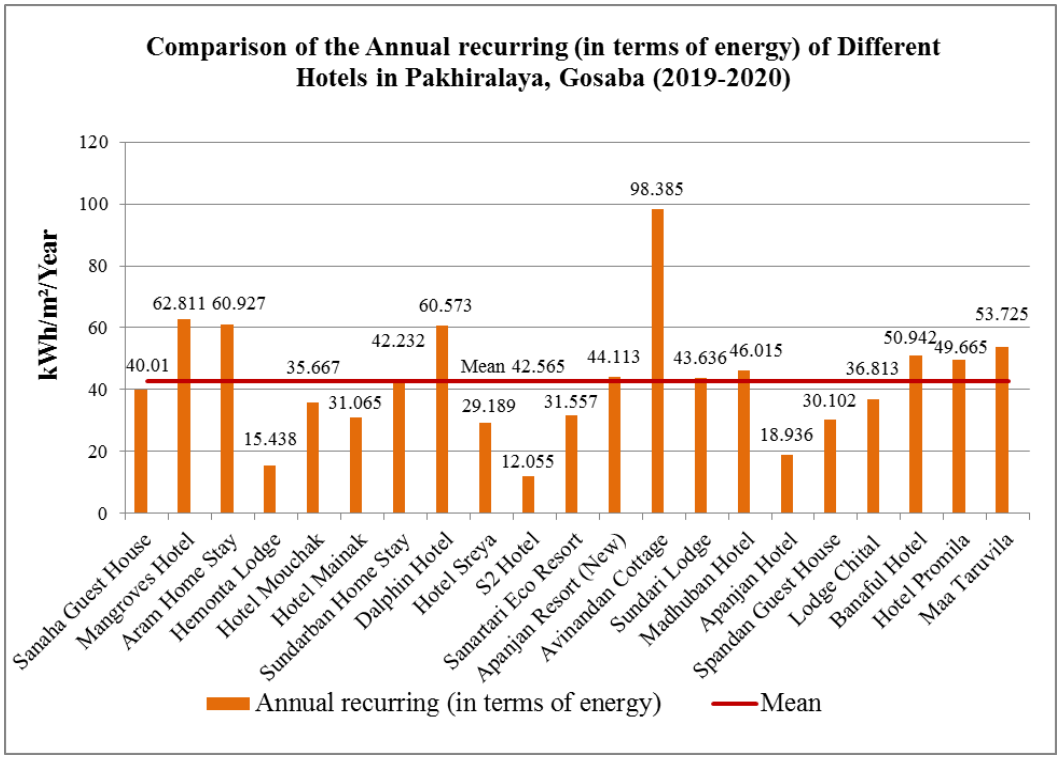


Figure 5.10 Energy Performance Index (EPI) of the different hotels in Pakhiralaya (2019-20)

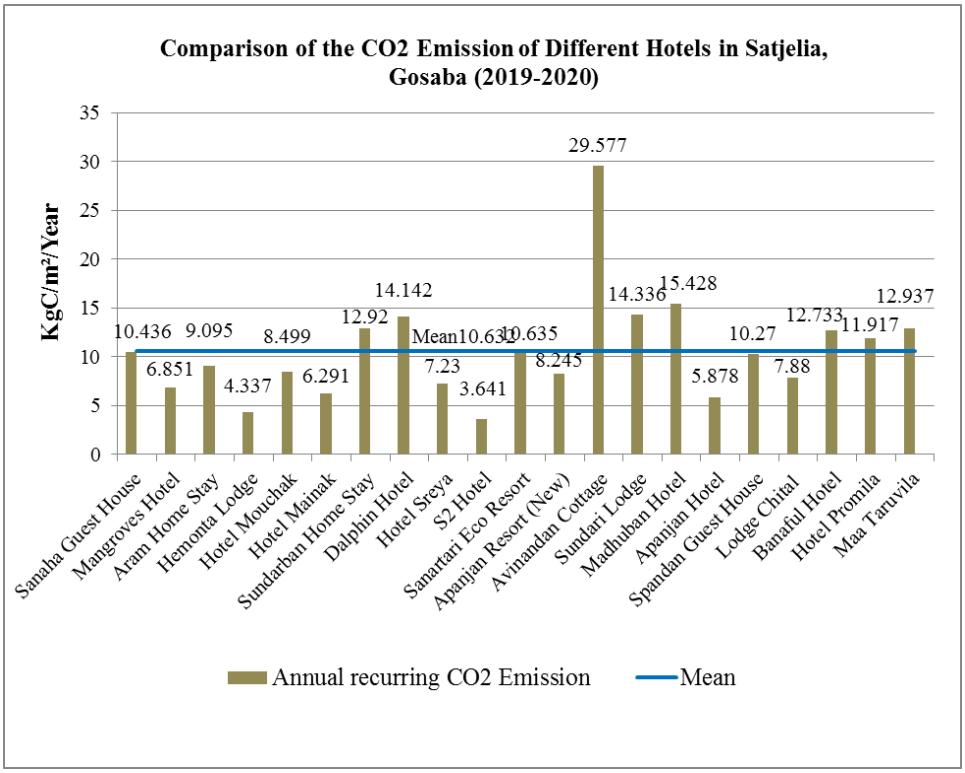


Figure 5.11 CO_2 Emission of the different hotels in Pakhiralaya (2019-20)

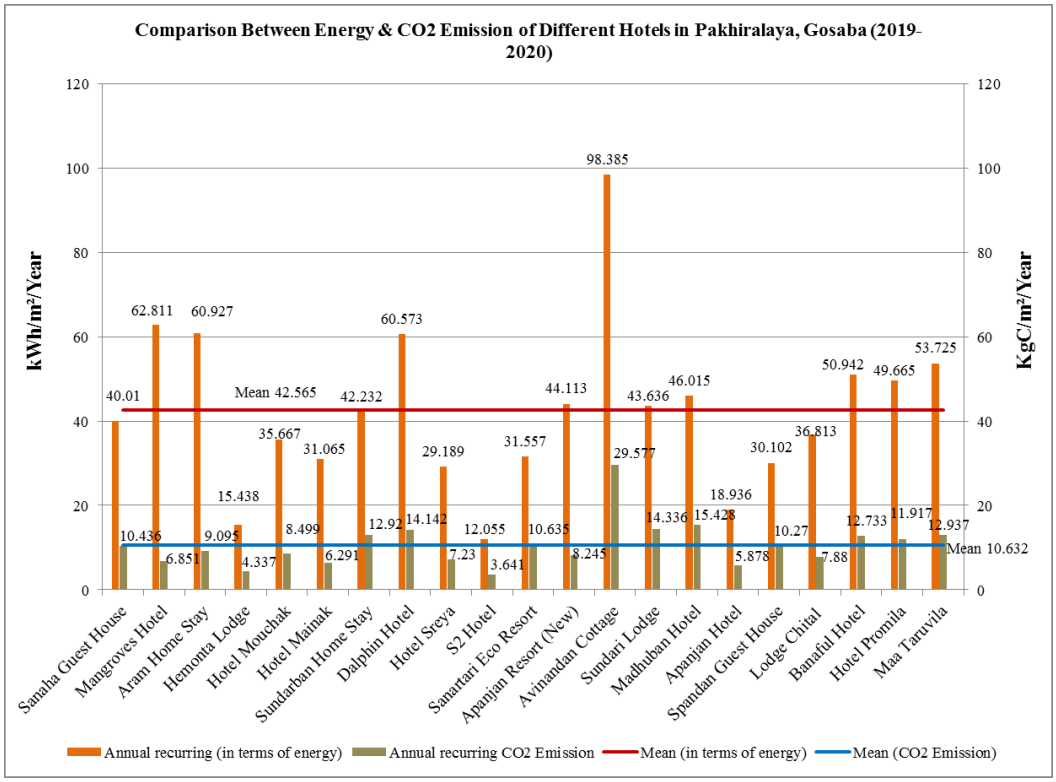


Figure 5.12 Comparison between Energy & CO_2 Emission of the different hotels in Pakhiralaya (2019-20)

Table 5.16 Type of Building and Energy use in the lodging facilities studies at Dayapur (Gosaba)

Sl No.	Name of the Hotel	Built-up area (m^2)	No. of storeys	No. of Beds	DG Service & Power (KVA)		No. of AC/NON AC Room		Power Grid Energy Used per Month (kWh)	Waste (Solid Waste) generated/kg/bed/day
					YES	NO	AC	NON AC		
1	Sundarban Green House	300	Two	42	Yes (5.5 KVA & 4 KVA)	-	-	14	-	0.2
2	Tiger View Point	320	Two	50	Yes (10 KVA & 5 KVA)	-	-	20	-	0.2
3	Sundarban Tiger Camp	400	One	21	Yes (4 KVA, No – 2)	-	7	-	-	0.2
4	New Suranjana Resort	1200	Two	100	Yes (125 KVA & 5 KVA)	-	50	-	-	0.2
5	Royel Bengal Resort	660	Two	60	Yes (45 KVA, 8 KVA, 3.5 KVA & 125 KVA)	-	30	-	-	0.2
6	Sundarban Monisha Resort	334	Two	40	Yes (4 KVA, No. – 2)	-		20	-	0.2
7	Cottage Banobas	220	One	21	Yes (4KVA, No. – 2)	-	7	-	-	0.2
8	Sundarban Riverside Holiday Resort	1400	Two	74	Yes (30 KVA, No. – 2, 20 KVA, No. – 1, 5 KVA, No. – 1)	-	24	5	-	0.2

Source: Primary data source (Field survey)

Table 5.17 Comprehensive Assessment of Resource Consumption & Co_2 Emission in Building Operation for 8th Hotels at Dayapur, Gosaba (2019 – 2020)

SL NO.	Hotel's Name	Annual recurring (in terms Building operation energy), 2019-2020	Annual recurring CO_2 Emission, 2019-2020	Annual recurring (in terms waste generate energy), 2019-2020	Annual recurring CO_2 Emission, 2019-2020	Annual recurring (in terms of total energy), 2019-2020	Annual recurring (in terms of total CO_2 Emission), 2019-2020
		kWh/m^2/Yr	KgC/m^2/Yr	kWh/m^2/Yr	KgC/m^2/Yr	kWh/m^2/Yr	KgC/ m^2/Yr
		A	B = (A x 0.85*)	C	D = (C x 0.045**)	A + C	B + D
1	Sundarban Green House	10.452	8.88	21.9	1.095	32.352	9.975
2	Tiger View Point	17.436	14.82	25.55	1.095	42.986	15.915

3	Sundarban Tiger Camp	11.844	10.068	18.25	0.73	30.094	10.798
4	New Suranjana Resort	95.328	81.036	13.14	0.73	108.468	81.766
5	Royel Bengal Resort	226.596	192.6	14.6	0.73	241.196	193.33
6	Sundarban Monisha Resort	7.092	6.024	18.25	0.73	25.342	6.754
7	Cottage Banobas	37.236	31.644	30.66	1.46	67.896	33.104
8	Sundarban Riverside Holiday Resort	53.424	45.408	7.3	0.365	60.724	45.773

* Greenhouse gas emission is 850 grams per kilowatt-hour of CO_2 Equivalent for oil-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

**Greenhouse gas emission is 45 grams per Kilowatt-hour of CO_2 Equivalent for bio-mass based fossil fuel form of energy supply i.e. (75.92 x 45) = 3416.4 gms C = 3.416 KgC [IEEE Spectrum, Issue: Feb 2008, Vol. -45, No. 2, Pg 56].

Table 5.18 Comparative Environmental Impact of the no. of 8th Hotels at Dayapur, Gosaba (2019 – 2020)

SL NO.	Name of the Hotel			Annual recurring CO_2 Emission, 2019-2020	
		kWh/m²/year		KgC/m^2/Year	
		****Sustainable EPI benchmark 183.33 kWh/m²/Year [GRIHA, 2015]**		*****Sustainable CO_2-foot-print 2.363**	
1	Sundarban Green House	32.352	82% lower	9.975	4 times larger and more intensive than the sustainable threshold
2	Tiger View Point	42.986	77% lower	15.915	7 times larger and more intensive than the sustainable threshold
3	Sundarban Tiger Camp	30.094	84% lower	10.798	5 times larger and more intensive than the sustainable threshold

4	New Suranjana Resort	108.468	41% lower	81.766	35 times larger and more intensive than the sustainable threshold
5	Royel Bengal Resort	241.196	32% higher	193.33	82 times larger and more intensive than the sustainable threshold
6	Sundarban Monisha Resort	25.342	86% lower	6.754	3 times larger and more intensive than the sustainable threshold
7	Cottage Banobas	67.896	63% lower	33.104	14 times larger and more intensive than the sustainable threshold
8	Sundarban Riverside Holiday Resort	60.724	67% lower	45.773	19 times larger and more intensive than the sustainable threshold

**The Energy Performance Index are compared with the 'Green Rating for Integrated Habitat Assessment (GRIHA)' prescribed threshold of 275 kWh/m^2/year (GRIHA, 2019). Considering river or sea-side activities at Sundarbans tourism spots for eight hours and indoor space usage for 16 hours, the benchmark comes down to [275 x (16/24)] = 183.33 kWh/m^2/year (GRIHA, 2015).

***One Joule = 2.78 x 10^{-7} kWh; 100 GJ = 100 x 10^9 Joule = (100 x 10^9) x (2.78 x 10^{-7}) kWh = 27800kWh

One Hectare = 10,000Sqm; if sustainable capacity of 1 Ha is 100 GJ or 27800 kWh, then (27,800/10,000) = 2.78 kWh is that of one Sqm.

For oil-based energy supply, this amounts to (2.78 x 0.85) Kg or 2.363 Kg of CO_2 released to the atmosphere. It is to be noted that for coal based energy supply (i.e. thermal power stations), the same will be (2.78 x 0.9) = 2.5 Kg CO_2 equivalent Green House Gases (GHGs) emitted to the atmosphere.

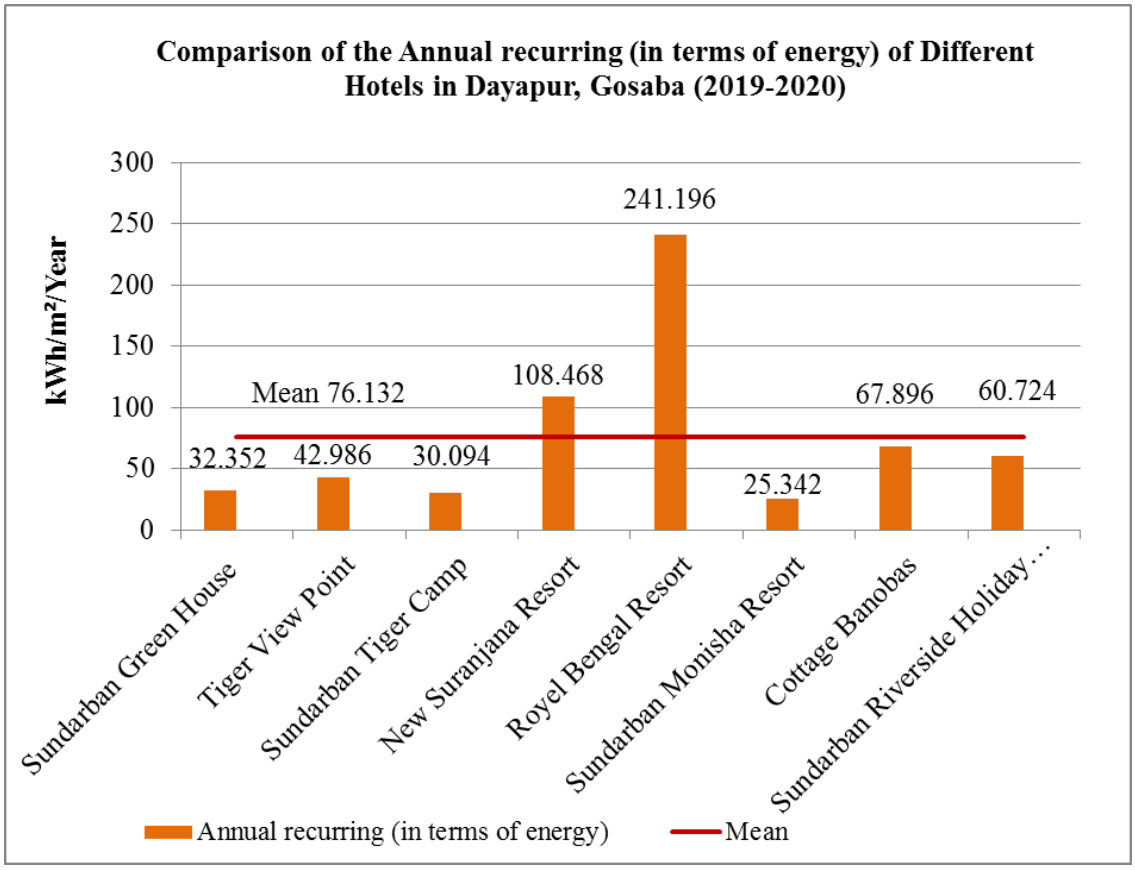


Figure 5.13 Energy Performance Index (EPI) of the different hotels in Dayapur (2019-20)

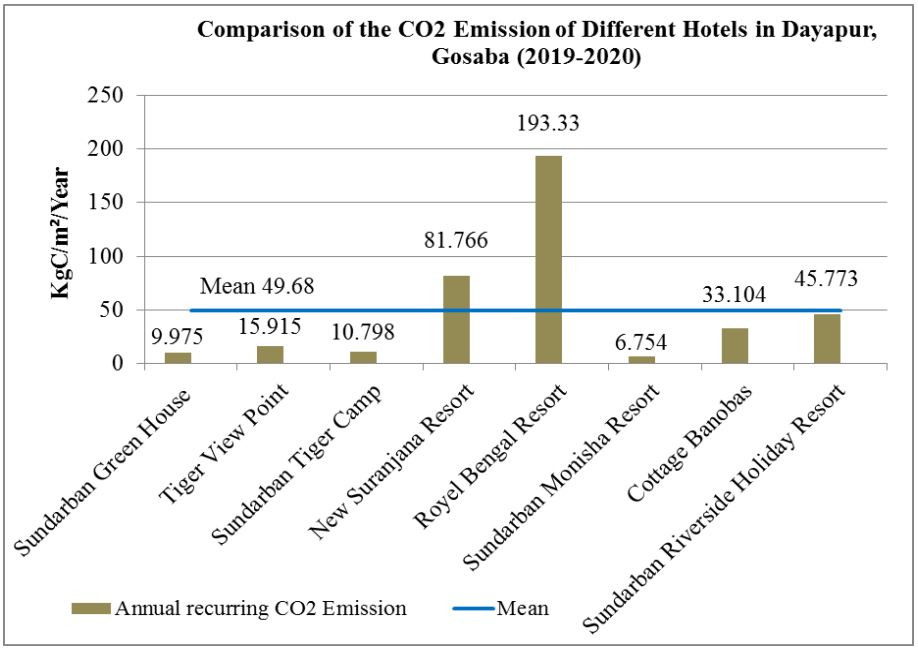


Figure 5.14 CO_2 Emission of the different hotels in Dayapur (2019-20)

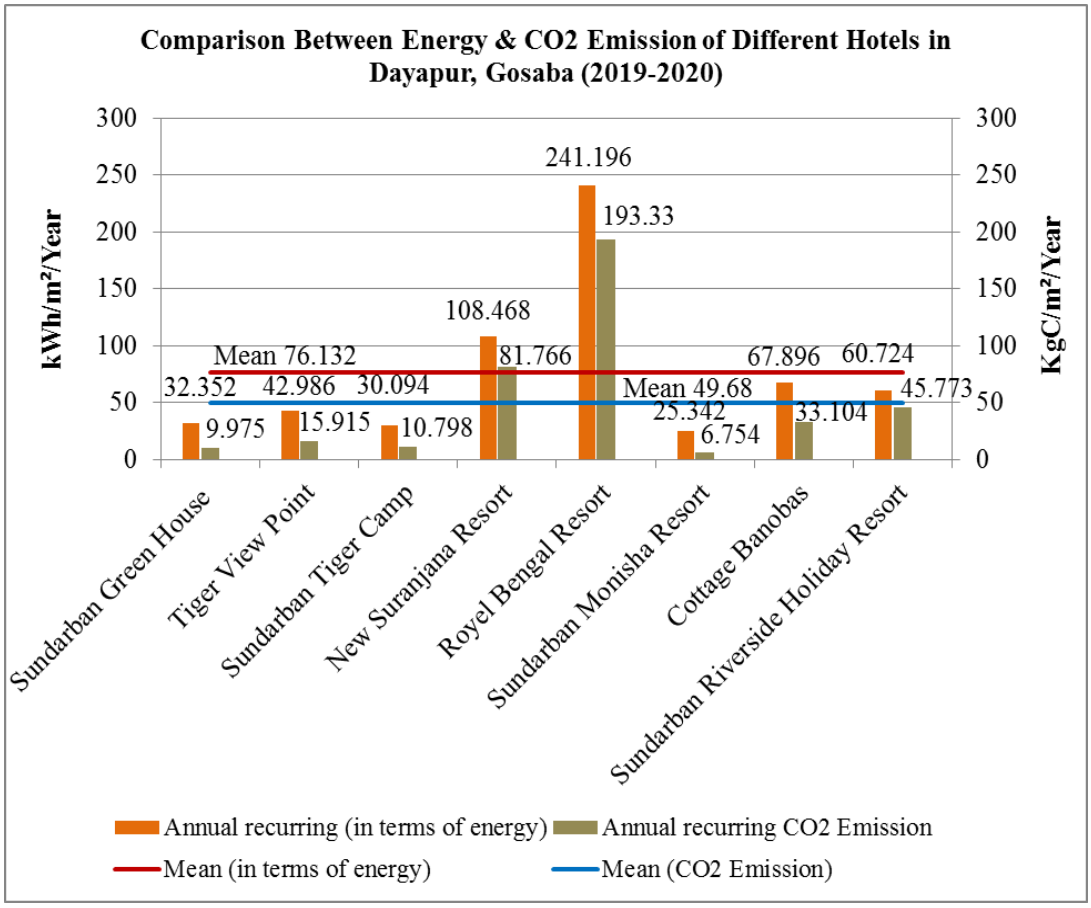


Figure 5.15 Comparison between Energy & CO_2 Emission of the different hotels in Dayapur (2019-20)

5.4. Conclusion:

The hospitality sector is known to be resource-intensive, particularly during its operational period. For the nature-based tourism in sensitive ecological belts, these twenty-four-hour operational buildings run an additional risk of exceeding the sustainable limits of the region and degrading the inherent natural qualities leading to the poor visitor experience. This chapter discussed the current energy consumption and carbon emission of five study areas. The purpose is to inventories their eco-profile to benefit the immediate environment, and the host community as well as invite favorable tourist perception.

Chapter VI:

Demography of the study areas

6.1. Introduction:

The main source of the economy of the Sundarbans depends on nature. The main livelihood of the people of this region is agriculture, fishing, catching crabs, collecting honey and beeswax and animal husbandry, etc. Where 80% to 90% of the people are directly and indirectly dependent on agriculture and fishing and more than 40% of the people are landless agricultural workers (Sundarban Samasya o sambhabana book). At present, besides these, many people are directly and indirectly employed in the transport and tourism industries. Under the eco-tourism range, two organizations, the 'Forest Protection Committee' (FPC) and the 'Eco-Development Committee' (EDC), have been set up to provide employment opportunities to unemployed youth in the region. For example, on the basis of experience and education in the area of eco-tourism, the responsibility of guiding the youth has been given (Swapan Kumar Mandal). According to the survey, one guide is assigned to each tour group. Lots of people in the Sundarbans rely on forest resources for their livelihood and about 79% of their annual income depends on Non-Timber Forest Products (Singh et al., 2010). Non-Timber Forest Products (NTFP) are such as shrimp, crab, honey, bees wax, green coconuts, various mangrove fruits, etc. Apart from agriculture and fishing in the Sundarbans, there are alternative livelihood opportunities, as the tourism industry developed in these areas has provided alternative livelihood opportunities to the people of the region, such as cultural activities, handicrafts, food processing items and about 55% of households interested in forest product, dependent their average annual income from which they earn about 15% extra money from all these sources (Iqball et al., 2010). The tourism industry focuses on the developed regions to help the people of the region economically and earn a living, resulting in an upward trend in the annual income of the people of the region. The positive side of this is to reduce the pressure absorption on the forest and make eco-tourism sustainable (Rajasenan et al., 2012).

The rural cultural ideology of the people of the Sundarbans region is different from other regions. Just as the people here worship the mythical gods and goddesses Sitala and Manasa, there are also special regional gods and goddesses, such as the tiger god Dakshin Ray, worshiped only in the Sundarbans region, and various mythological ballads have been composed of them (Srikhand Sundarban). In all the areas of the Sundarbans where tourist centers have sprung up, folk culture is introduced for the evening entertainment of the tourists, such as Banabibir Pala, Gazi's story, Kabir's song, Dukhe Jatra, Behula Bhasan, Baul song, tribal dance, etc. These are played by local people, which is an alternative way of earning money (Swapan Kumar Mandal).

6.2. Demographic profile of Sagar:

6.2.1. Demographic profile of the local population of Sagar Island:

The main tourist destination of Sagar Island is in the Gangasagar, the main attraction of which is the Kapil Muni Temple. According to the 2011 census, the total number of families in Gangasagar is 2030 and the total population is 10340. The survey was conducted in 138 out of 2030 households in Gangasagar, with a total population of 703, of which 51% are males and 49% are females (figure 6.1). Figure 6.2 shows the proportion of the age-sex pyramid of the surveyed populace, which proves that the number of middle-aged men and women is higher, which predominates in the working population of the region.

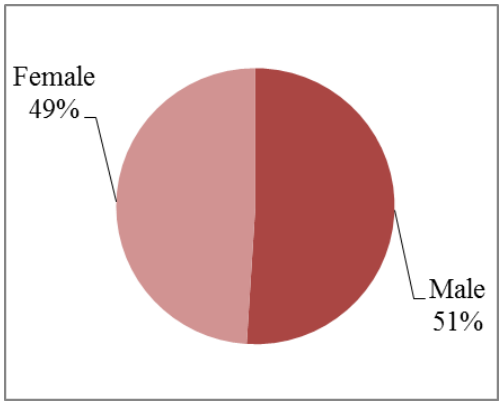


Figure 6.1. Percentage of Male-Female

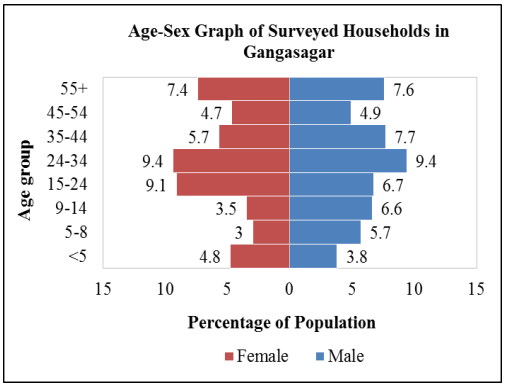


Figure 6.2. Population Pyramid population

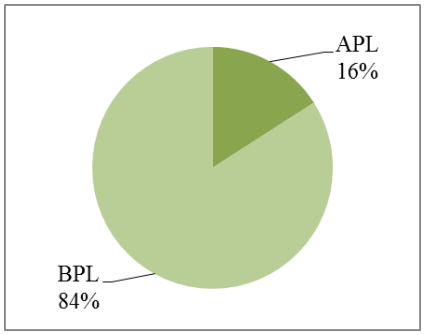


Figure 6.3. Economic status of surveyed population

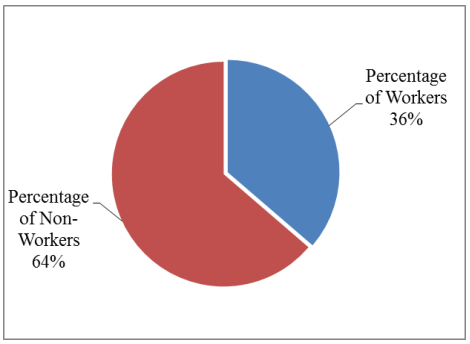


Figure 6.4. Worker & Non-Worker population

The survey was conducted to assess the socio-Monterey structure within local rural communities in terms of their well-known of residing, academic fame, and earnings shape. In phrases of profits, 116 households are below the Poverty Line or BPL (84%) and the handiest 22 households are Above the Poverty Line or APL (16%), as shown in figure 6.3. the world over, the below poverty line consists of those earning 1.90 USD /day in 2015 (global financial institution group, 2016).

however, on this look, the APL and BPL divisions were decided on the idea of what changed supplied on their ration playing cards under the national meals protection Act.

Figure 6.5 shows the percentage of working and non-working population (both male & female separately), with 6.8% females and 26.59% males being the source of income.

Figure 6.4 also shows that 36% of the total populations are involved in earning money, while 64% are non-working people.

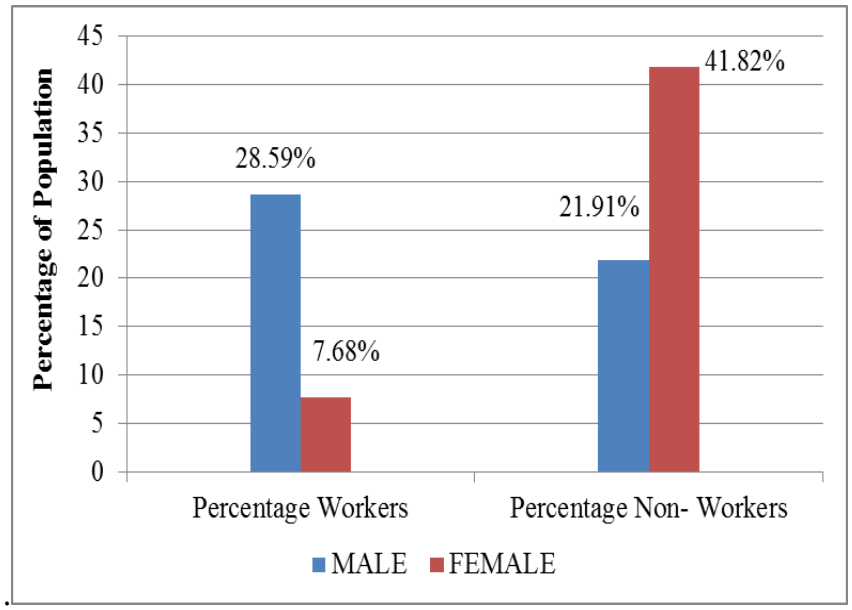


Figure 6.5. Sex-wise Working status of population

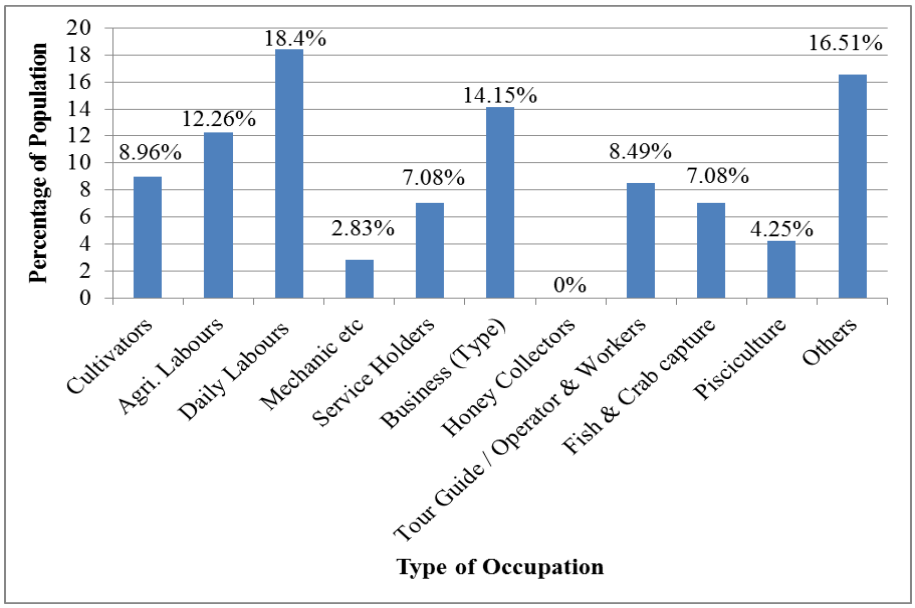


Figure 6.6. Occupation status of surveyed population

The monthly income, type of work, etc. of the households in the study area are shown in the percentage of the population (Figure 6.6). Figure 6.6 shows that out of the total working population of the region, 18.4% are daily laborers, 12.26% are agricultural laborers and 8.96% are cultivators and 8.49% are people who are directly dependent on the tourism industry. People employed in the tourism industry are involved as tour guides, tour operators, and other professions. On the contrary, about 11.33% of the people are indirectly dependent on the tourism industry, whose occupations are fish and crab capture and pisciculture, etc. So it turns out that a good portion of working people is now, directly and indirectly, dependent on the tourism industry.

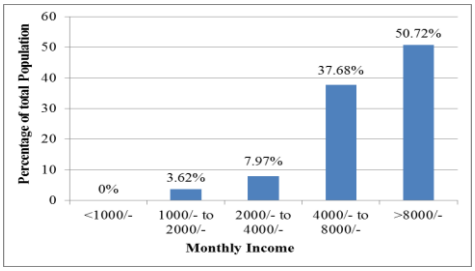


Figure 6.7. Monthly Income status of surveyed population

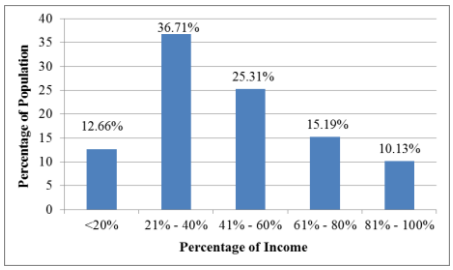


Figure 6.8. Income generated from tourism industry

As a result of analyzing the income assessment of the people, the overall picture of the financial condition of the region has been presented (Figure 6.7). The number of people (50.72%) earning more than Rs 8,000 per month. However, 3.62% of the people earn money between Rs.1000 and Rs.2000 per month but 36.7% of the people earn Rs 4,000 to Rs 6,000 per month. On the other hand, Figure 6.8 shows that 36.71% of the people in the tourism industry earn 21% to 40% of their income and 10.13% of the people earn 81% to 100% directly. Therefore, it can be said that 10.13% of the people are directly dependent on the tourism industry financially.

6.2.2. Community perception of economic impact of tourism in Sagar Island:

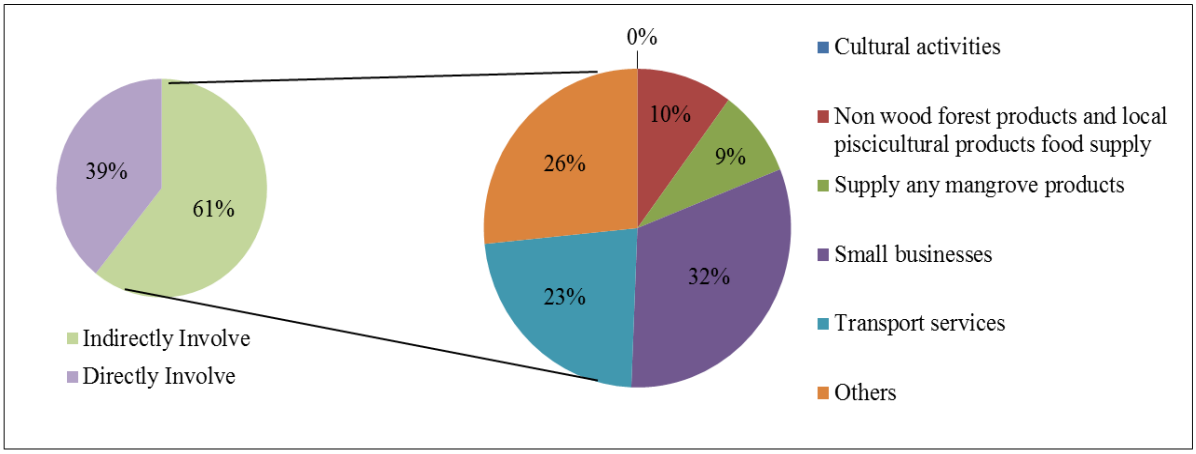


Figure 6.9 Share and type of community involvement in tourism sector

Figure 6.9 shows the percentage of people, directly and indirectly, who depend on tourism and the percentage of people who are indirectly involved in what kind of occupation. 39% of the total population is directly and 61% is indirectly involved in the tourism industry. About 32% of the people indirectly involved are small traders, 23% are involved in transport services and 26% are in other jobs. Also, 10% of people sell non-wood forest products.

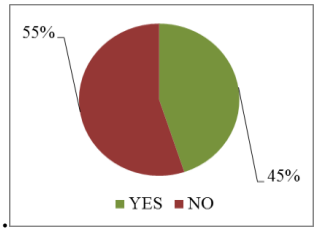


Figure 6.10 Percentage of interested people to extend their house for home stay tourism

The home-stay idea has now become popular in tourist destinations in the Sundarbans coastal region and tourists have also decided on an authentic local experience and to connect with the local community, but preliminary studies have asked the local community if the idea is open to you, then unlocks alternative economic opportunity for the local people which leads to extra financial gain for them. The results didn't go that way because they were weak from the financial. So, 45% of people support home-stay (figure 6.10).

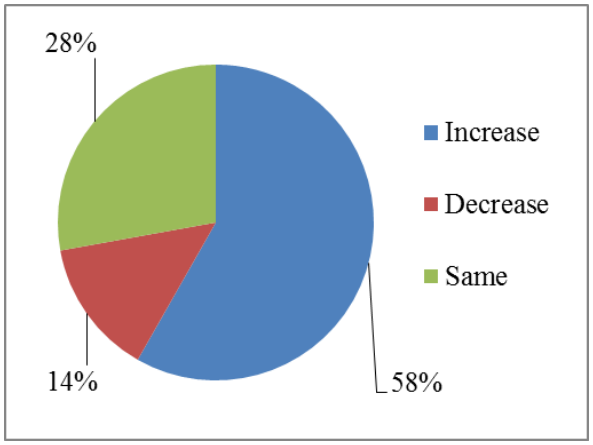


Figure 6.11 Change in income due to incresed tourism activity in the region

Figure 6.11 Indicates the area people reply that tourism has improved their development in this region. Wherever 58% of the surveyed population gave a nice response. The handiest 14% populace replied negatively whilst 28% did no longer perceive any exchange of their profits levels.

6.2.3. Community perception of environment impact of tourism in Sagar Island:

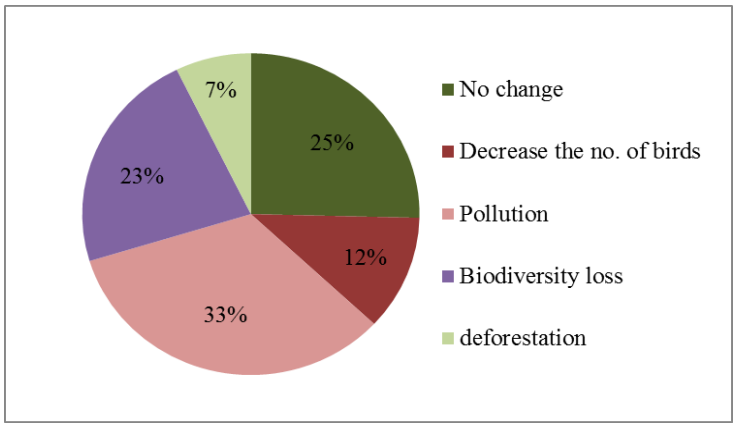


Figure 6.12 Community perception on environmental damage due to tourism industry

The above figure 6.12 shows how the local community in the area perceives their changed environment due to the development of the tourist center as well as the growing crowds of tourists coming to visit their place. Analysis of preliminary interview data showed that 25% did not see any negative changes but 75% of the population shared their environmental concerns about biodiversity, deforestation and pollution. However, people are more concerned about pollution, especially water and air pollution, because the crowds of pilgrims who come to the Ganga Sagar fair (Ganga Sagar Mela) every year exceed the level of pollution.

6.2.4. Community perception of socio-cultural impact of tourism in Sagar Island:

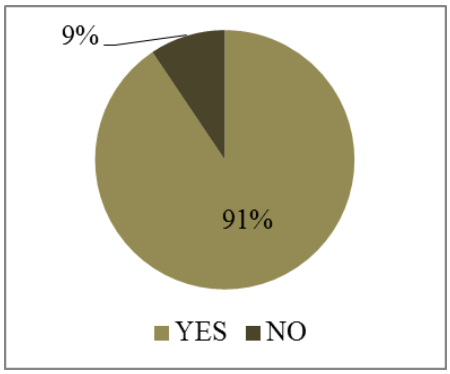


Figure 6.13 Community perception on positive social impact

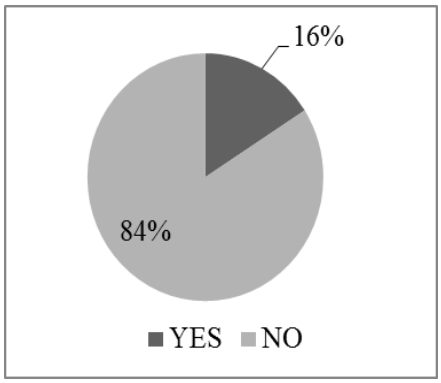


Figure 6.14 Community perception on negative social impact

The figures show the local perceptions of how tourism in the region has affected the local population and whether there is a threat to their social customs, way of life, culture and tradition. Preliminary surveys were conducted on the local population to see if tourism was negatively affecting them or improving their quality of life. The response to tourism was again overwhelming, with only a small percentage (9% - 16%) feeling otherwise. The results are shown in Figure series 6.13 and 6.14.

6.3. Demographic profile of Bakkhali:

6.3.1. Demographic profile of local population of Bakkhali:

Bakkhali tourist center in Namkhana block is located in Amrabati village. The total population of the region is 6675, comprising 1478 households (Census 2011). Similar to the above regions, the region and 138 households were surveyed, with a total population of 623, of which 49% are females and 51% are males (figure 6.15). Figure 6.16, the age-sex pyramid graph shows the percentage of the population, with more males and females aged 15 to 34. This figure proves that the region has a higher working population.

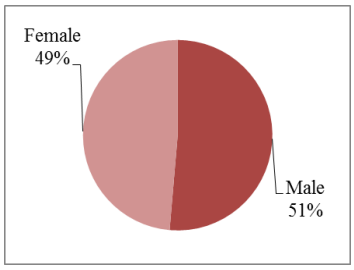


Figure 6.15 Percentage of Male-Female Population

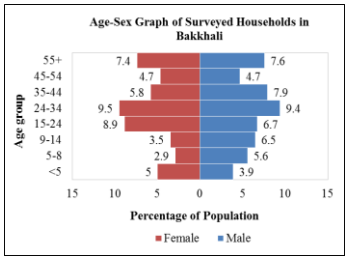
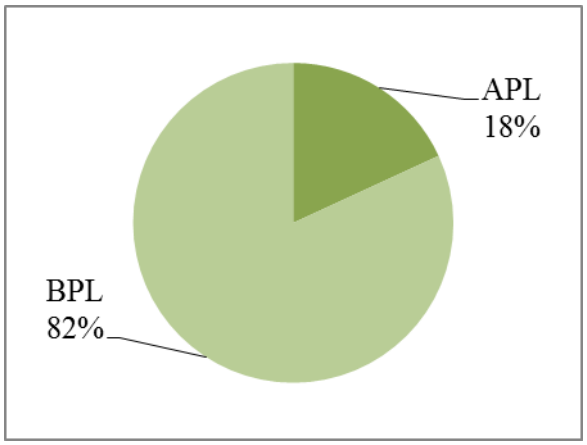


Figure 6.16 Population Pyramid



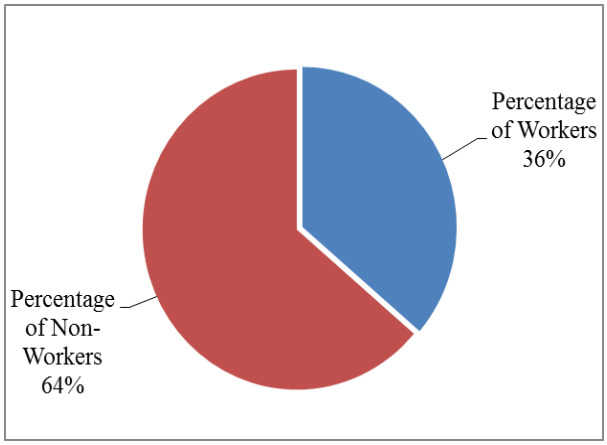


Figure 6.17 Economic status of surveyed

Figure 6.18 Worker & Non-Worker Population population

The survey became carried out to assess the socio-economic structure in the neighborhood rural communities in terms of their standard of dwelling, instructional repute and earnings structure. In terms of earnings, 113 households are under the Poverty Line or BPL (82%) and the handiest 25 families are Above the Poverty Line or APL (18%), as proven in figure 6.17. internationally, the beneath poverty line scenario includes the one's income of 1.90 USD /day in 2015 (World Bank Group, 2016). but, in this observation, the APL and BPL divisions have been determined on the basis of what was provided on their ration cards beneath the country-wide food safety Act.

Figure 6.19 shows that 8.03% of women and 28.25% of men are involved in earning money. On the other hand, figure 6.18 shows that 36% of the total surveyed population (both men and women) are employed and the rest are non-workers.

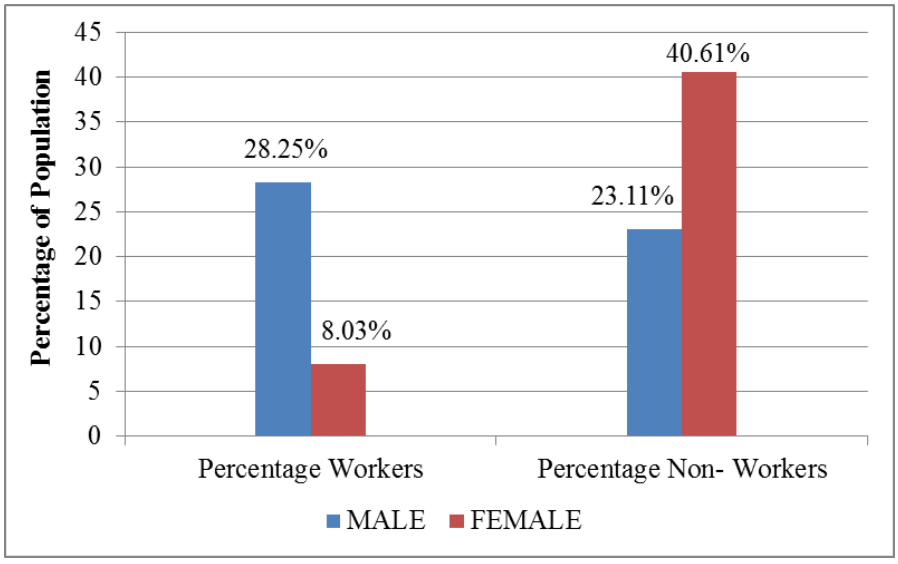


Figure 6.19 Sex-wise Working status of Population

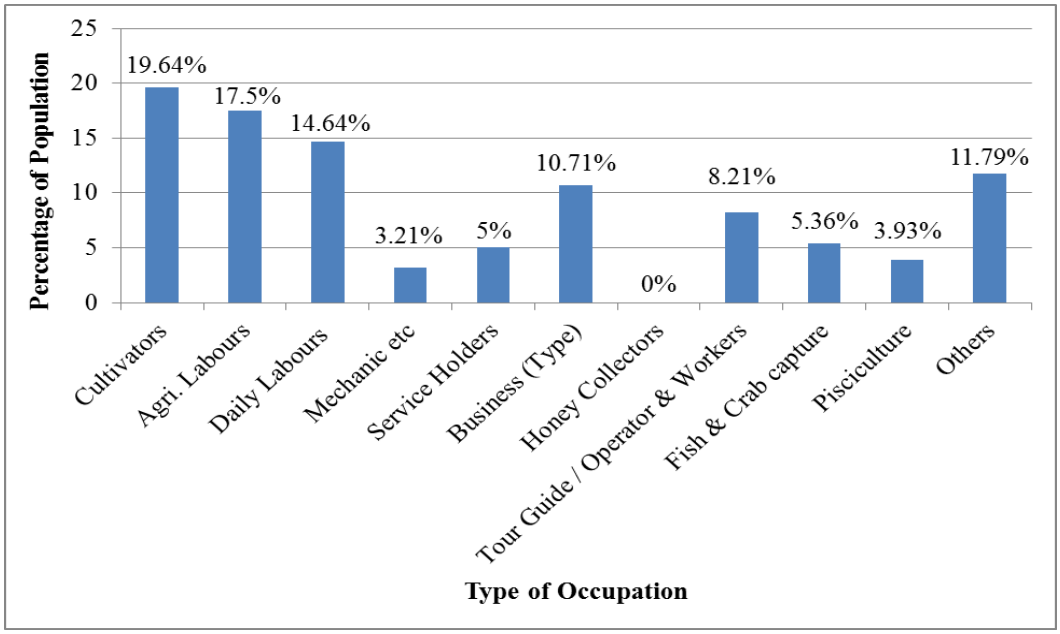


Figure 6.20 Occupation status of surveyed population

The monthly income, type of occupation, etc. of the surveyed households in this study area are shown in the percentage of the population (Figure 6.20). Figure 6.20 shows that out of the total working people of the region, 19.64% are cultivators, 14.64% are daily laborers and 17.5% are agricultural laborers. 8.49% are people who are directly dependent on tourism. People employed in the tourism industry are involved as tour guides, tour operators, and other professions. On the contrary, about 9.29% of the people are indirectly involved in the tourism industry, whose occupations are fish and crab capture and pisciculture, etc. So it turns out that a good portion of working people is now directly and indirectly, involved in the tourism industry.

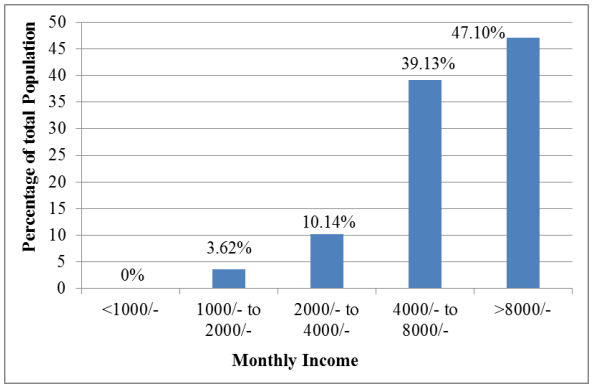


Figure 6.21 Monthly Income status of surveyed population

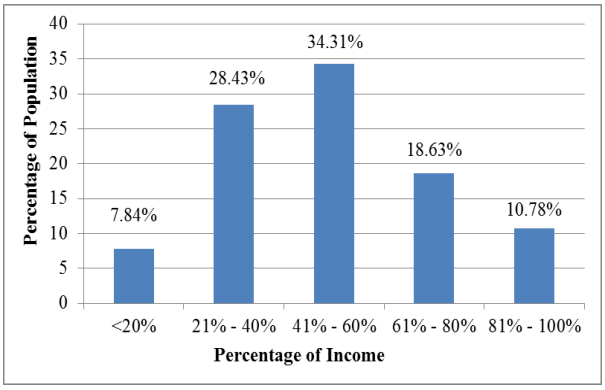


Figure 6.22 Income generated from tourism industry

The income assessment of the population of the area has been analyzed by presenting the overall picture of the financial condition of the study area. Figure 6.21 shows that most of the people involved in financial earning (47.10%) earn more than Rs8,000 per month. Again, the number of people earning Rs.1000 to Rs.2000 is very low (3.62%) and 39.13% of the people who earn Rs. 4,000 to Rs. 6,000. Another figure 6.22 shows that 34.31% of the population earns 41% to 60% of their income and 10.78% of the population earns 81% to 100% of the total income from this tourism industry. This proves that 10.78% of the people are directly involved in the tourism industry.

6.3.2. Community perception of economic impact of tourism in Bakkhali:

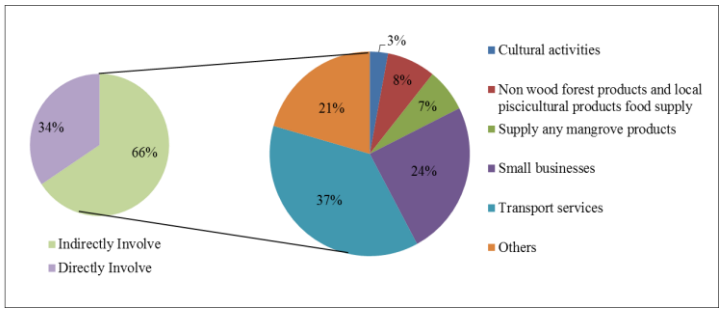


Figure 6.23 Share and type of community involvement in tourism sector

Above figure 6.23 shows the percentage of the population directly and indirectly involved in the tourism industry and the percentage of the population indirectly involved in various occupations. 34% of the total population involved in the tourism industry is directly and 66% indirectly. A large portion of this indirectly involved population, about 37% is involved in transportation services, 24% in small businesses and 21% in other occupations. Moreover, the rate of sale of non-timber forest products is 8% of the population.

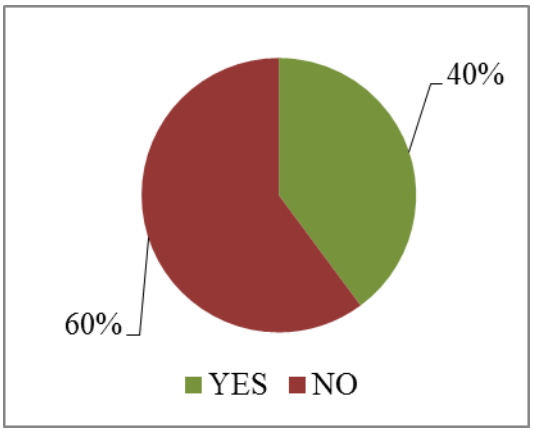


Figure 6.24 Percentage of interested people to extend their house for home stay tourism

For the reason that concept of home-stay has to emerge as popular among visitor destinations and also desired with the aid of vacationers for a proper local experience of the place and growing a reference to the area people, the number one survey enquired the local people if it changed into open to such thoughts. This would then unencumber yet every other monetary possibility for the network main to additional economic profits for them. The consequences are very bad, the best 40% of people opining in favour of domestic stays (figure 6.24). Because of the small to large hotels that have sprung up in the region like a frog's umbrella, the idea of creating a home-stay has received a negative response from the local people.

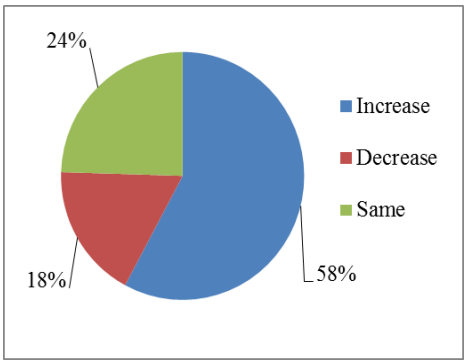


Figure 6.25 Change in income due to incresed tourism activity in the region

Figure 6.25 shows the reaction of the local population to income due to tourism in the Bakkhali area where 58% of the people surveyed responded positively but 24% of them did not understand any change in their income level and 18% responded negatively.

6.3.3. Community perception of environment impact of tourism in Bakkhali:

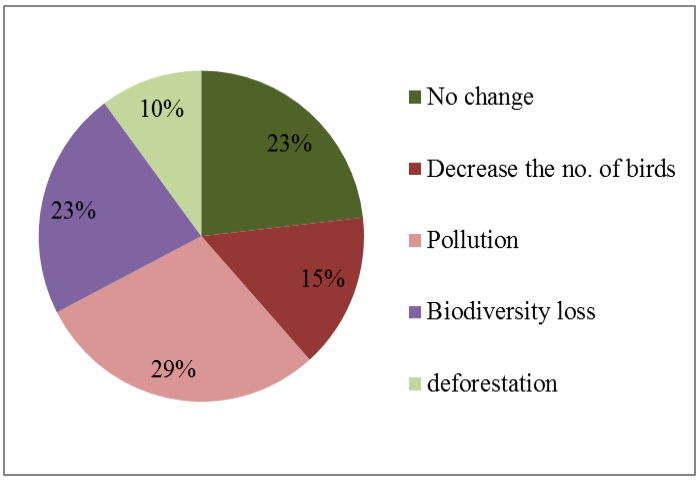


Figure 6.26 Community perception on environmental damage due to tourism industry

The survey also sought to understand how people perceive their changing environment as tourists and the number of tourists occupying their space increased. Here approximately 75% of the nearby population is worried about environmental biodiversity and pollutants, while the best 23% populace, did now not see any terrible exchange (figure 6.26). The principal concern expressed changed into in phrases of pollutants, Air pollution, in particular, is because large-scale tourism leads to an increase in vehicle visitors from Kolkata and Bakkhali.

6.3.4. Community perception of socio-cultural impact of tourism in Bakkhali:

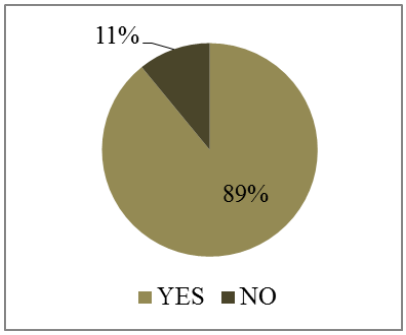


Figure 6.27 Community perception on positive social impact

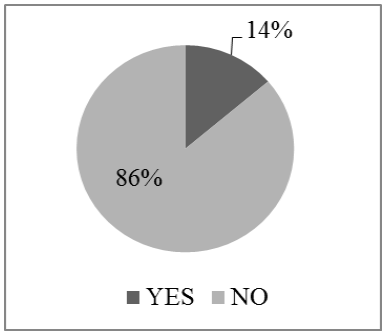


Figure 6.28 Community perception on negative social impact

The results of their exploration of local perceptions of how tourism has affected the local population and whether there is a threat to their social customs, way of life, culture and heritage are described. Preliminary studies were conducted on the local population to see if tourism was negatively affecting them or improving their quality of life. The response to tourism was again overwhelming, with only a small percentage (11%-14%) feeling otherwise. The results are shown in Figures 6.27 and 6.28.

6.4. Demographic profile of Jharkhali:

6.4.1. Demographic profile of local population of Jharkhali:

The Jharkhali Tourist Center was set up at Lot No. 126 on Jharkhali Island and the household survey was conducted in this region. According to the 2011 census, the total number of households in Lot No. 126 is 3820 and the total population is 15695, out of which 138 households were surveyed. The total population of the surveyed households is 560, of which males constitute 52% and females 48% (Figure 6.29). Figure 6.30 shows the percentage of the age-sex pyramid graph of the surveyed population, which proves that the number of males and females between the ages of 15 to 34 is higher, which predominates in the working population of the region.

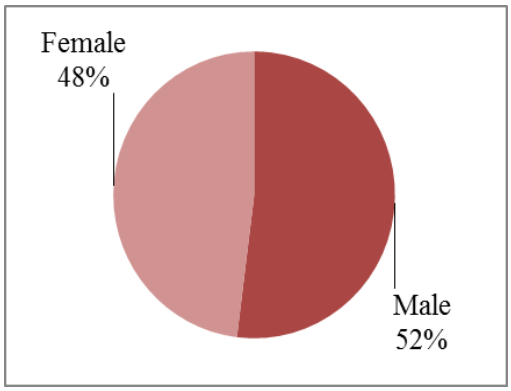


Figure 6.29 Percentage of Male-Female Population

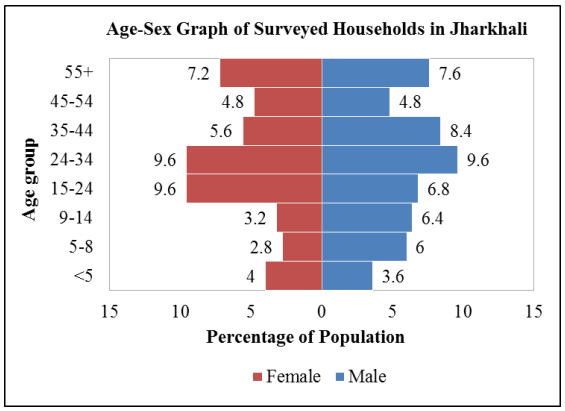


Figure 6.30 Population Pyramid

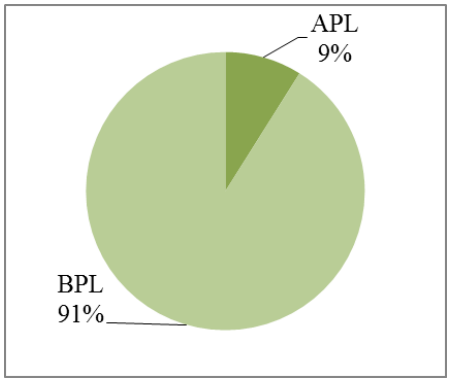


Figure 6.31 Economic status of surveyed Population

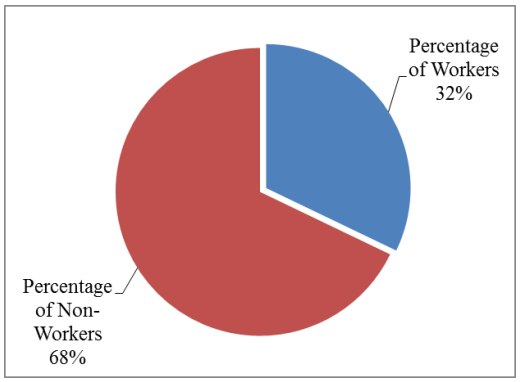


Figure 6.32 Worker & Non-Worker population

The survey was conducted to assess the socio-economic structure of the local rural communities in terms of their standard of living, educational status and income structure. In terms of income, 120 households are Below the Poverty Line or BPL (91%) and only 18 families are Above the Poverty Line or APL (9%), as shown in Figure 6.31. Internationally, the below poverty line scenario includes those earning 1.90 USD /day in 2015 (World Bank Group, 2016). However, in this study the APL and BPL divisions were determined on the basis of what was provided on their ration cards under the National Food Security Act.

Figure 6.33 shows that 1.6% of women and 30.4% of men are involved in money-making work. On the other hand, figure 6.32 shows that 32% of the total population surveyed (both male and female) are employed and the rest of the population are non-workers.

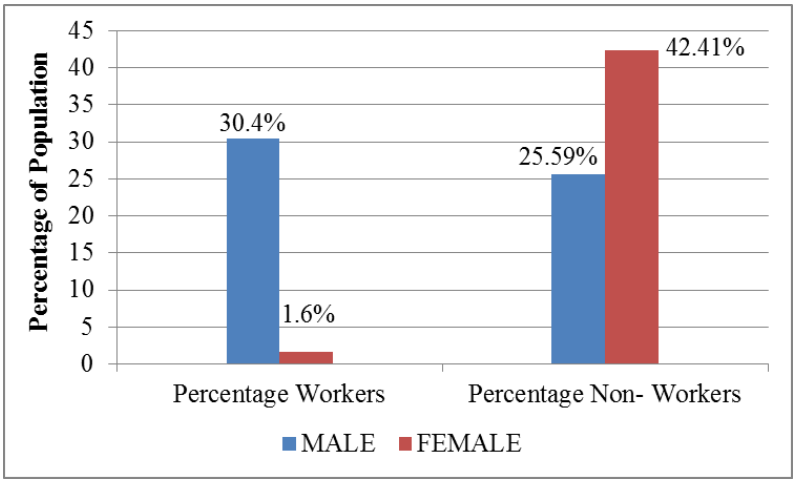


Figure 6.33 Sex-wise Working status of Population

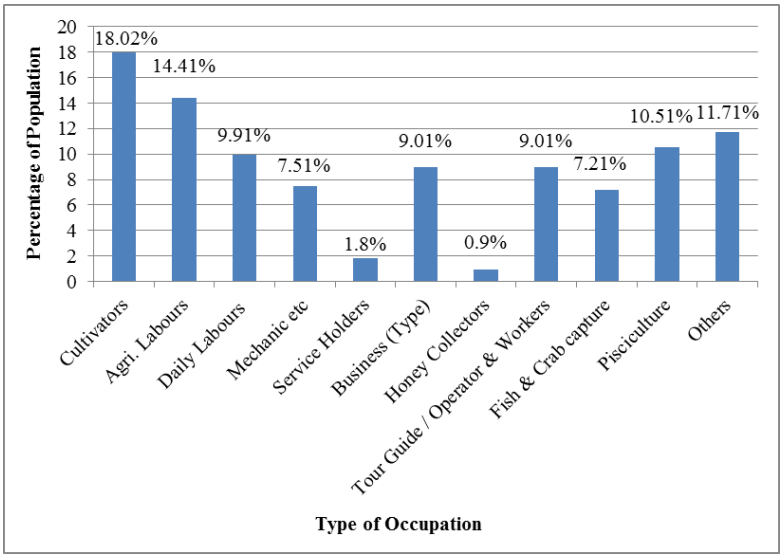


Figure 6.34 Occupation status of surveyed population

The monthly income status of the households surveyed their income from the industry and their direct and indirect involvement in the tourism industry, percentage of the population etc. are described in this chapter. Figure 6.34 shows the livelihood of the local people. Based on the initial data collection and analysis, it is known that about 18.02% of the cultivators, 14.41% of the agricultural labours and 9.91% of the people earn daily wages. The graph shows that most of the working people in the region are involved in primary economic activities. 9.01% of the population is directly dependent on the tourism industry, such as employing tour guides, boatmen, cooks, tour operators etc. And about 18.62% of the populace is not directly worried within the tourism industry, along with fish & crab capture, pisciculture and honey collection. Therefore, in step with the outcomes, it can be said that the area people of this region are at once and in a roundabout way worried about the tourism enterprise.

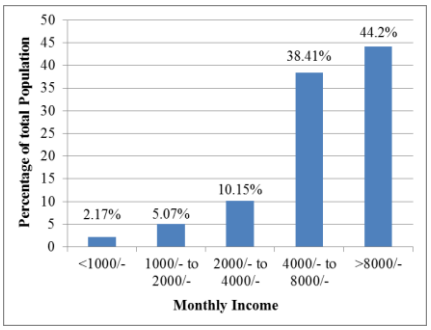


Figure 6.35 Monthly Income status of population

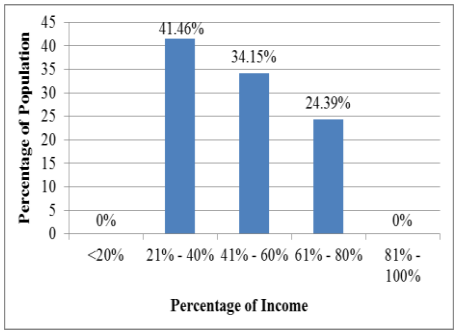


Figure 6.36 Income generated from surveyed tourism industry

The overall picture of the financial situation has been presented in this study area. Figure 6.35 shows that a big portion of the working population (44.2%) earns over Rs 8,000 per month. Very few local people (2.17%) earn less than Rs. 1000 per month and 38.41% of the population with a monthly income of Rs. 4,000-8,000. Figure 6.36 shows that 41.46% of people earn 20% to 40% of their income from tourism, whereas 24.39% of the population earns 61% to 80% of their total income from this tourism industry. So it proves that 24.39% of the population is financially directly dependent on the local tourism industry.

6.4.2. Community perception of economic impact of tourism in Jharkhali:

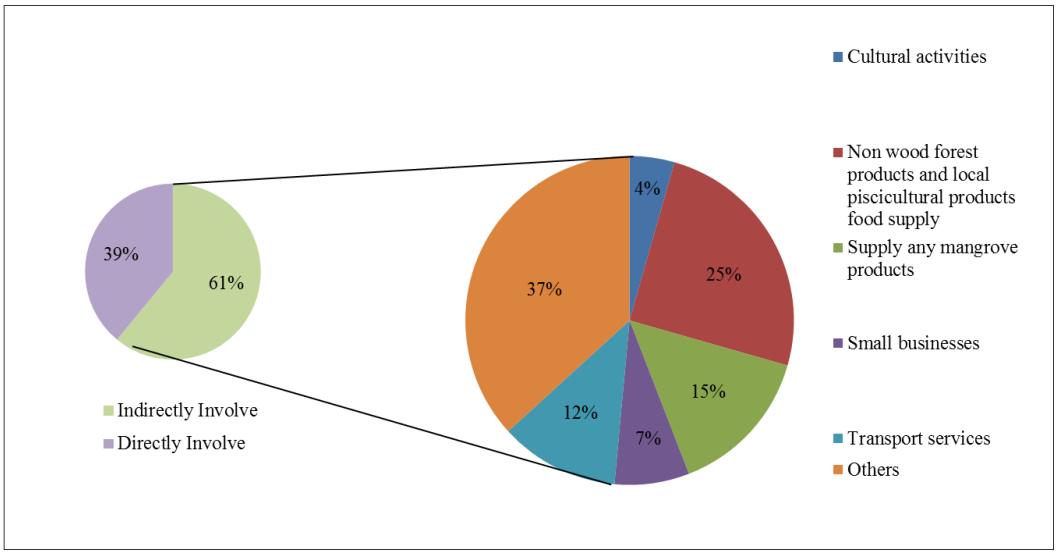


Figure 6.37 Share and type of community involvement in tourism sector

Figure 6.37 shows that 39% of the population is directly involved in the tourism industry, and the remaining 61% of the population is indirectly involved in the tourism industry. It found that a large proportion (25%) of Non-Wood Forest Products (NWFP) and fruit products were taken together and

others miscellaneous sales, both of which were 37% followed by small business 7%, transport services 12% and cultural activities 4%.

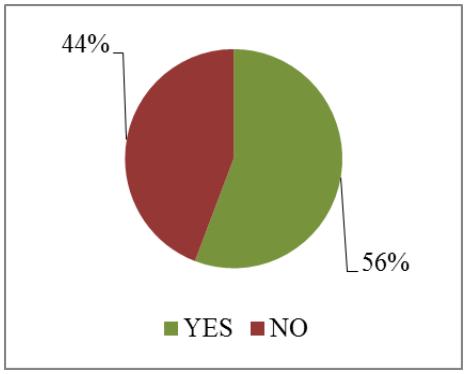


Figure 6.38 Percentage of interested people to extend their house for home stay tourism

As the concept of home-stay is a new trend in tourist spot and tourists have also chosen to have a clear local experience and connect with the local people, the initial survey asked the local people if it is open to such concepts then it is a community brings an opportunity to earn more money which leads to additional financial gain for them. As a result, 56% of people are motivated to stay home (figure 6.38).

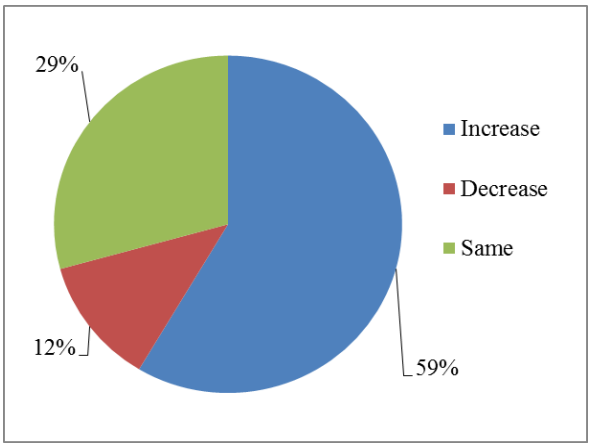


Figure 6.39 Change in income due to incresed tourism activity in the region

Figure 6.39 shows the reaction of local community income from tourism development in the Jakari region. Here, 59% of all respondents provided positive feedback and only 12% of individuals provided negative feedback. Otherwise, 32% of people did not understand the changes in their income levels.

6.4.3. Community perception of environment impact of tourism in Jharkhali:

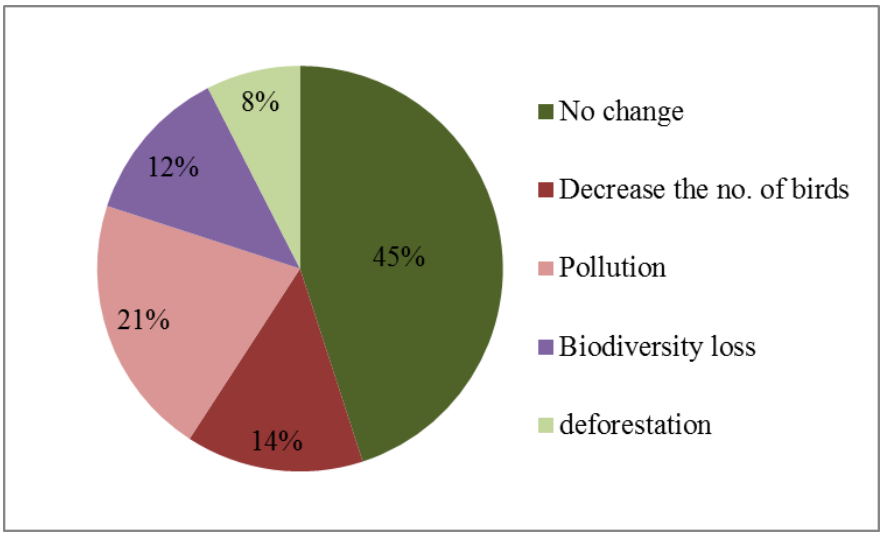


Figure 6.40 Community perception on environmental damage due to tourism industry

The survey in these takes a look at the vicinity similarly sought to understand how the community perceives its changed environment because of the development of tourism sites and the growing wide variety of visitor arrivals invading their region. There are about 55% of the populace who've shared their environmental issues approximately biodiversity, pollution and deforestation, at the same time as 45% have no longer visible any terrible changes in this region (figure 6.40). However, the main concern of the local community in the area is the issue of pollution, especially air pollution, due to increased traffic from Kolkata to Jharkhali.

6.4.4. Community perception of socio-cultural impact of tourism in Jharkhali:

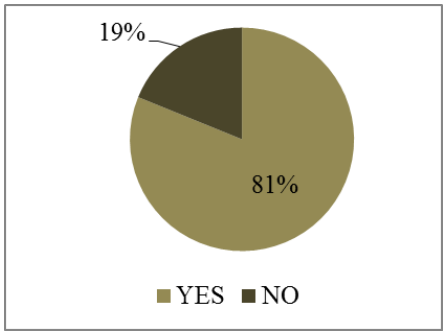


Figure 6.41 Community perception on positive social impact

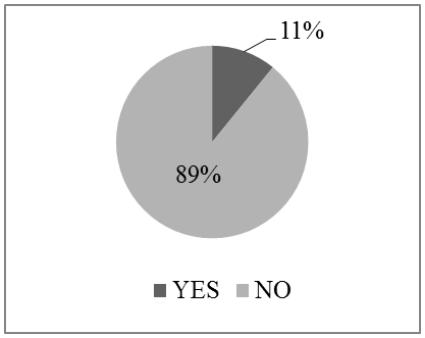


Figure 6.42 Community perception on negative social imp

Similarly, the survey explored local perceptions about the impact of tourism on their rural populations and whether there are any threats to their way of life, social customs and traditions. Questions were also asked as to whether tourism was negatively affecting their lives or improving

their quality of life. The response to tourism was again overwhelming, with only a small percentage (11% - 19%) feeling otherwise. The results are given in Figures 6.41 and 6.42.

6.5. Demographic profile of Pakhiralaya:

6.5.1. Demographic profile of local population of Pakhiralay:

Pakhiralaya in the Gosaba block is one of the places where tourists visiting the Sundarbans can rest and spend the night. So many big and small hotels and homestays have been built here, so Pakhiralaya is a tourist destination in the Sundarbans. According to the 2011 census, the total number of families in the region is 910 and the total population is 3946 people. The survey was conducted in 138 out of 910 households with a total population of 590, of which males constitute 51% and females 49% (figure 6.43). Figure 6.44 suggests the proportion of the age-sex graph of the surveyed population, which proves that the number of middle-aged men and women is higher, which predominates in the working population of the region.

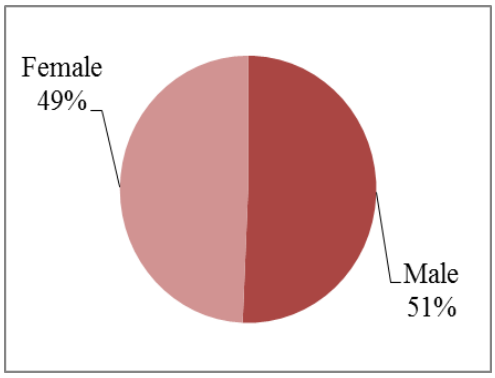


Figure 6.43 Percentage of Male-Female Population

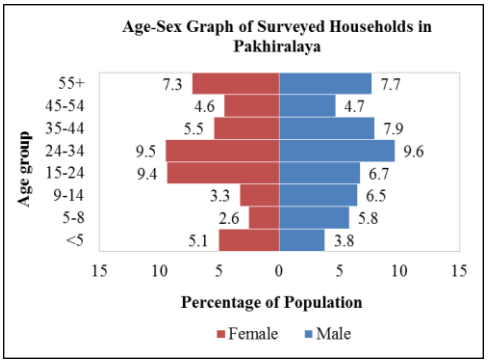


Figure 6.44 Population Pyramid

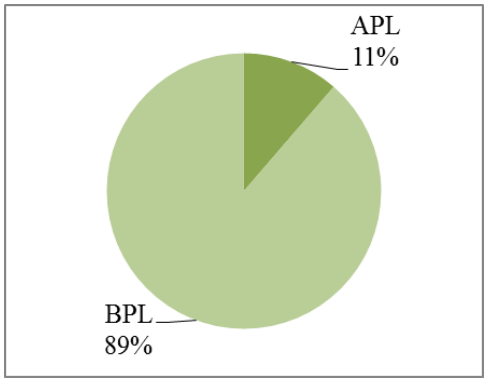


Figure 6.45 Economic status of surveyed Population

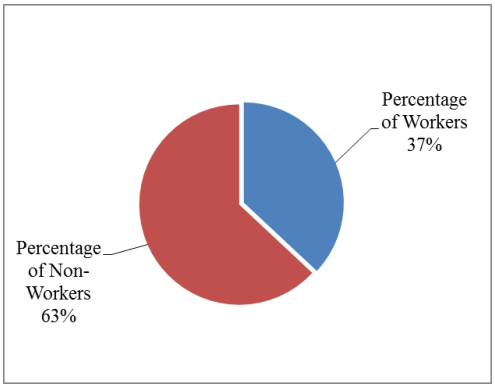


Figure 6.46 Worker & Non-Worker population

The survey was conducted to assess the socio-economic structure of the local rural communities in terms of their standard of living, educational status and income structure. In terms of income, 89% of households are Below the Poverty Line or BPL and only 11% of households are Above the Poverty Line or APL (figure 6.45). Internationally, the below poverty line scenario includes those earning 1.90 USD /day in 2015 (World Bank Group, 2016). However, in this study, the APL and BPL divisions were determined on the basis of what was provided on their ration cards under the National Food Security Act.

Based on the female-male population, Figure 6.47 shows the percentage of the working and non-working population, with 3.73% women and 33.22% men engaged in earning work. Wherein, figure 6.46 shows that 37% of the whole populace, both male and female, are working for group and the rest are unemployed.

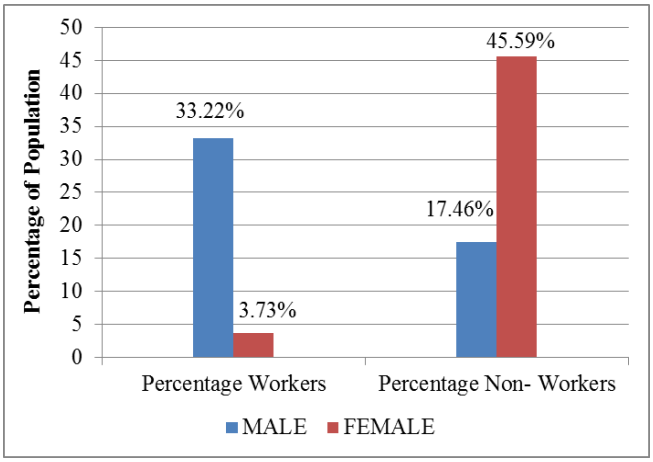


Figure 6.47 Sex-wise Working status of Population

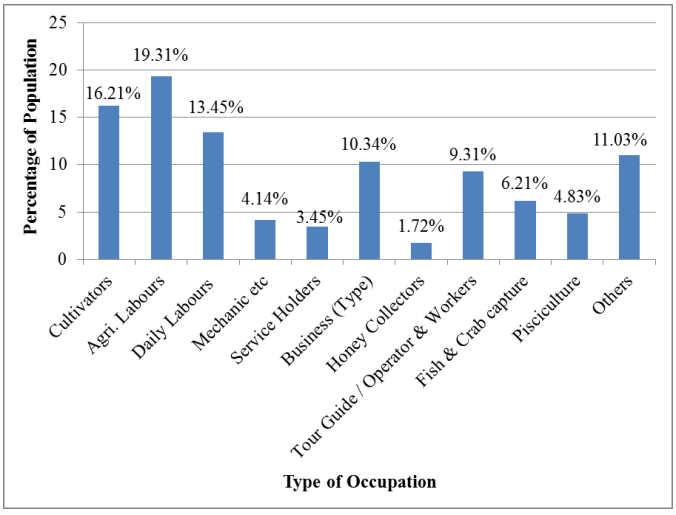
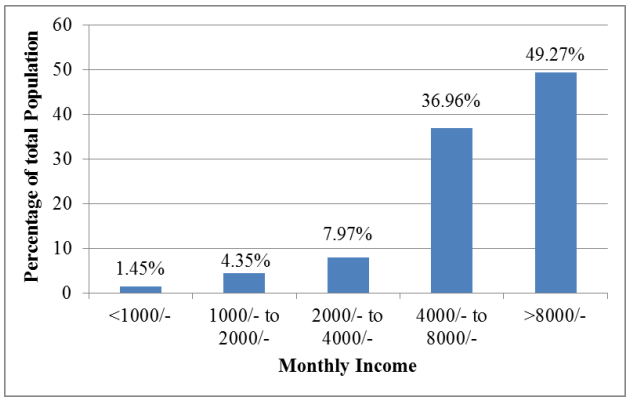


Figure 6.48 Occupation status of surveyed population

Preliminary surveys have shown the monthly income of households in the area, and their direct and indirect involvement in the tourism industry, as a percentage of the population. Figure 6.48 shows the livelihood of the local people. Preliminary data collection and analysis revealed that about 16.21% are cultivators, 19.31% are agricultural workers and 13.45% are daily wage earners. The graph shows that most of the working people in the region are involved in primary economic activities. 9.31% of the population is directly involved in the tourism industry, some as tour guides, some as tour operators and some as cooks. It is found that 12.76% of the population is indirectly involved in the tourism industry; they are involved in the honey collection, pisciculture, fish, and crab capture. Therefore, it may be said that the local people of this area are directly and in a roundabout way involved in the tourism enterprise.



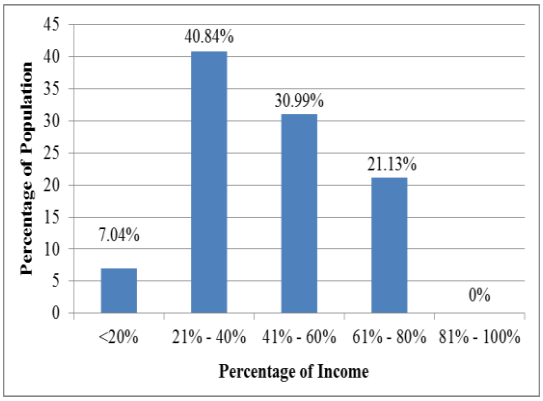


Figure 6.49 Monthly Income status of surveyed population

Figure 6.50 Income generated from tourism industry

The big picture of the financial situation in the survey of the income assessment of the people of the survey area is given in the figure above (figure 6.49). Most of the working people (49.27%) earn around Rs 8,000 per month as shown in Figure 6.49. Of the rest, very few (1.45%) earn less than Rs.1000 per month and 36.96% of the people, whose monthly income goes from Rs.4000 to Rs.6000. Figure 6.50 shows that about 40.84% of the people in the tourism industry make up 21% to 40% of their total income and 21.13% of the people make up 61% to 60% of their total income. So it can be said that 21.13% of people are directly involved in the tourism industry.

6.5.2. Community perception of economic impact of tourism in Pakhiralaya:

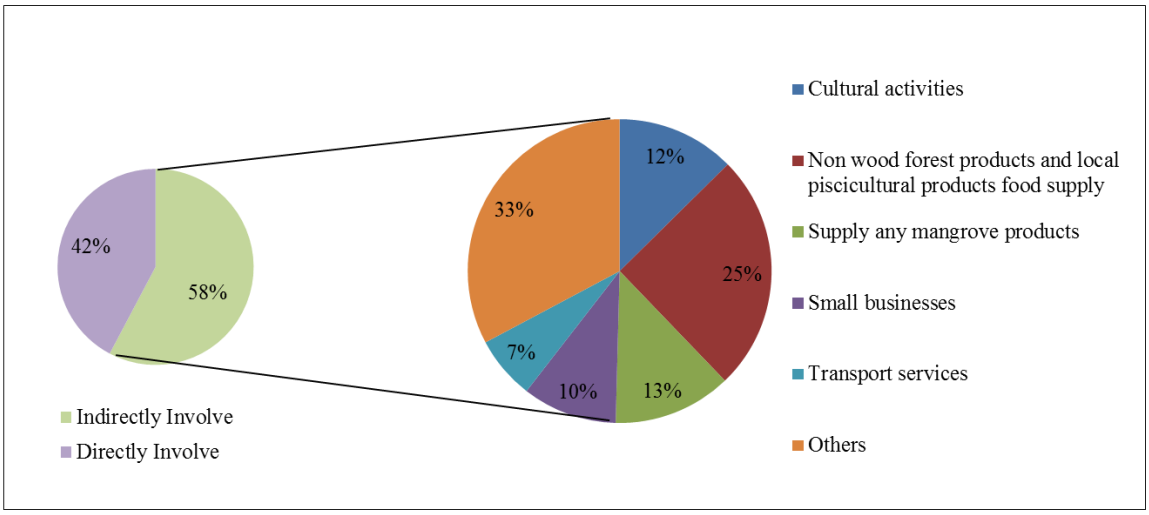


Figure 6.51 Share and type of community involvement in tourism sector

Figure 6.51 shows that 42% of surveyed population is directly engaged in the tourism industry, and 58% of the population is indirectly engaged in the tourism industry. It found that a large proportion (25%) of Non-Wood Forest Products (NWFP) and fruit products were taken together and others miscellaneous sales, both of which were 33% followed by cultural activities 12% , transport services 7% and small business 10%.

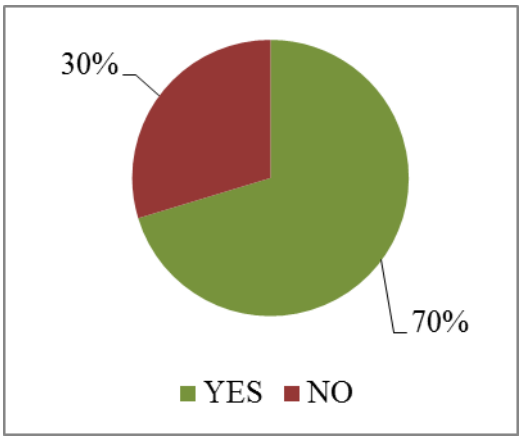


Figure 6.52 Percentage of interested people to extend their house for home stay tourism

The reason why the home-stay concept has become so popular in tourist destinations in the current situation is that tourists have chosen it for a transparent local experience and to connect with local people, preliminary survey has asked local households if this, in turn, brings more money to the community which in turn leads to additional financial gain for them. As a result, 70% of local people are motivated to stay home (figure 6.52).

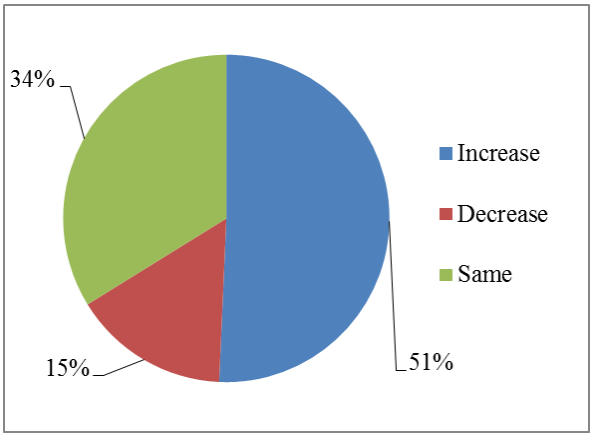


Figure 6.53 Change in income due to incresed tourism activity in the region

Figure 6.53 shows the reaction of the local people to the income due to the development of the tourism industry in this region, where 15% of the total population gave negative feedback and 51% of the people gave positive feedback. On the other hand, 34% of the people said that their income level has not changed at all.

6.5.3. Community perception of environment impact of tourism in Pakhiralaya:

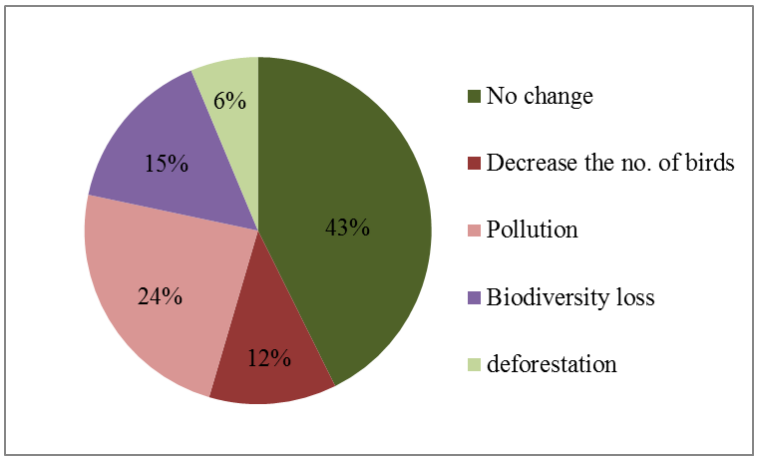


Figure 6.54 Community perception on environmental damage due to tourism industry

Figure 6.54 shows how local people perceive their changing environment because of the development of vacationer centers and the increasing number of incoming tourists invading their place. Analyzing the figure here, it is seen that about 57% of the population shared their environmental concerns about decreasing in the number of birds, biodiversity and pollution, and 43% did not see any negative effect (Figure 6.54). However, the surveyed population has expressed more concern about pollution follow. Especially on water and air pollution, because many tourists who come to the

Sundarbans are polluting the environment without following the rules of travel and the smoke from motor boats is polluting the air.

6.5.4. Community perception of socio-cultural impact of tourism in Pakhiralaya:

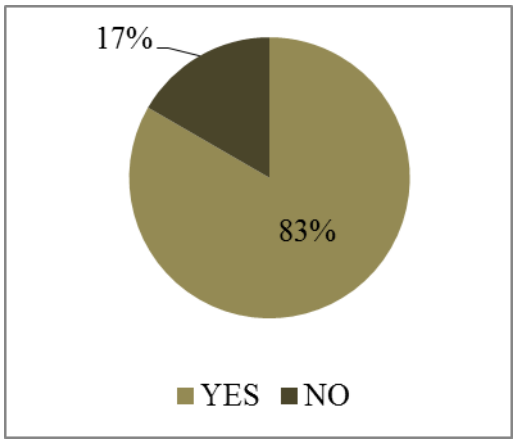


Figure 6.55 Community perception on positive social impact

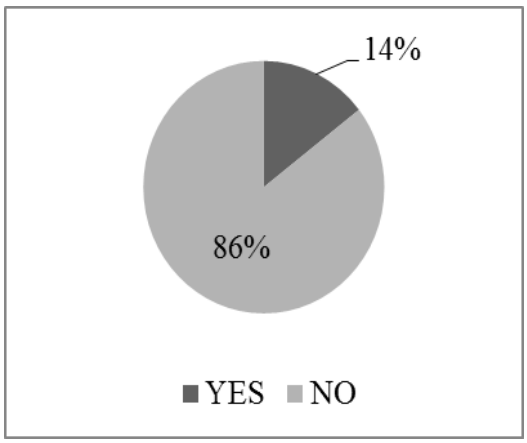


Figure 6.56 Community perception on negative social impact

Likewise, the survey also asked about the local opinion of tourism's effect on their rural community and whether they understand any change to their manner of dwelling, traditions, social customs, or notion systems. Questions had been additionally asked if tourism has any negative effect or has progressed their living standards. The reaction became again overwhelmingly in favour of tourism barring a small percentage (14% - 17%) who felt the alternative manner. The results are shown in figures 6.55 and 6.56.

6.6. Demographic profile of Dayapur:

6.6.1. Demographic profile of the local population of Dayapur:

Dayapur in Gosaba block is another tourist center like this in Pakhiralaya, on the opposite side of which is the Sajnekhali Reserve Forest. On the basis of this several large hotels have been built in Dayapur for the rest and overnight stay of tourists. The total number of households in Dayapur is 1215 and the total population is 4972 (Census 2011), out of which 138 households were surveyed with a total population of 560, of which 52% are males and 48% females (figure 6.57). The age-sex pyramid in the area shows that there are more males and females between the age group of 15 to 34, which indicates the working population of the area (figure 6.58).

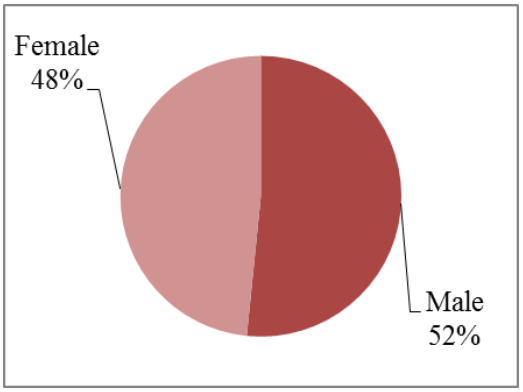


Figure 6.57 Percentage of Male-Female Population

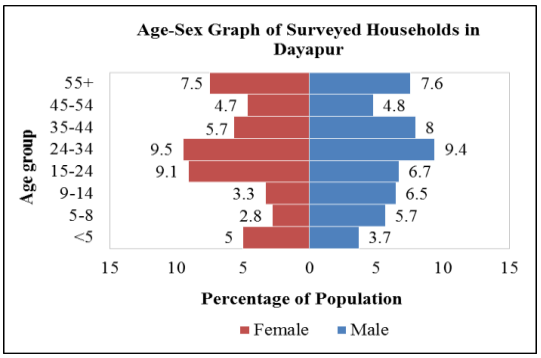


Figure 6.58 Population Pyramid

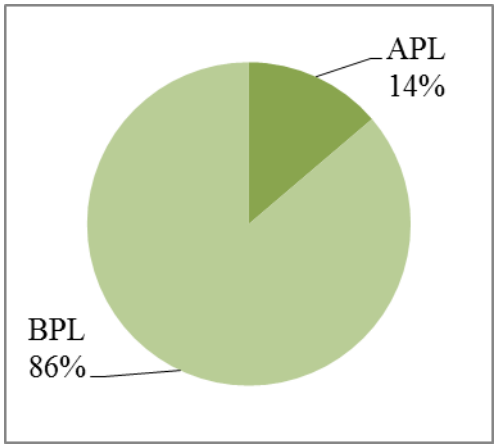


Figure 6.59 Economic status of surveyed Population

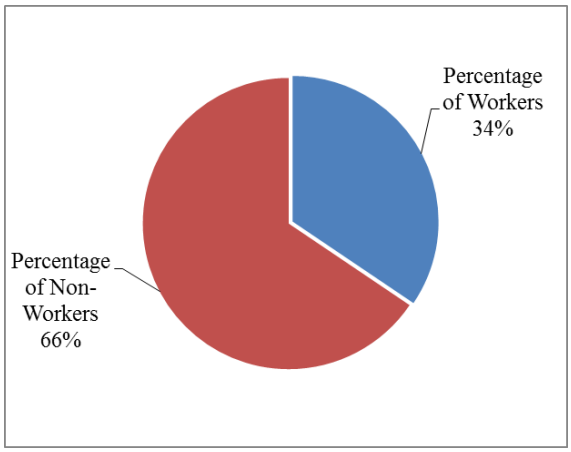


Figure 6.60 Worker & Non-Worker population

The survey was conducted to assess the socio-economic structure of the local rural communities in terms of their standard of living, educational status and income structure. In terms of income, 119 households are Below the Poverty Line or BPL (86%) and only 19 families are Above the Poverty Line or APL (14%), as shown in Figure 6.59. Internationally, the below poverty line scenario includes those earning 1.90 USD /day in 2015 (World Bank Group, 2016). However, in this study, the APL and BPL divisions were determined on the basis of what was provided on their ration cards under the National Food Security Act.

Figure 6.61 shows the percentage of the working and non-working population (both men and women separately), where, 9.11% of women and 25.36% of men are associated with the source of income. Otherwise, Figure 6.60 shows that 34% of the total surveyed population are engaged in actual work and 66% are unemployed.

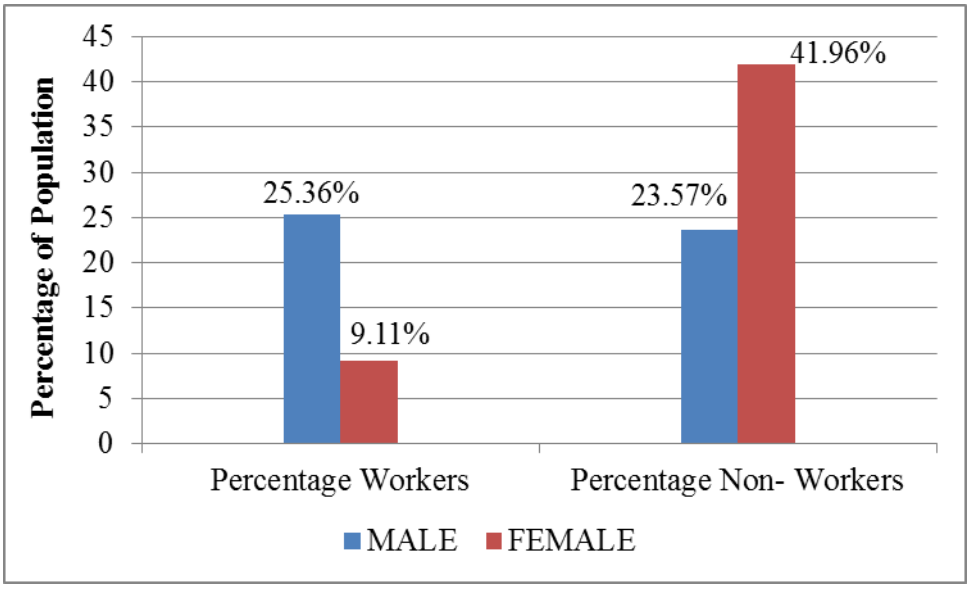


Figure 6.61 Sex-wise Working status of Population

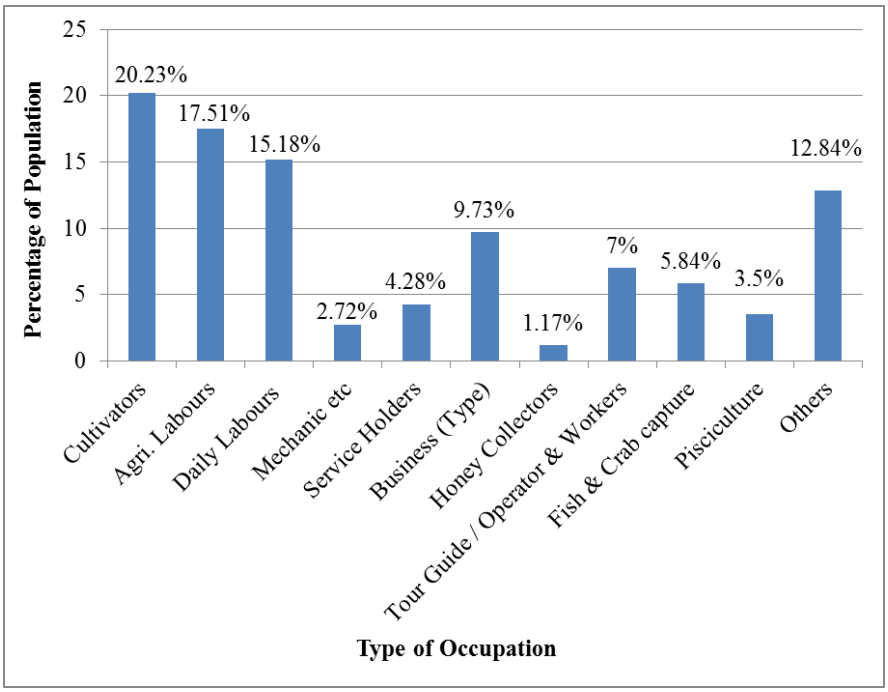
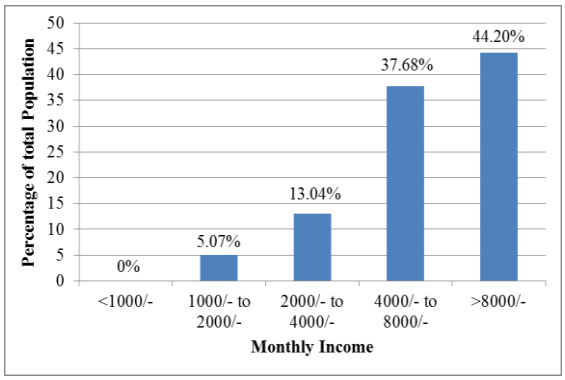


Figure 6.62 Occupation status of surveyed population

Figure 6.62 shows the percentage of the population surveyed in this region as the percentage of the monthly income, the direct and indirect involvement of the tourism industry. A review of Figure 6.62 shows that the majority of the working people in the region are involved in primary economic activity. Preliminary data analysis shows that about 20.23% are cultivators, 17.51% are agricultural labours and 15.18% are daily wage earners. Again, 7% of the working population is directly involved in the tourism industry (occupation type - tour guide, tour operator etc.). 10.51% of the population is

indirectly involved in tourism, honey collection, fish and crab capture and pisciculture. Therefore, it can be clearly said that a total of 16.51% of the population is directly and indirectly involved in the tourism developed in the region.



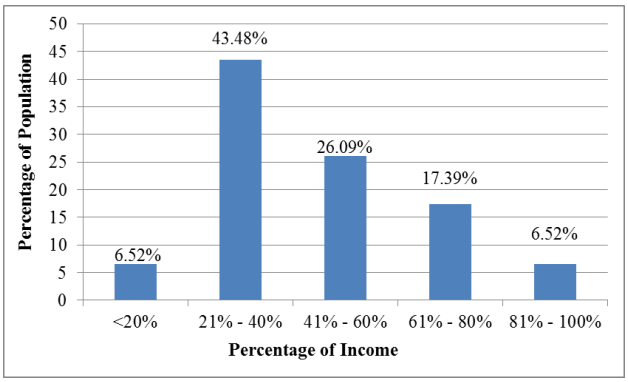


Figure 6.63 Monthly Income status of surveyed population

Figure 6.64 Income generated from tourism industry

A clear picture of the financial situation is presented in the study of the income assessment of the local population of the research area. Figure 6.63 shows that the working population (44.20%) earning more than Rs. 8,000 per month. However, a very small number of local people (5.07%) earn Rs.1000 to Rs.2000 per month and 37.68% population earn Rs.4000 to Rs.6000 per month. Another Figure 6.64 shows that 43.48% of the population earns 21% to 40% of their income, while 6.52% of the population earns 81% to 100% from the tourism industry developed in the region. So it is spot on that 8.52% of the people are directly employed in the tourism industry.

6.6.2. Community perception of economic impact of tourism in Dayapur:

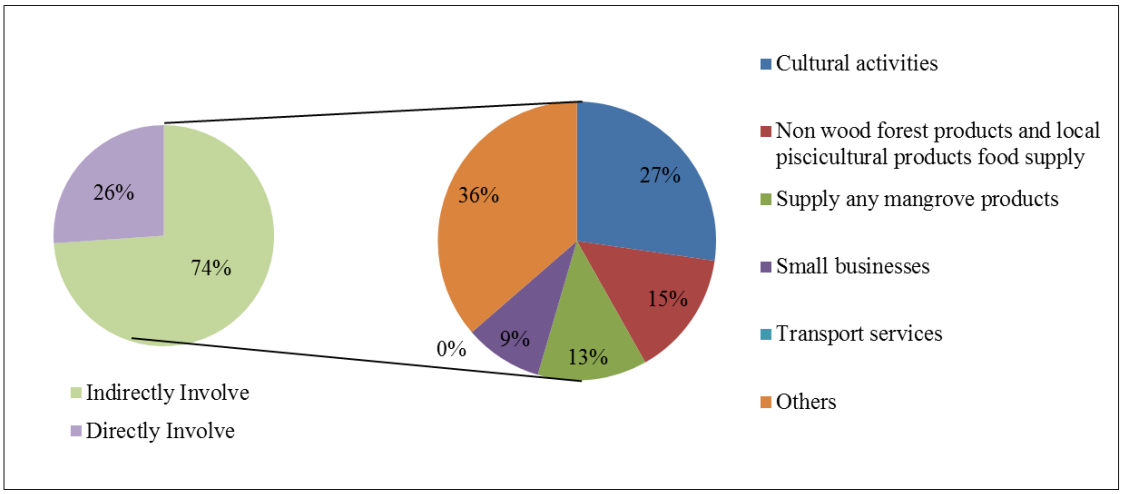


Figure 6.65 Share and type of community involvement in tourism sector

Above figure 6.65 shows that 74% of the total population associated with the tourism industry is indirectly involved, while the remaining 26% is directly involved in the tourism industry. It was found that 27% of the population is involved in cultural activities, and 36% in other activities. Also, 15% of the population sells non wood forest products and local food supply.

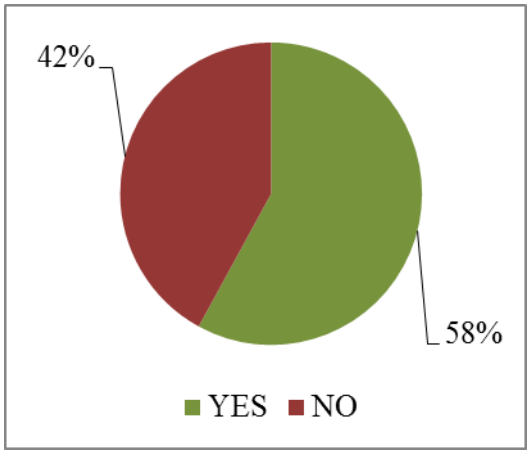


Figure 6.66 Percentage of interested people to extend their house for home stay tourism

As the home-stay concept has now become popular in tourist destinations in the Sundarbans region and tourists have also opted for an authentic local experience and to connect with the local people, a primary survey has asked the local community if the concept is open to you, then unlocks another monetary possibility for the community which leads to additional financial gain for them. Results 58% of people support home-stay (figure 6.66).

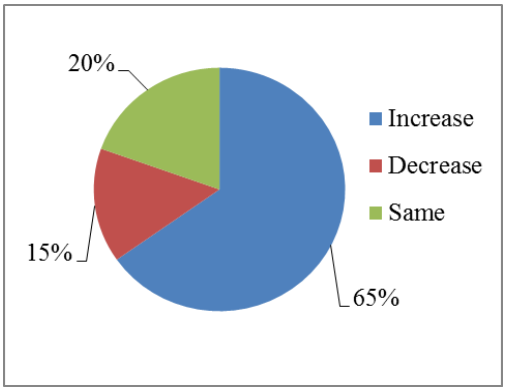


Figure 6.67 Change in income due to incresed tourism activity in the region

The above figure shows the reaction of the local people to the income due to the development of the tourism industry in the region, where 20% of the total population did not see any change in their income level, but 65% of the people responded positively. On the other hand, 15% of the people reacted negatively (figure 6.67).

6.6.3. Community perception of environment impact of tourism in Dayapur:

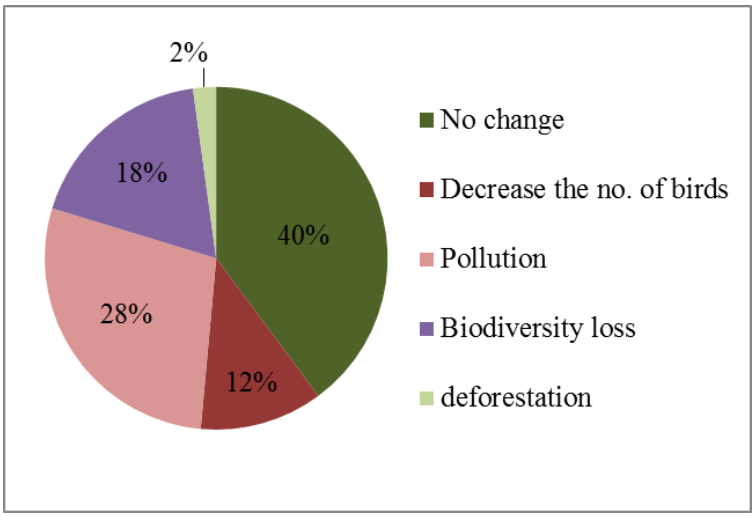


Figure 6.68 Community perception on environmental damage due to tourism industry

Figure 6.68 shows how the local people in the area perceive their changing environment due to the growth in the tourism industry in Dayapur and the growing number of tourists flocking to their place. Analysis of preliminary data shows that 40% people, who did not see any negative change but the 41% of the populace shared their concern about environmental worries about biodiversity and pollution. However, the surveyed people have expressed more concern about pollution, especially water pollution, as many tourists visiting the Sundarbans are polluting the environment by not following the rules of travel.

6.6.4. Community perception of socio-cultural impact of tourism in Dayapur:

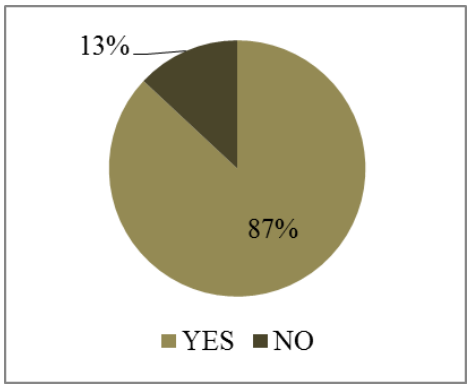


Figure 6.69 Community perception on positive social impact

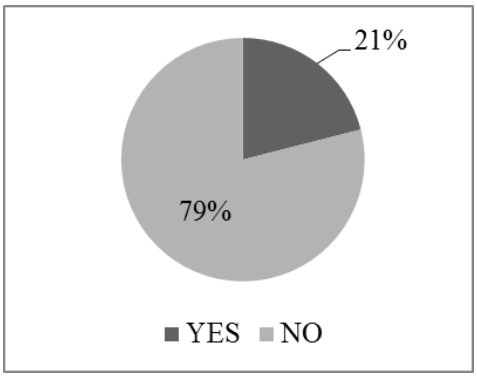


Figure 6.70 Community perception on negative social impact

The figure series 6.69 & 6.70 shows that they have explored local perceptions about the effect of tourism on the local population and whether there is a threat to their way of life, heritage, social

customs, or beliefs. According to the preliminary survey, the questions were asked whether tourism has improved their quality of life or is negatively affecting them. The response to tourism was again overwhelming, with only a small percentage (13% - 21%) feeling otherwise. The results are shown in Figures 6.69 and 6.70.

6.7. Conclusion:

Overall, the above data analysis and description it clearly displays that the impact of tourism on the local socio-economic economy was very positive and there is a lot of interest in the community for further development of tourism in these regions.

Chapter VII:

Comparative summary of the tourism locations

7.1. Introduction:

A comparative summary is discussed in this chapter based on the location of tourist centers and the location of hotels/lodges/ashrams built in those areas, what are the effect of tourism on the environment, the number of tourists, and the involvement of local people etc. The analysis of the different parameters of this study enables the researcher to understand their level of physical and environmental awareness in the host area. All these parameters will determine the kind of impact generated on the social, cultural and physical environment of the study areas. Chapters III, IV, V and VI have already been discussed in detail. A comparative discussion of which is briefly given in this chapter, in the earlier discussed chapters, issues related to tourism in 5 study areas have been discussed, which is also present in this chapter.

7.2. Comparative summary of the hospitality sub-sector:

It has already been mentioned earlier chapter that lack of information, data and documentation is the main constraint in the analysis of the background of the hotel industry in the Indian Sundarbans region. Yet it has been analyzed based on all the information that has been found. Of the 5 tourist centers that have been studied, it is seen that the Sagar has the largest number of tourists. If the other 4 tourist centers are sorted more than to less then it is seen that there are Bakkhali, Pakhiralaya, Dayapur and then Jharkhali. Since Sagardwip is a full-fledged land, it has more crowds of pilgrims than ordinary tourists, and the largest crowds are seen here in the month of January, which has been discussed in detail earlier chapter (table 7.1).

The other part of the hospitality sub-sector is the comparative discussion of the Energy Performance Index. Looking at Table 7.1, it is seen that energy consumption is highest in Bakkhali tourist center and its carbon emissions are relatively high. The reason for this is that Bakkhali is a seaside tourist center, so it is more or less crowded with tourists throughout the year (table 7.1).

Visiting the selected 5 tourism centers and initially collecting information from the hotels and analyzing it, it has been found that Bakkhali has the highest waste generation, about 66 kg per month followed by Sagardwip (waste generated 46 kg per month). The lowest waste generation is at the Jharkhali tourist center, at about 18 kg per month (table 7.1).

After analyzing the data collected by surveying almost all the hotels in 5 tourist centers, the results found that the average bed charge per night in hotels is highest in Dayapur tourist center, at about 1237 rupees per bed per night. In comparison, the average tariff in Sagardwip is much lower,

about 533 rupees. This is because there are more ashrams than hoteliers in Sagardwip and these are almost run on the basis of donations (Table 7.1).

Table 7.1 Comparative summary of the hospitality sub sector of five study areas

Sub sector	Sagar (Block Sagar)	Bakkhali (Block – Namkhana)	Jharkhali (Block – Basanti)	Pakhiralaya (Block – Gosaba)	Dayapur (Block – Gosaba)
Hospitality – no. of beds	2804	1705	368	805	408
EPI - kWh/m2/year	1591.751	2822.244	921.955	893.856	609.058
CO2 emission- $KgC/m^2/year$	227.766	1598.163	269.562	223.275	397.415
Waste Amount – Kg/month	46	66	18	37	16
Waste treatment	Burned & sold	Burned & sold	Burned & sold	Burned & sold	Burned & sold
Average Tariff (Rs./bed)	533	1090	640	1205	1237

7.3. Comparative summary of demography of tourist and community:

The tourist and communities of the 5 selected tourist destinations selected in the previous chapters are discussed in detail in various diagrams and graphs. This topic has been analyzed in this chapter in the form of a comparative discussion. It is clear from Table 7.2 below that the pressure of tourists is different in each tourist center. In the same way, the people of the local community, who are involved in the tourism industry, are also different.

Table 7.2 shows that the average annual number of tourists in Sagardwip is much higher than the average annual number of tourists in Jharkhali. The reason for the low number of tourists in Jharkhali is that the number of day tourists here is more than the number of tourists staying overnight. On the other hand, millions of pilgrims flock to Sagardwip on the occasion of Gangasagar Mela, which is much more than the average annual number of tourists in the remaining 4 tourist centers.

The number of local people in the tourist centers have been taken from the Indian census, 2011, where it is seen that the population density is the same in Jharkhali (Basanti Block) and Pakhirala and

Dayapur both (Gosaba Block). By comparison, the population density (490/km2) of the Bakkhali region is less than that of the other four tourist centers.

Table 7.2 shows the percentage of directly and indirectly involvement of the earning local people in the tourism industry. All the regions where tourist centers have been established. About 60% of the local community of the Pakhiralaya is directly and indirectly involved in the tourism sector. But in Dayapur, 29% of the locals are earning money by engaging in tourism.

Of the people involved in the tourism industry in the 5 tourist centers, 21% to 40% of the people in Bakkhali, Jharkhali and Pakhiralaya are earning money from the tourism industry.

Table 7.2 Comparative summary of the demography of tourist and community of five study areas

Sub sector	Sagar (Block Sagar)	Bakkhali (Block – Namkhana)	Jharkhali (Block – Basanti)	Pakhiralaya (Block – Gosaba)	Dayapur (Block – Gosaba)
Tourist footfall (annual av.)	**19.8 Lakh**	**2.35 Lakh**	**.57 Lakh**	**3.4 Lakh**	
Community- Demography (Census -2011)	Total – 212,037 Density - 750/km^2	Total – 182,830 Density - 490/km^2	Total – 336,717 Density - 830/km^2	Total – 246,598 Density - 830/km^2	
Degree of involvement in tourism (% people)	31%	49.56%	43%	59.63%	29%
Income from tourism (av.)	<20%	21% - 40%	21% - 40%	21% - 40%	<20%

7.4. Comparative summary of Landuse/Landcover:

Analysis of land use/land cover has already been discussed in detail in Chapter III. A comparative discussion in this chapter shows that out of the four blocks (Sagar, Namkhana, Basanti and Gosaba), two blocks namely Sagar and Namkhana, the Settlement with Vegetation Index is the most influential in these two regions, while Basanti and Gosaba blocks have the most influential Agricultural Land Index. Most of the indexes described in the LULC analysis show changes between the Agricultural Land and the Settlement with Vegetation Index (table 7.3).

Table 7.3 Comparative summary of the Landuse/Landcover of five study areas

Sub sector	**Sagar (Block – Sagar)**	**Bakkhali (Block – Namkhana)**	**Jharkhali (Block – Basanti)**	**Pakhiralaya (Block – Gosaba)**	**Dayapur (Block – Gosaba)**
LULC current status (most dominant LULC)	**Settlement with veg. – 101.02 km²**	**Settlement with veg. – 68.46 km²**	**Agriculture land – 77.08 km²**	**Agriculture land – 166.70 km²**	
Most changed LULC	Agri. Land & Sett. with veg.	Agri. Land & Sett. with veg.	Agri. Land & Sett. with veg.	Agri. Land & Sett. with veg.	
Erosion-accretion trend	Erosion 1986 – 254.42km² 2014 – 237.19km²	Erosion 1986 – 156.54km² 2014 – 146.46km²	Accretion 1986 – 163.307km² 2014 – 165.2km²	Erosion (Both under Gosaba block) 1986 – 328.90km² 2014 – 324.66km²	

7.5. Conclusion:

From the above-mentioned comparative study, it's clear that if these 5 selected tourist destinations are to move towards potential eco-tourism then the people of the local community need to be more dependent on the tourism industry and protect the environment and think of tourists. The tourist centers have to be developed. More important is the use of land through proper planning.

Chapter VIII:

Proposed Ecotourism Strategies for the Sundarbans

8.1. Introduction:

In terms of cultural, social and economic classification from a broader perspective, many sociologists consider the development of tourism industry activity arising from social development and introduce it as an indicator of development. It, therefore, needs to be pointed out in the tourism industry as a special part of the national plan. So, at least a few strategies have been considered in this plan.

The concept of community development is explored in terms of their participation and community empowerment as they are directly and indirectly related to tourism development (Singh, Timothy, & Dowling, 2003). Society or community development can be seen as social capital for cooperative or collective benefits. So, it uses knowledge and skill and strategy in its practice (Gilchrist, 2004). Community development and improvement aim to increase society's involvement in their community. Therefore, the process of tourism development in local communities is a special process of community development. Community development builds people's skills for community problems. So it is vital for the survival of the local community (Talbot & Verrinder, 2005).

8.2. Proposed Strategies:

8.2.1. Hospitality (Energy and Environment):

It has already been mentioned that the main obstacle in analyzing the background of the hotel industry in the Indian Sundarbans is the lack of information or proper documentation. Based on the results of the previous chapter, a number of strategies have been adopted to make the environment of the Sundarbans region pollution-free and carbon-free, as follows:

Proposed Strategies:

i. Tidal energy along with solar energy can be generated sufficient in the Sundarbans, so the use of diesel energy needs to be reduced by increasing the use of tidal energy and solar energy as a source of non-conventional energy. As a result, on the one hand, the environment will be free from pollution and on the other hand, the amount of carbon will be reduced. At the same time, the use of unconventional energy will gradually increase, which will enable tourism to move towards eco-friendly tourism

ii. Sundarban has a huge potential for solar energy, used by a significant number of people. Therefore the emphasis should be on the off-grid as well as in-grid use of solar energy in the tourism sector. This will serve as another strategy for developing eco-tourism.

iii. The plastic waste can be converted to cooking gas by catalytic conversion method at a temperature of 260̊ centigrade making it furan or dioxin free. As a result, on the one hand, the amount of combustible wood will be reduced and on the other hand, the waste can be used properly in a scientific way.

iv. In accordance with the guidelines of the Pollution Control Board, efforts should be made to reduce the amount of pollution as much as possible. There is no sewage treatment plant yet at any of the tourist locations. Special mention may be made for the amount of pollution in the Gangasagar Mela after the Sagar Mela and the amount of plastic waste pollution .on the beach in Bakankhali. Treatment plants are essential to achieving sustainable tourism.

v. In order to meet the demand for water and to reduce the use of groundwater, rainwater harvesting has to be practiced by the hotels through rooftops, and collection tanks and by storing rainwater in ponds, and small tanks and reusing it. As a result, just as it will serve as a means of conserving water, it will also prevent the groundwater level from falling. And if water conservation methods are adopted in this way, it will lead to potential eco-tourism.

vi. Promoting home stay tourism instead of star-marked hotels can generate the required community engagement for sustainability in the village. As a result, another way of earning money for the people of the local community will be opened. Indigenous people, both directly and indirectly, who are involved in tourism, will see an increase in their annual income. And this is homestay tourism, which is one of the strategies to build eco-tourism.

vii. Hotels and restaurants need to reduce food waste because if food waste is not treated properly, the environment will be polluted.

viii. Ensuring employment of 50% of local people in hotels and restaurants is made mandatory in tourist centers. As a result, the employment of local people will happen.

8.2.2. Tourist:

A number of strategies have been adopted to ensure that the tourists are aware of the natural balance of the tourist centers and also to take care of the cultural heritage of the people of the region.

Proposed Strategies:

i. A complete ban on the use of any plastic/littering while traveling in the Sundarbans (No Plastic Zone). In this case, every traveler will be aware of each other and will be aware of themselves. Plastics are extremely harmful in both terrestrial and aquatic ecosystems, so plastic is strictly prohibited in tourist centers.

ii. There will be punitive measures by the tourism development agency against polluting tourists. This means that wild animals, birds and aquatic animals should not be disturbed in any way while visiting the tourist centers of the Sundarbans region. Even playing the mike and any sound system while traveling is strictly forbidden. In this way, if any tourist causes pollution in the environment, the Tourism Development Board will take punitive measures.

iii. In order to encourage tourists to buy local products, opportunities need to be created to interact with the local community. In that case, the financial income of the local community will gradually increase and they will be able to directly engage themselves in the tourism industry.

Eco-tourist code of conduct to be published and followed:

a) The Forest Department's guidelines must be followed for entry into the Sundarbans forest.

b) Instructions of the forest guide should be followed mandatorily while roaming in the jungle.

8.2.3. Community:

In order to connect the local communities directly with the tourism industry in the areas where tourist centers have sprung up in the Sundarbans and to strengthen the tourist centers as eco-tourism hubs, some strategies are outlined as follows:

Proposed Strategies:

i. "Travel Guides“, with English language proficiency, can be trained from local unemployed educated youth to generate local employment. As a result, there will be the employment of educated unemployed youth in tourist centers. In addition, it will be able to guide foreign tourists in the right way. So the number of tourists coming not only from their own country but also from other countries will increase gradually.

ii. Encouraging the principles of home-based tourism as a way of earning a living for the local community, where Rural Bank and various NGOs will help financially so that they can strive

to build this community-based tourism. This could become a significant livelihood for the local poor and it will implement rural tourism.

iii. By training local shopkeepers to provide better quality food, the demand for local food will increase and employment will be created at the same time. Providing food to tourists will pave the way for the local community to earn a living.

iv. In the case of buying and selling various items made in the local handicraft/cottage industry, a village should be developed as community-based tourism so that the local people can invest in this industry and collect dividends from that industry themselves. In this way, if the tourist centers of different characters can be built in different parts of the Sundarbans, then on the one hand the pressure on the environment will be reduced but on the other hand the number of tourists in the Sundarbans will increase.

v. There is a demand from tourists to buy honey. The local community may be encouraged to become financially self-sufficient through beekeeping with the help of rural banks and various NGOs.

vi. The tourists should be provided with traditional cultural inputs through community performances like Dukhe Yatra, Mansa mangal and Ban bibir gaan etc. As a result, care will be taken to build cultural heritage among the people of the region. It refers to eco-tourism. And with the help of this eco-tourism, the lessons of sustainable income for the people will be widened along with the inter-cultural harmony among the people of the region.

vii. A battery-powered transport system is recommended for ferrying tourists, which will reduce environmental pollution and enable local people to earn money from the transport system.

viii. In all the areas of the Sundarbans where mangrove plantations are located, mangrove tourism or educative tourism centers can be set up where tourists can come and can participate in plantations preservation. As a result, on the one hand, the path of eco-tourism will be paved and on the other hand, different types of tourists will come to different tourist destinations. And this will create a way for local poor people to earn.

8.2.4. Landuse/Landcover:

Land use/land cover is a special part of developing eco-tourism. The Sundarbans Tourism Center has developed around the coastal areas, so it is necessary to analyze the land use/land cover in

order to develop the hotels, lodges and ashrams in the tourist centers by adopting the right strategy. Here are some strategies based on this:

Proposed Strategies:

i. The Department of Environment and the administrative organization will take strict steps to ensure that no hotel is built within 100 meters of the HTL following the Coastal zone Regulation. In this case, the river embankment will be protected and as a result, the environment will be free from damage.

ii. The credibility of the specific coast and sediment deposition cycle should be given proper weightage for the planning of tourist cottages and other tourist attractions. Spatial attention should be taken particularly for the coastal areas such as Bakkhali.

iii. Experienced planners and environmentalists need to be consulted on how to develop tourism in the Sundarbans by keeping an eye on the areas where tourism has developed by cutting mangroves. Especially in Jharkhali, mangrove patches are being destroyed due to the development of tourism.

iv. One of the attractions for tourists to visit the Sundarbans is to see different species of mangroves. It is necessary to plant a variety of mangroves, including in tourism centers, which can be used to develop mangrove tourism.

8.3. Conclusion:

It is imperative to adopt the above strategies to develop the Sundarbans tourist centers in a well-planned manner and as potential eco-friendly tourist destinations. These strategies are more important in developing countries and coastal tourism regions.

Chapter IX:

Concluding remarks and future avenues of research

9.1. Concluding Remarks:

The purpose of the study turned into discovering the potentiality of ecotourism in the five study areas in the Indian Sundarbans. This study presents sustainable approaches of GIS and EPI analysis to access the potentiality of ecotourism and its sustainability. These included approaches were able to handle universal and complex issues like biodiversity conservation, sustainable development of ecotourism, waste management and protect the environment in the Indian Sundarbans tourism areas.

The final commentary on what has been discussed in the previous chapters is given below:

i. With the growth in the tourism sector, land use/land cover planning is an important factor as it is seen that the development of tourist centers is taking place by destroying mangroves in Jharkhali and converting agricultural land into the fairground in the Sagar.

ii. Tourists are found to be mostly middle-aged, fairly educated, and belonging to the middle-income group.

iii. The number of 'overnight stay tourists' is higher than the number of 'day trippers' which has had a positive effect on the local economy of the region.

iv. The impact of tourism on the local socio-economy is effective and there is a lot of interest in the community for further improvement of tourism in the study areas (e.g. homestay tourism).

v. Ecotourism, therefore, can be a tool for environmental protection, local empowerment, and poverty alleviation.

vi. The carbon footprint check is an essential element of ecotourism, as the level of carbon emissions in this region must be regulated to be not more than the sustainable level to protect the environment.

vii. Local cultural heritage gets encouragement through eco-tourism practices, and heritage tourism centering on archaeological sites can also be promoted.

In conclusion, the benefits of tourism development and the use of ecotourism resources are discussed based on the results of five study areas that are practically viable. The findings and conclusions from the previous chapters show that if these 5 tourist centers in the Sundarbans are to be developed in an environmentally friendly manner, then the proposed ecotourism strategies discussed in Chapter 8 must be followed. If the tourism of the entire Sundarbans is arranged in a new way, its benefits to the tourism industry of West Bengal will be far-reaching. The Sundarbans will be able to

satisfy the travel thirst of people from any social background, not just any particular socio-economic group. Moreover, the inclusion of the common man in tourism in the Sundarbans will on the one hand raise awareness about the environment and tourism as well as create opportunities for the direct livelihood of some people. In this way, the entire tourism industry will protect nature from destruction. So tourism will be considered as one of the means, not destruction.

9.2. Future avenues of research:

Nowadays the most significant area of research is nature-based tourism. Ecotourism is seen as the next form of community and local regional development in many parts of the world. So in order to maintain the ecotourism site as a popular place, it requires a detailed study of individual choice patterns; inspired forces, etc. should be carried out. A comparative study of all the other ecotourism destinations in West Bengal would be an interesting site and we can appreciate its regional diversity. Researchers can compare inter-destinations using more advanced techniques and statistical tools. Therefore, there is ample scope for further research in these areas and it will help in raising the local/domestic ecotourism market and creating awareness about environmental protection and nature conservation for future generations. Much more research can be done on the ecological and biodiversity aspects of tourism. Extensive research is also possible for further theoretical research related to ecotourism. Ecotourism requires careful planning in the future to avoid further negative effects on biodiversity and the environment.

Such research has provided a unique resource for future research possibilities. Several indicators couldn't be measured due to the scope of cutting-edge research. Each and every indicating option that couldn't be measured went through a gap in the available data and represents an opportunity for further research, like Tourism Carrying Capacity Index (TCC), Beach Quality Index (BQI) and direct and indirect Carbon emission estimation. Longitudinal studies and monitoring are required for the indicators to be successful.

The tourism industry is one of the quickest and largest growing industries in the world. As the tourism industry grows, its effects have become more and more numerous. The academic community didn't grow with the growth of the tourism industry with the boom of tourism research. Educational and training institutions need to further promote tourism studies and research in order to make tourism professionals aware of the need for sustainable practice.

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ANNEXURE I

List of Publication

1. Sarkar, S., Bardhan, S., & Sanyal, P. (July, 2019). Ecotourism Studies: Lessons from Literature Review, *International Journal of Innovative Knowledge Concepts*, ISSN: 2454-2415, UGC Approved Journal No. 64094, 7 (7), 61 – 73.

2. Sarkar, S., Bardhan, S., & Sanyal, P. (December, 2019). Community Perception Towards Tourism Development in the Indian Sundarbans: Case Study of Jharkhali Island, *International Journal of Engineering Research & Technology*, ISSN: 2278-0181, 8 (12), 526 – 540.

3. Sarkar, S., Bardhan, S., & Sanyal, P. (2021). LULC Change Detection Studies and Its Possible Linkages with Increased Visitations in the Sagar Island, W.B., *International Journal of Engineering Trends and Technology*, ISSN: 2231-5381, doi:10.14445/22315381/IJETT-V69I8P207, 69 (8), 49 – 61, Scopus Indexed.

List of Conference Presentation:

1. Presented paper on "Ecotourism in an Indian Sundarban Island and its Socio Economic Impact on the Unique Mangrove Environment", in the International Conference on "Sustainable Tourism and Hospitality Marketing: Setting Agenda for Future Research (STHMCON – 2018) held on March 15th to 17th, 2018, organized by Department of Tourism and Hotel Management, North Eastern Hill University, Shillong, Meghalaya. (Link: https://sites.google.com/site/sthmcon/publication-plan, ISBN: 978-93-5300-511-5, Page No: 52)

2. P**resented paper on "Ecotourism as tools for Bio-diversity Conservation in Indian Sundarban, One of the Greatest Victims of Climate Change" (ISBN: 978-93-86453-97-6),** in the International Conference on "Livelihood promotion, Bio-diversity Conservation and Social Sequrity in Indian Sundarbans held at Jharkhali, Basanti on December 7th to 9th, 2018, organized by Department of Plant Protection, Palli-Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan; Hiranmaypur Agro-horticulture Socity for Technology and Rural Development, Basanti, South 24 Parganas in collaboration with Andrewspalli Centre for Integrated Development, Jogeshganj Project, North 24 Parganas.

ANNEXURE II

EPI CALCULATION SHEET

SAGAR ISLAND

Survey sheet on Calcutta Vastra Vyavsayi Seva Samiti Dharma Sala Resource Consumption pattern

	DESCRIPTION	INFORMATION
1	Owner	Private
2	Actual Built up area	1600 Sqm
3	Floor Height and no. of storey	3 m & Two storied
4a	No. of rooms (Double Bed)	-
4b	No. of rooms (Triple Bed)	-
4c	No. of rooms (Four Bed)	40
4d	Dormitories	10
4e	Dormitory capacity	50 persons/Dormitory
5	Total Tourist Capacity	660
6	AC Rooms	10
7	No. of resident staff	10
8	Preference of conditioned space	Summer time
9	Average Occupancy in a year	100 % in Nov to Feb mostly and 15 % March to Oct
10	Preferred Tourist season	Nov to Feb, Holidays and week-ends, winter season
11	Average No. of tourist days	150 (conservative estimate) & 200 (optimistic estimate)
12a	Average No. of FTT	
12b	Average No. of DTT	Mostly
13	Remarks	
	ENERGY CONSUMPTION	
E. 1	Power supply	WBSEDCL (West Bengal State Electricity Distribution Company Limited)
E. 2	Consistency of supply	Average 1 hr. power cut/day
E. 3	Average Power Bill/month	5500/- per month (11/- INR per unit)
E. 4	Electric power consume/month	500 KWh
E. 5	Diesel Generator (DG) capacity	10KVA
E. 6	Average operational hours of DG	10 Hours per month
E. 7	Quantity of diesel used	30 litres
E. 8	Kitchen fuel: wood/coal/LPG	Not Applicable due to absence of dining facilities
E. 9	Kitchen fuel: consumed/month	Same as above
E. 10	AC Tonnage	1.5
E. 11	Capacity of water pump	2 no. 1.5 H.P.
E. 12	Average operational hours of water pump	30 minutes operation /day
	WATER CONSUMPTION	
W. 1	Volume of water tank	2000
W. 2	No. of re-fills	2

W. 3	Tourist Habit of water usage	Women have a tendency to over-wash clothes after travelling the tourist spots
W. 4	Source of water: Deep tube well (DTW)/ BORE WELL/ Hand TW/ surface or pond source	DTW, DEPTH 1000 Feet
	WASTE MANAGEMENT	
W. 1	Type of solid waste generated	Papers/plastic wrappers/mineral water bottles/glass bottles
W. 2	Quantity of solid waste generated	25 kg/month
W. 3	Disposal method	Burning
W. 4	Septic tank / others	Septic tank

Energy Utilization in Building Operation in Calcutta Vastra Vyavsayi Seva Samiti Dharma Sala

Gadgets/ Fuel	Rating2	Quantity	Assumed Operation time per month	Energy used per Month	CO_2 Emission per month (coal- based fossil fuel)	CO_2 Emission per month (oil- based fossil fuel)	Total CO_2 Emission per month
	W	Nos.	H	kWh	Kg	Kg	Kg
	a	b	c	A = (a x b x c)/1000	B = [A x 0.9][1]	C = [A x 0.85][2]	D = (B + C)
1. Power Grid (West Bengal State Electricity Distribution Company Limited) [One Meter]				500	450		518
a. Indoor Lighting (Light Emitting Diode Lamps and Tubes) b. Outdoor Lighting (Corridor, Garden, Signage, Gate and Security lights c. Fan (Ceiling /Wall / Table) d. Television (Colour, LCD / LED) e. Air Conditioner f. Geyser g. Hotel h.Refrigerator i. Electric Iron j. Water Pump							

2. Diesel Generator	(10KVA x .8) = 8KVA = 8000	1	10	80		68	
TOTAL				580			518
Total Energy Used Per Month Per Sqm in Building Operation (=∑ A/3200)					0.181 kWh/Sqm/ month		
Total Energy Used Per year Per Sqm in Building Operation = (0.181 x12)					2.172 kWh/Sqm/y ear		
Total CO_2 Emission Per Month Per Sqm in Building Operation (=∑ D/3200)							0.162 KgC/Sqm/mo nth
Total CO_2 Emission Per year Per Sqm in Building Operation = (0.162 x 12)							1.944 KgC/Sqm/yea r

[1] Greenhouse gas emission is 900 grams per kilowatt-hour of CO_2 Equivalent for coal-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

[2] Greenhouse gas emission is 850 grams per kilowatt-hour of CO_2 Equivalent for oil-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

[3]WBSEDCL (West Bengal State Electricity Distribution Company Limited) Power Consumption Guide

WASTE (Solid Waste) generated in Building Operation in Calcutta Vastra Vyavsayi Seva Samiti Dharma Sala

Waste Type	Quantity	Treatment Method	Energy Equivalente/ Day*	Possible Emission**
	Kg		kWh/Day	KgC/Day
	A		B=(A x 4.42)	C=B x 0.045
1. Bio-Degradable a. Food waste b. Paper / cardboards c. Leaf litter 2. Non- Bio-Degradable	Food waste is minimum as the Lodge doesn't offer dining facilities. While other recyclable wastes are sold-out,	Incineration Aided with fuel wood	437.58	19.691

a. Glass (bottles/ broken window panes/ bulbs etc.) b. Metals (Cans/ Containers) c. Plastics (food packets/poly bags/ household objects/ cans & containers) d. Paper e. Fabric f. Hair/Nails	leaf-litter, papers and plastics are burnt on a weekly basis. Considering 150 gm of such waste per bed per day, total waste generated was calculated as (0.15 x 660 = 99 Kg/Day), which was corroborated by the staff of Calcutta Vastra Vyavsayi Seva Samiti Dharma Sala.			
3. Toxic				
a. Batteries (Pb) b. Disused Tube-light (Hg) c. Use oil				
Total Energy Equivalent of Waste Used Per Day Per Sqm in Building Operation (=∑ B/3200)			0.137 kWh/Sqm/day	
Total CO_2 Emission Per Day Per Sqm in Building Operation (=∑ C/3200)			0.006 KgC/Sqm/day	
Total Energy Equivalent of Waste Used Per year Per Sqm in Building Operation = (0.137 x 365)			50.005 kWh/Sqm/year	
Total CO2 Emission Per year Per Sqm in Building Operation = (0.006 x 365)			2.19 KgC/Sqm/year	

*Dias, W.P.S., 'Quality based energy contents and carbon coefficients for Building materials: A systems approach' specifies the TOE (tones of oil equivalent) of biomass, mainly firewood to be 0.38 [12], where, one TOE= 41.84 GJ, meaning 1 Mt of firewood will consume (0.38 x 41.84 GJ) = 15.9 GJ of energy [i.e. ≡ 4420 kWh for 1000Kg of biomass or 4.42 kWh/Kg]. For 99 Kg, energy consumed 437.58 kWh.

**Greenhouse gas emission is 45 grams per Kilowatt-hour of CO_2 Equivalent for bio-mass based fossil fuel form of energy supply i.e. (437.58 x 45) = 19691.1 gms C = 19.691 KgC [IEEE Spectrum, Issue: Feb 2008, Vol. -45, No. 2, Pg 56].

FOOT-PRINTS of Calcutta Vastra Vyavsayi Seva Samiti Dharma Sala: Capital & Annual

FOOT-PRINTS	Capital (in terms of energy)	Annual recurring (in terms of energy)	Capital	Annual recurring	Capital CO_2 Emission	Annual recurring CO_2 Emission
	kWh/Sqm	kWh/Sqm/Yr	Lt/Sqm	Lt/Sqm/Yr	KgC/Sqm	KgC/Sqm/Yr
ENERGY		2.172				1.944
WASTE		50.005				2.19
Total Energy Equivalent		**52.177**				
CO_2						**4.134**

BAKKHALI

Survey sheet on Balaka Lodge Resource Consumption pattern

	DESCRIPTION	INFORMATION
1	Owner	Private
2	Actual Built up area	397 m^2
3	Floor Height and no. of storey	2.9 m & Three storied
4a	No. of rooms (Double Bed)	12
4b	No. of rooms (Triple Bed)	32
4c	No. of rooms (Four Bed)	-
4d	Dormitories	-
4e	Dormitory capacity	-
5	Total Tourist Capacity	120
6	AC Rooms	44
7	No. of resident staff	5
8	Preference of conditioned space	Summer time
9	Average Occupancy in a year	100 % in Nov to Feb mostly and 20 % March to Oct
10	Preferred Tourist season	Nov to Feb, Holidays and week-ends, winter season
11	Average No. of tourist days	150 (conservative estimate) & 200 (optimistic estimate)
12a	Average No. of FTT	5% (very rare)
12b	Average No. of DTT	Mostly
13	Remarks	
	ENERGY CONSUMPTION	
E. 1	Power supply	WBSEDCL (West Bengal State Electricity

		Distribution Company Limited)
E. 2	Consistency of supply	Average 1 hr. power cut/day
E. 3	Average Power Bill/month	50000/- per month
E. 4	Electric power consume/month	4545.45 kWh
E. 5	Diesel Generator (DG) capacity	80 KVA
E. 6	Average operational hours of DG	25 Hours per month
E. 7	Quantity of diesel used	25 litres
E. 8	Kitchen fuel: wood/coal/LPG	Not Applicable due to absence of dining facilities
E. 9	Kitchen fuel: consumed/month	Same as above
E. 10	AC Tonnage	1.5 T
E. 11	Capacity of water pump	1 no. 1.5 H.P.
E. 12	Average operational hours of water pump	30 minutes operation /day
	WATER CONSUMPTION	
W. 1	Volume of water tank	2000
W. 2	No. of re-fills	3
W. 3	Tourist Habit of water usage	Women have a tendency to over-wash clothes after travelling the tourist spots
W. 4	Source of water: Deep tube well (DTW)/ BORE WELL/ Hand TW/ surface or pond source	DTW, DEPTH 1000 Feet, Bore well
	WASTE MANAGEMENT	
W. 1	Type of solid waste generated	Papers/plastic wrappers/mineral water bottles/glass bottles
W. 2	Quantity of solid waste generated	60 kg/month
W. 3	Disposal method	Burning
W. 4	Septic tank / others	Septic tank

Energy Utilization in Building Operation in Balaka Lodge

Gadgets/ Fuel	Rating2	Quantity	Assumed Operation time per month	Energy used per Month	CO_2 Emission per month (coal- based fossil fuel)	CO_2 Emission per month (oil- based fossil fuel)	Total CO_2 Emission per month
	W	Nos.	H	kWh	Kg	Kg	Kg
	a	b	c	A = (a x b x c)/1000	B = [A x 0.9][1]	C = [A x 0.85][2]	D = (B + C)
1. Power Grid (West Bengal State Electricity Distribution Company Limited) [One Meter]				4545.45	4090.905		5450.905

a. Indoor Lighting (Light Emitting Diode Lamps and Tubes) b. Outdoor Lighting (Corridor, Garden, Signage, Gate and Security lights c. Fan (Ceiling /Wall / Table) d. Television (Colour, LCD / LED) e. Air Conditioner f. Geyser g. Hotel Refrigerator i. Electric Iron j. Water Pump							
2. Diesel Generator	(80 KVA x .8) = 64 KVA = 64000	1	25	1600		1360	
TOTAL				6145.45			5450.905
Total Energy Used Per Month Per m^2 in Building Operation (=∑ A/1191)					5.160 kWh/m^2/month		
Total Energy Used Per year Per m^2 in Building Operation = (5.160 x 12)					61.92 kWh/m^2/Yr		
Total CO_2 Emission Per Month Per m^2 in Building Operation (=∑ D/1191)							4.577 KgC/m^2/month
Total CO_2 Emission Per year Per m^2 in Building Operation = (4.577 x 12)							54.924 KgC/m^2/year

[1] Greenhouse gas emission is 900 grams per kilowatt-hour of CO_2 Equivalent for coal-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

[2] Greenhouse gas emission is 850 grams per kilowatt-hour of CO_2 Equivalent for oil-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

[3]WBSEDCL (West Bengal State Electricity Distribution Company Limited) Power Consumption Guide.

WASTE (Solid Waste) generated in Building Operation in Balaka Lodge

Waste Type	Quantity	Treatment Method	Energy Equivalente/ Day*	Possible Emission**
	Kg		kWh/Day	KgC/Day
	A		B=(A x 4.42)	C=B x 0.045
4. Bio-Degradable	Food waste is minimum as the Lodge doesn't offer dining facilities. While other recyclable wastes are sold-out, leaf-litter, papers and plastics are burnt on a weekly basis. Considering 200 gm of such waste per bed per day, total waste generated was calculated as (0.2 x 120 = 24 Kg/Day), which was corroborated by the staff of Balaka Lodge.	Incineration Aided with fuel wood	106.08	4.774
d. Food waste e. Paper / cardboards f. Leaf litter				
5. Non- Bio-Degradable				
g. Glass (bottles/ broken window panes/ bulbs etc.) h. Metals (Cans/ Containers) i. Plastics (food packets/poly bags/ household objects/ cans & containers) j. Paper k. Fabric l. Hair/Nails				
6. Toxic				
d. Batteries (Pb) e. Disused Tube-light (Hg) f. Use oil				
Total Energy Equivalent of Waste Used Per Day Per m^2 in Building Operation (=∑ B/1191)			0.089 kWh/m^2/day	
Total CO_2 Emission Per Day Per m^2 in Building Operation (=∑ C/1191)			0.004 KgC/m^2/day	
Total Energy Equivalent of Waste Used Per year Per m^2 in Building Operation = (0.089 x 365)			32.485 kWh/m^2/year	
Total CO2 Emission Per year Per m^2 in Building Operation = (0.004 x 365)			1.46 KgC/m^2/year	

*Dias, W.P.S., 'Quality based energy contents and carbon coefficients for Building materials: A systems approach' specifies the TOE (tones of oil equivalent) of biomass, mainly firewood to be 0.38 [12], where, one TOE= 41.84 GJ, meaning 1 Mt of firewood will consume (0.38 x 41.84 GJ) = 15.9 GJ of energy [i.e. ≡ 4420 kWh for 1000Kg of biomass or 4.42 kWh/Kg]. For 24 Kg, energy consumed 106.08 kWh.

**Greenhouse gas emission is 45 grams per Kilowatt-hour of CO_2 Equivalent for bio-mass based fossil fuel form of energy supply i.e. (106.08 x 45) = 4773.6 gms C = 4.774 KgC [IEEE Spectrum, Issue: Feb 2008, Vol. -45, No. 2, Pg 56].

FOOT-PRINTS of Balaka Lodge: Capital & Annual

FOOT-PRINTS	Capital (in terms of energy)	Annual recurring (in terms of energy)	Capital	Annual recurring	Capital CO_2 Emission	Annual recurring CO_2 Emission
	kWh/m^2	$kWh/m^2/Yr$	Lt/m^2	$Lt/m^2/Yr$	KgC/m^2	$KgC/m^2/Yr$
ENERGY		61.92				54.924
WASTE		32.485				1.46
Total Energy Equivalent		**94.405**				
CO_2						**56.384**

JHARKHALI

Survey sheet on JHAR BANGLOW'S Resource Consumption pattern

	DESCRIPTION	INFORMATION
1	Owner	WB GOVT
2	Actual Built up area	79.37 Sqm
3	Floor Height and no. of storey	2.8 m & one storied
4a	No. of rooms (Double Bed)	-
4b	No. of rooms (Triple Bed)	-
4c	No. of rooms (Four Bed)	2
4d	Dormitories	1
4e	Dormitory capacity	6
5	Total Tourist Capacity	14
6	AC Rooms	-
7	No. of resident staff	3
8	Preference of conditioned space	-

9	Average Occupancy in a year	100 % in Nov to Feb mostly and 10 % March to Oct
10	Preferred Tourist season	Nov to Feb, Holidays and week-ends
11	Average No. of tourist days	150 (conservative estimate) & 200 (optimistic estimate)
12a	Average No. of FTT	No
12b	Average No. of DTT	Mostly
13	Remarks	
	ENERGY CONSUMPTION	
E. 1	Power supply	WBSEDCL (West Bengal State Electricity Distribution Company Limited)
E. 2	Consistency of supply	Average 1 hr. power cut/day
E. 3	Average Power Bill/month	1500/- per month (11/- INR per unit)
E. 4	Electric power consume/month	136.36 Kwh
E. 5	Diesel Generator (DG) capacity	-
E. 6	Average operational hours of DG	-
E. 7	Quantity of diesel used	-
E. 8	Kitchen fuel: wood/coal/LPG	Not Applicable due to absence of dining facilities
E. 9	Kitchen fuel: consumed/month	Same as above
E. 10	AC Tonnage	-
E. 11	Capacity of water pump	1 no. 1 H.P.
E. 12	Average operational hours of water pump	20 minutes operation /day
	WATER CONSUMPTION	
W. 1	Volume of water tank	1000
W. 2	No. of re-fills	1
W. 3	Tourist Habit of water usage	Women have a tendency to over-wash clothes after travelling the tourist spots
W. 4	Source of water: Deep tube well (DTW)/ BORE WELL/ Hand TW/ surface or pond source	DTW, DEPTH 1000 Feet
	WASTE MANAGEMENT	
W. 1	Type of solid waste generated	Papers/plastic wrappers/mineral water bottles/glass bottles
W. 2	Quantity of solid waste generated	7 kg/month
W. 3	Disposal method	Burning
W. 4	Septic tank / others	Septic tank

Energy Utilization in Building Operation in Jhar Banglow

Gadgets/ Fuel	Rating2	Quantity	Assumed Operation time per month	Energy used per Month	CO_2 Emission per month (coal- based fossil fuel)	CO_2 Emission per month (oil- based fossil fuel)	Total CO_2 Emission per month
	W	Nos.	H	kWh	Kg	Kg	Kg
	a	b	c	A = (a x b x c)/1000	B = [A x 0.9][1]	C = [A x 0.85][2]	D = (B + C)
1. Power Grid (West Bengal State Electricity Distribution Company Limited) [One Meter]				136.36	122.724		122.724
a. Indoor Lighting (Light Emitting Diode Lamps and Tubes) b. Outdoor Lighting (Corridor, Garden, Signage, Gate and Security lights c. Fan (Ceiling /Wall / Table) d. Television (Colour, LCD / LED) e. Water Pump							
2. Diesel Generator	-	NA	-	-	-	-	-
TOTAL				136.36			122.724
Total Energy Used Per Month Per Sqm in Building Operation (=∑ A/79.37)					1.718 kWh/Sqm/ month		
Total Energy Used Per year Per Sqm in Building Operation = (1.718 x12)					20.616 kWh/Sqm/ Yr		
Total CO_2 Emission Per Month Per Sqm in Building Operation (=∑ D/79.37)							1.546 KgC/Sqm/month
Total CO_2 Emission Per year Per Sqm in Building Operation = (1.546 x 12)							18.552 KgC/Sqm/year

[1] Greenhouse gas emission is 900 grams per kilowatt-hour of CO_2 Equivalent for coal-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

[2] Greenhouse gas emission is 850 grams per kilowatt-hour of CO_2 Equivalent for oil-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

[3]WBSEDCL (West Bengal State Electricity Distribution Company Limited) Power Consumption Guide

WASTE (Solid Waste) generated in Building Operation in Jhar Banglow

Waste Type	Quantity	Treatment Method	Energy Equivalente/ Day*	Possible Emission**
	Kg		kWh/Day	KgC/Day
	A		B=(A x 4.42)	C=B x 0.045
7. Bio-Degradable	Food waste is minimum as the Lodge doesn't offer dining facilities. While other recyclable wastes are sold-out, leaf-litter, papers and plastics are burnt on a weekly basis. Considering 200 gm of such waste per bed per day, total waste generated was calculated as (0.2 x 14 = 2.8 Kg/Day), which was corroborated by the staff of Jhar Banglow.	Incineration Aided with fuel wood	12.376	0.556
g. Food waste h. Paper / cardboards i. Leaf litter				
8. Non- Bio-Degradable				
m. Glass (bottles/ broken window panes/ bulbs etc.) n. Metals (Cans/ Containers) o. Plastics (food packets/poly bags/ household objects/ cans & containers) p. Paper q. Fabric r. Hair/Nails				
9. Toxic				
g. Batteries (Pb) h. Disused Tube-light				

(Hg) i. Use oil				
Total Energy Equivalent of Waste Used Per Day Per Sqm in Building Operation (=∑ B/79.37)			0.156 kWh/Sqm/day	
Total CO_2 Emission Per Day Per Sqm in Building Operation (=∑ C/79.37)			0.007 KgC/Sqm/day	
Total Energy Equivalent of Waste Used Per year Per Sqm in Building Operation = (0.156 x 365)			56.94 kWh/Sqm/year	
Total CO2 Emission Per year Per Sqm in Building Operation = (0.007 x 365)			2.555 KgC/Sqm/year	

*Dias, W.P.S., 'Quality based energy contents and carbon coefficients for Building materials: A systems approach' specifies the TOE (tones of oil equivalent) of biomass, mainly firewood to be 0.38 [12], where, one TOE= 41.84 GJ, meaning 1 Mt of firewood will consume (0.38 x 41.84 GJ) = 15.9 GJ of energy [i.e. ≡ 4420 kWh for 1000Kg of biomass or 4.42 kWh/Kg]. For 2.8 Kg, energy consumed 12.376 kWh.

**Greenhouse gas emission is 45 grams per Kilowatt-hour of CO_2 Equivalent for bio-mass based fossil fuel form of energy supply i.e. (12.376 x 45) = 556.92 gms C = 0.556 KgC [IEEE Spectrum, Issue: Feb 2008, Vol. -45, No. 2, Pg 56].

FOOT-PRINTS of Jhar Banglow: Capital & Annual

FOOT-PRINTS	Capital (in terms of energy)	Annual recurring (in terms of energy)	Capital	Annual recurring	Capital CO_2 Emission	Annual recurring CO_2 Emission
	kWh/Sqm	kWh/Sqm/Yr	Lt/Sqm	Lt/Sqm/Yr	KgC/Sqm	KgC/Sqm/Yr
ENERGY		20.616				18.552
WASTE		56.94				2.555
Total Energy Equivalent		**77.556**				
CO_2						**21.107**

PAKHIRALAYA

Survey sheet on SANAHA GUEST HOUSE'S Resource Consumption pattern

(Jela Parishad Banglow)

	DESCRIPTION	INFORMATION
1	Owner	Private
2	Actual Built up area	270 Sqm
3	Floor Height and no. of storey	2.9 m & Two storied
4a	No. of rooms (Double Bed)	-
4b	No. of rooms (Triple Bed)	-
4c	No. of rooms (Four Bed)	8
4d	Dormitories	2
4e	Dormitory capacity	18 (9 persons/Dormitory)
5	Total Tourist Capacity	50
6	AC Rooms	2
7	No. of resident staff	3
8	Preference of conditioned space	Summer time
9	Average Occupancy in a year	100 % in Nov to Feb mostly and 20 % March to Oct
10	Preferred Tourist season	Nov to Feb, Holidays and week-ends, winter season
11	Average No. of tourist days	150 (conservative estimate) & 200 (optimistic estimate)
12a	Average No. of FTT	1% (very rare)
12b	Average No. of DTT	Mostly
13	Remarks	
	ENERGY CONSUMPTION	
E. 1	Power supply	WBSEDCL (West Bengal State Electricity Distribution Company Limited)
E. 2	Consistency of supply	Average 1 hr. power cut/day
E. 3	Average Power Bill/month	4000/- per month
E. 4	Electric power consume/month	363.64 kWh
E. 5	Diesel Generator (DG) capacity	7.5KVA
E. 6	Average operational hours of DG	15 Hours per month
E. 7	Quantity of diesel used	30 litres
E. 8	Kitchen fuel: wood/coal/LPG	Not Applicable due to absence of dining facilities
E. 9	Kitchen fuel: consumed/month	Same as above
E. 10	AC Tonnage	1.5 T
E. 11	Capacity of water pump	1 no. 1.5 H.P.
E. 12	Average operational hours of water pump	45 minutes operation /day
	WATER CONSUMPTION	
W. 1	Volume of water tank	2000 (No. of tank – 3)
W. 2	No. of re-fills	1

W. 3	Tourist Habit of water usage	Women have a tendency to over-wash clothes after travelling the tourist spots
W. 4	Source of water: Deep tube well (DTW)/ BORE WELL/ Hand TW/ surface or pond source	DTW, DEPTH 1000 Feet, Bore well
	WASTE MANAGEMENT	
W. 1	Type of solid waste generated	Papers/plastic wrappers/mineral water bottles/glass bottles
W. 2	Quantity of solid waste generated	30 kg/month
W. 3	Disposal method	Burning
W. 4	Septic tank / others	Septic tank

Energy Utilization in Building Operation in Sahana Guest House

Gadgets/ Fuel	Rating2	Quantity	Assumed Operation time per month	Energy used per Month	CO_2 Emission per month (coal- based fossil fuel)	CO_2 Emission per month (oil- based fossil fuel)	Total CO_2 Emission per month
	W	Nos.	H	kWh	Kg	Kg	Kg
	a	b	c	A = (a x b x c)/1000	B = [A x 0.9][1]	C = [A x 0.85][2]	D = (B + C)
1. Power Grid (West Bengal State Electricity Distribution Company Limited) [One Meter]				363.64	327.276		403.776
a. Indoor Lighting (Light Emitting Diode Lamps and Tubes) b. Outdoor Lighting (Corridor, Garden, Signage, Gate and Security lights c. Fan (Ceiling /Wall / Table) d. Television (Colour, LCD / LED) e. Air Conditioner f. Geyser g. Hotel h.Refrigerator i. Electric Iron j. Water Pump							

2. Diesel Generator	(7.5 KVA x .8) = 6 KVA = 6000	1	15	90		76.5	
TOTAL				453.64			403.776
Total Energy Used Per Month Per Sqm in Building Operation (=∑ A/540)					0.840 kWh/Sqm/ month		
Total Energy Used Per year Per Sqm in Building Operation = (0.840 x12)					10.08 kWh/Sqm/ Yr		
Total CO_2 Emission Per Month Per Sqm in Building Operation (=∑ D/540)							0.748 KgC/Sqm/mo nth
Total CO_2 Emission Per year Per Sqm in Building Operation = (0.748 x 12)							8.976 KgC/Sqm/yea r

[1] Greenhouse gas emission is 900 grams per kilowatt-hour of CO_2 Equivalent for coal-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

[2] Greenhouse gas emission is 850 grams per kilowatt-hour of CO_2 Equivalent for oil-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol. – 45, No. 2, Pg. 56]

[3]WBSEDCL (West Bengal State Electricity Distribution Company Limited) Power Consumption Guide

WASTE (Solid Waste) generated in Building Operation in Sahana Guest House

Waste Type	Quantity	Treatment Method	Energy Equivalente/ Day*	Possible Emission**
	Kg		kWh/Day	KgC/Day
	A		B=(A x 4.42)	C=B x 0.045
10. Bio-Degradable j. Food waste k. Paper / cardboards l. Leaf litter	Food waste is minimum as the Lodge doesn't offer dining facilities. While	Incineratio n Aided with fuel	44.2	1.989

11. Non- Bio-Degradable s. Glass (bottles/ broken window panes/ bulbs etc.) t. Metals (Cans/ Containers) u. Plastics (food packets/poly bags/ household objects/ cans & containers) v. Paper w. Fabric x. Hair/Nails	other recyclable wastes are sold-out, leaf-litter, papers and plastics are burnt on a weekly basis. Considering 200 gm of such waste per bed per day, total waste generated was calculated as (0.2 x 50 = 10 Kg/Day), which was corroborated by the staff of Sanaha Guest House.	wood		
12. Toxic j. Batteries (Pb) k. Disused Tube-light (Hg) l. Use oil				
Total Energy Equivalent of Waste Used Per Day Per Sqm in Building Operation (=∑ B/540)			0.082 kWh/Sqm/day	
Total CO_2 Emission Per Day Per Sqm in Building Operation (=∑ C/540)			0.004 KgC/Sqm/day	
Total Energy Equivalent of Waste Used Per year Per Sqm in Building Operation = (0.082 x 365)			29.93 kWh/Sqm/year	
Total CO2 Emission Per year Per Sqm in Building Operation = (0.004 x 365)			1.46 KgC/Sqm/year	

*Dias, W.P.S., 'Quality based energy contents and carbon coefficients for Building materials: A systems approach' specifies the TOE (tones of oil equivalent) of biomass, mainly firewood to be 0.38 [12], where, one TOE= 41.84 GJ, meaning 1 Mt of firewood will consume (0.38 x 41.84 GJ) = 15.9 GJ of energy [i.e. ≡ 4420 kWh for 1000Kg of biomass or 4.42 kWh/Kg]. For 10 Kg, energy consumed 44.2 kWh.

**Greenhouse gas emission is 45 grams per Kilowatt-hour of CO_2 Equivalent for bio-mass based fossil fuel form of energy supply i.e. (44.2 x 45) = 1989 gms C = 1.989 KgC [IEEE Spectrum, Issue: Feb 2008, Vol. -45, No. 2, Pg 56].

FOOT-PRINTS of Sanaha Guest House: Capital & Annual

FOOT-PRINTS	Capital (in terms of energy)	Annual recurring (in terms of energy)	Capital	Annual recurring	Capital CO_2 Emission	Annual recurring CO_2 Emission
	kWh/Sqm	kWh/Sqm/Yr	Lt/Sqm	Lt/Sqm/Yr	KgC/Sqm	KgC/Sqm/Yr
ENERGY		10.08				8.976
WASTE		29.93				1.46
Total Energy Equivalent		**40.01**				
CO_2						**10.436**

DAYAPUR

Survey sheet on SUNDARBAN GREEN HOUSE Resource Consumption pattern

	DESCRIPTION	INFORMATION
1	Owner	Private
2	Actual Built up area	300 Sqm
3	Floor Height and no. of storey	2.74 m & 2 storied
4a	No. of rooms (Double Bed)	-
4b	No. of rooms (Triple Bed)	14
4c	Dormitories	-
4d	Dormitory capacity	-
5	Total Tourist Capacity	42
6	AC Rooms	-
7	No. of resident staff	2
8	Preference of conditioned space	-
9	Average Occupancy in a year	100 % in Oct to Feb mostly and 10 % March to Sep
10	Preferred Tourist season	Oct to Feb, Holidays and week-ends
11	Average No. of tourist days	150 (conservative estimate) & 200 (optimistic estimate)
12a	Average No. of FTT	No
12b	Average No. of DTT	Mostly
13	Remarks	
	ENERGY CONSUMPTION	
E. 1	Power supply	-
E. 2	Consistency of supply	-

E. 3	Average Power Bill/month	-
E. 4	Diesel Generator (DG) capacity	One no. 5.5 KVA & One no. 4 KVA
E. 5a	Seasonal operational hours of DG	130 Hours per month (Seasonal time – 5 months)
E. 5b	Off-seasonal operational hours of DG	25 Hours per month (Off-season time – 7 months)
E. 5c	Average operational hours of DG	68.75 Hours per month
E. 6a	Quantity of diesel used (Seasonal time)	110 litres per month (Seasonal time – 5 months)
E. 6b	Quantity of diesel used (off-seasonal time)	20 litres per month (Off-season time – 7 months)
E. 6c	Average quantity of diesel used	57.5 litres/month
E. 7	Kitchen fuel: wood/coal/LPG	-
E. 8	Kitchen fuel: consumed/month	-
E. 9	AC Tonnage	-
E. 10	Capacity of water pump	1 no. 1 H.P.
E. 11	Average operational hours	45 minute/operation /day
	WATER CONSUMPTION	
W. 1	Volume of water tank	2000
W. 2	No. of re-fills	2
W. 3	Tourist Habit of water usage	Women have a tendency to over-wash clothes after travelling the tourist spots
W. 4	Source of water: Deep tube well (DTW)/ BORE WELL/ Hand TW/ surface or pond source	Pond water, depth 2.8 m
	WASTE MANAGEMENT	
W. 1	Type of solid waste generated	Papers/plastic wrappers/mineral water bottles/glass bottles
W. 2	Quantity of solid waste generated	20 kg/month
W. 3	Disposal method	Burning
W. 4	Septic tank / others	Septic tank

Energy Utilization in Building Operation in Sundarban Green House

Gadgets/ Fuel	Rating[1]	Quantity	Assumed Operation time per month	Energy used per month	CO_2 Emission per month (oil – based fossil fuel)
	W	Nos.	Average Hours	kWh	Kg
	a	b	c	A = (a x b x c)/1000	B = [A x 0.85][2]
Diesel Generator	(5.5 KVA x .8) = 4.4 KVA =	1	68.75	302.5	257.125

	4400				
	(4 KVA x .8) = 3.2 KVA = 3200	1	68.75	220	187
Total				**522.5**	**444.125**
Total energy used per month per Sqm in building operation (=∑ A/600)					0.871 kWh/Sqm/day
Total energy used per year per Sqm in building operation = (0.871 x 12)					10.452 kWh/Sqm/year
Total CO_2 emission per day per Sqm in building operation (=∑ B/600)					0.740 KgC/Sqm/month
Total CO2 emission per year per Sqm in building operation = (0.740 x 12)					8.88 KgC/Sqm/year

[1] CESC Power Consumption Guide

[2] Greenhouse gas emissions is 850 grams per Kilowatt-hour of CO_2 Equivalent for oil-based fossil fuel form of energy supply. [IEEE Spectrum, Issue: Feb 2008, Vol.-45, No.2, Pg56]

[3] WBSEDCL (West Bengal State Electricity Distribution Company Limited) Power Consumption Guide

WASTE (Solid Waste) generated in Building Operation in Sundarban Green House

Waste Type	Quantity	Treatment Method	Energy Equivalente /Day*	Possible Emission**
	Kg		kWh/Day	KgC/Day
	A		B=(A x 4.42)	C=B x 0.045
1. Bio-Degradable a. Food waste b. Paper / cardboards c. Leaf litter 2. Non- Bio-Degradable a. Glass (bottles/ broken window panes/ bulbs etc.) b. Metals (Cans/ Containers) c. Plastics (food packets/poly bags/ household objects/ cans & containers) d. Paper e. Fabric	Food waste is minimum as the Lodge doesn't offer dining facilities. While other recyclable wastes are sold-out, leaf-litter, papers and plastics are burnt on a weekly basis. Considering 200 gm of such waste per bed per day, total waste generated was calculated as (0.2 x 42 = 8.4 Kg/Day), which was corroborated by the staff of Sundarban	Incineration Aided with fuel wood	37.13	1.67

f. Hair/Nails	Green House.			
3. Toxic				
a. Batteries (Pb) b. Disused Tube-light (Hg) c. Use oil				
Total energy equivalent of waste used per day per Sqm in building operation (=∑ B/600)			0.06 kWh/Sqm/day	
Total CO_2 emission per day per Sqm in building operation (=∑ C/600)			0.003 KgC/Sqm/day	
Total energy equivalent of waste used per year per Sqm in building operation = (0.06 x 365)			21.9 KWh/Sqm/year	
Total CO2 emission per year per Sqm in building operation = (0.003 x 365)			1.095 KgC/Sqm/year	

* Dias, W.P.S., 'Quality based energy contents and carbon coefficients for Building materials: A systems approach' specifies the TOE (tones of oil equivalent) of biomass, mainly firewood to be 0.38 [12], where, one TOE = 41.84 GJ, meaning 1 Mt of firewood will consume (0.38 x 41.84 GJ) = 15.9 GJ of energy [i.e. = 4420 kWh for 1000Kg of biomass or 4.42 kWh/Kg]. For 8.4 Kg, energy consumed is 37.13 kWh.

** Greenhouse gas emissions is 45 grams per kilowatt-hour of CO_2 Equivalent for bio-mass based fossil fuel form of energy supply i.e. (37.13 x 45) = 1670.85 gmsC = 1.67 KgC [IEEE Spectrum, Issue: Feb 2008, Vol.-45, No.2, Pg 56].

FOOT-PRINTS of SMR: Capital & Annual

FOOT-PRINTS	Capital (in terms of energy)	Annual recurring (in terms of energy)	Capital	Annual recurring	Capital CO_2 Emission	Annual recurring CO_2 Emission
	kWh/Sqm	kWh/Sqm/Yr	Lt/Sqm	Lt/Sqm/Yr	KgC/Sqm	KgC/Sqm/Yr
ENERGY		10.452				8.88
WASTE		21.9				1.095
Total Energy Equivalent		**32.352**				
CO_2						**9.975**

ANNEXURE III

SURVEY QUESTIONNAIRE

HOTEL SURVEY QUESTIONNAIRE

Surveyor:

Date of survey:

A. BASIC INFORMATION

Name of the Tourist spot:

Name of Hotel / Lodge / Establishment & Address:

Geographic position: Long: Lat:

Type of ownership: Government ☐ Private ☐ Semi – Govt. ☐

Standard of the hotel :

Luxury ☐ Middle market ☐ Budget/Economy ☐

Name of respondent:

B. PRIMARY INFORMATION OF THE HOTEL

Which type of facilities is available in the Hotel?

Lodging ☐ Fooding ☐ Lodging with fooding ☐

When the hotel was established?

Year: ☐

How many floors are there? ☐ Floor height ☐

How many rooms are there? ☐

How many beds are there? ☐

How far is the hotel from its nearest bus stand and jetty ghat?

Name of the bus stand (Distance from hotel)	Name of the jetty ghat (Distance from hotel)

C. SERVICES: (Tick the right answer)

1) Which types of booking process are available in the hotel?
   a) Spot Booking
   b) Online Booking
   c) Others Media
2) Which types of energy source is utilized by the hotel?
   a) Power Grid
      i. Mention service time per day:_____
      ii. Electric power supply board:_____
      iii. Amount of electric bill per month:_____
      iv. Electeric power consume per month:_____
   b) Diesel Generator (DG) service
      i. Mention service time per month:_____
      ii. Diesel Generator capacity:_____
      iii. Quantity of diesel used per month:_____
3) What type of water sources are used in the hotel?

   If pipe line water is the right answer then please mention the service time per day.
   a) Tube well water
   b) Pipe line water
   c) Surface water/ pond water
4) Which types of drinking water sources are used in the hotel?
   a) Minerals water
   b) Tube well water
   c) Surface or pipe line water
5) How much water is used per day in the hotel?
   a) Peak Season (Mention quantity Lt. Per day_____)
   b) Off Season (Mention quantity Lt. Per day_____)
6) Has there any fire proofing service in hotel?

   Yes ☐ No ☐

D. ACCOMMODATION OF THE HOTEL:

How many types of bed rooms are there and do mention the average occupancy rate per types of bed room?

Single bed room (No.)	Double bed room (No.)	Dormitory (No.)	Others

Which type of toilet and bath are there?

Attached Toilet & Bath (No. of rooms)	Non attached Toilet & Bath (No. of rooms)

How many rooms are AC and non AC in the Hotel?

AC (No. of rooms)	Non AC (No. of rooms)

E. QUANTITY AND QUALITY OF TOURIST

1) What kind of tourists come to this hotel? (Mention the numbers of peoples)

a) How many International tourists are visit in the hotel?

i) Number of peoples in peak season per day_____ or per week_____ or per month_____ or per year_____

ii) Number of peoples in off season per day_____ or per week_____ or per month_____ or per year_____

b) How many national tourists are visit in the hotel?

i) Number of peoples in peak season per day_____ or per week_____ or per month_____ or per year_____

ii) Number of peoples in off season per day_____ or per week_____ or per month_____ or per year_____

c) How many home state (West Bengal) tourists are visit in the hotel?

i) Number of peoples in peak season per day_____ or per week_____ or per month_____ or per year_____

ii) Number of peoples in off season per day_____ or per week_____ or per month_____ or per year_____

d) How many local people are visit in the hotel?

i) Number of peoples in peak season per day_____ or per week_____ or per month_____ or per year_____

ii) Number of peoples in off season per day_____ or per week_____ or per month_____ or per year_____

e) How many students are visit in the hotel?

i) Number of students in peak season per day_____ or per week_____ or per month_____ or per year_____

ii) Number of students in off season per day_____ or per week_____ or per month_____ or per year_____

f) How many Educationlist are visit in the hotel?

i) Number of Educationlist in peak season per day_____ or per week_____ or per month_____ or per year_____

ii) Number of Educationlist in off season per day_____ or per week_____ or per month_____ or per year_____

g) How many Institutes and Universities are visit in the hotel

i)Number of Institutes and Universities in peak seqason per day_____ or per week_____ or per month_____ or per year_____

ii) Number of Institutes and Universities in peak seqason per day_____ or per week_____ or per month_____ or per year_____

F. SANITATION AND WASTE DISPOSAL

1) In which place the gray water from the Hotel is disposed?

a) Cannel

b) River

c) Pond

d) Septic chamber

2) In which place the black water from the hotel is disposed?

a) Cannel

b) River

c) Pond

d) Septic chamber

3) What kind of solid waste is generated?

4) How much solid waste is generated per month?

5) In which place the solid waste from hotel is transferred? Or

6) In what way do you dispose of solid waste from hotels?

7) Which types of bin you do use?

Type of Containers		Ranking			
		A	F	S	N
Individual Containers	Metal bin				
	Plastic bin				
	Plastic bag				
	Oil drum				
	Others				
Communal Containers	Metal bin				
	Plastic bin				
	Oil drum				
	Concrete bin				
	Others				

A = Almost exclusively used, F = Frequently used, S = Sometimes used, N = Never used

8) Are you recycling the solid waste of the Hotel?

G. INCOME & EXPENDITURE

What is the average annual income of the Hotel?

>3 Lakh	2-3 Lakh	1-2 Lakh	<1 Lakh

What is the average annual expenditure of the Hotel?

>1 Lakh	70 Thousand – 1 Lakh	50-75 Thousand	25-50 Thousand	< 25 Thousand

H) ENVIRONMENTAL AWARENESS IN THE HOTLE

1. In your opinion which of the factors mentioned below have the highest influence on the customer's choice of the hotel (1 – the most important, 6 – the least important)

Localisation ☐ Quality of services offered ☐ Tradition of the hotel ☐ Price ☐ rn for the natural environment ☐ ☐

2. Are, in your opinion, the issues of natural environment and its protection important for the performance and development of tourism:

   Yes ☐ No ☐

3. Is your establishment concerned with environmental issues:

   Yes ☐ No ☐

4. Is your hotel involved in any environmentally-oriented activities:

   Yes ☐ No ☐

5. If you answered YES for previous question please mark the field of activities and give an example:

a) Environmental Policy Statement ☐
b) Energy conservation ☐
   Energy efficient lighting ☐ energy efficient equipment ☐ Leaflets encouraging customers to save energy ☐ other..... ☐
c) Water Conservation: ☐
   Water efficient bathroom and kitchen fixtures, toilets ☐
   Linen and towel re-use program ☐
   Leaflets encouraging customers to save water ☐
   Other..... ☐
d) Reduction, shorting and recycling of waste: ☐
   Shorting of waste in guestroom, offices and kitchens ☐
   Donation of hotel furniture and equipment to local charity organisation ☐
   Reusable food and detergent packaging instead of throwaway ones ☐
   Other..... ☐

e) Ecological food

f) Other.....

I) Are you feeling any problem to run the Hotel?

TOURIST SURVEY QUESTIONNAIRE

Surveyor:

Date of survey:

A. Visitor Profile:

1. Name of the tourist spot:
2. Name of the tourist person (Responded):
3. Where are you coming from at tourist spot?
4. Are you: 1. Male ☐ 2. Female ☐
5. Which age group do you belong to?

1. <15 ☐ 2. 16 to 30 ☐ 3. 31 to 45 ☐ 4. 46 to 60 ☐ 5. >60 ☐

6. Marital status: 1. Married ☐ 2. Unmarried ☐
7. Highest level of education completed:

1. Secondary education ☐ 2. Higher secondary education ☐ 3. Diploma ☐

4. Graduate ☐ 5. Post graduate and above ☐

8. Employment status:

1. Govt. Employment ☐ 2. Semi Govt. Employment ☐ 3. Private ☐

4. Student ☐ 5. Unemployment ☐

B. Characteristics of visits:

1. What types of tourist are you? (Mark the appropriate answer)

a) International

b) National

c) Local or Domestics (Local business / Political / Educationist / Student)

d) Student

2. How many times have you visited this spot?

a. First time ☐ b. Twice ☐ c. 3rd time ☐ d. Four time/ more ☐

3. How did you arrive to Spot? (Mark the appropriate answer)

1. By car.
2. By bus.
3. With low-cost airline.
4. With major airline.
5. By train.
6. Other, what: _____

4. Where did you hear about this Spot (mark the appropriate answer, more answers possible)?

1. I already knew of it.
2. The Internet.
3. Friends and relatives.
4. Media.
5. Books and guides.
6. Travel agency.
7. Fairs and/or exhibitions.
8. It was part of the travel package.
9. Other, what: _____

5. How did you make your travel agreement?

1. Self 2. Travel agency 3.Tour operator 4. Office 5. Any others_____

6. Which type of place do you stay?

1. Home stay 2. Star hotel 3. Luxury hotel 4. Economy hotel 5. Tourist bungalow 6. Others_____

7. How many nights are you planning to stay at this Spot?

9. Are you travailing_____

1. Alone 2. Family 3. Friends 4. Institution

5. Others_____

10. What were the main reasons for your visit to this Spot? (Mark the appropriate answer)

1. Rest and relaxation.
2. Visiting relatives and friends.
3. Business reasons.
4. Attending a conference, seminar, and other forms of educations.
5. Local socio economic culture.
6. Sports and recreation.
7. Local food (Crabs & Prawn)
8. Home stay.
9. Religious reasons.
10. Mangrove Eco garden
11. Wild life (Vertebrate ☐ Invertebrate ☐)
12. River site Canopy Walk on mangrove plantation
13. Butterfly garden
14. Water body (Aquaculture farm) on the type of Ox Bow Lake
15. Govt. Of West Bengal Directorate of Forest Wild Animal Park
16. Scenic beauty
12. Others, what: _____

11. What is the total cost of tour package par day?

12. What type of food do you like?

1. Local food ☐ Name of local food, do you like this: _____

2. Out food ☐ Name of out food, do you like this: _____

C. Evaluation:

1. Which type of the transport facilities in this centre?

1. Excellent 2. Good 3. Satisfactory 4. Poor

2. Which of the accommodation facilities?

1. Excellent 2. Good 3. Satisfactory 4. Poor

3. Food quality in these hotel and restaurants:

1. Excellent 2. Good 3. Satisfactory 4. Poor

4. Tourist attraction in the spot:

1. More interesting 2. Interesting 3. Average 4. Not interesting

5. Entertainment facility has:

1. Excellent 2. Satisfactory 3. Poor

C. What are the star attractions you consider?

1. Mangrove eco garden 2. Watch tower viewing 3. Birding 4. Boating 5. Angling 6. Butterfly garden 7. Tiger rescue centre 8. Wild life the observation 9. Scenic beauty 10. Observation of mud flood fauna (Such as different species of crabs, moles etc)

Problems/Suggestion:

QUESTIONNAIRE FOR HOUSEHOLDERS
INTERVIEW

Date: Surveyor:

Place: GPS model.

A. PRIMARY INFORMATION:

1. Name of Head of the Family:_____Sex: M / F

2. Name of respondent:_____Sex: M / F

3. Location of the Family: Island:_____Village_____

   GP_____, Block_____District_____

4. Geographic coordinates of the House: Lat_____, Long _____

5. Does your family come under APL/BPL category? ☐

6. No. of family members: Male ☐ Female ☐
   Total ☐

7. Type of family: Joint family / Nuclear family

8. Age of family members:

Age Group	55+	45-54	35-44	24-34	15-24	9-14	5-8	>5
Male								
Female								

9. Languae ☐ Religin ☐ Caste ☐

10. No of Literates: Male ☐ Female ☐
    Total ☐

11. No of Illiterates: Male Female
Total

12. Level of Education:

Education level	Under going education	Up to IV. (Primary)	V – VIII (Upper Primary)	Secondary	Higher Secondary	Graduate	Post Graduate	Technical
Male								
Female								

Male Female

13. a) No. of workers:
Total

b) No of non-workers: Male Female
Total

14. What is/are the source (s) of family income? (Give rank according to importance)

I. :
II. :
III. :

15. State kind of occupation of your family members.

Occup ation	Cultivators	Agri. Labours	Daily Labours	Mechanicetc	Service Holders	Business (Type)	Honey Collectors	Tour Guide	Politician	Others
Male										
Fe-male										

16. How many years of your family engage with this livelihood or occupation?

17. Monthly Income:

a. Less than Rs. 1000/- b. Rs.1000/- to Rs. 2000/- c. Rs.2000 to Rs. 4000/-

d. More than Rs. 8000/- e. Rs. 4000/- to Rs. 8000/-

f. others ☐

18. Monthly Expenditure:

Food	Clothing	Rent	Transport	Education	Medical	Others

19. Details of the House of the Family:

Years of construction	Stories	No. of Rooms	Kachcha/ Pakka	Roof type

20. Facilities / amenity or assets available in your family:

Water supply ☐ Electricity ☐ Radio ☐ Mobile / Telephone ☐ T.V. ☐ Boat ☐

Vehicle ☐ Self installed solar energy ☐

Others ☐ Solar energy installed by Govt. ☐

Biogas ☐ Power Grid ☐

21. Source of Energy:

22. Usage of Electricity: Domestics purpose ☐ any other purpose ☐

23. Is electricity supply sufficient to your family demand? Y / N

If no, reason (purposes) _____

24. Source of Drinking water: Tap water / Tube-well / Well / Pond

25. Name of the nearest Health-center:_____, Distance: _____

A. Frequency of visit to the hospital mode of transport_____

26. Name of the nearest School:_____, Distance:_____

A. Frequency of visit to the School mode of transport_____

27. a) since when your family staying here?
_____

b) Name of Original place if any _____

c) Reason of migration, if any_____

B. LIVELIHOOD:

I) AGRICULTURAL & LIVESTOCK:

28. Are you holding any agricultural land? Y / N If yes, Size of Land _____

29. What Type of crops or vegetables?

30. Usage of the total Production: Domestic use / Commercial Purpose/ partly consumed &Partly Sold

31. Details of domesticated cattle / poultry / others:

Cow	Buffalo	Duck	Hen	Hog	Goat	Sheep	Bee-keeping	others

II) FISHERY:

Fish Culture		Capture Fishing	
Fresh Water	Brackish Water	River/Estuary	Marine Fish

FRESH WATER FISH CULTURE

32. General characteristics of pond:

Number of pond	Total size	Depth

33. Do you possess any pond / water body? Y / N If yes, Number_____, Size _____

34. Do you Use these water bodies for fishery purpose? Y / N

If yes, variety of fish: _____

35. Usage of Fishes-Produced: Domestic use / Commercial Purpose/ partly consumed &Partly Sold

III) HONEY COLLECTION:

36. Has there been any change in the size of honey collection area? YES / NO

If Yes, Increase or Decrease

37. What are average yield / head_____

38. Have you noticed any change in the quality of honey normally collected by you?

% of change	Increased	Decreased	Same	Flowering of agri crop
Quantity wise				
Quality wise				

39. What is the quantity of Khalsi Honey in your collection _____

40. The best seasons for honey collection of the year_____

41. Any change in the time for honey collection in last 10

years? If Yes, How_____

42. Mention the average distance you usually travel into the forest for honeyCollection?_____

IV) WOOD COLLECTION:

43. Has there been any change in the size of wood collection area?

If yes, Increase or Decrease

44. Mention the species or type of trees from which wood is generally collected?

45. Have you noticed any change in the recent past in the quantity of wood normally collected byyou?

If yes, Increase or Decrease

46. Mention the average distance you usually travel into the forest for wood collection?

_____

V) (ECO) TOURISM BENEFITS:

47. Are you involved in that tourism industry: YES/NO

If Yes, How _____

a) Tour Guide b) Boat operator c) Small scale business d) Other

48. Since when are you involved in that tourism:_____

49. Have you derived any benefit: YES/NO

If Yes, How_____

50. Do you supply any type of things?

a) Vegetables b) Fish c) Meat d) Egg e) Others

51. Do you sell any item to the tourist: YES/NO

If Yes, a) Trinkets b) Key ring c) Kids bag d) others

52. Do you have any transport services rent for the tourist: YES/NO

If Yes, a) Car b) Auto c) Motor Van d) Boat e) Others

53. Do you think that local environment is damage due to the tourism industry? YES / NOIf yes, how_____

54. Is there any economic development in this area due to the tourism industry: YES / NO If Yes, How _____

If No, Why_____

55. Do you think that competition has increased for the tourism development: YES / NO

56. Is your income increased or decreased with time: YES / NO

57. What percentage of your income is earned from tourism industry? [ ]

58. Do you think that tourism development is required of this area: YES / NO

If yes, How and Why_____

If No, Why_____

59. What steps should be taken to developed in this place according to do:

_____

_____

60. Do you supply any mangrove fruits: YES/NO

If yes, mention the specific fruits, a) Chak Kaura b) Kaura c) Cow Fall d) Other

61. Do you supply how much honey/month is sold to tourist _____

62. a. Number of mangrove sapplings sold to tourist _____

b. Type of species (Mangrove) _____

63. Do you organized / participate cultural activities for tourist recreation:

a) Bonobibi Pala b) Dhukhe Rajar Pala c) Monsha Pala d) Sitala Pala e)

OthersWest Bengal tourism department is given interested to Home Stay:

64. Do you think tourism in your locality improve your life: YES / NO

If Yes, How_____

If, No, Why_____

65. Do you think tourism in the anyway affected your life negative way: YES / NO

If Yes, How_____

If, No, Why_____

66. Are you interested to extent your own house for home stay tourism: YES /NO

If Yes, Why_____

If, No, Why_____