# Chapter 3

## Relationship between physical and cultural aspects of the coastal society

### 3.1 Concept

Livelihood diversification is defined as a process by which household members assemble a varied range of activities and improving standard of living capabilities in their struggle for survival. In this chapter, the constraints of livelihood diversification have been assessed spatially and temporally on the coastal stretch of 11 villages of Mandarmani and adjacent area of Ramnagar I and Ramnagar II administrative blocks, Purba Medinipur, West Bengal. The sand dunes fringe area are degraded and losing its biodiversity in the entire coastal stretch due to shoreface cliffing, encroachment of salt water in back water wetlands by storm breaks, tide water flooding, overtopping and also by beach lowering and beach narrowing processes with active marine forcing factors on the one hand and due to flattening of sand dunes by tourism area development on the other hand. The present study is conducted to analyze the actual livelihood diversification scenario of the study area and the reasons behind the diversification on this small stretch of land with coastal morphodynamic characteristics, increasing population pressure and hazard vulnerability. Comparative Census data analysis and the temporal and spatial mapping show a wide range of livelihood. The household wise human perception surveys about the occurrences of various marine hazards have enabled to prepare the composite survey schedule for estimating the livelihood diversification index (LDI). Further statistical and GIS based data analysis shows the clear picture of the struggle for existence against the constraints of livelihood adaptation. The study has suggested that due to the ongoing processes of climate change and unplanned anthropogenic modifications of wilderness, diversity of livelihood is getting reduced to a minimum which are ultimately leading to out-migration. Existing infrastructural facilities and options of livelihood are not enough to provide the further opportunities of livelihood diversification.

A livelihood comprises of the capabilities, activities and assets (including both material and social resources) required for a means of living. Livelihood diversification is defined as a process by which household members construct a diverse portfolio of activities and social support capabilities in their struggle for survival and in order to improve their standards of living (Khatun et al., 2012).

It is now a recognized fact that farming on its own does not provide a sufficient means of survival for a majority of rural households in most of the developing countries. Accordingly, most of the rural households depend on a diverse portfolio of activities and income sources, alongside crop and livestock production. Such a tendency on the part of rural households has

been termed as diversification. Diversification helps to mitigate these adverse effects by utilizing labour and generating alternative sources of income in off-peak periods. Another beneficial effect of diversification is that it reduces the risk of income failure by spreading risk across activities that confront different risk profiles (Khatun et al., 2012).

Livelihood practices in the low lying coastal stretch is a challenging task (Plate 3.1, 3.2, 3.3 & 3.4) of the marginal class of people who are living in and around Mandarmani and Dakshin Purushottampur villages. The traditional livelihood activities have been changed and modified in different forms due to the constraints like physical effect of climate change in the low lying coastal stretch, increased number of population within the villages of the coastal belt and the encroachment of tourism recreational activities on the coast as well as the large scale development of fish farming activities in the coastal wetland areas by entrepreneurs.

Plate 3.1: Semi Pakka House

Plate 3.2: Thatched house (Kachha)

Plate 3.3: Pakka House

Plate 3.4: Kachha-Pakka House

People of the marginal environment always adjust with the frequent occurrences of hazards and maintain their livelihoods with the application of innovative ideas. Initially the low lying areas of this coastal belt were surveyed by the Britishers to identify the coastal wetlands touching with the shoreline and dissected by the network of tidal creeks and

channels. These areas were not favourable for the settlements and livelihood practices due to landfall of cyclones and associated phenomenon. The large embankment was constructed by the Britishers for the protection of coastal inland area to avoid the frontal wetland areas affected byfrequent saltwater floods. Only the coastal bluff was present along the shoreline with beach ridges and sand dunes. This part of the coastal belt was topographic highs in compared to adjacent low lying areas. The marginal class of people was shifted to the wetland areas and coastal bluff areas for settlement and livelihood practices in the year of 1977 by implementation of land use policy of the then government of West Bengal.

The local people of this area selected the specific land and water bodies for practicing their various livelihood activities. Among them marine fishing, river fishing, paddy farming, salt manufacturing, livestock practicing, boat manufacturing, crab potting etc. are major livelihood activities of the marginal class of people. Later with experiences they have adopted some new occupations and avoided other occupations for adjustment with salt water flooding, land erosion, windblown salt particles and on the basis of availability of fresh water storage. After the landfall of Aila cyclone in 2009 and promotion of tourism with fish farming activities in the low lying coastal belt, a number of constraints had been faced by the local people for adjustment of livelihood practices. They have selected only 3 occupations viz. paddy farming, marine fishing and vegetable gardening to survive in the present. Few people are also involved in tourism related occupations and fish farm related occupations at present. The salt processing is only maintained in fewer plots at subsistence level after the closing of Bengal Salt Factory in Dadanpatrabar.

This chapter deals with the aspects like actual livelihood diversification scenario in the diverse landform setup with increasing population pressure in the study area and the reasons behind the variation on this small stretch of land with coastal morphodynamic characteristics and hazard vulnerability. It will also show the mutual co-adjustment and conflicts between the coastal environment and human interferences and few adaptive measures by the local people for maintaining the livelihood sustainability of the low lying coastal belt.

## 3.2 Analysis

### 3.2.1 Estimation of Decadal Population Change

Census data of 1991, 2001, 2011 of Ramnagar I and Ramnagar II administrative blocks have been considered for the present study to identify the types of livelihood practices by the local people.The census data is showing a huge change in the socio-economic condition of the local people. Due to the location of the Bengal Salt Factory in the Mania mouza with a lustrous scope for other livelihood practices there is always a residence of more amount of people in the mouza of Dakshin Purushottampur. So in the consecutive 3deacades the maximum population resides in this area. The choropleth maps (Figure 3.1, 3.2 &3.3) are also showing a steady increase in population with maximum population rising by 400 peoples. The remaining mouzas are gradually losing its own importance due to encroachment by the tourism industry. As has been established from the last chapter that the western part of the coastal stretch of Mandarmani is gradually been lowered so the administrative margin also alters if we visit the place today. Today the seaward extention of Silampur mouza is washed away and parts of the Mandarmani and Tajpur mouza are eroded.

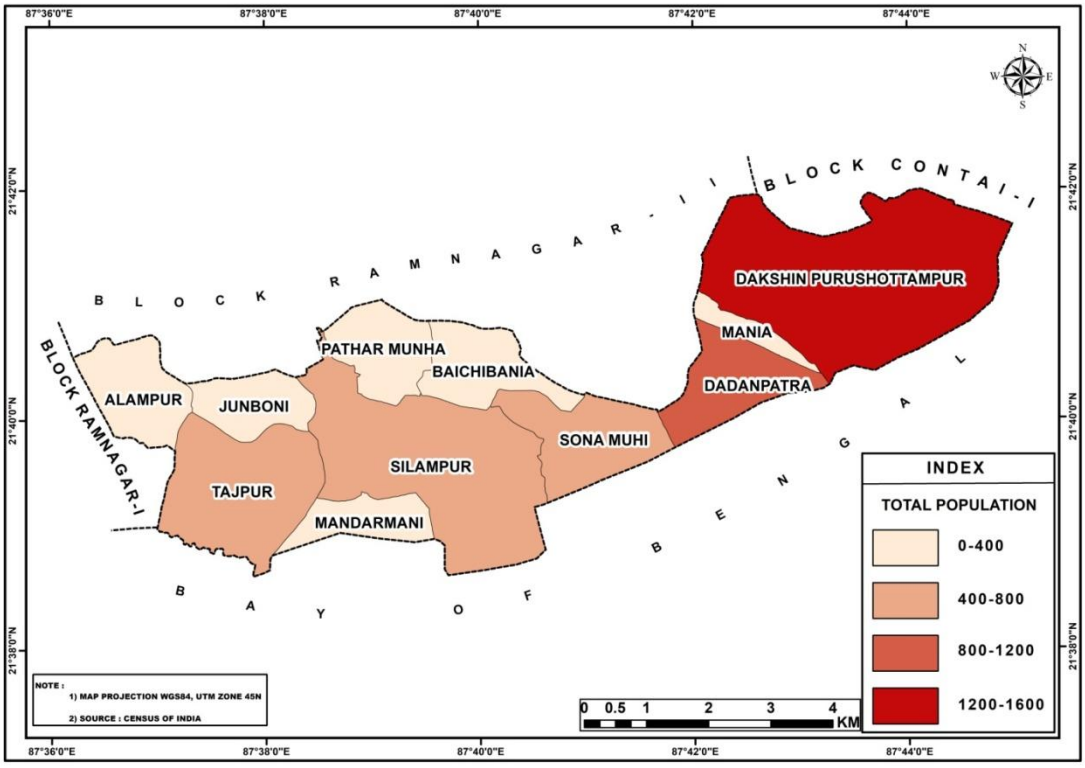


Figure 3.1: Map showing mouza wise distribution of population in the study area (1991)

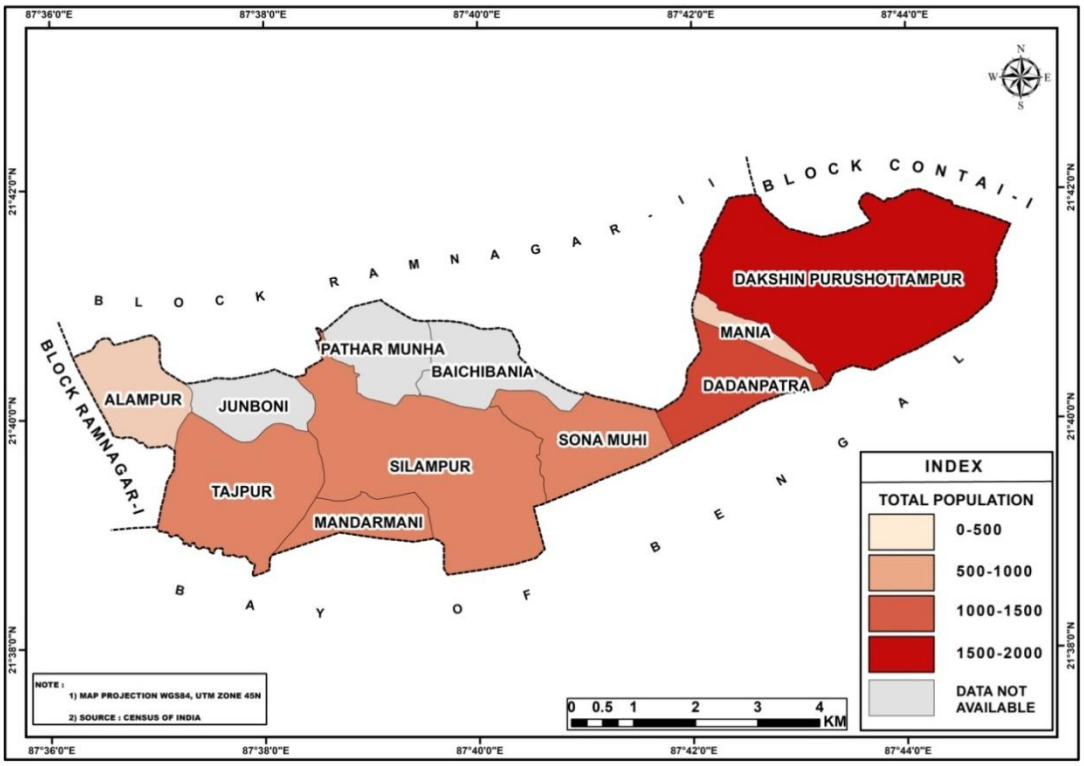


Figure 3.2: Map showing mouza wise distribution of population in the study area (2001)

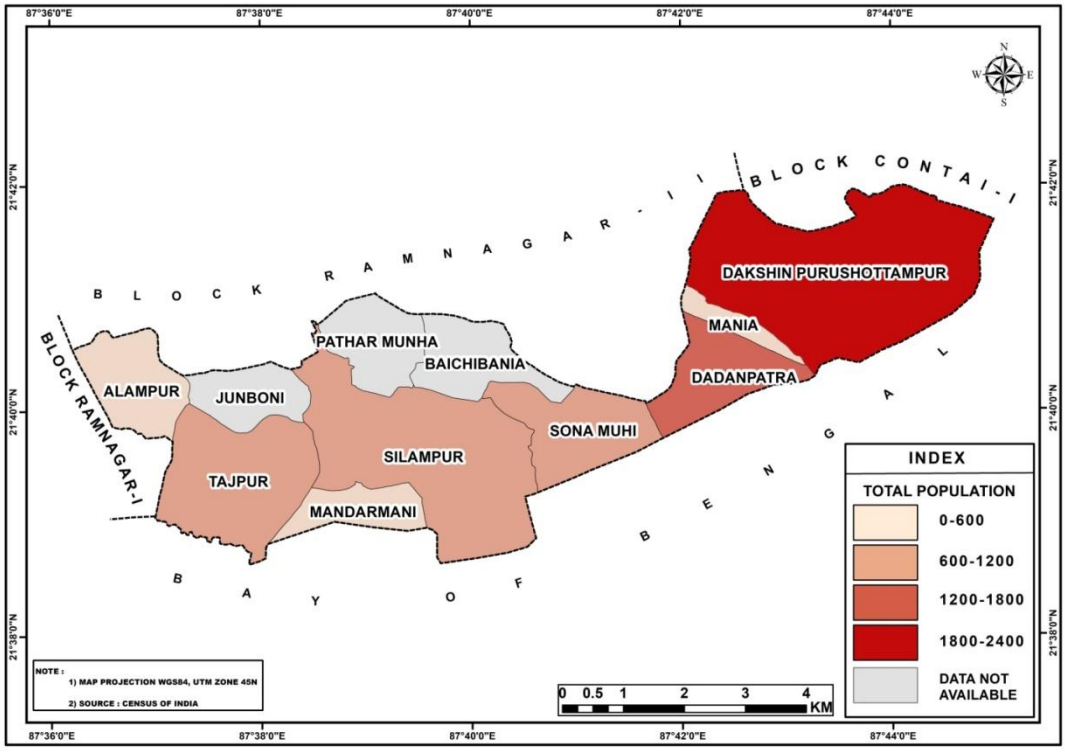


Figure 3.3: Map showing mouza wise distribution of population in the study area (2011)

Considering the decadal changes during and after the advent of tourism industry and the causes behind the in-migration and out-migration a table (see appendix 3a) has been produced to have a closer look upon the negative and positive growth of the villagers. After converting acres of land into government controlledwetland conservation plot population data are not available for Junboni. PatharMunha and Baichibania. The Decadal changes show a negative growth rate of the remaining 8 mouzas, Mandarmani, Silampur, Sonamuhi, Dadanpatrabar, Mania, Dakshin Purushottampur, Alampur and Tajpur. The Table clearly shows though there is a growth of population in a decreasing rate but the mouza named Dakshin Purushottampur is showing a huge negative laidback due to varities of reason like out-migration, shut down of the Bengal Salt Factory in search of varieties of profession and for higher education mainly in South India (as recorded from respondant survey). In close proximity another rising tourist spot is Tajpur is also gaining impetus these days where the local people are substituted by the outsiders like builders, labourers, administrators, etc. Other mouzas show moderate to low decadal change of negative or decreasing growth rate.

### 3.2.2 Change detection analysis through LULC

The Land Use Land Cover maps generated from Landsat TM 2 and Landsat TM 7 for 2009 and 2018 respectively. The maps show an aerial coverage of 39.46 sq km of the whole study area. The supervised classification showing a breakup of nearly 1.04 sq km of vegetated land cover for 2008 which reduced by 2% on 2018 and for orchard or mangrove or scrubland it comprises of nearly 9 sq km of land reduced by 12 % in 9years. The maximum portion of the land is covered by coastal wetlands or abandoned fisheries or tidal creeks or river inlets which have increased from 20.28 to 20.89 sq km. Other than this water bodies with fisheries has an aerial extension of negligible amount i.e. 50 sq m. But the special mention is to show the drastic variation of the built-up area or tourism area or road which jumped nearly the double within a decadal period. The Land use land cover maps (Figure 3.4 and 3.5) of 2009 and 2018 show a clear picture of the flourishment of tourism sector throughout the stretch of the land. The first resorts of hotel dates back to even late 20th century. It was heard from ancestors that the Britishers use to land there private jets on the flat serene beaches of coastal Medinipur. But actually the tourism was converted to gross business and profitable market from the year 2008. In this year a huge resort project named Rose Valley resort (later after 2013 name changed in Sun City Resort). This phenomenon totally changed the fate of Mandarmani coastal stretch. This year proved the drastic change on the livelihood options of the local residents.

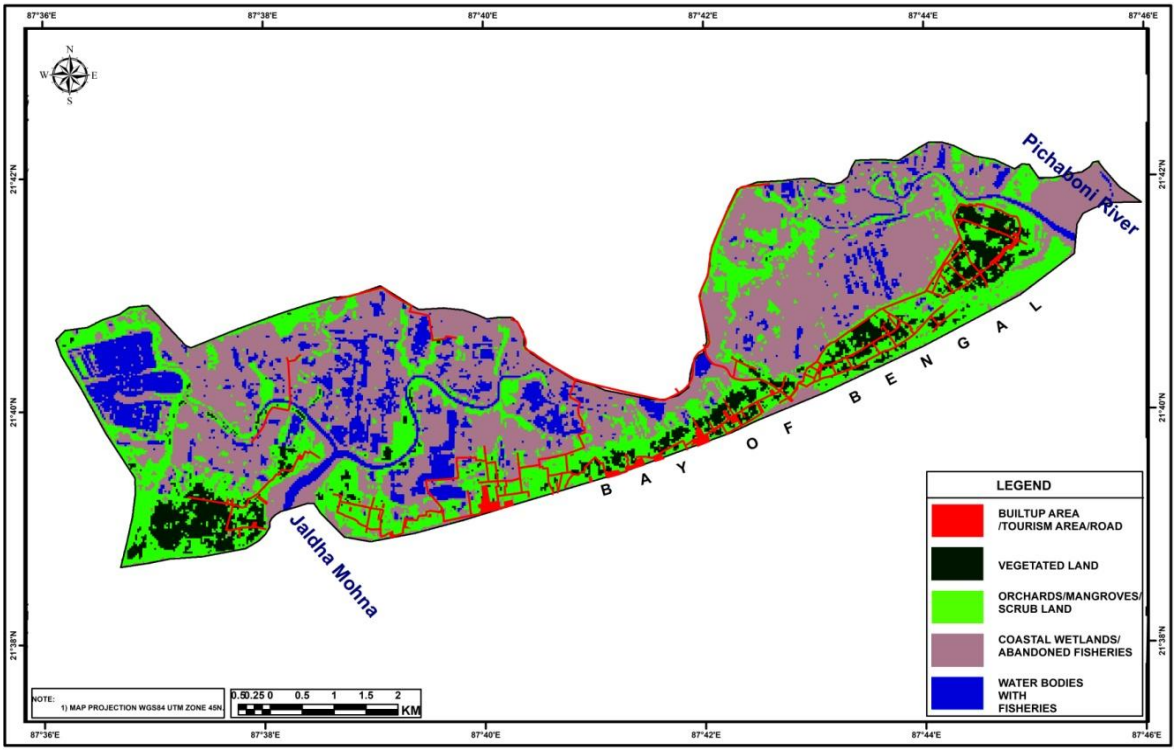


Figure 3.4: Land Use Land Cover of 2009

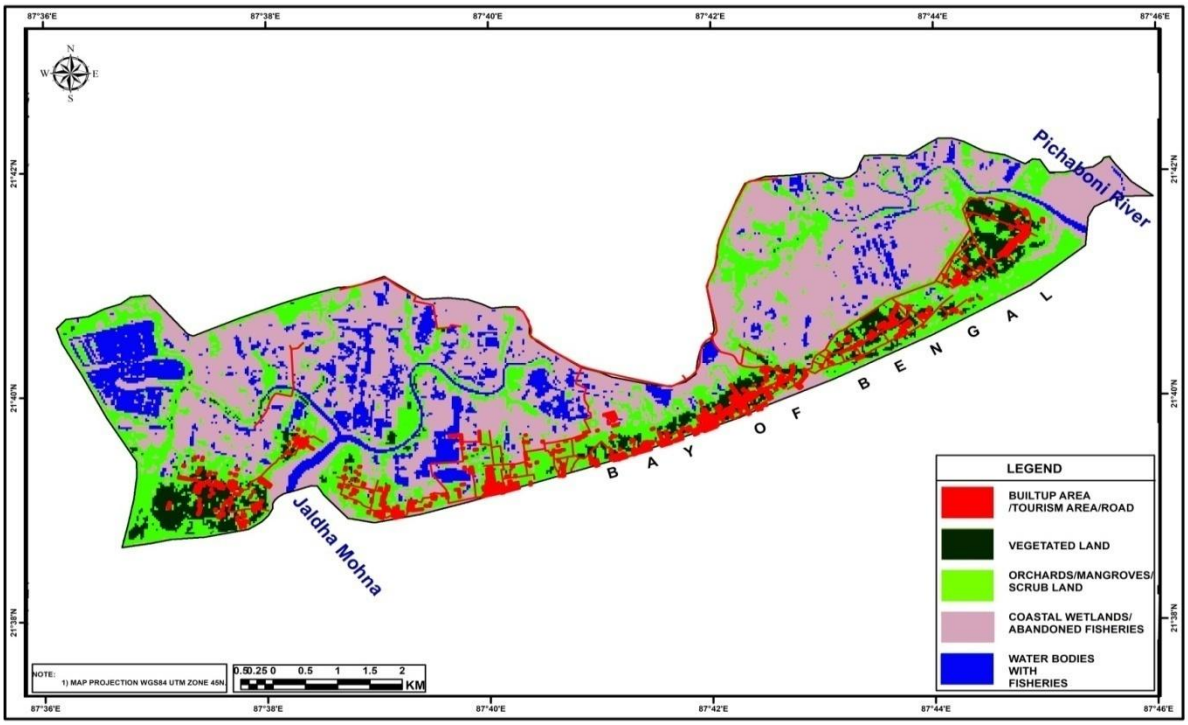


Figure 3.5: Land Use Land Cover of 2018

### 3.2.3 Estimation of Livelihood Diversity Indices

Being the largest mouza of our study area Dakshin Purushottampur has been selected as a sample survey. The main reason behind this is that there are many options behind the selection of livelihood. A respondent survey was conducted in 100 households of Dakshin Purushottampur village to identify and estimate the existing livelihood practices in the low lying coastal belt against the constraints of hazards. The photographic documentation is also done on the issues of hazards and livelihood types. The purpose of the respondent survey is to estimate various Livelihood Diversity Indices (LDI) viz., Simpson Index, Herfindahl-Hirschmann Index, Ogive Index and Entropy Index, Modified Entropy index, Composite Entropy index, etc (Khatun et al., 2012; Amos et al., 2014; Palanisami et al., 2009).

#### 3.2.3.1 Simpson Index

In this study Simpson index is used because of its computational simplicity, robustness and wider applicability. The formula for Simpson index is given below:

$$Simpson\ Index = 1 - \sum_{i=0}^{n} Pi^2$$

where, n is the total number of income sources and Pi represents income proportion of the i-th income source. Its value lies between 0 and 1. The value of the index is zero when there is a complete specialization and approaches one as the level of diversification increases (Khatun et al., 2012).

#### 3.2.3.2 Herfindahl-HirschmannIndex (HHI)

The Herfindahl-Hirschmann Index (HHI) is widely used to calculate market concentration and economic diversity. It is further used for macroeconomic specialization analyses. It measures the whether a monopoly exists within a market and is calculated as follows:

$$Herfindahl-Hirschmann\ index = \sum_{i=1}^{n} S_i^2$$

where Si is the share of economic activity in sector i of the total economy and n is the number of sectors in the economy. The value of the index ranges from zero to one. A country with a perfectly diversified economy will have an index close to zero. A higher value indicates more concentration or greater specialization. The share of each industry is squared ($Si^2$), which brings more weight to larger firms in the final estimation. This could be because HHI also aims to determine if a monopoly exists.

When HHI is calculated as a measure of diversity, total HHI diversification can be split into inter-sectoral HHI diversification and inter-industry HHI diversification (Acar and Sankaran, 1999).

### 3.2.3.3 Ogive Index

The ogive index of economic diversity measures the distribution of economic activity among sectors in a country and is calculated as follows (McLaughlin, 1930; Tress, 1938):

$$Ogive\ Index = \sum_{i=0}^{n} \frac{(Si - 1/N)^2}{1/N}$$

where N is number of sectors in a region and Si is the share for a sector of economic activity for the ith sector. An even distribution of economic activity among sectors represents higher economic diversity. With N sectors, an equal distribution implies that Si is equal to 1/N, the ideal share for each sector, and the ogive index equals zero, meaning perfect diversity. The ogive index can also be explained as a linear transformation of HHI (Palan, 2010).

### 3.2.3.4 Entropy Index

The entropy index, also called the Shannon entropy index (SEI), compares the existing economic activity distribution among industries in a country with an equi-proportional distribution, and is calculated as the negative sum of income shares multiplied by the natural logarithm of income shares of each single industry, as follows:

$$Entropy\ Index = \sum_{i=0}^{n} Siln\left(\frac{1}{Si}\right) = -\sum_{i=0}^{n} Siln(si)$$

where n is the number of sectors, Si is the share of economic activity in the ith industry and ln is the natural logarithm. Considering that equally divided economic activity is considered more assorted, higher entropy index values point out greater relative diversification, while lower values show greater relative specialization. If employment is considered as a pointer of economic activity, the equal allocation of employment among all industries will give an outcome of higher entropy index. The minimum value of zero would occur if employment were concentrated in one industry (i.e. maximum specialization).

Because SEI measures in logarithmic form the relative weights of large industries are reduced compared with the HHI or the ogive index. This means that countries that are specialized as a result of having large industries will be shown as being more specialized by HHI and the ogive index than by SEI (Palan, 2010).

HHI is an easily computable index and is regarded as superior to other indices used to measure absolute specialization. SEI can be challenging to deduce if industries with a nil employment share are contained in the sample. The Gini index is more time-consuming to calculate and fails to meet other criteria for preferred indices (Palan, 2010).

Table 3.1: Estimated Livelihood Diversity Indices

| Indices | Total Income | Income share in Agriculture | Income share in fishing | Income share in Livestock Rearing | Index values |
|---|---|---|---|---|---|
| **Total** | 6489607 | 3059498 | 2702939 | 727170 | |
| **Percentage** | 100 | 47.14 | 41.65 | 11.21 | |
| **Proportion** | | 0.47 | 0.42 | 0.11 | |
| **SI( in decimal)** | | 0.22 | 0.17 | 0.01 | 0.59* |
| **HHI(in decimal)** | | 0.22 | 0.17 | 0.01 | 0.40* |
| **OI in Decimal** | | 0.136 | 0.086 | -0.22 | 0.22* |
| **SEI( in decimal)** | 1/SI | 2.12 | 2.38 | 9.09 | 0.96 |
| | SI | -0.75 | -0.86 | -2.20 | -0.96* |

The value (Table 3.1) for Simpson Index is 0.59, Herfindahl-Hirschmann index is 0.41, its 0.23 for Ogive Index and Entropy Index gives a result of 0.96 (or -0.96). All the values signify that there is diversification in livelihood but not in perfect proportion which means there is scope for much more diversification in this coastal belt.

### 3.2.4 Estimation of Hotel survey

The Hotel Survey data is showing a clear picture of the presence of maximum hotels within the limit of not more than 100-50m from HTL (Figure 3.4) which is posing a threat to the tourism industry itself. Another data portrays the fact that these hotels are deliberately extracting fresh ground water within the reach of 600 ft (Figure 3.5). This may totally alter the situation for gradient of the ground water table.

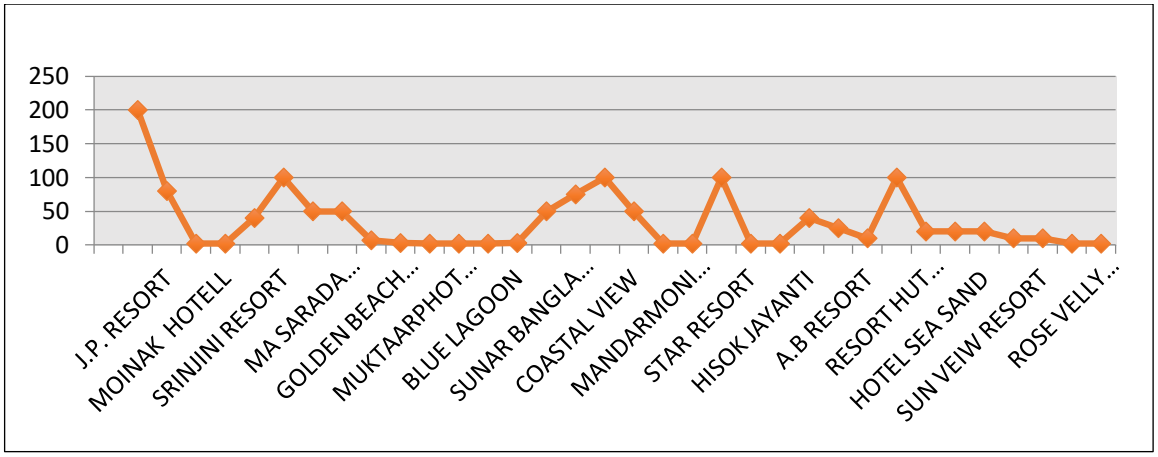


Figure 3.4: Line diagram showing distance between hotels and HTL

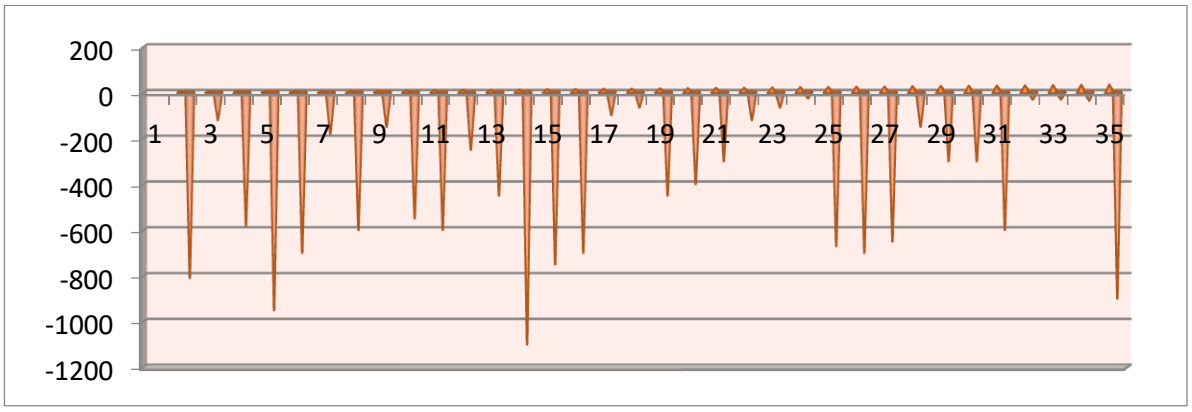


Figure 3.5: Inverted conical bar diagram showing depth of ground water extraction by hoteliers

### 3.3 Outcomes

Major finding of this chapter to be topographic dependence on the livelihood is options evidently shown from the surveys done.The diversification of livelihood is much lower with concentration on mainly 3types of livelihood options- paddy farming, fishing and livestock rearing.More than 50%of the hotels surveyed are located within 50m from the highest high tide line.Nearly 40% of the hoteliers are lifting the drinking water within the limit of 400ft i.e. from the perched water table. Morphologicaly the alluvium coast is very dynamicin terms of temporal erosion and accretionary processes of seasonal sand blown activities and tidal siltaion as well as long shore current transport of sediment along the sea shore. Maximum diversity of livelihood on a single morphologic unit is the Dune belt and Back Dune Surface. Thus, the ground water resourcesof the coastal belt are very sensitive,

they are over utilized by tourism recreation pressures in one area and irrigation activities in other areas of the coastal belt without conservation measures.

Plate 3.5: Fish farming plots

Plate 3.6: Rice Paddy farms

Plate 3.7: Fish land station

Plate 3.8: Fish drying platform

By comparing and contrasting the census data with field observation, it is observed that the total diversity of livelihood is of 10 types (Table 3.2 & Plate 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13 & 3.14) viz. marine fish extraction, fish farming in the low lying coast, dry fish processing, vegetable gardening, rice paddy farming, salt manufacturing, boat manufacturing, livestock rearing, brick factory and tourism recreation activities.


Plate 3.9 & 3.10: Vegetable gardening farms


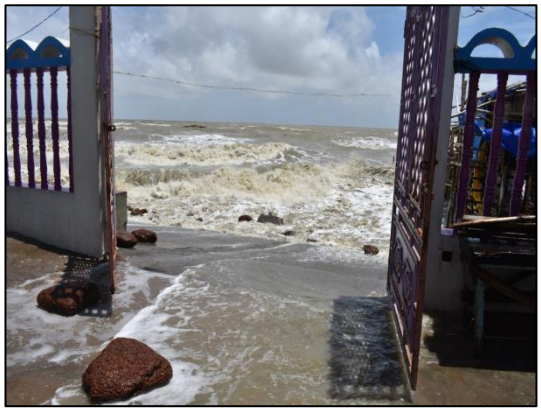

Plate 3.11 & 3.12: Tourism Sector over the HTL


Plate 3.13 & 3.14: Boat landing and manufacturing ground

Table 3.2: Dependency of Livelihood Diversity on varieties of micro physiography on the coastal area

| Sl No | Types of Livelihood | Dependant Micro Physiography |
|---|---|---|
| **1** | Marine fish extraction | Shallow seas (Continental Self) |
| **2** | Fish farming | Coastal wetland fringes |
| **3** | Vegetable Gardening | Dune belt & back dune surface |
| **4** | Rice paddy farming | Lowland clayey surface |
| **5** | Tourism recreation activities | Sand dunes &beaches |
| **6** | Salt Manufacturing | Wetland area |
| **7** | Dry fish processing | Sandy surface of the dune belt |
| **8** | Boat Manufacturing | Tidal channel bank platform |
| **9** | Livestock rearing | Coastal grassland |
| **10** | Brick manufacturing factory | Tidal channel bank |

The decadal change of livelihood practices shows that maximum diversity is only concentrated in one village Dakshin Purushottampur this is because of the ample scope for diversification (Figure 3.6) due to the morphology, fresh water availability, negligible encroachment by the entrepreneurs of tourism activities and maximum density of population. Following this, is the Dadanpatrabar village having a scope for diversification of livelihood only in between fishing activities and vegetable gardening. Other villages are mainly concentrated on either tourism or fishing activities. In these villages the diversity is low because of the encroachment of tourism, shoreline erosion, wetland conservation, closing up of Bengal Salt Factory. These are the reasons for out-migration also. Besides these the cyclone landfall and storm surge also act as the constraints of livelihood diversification. The Livelihood Diversification Index in a small pocket of Dakshin Purosatyampur also shows that at present the livelihood is mainly seen among fishing, farming and livestock rearing on the one hand and tourism industry on the other hand.

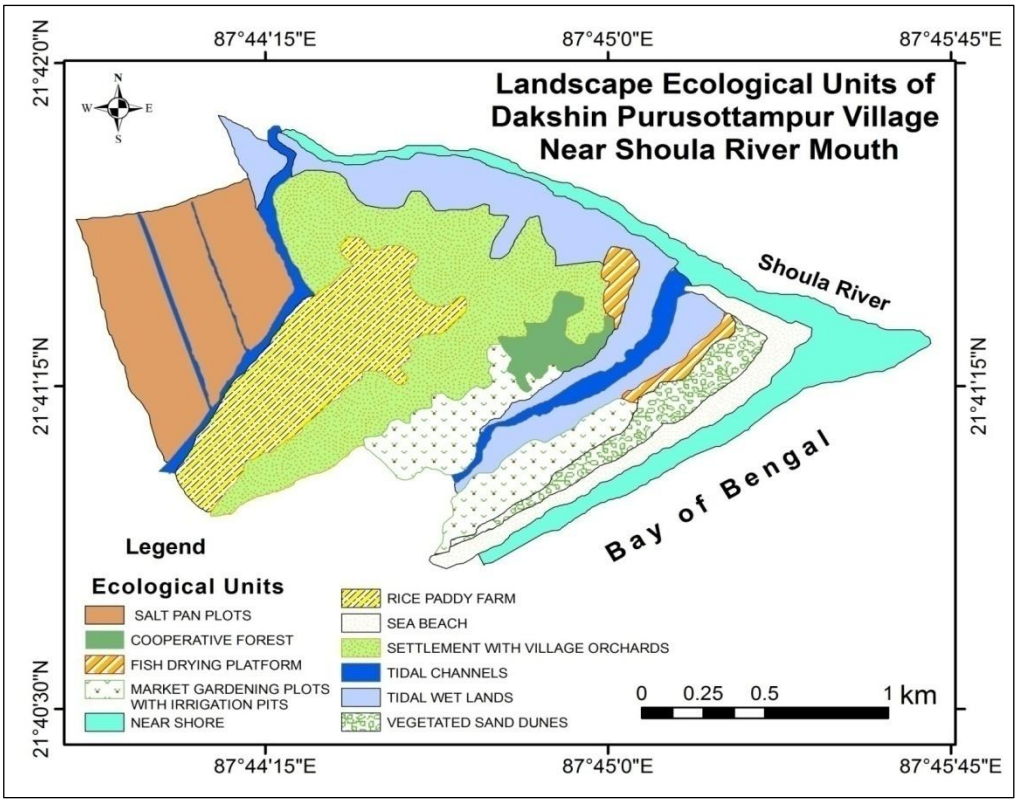


Figure 3.6: Landscape Ecological Units of Dakshin Purushottampur village near Soula river mouth

### 3.4 Discussion

Various land units have been classified on the basis of elevation and topographic characters with the use of Total Station Survey records (contour plans and cross sectional forms of the land). The types of the lands are very selectively utilized for specific livelihood practices. The sea beaches and sand dunes of Mandarmani, Sonamuhi, Silampur and Dadanpatrabar are utilized for Tourism recreation and tourism related business activities. The areas of backwater wetlands behind the dune field are practiced for paddy crops and fish farm activities, some areas of backshore dune flat are utilized by marginal class of people for construction of fish drying platforms to produce dry fish products. The vegetable gardening over the backshore sandy plain is a significant activity to produce a number of vegetative crops to support the demand of local tourism market. Marine fishing, boat manufacturing and livestock activities are practiced by local people in Dakshin Purostayampur village near the Pichhaboni river mouth and low lying coastal belt at present. Very few people are now practicing the salt manufacturing process insome selective plots at a subsistence level to support their livelihood in wetland areas of Dadanpatrabar and Mania.

The sensitive ecology of the morphologic units is identified and delineated for the low lying areas of Dakshin Purosatyampur village adjacent to Pichhaboni (Soula) river, for considering the environmental regulations and significance of environmental conservations in support of the selective livelihood practices by the localpeople.

Livelihood Diversity is estimated on the basis of the census study (1991, 2001, and 2011). There are 3 types of Livelihood Diversity observed where maximum Livelihood Diversity is practiced in Dakshin Purosatyampur village in the form of Fishing plots extended, seasonal rice paddy farming, market gardening along the shoreline with migration, marine fish landing stations, fish drying platforms (5 or more than 5). However the moderate Livelihood Diversity is observed in the case of Dadanpatrabar and Mania villages in the form of Market Gardening, Fish Activities, Bengal salt factory (3 or more than 3). Other villages of the entire region have simple livelihood practices related to Tourism or Fish farming related activities.

Following hazards are observed in the present study area during the year 2009 (Aila cyclone landfall), 2014 August and 2016 August during the effect of depressions and storm surge activities. The entire low lying areas behind the sand dunes and beach ridges were flooded by encroached salt water and shoreline erosion on the sea front sand dunes of unaltered villages as well as altered villages by tourism related built up area with number of hotels.Thus the above observation proves that the area is basically affected by frequent salt water flooding, wind dangers and shoreline erosion activities.

The present study shows that there was the ample of livelihood options in the coastal belt dominated by wetlands (10 diverse types). Currently people have selected only three standard livelihood practices as an adaptive measure against the global environmental change and local hazards and introduction of tourism development in the coastal belt.

Soil salinity, salt water flooding and shoreline change hazardshave been rapidly increasing due to the over exploitation of land water and vegetation of the coastal belts. Salinity level is slowly increasing over the time and causing serious threats to traditional agricultural practices, modern farming, vegetable gardening and mangrove ecosystem.There are constant conflicts between the villagers and tourism sectorsin terms of resource use of the low lying coasts. Some of the previous coastal disastersremind us what can happen if the landfall of the repeated cyclones produces salt water flooding, erosion and soil salinity in the coastal belt. Such hazards have long-term impacts on social and economic functions of the coastal environment.

This study area was always attractive site to the local poor for location of cultivable lands on the wide sandy tracts dominated by loamy sands on the sea front dune platforms and sandy clay loam on the back barrier surface of the landward sides. Open marine fishing and the salt processing at the subsistence level were other opportunities to the local people for maintaining their livelihoods in the region. Introduction of Farm Fishing in the tidal wetlands behind the barrier back surface, shallow marine trawling at the commercial level, and spread of tourism recreation activities on the beach fringed platforms and wide dunal platforms has changed the significance of the area in West Bengal coast.

However the local poor have selected few options of livelihood activities after the events of storms (2007, 2008, 2009, 2013, and 2019), salt water inundations and effective erosion of the backdune landscapes in Astronomic Tides in the low lying coasts of the region.

The coastal zone management practices are discussed in the next chapter for resource management and sustainable development of the economy of the rural poor in the coastal belt.