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CLIMATE CHANGE IMPACTS ON ENVIRONMENT: DYNAMICS LIVELIHOOD, A CASE STUDY ON COASTAL AREAS OF KENDRAPARA DISTRICT IN ODISHA, INDIA

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Abstract: Climate change has become a threat for human being. It has poignant effect on the basic elements of life – access to water, food, health and use of land, and the basic environment. Climate change is an additional burden because ecological and socio-economic systems are already facing pressures from intensive industrialization, urbanisation and population explosion in ta tropical and agrarian country like India and her states. India has variegation of natural coastal ecosystems. The study area i.e. Rajnagar block, Kendrapara district, Odisha consists of 480 km. of coastal stretch situated in the east coast of India, which is most unguarded due to climate change. The disproportions that arise out of the reverberations of climate change hamper human livelihood, settlements, and socio-cultural practices. The antennules of climate change have grabbed everybody and the farmers are not divorced from this. Changes in climate exhibits huge impact on agricultural activity or production, so the farmers are worst affected. Therefore, there is a necessity to assess the climate change and manoeuvre adopted by the people to improvise rural livelihoods. This study mainly focuses on the impact of climate change (rainfall and temperature) on environment which has brought a dynamic life style in Bektakolha village of Rajngar Block,Kendrapara district,Odisha.The study anticipates analyzing the impact of climate change on socio economic change of local people. The repercussions present that climatic variation impacts the livelihood systems of rural communities through its synergy with local natural environmental resources and other socio-economic characteristics of the communities. There is a momentous change in rural livelihood system of marine fisher folk, farmers, and local inhabitants which affects the socio-ecological status. The study outlines the gaps and challenges for mainstreaming climate change and contriving strategies in the coastal zone with some suggestive planning structure.

***Index Terms*:** Climate change, rural livelihood system, coastal zone, dynamic life style

1. INTRODUCTION

Article 1 of the United Nations Framework Convention on Climate Change (UNFCCC), elucidates climate change as: “a change of climate owing to human activities directly or indirectly that modify the global atmospheric

composition and which is furthermore climate variability through natural process revealed over comparable time periods." The UNFCCC thus differentiates anthropogenic sources leading to altering the atmospheric composition and natural causes of climate change. Climate change has been differentiated into climatic Shocks (i.e. significantly different from average conditions like tropical cyclone, floods and droughts) and Climatic Stresses (i.e. gradual changes in the climate (variability) or a few months above or below normal rainfall). Climate stresses and climate shocks oscillate over time and space to regulate the pattern of households' vulnerability.

Vulnerability is the predisposition or the state of condition of a system or setting and is dogged by the magnitude and frequency of subjection of the system, susceptibility to harm and lack of capacity to adapt. Climate Change has been viewed as one of the most serious global issues and likely to affect ecosystems and biodiversity, water resources, agriculture and food security, and human health (Gosling et al.2011).

Overall, the reports divulge there are projections on many negative impacts than positive impacts for the future due to climate change with higher magnitudes. Climate change will have diverse impacts on people across the world and those effects will differ not only by region but also over time, contingent on rate and degree of climate change. For example, challenges for economic development will be increased for many countries along with increased risks, declined yield, and degraded ecosystems.

2. BACKGROUND OF THE PROBLEM

Based on many studies awning a wide range of regions and crops, it is found that the negative impacts of climate change on crop yields have been more conspicuous than the positive impacts (IPCC, 2007).

It is extrapolated that the major crops like wheat, rice, and maize in tropical and temperate regions will have negative impacts on production for local temperature increases of 2°C or more above late-20th-century levels if appropriate adaptation mechanism is not put in place.

As revealed by many studies, some ecosystems and many human systems, have greater exposure and significantly vulnerable to current climate variability such as heat waves, droughts, floods, cyclones, and wildfires.

It is cut-and-dried that in the 21st century, climate-change will slacken economic growth, make poverty reduction more arduous, question food security, and protract existing and fabricate new poverty traps.

Intensify understanding is required on possible impacts of climate change on the vulnerability of the resources, so that pliability to current climate variability as well as to the risks associated with longer-term climate change can be measured, and appropriate actions can be outlined to expand or rebuild resilience where this is jeopardized.

2.1 Ecosystem problem

Climate is the paramount decider of economic shape of any country or state. The Focused Group Discussion (FGD) with the villagers divulged enthralling facts on coping strategies of the people in the episode of natural disasters. The coastal economy is more prone to its control due to enormous contribution it makes to livelihoods of the people. The villages Bektakolha under Rajnagar block in Kendrapara districts of Odisha, the perpetual victim to the climatic aberrations testified this.

1 Gender, Development and Climate Change, Oxfam GB (2002)

2 Climate Change: Impacts, Adaptation and Vulnerability, Working Group II, IPCC (2007)

Sea Level Rise- Salinity of ground is also in increased by rising sea level also increases the water and shoves salt water further upstream. Without desalination higher salinity can make water undrinkable, and many aquatic plants and animals get affected.

Impacts of Changes in Storm Surge and Precipitation-Climate change are predisposed to bring heavier rainfall to some coastal areas, which would also shoot up runoff and flooding. Dwindle precipitation could also increase the salinity of coastal waters.

Impacts of Coastal Water Temperature- During the last century coastal waters have warmed, and are very odds-on persist to warm in the 21st century. Due to this big changes may be expected in coastal ecosystems, affecting species that cohabit these areas.

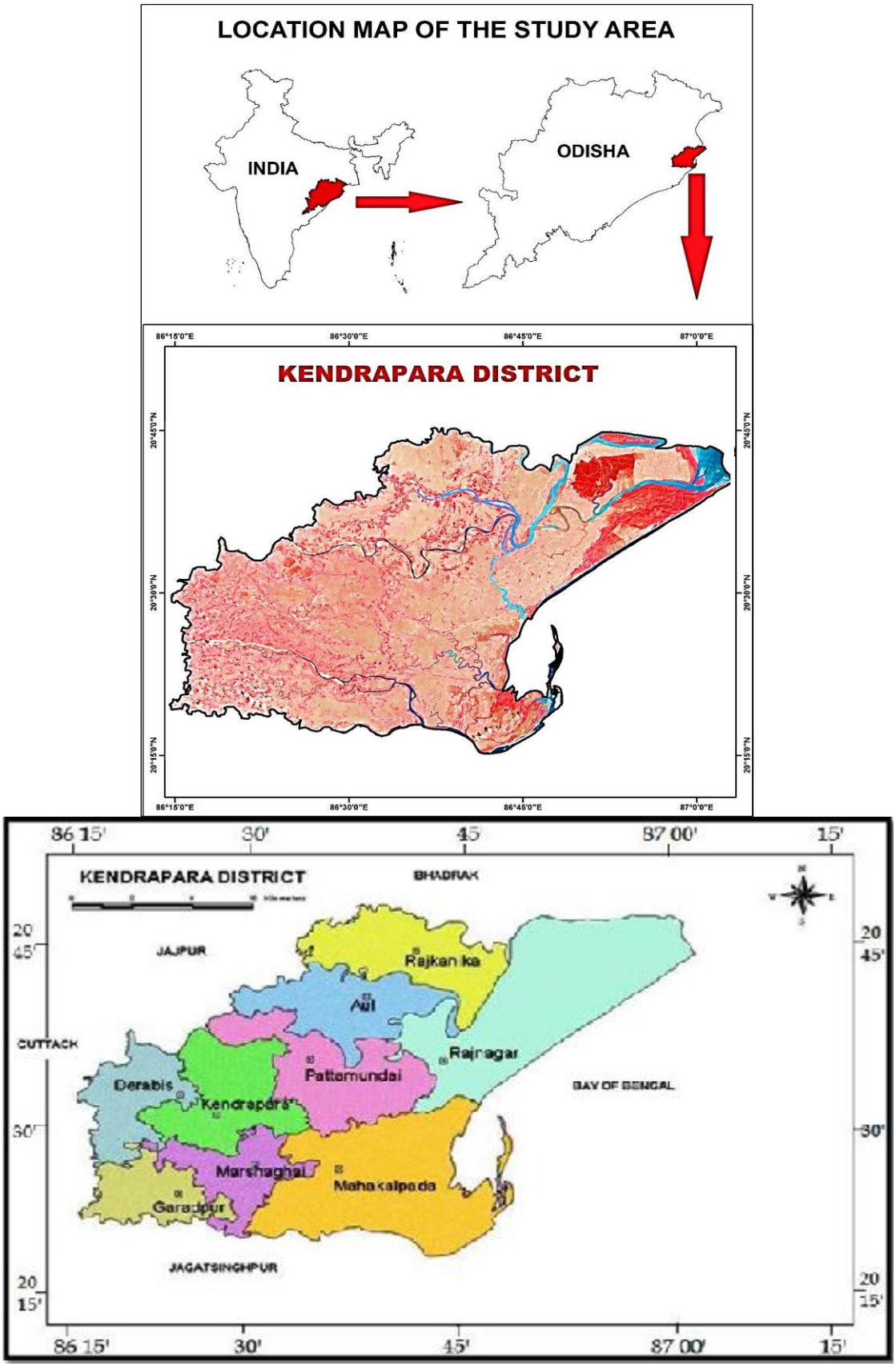
Impacts to Coral Reefs and Shellfish-Higher sea surface temperatures increase the imminence of coral bleaching, which can expedite to coral death and the dropping down of critical habitat for other species.

Climate Change and Agriculture: - The unfavorable effects of climate change falls heavily on climate sensitive agricultural sector (Nordhaus, 1991; Cline, 2007). Studies have prognosticated that agriculture yield will likely be markedly affected over the next hundred years due to unparalleled rates of changes in the climate system (Jarvis et al., 2010; Thornton et al., 2011). Climate change is likely to have both positive and negative impacts on agriculture (Antle, 2008) depending on the physiological characteristics of the region and the crops being yield. The effects of climate variables on agriculture are more noticeable in regions where agriculture is backward or primitive with less scope for technological adoption and transmission (Mishra et al., 2015). The calamitous effects of climate change falls heavily on climate sensitive agricultural sector (Nordhaus, 1991; Cline, 2007). The effects of climate variables are more pronounced on agriculture in regions where agriculture is backward or primitive with less scope for technological endorsement and transmission (Mishra et al., 2015).
This paper makes a venture to explore how climate change is impacting the rural livelihood systems by analyzing the trends of change in climatic variables at micro level, perception of the people about such changes and the adaptation strategies of the households and along with the following objectives.

- Effects of climate change on the coastal rural communities, Odisha.
- To study the compelling changes in rural livelihood systems.
- To pin down gaps and challenges between the effect of climate change and livelihood.
- To propose development and planning strategies.

3. METHODOLOGY AND STUDY AREA

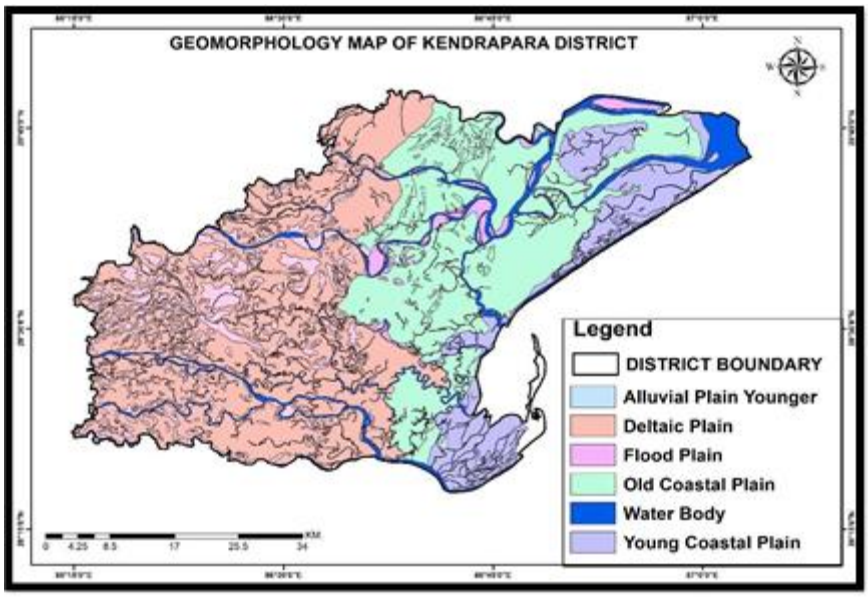
The current research delves into the hydro geochemistry of the coastal aquifer system of Rajnagar block, Kendrapara district. The alluvial aquifer system of Rajnagar block lies in the eastern part of the Kendrapara district along the coastal tracts of Odisha (Map 3.1.a). The study area encompasses approximately 650 kms with a perimeter of about 185 km. Rajnagar has a very close proximity to the Paradeep port, one of the major industrial hubs of Odisha, along the coast (Map 3.1.a). The study area Bektakolha village is situated in Teshil Rajnagar , District Kendrapara and in State of Odisha, India. This village has population of 156 as per census data of 2011, in which male population is 80 and female population is 76. Total geographical area of Bektakolha village is 110 Hectares. Population density of Bektakolha is 1 person per Hectares. Total number of house hold in village is 39.



Map 3.1 (a) Location of the Study area

3.1 Geomorphology

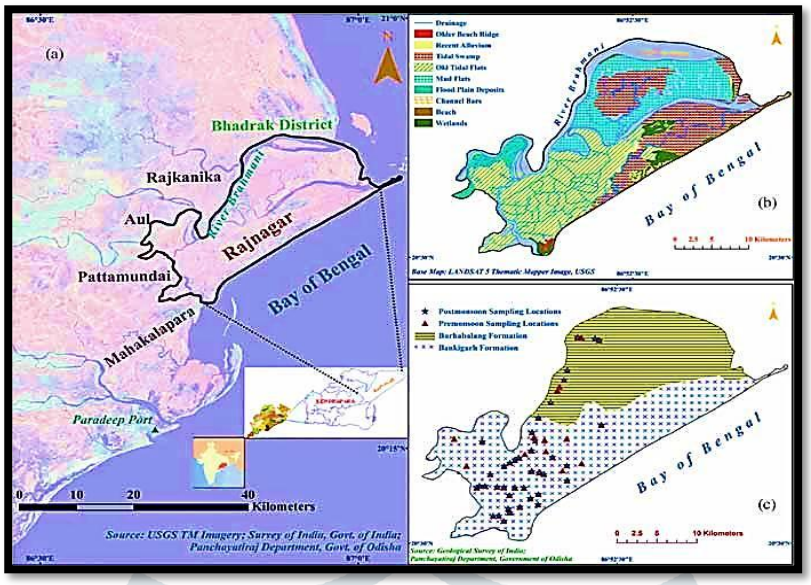
Topographically, the relief is very even with the elements of slope, aspect and curvature denoting a very gently east and northeast sloping landscape (Das and Sahoo 2014). Physiographically, the study area is broadly divided into (a) coastal saline marshy tract and (b) gently sloping plain (CGWB Technical report 2002; GSI Technical report 2011). The tract is primarily covered by shrubby vegetation and display fluviomarine.(Map 3.1.b). Older beach ridges and newer dunes of varying relief, between 3 and 6 m, are located parallel to the coast (Map 31.b). The alluvial plains take place along the Southwestern part of the study area with a very gentle slope to the west of marshy tract (Map 3b).



Map 3.1 (b) Location of the Study area

3.2 Geology

Quaternary age's recent alluvium and sand bodies uncovered in the study area, belong to the Burahbalang and Bankigarh Formations (Mishra et al. 2003; GSI Technical report 2011; GSI Miscellaneous publication 2012). These are fluvial to marine alluvial deposits. The Bankigarh Formation is primarily composed of old sand dunes, fluvial silt, fluvial and marine clay and deltaic deposits covering the entire southern part of the study area (Map 3.2). The lithology of the northern part is constitute alternating recent sand dunes ,floodplain layers of sand and silt and marine deposits belonging to the Burahbalang Formation (Map 3.2). The reducible stratigraphic sequence of this coastal aquifer system is given below (CGWB Technical report 2002; Mishra et al. 2003; GSI Technical report 2011).



Map 3.2 Geomorphology Map

3.3 Demographic Profile

Rajnagar CD Block is part of the Bakreshwar Upland, one of the four sub-micro As per available data from the year 2009, 156 persons live in 39 households in the village Bektakolha. The village consists of 76 female individuals and 80 male individuals. Females constitute 48.72% and males constitute 51.28% of the total population.
Bektakolha village population density of is 141.82 persons per square kilometer.

About Bektakolha

Map 3.3 Location of the Study area

The village Bektakolha is situated in Rajnagar Police Station Jurisdiction of Kendrapara District in the State of Odisha in India. It is administered by Kandira Gram Panchayat. It comes under Rajnagar Community Development Block. The closest city is Pattamundai, which is about 40 kilometers away from Bektakolha.

3.4 Weather and Climate

It is Hot in summer. Summer highest day temperature of Rajnagar is in between 27°C to 43°C. Average temperatures of January is 17 °C, February is 22 °C, March is 27 °C , April is 30 °C, May is 33°C.

Table - 3.4.1 Climate Report of Bektakolha

Category	Resolution	Period
Precipitation - h	Half Hourly / 0.1 deg (11 kms) grid	2001 - 2022
Precipitation - l	Daily / 0.25 deg (28 kms) grid	1901 - 2022
Temperature - h	Monthly / 0.5 deg (55 kms) grid	1901 - 2021
Temperature - l	Daily / 1 deg (111 kms) grid	1951 - 2022

Source: Statistical data, Census-2011

3.5 Local Geology

The soil type of the district range from alluvial, saline and sandy clay. The western part of the district is alluvial which is very fertile in nature whereas the eastern part contains mainly sandy clay type soil which is saline in nature due to its propinquity to the sea. Most element of the district is roofed with plain lands and traversed by rivers like Birupa, Brahmani, Luna, Paika, Chitrotpala and Gobari. It is also overlaid with many tributaries and canals etc.

3.6 Working Population

As per available data from the year 2009, 156 persons live in 39 households in the village Bektakolha. There are 80 male individuals and 76 female individuals in the village. Females represent 48.72% and males reprsent 51.28% of the total population. Population density of Bektakolha is 141.82 persons per square kilometer.

Table - 3.6.1 Census Data of Village Bektakolha, Teshil Rajnagar , District Kendrapara

Population	Area (Ha)	Density (P/Ha)	Sex Ratio	Literacy
156	110	1	950	64.23%

Source: Statistical data, Census-2011

Kandira is the Gram Panchayat of Bektakolha village. Rajnagar is the CD Block and Teshil/Taluk or sub-district is Rajnagar . Data Reference year is 2009 of Census 2011. Sub District HQ Name is Rajnagar and it is 4 Km from the village. District Head Quarter name is Kendrapara and its distance from the village is 44KM. Nearest Town of the Bektakolha village is Pattamundai and nearest town distance is 40 km. Pincode of Bektakolha village is 754225. The code of village Bektakolha is 395887 as per census 2011.
Sex Ratio of Bektakolha Village -Census 2011

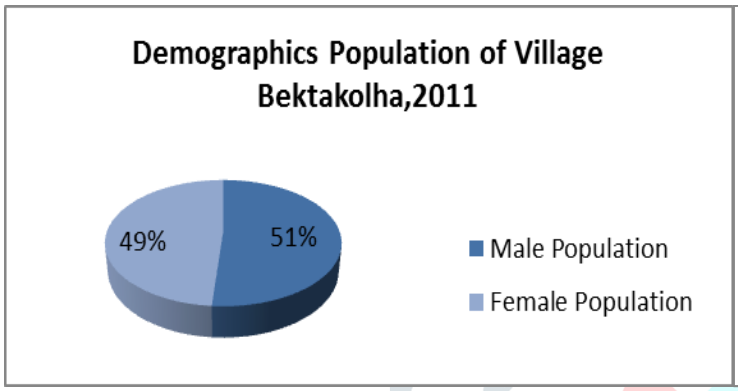
As per the Census Data 2011 out of 156 total population of village there are 950 Femals per 1000 males. Under 6 years of age in the village there are 941 girls per 1000 boys.

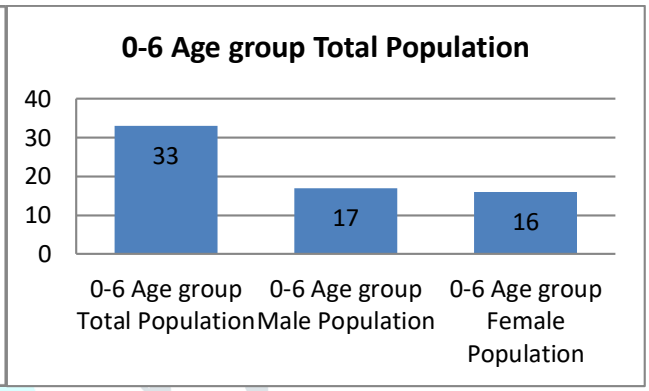
Table - 3.6.2 Demographics Population of Village Bektakolha, Teshil Rajnagar , District Kendrapara

Total Population	Male Population	Female Population
156	80	76

Description	Census 2011 Data
0-6 Age group Total Population	33
0-6 Age group Male Population	17
0-6 Age group Female Population	16

Source: Statistical data, Census-2011



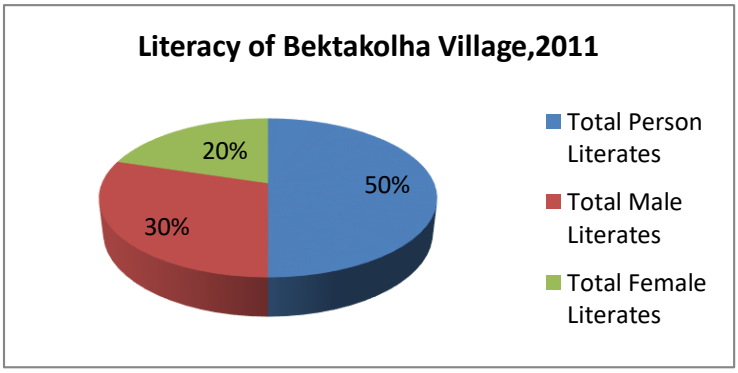


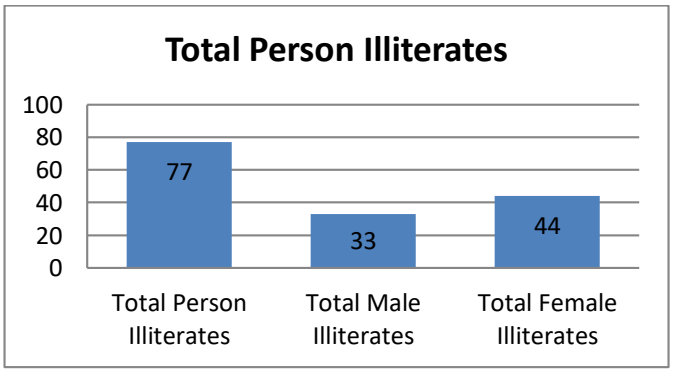
Literacy of Bektakolha Village

Out of total population total 79 people in Bektakolha Village are literate, among them 47 are male and 32 are female in the village. Total literacy rate of of Bektakolha is 64.23%, for male literacy is 74.6% and for female literacy rate is 53.33%.

Table - 3.6.3 Literacy Population of Village Bektakolha, Teshil Rajnagar , District Kendrapara

Description	Census 2011 Data	Description	Census 2011 Data
Total Person Literates	79	Total Person Illiterates	77
Total Male Literates	47	Total Male Illiterates	33
Total Female Literates	32	Total Female Illiterates	44





Bektakolha Working Population ---Census 2011

Table - 3.6.4 Occupational Structure of Village Bektakolha, Teshil Rajnagar , District Kendrapara

	Total	Male	Female
Total Workers	72	46	26
Main Workers	48	46	2
Main Workers Cultivators	17	17	0
Agriculture Labourer	27	25	2
Household Industries	0	0	0
Other Workers	4	4	0
Marginal Workers	24	0	24
Non-Working Persons	84	34	50

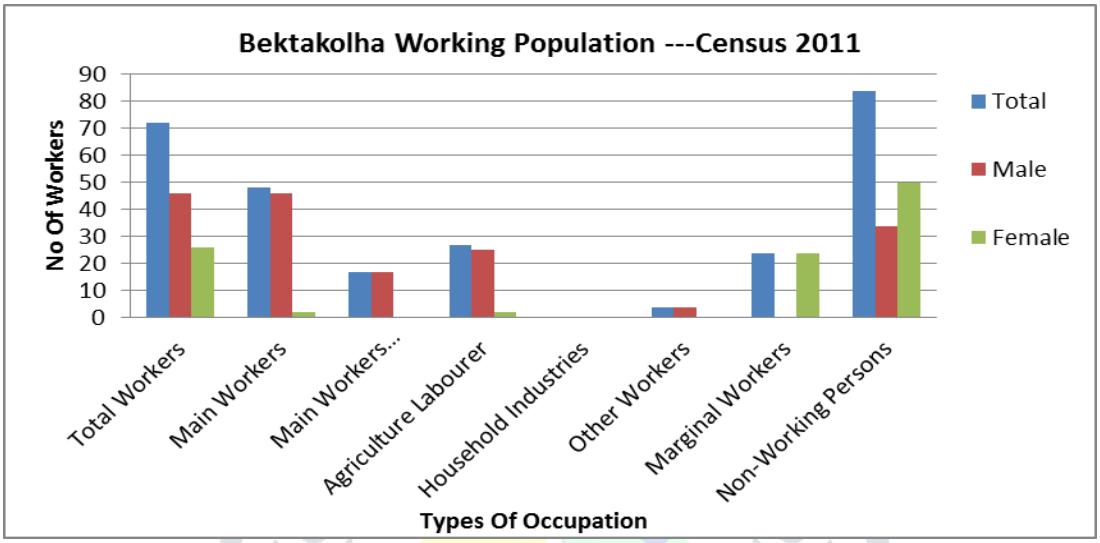


Fig:-3.6.5 -Variation of different occupation with population for the Rajnagar Block, Kendrapara district,2011

Bektakolha Manufacturers and Agricultural Commodities Data

Description Type	Commodities
Agricultural Commodities (First)	PADDY
Manufacturers Commodities (First)	N/A

4. Data Analysis and Result

The present study is focused on the environment and ecosystem of Rajnagar Block, Kendrapara and the notable change in rural livelihood system and the change in their socio-ecological system in which they live due to variety of factors. Since the micro level secondary data comprises physical, social, economic, environment and quality of life is not accessible, researcher has to depend on the primary data. The Simple Random Sampling Technique has been used by the researcher to collect the primary data.

To know the coping strategies of the people in the event of natural disaster in secondary data we have taken some villages out of 309 villages in Rajnagar Block. To know the working population primary data has been taken planning strategies.

Indicators of Climate Variability (Secondary Data)

1. Rainfall

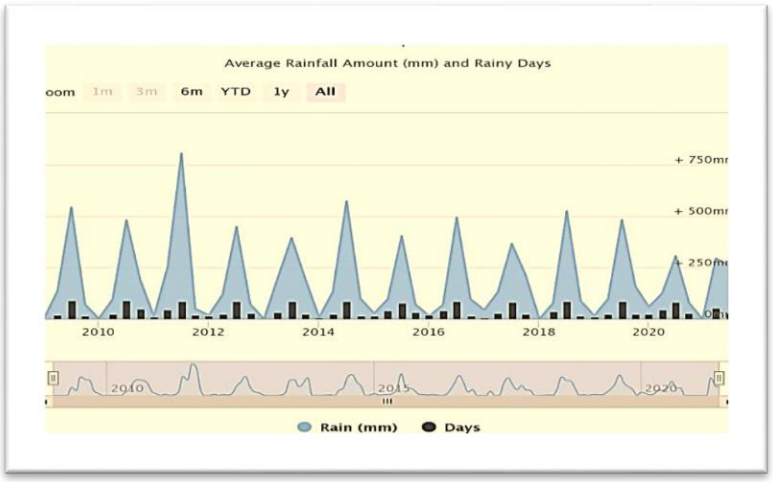


Fig:-4-a-Average Rainfall Amount of Rajnagar Block, Kendrapara district.

- The amount of rainfall in the study area is in the range of 500 mm .In year 2020 apparently it is very less.
- In order to endure under these conditions, people go for cultivation of their staple food crop rice during rabi in the assured irrigated areas.

2. Humidity

Fig:-4a-Average Cloud and Humidity of Rajnagar Block, Kendrapara district.

- As per the graph there is significant decrease in temperature which affects the agriculture production.
- The regular cropping pattern is getting changed which affect the traditional farming schedule of the farmers.

4.1 Effect On The Occupation of Local People

Fig:-5-Non-Farm activities in Pentha and Bektakolha Village of Rajnagar Block, Kendrapara.2020

Name Of The Village	No.of Farmers	No.of Fishermen	Nalia Grass Weaver	Poultry Farm	Dairy Farm
Baghtaila	310	75	58	36	40
Rajgarh	960	174	40	33	0
Kani	698	0	0	0	0
Mahulia	890	0	0	0	0
Pokharia	527	0	0	120	67
Manapada	779	58	0	63	88

Table-2:-Occupational Structure (Primary Data)

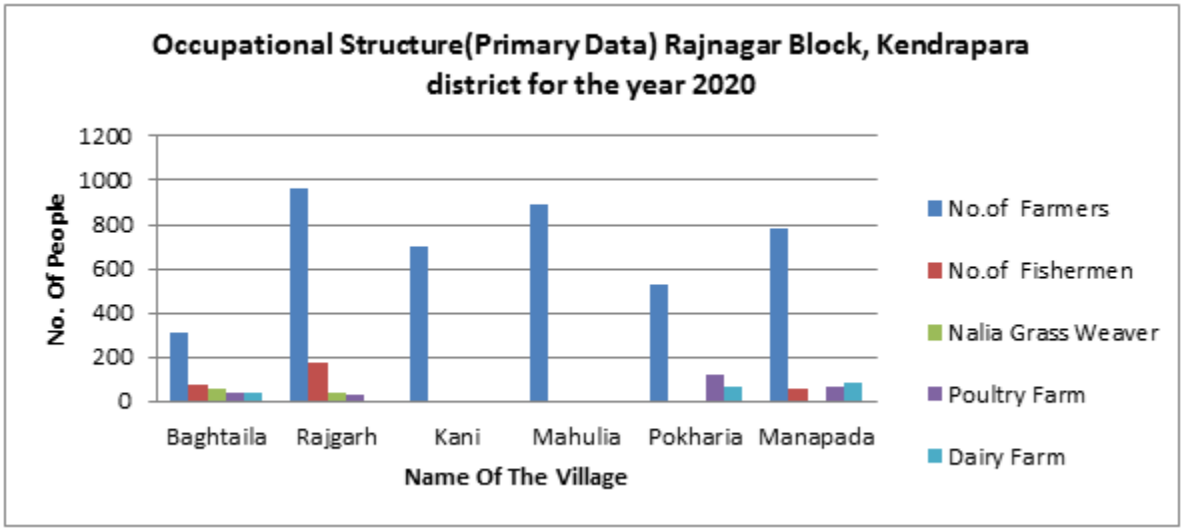


Fig:-6-Variation of different occupation with population for the Rajnagar Block, Kendrapara district for the year 2020

People have explored various other sources of occupation which can supplement them. They can be suggested for diversified non-farm activities. They can be advised both how to take government help for availing loans and training programme etc.

Greenfix Rock Rolls and Rock Mattresses | Greenfix Soil Stabilisation & Erosion Control, Pentha village

5. Suggestion

Referring to Table no:-2 The people of the village Kani and Mahulia can be embolden to adopt diversified non-farm activities like dairy farming, poultry etc. on this matter they can be helped by the respective Government Department. There are some villages under my study area where fishing activities have been stopped. They can be advised to go for mud crab farming.

Conclusion

The inimical effects of climate change are having a heavy impost on many coastal villages in Odisha. Rural development is therefore a democratic, dynamic and integrated process for improving the quality of life of rural communities by breaking out of the straight jacket of dependency syndrome and initiating a process of self-reliance through optimum mobilization of natural and human resources. As Robert Chambers says, “Human Resources – not capital, nor income, nor material resources – constitute the ultimate basis for the wealth of nations. Clearly, a country which is unable to develop the skills and knowledge of its people and utilize them will be unable to develop anything else”. He rightly cuts the myth that rural people are empty vessels waiting to be filled and emphasizes on the need for the ‘professionals’ to learn from rural people. Effective coastal protection measures can act as a catalyst for increased economic production in the coastal area to develop resources for tourism and more intensive

agricultural production. Coastal protection interference (Geo-tube embankment to prevent coastal erosion).Alternative source of livelihood like poultry, innovative agricultural implementation, modulation of cropping) can also reinforce people's livelihoods and resilience to natural disasters in a very positive way, not solely through the avoided costs of damage. It can be evaluated as the increase in income, or income-in-kind over the life of the project. As an adaptation strategy in the context of Marine fisher folk community, migration and diversification into agricultural activities are seen. Promotion of Kitchen Garden at household level in the monsoon season is contemplated as a coping mechanism in the context of Marine fisheries.

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