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IMPACT OF CLIMATE CHANGE ON LIVELIHOOD OPTIONS, CASE STUDY OF A COASTAL DISTRICT IN ODISHA, INDIA

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Abstract: Climate change has become a menace for human being. It is affecting the basic elements of life – access to water, food, health and use of land, and the basic environment. In developing country like India and her states, climate change is an additional burden because ecological and socio-economic systems are already facing pressures from intensive industrialisation, urbanisation and population explosion. India has variegation of natural coastal ecosystems. The study area i.e. Rajnagar block, Kendrapara district, Odisha has 480 km. of coastal stretch situated in the east coast of India, which is most vulnerable due to climate change. Climate change is a long-term change in the average weather patterns that have come to define Earth's local, regional and global climates. The main objective of the study is to measure the relative vulnerability of the region or community based on the premise that human vulnerability is a function of physical characteristics of climate events. The indicators are like Sea Level Rise, Coastal Water Temperature, tidal shift, salt water intrusion, drowning of low-lying areas and affect coastal habitats.The climate change is associated with the vulnerabilities of human system arising from climate variability. The study envisages analyzing the impact of climate change on socio economic development of local people. The results show that climatic variation impacts the livelihood systems of rural communities through its interaction with local natural environmental resources and other socio-economic characteristics of the communities. There is a significant change in rural livelihood system of marine fisher folk, farmers, and local inhabitants which affects the socio-ecological status. The study overview the gaps and challenges for mainstreaming climate change and coping strategies in the coastal zone with some suggestive planning structure.

***Index Terms*:** Climate change, rural livelihood system, coastal zone, relative vulnerability

1. INTRODUCTION

Climate change is can be termed as "global warming" and "the greenhouse effect," but is a more illustrative term and refers to any change in climate over time and space whether due to natural variability or as a result of human activity (IPCC, 2007).

Current climatic variability and change is forecasting the increasing global temperature and subsequently impact the global hydrological system, crop production and other natural ecosystems functions adversely (Sathaye et al, 2006, Siva Kumar er al, 2005). There is increasing corroboration that these changes will strongly affect the livelihood of millions of people in the world. The projected immensity of such changes and its

impacts are diverse (Stern, 2007) and expected to be more in case of tropical and sub tropical regions (UNFCCC, 2009, Parry et al, 2007).

2. BACKGROUND OF THE PROBLEM

The increasing changes in the climate intensify the problems in human securitythat developing countries like India have been facing. It has been stated that 94 per cent of theworld's major natural disasters between 1990 and 1998 occurred in developing countries s (Oxfam,2002) and their root causes lie in global climatic changes. Vulnerability in the context of climate change is a function of sensitivity, exposure and adaptive capacities. Hence, a highly vulnerable system is one that is highly sensitive to modest changes in climate and one for which the ability toadapt is severely constrained (IPCC, 2007). The impacts of climate change in nature and nature's contributions to humans are projected to become more pronounced in the next few decades.

2.1 Ecosystem problem

Climate is the prime decider of economic condition of any country or state. The Focused Group Discussion (FGD) with the villagers revealed interesting facts on coping strategies of the people in the event 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 Naladiapalda under Mahakalpara block and Belpala of 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- Rising sea level also increases the salinity of ground water and pushes salt water further upstream. Higher salinity can make water undrinkable without desalination, and harms many aquatic plants and animals.

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

Impacts of Coastal Water Temperature-Coastal waters have warmed during the last century, and are very likely to continue to warm in the 21st century. This warming may lead to big changes in coastal ecosystems, affecting species that inhabit these areas.

Impacts to Coral Reefs and Shellfish-Higher sea surface temperatures increase the risks of coral bleaching, which can lead to coral death and the loss of critical habitat for other species.

Climate Change and Agriculture: - The adverse effects of climate change falls heavily on climate sensitive agricultural sector (Nordhaus, 1991; Cline, 2007). Studies have predicted that agriculture yield will likely be severely affected over the next hundred years due to unprecedented 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 produced. The effects of climate variables are more pronounced on agriculture in regions where agriculture is backward or primitive with less scope for technological adoption and transmission (Mishra et al., 2015) The adverse effects of climate change falls heavily on climate sensitive agricultural sector (Nordhaus, 1991; Cline, 2007). Studies have predicted that agriculture yield will likely be severely affected over the next hundred years due to unprecedented 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 produced. The effects of climate variables are more pronounced on agriculture in regions where agriculture is backward or primitive with less scope for technological adoption and transmission (Mishra et al., 2015).

This paper makes an attempt 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 significant change in rural livelihood systems.

- To identify gaps and challenges between the effect of climate change and livelihood.
- To suggest development and planning strategies.

3. METHODOLOGY AND STUDY AREA

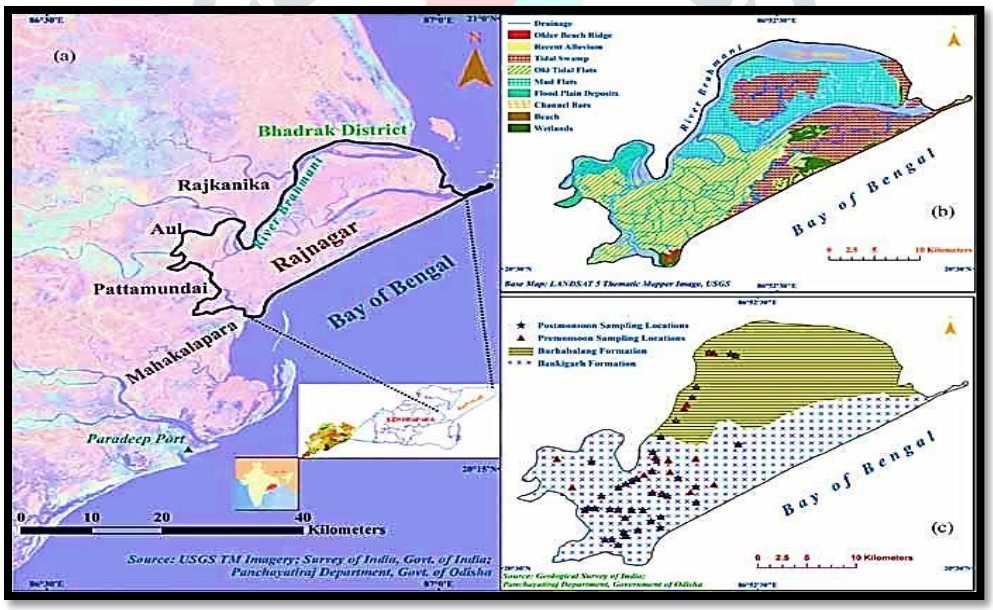
The present research looks into the hydro geochemistry of the coastal aquifer system of Rajnagar block, Kendrapara district. The Rajnagar block alluvial aquifer system lies in the eastern part of the Kendrapara district along the coastal tracts of Odisha (figure 1a). The study area encompasses approximately 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 (figure 1a).

3.1 Geomorphology

Topographically, the terrain is very even with the elements of slope, aspect and curvature indicating a very gently east and northeast sloping landscape (Das and Sahoo 2014). Physiographically, the study area is broadly classified 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.(figure 1b). Older beach ridges and newer dunes of varying relief, between 3 and 6 m, are found parallel to the coast (figure 1b). The alluvial plains occur along the Southwestern part of the study area with a very gentle slope to the west of marshy tract (figure 1b).

3.2 Geology

Recent alluvium and sand bodies of Quaternary age, exposed 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 (figure 1c). The lithology of the northern part is composed of alternating floodplain layers of sand and silt, recent sand dunes and marine deposits belonging to the Burahbalang Formation (figure 1c). The generalised stratigraphic sequence of this coastal aquifer system is given below (CGWB Technical report 2002; Mishra et al. 2003; GSI Technical report 2011).



(Fig;- 1a,1b,1c)

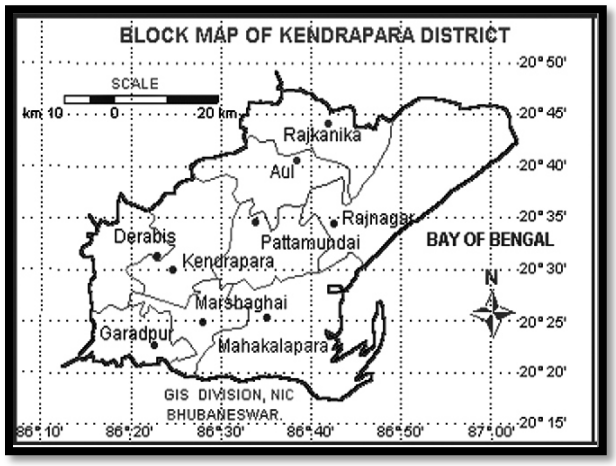
(Fig:-2a)

(Fig:-2b)

3.3 Demographic Profile

Rajnagar CD Block is part of the Bakreshwar Upland, one of the four sub-micro physiographic regions occupying the western portion of the district. This area is a heavily dissected extension of the plateau region of Santhal Parganas. Rajnagar Block of Kendrapara district has total population of 163,450 as per the Census 2011. Out of which 82,469 are males while 80,981 are females. In 2011 there were total 33,724 families residing in Rajnagar Block. The Average Sex Ratio of Rajnagar Block is 982. As per Census 2011, all of the population of Rajnagar Block lives in urban areas. The average literacy rate in urban area is 84.9% and the sex ratio of Rajnagar Block is 982.The population of Children of age 0-6 years in Rajnagar Block is 21,787 which are 13% of the total population. There are 11,308 male children and 10,479 female children between the ages 0-6 years. Thus as per the Census 2011 the Child Sex Ratio of Rajnagar Block is 927 which is less than Average Sex Ratio (982) of Rajnagar Block.The total literacy rate of Rajnagar Block is 84.87%. The male literacy rate is 79.27% and the female literacy rate is 67.74% in Rajnagar Block.

About Rajnagar Block



(Fig:-2c)

Rajnagar is a Block located in Kendrapara district in Odisha. Positioned in rural part of Odisha, it is one of the 9 blocks of Kendrapara district. As per the government records, the block number of Rajnagar is 106. The block has 309 villages and there are total 35005 houses in this Block.

3.4 Weather and Climate of Rajnagar Block

It is Hot in summer. Rajnagar summer highest day temperature 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.

3.5 Local Geology

The soil type of the district varies from alluvial, saline and sandy clay. The western part of the district is alluvial which is very fertile in nature whereas the eastern part comprises mainly sandy clay type soil which is saline in nature due to its proximity to the sea. Almost all parts of the district is covered with plain lands and traversed by rivers like Birupa, Brahmani, Luna, Paika, Chitrotpala and Gobari. It is also covered by many tributaries and canals etc.

3.6 Working Population - Rajnagar Block

In Rajnagar Block out of total population, 55,994 were engaged in work activities. 59% of workers describe their work as Main Work (Employment or Earning more than 6 Months) while 41% were involved in Marginal activity providing livelihood for less than 6 months. Of 55,994 workers engaged in Main Work, 13,959 were cultivators (owner or co-owner) while 8,815 were agricultural laborers.

Occupation	Total	Male	Female
Main Workers	33,009	30,604	2,405
Cultivators	13,959	13,650	309
Agriculture Labourer	8,815	8,371	444
Household Industries	674	603	71
Other Workers	9,561	7,980	1,581
Marginal Workers	22,985	13,915	9,070
Non-Working	107,456	37,950	69,506

(Table :-1)

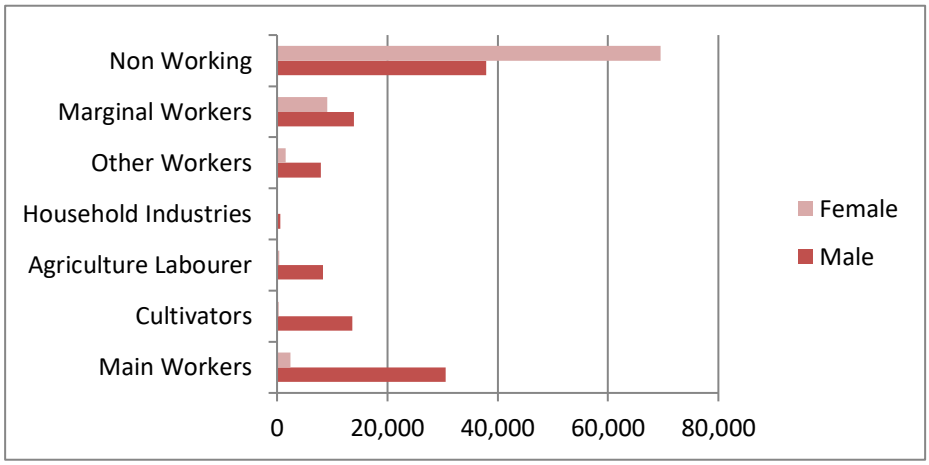


Fig:-3-Variation of different occupation with population for the Rajnagar Block, Kendrapara district for the year 2011

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 consisting physical, social, economic, environment and quality of life is not available, 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

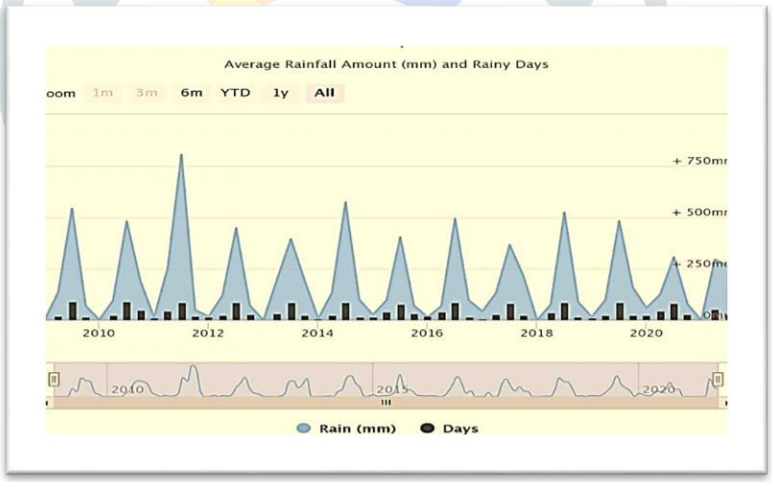


Fig:-4a-Average Rainfall Amount of Rajnagar Block, Kendrapara district.

- 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 survive 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 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)

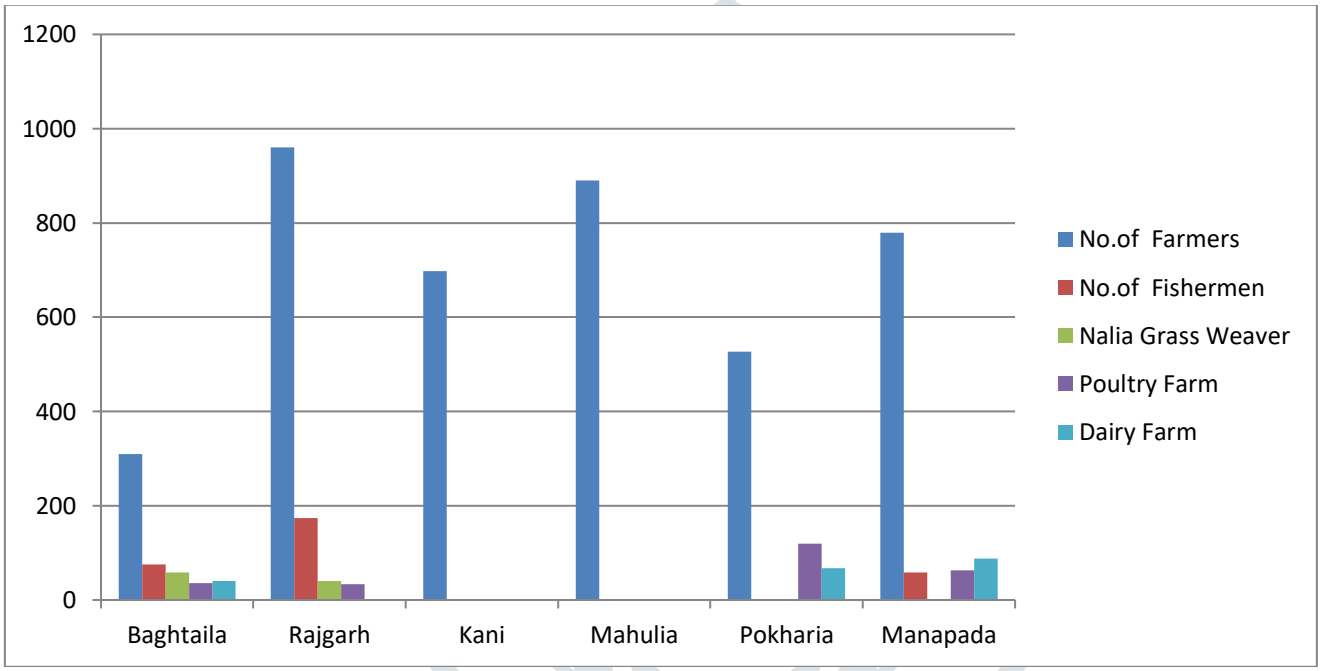


Fig:-6-Variation of different occupation with population for the Rajnagar Block, Kendrapara district for the year 2020

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 encouraged to adopt diversified non-farm activities like dairy farming, poultry etc. In this regard 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.

Summary

The adverse effects of climate change are having a heavy impost on many coastal villages in Odisha. Effective coastal protection measures can act as a impetus for increased economic production in the coastal area to develop resources for tourism and more intensive agricultural production. Coastal protection interventions (Geo-tube embankment to prevent coastal erosion).Alternative source of livelihood like poultry, innovative agricultural implementation, modulation of cropping) can also enhance people's livelihoods and resilience to natural disasters in a positive way, not only through the avoided costs of damage. It's can be estimated as the increase in income, or income-in-kind over the life of the project. Migration and diversification into agricultural activities is seen as an adaptation strategy in the context of Marine fisher folk community. Promotion of Kitchen Garden at household level in the monsoon season is viewed as a coping mechanism in the context of Marine fisheries.

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