P: ISSN No. 0976-8602 RNI No. UPENG/2012/42622 VOL.-9, ISSUE-2, April 2020
E: ISSN No. 2349-9443 Asian Resonance

Climate Change and its Impact on Food Security: A Comparative Analysis of Gupti Panchayat of Kendrapada and Bhaliadal Panchayat of Mayurbhanj District in Odisha

Paper Submission: 12/04/2020, Date of Acceptance: 23/04/2020, Date of Publication: 28/04/2020

Shakuntala Pratihary
Research Scholar,
Dept. of Geography,
Utkal University,
Odisha, India

Kabir Mohan Sethy
Professor,
Dept. of Geography,
Utkal University, Bhubaneswar,
Odisha, India

Abstract

Climate change is impacting badly on the life and livelihood of the people. This has brought in an increase in the frequency of extreme climate events, which ultimately affects the livelihood of the people. Odisha is a state in India, which experiences natural disasters every year. The data for the last century shows an increasing trend in the frequency and also multiple disasters affecting the life and livelihoods of the people. Majority of the population in Odisha are dependent on natural resources to earn their livelihoods and increased disasters have ruined the income and the confidence of the people. This research focuses on the experience of the people in two Panchayats, one coastal and another tribal Panchayat to assess the impact of climate change on the food security of the people. The recurring disasters have affected the agricultural systems and many of the small and marginal farmers have given up farming because of the rising risk and vulnerability. The food security is getting disturbed and many of the family members are migrating to distant locations to earn their livelihoods.

Keywords: Climate Change, Disasters, Food Security, Risk, Vulnerabilities and Migration.

Introduction

Climate change is the defining human development issue of our generation. The development initiatives towards expanding human potential and enlarging human freedom is seriously threatened by the global warming and ultimately impacting largely on climate change. Unprecented change in climate is having its impact on agriculture, food and water availability, rising temperature of the earth and sea, changing precipitation pattern, onslaught of disasters are going to severely affect marginal and vulnerable section of the society. Not only are the poor of present world but also the future humanity as a whole going to bear the brunt of the climate change.

Food production is the most important and critical aspect of human existence. However the humans and animals can't produce their own food, rather they depend on the Autotrophs for their survival. Autotrophs are the primary food producer in any food chain or food web. Survival and growth of plants depend on the climatic factors like temperature, rainfall, moisture content in the atmosphere and sun light. Changes in these climatic factors affect the life and productivity of the Autotrophs in general and agricultural plants in particular. Agricultural plants are very sensitive to the climatic factors at different stages of their life. They succumb to the changes beyond a certain range which result in sharp fall in food production.

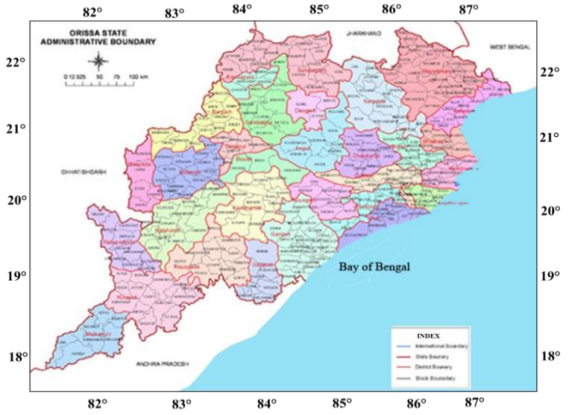
Dimensions of Food Security

Food security is an essential component of any development initiative. It enhances human potential in multiple ways and leads to economic prosperity and social cohesion. In order to build a prosperous and resilient society primary focus should be on the food security aspect of the economy. However in the context of climate change, food security gets impacted badly with the changes in the climate. The impact is through

complex ways by affecting agricultural crops, livestock, forestry, fisheries and aquaculture. Food insecurity has grave consequences in the form of stunted growth of children, underdevelopment of cognitive skills, reduced life expectancy, deficiency in immune system of body and never the less the productivity and income earning opportunity of the individual is compromised. In holistic manner it can be said that food insecurity affects individual's right to lead a dignified life in the society. It is important to note that climate change by having impact on the chances of survival of agricultural plants is going to severely impact on the food security of the society. The effect of climate change on food security depends not only on the climate shock but also on the vulnerabilities of the affected population.

Introduction about the State of Odisha

Food security is an important issue for the state of Odisha because of the poverty condition.High maternal death rate, infant mortality rate, stunted growth rate of children, high incidence of anemia in children and pregnant women, hunger deaths and prevalence of large scale malnutrition indicates about the dwindling food production of the state.



Agriculture and allied sector is the dominant employer of the state giving 70% employment opportunity while contributing merely 27% to the GSDP, the least contributor to the state GDP. Agriculture sector is operating at the subsistence level that can be attributed to the frequent disasters. Natural disaster can push back an economic system by few years depending on the impact that whether it has caused more loss or more displacement or both.[1] Striking of disasters has multiple implications that disrupt the life of locals.

Increasing Vulnerability of Odisha to Disasters

The location and the geo-climatic conditions of Odisha make the state vulnerable to various natural disasters. The eastern part of Odisha surrounded by Bay of Bengal makes the state highly vulnerable to cyclone, storm surge and coastal erosion. Long coast line of 480km, constituting 17percent of total east coast of India receives around 35percent of total cyclonic and deep depression storms that often inundate large tract of coastal districts.This coastal state is under tropical climatic zone and is controlled by south west monsoon and retreating north east monsoon wind.However since the later part of 20th Century, the unfolding situation of global warming and subsequent climate change situation is critically affecting Monsoon wind pattern thus disrupting life and livelihood of the local population. Unprecedented and unpredictable monsoon wind is creating condition for water log, flash flood, erosion of top soil, drought and infestation of unknown pest and bugs that has strong impact on the agricultural productivity.

Rivers like Mahanadi, Brahmani, Baitarani, and Budhabalang along with their tributaries flow through the length and breadth of Odisha to fall in Bay of Bengal. The stretch of rivers also cause flood in the state at regular interval. Around 1.40 lakh hectares of land out of total geographical area of 15,571 lakh hectares are highly flood prone. Flash floods and landslides are the other features of the geographical characteristics of the state. The coastal zone is highly flood prone due to low elevation from sea level and regular siltation because of deforestation.Odisha is also very prone to frequent drought condition especially the western part of the state. Change in climate, rapid deforestation due to mining activity leading to degradation of top soil, decline in surface and ground water level, gradual degradation of ecology are some of the factors escalating drought condition of the state.

Flood, drought and cyclone are the traditional disasters that continually disturb life of local population because of the geographical positioning of Odisha. But the disaster profile of the state has increased in recent years owing to global warming condition which is adding to the suffering of the people. New form of disasters like heat wave, lightning, coastal erosion, increased magnitude of turbulence in sea, unknown pest attack are to mention few climate shocks that devastate agricultural production and economic backbone of Odia farmers. The frequency and intensity of natural disaster has increased many times for the state especially after 1965. Within a span of 119 years, 1900-2019, the state experienced 166 natural calamities, 1.4 natural disaster per year since the beginning of 20th century.[2] Even though the geographical location of the state makes it vulnerable to natural calamities, global warming induced climate change is having significant impact on agricultural production of state. Frequent and massive lightning, heat wave, high intensity cyclone, long dry spell, irregular and torrential rain creating heavy flood is continually affecting agricultural productivity and de-motivating farmers to pursue farming as a livelihood opportunity.The time line data in Table 1 indicates various forms of climate shock that had disturbed lives, livelihood and the state economy within a period of 1975 to 10th June 2020.

Table 1-Time Series Analysis of Disaster in Odisha (1975-2016)

Year	Flood	Drought	Cyclone	Heat Wave	Lightning
	Number of districts affected in bracket	Number of districts affected in bracket		Death toll due to heat wave in bracket	Death toll due to lightning in bracket
1975	MF (8)	MD (1)	0	MH	NA
1976	NA	NA	SC	0	NA
1977	MF (5)	MD (2)	0	0	NA
1978	SF (20)	0	0	MH	NA
1979	0	MD (11)	SC	MH	NA
1980	MF (10)	NA	0	0	NA
1981	MF (2)	NA	SC	MH	NA
1982	MF (8)	MD (3)	VSC	0	NA
1983	MF (3)	0	0	MH (3)	NA
1984	MF (8)	NA	SC	0	NA
1985	MF (9)	MD (1)	2 Cyclone	0	NA
1986	MF (9)	NA	0	0	NA
1987	MF (2)	MD (13)	0	MH (1)	NA
1988	MF (2)	NA	0	SH (22)	NA
1989	MF (5)	MD (13)	SC	SH (1)	NA
1990	MF (8)	0	0		NA
1991	MF (10)	0	0		NA
1992	MF (11)	MD (1)	0		NA
1993	0	MD (6)	0		NA
1994	SF (20)	0	0		NA
1995	SF (23)	0	VSC	SH (9)	NA
1996	Flood (1)	VSD (28)	0	SH (3)	NA
1997	SF (18)	MD (15)	0	0	NA
1998	0	VSD (25)	0	SH (2024)	NA
1999	MF (7)	0	VSC & Super Cyclone	SH (91)	NA
2000	0	VSD (29)	0	MH (29)	NA
2001	SF (24)	0	0	MH (25)	183
2002	0	SD (18)	0	SH (41)	220
2003	SF (26)	0	0	SH (68)	221
2004	MF (5)	0	0	MH (45)	277
2005	MF (13)	MD (5)	0	SH (236)	250
2006	VSF (27)	0	0	MH (21)	204
2007	MF (13)	MD (5)	0	SH (47)	351
2008	SF (21)	MD (5)	0	SH (71)	362
2009	MF (15)	VSD (18)	Cyclone	SH (89)	214
2010	MF (13)	VSD (15)	0	SH (104)	280
2011	MF (13)	VSD (16)	0	SH (22)	350
2012	MF (5)	0	0	SH (83)	293
2013	MF (18)	0	VSC	MH (16)	371
2014	MF (12)	0	SC	SH (40)	310
2015	MF (5)	VSD (16)	0	SH (70)	401
2016	MF (1)	VSD (27)	Cyclone	SH (50)	395
2017	MF (2)	VSD (15)	0	37	465
2018	MF (14)	MD (9)	VSC		320
2019	MF (6)	MD (9)	2 VSC		NA
2020			Cyclone		NA

MF- Moderate flood, MD- Moderate drought, MH-Moderate heat wave, SF- sever flood, SD- Sever drought, SC-Sever cyclone, SH- Sever heat wave, VSF- Very sever flood, VSD- Very severe drought, VSC-Very sever cyclone.)

Source: Orissa Human Development Report 2004
Climate of Orissa 2002 (Indian Meteorological Department)
Annual reports of OSDMA, Annual reports on natural calamities
Special Relief Commissioners Annual report
Economics of Natural Disaster in Odisha – Saudamini Das

Objective of the Research and the Geographic Locations

This research is carried out in two Panchayats, one a coastal and another tribal area in Kendrapada and Mayurbhanj districts. The objective of the study is to make a comparative analysis of the impact of climate change on the food security. The coastal Panchayat experiences multiple disasters every year and has impacted badly on the livelihood and the confidence of the people. This area has witnessed large scale migration and ultimately shatters the social relations and threatens the capability of the younger generation. Similarly, in Bhaliadal, the impact of climate change is felt differently. This has impacted badly on the Non Timber Forest Produced (NTFP) which caters to the large part of forest dweller's income and up to forty percent of their food requirement. When there is a crop failure, government declares drought and people get assistance from the welfare state, but when there is a failure of forest produced, this does not call the attention of the policymakers.

Objective of the Study

1. Impact of climate change on local food production
2. Impact of frequent disasters on the agricultural production
3. Response of the various state and non-state institutions
4. Impact on the food security

This research has made an attempt to make certain recommendation based on the findings. Further to this the findings will be shared with larger audience to address the food security needs of the people who are in difficult situation through policy interventions.

Research Methodology

In order to carry forward this study, literature survey was carried out to comprehend the difference between the two geographic locations. Based on the literature survey, a questionnaire was developed and two hundred questionnaires were administered in both the Panchayats. The data was collated and was analyzed statistically to find out the significance of difference. Further to this Participatory Rural Appraisal (PRA) and community interaction was carried out to gather qualitative information to substantiate the data based findings.

Bhaliadal Panchayat

Bhaliadal Gram Panchayat comes under Thakurmunda Block of Mayurbhanj district, is a forest dominated Panchayat and hence mostly inhabitated by the tribal population. This Panchayat consists of six villages out of which only two villages come under revenue village and rest are the declared forest village. This part of the forest area comes under Tiger Reserve Forest Area of Simlipal Bio Reserve National Park and hence construction activity in this Panchayat is prohibitory. However after Forest Reserve Act 2006, this Panchayat could witness some development initiatives in terms of establishment of primary and upper primary schools, SHGs, construction of forest roads, bore well. However looking at the number of households there is discrepancy between the number of population and availability of basic utility services. As per 2011 census, the Panchayat has 785 households with 3357 population. Out of the total population 3202 belongs to Schedule Tribes and 155 belong to Schedule Cast group. Total land area under Panchayat is 786acres of which 482 acres are under cultivation. However the Gram Panchayat has no irrigation facilities and people are dependent on the nearby streams and community tube well for their daily requirements. Being inside the protected forest area any construction oriented work is strictly prohibited under Forest Rights Act 2006 in this Panchayat. So there is absence of any industrial base including village industry or cottage industry. People are completely dependent on the forest for their livelihood. They collect Non Timber Forest Products (NTFP) like seeds of Karanj (Pongamia Glabra), flowers of Mahua (Madhuca Longifolia), Kendu (Tendu) leaves, Kusum (Ceylon Oak) seeds, Tamarind and other varieties of forest products for their livelihood. On an average they collect Rs 400-600 per week by selling NTFPs. With the change in the temperature and precipitation, the quality and quantity of forest product got affected thereby affecting the earning opportunities of the tribals of this Panchayat.

One significant aspect of the population of this Panchayat is that they practice sustainable approach in collecting the NTFP as they believe Forest as their Mother and they respect, care for the forest. Agriculture is not that way remunerative in this Panchayat due to lack of irrigation facility. Rain fed agriculture is completely dependent on the pattern of rain and any aberration in the rain make the growing plant vulnerable to various pest attacks. Tribals of this Panchayat do organic farming with traditional technique and are highly susceptible to economic loss in the wake of unpredictable unprecedented change in climate. Most of the household belong to BPL category and receive rice supply from Government at a subsidized rate. Other needs of the household are met by direct purchase from the market. Few years back people of this Panchayat rarely purchase from the market to satisfy their food requirement because the forest was providing everything as per their need. But within a time span of few years number of trees have vanished and some trees are not flowering adequately due to variation in temperature and precipitation.The residents are experiencing absence of number of tuber crops, fruits and vegetables from their platter within a short span of time. Increasing dependence on the market with low income earning opportunity severely affect the food security of the local population. The Panchayat has 27 SHGs, 5 primary school, 2 Upper primary School and 1 health center[3]

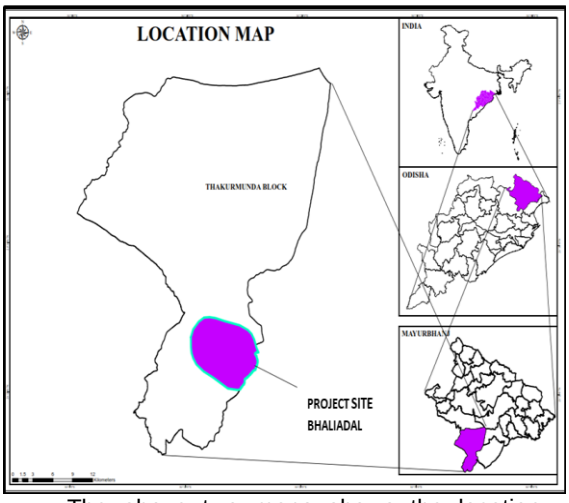
Gupti Panchayat

Gupti is a coastal Panchayat in Rajnagar block in the Kendrapada district. It is situated on the river mouth of the tributaries of mighty river like Mahanadi, Brahmani and Baitarani. There are nineteen villages in this Panchayat. River and river based ecology is the prominent environment of this Panchayat. People are dependent on agriculture and fishing as the major livelihood source. However due to

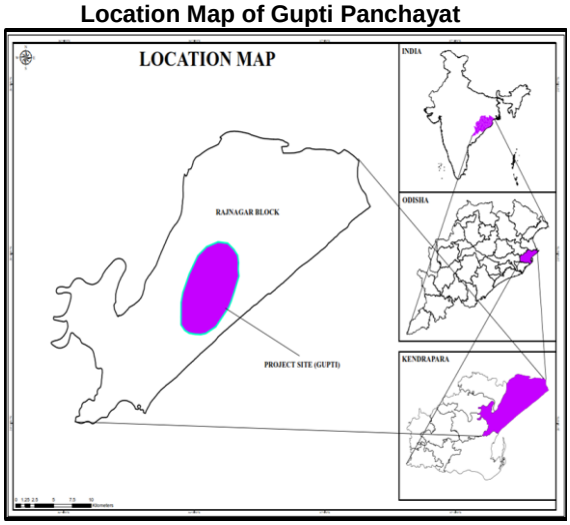
creation of Bhitarkanika national park, a famous crocodile breeding research centre, fishing is prohibited in the nearby river tributaries in order to safeguard lives. Fishing communities of this Panchayat are dependent on high sea contract farming for certain duration of time. They are hired by the big trawlers as contract labourer for certain time period. For this reason fisherman doing fishing for local market is absent in the Panchayat. Backyard ponds supply the household fish consumption needs. Women of poor economic class catch crabs from the nearby mangrove forest for household requirements as fishing in the reserved mangroves are strictly banned by the forest department.

Agriculture is another important livelihood option in this Panchayat. However there is no irrigation facility in the region and people depend on the rain for agriculture requirement. People practice one crop per year due to lack of irrigation facility. Any change in the pattern of rain fall severely affects the economic productivity of the people. Vulnerability to change in rainfall pattern is added to the problem of increasing salinity of the agricultural field. Sea level rise and increased frequency of storm surge in the wake of global warming is adding to problem of salinity of the agricultural field. The existence of number creeks in the Panchayat makes the agricultural field vulnerable to increasing salinity. Sea water ingression due to sea storm, cyclonic pressure or tidal wave in no moon and full moon period reduces the fertility of the soil and make it infertile for agricultural activity. Saline water reduces the productivity of the agricultural field and also contaminates the inland water bodies and make it unfit for use. Agriculture and fishing the traditional livelihood option of the region is no more providing sufficient income required for the wellbeing of the family, hence people resort to migration to supplement the income. The semiskilled male member of the family migrates to urban location in different parts of the state and country to supplement the income from agriculture. They are primarily engaged in the construction, plumbing and hospitality industry via third party contract without any formal insurance coverage.

Location Map of Bhaliadal Panchayat



Location Map of Gupti Panchayat



The above two maps shows the location, where Gupti is a coastal Panchayat and Bhaliadal is a tribal Panchayat. Both the Panchayats have distinct climatic condition and also fall in different agro-climatic zones in Odisha. This determines the agriculture and livelihood pattern in both the Panchayats.

Food Security in the Sample Panchayats

Food security at any particular point of time is not only the availability of food but also people's access and the necessary condition of converting food into energy. This can be analyzed by the following three aspects:

I. Availability/ Production of Food
II. Accessibility to Food
III. Absorption of Food

Adequate food production or availability of food alone is primary condition for a country's food security[2], whereas accessibility to food and absorption of food are the secondary condition to ensure security.

Adequate food production or availability of food alone is primary condition for a country's food security[4], whereas accessibility to food and absorption of food are the secondary condition to ensure security.

Food Production/Availability of Food

In the context of the both the Sample Panchayat agricultural productivity has great significance as more than 60percent of the people are engaged in the agricultural activity even though there are infrastructural bottlenecks in the region. Both the tribal Panchayat and coastal Panchayat are rain fed without having any irrigation facility. Electricity is of poor quality to adopt lift irrigation technique for farming along with the poor economic ability of farmers to adopt any other technique of irrigation. Agricultural productivity is important for the poor farmers not only from the income perspective but also from the food production perspective of the region. Change in temperature, precipitation affect plant's health in terms of pest attacks, drying up the stems of

plants, maturation of leaf and fruits. Each aspect has bearing on the agricultural productivity.

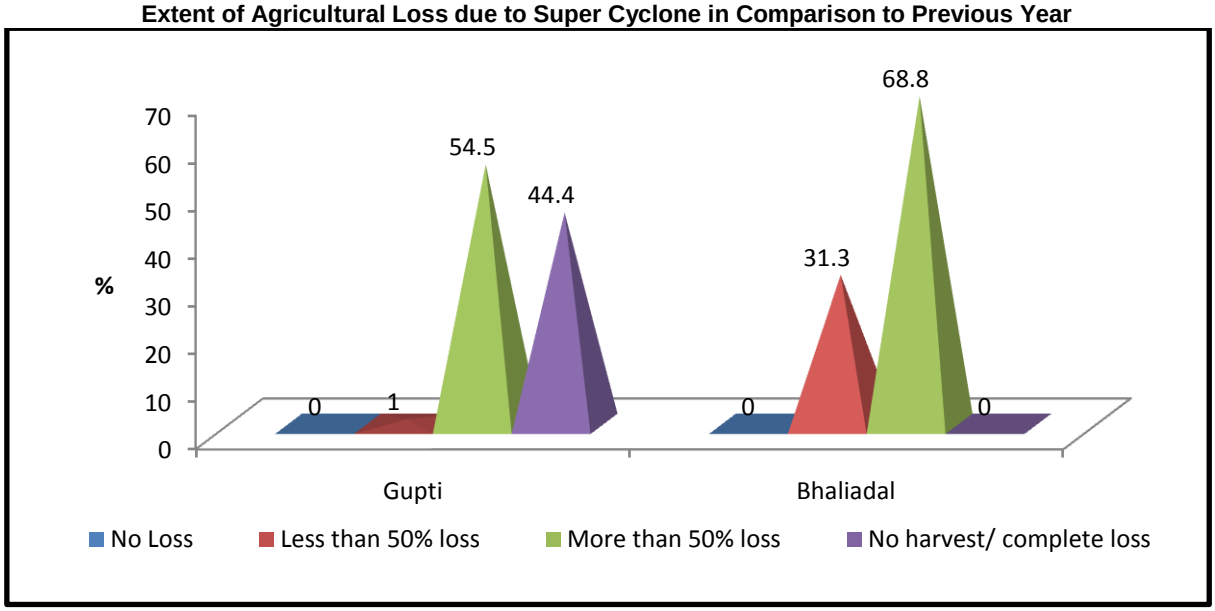
This has been further accentuated by the onslaught of frequent disasters. The rise in the temperature, non-existence of monsoon rainfall has also badly impacted the crop cycle. Further to this, regular extreme climate events have impacted very badly on the agriculture systems. This has been explained by collecting data in both the Panchayats and the same set of information has also undergone statistical analysis for the test of significance[5].

Table 2
Extent of Agricultural Loss due to Super Cyclone 1999 in comparison to Previous Year

District	Kendrapara			Mayurbhanj		Total		$\chi 2$,p
Block	Rajnagar			Thakurmunda				
Panchayat	Response	Gupti		Bhaliadal				
Agricultural loss		No.	percent	No.	percent	No.	percent	$\chi 2$=49.595 p=0.000
	No Loss	0	0.0	0	0.0	0	0.0	
	Less than 50percent loss	1	1.0	15	31.3	16	10.9	
	More than 50percent loss	54	54.5	33	68.8	87	59.2	
	No harvest/ complete loss	44	44.4	0	0.0	44	29.9	
	Total	99	100	48	100	147	100	

Table2 shows extent of agricultural loss due to Super Cyclone in 1999 in comparison to previous year.In Gupti Panchayat out of 100 respondent 99 responded to this question of extent of agricultural loss in Super Cyclone 1999. Out of 99 individuals only 54 said they incurred loss more than 50 percent where as 44 person said they incurred complete loss in the Super Cyclone.

Figure-1
Extent of Agricultural Loss due to Super Cyclone in Comparison to Previous Year



One critical aspect of Gupti Panchayat is that, having close proximity with the Bhitarkanika Mangrove forest, the Panchayat was saved from the ferocious wind speed of major cyclones like Super Cyclone, Phailin, Hudhud or Titili. The wind speed used to be checked by the long coverage of mangrove forest but the accompanied torrential rain followed by water logging in the agricultural field destroys the crop. On the other hand in the tribal Panchayat only 48 respondents responded to this question of extent of agricultural loss in the Super Cyclone. Figure-1 shows the extent of agricultural loss in Super cyclone in both the studied Panchayat. It shows that in the tribal Panchayat only 31.3% of the sample population had incurred losses less than 50% in comparison to previous year and 68.8% of the sample respondent said that they have received more than 50% agricultural loss in comparison to previous year due to Super cyclone.

Odisha is constantly invaded by disasters of various types and magnitude that has tremendous impact on the agricultural food production. However while asking questions about the loss of agricultural crop due to disasters; questions were only limited to cyclone in order to avoid any ambiguity. In the post 1999 super cyclone the Metrology Department have started giving names to the cyclone and it made easy for the respondents to recall the past events and respond the questions. Table-3 and Figure-2 shows the extent of agricultural loss that the respondents of both the Panchayat incurred in the cyclone Phailin that severely affected the state of Odisha in 2013.

P: ISSN No. 0976-8602 RNI No. UPENG/2012/42622 VOL.-9, ISSUE-2, April 2020
E: ISSN No. 2349-9443 Asian Resonance

Table 3
Extent of Agricultural Loss due to Phailin in comparison to Previous Year

District	Kendrapara			Mayurbhanj		Total		$\chi 2$,p
Block	Rajnagar			Thakurmunda				
Panchayat		Gupti		Bhaliadal				
Agricultural loss	Response	No.	percent	No.	percent	No.	percent	$\chi 2$=1.259 p=0.739
	No Loss	3	3	0	0.0	3	2.9	
	Less than 50percent loss	37	37	2	66.7	39	37.9	
	More than 50percent loss	48	48	1	33.3	49	47.6	
	No harvest/ complete loss	12	12	0	0.0	12	11.7	
	Total	100	100	3	100	103	100	

Table 3 shows the agricultural loss in comparison to previous year due to Phailin. In Bhaliadal Panchayat only 3 persons responded to the question and rest denied any knowledge about Phailin cyclone. Out of 3, 2 individuals agreed to the fact that the cyclone cost them less than 50percent whereas only 1 person said he incurred loss more than 50percent. Contrary to the tribal Panchayat experience the coastal Panchayat express different story. 12 persons incurred complete agricultural loss and 48 persons incurred more than 50 percent while 37 people had loss less than 50 percent and 3 individual incurred no loss.

Figure -2
Extent of Agricultural loss due to Phailin in comparison to previous year

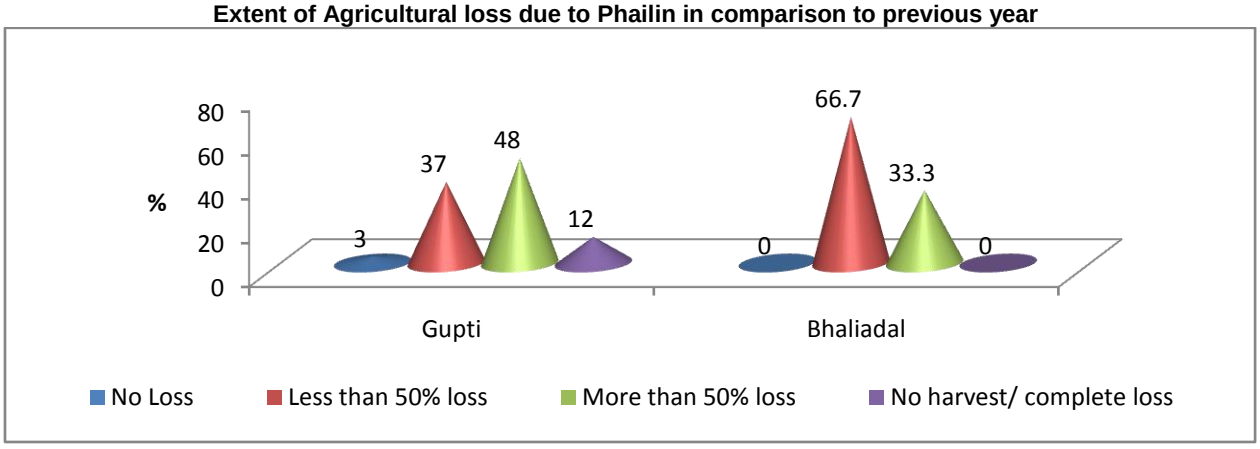


Table 4 shows extent of damage of Rice in 2014 due to the cyclone Hudhud. 78 individuals from Gupti Panchayat incurred loss less than 50percent, whereas 18 individuals incurred loss more than 50percent and 3 individuals incurred complete loss. In Bhaliadal Panchayat only 3 persons said they have experienced the cyclone Hudhud and all of them incurred loss less than 50percent of agricultural produce in comparison to previous year. On the other hand 97 individuals are clueless about the Cyclone Hudhud in the tribal Panchayat.

Table 4
Extent of Damage of Staple Food (Rice) due to Hudhud in 2014

District	Kendrapara			Mayurbhanj		Total		$\chi 2$,p
Block	Rajnagar			Thakurmunda				
Panchayat		Gupti		Bhaliadal				
Hudhud		No.	percent	No.	percent	No.	percent	$\chi 2$=0.839 p=0.840
	No Loss	1	1	0	0	1	1	
	Less than 50percent loss	78	78	3	100	81	78.6	
	More than 50percent loss	18	18	0	0	18	17.5	
	No harvest/ complete loss	3	3	0	0	3	2.9	
	Total	100	100	3	100	103	100	

Cyclone is a large scale air mass that rotates around a strong centre of low atmospheric pressure that brings in ferocious wind speed and heavy rainfall causing heavy devastation in the land mass area. When a cyclone hit any region its impact is felt by all the local population. While collecting data about the extent of damage of rice due to the cyclone Hudhud, 97 respondents from Bhaliadal Panchayatignorance about the event as is evident from Table -4 shows that the cyclone had no impact in the region. However the three respondents agreed that they had incurred losses less than 50% that might have happened by chance and not due to the event. The extent of damage of staple food rice due to Hudhud in both the Panchayat is expressed in Figure-3. The figure shows that in Bhaliadal Panchayat 100% population have incurred agricultural loss less than 50% due to cyclone Hudhud. However this figure is due to the fact that only 3 respondents responded to the question and rest didn't said any word. On the other hand 78 respondents in Gupti Panchayat had agricultural loss

less than 50% and 18 respondents incurred loss more than 50% due to the cyclone Hudhud.

Figure -3
Extent of Damage of Staple Food (Rice) due to Hudhud in 2014

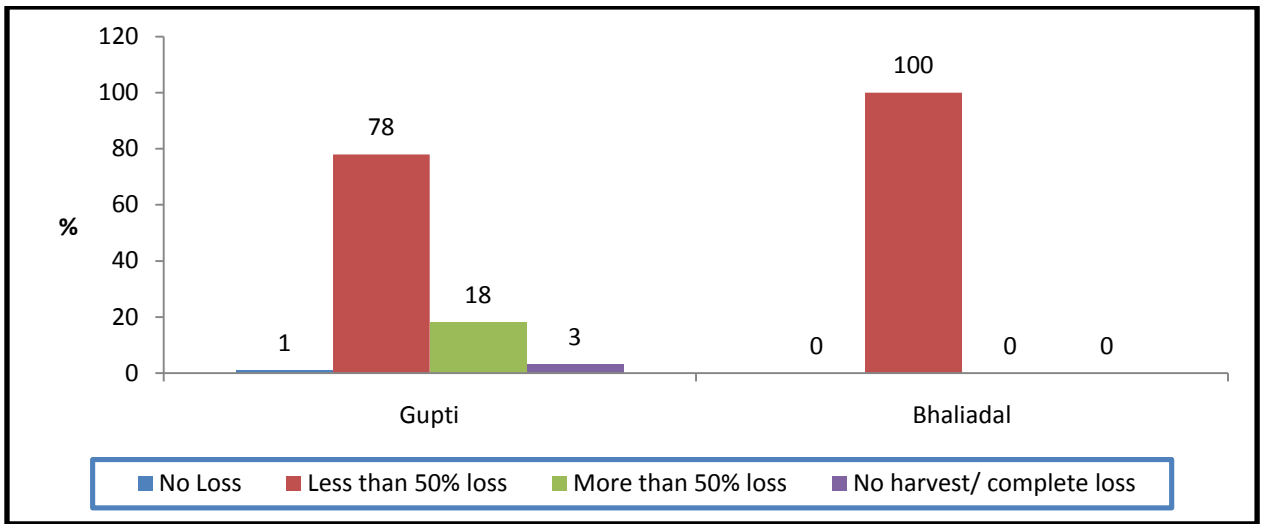


Table-5 shows magnitude of different losses due to cyclone Titili that hit Odisha land mass on 11th October 2018. While collecting data for this research work during early 2019, cyclone Titili was fresh in the mind of respondents, so they could recollect the magnitude of different losses due to the cyclone. Other than the agricultural loss, people of the locality suffered infrastructure loss, loss of live stocks, scarcity of drinking water due to contamination of water bodies and loss of houses. The response of the respondents have been categorised in the Table-5 and Figure-4. However Table-5 shows only 65 respondents had answered to the question of magnitude of different losses to the cyclone Titili in Gupti Panchayat and only one person from Bhaliadal Panchayat responded to the question. 58 respondents out of 65 in Gupti Panchayat incurred agricultural loss where as only one person in the tribal Panchayt suffered agricultural loss. With regard to livestock loss only 3 individuals out of 65 suffered loss in Gupti Panchayat and no loss was incurred in Bhaliadal Panchayat. 20 individuals suffered infrastructure loss and 13 individuals faced water scarcity problem in Gupti Panchayat due to the Cyclone Titili, that is completely absent in the tribal Panchayat Bhaliadal.

Table 5
Magnitude of Different Losses due to Titli in 2018

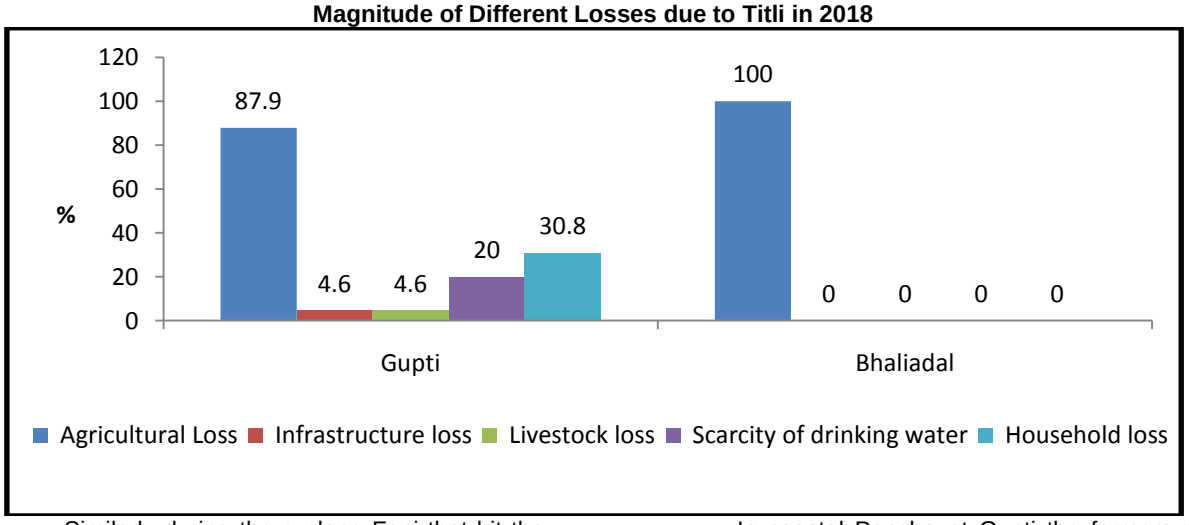
District	Kendrapara			Mayurbhanj		Total		χ^2,p
Block	Rajnagar			Thakurmunda				
Panchayat		Gupti		Bhaliadal				
Agricultural Loss	Response	No.	percent	No.	percent	No.	percent	χ^2=0.138 p=0.711
	Yes	58	87.9	1	100	59	88.1	
	No	8	12.1	0	0	8	11.9	
	Total	65	100	1	100	66	100	
Infrastructure loss	Yes	3	4.6	0	0	3	4.5	χ^2=0.048 p=0.826
	No	62	95.4	1	100	63	95.5	
	Total	65	100	1	100	66	100	
Livestock loss	Yes	3	4.6	0	0	3	4.5	χ^2=0.048 p=0.826
	No	62	95.4	1	100	63	95.5	
	Total	65	100	1	100	66	100	
Scarcity of drinking water	Yes	13	20	0	0	13	19.7	χ^2=0.249 p=0.618
	No	52	80	1	100	53	80.3	
	Total	65	100	1	100	66	100	
Household loss	Yes	20	30.8	0	0	20	30.3	χ^2=0.441 p=0.506
	No	45	69.2	1	100	46	69.7	
	Total	65	100	1	100	66	100	

Figure-4 shows magnitude of different loss due to Titili in terms of percentage. In Bhaliadal Panchayat as only one person responded to the question and he had suffered agricultural loss during that period the Figure-4 shows 100% agricultural loss due to the cyclone Titili. Other than that in the tribal Panchayat no loss was incurred in any other head. On the other hand in Gupti Panchayat 87.9% respondent suffered agricultural loss followed by 30.8% respondents suffered house hold loss. 20% of the respondents suffered scarcity of drinking water in the Panchayat due to the cyclone Titili.

One interesting point about the Cyclone Titili was that it hit Odisha in 11thOctober in 2018 and

made a south ward direction. The residents of Bhaliadal Panchayat of Mayurbhanj district were spared the wrath of ferocious wind speed unlike the tribals of Gajapati District. The tribal District Gajapati had never experienced cyclone of wind speed 140-150kmph earlier. When the cyclone unfolded, it brought devastation and destruction in the forest and tribal people's life. Unpredictable cyclone Titili was tracked by the metrological department since the beginning of its inception but every now and then the cyclone was changing its course. After making land fall near Berhampur it immediately changed its course towards south ward direction falsifying the metrological department's cyclone model analysis.

Figure-4
Magnitude of Different Losses due to Titli in 2018



Similarly during the cyclone Fani that hit the state on 3rdMay 2019, it also broke all the pre-modelling analysis of the cyclone path and made inroad into main inland Odisha consisting of major urban set ups. The strong wind speed of 220kmph devastated the capital twin city breaking almost all the infrastructure, uprooting all the trees of the capital. Once boasting itself as green city, the capital of Odisha, Bhubaneswar just after 3rd May 2019, turned into completely devastated battle field. Life, livelihood, infrastructure, landscape and all the beauties of the capital city turned upside down. Another cyclone named Bulbul once again hit Odisha on 8th October 2019. This time impact area of the cyclone was northern parts of Odisha, consisting of Mayurbhanj district. Ready to be yield crop got water logged in the agricultural field when incessant rain due to cyclonic pressure started pouring. The matured crop got infested by the pest and bugs due to moist climate and water logging in the field. Most of the farmer faced huge loss but more than that it affected the food production and availability of food in the region. Loss in agriculture has twin meaning, it reduce the income of the farmer and affect gross availability of food in the region. Empirical data shows, in post natural disaster situation the agricultural food product prices shoot up due to limited availability of products. Empirical data and above data analysis shows that extreme climatic events like flood, cyclone and drought immediately disrupt the agricultural food production. But the slow onset of disaster like continuous change in temperature and precipitation has strong bearing on the agricultural productivity that goes unrecorded due to lack of proper record keeping activity in this sector.

In coastal Panchayat Gupti the farmers are increasingly facing the problem of salinity of agricultural land due to frequent storm surge, and rise in sea level. This is reducing the fertility of the soil and the lands are turning barren due to increased salinity. Farmers are finding agriculture as no more remunerative and trying to switching off to some other profession which is going to have strong bearing on food production and availability in the region in the coming days. In the tribal Panchayat Bhaliadal rain fed agriculture system cripple under the effect of erratic rainfall and impacts on the quality and quantity of food production. Agriculture proves to be non-remunerative for the youth and they are migrating to urban set up in search of jobs leaving behind the agricultural land. It shows agriculture being solely dependent on the climatic factors in both the region change in these events affect the agricultural productivity which impact the welfare of farmer's family and thus the future generation of farmers' family trying hard to switching to some other job leaving agriculture work. It acts in a spiral manner impacting on the overall food production.

Access to Food

Accessibility to food depends on the family income. Climate change by directly affecting household income adversely affects the food security of the family especially of women and children. Noted expert Nira Ramachandran warns that "climate change can slow down, and even drastically reduce, the improvements in food security and nutrition that India has managed to achieve so far."[6]

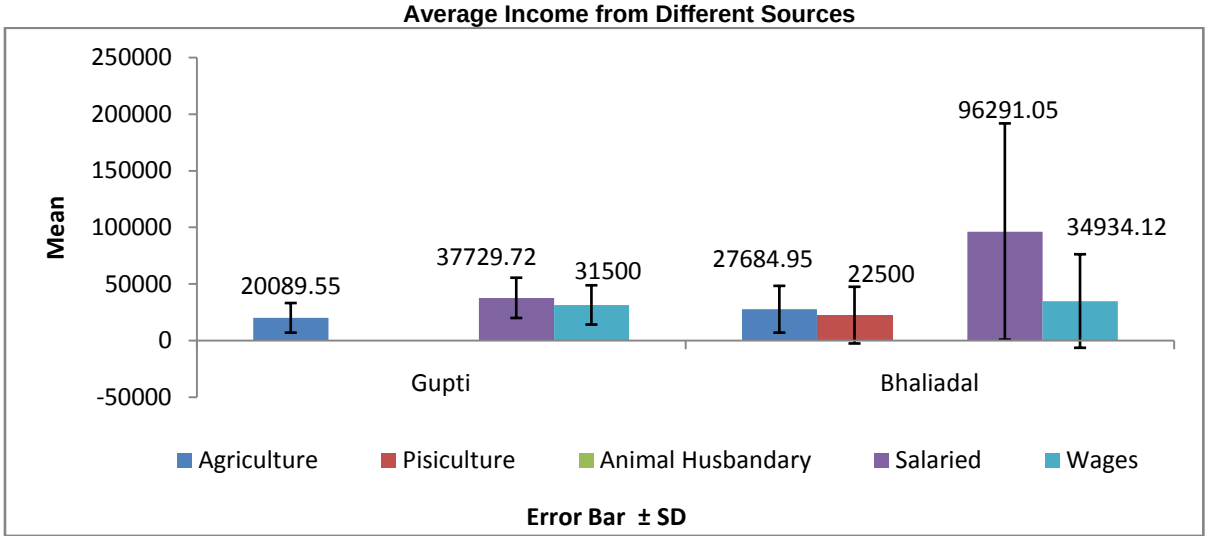
P: ISSN No. 0976-8602 RNI No. UPENG/2012/42622 VOL.-9, ISSUE-2, April 2020
E: ISSN No. 2349-9443 Asian Resonance

Table 6
Average Income from Different Sources

District	Kendrapara			Mayurbhanj		Total	
Block	Rajnagar			Thakurmunda			
Panchayat		Gupti		Bhaliadal			
Economic activities	Main Economic Activities	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD
	Agriculture	67	20089.55 ± 13070.59	93	27684.95 ± 20647.34	160	24504.37 ± 18213.08
	Fishery		*	6	22500 ± 25017.99	6	22500 ± 25017.99
	Animal Husbandry		*	*	*	*	*
	Salaried	74	37729.72 ± 17774.31	38	96291.05 ± 95432.19	112	57812.5 ± 63529.69
	Wages	10	31500.00 ± 17328.52	85	34934.12 ± 41272.07	95	34572.63 ± 39396.00

Table 6 shows average income of respondent family from different sources in both the Panchayat in a normal year. Out of 100 respondents from each Panchayat in Gupti, 67 individuals have annual average income of Rs 20, 089 from agriculture whereas in Bhaliadal Panchayat almost93 individuals are engaged in agriculture sector with an annual average income of Rs 27,684. Other than agriculture next important income activity is salaried section. In this context salary is not synonymous with the formal sector engagement, rather family member engaged in informal sector doing little odd jobs in urban setup is considered as salaried job. The jobs are highly volatile and driven by market requirement and the job doers are paid very low amount of Rs 37,729 per annum in Gupti and in Bhaliadal it is Rs 96,291 per annum. However the people of Bhaliadal are generally migrating to urban setup like Bangalore, Hyderabad and Gupti Panchayat people migrate into other urban setup in Odisha.

Figure-5
Average Income from Different Sources



The qualitative discussion does not reveal anything about the quantity of money remitted to family back home in villages by the migratory family members. Living in urban set up with such meager amount is difficult and in critical extreme climatic events how much money would have been remitted is a matter of concern. Wage income is also another economic activity in both the Panchayats. In Gupti Panchayat people are mostly engaged as agricultural wage labourer whose annual average income is Rs 31, 500 per annum where as in Bhaliadal Panchayat the annual average income is Rs 34, 934 and people are engaged in forest department activity as wage labourer.

Analysis of Table 6 shows that people of both the Panchayats are having sub-standard annual income from all the sources taken together. In case of extreme climatic events as it is happening very frequently these days, the income from agriculture gets reduced which ultimately affects the family income. This has multiple expressions in terms of reduced consumption of food, removing the children from school and pushing them to labourer market to supplement family income and also reduced care of

health by reducing medicine related expenditure. "Food shortage during formation stage leads to hunger, malnutrition, stunted growth specifically dangerous for pregnant women and children. Malnutrition affects the cognitive skill development of the children and affects different mile stone in their physical and mental growth. Landless agricultural labourers wholly dependent on agricultural wages are at the highest risk of losing their access to food".[7] Large fall in family income of agricultural labourer negatively affects the nutrition of the children. According to a study, "children exposed to floods during their first year of life presented higher levels of chronic malnutrition".[8]

Food is the single largest expenditure for poor households. Loss of livelihood, damage to productive assets due to any such extreme weather event or migration in search of income has a direct impact on household food security.[9] In regions with high climate vulnerability food insecurity and inequality increase the risk of malnutrition among children increasing the possibility of retard growth thereby disrupting the chance of growth and prosperous life in future.

Food Absorption

Change in climatic condition could lead to reduction in the nutritional quality of foods due to elevated carbon dioxide levels. Another reason of mal food absorption is reduced availability of clean drinking water and hygiene condition. Impact of food availability and accessibility is nullified by the lack of food absorption in the body. Absorption of food means digestion of food within the small intestine to provide vital nutrition to the organisms in the body. Digestion of food is a complex procedure of breakdown of large insoluble food particles in to smaller water soluble food molecules so that they can be absorbed in to watery blood plasma. For this complex procedure of food absorption, body needs clean and safe drinking water of sufficient quantity. In the face of climate change the scarcity of clean drinking water reduce the scope of food absorption by the body.

Climatic events like flood, cyclone, intrusion of sea water into water bodies of coastal area and drought have their impact on the safe drinking water availability. Water availability has great impact on the nutrients aspect in the food production as that reduces nutrient quality in fish, fruits, crops and wild food. Such changes in the quality of food crops accelerate micronutrient deficiency among population. This deficiency increases the risk of acquiring infectious disease which in turn worsens the problem of under nutrition, creating a vicious circle[10] of mal absorption of food by the body. This increases the risk of high mortality and morbidity from diarrhea. Climate change by impacting on the temperature and rainfall, affects spread of the vector borne diseases. New pattern of pests and diseases affecting human health lower the capacity of human body to absorb food. Children are found to be at greater risk when food supplies are restricted along with available clean drinking water. An alarming 51 percent of women in the age group 15-49 years are anemic whereas 45 percent of children below 5 years of age are anemic in the state.[11] "The prevalence of stunting and wasting among children less than 5 year of age are 34.1 percent and 20.4 percent respectively. "Almost 8 percent children are severely affected malnourished and 30percent children fall under Grade I-IV malnutrition. The infant mortality rate is 40 and maternal mortality rate is 237. The recommended dietary intake gap for most nutrients is more than 50 percent. Only 54.9 percent children between 6-8 months receive solid and semi solid food and breast milk and 8.9 percent children in age group 6-23 months receive an adequate diet".[12]

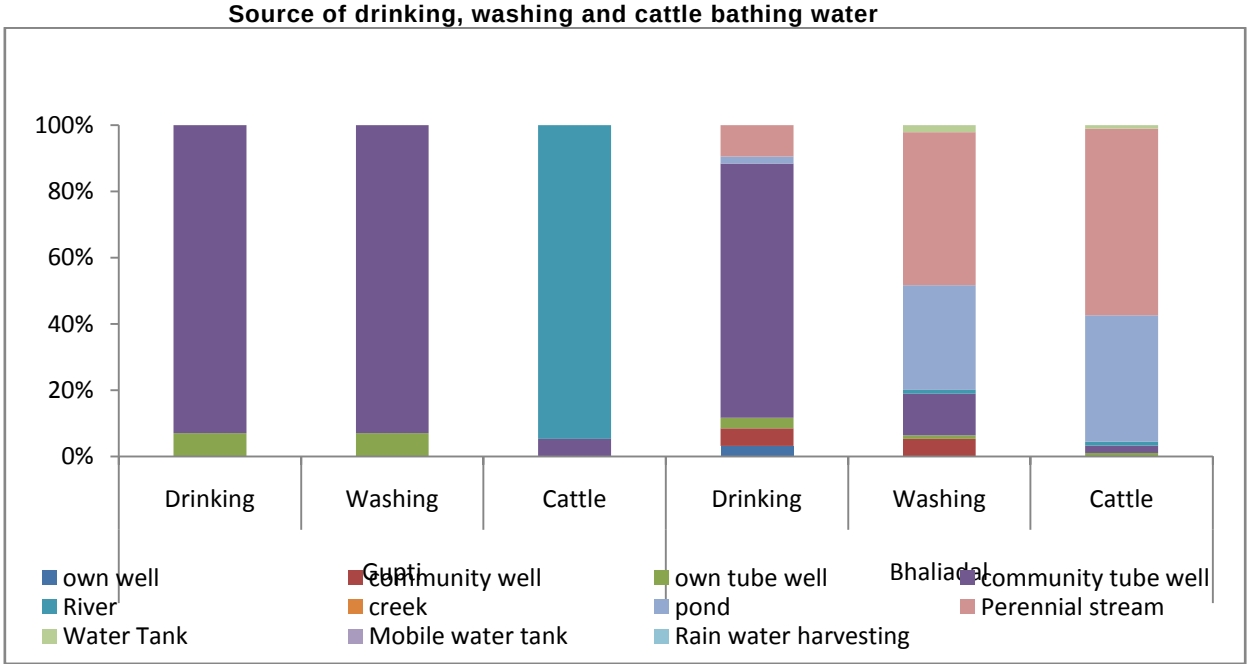
Table 7

Source of Drinking, Washing and Cattle Bathing Water

District	**Kendrapara**						**Mayurbhanj**					
Block	**Rajnagar**						**Thakurmunda**					
Panchayat		**Gupti**					**Bhaliadal**					
Source of water		**Drinking**		**Washing**		**Cattle**	**Drinking**		**Washing**		**Cattle**	
	Sources	**No.**	**percent**	**No.**	**percent**	**No.**	**percent**	**No.**	**Percent**	**No.**	**percent**	**No.**	**percent**
	Own well	0	0.0	0	0.0	0	0.0	3	3.2	0	0.0	0	0.0
	Community well	0	0.0	0	0.0	0	0.0	5	5.3	5	5.3	0	0.0
	Own tube well	7	7.1	7	7.1	0	0.0	3	3.2	1	1.1	1	1.1
	Community tube well	91	92.9	91	92.9	5	5.3	73	76.8	12	12.6	2	2.2
	River	0	0.0	0	0.0	90	94.7	0	0.0	1	1.1	1	1.1
	Creek	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Pond	0	0.0	0	0.0	0	0.0	2	2.1	30	31.6	34	38.2
	Perennial stream	0	0.0	0	0.0	0	0.0	9	9.5	44	46.3	50	56.2
	Water Tank	0	0.0	0	0.0	0	0.0	0	0.0	2	2.1	1	1.1
	Mobile water tank	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Rain water harvesting	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Total	98	100	98	100	95	100	95	100	95	100	89	100

Nutritional status of Odisha is a matter of concern from the growth perspective. Existing nutritional scenario when gets multiplied by the climatic events, this worsens the situation. It has been established by many researches that the quality of water is an important factor which helps the human body to absorb food and also helps in sustaining good health. Table 7 below shows the source of water for different household purposes in both the sample Panchayats. In Gupti Panchayat more than 90 percent people depend on the community tube well for the house hold requirement and for the need of cattle they depend on the river. While having qualitative discussion with the villagers they reveal that the underground water is becoming saline day by day due to intrusion of sea water in to fresh water aquifer which is happening because of frequent cyclonic storm and sea level rise. It is contaminating the drinking water source creating skin related diseases and kidney problem. There is no study with regard to establish relationship between contamination of drinking water source by saline water and prevalence of hypertension in this part of region but theory says salt intake increase the risk of hypertension. During climate events like flood or drought availability of water become a cause of worries for the cattle population. Flood contaminates the river water with multiple pollutant elements and drought creates scarcity of water grossly impacting on the animal health.

Figure-6
Source of drinking, washing and cattle bathing water



Tribal Panchayat Bhaliadal is increasingly becoming a water stress area due to ongoing projects of mining activities and subsequent deforestation in Mayurbhanj district. People of the sample Panchayat use multiple source of water for their various requirements. Water for drinking and cooking is collected from the community tube well by 76.8 percent of the population whereas for washing and cleaning purpose 31percent of the population depend on the pond and 46percent of the population depend on the perennial streams. Erratic rainfall and change in temperature is increasing the incidence of water stress in the region. This has strong impact on the water availability as well as on the food absorption ability of the body.

Conclusion and Recommendations

Climate change has significant impact on the quality and quantity of food production in both the Panchayats. However it has differential impact and the process of influence has been different in both the locations. In Gupti Panchayat the impact is felt due to increased frequencies of disasters that devastate agricultural field and ruin the farmers having significant impact on their income and food availability. Other than the abiotic elements that affect the agriculture due to climate change, the biotic elements like unknown pest and bugs have been attacking agricultural field is a matter of concern for the farmers in this coastal Panchayat. On the other hand in the tribal Panchayat, the rain fed agriculture is critically affected due to irregularities in the rainfall pattern. The non timber forest products that supply around 40% of food requirements of tribal people gets influenced by the change in temperature and precipitation pattern. This disturbs their food security and causes migration for different works.

The impact on the food production not only disturbs the availability of the quantity of the food but affects the confidence of the farmers on the agriculture as a livelihood option. This has resulted in forcing the small and marginal farmers to leave farming as a source of livelihood and have been migrating to different location for non-farm activities. The response of the state and non state institutions are forthcoming when there is a disaster of higher magnitude causing large number of deaths, but sometimes have a lukewarm response when people suffer from silent disasters.

In order to address the food security issues, the state needs to bring efficiency in the Public Distribution Systems (PDS) and the basket of food support needs to cover the nutritional aspects. Provisioning of pulses and oil need to be included to address the protein and the micro-nutrient needs of the body. Many countries have introduced Direct Benefit Transfer (DBT) where money is transferred to the accounts of the poor and needy people who buy their food as per the family requirements. This helps the market to generate demand and also helps the farmers of other regions to produce. This needs the attention of the policy makers so that there is availability of right combination of livelihood options, so that people are not left alone to suffer because of the climate change but also have the option to mitigate the risk with some wage employment and non-farm livelihood opportunities.

Bibliography

1. *Anderson Simon, Kaur Nanki and Ayers Jessica, Approaches To Building Climate Change Resilience in South Asia, Working Paper 2014, International Institute for Environment and Development (IIED)*
2. *Atlas of the Sustainability of Food Security, M S Swaminathan Research Foundation, World Food Programme, 2004*
3. *Attacking Poverty, World Development Report 2000/2001, 2000, Oxford University Press for World Bank*
4. *Beyond Scarcity : Power, Poverty and the Global Water Crisis, Human Development Report, 2006, Palgrave Macmillan, New York*
5. *Burton Ian, Derringer Elliot and Smith Joel, Adaptation To Climate Change : International Policy Option, Prepared for the Pew Centre on Global Climate Change, 2006*
6. *Climate Resilient Development : A Framework For Understanding And Addressing Climate Change- USAID Global Climate Change Office, 2014*
7. *Cyclone Fani Damage, Loss and Needs assessment, 2019, done by Government of Odisha in collaboration with United Nation India, Asian Development Bank and The world Bank*
8. *Das Saudamini- Economics Of Natural Disasters In Odisha, February 2016, https://www.researchgate.net/publication/301887682*
9. *District Human Development Report, Mayurbhanj, 2011, Poverty and Human Development Monitoring Agency, Planning and Coordination Department, Government of Odisha*
10. *District Statistical Hand Book, Kendrapara, 2011, Directorate of Economics and Statistics, Odisha*
11. *District Statistical Hand Book, Mayurbhanj, 2015, Directorate of Economics and Statistics, Odisha*
12. *Eco System and Human Well –being- A Report of the Conceptual Framework Working Group of Millennium Ecosystem Assessment, Island Press, 2009*
13. *Ecosystem and Human Well Being : Synthesis Report, Millennium Ecosystem Assessment, 2005, Island Press, Washington DC*
14. *Fighting climate change: Human Solidarity in a Divided World, Human Development Report 2007/2008, Palgrave Macmillan, New York*
15. *Guhathakurta, P., & Rajeevan, M. (2008). Trends in Rainfall Pattern over India. International Journal of Climatology, 28(11), 1453-1469*
16. *Hedger M and Reddy, M., Building Climate Resilience At State Level: Disaster Risk Management And Rural Livelihood in Orissa, Strengthening Climate resilience Discussion Paper 5, September 2010, Strengthening Climate Resilience Institute of Development studies, University of Sussex, UK*
17. *Khan, S.A, S. Kumar, M.Z. Husain and N. Kalra, 2009. Climate Change, Climate Variability and Indian Agriculture: Impacts Vulnerability and Adaptation Strategies. In Climate Change and Crops, 19-38. Heidelberg/Berlin: Springer*
18. *Manas Jena, Inclusive Development Of Odisha Prospect And Challenges, Auroshree Publication, Bhubaneswar, 2015*
19. *Mishra, P.K., Socio Economic Impact of Climate Change In Odisha : Issues, Challenges And Policy Options, Journal of Climate Change, Vol.3, No. 1 (2017), pp. 93-107, DOI 10.3233/ JCC-170009*
20. *Monica, D.G., Fatorelli, L., Paavola, J., Locatelli, B., Paramova, E., Nurrochmat, D.R., May, P. H, Brockhaus, M., Sari, I.M., Kusumadewi, S.D, Multi-level Governance And Power In Climate Change Policy Network, Global Environmental Change, www.elsevier.com/locate/gloevcha*
21. *Nanda Ambika Prasad & Patra Sudhakar, Climate Change, Agriculture And Environment, SSDN Publishers And Distributers, New Delhi, 2019*
22. *Odisha Climate Change Action Plan (For the Period 2018-23) Phase-II, 2018, Forest & Environment Department, Government of Odisha*
23. *Odisha Economic Survey 2017-18, Planning and Convergence Department, Government of Odisha*
24. *Paavola, Jouni and W. Neil Adger, Justice and Adaptation to Climate Change, Working Paper 23, 2002, Tyndall Center for Climate Change Research, Mimeo*
25. *Parsuraman S. and Unnikrishnan P.V., India Disaster Report towards a policy initiative, 2000, Oxford University Press*
26. *Progress Report on Implementation of Odisha Climate Change Action Plan, 2015, Climate Change Cell, Forest and Environment Department, Government of Odisha*
27. *Ramachandra Guha- How Much Should A Person Consume? Thinking Through The Environment, Hachette India, Gurgaon, 2006*
28. *Report on the State Of Food Insecurity In rural India, M S Swaminathan Research Foundation, Chennai & World Food Programme, New Delhi, 2008*
29. *Sangram, K.P.- Climate Change And Climate Induced Disasters In Odisha, Eastern India: Impact, Adaptation, And Future Policy Implication, International Journal Of Humanities*

And Social Science Invention, Volume-5 , Issue-8, August-2016, pp60-63, www.ijhssi.org

30. *Sustainability and Equity: A Better Future for All, Human Development Report 2011, Palgrave Macmillan, New York*

Endnotes

1. *Economics of Natural Disasters in Odisha- Saudamini Das*
2. *State Disaster Management Plan, June 2017, OSDMA, Government of Odisha*
3. *District Human Development Report Mayurbhanj, 2011, Planning and Coordination Department Government of Odisha*
4. *Climate change and food security in India- Malancha Chakrabarty, Observer Research Foundation, 9th September 2016 https://www.orfonline.org/research/climate-change-and-food-security-in-india/*
5. *Chi-square test evaluates two categorical variables are related in any way. This evaluates whether there is any significant association between two variables.*
6. *Nira Ramachandran, Persisting Undernutrition in India: Causes, Consequences and Possible Solutions (New Delhi: Springer, 2014)*
7. *Josef Schmidhuber and Francesco N. Tubiello, "Global food security under climate change", Proceedings of the National Academy of Sciences, 104(2007): 19703, http://www.pnas.org/content/104/50/19703.full.pdf*
8. *Rodriguez-Llanes et al., "Child malnutrition and recurrent flooding in rural eastern India: A community-based Survey",* BMJ Open*, 1(2011), http://bmjopen.bmj.com/content/1/2/e000109*
9. *Cecilia Tacoli et al., "Urban poverty, food security and climate change", Working Paper 37. International Institute for Environment and Development, London, 2013. http://pubs.iied.org/10623IIED.html*
10. *Samuel S. Myers et al., "Rising CO2 threatens human nutrition", Nature, 510 (2014): 139, http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4810679/*
11. *Malnutrition Still a Top Death Tool in Odisha- Sanjeev Kumar Patro, the Pioneer, 18th November 2017.*
12. *Coalition Food & Nutrition Security- http://www.nutritioncoalition.org.in/state-chapters/odisha/*