

## **Vulnerability to Climate Induced Natural Disasters with Special Emphasis on Coping Strategies of the Rural Poor in Coastal Orissa, India<sup>1</sup>**

*B. C. Roy, Mruthyunjaya, and S. Selvarajan\**

### **ABSTRACT**

Climate induced natural disasters (CINDs) like drought, flood and cyclone have become serious problems to Orissa. CINDs are of regular occurrence particularly in coastal Orissa and have become the part of normal life. The poor people are the worst affected. In most years, adjustment in household activities combined with relief works provides the minimal succors (employment, food, etc). However, occasionally the situation gets worsen like the case in coastal Orissa since late 1990s. The farmers and fishermen who are the traditional food producers living in such fragile environments become ecologically, geographically and economically marginalized. However, over time they have evolved certain coping mechanisms and adaptive strategies to reduce drought, flood and cyclone vulnerability.

This communication focuses on coping strategies of the poor to drought, flood and cyclone vulnerability in coastal Orissa. The vulnerability towards all these three extreme events and the rural household's coping strategies are discussed. Rural people's perception and attitudes about natural disasters are also reported. For the study, a simple random sample was adopted and interviews were carried out through questionnaire. From the study a picture of coping responses was built up.

The common perception of rural households in the study area is that climate has changed for the worse with increased frequency as well as intensity of CIND events in recent years. Although the warning system was also developed and found to be timely and largely accurate, the rainfall forecasting in drought years were misleading. Further, the cyclone warning was ignored by the rural households which resulted in higher causality than expected. As with most other warning systems, there appears to be a missing link between the warning signals and follow up action.

A classical pattern of sequential and/or simultaneous quick responses was seen, building up from minor adjustments, such as diet changes or increased reliance on off-farm income sources, to the disposal of assets, notably land and cattle to a major shift such as out-migration. The study has found out that 94% of the selected sample households have adopted one or the other strategies and mechanisms to address drought, flood, and cyclone vulnerability. These coping mechanisms reported to vary over time on the basis of nature of extreme events. Results suggest that households seek access to a secured source of income that provides basic food and income for the household when agricultural production fails. The favoured strategies are mainly seeking wage earning locally. Only a small percentage of households have access to such favoured activities and many households, therefore, resort to out-migration for daily wages. Out migration in search of non-farm income was critical. Those who cannot migrate and does not find adequate employment locally attempt for a multitude of activities that complement each other in securing food or income for the household. Most of these activities are informal and include activities such as catching fish and turtles from the river, collection of forest products, local handicrafts, and even assistance from close relatives. However, the study concludes that the poor have become active agents and victims to such vulnerability, because of various internal and external factors imposed upon them. But government relief was vital. In spite of inefficiency and also corruption in the distribution system, relief in terms of food, medicine, housing and cyclone shelters saved many poor from further suffering. Majority of the respondents felt that the relief operations were just in time, but inadequate and short-lived. The paper concludes that the various coping mechanisms, particularly out-migration, modifying household consumption, social co-operation and government relief and rehabilitation programmes help the poor people to reduce the risk of CIND vulnerability. However, there is an urgent need for shift in focus from food aid to long-term mitigation measures such as drought proofing, development of resistant cultivars (against drought, flood and salinity), infrastructural development in terms of road and irrigation, and generating off-farm employment opportunities.

---

<sup>1</sup> Paper prepared for the UNFCCC COP8 Conference organised by the Government of India, United Nations Environment Programmes, and FICCI during October 23-November 1, 2002, Vigyan Bhavan, New Delhi, India

\* Scientist, Director, and Principal Scientist, National Centre for Agricultural Economics and Policy Research (ICAR), Library Avenue, Pusa, New Delhi-110 012

## 1. Introduction

Orissa has been reeling under contrasting extreme weather conditions. Climate induced natural disasters (CIND) like droughts, floods, and cyclones have been visiting the state with regularity. In the last four years, calamities have claimed more than 30,000 lives mostly from coastal belt. Agricultural lands have become fallow and this has led to widespread malnutrition and even starvation deaths in some parts of the state. Further, this is one of the poorest states in India where more than two third of the population are below poverty line. The poverty has made the vulnerable segment of the population still more vulnerable to the consequences of natural disaster, specially for those living in high risk coastal areas. The farmers and fishermen who are the traditional food producers living in such fragile environment are ecologically, geographically and economically marginalized. However, people living under such fragile risky environment, where natural disasters become a part of life have developed certain coping mechanisms and adaptive strategies over time to reduce drought, flood and cyclone vulnerability.

There are few literatures on coping mechanisms for dealing with mainly drought vulnerability in India (Jodha and Mascarenhas, 1989; Chen, 1991; Cynthia, 2002). However, these experiences are from arid and semi-arid region which are very different from coastal ecosystems. The broad objective of present study was to document the existing adaptive mechanisms in coastal ecosystem which are prone to drought, flood and cyclone. This communication specifically attempts to answer the following questions:

- i) How do poor people perceive and cope with CIND?
- ii) Do the coping strategies of the poor reduce CIND vulnerability?

The possibilities for any large-scale adaptation programmes by governments are also few because of resource scarcity and immediate poverty and development problems that this state already faces. Therefore, efforts by those who feel the impacts of climatic changes, such as farmer households, are crucial in ameliorating potential adverse impacts of climatic changes. The paper also gives some suggestions that can be used to reduce CIND vulnerability.

## 2. Methodology

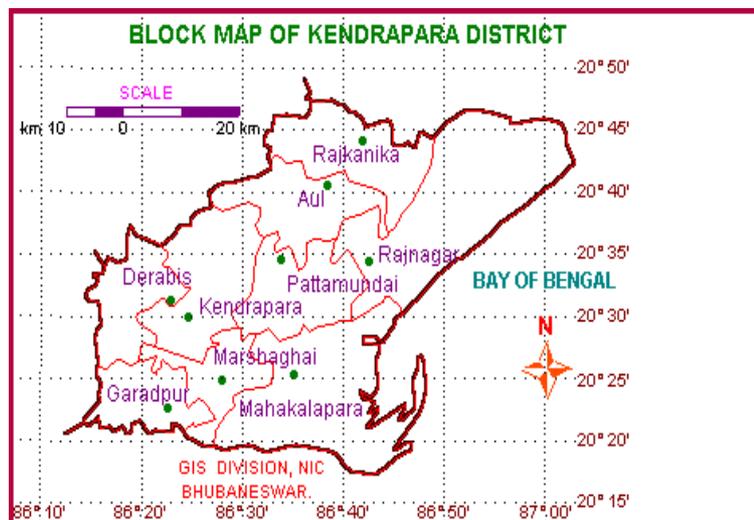
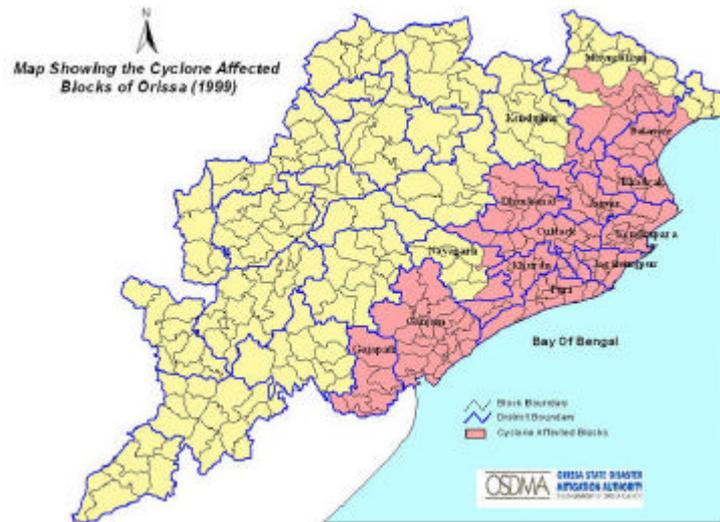
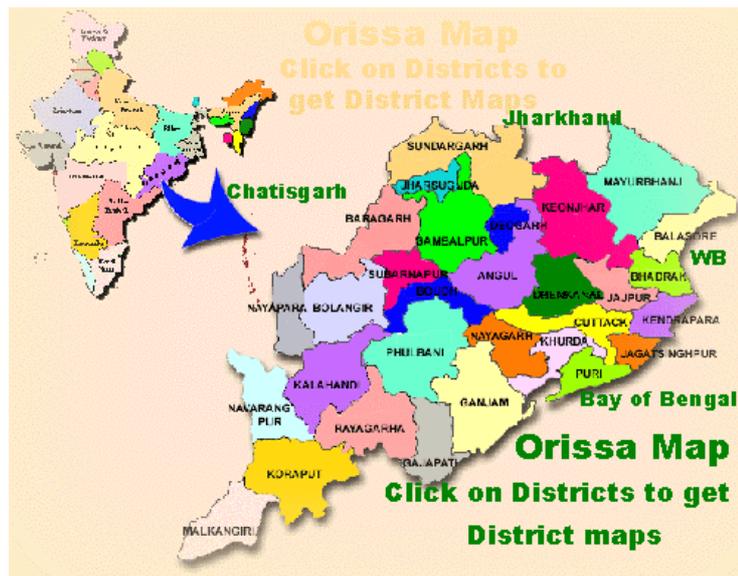
### *Study area*

Keeping in view the objective of this field study, basic information on how households and rural communities respond to CINDs are gathered. The coping strategies, rural households use in responding to various CIND events, are being assessed through household survey in Kendrapara district of Orissa. Kendrapara district, forming a part of coastal Orissa, is characterized by fragile environment, prone to flood and cyclone, low and highly variable rainfall, high water deficiency, frequent rainfall failure, and of late also emerging as a drought prone district (Info Change, 2002; Down to Earth, 2001). The area is intersected by a network of river and creeks with Bay of Bengal on the eastern side making it flood prone. This is also one of the worst cyclone affected districts in Orissa. With 1.3 million populations, the district is home to more than 1.5 lakh rural families living below the poverty line.

### *Sampling design and analytical tool*

Four sample villages (Jambu and Mangalpur from Mahakalpara block and Gupti and Sanwara from Rajnagar block) were selected randomly. The two blocks Mahakalpara and Rajnagar were purposively chosen because of their proximity to sea and high degree of vulnerability to CINDs. These two blocks practically lie on the delta and floodplain of the four major rivers Brahmani, Baitarani, Dhubri and Salandi and hence are influenced by sea level rise. Both the blocks are vulnerable to a number of natural hazards, but most particularly flooding both from the rivers and storm surges (cyclone) in the

**Fig. 1 Maps of the study area**



Bay of Bengal. Of late droughts have also become regular phenomena as experienced during both 2000 and 2002.

The farmers, fishermen, landless labourers, persons involved in marketing as well as field level development and extension officials were interviewed for the study. The questionnaire covered coping mechanisms to reduce CIND vulnerability, its effectiveness and suggestions for improvement. Information regarding household activities during normal and calamity years were also collected from the households. Since simple and unstructured questions, supplemented by group interviews and discussions, has the ability to provide more insight in surveys conducted on subsistence farming (Jodha and Mascarenhas, 1985), data from group interviews as well as from household interviews were collected during the farming season (August-September, 2002). A total of 200 households were selected randomly, 50 each from four different locations. Simple statistical methods for tabulation and analyses were used.

### **3. Natural disasters in Orissa- magnitude, coverage, and people's perception**

A deadly cocktail of floods, cyclones and droughts has made Orissa the disaster capital of India. On the last 100 years, the state has been disaster affected for 90 years; floods have occurred for 49 years, droughts for 30 and cyclones have hit the state for 11 years. Since 1965, calamities are not only becoming more frequent but striking areas that never had a vulnerability record (Down to Earth, 2001). The sources for high volatility in agriculture growth in Orissa are three fold. Low irrigation coverage, an erratic climate and a very high degree of dependence on rice, which occupies 93.5% of the foodgrains area. Climatic variability in Orissa during the last three decades has shown deviations in rainfall of 20% or more every third year.

*Droughts:* Drought has been revisiting many parts of the state with an alarming regularity. For example, out of the last 100 years, the state has been severely drought affected for 30 years. Since, 1965 there is not a single year when the state has not experienced drought in one or another part. But it is not only the recurrence, but also the drought is striking areas that never were drought prone like Kendrapara (the study area) and Sundergarh district. During 1950s, only three districts namely Kalahandi, Balangir and Koraput were drought affected. By 1980s, the entire western Orissa was drought affected and by 1990s, entire southern and coastal Orissa were engulfed by drought (Down to Earth, 2001).

*Floods:* Floods are also a regular feature of coastal Orissa where the network of rivers inundate large parts of its catchment areas, uprooting houses, disrupting livelihoods and damaging infrastructure. The flood hazard is compounded by the problems of sediment deposition, drainage congestion and synchronisation of river floods with storm surges in the coastal plains. Between 1961 and 2000, the frequency of floods has increased in Orissa. Between 1834 and 1926 the state experienced flood once in four year; which rose to once in two year after 1926. The state experienced nine bouts of flood within a span of just 15 days in 2001, an all time high, damaging 2.12 million hectares of standing crops. The 2001 flood submerged as many as 25 (out of 30) districts of Orissa many of which were never witnessed a flood before. It even inundated hilly areas like Kalahandi and Phulbani.

*Cyclones:* The entire east coast of Orissa along the Bay of Bengal is vulnerable to cyclone-related hazards of varying frequency and intensity. On an average, about five to six tropical cyclones form in the Bay of Bengal every year, of which two to three may be severe. Cyclones are most deadly when crossing the coastal areas of Kendrapara, Jagatsinghpur, Puri, Khurda and Ganjam districts of Orissa, mainly because of the serious storm surge problem in this area. The impact of these cyclones is confined to the coastal districts, the maximum destruction being within 100 km from the centre of the cyclones and on either side of the storm track. The worst devastation takes place when and where the peak surge occurs at the time of the high tide. In last 100 years, 13 cyclones with rising frequency have hit the east coast. The Orissa super cyclone in October 1999 left the state virtually paralysed with communication and infrastructure totally wrecked. The cyclone severely affected around 13 million people in 12 districts. Sea waves reaching 7 metres rushed 15 kms inland. Ten thousand

people died, and one-third of the total population of the state was affected. It had spread to places like Bhubaneswar and Nayagarh that were never known to be cyclone prone. Human casualties were mostly in two districts Jagatsingpur and Kendrapara. The loss of animal lives was also very high with 6.32 lakh animals and 18.83 lakh poultry perishing. A total of 17.33 lakh hectares of agricultural land were affected. As many as 16.50 lakh houses were damaged of which 0.23 lakh were washed away, 7.46 lakh fully collapsed and 8.80 lakh were partly damaged.

**Table 1. Increasing incidence of natural calamities in Orissa**

<i>Drought</i>		<i>Flood</i>		<i>Cyclone</i>	<i>Hailstorm, Whirlwind, Tornado</i>	<i>Whirlwind, Tornado</i>
<b>1965</b>	1984	<i>1967</i>	<b>1980</b>	<i>1967</i>	1978	<i>1981</i>
1966	<b>1987</b>	<i>1968</i>	1981	<i>1968</i>		
<i>1972</i>	1992	<i>1969</i>	<b>1982</b>	<u><i>1971</i></u>		
<b>1974</b>	<u>1996</u>	<i>1970</i>	<u>1985</u>	<i>1982</i>		
<b>1976</b>	1998	<u>1971</u>	<u>1990</u>	<b>1999</b>		
<b>1979</b>	<b>2000</b>	<i>1972</i>	<i>1992</i>			
1980	<u>2002</u>	<i>1973</i>	<u>1994</u>			
<i>1981</i>		<u>1974</u>	1995			
<b>1982</b>		<b>1975</b>	<b>2001</b>			
		<i>1977</i>				

Note: Bold letter represents severe incidence of drought/flood/cyclone during that year; Italic letter represents the occurrence of more than one natural calamity during that year. Underlined letter represents deviations in rainfall of 20% or more than the normal (Source: Selvarajan et al, 2002). Also refer Appendix II for more details.

### **Rural people's perception about extreme events**

Rural people's perceptions to natural disasters/extreme events are important because they represent the first step towards planning a rational coping strategy to reduce such vulnerability. The perception of natural disaster is very complex and varies enormously over both space and time. However, two perceptions were identified to be significant from the field survey. Those are the ends and means of disaster. Perceptions relating to end consider natural disasters as extreme variation in climatic conditions that result in damage to livelihood. Whereas the perceptions relating to means of natural disasters identify with the beginning, on where end and severity of extreme events. For example, in the study area most of the informants perceived drought as decrease in rainfall. Their perception involves timing of the arrival of the rains and the amount received. This perception is supported by some indigenous methods of predicting drought e.g. delay in arriving time, long dry spell, water scarcity, etc.

As seen from Table 2, more than 90% of the respondents felt that both the frequency and intensity of droughts have increased in recent years in the study area which was almost drought free till late 1980s. However, though the study area had faced moderate droughts in past but the drought during 2000 and 2002 are the worst in the memory of the people. Though 57% of the respondents felt increased incidence of flood, but majority of them are of the opinion that the intensity has reduced significantly mainly because of construction of upstream dams and embankments. Contrary to media reports and claims by some international agencies, nearly three fourth of the respondents did not support the contention that the frequency of cyclone has increased significantly in recent years. This revelation came in spite of experiencing the 1999 super cyclone which washed away almost the entire coastal Orissa. For the village households who have learnt to live with natural disasters, it is intensity rather frequency which has increased in the recent past.

However, a large part of the respondent households in the study area who are getting used to all types of CIND events felt that climate has changed for the worse. More than 95% of respondents felt decline in rainfall while 86% of respondents felt that not only there has been a secular decline in the quantity of rainfall but also the pattern of rainfall has become erratic.

**Table 2: Peoples' perception about recent trends in CINDs**

(% of respondents)

Frequency/Events	Increased	No Change	Decrease	
Drought	Frequency	92	6	2
	Intensity	90	7	3
Flood	Frequency	57	23	20
	Intensity	17	48	35
Cyclone	Frequency	26	56	18
	Intensity	54	39	7

#### 4. Preparedness and coping mechanisms to reduce CIND vulnerability

Coping strategies had been defined by Davies, (1993) as individual or community responses to change in environmental conditions, or responses to its consequences such as responses to declining food availability. Coping strategies is a short-term response in securing livelihood system to periodic stress. Where as the term adaptive strategies means the way in which individuals, households and communities have changed their mix of productive activities, and modified their community rules and institutions over the long term in response to economic or environmental shocks or stresses, in order to meet the livelihood needs. The characteristics of the adaptive and coping mechanisms are given below Table 3.

**Table 3. Characteristics of coping and adaptive strategies**

Characteristics	Coping mechanisms	Adaptive strategies
Time dimension	Short-term	Long-term
Cause	Locally or externally induced	Locally or externally induced
Space	Acting within the prevailing rule system	Change the rule systems, or moral economy
Efficiency	Efficient in short terms	Efficient in long term
Nature	Socio-economic in nature	Socio-economic and environmentally responsive. Interactive and dynamic
Resilience	Reversible in short term	Can be sustainable one. Difficult resilience

Source: IISD1993

#### Preparedness

Preparedness is seen as a means by which the anticipated adverse effects of extreme events can be reduced and new opportunities seized. While preparedness represents an 'advance' action based on past experiences and anticipated outcomes, coping strategies represent actual measures to adjust once the event occurred. However, both the terms are vaguely defined and sometimes overlapping.

**Table 4. Preparedness against CIND events**

Strategy	Percentage of household adopting these strategies
<b>Individual/group preparedness</b>	
Diversifying income sources	
a. Livestock rearing	72
b. Wage earning along with farming	66
c. Rope making etc	13

d. Small business	11	
Using resistant crop varieties	68	
Risk minimizing strategies		
a. Crop insurance	07	
b. Share-cropping	28	
Seeking institutional support		
a. BPL listing	54	
b. Demanding relief	Various social and political groups	
Building up stocks and inventories	78	
Collective action		
a. Raising high bunds	44	
b. Joint cultivation	19	
<b><i>Institutional preparedness</i></b>	<b><i>Officials response</i></b>	<b><i>Community perception</i></b>
Construction of cyclone shelter	Adequate	Need more
Construction of village grain bank	On-going	Slow progress
Construction of embankments	Adequate	Very poor
Disaster awareness campaign	Adequate	Poor
Disaster awareness system	Very efficient	Good
Ready rescue team	Efficient	Not so efficient
Rescue infrastructure (Boat etc)	Adequate	Poor

### ***Individual/group preparedness***

The possibilities for any large-scale adaptation programmes by governments are few because of resource scarcity and immediate poverty and development problems that this state already faces. Therefore, efforts by those who feel the impacts of climatic changes, such as farmer households, are crucial in ameliorating potential adverse impacts of climatic changes. Few important measures undertaken by the rural community are listed in Table 4.

*Diversifying income sources:* Women from marginal farm households as well as landless agricultural labourer group engage themselves with multiple activities like back yard poultry, duckery, small animal rearing, rope making, mat weaving, and part time non-farm jobs. Besides meeting family consumption, these activities also earn some cash income. This is an important way of countering vulnerability. As regards primary and secondary occupations, more than 62% respondents stated more than one occupation.

*Building up stocks and inventories:* Building up stocks and inventories so as to meet future hardship during calamity period is a common practice. Since CIND disasters are regular phenomenon, rural households normally prepare for the expected eventualities. Many farmers store surplus foodgrains. A few also purchase the same when prices are low and store for future. However, the landless daily labours are unable to generate or procure surpluses.

*Risk minimizing:* Sharecropping is one such means which reduces risk for both the landowner and the tenant and thus extensively followed in the study area. Though the underlying objectives for entering into sharecropping are different than managing disaster impacts, it also serves well during calamity. It allows the households to make better use of their specific resource base: labour by the tenants and cash inputs by the landlords. Crop insurance though an important risk management strategy, is practiced by a small number of households, mostly by the large farmers or those who have the ability to pay the premiums.

*Seeking institutional support:* As various CIND events gripped coastal Orissa with alarming regularity, people had to jostle to get some work under relief operations. There are evidences of rural households demanding relief as a moral right. Direct public pressure by CIND affected people in Orissa is quite visible for relief and for inclusion of their name in the BPL (below poverty line) list. Since, in many instances BPL list was the basis for allotting cash relief under Indira Awas Yojana

(IAY), the village households particularly educated youths from forward communities are aware of this benefit and took advantage accordingly. On the other hand, relief operations, particularly employment programmes, were also the focus for a great deal of radical political activity among the backward community. With the assurance of anonymity even some government official pointed out that the radical political agitations and media coverage forced the government to start relief operation quickly and continued for a longer period.

### ***Institutional preparedness:***

Cyclone shelters in this area, constructed by Orissa government as well as by various national and international organizations, played an undeniable role in averting large number of human deaths during 1999 super cyclone in the study area. Since the 1971 cyclone claimed more than 7000 human lives in these districts construction of large number of cyclone shelters received priority attention. Accordingly a large number of cyclone shelters were built with the help from various organizations mainly International Red Cross Society. This may be one reason that the number of cyclone death in 1999 was much lower in Kendrapara as compared to Jagatsinghpur district both of whom were equally hit. Construction of cyclone shelter got another momentum in recent years mainly by the Orissa State Disaster Management Authority (OSDMA) which came into existence after the catastrophic 1999 super cyclone with an objective to have an autonomous body exclusively devoted to disaster management, to promote a culture of preparedness for different types of disasters and also for coordinating disaster mitigation activities including restoration and strengthening of infrastructure. It works in close coordination with various government and non-government bodies, village communities, national and international donor agencies, and various institutions engaged in disaster management. The presence of OSDMA was visible in the study area and the rural households were also found to be quite aware of this organization. Besides constructing cyclone shelters, OSDMA has also organised several disaster awareness campaigns in the study area.

Orissa government, with active support from the World Food Programme, has lunched a scheme to construct one grain storage in each of the 'Gram Panchayat' in order to make food available locally during natural disasters. This scheme is still ongoing and many such storage units have already come up in the study area.

Government has also constructed long embankments under various rural employment generation programmes in order to prevent flood and saline water which could cause damage to both the standing crops as well as farm lands.

The state is also having an institutional disaster warning system which was found to be timely and largely accurate. However, due to obvious reasons the response regarding efficiency and adequacy of various institutional measures were different between the officials and the households. Though it is not possible to satisfy everyone, still scopes for improvements are ample.

### **Coping strategies**

Various coping mechanisms and adaptive strategies have been adopted by the rural households in the study area to reduce the impact of CIND events. Some of them are individual measures, while others are community based requiring group action. The coping mechanisms can be visualized as a network to maximize utility of resources from both livestock keeping and agriculture. The adopted strategies and coping mechanisms depended on households' perception on extreme events and the problem associated with it. The problems included crop failure, concomitant decline in income and employment opportunities, low yields, escalation of food prices, hunger and malnutrition, decrease in grazing land and fodder availability, and loss of properties and life. However, the coping mechanisms vary according to the nature of extreme events. Accordingly, the strategies practiced to reduce CIND vulnerability are classified into four groups namely common strategies for any extreme events in general, specific strategies to reduce drought, flood, and cyclone impacts.

**Table 5. Coping strategies during calamity year in the study area**

Sl No	Strategy	Percentage of respondents following these strategies			
		Common	Drought	Flood	Cyclone
1.	Adjustment in crop practices				
	a. Late (early) sowing of crops	NA	74	30	NA
	b. Use resistant crop variety	NA	63	42	NA
2.	Adjustment in livestock management				
	a. Changing livestock composition	60	-	-	-
	b. De-stocking of animals	19	-	-	-
3.	Water management				
	a. Soil moisture control	-	24	NA	NA
	b. Traditional water harvesting	-	17	NA	NA
4	Seeking alternate employment				
	a. In relief works	37	-	-	-
	b. Within same locality	52	-	-	-
	c. Migration	22	-	-	-
5	Drawing down inventories				
	a. Stored foodgrains	56	-	-	-
	b. Sale of cattle	17	-	-	-
	c. Sale or mortgage of land	22	-	-	-
	d. Sale of other assets	08	-	-	-
6	Reduced expenditures towards				
	a. Food consumption	77	-	-	-
	b. Clothes & festivals	82	-	-	-
	c. Education etc	60	-	-	-
7	Co-operation/collective action				
	a. Raising high bunds/embankments	-	NA	44	NA
	b. Joint cultivation of common land	19	NA	-	NA
	c. Helping neighbour in reconstruction	11	-	-	-
8.	Drawing upon common property resources				
	a. Fish/turtle catching	27	-	-	-
	b. Fuel wood collection	32	-	-	-
9	Other strategies				
	a. Cases of non-payment of dues	11	-	-	-
	b. Postponed family festivals	07	-	-	-
	c. Borrowing	22	-	-	-

### Common strategies to reduce CIND vulnerability

#### *1. Reducing consumptions and social obligations*

A large number of respondents (77%), mainly the marginal farmers and daily labourers, drastically cut food intake during calamity year. Further their preparedness to consume inferior diet helps match the demand with restricted supply situation. Diet during calamity year mainly consists of relief food and some additional rice. This is insufficient in terms of vitamin, protein, and minerals. However, around 40-45% of the households could add fish to their daily menu. The survey reveals that consumption expenditures of sample households during calamity years declined by 5 to 38 percent (Appendix II). The magnitude of decline is highest for expenditures towards family festivals followed by food, education and medical expenses.

The need for cash, particularly to buy food and other basic necessities, as well as to pay medical bills and school fees, strongly influences the choice of wage earning activities undertaken by the households. Children are also being used by their families as a source of income during calamity years. This is particularly disturbing where girl children are being withdrawn from school and engaged as daily labour.

## ***II. Livestock keeping***

The other complementary side of household strategies to reduce CIND vulnerability related to livestock keeping. These strategies aimed at coping with mainly drought and flood.

*Livestock composition:* A shift from cattle and /or sheep rearing to goat and/or buffalo has been observed in recent years. Goat and buffalo were considered to be hardy as compared to sheep and cattle, respectively. Goats are non-selective animals, can survive on any type of feed/fodder/food, and the buffalos are highly tolerant to the extreme environments. In the past, farmers/households used to concentrate on one type of animals mainly milch cow and bullocks. Now about 60% of the respondents argue that this strategy no longer exists. They have changed towards keeping more than one type of animals. This is necessary because it gives a cushion to compensate losses during severe droughts or floods, as different animals respond differently to the various environmental stress conditions.

*De-stocking of animals:* During or after any calamity, de-stocking of animals is an important strategy followed by nearly a little less than 20% households. This includes mainly sale of milch animals. Selling of animals is mainly due to fodder scarcity and to avoid losses through death as well as in order to earn some cash income for the households. The distress selling price of cattles during calamity year was 25-30% less than the normal price but this was not as severe as reported in some earlier studies where the selling price was only 25 to 40 percent of the normal year price (Pratap Narain, 2001).

## ***III. Migration***

People in this region actively look for alternate employment opportunities during and/or after any extreme event. Opportunity to earn cash within the same locality through daily labour gets dwindled particularly during cyclone and flood years when traditional employers and larger farmers were also affected. Noticeable migration patterns to urban centers and nearby towns in search of employment are emerging. Around 22 percent of rural households were resorted to seasonal out-migration in search of job or wage earning.

## ***IV. Drawing down inventories***

It was already discussed in the previous section that a large number of rural households do build up stocks and inventories so as to meet future hardship. Therefore, drawing upon inventories mainly foodgrains is a well known coping strategy. However, the landless daily labourers who are unable to build stocks during normal years resort to sale or mortgage of family assets including residential plots and cattle. The 1999 super cyclone virtually destroyed the village economy of this coastal area. After this, a large number of households (17%) all of whom were either landless labourer or marginal farmers lost a substantial part of their assets (cattle & land) to feed their family.

## ***V. Drawing upon common property resources***

Rivers, creeks, village ponds, and mangrove forests are some common property resources that benefit rural poor during calamity period. Though collection of fuel wood from the forest or catching fish/turtles in the rivers and creeks are banned due to environmental reasons, poor households normally defy such restriction during extreme hardships. Around 29% of the respondents who are very poor revealed that they are forced to defy such bans. However, most of them do this illegally, a fact which they do not want to divulge to anybody.

## ***VI. Rural co-operation and collective action***

Traditional forms of rural co-operation among the villagers helped in managing CIND events. In one village, Sanwara, the village youths collectively decided to cultivate common lands once the floodwater receded and distributed the harvests among flood affected poor. In another village, Gupti, neighbours came forward in rebuilding cyclone affected dwelling units of the poor households in the village.

## ***VII. Other minor strategies***

Drawing upon social relationships, mainly taking help from close relatives and neighbours; borrowing; non payment of dues; postponement of marriage; leasing out coconut trees; and harvest of premature crops before flood are few other strategies practiced by some households.

### **Strategies to reduce drought vulnerability**

Most of Orissa's coastal regions are under paddy cultivation, which is sensitive to inundation and salinization. The traditional producers in order to reduce the risk of rainfall failure and to ensure some agricultural yields adopt these strategies.

#### ***I. Adjustment in crop practices***

*Late sowing:* In a normal year the farmers usually start seedbed preparation for rice in May and June before the first bout of rain. However, in a drought year they opt for delayed transplantation. The reasons behind this strategy as stated by the respondents were to take benefit from delayed rains. Further, through experiences farmers have become aware of the variable nature of rains. In Orissa, the long dry spell mainly during July causes the havoc. Therefore instead of keeping the land fallow they transplant the land with late shown rice cultivars during August. Late shown crops succeed and mature on time and give better yield than timely sown cultivars if water stress appears. Hence the farmers often change from cultivation of Chandrika or Sila 1018 (early maturing rice variety) to Swarna (late maturing rice variety). Accordingly, they avoid the risk of long dry spell that occurs frequently after the first bout of rain in June. However, the degree of success of late sowing strategy depends on the continuity of rainfall. If the second bout of rain is also very low and followed by another dry spell then the crop is bound to fail.

#### ***II. Water management***

Due to fluctuation and uncertainty of rainfall, and its uneven distribution over time and space, more than 20% respondents argued that they provide irrigation only during critical growth stages of the crop. Farmers improved soil moisture through providing pumped irrigation. Harvesting runoff water is an age-old practice in the study area. Since decades village households combat droughts with traditional ponds built either personally or with community participation. These ponds store runoff water which is used as a source of irrigation during the dry months. So a minor failure of rainfall or a short dry spell is addressed. These ponds have another important use. Besides for bathing, these ponds are also used for fishing and duckery which gives some alternate income and food to the village households.

### **Strategies to reduce flood vulnerability**

#### ***I. Adjustment in crop practices***

*Early sowing:* In flood prone areas the farmers normally go for early sowing. The objective is to have a sufficient time to mature the crop if the flood/cyclone arrives during October or beyond. Generally this strategy to reduce flood vulnerability is essential for good germination and good yields. This strategy is practiced by 30% of the respondents. However, a large number of respondents argued that

the early sowing could fail because of long dry spell, which the newly germinated crop species cannot tolerate. Therefore, use of flood resistant varieties was preferred over early sowing.

## ***II. Raising high bunds/embankments***

The coastal villages are prone to flooding with saline water. Therefore raising high bunds or saline embankments protect agricultural fields, ponds, and residential dwelling units from flooding, and therefore is an important strategy against flood and also tidal wave. The village community themselves or as sponsored by the food for work programme built long chain of embankment. However, such embankments are effective only against low intensity floods and tidal waves. But when the floods become fiercer, these embankments fail to control floods.

### **Strategies to reduce cyclone vulnerability**

Virtually there are no specific strategies adopted by the villagers to cope with cyclone vulnerability. The reason being that unlike drought and flood, cyclone does not follow any rule. Moreover, its frequency is much lower than drought and flood and once occurs, it becomes a catastrophe. However, strategies like mortgage and sale of assets, drastically reducing consumption, out-migration in search of job, and demanding relief are more intensive during cyclone as compared to drought or floods.

### **5. Some reflections on coping mechanisms**

1. The coping mechanisms reflect the awareness of the local people of their surrounding environment. However, some of these mechanisms like shrimp cultivation, fuel wood collection, fishing and turtle catching in the reserved territory become a strong agent of environmental degradation. This is not due to ignorance of the local people, but on account of needs and necessity.
2. The worst affected and vulnerable are the poor and marginalized sections of the society. Not only they are worst hit, but also their capacity to recover from a disaster is very low. Any extreme situation traps the poor in a situation to sell off productive assets that become difficult to retrieve and thereby reinforcing the poverty almost permanently. Majority of the residents in the study area have sustained damage to personal dwellings and loss of their personal effects. In some areas, inhabitants have lost all their assets, access to livelihood and services (cultivable lands, cattles, etc) or a combination of one or the other. Large farmers and households with some assured off-farm income could retrieve some of the lost assets. However, the poor, mainly landless labourers and marginal farmers were unable to buy back their assets even during normal years.
3. Although the warning system was timely and largely accurate, the rainfall forecasting in drought years were misleading. Further, the cyclone warning was ignored by the rural households which resulted in higher causality than expected. As with most other warning system, there appears to be a missing link between the warning signals and follow up action. The centralized warning system through radio and television tend to be distrusted and excuses for non-action can always be found. Early warning systems are most effective if based on a decentralized local level network, where decision makers are close to the problem and the people affected. They are most credible if they are transparent, accountable and accurate.
4. The sources for high instability in agriculture in the study area are three fold. Low irrigation coverage, an erratic climate and a very high degree of dependence on rice, which occupies more than 90% of the foodgrains area.
5. Government relief is vital in the study area and was visible. However, the effective presence of relief works does not obscure several weaknesses in the government relief system. It emerged from the discussions and household interview that there are severe flaws in the relief

operations. Reliefs are not targeted. More than 20% of the respondents smelt corruption in relief operations favouring rich and influential section and rest of the 80% reported equal distribution of relief materials among the villagers irrespective of income or need. The coverage of relief works and the extent of employment generated also do not often meet the demands, specially during cyclone and severe droughts. Though it may be satisfy everyone, but scope for improvement exists.

## **6. Conclusion**

Recurring drought, floods, and cyclones in the study area have made the rural population extremely vulnerable. To minimize the losses in such exigencies, it is necessary that a system be created for increasing preparedness at all levels i.e. government, civil society and community. This paper reveals that coping mechanisms to reduce CIND vulnerability that were adopted by households in coastal Orissa provide them with greater flexibility to reduce CIND risk. These coping mechanisms were able to sustain the poor people at marginal level (economically, ecologically, and geographically). Also the field level experience shows that CIND vulnerability is a part and parcel of coastal Orissa, and cannot be totally escaped. But household's vulnerability to various CIND events can be managed and its effects can be reduced to certain extent.

The following points are suggested to reduce CIND vulnerability

1. Some coping mechanisms of the poor are efficient in reducing CIND vulnerability e.g. late sowing of crop and use of resistant cultivars. These coping mechanisms should be supported by scientific crop research in order to reduce losses due to CIND extreme events.
2. As far as agriculture is concerned, the first and foremost aim should be to have a permanent solution instead of giving doles and reliefs which are a diversion from development as it does not add to the creation of permanent or durable assets.
3. Drought proofing should be accorded priority over drought relief. Skewed policies have led to the decay of traditional water harvesting structures in the state. The state had a network of more than 20000 community ponds which were used successfully to combat drought. However, poor maintenance and neglect has resulted in those ponds being ineffective.
4. The relief is confined to providing food, medicine and wage earning to rural household as well as construction of small dwelling units under Indira Awas Yojana for families living below poverty line. The feed requirement for livestock and seed for farming community remained totally neglected, which require immediate attention.
5. Intervention of governments, specialized NGOs, and local farmer/fishers community based organization initiatives like self help groups (SHGs) in this matter is crucial to for tackling CIND vulnerability effectively.

## **References**

Chen, M., 1991: Coping with Seasonality and Drought. Sage Publications, New Delhi, India, 254 pp.

Cynthia, Bantilan (2002). Vulnerability and adaptation in semi-arid tropical agriculture: a village level case study, Paper presented in the South Asia Expert Workshop on 'Adaptation to Climate Change for Agricultural Productivity' organised by the Government of India, United Nations Environment Programmes, and CGIAR during 1-3 May, 2002, Vigyan Bhavan, New Delhi

Davies, S. (1993). Are coping strategies a cop out? IDS Bulletin 24(4): 60-72.

Devereux, S. (1993). Goats before Plough: Dilemmas of Household Response to Sequencing Food Shortages. IDS Bulletin 24(4): 52-59.

Down to Earth (2001). Down to Earth, Vol. 10, No. 10, October 15, 2001

Info Change (2002). News and Features. Internet site: [www.infochangeindia.org](http://www.infochangeindia.org) dated 19.04.2002

Jodha, N.S. and Mascarenhas (1989). Adjustment in Self-provisioning Societies. In: Climate Impact Assessment [Kates, R. W., Ausubel, J., and Berberian, M. (eds.)]. Chichester, U.K., John Wiley and Sons.

Selvarajan, S., Roy, B.C. and Mruthyunjaya (2002). Use of Vulnerability Indices for Agriculture, Paper presented in the South Asia Expert Workshop on 'Adaptation to Climate Change for Agricultural Productivity' organised by the Government of India, United Nations Environment Programmes, and CGIAR during 1-3 May, 2002, Vigyan Bhavan, New Delhi

### ***Appendix I. Impact of calamity events on rural livelihood***

Sl No	Particulars	Unit	Normal Year	Calamity year	Deviation from normal (%)
1	Performance of crop farming				
	Average Paddy Yield	Kg/ha	1188	702	-41
	Area sown as per cent of operational holding	%	100	73	-27
2	Expenditures per household				
	Food items	Rs/year	12324	10194	-17
	Medical	Rs/year	1179	1126	-05
	Education etc	Rs/year	1497	1161	-22
	Clothes & festivals	Rs/year	1435	883	-38
3	Average price received				
	Land	NA	-	-	-16
	Cattle	NA	-	-	-27
	Jewellery etc	NA	-	-	- 14
4	Income per household				
	Wage earning	Rs/year	13990	11920	- 15
	Crop production	Rs/year	4030	1854	- 54
	Others	Rs/year	2764	1728	- 37

### ***Appendix II. Selected major disasters in Orissa in the last three decade (1971-2002)***

*(Source: compiled from Orissa government website)*

1971

Tidal wave 15ft high swept 75 km stretch of coastline with maximum damage in Kendrapara district, wind speed was about 175 kmph., Houses damaged: 5,20,938 Area affected: 7,310 sq.km. Human casualty 7,397, Population affected: 33.04 lakhs Cattle casualty 77,921. Cultivated area affected: 6,065 sq.km.

1977

Flood in Brahmani, Baitarani, Mahanadi, Kharsuan, Kathjodi, Birupa, Genguti, 36 blocks affected. Extensive damages in 6 sub-division - Kendrapara, Jajpur, Sadar, Banki, Jagatsinghpur, Athagarh, 9,75,955 people affected. Estimated Crop loss: Rs.554.40 lakhs

1978

A severe tornado on 16th April almost wiped out Purunabandhagoda and 10 other villages in Keonjhar district. 176 persons and 817 cattle perished and 638 houses collapsed.

1982

Mahanadi at Naraj rose up to 93.60 ft., Road and train communication between Cuttack & Bhubaneswar completely disrupted. Kathajodi breached N.H.5, Affected : 4,478 villages, 33.78 lakhs people, A major breach in Dalaighai and opened up new water courses, Prachi and Alaka.

1982

Cyclonic storm hit 800 km South- East of Paradeep affecting 41 blocks, 10,017 sq.km. area and 46.17 lakh population. 201 human casualty, 4861 livestock perished, The anemometer at Paradeep blown away as wind reached 180 km, Devastation to public & private property far in excess of that of 1971, although loss of human life was less

1998

Worst heat wave conditions were experienced during April to mid June and nearly 2,000 people died of heat stroke.

1999

Two sever Cyclonic storms in October 1999 devastated the Coastal Orissa. The cyclone of October 17-18 with wind speed reaching up to 200 km/h caused extensive damage in 4 Districts. The second one during October 29-30, with wind speeds of 270-300 km/h for 36 hours and was accompanied by torrential rain ranging from 400 mm to 867 mm over a period of three days threw the economy of entire Coastal Orissa out of gear. The turbulent sea surged up to 7m high that rushed in and at places travelled up to 15-20 km inland. Population Affected: 1.9 crores, Affected Villages: 17,993, Blocks: 128, Districts: 14, Human lives lost: 8479, Livestock perished: 25 lakh, Houses damaged: about 20 lakhs, Cropped area affected: 21 lakh ha.

2000

One of the most severe droughts. 18 districts, 142 blocks, 2483 Gram Panchayats, were affected. Crop loss was more than 75% in 11,092 villages and between 50% to 75% in 7,783 villages.

2001

All the river systems in the State were in spate in five spells and 24 districts were affected. Precipitation by the end of July was 68% more than normal. The first spell of floods affected the districts mostly in Western and Southern Orissa and spells of floods in July affected the coastal districts. Discharge through Mahanadi reached 15 lakh cusecs and 14 lakh cusecs of water continued to flow through the system for about a week. 97 lakh people in 18,790 villages coming under 2,757 Gram Panchayats and 68 Urban Local Bodies were affected. 122 human lives were lost, 18,149 cattle perished, 2,12,296 individual dwelling units were damaged and agricultural crop over 80.87 lakh ha were affected.

2002

One of the most severe droughts. 28 districts, 286 blocks, 3324 Gram Panchayats, were affected. Damage to crops and income opportunities are expected to be very high.

### ***Appendix III. Few revelations***

#### **Comments:**

'During 1971 cyclone I could not save my wife and family members as there was no warning, no rescue team, no relief for several days. But this time (1999 super cyclone) we got everything on time and therefore, no death in our village'- an old villager who lost everything in 1971 cyclone.

'Men can survive on relief, but what about cattle? No one is giving any thought. No one is helping the cattles as they can not demand.' – a villager who suffered the loss of cattles after 2001 flood

'There are three crops in Orissa Rabi, Kharif, and Relief'- An agricultural scientist working in this area.

**Facts:**

The meaning of 'Mahakalpara' is 'the land of great famines'.

Recently the local MLA was suspended from the party as well as state cabinet and the Block Development Officer was sent to jail due to mishandling of relief materials. Large consignments of relief materials were black marketed in Mahakalpara after 1999 super cyclone.

The NGOs (other than RED CROSS SOCIETY or RAMAKRISHNA MISSION) does not enjoy much confidence among the educated people who perceive that mushrooming of NGOs in the study area are to make profit out of relief funds.

Though shrimp cultivation as well as turtle catching is banned such illegal activities can be seen. Most of the operators are rich and influential people who came from outside, took lease the village land, and makes huge profit even after bribing government officials. The fish trolleys also catch endangered turtle species and crocodiles for poaching.

The landless fishermen/farmers were denied bank loans since they do not have any land

People are availing cash relief under Indira Awas Yojana without constructing the house. This was availed by relatively rich people; and by multiple members within the family. All they have to produce is an affidavit, which verified by the Village Level Worker (VLW). It was very easy to get the affidavit and get it verified just bribing something.