CHAPTER-IV: CLIMATE VULNERABILITIES AND LEARNINGS FROM DISASTERS IN ORISSA

Orissa is an economy characterized by persistent poverty and unemployment, low per-capita income, low capital formation, under exploitation of abundant natural resources and inadequate development of socio-economic infrastructure. The economy has been further constrained by the recurrent natural calamities which have ravaged the State over the last four decades.

Socio-economic profile of Orissa

Orissa, comprises of 4.74% of India's landmass and 36.71 million people (2001 Census), accounts for 3.57% of the population of the country. Nearly 85% of its population live in the rural areas and depend mostly on agriculture for their livelihood. The State has abundant mineral resources including precious and semi-precious stones. It has also plentiful water resources. The total cultivable land of the State is nearly 65.59 lakh hectare of which only 26.02 lakh hectare has been provided with irrigation facilities (as of 2002-03) which constitutes 44.12% of the estimated irrigable land. The State is divided into ten agro-climatic zones on the basis of soil, weather and other relevant characteristics. Its land can be classified into three categories, low (25.6%), medium (33.6%) and up-lands (40.8%) with various types of soil like red, yellow, red-loamy, alluvial, coastal alluvial, laterite and black soil etc. with low and medium texture.

Demographic profile

Demographic profile has an important bearing on the development process. The population of Orissa increased from 316.60 lakh in 1991 to 367.07 lakh in 2001 portraying an increase in density from 203 persons per sq km in 1991 to 236 in 2001. The decennial growth rate of population of Orissa during 1991-01 was 15.94% as against 20.06% in the previous decade. The urban population of 13.38% in 1991 increased to 14.97% in 2001. On the literacy front the achievement has been impressive as the literacy rate increased from 49.09% in 1991 to 63.61% in 2001 as against an increase from 52.10 % to 65.38% at the national level during the same period. The male and female literacy rates which were 63.1% and 34.7% in 1991 have increased to 75.95% and 50.97% respectively in 2001. Female literacy continues to be an area of concern despite notable achievement during last decade.

Scheduled Castes and Scheduled Tribes, as per the 1991 Census, constitute 16.20% and 22.21% respectively of the total population of the State. The scheduled areas cover nearly 45% of the total geographical area. The literacy rate of scheduled caste and scheduled tribe population was 36.78% and 22.31% respectively according to 1991 Census.

Employment situation

With the increase in population and consequent addition to the labour force, supply of labour continues to outstrip demand resulting in accentuation of the problems of unemployment and under-employment. The occupational classification as per 2001 Census shows that the main workers comprise of cultivators (29.69%), agricultural labourers (35.04%), household industries workers (4.83%) and other workers (30.44%). It was estimated that the total backlog of unemployment at the beginning of 2003-04 was of the order of 10.04 lakh person years.

Agriculture

Agriculture and Animal Husbandry sector continues to be the mainstay of the State's economy with a contribution of about 22.09% to NSDP during 2002-03 at 1993-94 prices. Taking into account the predominant position of this sector and the large percentage of people dependent on this sector, the State Government have pronounced the State Agriculture Policy 1996 with the main objectives of doubling the production of foodgrains and oilseeds by the end of the Ninth Plan and to adopt agriculture as the main route for eradication of poverty. The Agricultural Policy 1996 is designed to bring about allround development of the agricultural sector. Agriculture has been accorded the status of an industry under the new Agricultural Policy with a view to encouraging private sector investment.

According to Agricultural Census conducted by the Orissa Board of Revenue, there were 39.66 lakh operational holdings in Orissa in 1995-96 of which small and marginal holdings accounted for 81.97% while the remaining 18.03% came under the category of semi-medium, medium and large holdings. As much as 50.27% of the total operated area was owned by small and marginal farmers and the remaining 49.73% by the semi-medium, medium and large farmers. percapita availability of land in Orissa has considerably gone down from 0.39 hectare in the year 1950-51 to 0.16 hectare in 2002-03. This feature is of special significance for climate change adaptation as such a large percentage of marginal farmer population makes the state's agriculture vulnerable as a whole.

Production of foodgrains has fluctuated over the years between 75 lakh MT to 35 lakh MT. In the recent years, low production has been witnessed, for example, during 1999-00 (Super Cyclone that hit the 14 fertile coastal districts of the State in Oct'99), 2000-01 (drought), and 2002-03 (severe drought during Kharif-2002.

In the absence of adequate irrigation facilities, agriculture is pathetically dependent upon the monsoons. The dependence is compounded by the fact that Kharif crops contribute more than 90% of food grain production as compared to whole India which derives substantially from Rabi production (see Fig. 8). As a result of the erratic behaviour of the monsoon, agricultural production fluctuates widely from year to year. The net irrigation potential created by the end of 2002-03 from all sources was 26.03 lakh hectare which is 44.12% of the total estimated irrigable area of the State. Out of 26.03 lakh hectare of irrigated area, 12.21 lakh hectare of land are irrigated through major and medium irrigation projects, 4.65 lakh through minor (flow), 3.47 lakh through minor (lift), and 5.70 lakh through other sources which include private tanks, ponds, dugwells, water harvesting structures and the like. Almost all irrigation source depends on good monsoon.

Climate vulnerabilities and major disasters in Orissa

With regards to India it can be said that the Eastern Coast is more vulnerable than the Western Coast with respect to the frequency of occurrence of extreme events like cyclones and depressions (Patwardhan et.*al* 2003). Within the eastern coast the districts in Orissa and Andhra Pradesh are the most vulnerable in terms of exposure to storms, super storms and depressions. The following table shows the district wise distribution of the three types of cyclones i.e. depression, storm and severe storm from 1877 to 1990, in the districts of these two coastal states.

Table 2: District-wise distribution of cyclones in districts of Orissa & Andhra Pradesh

District	**Frequency of storms, severe storms and depressions**
Puri	84
Cuttack	80
Balasore	76
Srikakulam	70
Vishakapatnam	31
East Godavari	31
Nellore	30
Ganjam	28
Krishna	25
Prakasam	7
Vizanagaram	5
Guntur	2
West Godavari	2
Dhenkanal	0

The impacts of climate change on infrastructure and to the population take place through a variety of ways. Physical infrastructure is directly affected by climate related changes. The economy of the area in concern can also be affected in an indirect way. This is through the change in market demand for goods and services produced in the concerned area. In terms of our analysis we see that the most vulnerable areas to climatic changes as accounted by the frequency of storms, severe storms and depressions perform very low in terms of infrastructure. Relief services post extreme events are dependent on physical and social infrastructure such as roads, communication, banks etc., and the lack of these can inhibit effective provision of relief services. Therefore the presence of infrastructure services in a particular region will seriously affect the vulnerability condition of that area. Taking some of the indicators of infrastructure development as proxies for poverty, one can figure out the different aspects of vulnerability. Therefore the vulnerability will increase in the sense that these areas are less resilient in coping with the shocks of climatic changes. In terms of demography, human settlements and the people living in the area also directly affected by the negative shocks like cyclones, floods, droughts, sea level rise etc. Here we find that the density of population in these coastal districts of India is quite high. This increases the scale of vulnerability because a larger proportion of the population is exposed to extreme events.

Table 3: Growth Rate of Infrastructure Index and frequency of extreme events in coastal Orissa:

District	1980-85	1985-90	1990-95	Rank	Frequency of severe storms, storms and depressions
Puri	0.34	-14.88	9.56	11	84
Cuttack	2.29	-13.31	11.55	9	80
Balasore	-0.70	-21.33	15.95	5	76
Dhenkanal	10.98	-13.62	17.37	4	0

A district like Puri, which has the maximum number of these events, is ranked quite low in terms of infrastructure index. The maximum vulnerability as measured in terms of historic data for cyclones is to the districts in the state of Orissa and these perform quite badly in terms of indicators considered in infrastructure index. Therefore to conclude we can say that lower the district is in terms of infrastructure index and the growth of it, the more exposed it is to climate change and hence people living in this region are likely to be highly vulnerable. Rehabilitation of people and the place would require tremendous effort and huge resources.

Vulnerability Index for the eastern coastal districts of India

Patnaik and Narayanan (2005) undertook an extensive analysis of the index of vulnerability of the eastern coastal districts of India is presented. Their vulnerability index, tries to capture a more comprehensive scale of vulnerability. This is done by including many indicators that serve as proxies to look at different aspects of vulnerability. In other words it was assumed that vulnerability can arise out of a variety of factors. In particular they looked at four different sources of vulnerability. This included the climatic factors, demographic factors, agricultural factors and occupational factors which are trivial in determining the overall vulnerability of an area. The idea was to prepare an index to map the vulnerability among the various coastal districts of the eastern coast of India and rank the districts in terms of vulnerability. The construction of the Index was based on the districts of Orissa, Andhra Pradesh and Tamil Nadu which are states or provinces on the eastern coast of India. The methodology used to calculate the vulnerability index followed the basic approach developed by for the calculation of the human development index (HDI).

Patnaik and Narayanan (2005) conclude that the vulnerability profile has undergone a complete change for some of the districts being considered. But one fact is quite evident that some of the districts of Orissa are the most vulnerable ones throughout the time frame of consideration. Especially the district Dhenkanal remains the most vulnerable district throughout. This is also the case in reality. This district comprises of the areas now divided into Kendrapara and Jagatsinghpur which are the most affected areas due to tropical cyclones and storms.

Patnaik and Narayanan (2005) also presented correlation results which were significant either at one percent or five percent significance levels. It was interesting to see that Infrastructure Index of 1981 and the frequency of occurrence of extreme events were highly correlated and is also significant at one percent level. Also the vulnerability index of 1981 and 1991 are highly correlated and significant. This is understood since the frequency of occurrence of extreme events is one of the sources of vulnerability considered in the study.

But the important thing that is noteworthy is that there is also correlation between vulnerability index of 1981 and 1991. This result is of great importance for analysis and policy formulation purposes. This correlation coefficient of 0.268 suggests that past vulnerability also has some effect on the present vulnerability. In other words the vulnerability pattern is interrelated across different time periods. If the people of any region have been vulnerable for past certain periods then they are more likely to be vulnerable in the present period also.

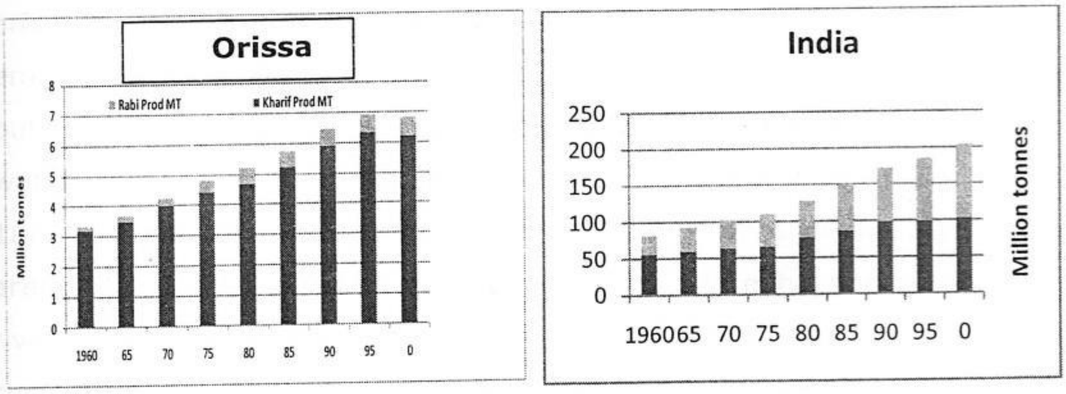

Fig. 8: Comparative share of rabi and kharif production in Orissa and India

The 2008 Orissa floods

Orissa state has seen a paradigm shift in the management of water resources the state. This shift could be well discerned in a promotional scheme called Biju Krishak Yojana or Biju Farmers' Development Scheme, where small and live irrigation projects are carried out with involvement of the farmers, and where *pani panchayats* or water user associations (WUAs) are formed prior to project implementation. This program, for which the National Bank for Agriculture and Development (NABARD) has been extending loan assistance, began about 6 years ago. Irrigation engineers are responsible for forming WUAs and conducting elections according to the Orissa Pani Panchayat Act and Rules. (The Act came into force with effect from 15 November 2002 and the Rules came into force with effect from 23 April 2003). Orissa is already going through the IWRM process. Major institutional reforms took place under OWRCP, after which the river basins were considered units for development planning. Yet this paradigm shift could not save the state from the fury of floods in September 2008, and large areas under standing crops were totally devastated.

Heavy rains in the lower catchments of Orissa's major river Mahanadi has triggered a major flood situation in at least 6 districts in the state during September 2008. At least 15 of the 30 districts in the state were affected. In 1982, [23] an inflow of nearly 16 lakh cusecs had breached embankments and caused large scale devastation across coastal Orissa, but this time the situation was worse (*pers. com.*). About 15 lakh cusecs water released from the Hirakud dam (on Mahanadi river) late night on 18/19 September 2008 compounded the heavy rains in the catchments areas of Mahanadi, Baitarani, Rusikulya, Subarnarekha and other major rivers due to deep depression which lay centered near Keonjhar also contributed towards rise in water level. Many seaside villages in Kendrapara, Jagatsinghpur, Balasore and Bhadrak districts were swept

[23] Comparison with 1982 flood is relevant here, as many villagers in my sample villages compared the 2008 flood with 1982 flood.

away by tidal wave which caused breaches in several saline embankments and left a large number of villagers marooned.

By the time water was released from Hirakud dam, the Mahanadi waters have already inundated several low lying areas of Cuttack district including Banki, Athgarh and Narsinghpur, besides Athamallick, Boudh and Sonepur. Officials of Orissa government met during field visit, though likened the flood situation in Mahanadi to the one faced in both 1982, and 2001 when 14.8 lakh cusec of water passed through the plains creating a havoc.

Extent of damage

Overflows in Mahanadi system and Kathajodi, Kushabhadra, Devi, Bhargavi, Dhanua affected more than 45 lakh people in 18 districts . Altogether, 5514 villages in 129 blocks & 1513 GPs and 18 urban areas were affected. 48 people and 150 cattle lost their lives. Flood waters entered through more than 100 breaches on river embankments putting huge strain on the civic and government vigil committees constituted for the purpose, and far outsrippedthe capacity of the Orissa water resources department. Altogether 1522 km roads, 4.5 lakh hectare agriculture crops, and1.27 lakh houses were destroyed plunging the state in deep economic crisis and putting people's livelihoods in deep downward spiral of vulnerability. Along with the flood damage new threat emerged including rising number of snake bite, overflowing of tubewells with flood water resulting in great scarcity of drinking water and spread of diseases like Cholera, and diarrhoea. The cattle was badly affected due to non availability of cattle feed, and continued low pressure rain caused woe to flood affected people. Puri, which is one of my sample districts, suffered the most heavily. More than 8 lakh people in 180 GPs and 9 blocks were affected. 128 cattle swept away in flood. More than 67 thousand ha of agricultural land submerged for days. 11 breaches on river embankments, and roads cut off at 15 places due to flood water, causing disruption of road communication disrupted between Bhubaneswar-Puri and many inside villages. So much so that train communication got disrupted between Bhubaneswar and Puri for 3 days.

Peoples' adaptive responses to the flood threat

The series of floods in the state has only made the people more knowledgeable and pro-active. Their autonomous adaptation included for example, raising the height of tubewell by 5-10 feet to ensure safe drinking water. Training in relief operation was provided by autonomously formed people's committees, youth club, etc., and in general there was an increase in people's engagement with governance issues which was good for enduring democracy in such poor economies. The recurrent flood has also drawn general people's attention towards long term adaptive measures, as opposed to short term relief measures, such as cropping system change including adoption of crop varieties that could withstand inundation for longer duration. Officers of OSDMA concurred that there is now much qualitative improvement in disaster management planning, implementation and monitoring meetings at the village level than before.[24]

Learning from Orissa Supercyclone

Orissa has been termed as the disaster capital of India because of recurring cyclones (see Figs. 2, 9A) which make all the coastal districts highly vulnerable, yet the cyclone of October 29th, 1999 (or the Supercyclone as it is commonly called) stands far apart. The cyclone was compounded with 48 hours of rain. The Orissa Supercyclone is categorised as the largest human disaster in India after the Great Bengal Famine of the 1942-43. Altogether 8913 human and 4,44,500 cattle lives were lost. Over 8000 villages in 14 districts (see Figs. 9A&B) and 1,89,71,072 people were affected, and 2 million houses and over 1.8 million ha of cropped area was damaged. Extensive studies have been undertaken (e.g. see

[24] The village disaster management committee could be operationlaised in Baliguali village (Puri Block, Puri District) only after the 2008 floods affected this village even though this village is routinely inundated by cyclonic depressions and salt water ingress during the rainy season by flooding in the backwaters. (Pers. Com).

Action Aid *undated*). [25] One of the clearest learning from such studies is the fact that the poorest are also the hardest hit, and the state needs to take 'side' with socially excluded communities like the Scheduled Castes, marine fisher folk, Bengal migrants, person with disabilities, children and women at risk, while the decision making power and control must be given directly in the hands of the target groups. The second most important learning was that planning and implementation of disaster management or livelihoods restoration work has to be through people's committees through a hamlet-based approach (as against Revenue Village or Gram Panchayat based planning approach), and that a "Systems-based" approach has to be adopted for livelihoods security. This approach is essentially an ecosystem approach to development, and simultaneously takes into account people's, especially poor people's dependence on common pool resources (CPRs, e.g. village forests, coastal belt plantations, ponds etc.). It has been understood that restoration of CPRs is vital for insuring the subsistence needs of the poor thereby lowering their dependence on the rich and hence evading the debt traps.

The Orissa government also took a number of steps based on the learnings from the Supercyclone. Important ones include: OSDMA set up, DM Policy Approved, State DM Plan prepared, Reconstruction of Schools, Health Institutions, Disaster Risk Management Programme started, a Hazard Safety Cell established, systematic capacity building of Engineers, Architects, PRIs, others has been undertaken and a comprehensive Orissa Vulnerability Report has been prepared (see Fig. 10, 11).

Conclusions

The global climate is already changing, and will continue to change over coming decades and centuries. In many places, local trends in average temperature and precipitation due to climate change are already being observed, and fairly reliable projections for the future can improve planning decisions.

---

25 http://www.sphereproject.org/documents/orissa/case%20study_actionaid.pdf (accessed 20 Jan 2009)

However, climate change is not just about gradual changes. Key impacts of climate change will be due to changes in climate variability and weather extremes, such as floods and cyclones. Many of these trends in variability and weather extremes are clear enough to warrant attention in regional and local risk reduction strategies.

In this chapter, therefore, the vulnerabilities of the coastal communities of Orissa (from where field data for this study has been collected) to climate change have been highlighted, and the experience in dealing with the effects of two major disaster events in Orissa - the 1999 Supercyclone, and 2008 floods - have been described. As outlined in the methodological section in Chapter-II, this dissertation mainly uses the experience of flood disaster as a proxy to construct climate change responses. However, it may be noted that disasters and climate change are not one and the same thing. The current climate models provide information at a scale of approximately 100 by 100 kilometres at most. This would have to be brought down to about 10 by 10 kilometres to be able to couple it to a local basin hydrological model to calculate specific flood risks. Such a 10-fold increase in resolution not only requires better validation of climate models at the local scale, but would also increase the computation time by at least a factor of 100, making it impossible to generate the number of model simulations required to produce reliable statistics. Besides, in general, despite some climate research pointing up serious concerns regarding the rising frequency of flood events in particular areas, one should be careful not to attribute all current extreme events to climate change. For instance, in an 80–150-year analysis of observations of flood occurrence in the Oder and Elbe rivers (which generated heavy flooding in 1997 and 2002, respectively), Mudelsee et *al.* (2003) showed that winter flooding has actually decreased, while summer flooding has remained essentially unchanged. It is interesting to note that the reduction in wintertime flooding can possibly be linked to global warming—warmer and/or more polluted rivers result in a reduction in strong freezing events, which create water barriers, whose breaking up triggers enhanced flooding.

But it is also true that in many areas, riverine flood risks may well be influenced by climate change, and the general tendency is towards higher flood risk. However, there is no generic answer in relation to the extent or even the direction of the change, other than that there is generally increasing uncertainty. Location-specific flood risk analyses should take account of all risk-related trends, including geographic changes in the catchment area, changes in exposure of assets and population, as well as climate change.

To benefit from good information on such local information on climate change, organisations working on disaster risk reduction and development will need to establish linkages with new partners, such as national meteorological offices or global centres of expertise on climate research. In addition, some methods and tools for disaster risk assessment may need to be adjusted to address better hazard trends. Disaster risk reduction and more robust development planning are crucial in adapting to the increasing risks associated with climate change. This is particularly important in the face of mounting vulnerability to natural hazards, as reflected, for instance, in rising numbers of people affected and escalating levels of economic damage. In almost all cases, climate change is just an additional factor to consider, which can be embedded in existing risk reduction strategies. Accordingly, the next chapter also deals with empowerment of PRIs in disaster management, and thereafter the chapter relating to field data relies on information about individual and institutional response to a recent disaster, i.e. 2008 floods. [26]

****

[26] The use of word disaster in this dissertation to denote the severe flooding in Orissa in 2008, has no relation with the demand for official proclamation of this event as a 'disaster' in terms of NDM Act 2005.