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A Study of Natural Disasters in Orissa Coast for Last 100 Years with Special Refernce to Cyclonic Disaster Risk Reduction

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Abstract: The Orissa coast located in the East coast of India has highly gifted natural systems like Chilika Lake, a Ramsar wetland site and unique mangrove systems like Bhiterkanika National Park. As all over the world, Orissa coast is also a hub of variety of economic activities that includes agriculture, tourism industry, ports etc. Also each year, the coast is exposed to one or the other kind of natural hazards, making the coast extremely vulnerable to both economic and ecological loss. Thus any coastal zone development plan has to take into consideration disaster risk reduction in integrated coastal zone management. The coastal zone regulation zone (CRZ) notification was issued in 1991 in India under Environment (Protection) Act, 1986, which is an umbrella act which provides for regulation of environment quality in India. The notification aims at protecting and improving the quality of the coastal environment but does not take coastal natural disasters into considerations. The major objective of this paper was to analyze the past damage caused by the natural disasters along Orissa coast, to establish that there is a dire need to integrate ICZM and DRR for inclusive development of the coastal stretch and to suggest an integrated approach based on the analysis of best practices around the globe.

Key words: ICZM · DRR · Orissa · Natural disasters

INTRODUCTION

Natural hazards are happening since the time immemorial and have taken part in shaping any community, both its existence and perish. In the years that are passing by we are getting increasingly subjected to the natural hazards culminating into disasters, claiming a large portion of life and property [1]. If we look into the recent trend of natural disasters, it can be strongly argued that in the coming years the number, frequency and impact of natural disasters are increasing. This compels us to think that physical event is equally responsible as is the social construct of the given community which is exposed to it [2-4]. In this scenario, a disaster free world can only be a valid argument when disaster warning/prediction, preparedness and management are priority concerns in disaster prone regions [5-7].

A natural hazard is any natural event which possesses any threat to the natural environment and human population. While disaster can be a serious disruption of the functioning of the community or a society, it essentially involves widespread human, material, economic or environmental losses and impacts that exceeds the ability of the affected community or society to cope using its own resources. Disasters are often described as a result of the combination of exposure to natural hazards, vulnerability of the resident human population and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well being, together with damage to property, destruction of assets, loss of services social and economic disruption and environmental degradation[7]. UNISDR defines *disaster risk reduction* as "the conceptual framework of elements considered with the

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possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development Disaster risk management includes both disaster risk reduction (prevention, preparedness and mitigation) and humanitarian and development action (emergency response, relief and reconstruction). Major aim of any disaster risk reduction programme is to reduce vulnerability and creating more resilient indivisuals and communities. Understanding the reasons for vulnerability of a community to natural disasters can help us fill the gap between vulnerability to resilience. Assessing the economic, social, political, cultural, institutional, psychological factors along with natural hazards perceptions of the exposed population, could lead to more effective interventions and practical adaptation strategies to enhance the ways people deal with natural hazards [8-11].

Concept and Need Integration of Drr into Mainstream Development Policy in Developing Countries: UNISDR defines *disaster risk reduction* as "the conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development Though disasters have a global occurrence the amount of suffrage caused is more in countries with low development index, more among vulnerability groups like women and children. Underlying social conditions and structures determine who is most vulnerable to the impact of natural hazards such as extreme weather events and disasters consequently follow. Need for mainstreaming disaster risk reduction into the developing countries is based on the argument that disasters not only cause immediate suffering but hold back long-term development [7]. Hence integrating the DRR concepts into development policy can help improve social conditions as well as cut on the cost incurred on the post- disaster relief activities. Although on average the 50 poorest countries are exposed to only 11 per cent of the world's natural hazards, they suffer 53 per cent of deaths from disasters each year. In contrast, countries with high levels of human development, despite their exposure to 15 per cent of all hazards, account for only 1.5 per cent of the death toll (UNDP, 2004). Poverty forces people to live in dangerous locations and unsafe shelters. The options open to people depend on their wealth. Better-off families are more likely to obtain s helter with friends or relatives and also to recover at least part of their incomes and assets [7]. Every time a natural disaster strikes in South Asia, invariably more women die than men. In Nagapattinam and Cuddalore, the districts of the Indian state of Tamil Nadu that were worst affected by the tsunami, twice as many women died as men. They are expected to take more responsibility of family, perform domestic scores as well as provide as an extra hand. Studies show that women are more likely to volunteer for projects in their communities for activities related to emergency management. When disasters strike, socially excluded groups are at the greatest risk. Minorities and low caste people suffer more and find it harder to recover from disasters. Poor economic development practices can contribute to 'natural' disasters through flawed implementation, over-emphasis on badly designed large projects and environmental degradation.

Distribution of Cyclones Around the Globe: While the number of storms in the Atlantic has increased since 1995, there is no obvious global trend; the annual number of tropical cyclones worldwide remains about 87 ± 10. However, the ability of climatologists to make long-term data analysis in certain basins is limited by the lack of reliable historical data in some basins, primarily in the Southern Hemisphere. In spite of that, there is some evidence that the intensity of hurricanes is increasing. Kerry Emanuel stated, "Records of hurricane activity worldwide show an upswing of both the maximum wind speed in and the duration of hurricanes. The energy released by the average hurricane (again considering all hurricanes worldwide) seems to have increased by around 70% in the past 30 years or so, corresponding to about a 15% increase in the maximum wind speed and a 60% increase in storm lifetime (http://en.wikipedia.org/ wiki/ Tropical_cyclone).

India has a very long coastline of 8040 km, which is exposed to tropical cyclones arising in the Bay of Bengal and the Arabian Sea in the ratio of 4:1. The Indian Ocean is one of the six major cyclone prone regions of the world. The Coromandal coastline is more prone, about 80 per cent of the total cyclones generated in the region hit this area (http: //www. rrtd. nic. in/ DISASTER % 20 REDUCTION. html).

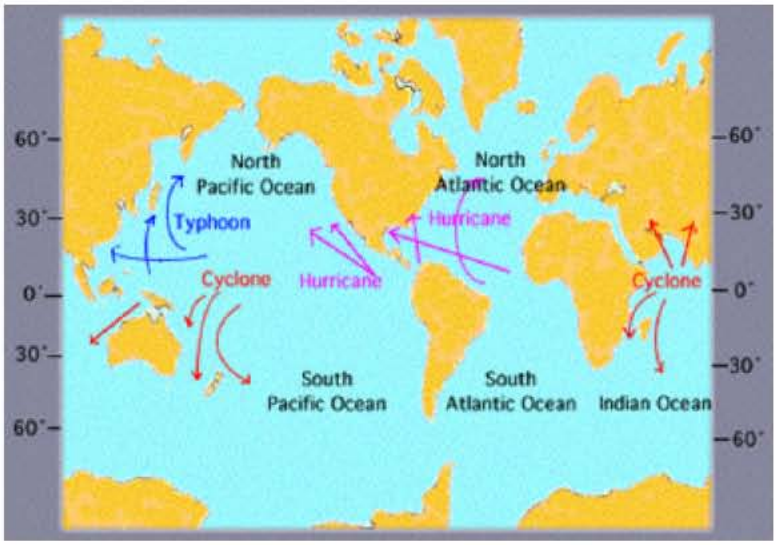

Table 1: Mean annual rainfall and rainy days in the Orissa coastal zone

	Rainfall (cm)				Rainy days(No.)			
Meteorological centre	Monsoon	Winter	Summer	Annual	Monsoon	winter	Summer	Annual
Baleswar	107	12	45	164	45	9	26	80
Chandbali	109	14	42	165	43	10	17	70
Paradip	108	19	32	159	47	9	18	74
Cuttack	106	13	38	157	49	9	20	78
Bhubaneswar	111	14	33	158	46	8	19	73
Puri	101	16	29	146	44	16	16	76
Gopalpur	88	18	24	130	38	10	16	64
S.W.Monsoon(mean)	104	15	35	154	45	10	19	74

Table 2: Number of Cyclonic disturbances (1900-2007)

Sl no.	Nature of disturbances	Frequency	% Total disturbances
1	Depressions	180	69
2	Storm	57	22
3	Severe torm	23	9
Total		260	100

Orissa Coastal Zone: The Orissa coastal zone enjoys a tropical monsoon climate. The region receives rainfall from the southwest, retreating and northeast monsoon. The heavy torrential rain downpour with raging cyclonic storms and depression from the Bay of Bengal are the climatic characteristics of the coastal zone. About of the annual rainfall occurs over the region during the southwest monsoon season with two peaks i.e July-August and October. In the coastal region the normal rainfall ranges between 130-165 cm indicating a sub-humid zone(Table: 1)

The rainy days in a year ranges from 55-80 days. The May is the hottest month and the maximum temperature varies from 38°C to 45°C. The December is the coldest month and the average temperature comes down to 10°C to 15°C. Relative humidity remains high throughout the year ranging from 90% in the South West to 65% in the winter months. The wind is predominantly from the south and southwest. The shore areas of the coastal zone experiences high speed wind and soothing effect of the onshore wind. Although the quantum of rainfall received by the coastal zone is fairly good, yet its irregular distribution and variation, in time and space leads to heavy downpour in certain areas and low precipitation in some areas. Hence the Orissa coastal zone is both cyclone and flood prone besides cyclones.

Magnitude and Frequency of Cyclones in Orissa: Natural disasters kill about 1,300 people every year in Orissa [12]. Studying the magnitude and frequency of cyclonic disturbances is an indispensible, when u needs to study the component of understanding the relative vulnerability of the coastal areas towards the cyclone. The present study analyses the cyclonic disturbances of the last century (1900-2008) chronologically which had a

Table 3: Magnitude and frequency of cyclonic disturbances along Orissa coast in comparisons to other states of eastern India.

Low pressure system	Number of disturbances having landfall					Total cyclones having landfall	Cyclones having no landfall	Grand total
	Orissa coast	Bengal coast	Andhra coast	Tamil Nadu coast	Other areas			
Depression	180(35)	78(15)	56(11)	21(4)	66(13)	401(88)	110(22)	511(100)
Storm	57(25)	21(9)	32(14)	17(8)	56(25)	183(81)	41(19)	224(100)
Severe storm	23(15)	21(14)	23(15)	25(16)	41(26)	133(86)	22 (14)	155(100)
Total	260(29)	120(14)	111(13)	63(7)	163(18)	717(81)	173(19)	890(100)

Table 4: Periodicity of cyclones

Nature of disturbance	Jan	May	June	July	Aug	Sept	Oct	Nov	Total
Depression	-	1	17(10)	50(28)	60(33)	45(25)	7	-	180(100)
Storm	1	-	15(26)	13(24)	14(25)	10(18)	3(5)	1(1)	57(100)
Severe storm	-	2(9)	1(4)	3(13)	1(4)	4(18)	9(39)	3(13)	23(100)
Total	1	3(1)	33(13)	66(26)	75(29)	59(23)	19(7)	4(1)	260(100)

November 14, 2010*The figures within bracket refer to probability of occurrence in the month in %.

landfall and affected Orissa. According to the report, natural disasters have taken the lives of over 50,000 people in a span of 38 years (1970-2007). The disasters include cyclones, floods, lightning, heat wave, fire, epidemics and droughts. Among the natural disasters, the worst killers are floods, tropical cyclones and health hazards. They claim about 88 percent of the total lives lost to disasters. The report uses Disaster Risk Index (DRI) to measure the risk and vulnerability to disasters. As per the about 10 percent of the state's total population is exposed to these disasters every year [12].

The average financial loss of the State per annum due to different disasters has been estimated at Rs 1,241.82 crore. In its memorandum submitted to the Thirteenth Finance Commission (TFC), the State Government maintained that the financial loss due to disasters during the last 14 years stood at Rs 17,385.61 crore. Giving the disaster profile of the State from 1900 to 2007, the memorandum reported that there had been 125 disasters in Orissa during the last 107 years (New Indian Express, 2009).

In the last century the Indian subcontinent has experienced 1019 cyclonic disturbances of which 890 were along the coromondal coast and 129 on the western coast. Orissa had a mojor share of 260 disturbances, out of which 180 depressions(69%), 57 storms(22%) and 23 severe storms(9%).out of the total severe storms in the bay of Bengal region 15% of them i.e. one in every six affect Orissa coast(Table 1).

The 29% of the total disturbances affecting Orissa coast is relatively higher to other neighboring states like West Bengal (14%) andhra Pradesh (13%) and Tamil Nadu (7%). As a result the total number of cyclones affecting is almost double the other states. Thus we can conclude that the vulnerability of people to cyclonic hazards in coastal area is more than corresponding neighboring states (Table 3).

Periodicity of Occurrence: Although the cyclonic disturbances are found distributed throughout the year, the month wise frequency reveals a specific distribution in a particular part of the years.

The analysis reveals that more number of depressions have affected Orissa coast in the month of july and august, more number of storms in the month of June and July and severe storms in the month of May and October. More number of cyclones is observed in pre-monsoon period than in the post monsoon season (Mishra, 2001). The probability of occurrence of storms is the highest in the month of June, July and august. The foregoing analysis reveals that most vulnerable months of occurrence of a severe cyclone is October followed by the month of September.

Cyclone Damage: Damage due cyclones are of two types, tangible and non tangible damages. While the tangible damages include direct damages during and after the cyclone such as collapsed buildings, bridges, human life etc whereas the intangible effects are indirect effects like salinisation of agricultural land, loss of livelihood etc.

The three important agents of damage in a cyclone are wind, rain and storm surges. While the wind velocity being high uproots trees, blows away the thatched roofs, fish harbours, electrical poles etc, the torrential that follow

Table 5: Some major cyclones and its damages (12)

Sl.no.	Year of occurrence	Landfall	Human life lost/other damages
1	Oct,1831	Baleswar	22,000
2	July, 1872	Baleswar	21
3	July,1885	Paradip	5000
4	July, 1942	Kendrapada	20,000
5	Sept ,1963	Orissa coast	200(affected 5,00,000 people)
6	Oct,1967	between puri and paradeep	1000 (affected 49,00,000 people)
7	Oct ,1971	paradeep	9658(affected 50,000 people)
8	Sept 1980	-	200(1,000,000 affected)
9	Sept,1981	Kendrapada	200(20,000 affected)
10	Dec 1982	baleswar	244(300,000 affected)
11	June, 1984	-	512 killed(1.3million affected)
12	Nov 1985	False point	84
13	May 1988		43 (3.2 affected)
14	Nov 1989	-	250 killed (1.5 million affected)
15	Oct 1990		100 and damage of was Rs 700 crore
16	Oct,1995	Gopalpur	96
17	Oct,1998		200(3000 affected)
18	Oct,1999	Gopalpur	205
19	0ct 1999	Kendrapada and jagatsinghpur	10,000

Table 6: History of natural hazards in Orissa(13)

Sl No.	Year	Month	Type of Natural Hazard	Sl No.	Year	Month	Type of Natural Hazard
1	1823	May	Cyclone				
	59	1933	-	Flood			
2	1831	October	Severe cyclone	60	1934	-	Severe flood
3	1832		Cyclone, drought	61	1935		Flood
4	1833	may	Cyclone				
	62	1936	-	Flood, cyclone			
5	1834	-	Flood	63	1937	-	Flood
6	1840	April	Cyclone	64	1938	-	Cyclone
7	1842	Oct	Flood	65	1939	-	Flood
8	1845	-	Flood	66	1940	-	Flood
9	1846	-	Flood	67	1941		
10	1848	Oct	Cyclone, flood	68	1942	Oct	Cyclone
11	1850	April	Severe cyclone	69	1943	Oct	Cyclone, flood
12	1851	oct	Flood, severe cyclone	70	1944	-	Flood
13	1852	0ct	Flood	71	1945		Flood
14	1853	-	flood	72	1947	-	Flood
15	1854	-	Flood	73	1955	-	Flood
16	1855	-	Flood	74	1956	-	Flood
17	1856	-	Flood	75	1959	Sept	Cyclone, flood
18	1857	-	flood	76	1967	-	Cyclone
19	1864	Oct	Severe cyclone	77	1968	-	Cyclone
20	1867	Oct- nov	Cyclone ,flood	78	1969	-	Flood
21	1868	-	Flood	79	1971		Cyclone
22	1872	July	Cyclone,, flood	80	1972		Flood
23	1874	Oct	Cyclone, flood	81	1973	-	Flood

Table 6: Continued

24	1876	April	Tornado	82	1975	-	Flood
25	1877	-	Flood	83	1977	-	Flood
26	1878	May	Drought	84	1978	-	Tornado
27	1879	-	Flood	85	1979	-	Drought
28	1880	-	Flood	86	1980	-	Flood , drought
29	1881	-	Flood	87	1981	-	Tornado , drought
30	1885	-	Flood	88	1982	-	Severecyclone,flood
31	1887	May	Cyclone	89	1985	May	Tornado
32	1888	Sept	Flood and cyclone	90	1986	-	Flood, cyclone
33	1889	nov	Cyclone	91	1991	-	Flood
34	1890	-	Cyclone	92	1992	-	Flood
35	Nov	-	Cyclone	93	1994	-	Flood
36	1892	June	Cyclone	94	1995	-	Flood
37	1893	May	Cyclone, saline inundation	95	1996	-	Drought
38	1894	-	Flood	96	1997		Drought
39	1895	-	Flood	97	1998		Drought
40	1896	-	Flood	98	1999		Super cyclone,flood
41	1889	May	Tornado	99	2000		Drought
42	1900	-	Flood	100	2001		Flood
43	1901	Nov	Cyclone, drought				
44	1902	-	Drought				
45	1907	-	Flood				
46	1908	-	Inundation				
47	1909	Oct	Cyclone				
48	1911	-	Flood				
49	1913	-	Flood				
50	1915	-	Drought				
51	1920	-	Flood				
52	1923	Nov	Cyclone				
53	1924	Nov	Cyclone				
54	1925	March	Tornado, flood				
56	1926	-	Flood				
57	1927	-	Flood				
58	1929	-	Flood				
59	1930	-	Flood				
60	1933	-	Flood				
61	1934	-	Severe flood				
62	1935	-	flood				
63	1937	-	Flood				
64	1938	0ct	Flood, cyclone				
65	1939	-	Flood				

hence after are responsible for local flooding, erosion etc. the storm surges which become an important agent for the loss of life as well property in coastal area. Some of the major cyclonic events are listed in table 5 whereas the table 6 gives the total number of natural hazards that have taken place over 100years.

Suggested Drr Strategies

Community/ Social Level: Policy interventions need to be addressed at social/community level, improving infrastructure level and economic level. Level of preparedness plays a major role in reducing the impact of the disaster on the community. For a community to be

prepared for any natural hazard, they need to realize that they are at risk. In the study area the community though is aware of the risk it faces it is not totally prepared. The main reason as claimed by the people is they have little resources to spare for other than meeting their daily needs. Also the number of helping hands has decreased as the majority of people are migrating out of village for work. These factors must be taken into account while designing any DRR programme and the whole community should be brought together to understand the risks they face and also their vulnerabilities. Local people are the first responders to any disaster, so disaster risk reduction programmes must work to strengthen self reliance and resilience [7]. Community based DRR have been very successful in many countries. Early level preparedness like among school children and women who are general the worst sufferers can be an effective way of reducing disaster risk. Better warning systems can go a long way in helping people avoid disasters. Every community has indigenous way of predicting natural disasters; these practices should be recorded and used. With the increased use of mass communication both in print media as well as televisions, media needs to play a proactive role in advocating preparedness for disaster. Better infrastructure like pucca houses can help reduce high velocity cyclonic winds. The red cross made cyclone shelters in the coastal Orissa helped save thousands of life during supercyclone of 1999. Similarly better roads aid the evacuation process. Infrastructure must be built to withstand local conditions and hazards and a careful analysis of the risks is vital before construction starts. For example, in sandy areas experiencing cyclones, buildings need to be built with deepe foundations. In India, traditional houses of wood and stone survived the Uttarkashi earthquake in 2000, while modern buildings collapsed. Similarly, during the Kutch earthquake, Bhunga circular houses with thatched roofs suffered from minimal damage. Important way of increasing community resilience to disasters is to enhance the financial safety nets. Better insurance policies and available of credit locally can help them tide over the immediate crisis. Helping communities diversify livelihoods has been known to increase the community resilience.

Ecosystem and Natural Resources Management: Ecosystem based disaster management refers to decision-making activities that take into consideration current and future human livelihood needs and biophysical requirements of ecosystems and recognize the role of ecosystems in supporting communities to prepare for, cope with and recover from disaster situations. Healthy ecosystems both reduce vulnerability to hazards by supporting livelihoods, while acting as physical buffers to reduce the impact of hazard events. Developing and protecting wetlands for instance can help reduce the onset of flood. Similarly mangroves have been debated as having storm protection values.

Legislative: India has many legislative acts that are aimed at disaster risk reduction. Coastal zone regulations, 1991 help limit the development in the coastal zone. Similarly Disaster management Act 2005 lays down provision The Act provides for establishment of National Disaster Management Authority. Major functions are to lay down policies on Disaster Management, approve the National plan, approve plans prepared by Ministries/Departments of GOI, lay down guidelines to be followed by State Authorities in drawing up state plans, coordinate enforcement and implementation of policies and plans, recommend provision of funds for mitigation and take measures for prevention, mitigation, preparedness and capacity building for dealing with threatening disaster situation or disasters.

CONCLUSION

From the above discussion it is evident that the natural hazards have induced environmental change in the given study area. The environmental change has increased the vulnerability of the residents. It also has shaped the people in terms of their livelihood, lifestyle etc. The community has tried to adapt with short term strategies. But if there has to be included in the mainstream, better long standing measures needs to be planned and implemented. A holistic approach from economics, ecology, natural sciences is needed to address the present problem along with disaster risk reduction strategies.

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