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CLIMATE CHANGE :- COASTAL DEGRADATION

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Abstract : Climate change threatens coastal areas, which are already stressed by human activity, pollution, invasive species, and storms. Seal level rise could erode and inundate coastal ecosystems and eliminate wetlands. Warmer and more acidic oceans are likely to disrupt coastal and marine ecosystems. Coastal development reduces the ability of natural systems to respond to climate changes. In addition, rising atmospheric concentrations of carbon dioxide (CO_2) are causing the oceans to absorb more of the gas and become more acidic. This rising acidity can have significant impacts on coastal and marine ecosystems. The impacts of climate change are likely to worsen problems that coastal areas already face. Confronting existing challenges that affect man-made infrastructure and coastal ecosystems, such as shoreline erosion, coastal flooding and water pollution, is already a concern in many areas. Addressing the additional stress of climate change may require new approaches to managing land, water, waste and ecosystems.

Index Terms : Climate Change, Coastal Degradation, Salinization, Tropical, Precipitaton, Aquaculture, Calamities, Mangroves, Fog, Meteorological, Dissaster.

INTRODUCTION

One of the most significant aspects of the impacts of climate change, which has unfortunately not received adequate attention from scholars in the social sciences, relates to the equity implications of changes that are occurring and are likely to occur in the future. In general, the impact of climate change on some of the poorest and the most vulnerable communities in the world could prove extremely unsetting. And, given the inadequacy of capacity, economic strength, and institutional capabilities characterizing some of these communities, they would remain extremely vulnerable to the impacts of climate charge and may, therefore, actually see a decline in their economic condition, with a loss of livelihoods and opportunities to maintain even subsistence levels of existence[1].

India has a low-lying densely populated coastline of about 6,500 km. Most of the coastal regions are agriculturally fertile, with paddy fields that are highly vulnerable to inundation and Salinization. Coastal infrastructure, tourist activities, and onshore oil exploration are also at risk. The impact of any increase in the frequency and intensity of extreme events, such as cyclones associated with storm surges, could be disproportionately large. In addition to the loss in heavily developed coastal areas, the people in low-income rural areas will also be affected. The loss of life, property and damage to the infrastructure during the 1999 Super-Cyclone that hit the Odisha Coast is the best example in this case[2].

I. IMPACT OF COASTAL ZONES

India's coastline will be particularly hard-hit by storm surges and Sea-level rise displacing millions, flooding low-lying areas and damaging economic assets and infrastructure. Submergence and deterioration of coastal ecosystems such as Mangroves & Salinization. In many cases, these problems are either caused by, or exacerbated by Sea level rise & tropical cyclones. The key climate related risks in the coastal zone include tropical cyclones, Sea level rise and changes in temperature and precipitation. A rise in the Sea level is likely to have significant implications on the coastal population of India. A one metre rise in Sea level is projected to displace approximately 7.1 million people in India and about 5,764 sqkm of land area will be lost, along with 4,200 km of roads. Damage to coastal infrastructure, aquaculture and coastal tourism, due to the erosion of sandy Beaches is also likely[3].

The coast is under stress of development activities such as industries, ports, defence activities, shrimp farming fishing, tourist inflow, commercial and other activities. The Sea level is rising steadily as an effect of global Sea level rise. The impact has been visible with the symptoms of frequent coastal erosion, water ingress land ward, and Supper-Cyclone in

Odisha (1999). Like any other Country and coastal states in India, the Bay of Bengal Sea Coast in Odisha is also exposed to many developmental activities. The coast will be studded with fourteen ports. Years back these was only one port at Gopalpur which is now upgraded to all-weather port; Paradeep port is already in place in its full capacity; and the Dhamara port is due to be commissioned soon. Expansion of developmental projects and the ancillary activities as well as increase in population density is bound to impact on the mangrove vegetation along the coast[4]. Strengthen coastal defences against a rise in the Sea level as well as the more frequent occurrence of storms and tsunamis through the establishment of bio-shields of mangroves and non-mangrove species[5].

II. TROPICAL CYCLONES

Increasingly frequent and intense tropical and extra tropical cyclones will likely cause severe wind damages and storm surges which, compounded with a rise in Sea level, are expected to become a severe problem for low-lying coastal regions and cities. Ports and other coastal infrastructure are especially at risk[6]. While many states have had to deal with natural disasters and calamities in history, states like Odisha suffers it's almost every other year. 1999 Super Cyclone, 2013 Phailin, 2014 Hudhud, 2016 Ruanu, 2018 Titli, 2019 Fani, Bulbul, 2020 Amphan. In total, Odisha faced 17 big calamities since 2000. 4 most severe cyclones in Odisha :-

1999 Super Cyclone	2013 Phailin	2014 Hudhud	2019 Fani
Wind Speed 276 Km/Hr	Wind Speed 215 Km/Hr	Wind Speed 185 Km/Hr	Wind Speed 250 Km/Hr
Loss of lives 10,000	Loss of lives 44	Loss of lives 02	Loss of lives 64

A Severe Super Cyclonic storm with winds of up to 276 km/hr, crossed the Coast in Odisha on 29 October, 1999. This may prove to have been the worst cyclone of the century in the Odisha region and is responsible for as many as 10,000 deaths, for rendering millions homeless and for extensive damage. Over the past decreased the frequency of tropical cyclones in the North Indian Ocean has registered significant increasing trends (20% per hundred years) during November and May which account for maximum number of intense cyclones[7]. Analysis shows that only 7% of the total tropical cyclones occur in the North Indian Ocean. Based on the data for the period 1891-2000, it is found that only 58% of the total cyclones in the Bay of Bengal crossed the Indian Coasts. In the recent three decades there has been a decline in the number of cyclones crossing the East Coast. Also, the State of Odisha is found to be the most vulnerable to tropical cyclones[8].

An increase in Sea surface temperature in the Oceans, resulting in an increase in the intensity or wind speed of cyclones that form in them, particularly over the Bay of Bengal where over 80 percent of the cyclones originate. Higher wind speeds will also result in bigger storm surges. Combining this projections with over surveys, scientists have concluded that storm surge heights will be far greater under warm conditions. The increased surge heights are over and above the mean Sea level, which itself rises under the impact of warming. The risk of cyclone related disasters is thus far greater in a warmer sub-continent. The vulnerability of the large number of Indians living on the 7000 km Indian Coastline is huge due to the fact that a quarter of India's population lives within 50 km of the coastline. The mean Sea level rise itself, in the absence of protection, can inundate a large chunk of predominantly agricultural land on the coast and the surviving coastline faces the threat of extreme storm surges (A. Nayyar Shami, 2007).

III. MANGROVE WETLANDS AND SUPER CYCLONE

Millions of species of plants, animal and other organisms enrich our environment. Awareness of the importance of this biological diversity has grown in recent years along with concern that more effective action is needed to preserve it. There is an urgency because destruction of ecosystems and species extinction entails irreversible losses. Ecological degradation of wetlands together with pollution has resulted in the loss of flora and fauna. The high amount of fertilizers and other inputs required in agriculture for increasing the productivity has led to the degradation of the environment. Coral reefs and mangroves are threatened by increasing discharge from industrial establishments along the coastal belt. The mangroves of Sunderbans delta have been reduced to half (Kumar, 1999)[9].

Mangroves are exposed to cyclones and storms, therefore, the poor living in low-lying areas and along river channels are most affected by non-maintenance of coastal environment systems. Further, in Gorakhpur city in UP, a low-living region of middle Ganga Basin is facing serious problem of water, logging and flooding due to change in rainfall (average intensity of rainfall has increased in summer) as well as by the degradation of water bodies, unplanned growth and land encroachment[10]. At least 36.9 percent area of the coastline along Odisha Coast is facing Sea erosion, the report said. One of the worst hit due to sea erosion is Satabhaya Panchayat under Rajnagar Block of Kendrapara District. Once a cluster of seven villages, barely one is left as six villages have been gobbled by Sea. At least 91 villages have become highly vulnerable to Sea erosion threat in the Coastal Belt of Odisha. Kendrapara has 49 villages, Balasore and Bhadrak districts have eight villages each, while four are villages in Ganjam. Tandaghar, Chhenu, Udayakani villages under Shishua Panchayat and Kanrapur under Chitreswari Panchayat in the Puri District of Odisha are already threatened by storm events and severe coastal erosion.

Odisha's Forest, Environment, and Climate Change Department has submitted an action plan before the Centre for 2021-30. A number of initiatives are being taken under this plan to prevent sea erosion. The 17 km stretch of the coast near satabhaya is described as the fastest eroding Beach in Odisha and only a small portion of the cluster remains. Around 600 families of satabhaya were shifted to the rehabilitation colony at Bagapatia four years ago facing the fury of the sea. Similarly, Chikiti and Ganjam Blocks are the worst affected by Sea erosion in Ganjam District. Ramayapatana, Chandanbada, and Alatpur in Chikiti and Podempeta in Ganjam are most prone to sea erosion and over 100 houses including pucca ones were washed away in the area during monsoons. The stretch between Gopalpur and Chilika is in a stable condition while the stretch between Paradeep and Dhamara is most vulnerable. The Rushikulya River Mouth is also in a vulnerable situation[11].

Large delta systems are at particular risk of flooding. The area of coastal wetlands is projected to decrease as a result of sea level rise. For a high emissions scenario and high climate sensitivity wetland loss could be as high as 25 percent and 42 percent of the world's existing coastal wetlands by the 2050s and 2100s respectively[12]. Thus increased temperature, lower humidity and reduced precipitation increase the risk of forest fires, which ultimately lead to lower plant

diversity. A Super Cyclone with wind speed of about 276 km per hour struck the coastal areas of Odisha on 29th October 1999 causing extensive damage to life and properties. Immediately after the Super Cyclone, a study was conducted to evaluate the extent of damage caused in areas that were under the umbrella of Bhitarkanika mangrove forest and areas that were not sheltered by mangroves (Badola and Hussain, 2005).

Three Villages with three different physical settings, (i) a village within the shadow of mangrove forest, (ii) a village which is not in the shadow of mangroves and also not protected by embankment that is constructed to avoid sea water intrusion and (iii) a village not protected by mangroves but protected by embankment was selected for the study. All these three villages were located at equidistance from the sea and the socio-economic conditions were also same. Eleven variables such as the cyclone damage to houses, livestock, fisheries, trees and other assets owned by the people and level and duration of flooding etc were used to compare the damage in these three villages. In the mangrove protected villages, variables had the lowest values for adverse factors such as damage to houses. The economic loss incurred per household was higher in the village that was not protected by mangroves but had an embankment. Attitude survey conducted among the people of the villages near by the Bhitarkanika areas showed that they were aware of the rolled played by the mangroves in protecting their lives and properties during the Super Cyclone and also appreciated the protective functions performed by the mangroves. The coastal zone in India, particularly the east coast is vulnerable to hydro meteorological hazards such as cyclones, floods and geophysical hazards like tsunami. A recent simulation study showed an increase in occurrence of cyclones in the Bay of Bengal in the increased greenhouse gas scenario, particularly in the post monsoon period. The same study also indicated that wind speeds associated with cyclones will also reach maximum increased due to climate change[13].

IV. SALINIZATION OF THE COASTLINE

The ground water reservoirs in coastal areas will get contaminated due to intrusion of seawater, decreasing the quality of potable water in the major metro cities such as Chennai and Mumbai. Fresh water bodies in many many coastal areas such as the backwaters of Kerala, the Sunderbans of Bengal and Chilika, Udayakani, Chhenu, Tandaghara, Kanrapur, Keutajanga in Puri District in Odisha will also get contaminated due to saline influx from the sea. Hence, the salinity of the water both within the mangrove forest, as well as near the sea is lower than that of seawater. In most of the mangrove wetlands, dramatic changes are noticed in the species. Expect in Andaman and Nicobar Islands, in all other mangrove wetlands of India, low saline-tolerant species are gradually disappearing and species that can tolerate a high and broad range of salinity are becoming dominant. At the micro-level the floral components, forest structure and biomass of the mangrove wetlands are determined by the quality of fresh water and the salinity of water present in the pores of the soil. Climate, tidal amplitude and mineral content of the soil are the factors that control soil and poor water salinity[14]. These factors very slowly over a long time period of human activities, experimental evidences indicate that at high salinity, mangrove plants spend more energy to maintain water balance and ion concentration rather than for net primary production and growth. Hence, an increase in salinity due to reduction in fresh water flow would lead to the disappearance of the low salinity tolerant species, through a gradual decline of the population[15].

V. IMPACT OF FOG DAYS

Scattering of Sunlight by extremely small (usually 1 micrometer) particles suspended in the atmosphere gives rise to hazy conditions. However, in winter, fog is formed under various meteorological conditions. Such as night cooling, inversion layer, high relative humidity, little or no wind conditions in the presence of suspended particles etc. Fog by itself is a natural phenomenon. Under normal circumstances, fog dissipates as the Sun rises sometimes the cool air is so deep that the radiation effects accompanied by subsiding anticyclone makes the fog last all day or even for several days continuously. If a large amount of pollutants are trapped within the atmosphere, the dissipation of fog may be prolonged. Because the suspension of water droplets, visibility reduces during fog. By international agreement, horizontal visibility less than 1 km is classified as fog. There are different types of fogs depending upon the physical process that produces saturation or near saturation of the air. Such as Sea fog, land-and-Sea breeze fog, tropical air fog, ground fog, high-inversion fog, advection fog. radiation fog, upslope fog, steam fog and so on[16].

Fog conditions during winter, especially in the coastal part of our Country, not only create a lot of inconvenience to the public, but also cause loss of lives and damage to agricultural products. On most occasions, fogs are the result of the combined effect of two or more such physical processes. Dew point temperature is a very important factor for fog formation. It is the temperature to which the moist air must be cooled so that it is saturated with respect to water at the existing pressure and humidity of the atmosphere. The exact atmospheric conditions necessary for fog formation are not well understood. In addition to the favorable meteorological conditions described above, development of high pressure, and spells or rainfall can enhance or prolong the fog. Based on the recent past, fog is observed to be much intense in rural areas and over agricultural fields where the pollution is far less. This fact makes the understanding of fog formation more complicated. The inter-annual variation of the characteristics of this anticyclone, when combined with other factors may give rise to different fog conditions from year to year. On the scientific facts for fog formation and the limited observations over a period of only three years, it may be stated that visibility does not have a one-to-one relationship with any single meteorological or air quality parameter. Such as relative humidity, dew-point temperature[17].

VI. DISASTER MANAGEMENT IN COASTAL AREAS

The livelihood security of the coastal communities and ecological security of the coastal zones of India is already under stress due to high population density, rapid urbanization and industrial development high rate of coastal environmental degradation and frequent occurrence of natural disasters such as cyclones and storms. This made more than 100 million people, who directly or indirectly depend on coastal natural resources for their livelihood, vulnerable. The problem is going to be further aggravated by increase in Sea level rise due to climate change. It has been projected that along the Indian coast Sea level would rise by 39 to 57 cm by 2050 and 78 to 114 cm by 2100 due to climate change.

The coastal zone in India, particularly the East Coast is vulnerable to hydro meteorological hazards such as cyclones, floods and geophysical hazards like tsunami. Meteorological data show that more than 1000 cyclonic disturbances

occurred in the Bay of Bengal during the last century; out of which over 500 were either depressions or over 400 were either cyclonic storms or severe cyclonic storms. Out of 205 severe cyclones for which records are well documented, 55 affected the coastal zone of Tamil Nadu, 59 crossed the coastal areas of Andhra Pradesh, 58 hit Odisha coast and 33 struck West-Bengal. Depending on the location, the risk of hydro meteorological hazards ranges from moderate to high and that of geophysical hazards from low to moderate. A recent simulation study showed an increase in occurrence of cyclones in the Bay of Bengal in the increased greenhouse gas scenario, particularly in the post monsoon period. The same study also indicated that wind speeds associated with cyclones will also reach maximum increased due to climate change[18].

VII CONCLUSION

Coastal areas are also vulnerable to increases in the intensity of storm surge and heavy precipitation. Storm surges flood low-lying areas, damage property, disrupt transportation systems, destroy habitat, and threaten human health and safety. Climate change is likely to bring heavier rainfall to some coastal areas, which would also increase runoff and flooding. In addition, agricultural fertilizers contribute to algal blooms. When the algae sink and decompose, the process depletes the oxygen in the water. Decreases in precipitation could also increase the salinity of coastal waters. Droughts reduce fresh water input into tidal rivers and Bays, which raises salinity in estuaries, and enables salt water to mix further upstream. Estuaries are particularly sensitive to many projected impacts of climate change, including erosion from rising seas, changes in storms frequency and intensity and the amount of precipitation. EPA's climate Ready Estuaries Program work with National Estuary Programs and other coastal managers to :- (i) Assess climate change vulnerabilities. (ii) Engage and educate stakeholders. (iii) Develop and implement adaptation strategies. (iv) Share lessons learned with other coastal managers.

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