

# Climate Change Induced Inequality in the Sundarbans, India

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**Abstract:** *Inequality is the most anticipated topic to dwell on climate change discussions. Evidence - based research shows that there is a vicious cycle of suffering for disadvantaged people due to the adverse effect of climate change which has eventually given way to inequality. Sundarbans is one of the world's largest tidal mangrove forests, home to many endangered species of wildlife and approximately 4.5 million inhabitants. With its unique flora and fauna, Sundarbans consists of a total of 102 islands out of which only 54 islands are inhabited by humans. Its unique ecosystem is the epitome of several natural calamities that have caused havoc on the region and its population. Being the hotspot of climate change, Sundarbans have faced multiple natural hazards like depletion of islands, the epicentre of the tropical cyclone, sea level rise, sudden climate change, high tide, etc. which has resulted in nearly 30, 000 climate induced refugees in the last three decade of the region. The presence of adequate healthcare facility and proper health of the community not only enhances the community growth but also results in socio - economics development of the community. The study of this paper shall intend to investigate the recurring issues that are faced due to climate change by the community of the Sundarbans region of India. Identifications of the probable issues and their impact on the inadequacies of healthcare facility due to climate change resulting on the exposure of the vulnerability of the community which are further amplifying in inequality and disparity of the region.*

**Keywords:** climate change; vulnerability and inequality; health; healthcare infrastructure

## 1. Introduction

Climate change has surfaced as one of the emerging topic of global issues around the world over the past few decades. Climate change has resulted in many calamities like rising sea level, increase in surface temperature, unpredictable weather, storms surges and tidal surges, cyclones, increase in flood and erosion of shore line. Climate change is a subtitle effect which has resulted in creation of havoc due to prolonged ignorance. It has not only effected the nature but also humankind which has led to issues like food scarcity, social problems, and health hazards and many more. Livelihood, health and quality of life plays a vital role in the development of the community as well as of socio - economic development of a country [1]. Exposure to bio - physical factors emerges the vulnerability of a communities to climatic changes and hence results in factors like socio - economy of the communities. Recent study of Intergovernmental Pannel on Climate Change report says that the coastal region and low - lying regions are at greater threats due to global warming which results in sea level rise, health hazards, salinity of water, embankment erosions. The burning example of these are the regions of Sundarbans, India. With the increase of climate induced inequality in the regions there are approximately 30, 000 climate induced refugees in the last three decade. This region has many islands which have submerged or on the verge of submerge among which islands like Ghoramara and Lohachara have faced the fate [2]. The region is prone to annual cyclones, receives heavy rainfalls. The Amphan cyclone in 2020, Aila in 2000 and Sidr in 2007 few strong cyclones that has cause havoc in the region [3]. Infrastructure in this region is very fragile and under - developed [2]. There is a pertinent issue of electricity, poor road network connection. There are still few islands which have no direct road connectivity to the main island. Thus this rise too many difficulties faced by the locality. Therefore assessing all these related factors are essential for preparedness and sustainability development of these community to become resilient.

Human development is very essential for the vulnerability resilient development of any study area. In the report prepared by UNDP, it says that Human Development Index (HDI) is the measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living [4]. Further factors affecting development in terms of HDI are the presence of social infrastructure that is equally important and helps in achieving HDI. These social infrastructure consists of amalgamation of all the factors which are requires for the development of humans that results in economic development also. Theses infrastructure consists of healthcare facilities; educational facilities; public facilities and transportation facilities [5]. One of the major factor for human development are the availability of health and healthcare facility that resilient to exposure of vulnerability of climate change. Internationally, researchers have used vulnerability indices consists of indicators of climate change in terms of change of temperature and precipitation, change in sea level change, amplification of hazards, storm surges, and coastal erosion, and their cumulative effect on the livelihood vulnerability of the local marginal people [6]. Therefore the present study has attempted to identify the indicators of climate change in terms of available healthcare facility in the region, storms surge susceptibility, flood suspetibility, availability of ground water, connectivity of transportation and analysing and finding out the most vulnerable parts of the region which are suffering climate induced inequalities.

## 2. Study Area

The Indian Sundarbans is a part of delta which has formed due to silting of Ganga - Brahmaputra - Meghna [7]basin along with other tributaries of Mayurakshi, Damodar, Ajay and Kansai river. It is dominated by periodic high tide and low tide and falls under the lower deltaic plain of India and Bangladesh. The main estuaries from east to west are the Raimongal, the Kalindi, the Gosaba, the Bidyadhari, the

Volume 12 Issue 12, December 2023

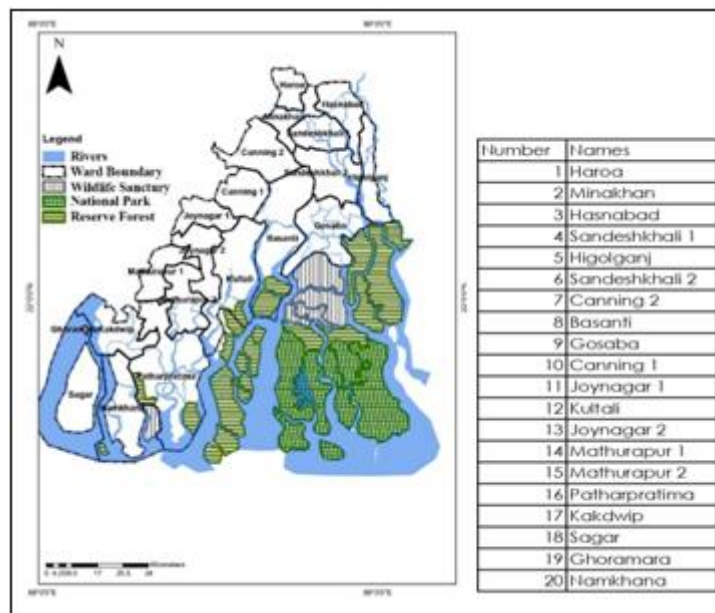
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Herobhanga, the Bidya, the Matla, the Thakuran, the Saptamukhi and the Hooghly [8]. The average tidal amplitude in these estuaries ranges from 3.5 to 5.0 metres [8]. Sundarbans comprises of nineteen blocks of North 24 - Parganas and South 24 - Parganas Districts of West Bengal [8]. There are total 102 islands among which 54 islands of this region are inhabited by human. The land area measures about 9629 sq. km., of which, 4493 sq. km. is liveable and the rest are Reserve Forest.

Sundarbans is home of 4.5 million people [7], among which socio - economic profile of 85 percentage of the demography depends upon single paddy crop and other

occupation consists of fishing, agriculture, aquaculture, forestry and tourism sector [9] [10]. The main source of economic activity of the Sundarbans region is the rain - fed paddy agriculture. Over 32000 household are involved in forestry. Approximately 60 percentage of the total working population depends upon agriculture. According to the survey carried out by World Bank it is observed that 11 percent of the household are engaged in fishery occupation. . The dominating traditional fishing areas area Sagar Island, Fraserganjand Bakkhali [10]. As per census 2011 the total population is 4426259 among which 1573859 is the total schedule cast population and 211927 is total schedule tribe [11].



Map of Sundarbans

Source: Author

**Climate and its impact:**

The Sundarbans of the Indian region is currently under severe climate change threats which has resulted in multiple natural hazards like cyclone, high sea level rise, erosion of the islands, climate refugees, threat to endangered species and wildlife of the region, increasing salinity of the water. Although there are various uprising issues related to climate change, few of them has been broadly categories after secondary survey.

As of rising sea level it is observed that the tide gauge data of Sagar Island observatory for the period 2002 - 2009 indicated a rise in the Relative Mean Sea Level (RMSL) at the rate of 12 mm/year during the decade [9]. There is an average 3 centimetres rise of sea level in the past two decades leading to the fastest rates of coastal erosion in the world and has lost 12 percentage of its shoreline in the last four decacde [12] [13]. It is clear from the Land Use Land Cover map of 2017 and 2022 that due to the rise in sea level has resulted in land cover of water logged area. The situation in Ghoramara Island is one of the worse as thousands of settlers were forced to migrate to nearby islands as half of the land mass was lost due to rising sea level. Sundarbans is the world’s largest contiguous mangrove forest and is a designated world heritage site. Shared by India andBangladesh, it is home to several species including

tigers. The habitat supports approximately 4.37 million people. As per the research conducted it is believed that the Sundarbans have soaked in 4.15 crore tonnes of carbon dioxide. Due to climate change the Sundarbans faces several challenges. With rising sea levels, islands are disappearing and the increasing salinity in the water and soil has severely threatened the health of mangrove forests and the quality of soil and crops. Additionally, there have been serious disturbances to hydrological parameters and change in fishing patterns, resulting in disastrous consequences for fishermen. Frequent cyclones and erratic monsoon raining pattern are damaging ecology and humanity.

In addition to general environment protection laws, India has also set up institutes at both the Central and State levels to specifically tackle the effects of climate change on Sundarbans. However, split responsibilities between Centre and States and multitude of institutions has resulted in overlap of responsibilities, loss of time and resources, which makes the institutions ineffective.

With risk of the Sundarbans submerging, there is an urgent need for global reduction of emissions and replacement of fossil fuels with renewable energy. Governments also need to promote plantation of local saline resistant seeds. Even as the State and Central Government of India finalise action

plans to tackle the problems of climate change and take steps for poverty alleviation in one of the world’s poorest regions, there is a pressing requirement to set up flood relief centres and rapid action response teams to cyclones and storms.

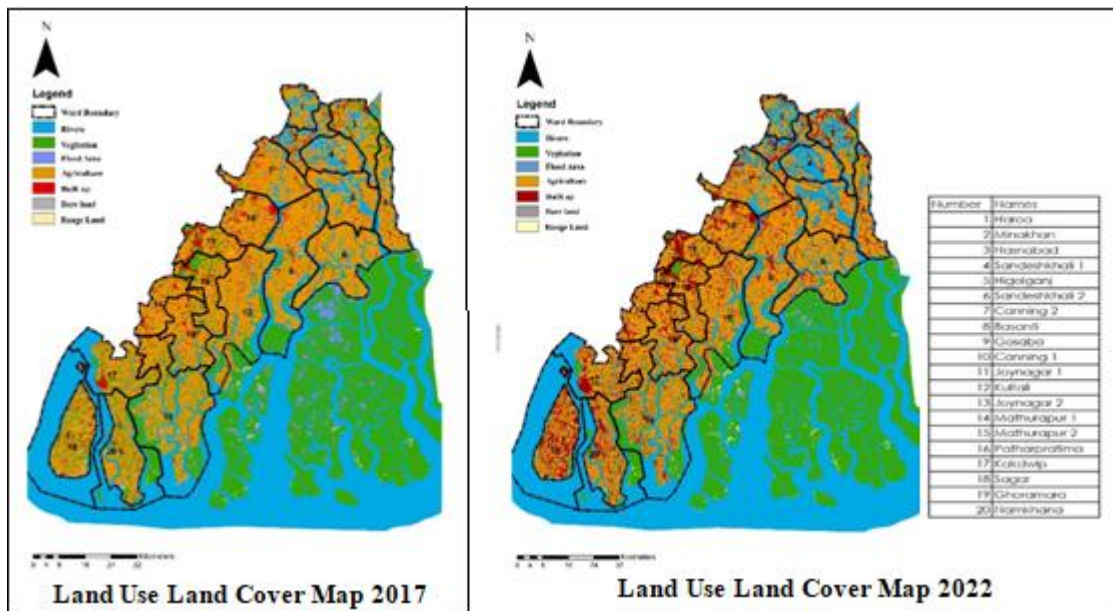
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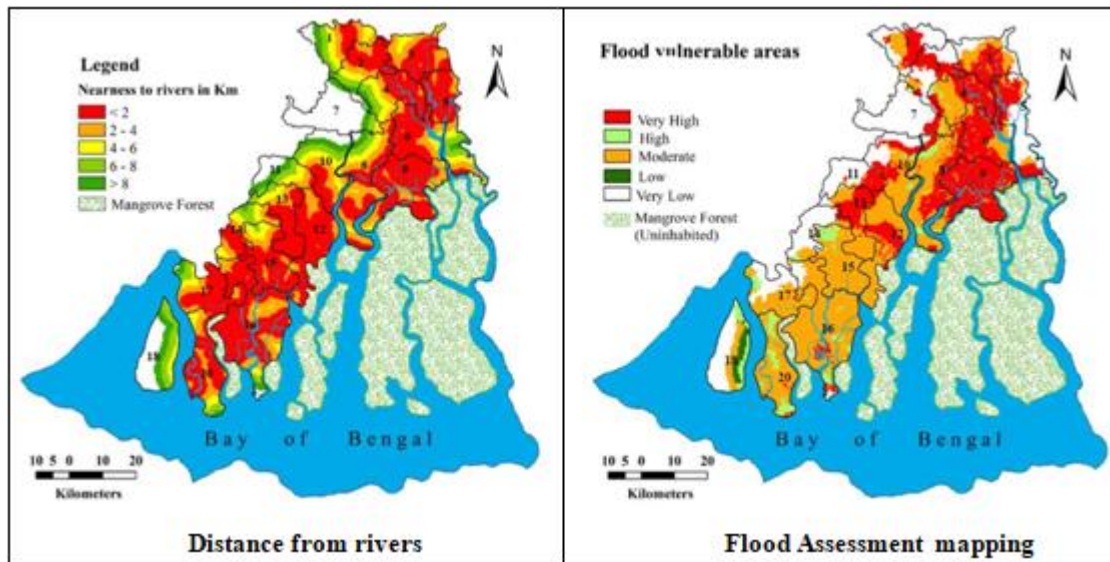
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There is significant effect of climate change which has resulted in temperature change, rainfall pattern and cyclone activity in the region. From 1980 to 2007, the temperature of the water has increased at an accelerated rate of 0.5<sup>0</sup>C per decade compared to the observed global sea level temperature warming at the rate of 0.6<sup>0</sup> per decade [14]. Current projections forecasts that the temperature will rise by 1<sup>0</sup>C by 2050 [9]. The figure below shows that the susceptible floor prone area that will be effected due to the climatic changes. Due to the climatic changes consequences like severe cyclone like Sidr, Nargis, Bijli, Fani, Amphan has occurred and its frequency are increasing. Many climate changes can be the results of human interventions; as the below maps show that there is increase in built - up area in past five years, which has resulted decrease of green vegetation.



Source: ESRI and Author



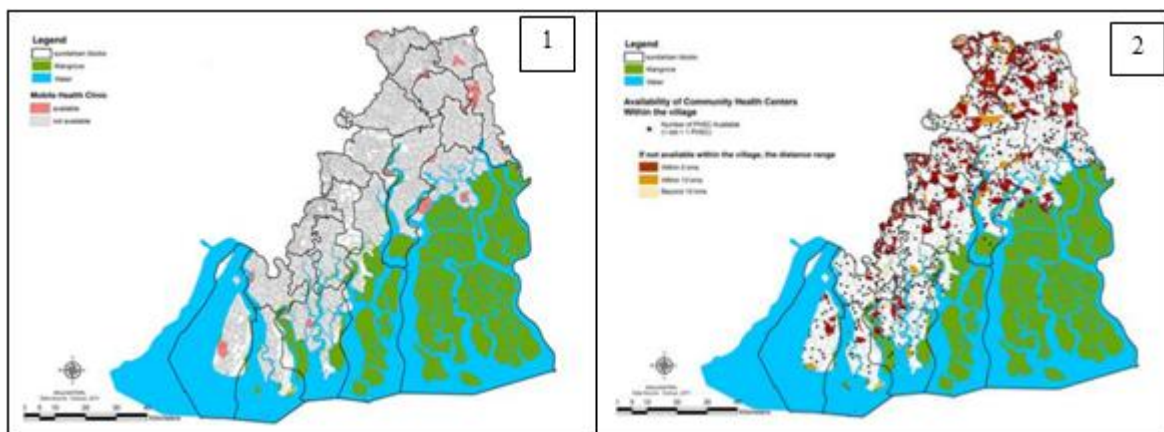
Source: [15]

**Climate change effecting health and healthcare infrastructure:**

Health and Healthcare infrastructure is very essential for development of a community. But from the study it is observed that health is a major issues that are extremely alarming in the region. With most of the islands deprived of proper road infrastructure, makes them completely isolated and hard to reach. Increasing water salinity in the region and improper WASH (Water, sanitation and hygiene) has targeted majorly women, children and elderly in terms of inequality and disparity.

With drastic climate change resulting in induced sea level rise, flooding and cyclone have increased the manifold in the Sundarbans putting poor villager’s into health risks. Almost every type of communicable diseases primarily related to respiratory and gastro - intestinal system are highly prevalent in the region [16]. Above all as per research carried forward by The Indian Institute of Health Management Research (IIHMR) is observed that children are the worst affected in the region with diseases like diarrhoea, typhoid, malaria, dengue among all and facing problems related to malnutrition and stunting are extremely prevalent. Spending hours in waist deep water as their regular practice for aquaculture and fishing, women in the region face issues like menstrual, urinary tract and other

infections. Irregular menstrual cycle, vaginal infection, recurring UTI and miscarriages are some of the prevailing problems due to exposure to saline water among the women [16]. Tube wells in the area has been constantly being contaminated due to frequent floods and storms. During flood and storms the tube wells in low lying area gets submerged leaving behind trail of impurities after the water recedes. Open defecation along the river banks leads to severe pollution of the waterlogged area during disasters enhancing in water borne diseases. As per studies and surveys carried out by Institute of Health Management Research under Future Health Systems exposes that there is high malnutrition rate within the households that has faced at least one climatic shock in the five years. The result describes that 45 percent of children among poor families who faced at least one climatic shock in the last five years are underweight [17]. Forty four percent of them are stunted, compared to 39 percent and 33 percent respectively for the children who did not face any shock. [17]. With disrupted health care system and other infrastructure during natural calamity events, the hardship is drastically faced by pregnant women, physically challenged people, elderly who constantly need medical help. Lack of adequate access to safe water and sanitation is one of the major issues for child mortality.



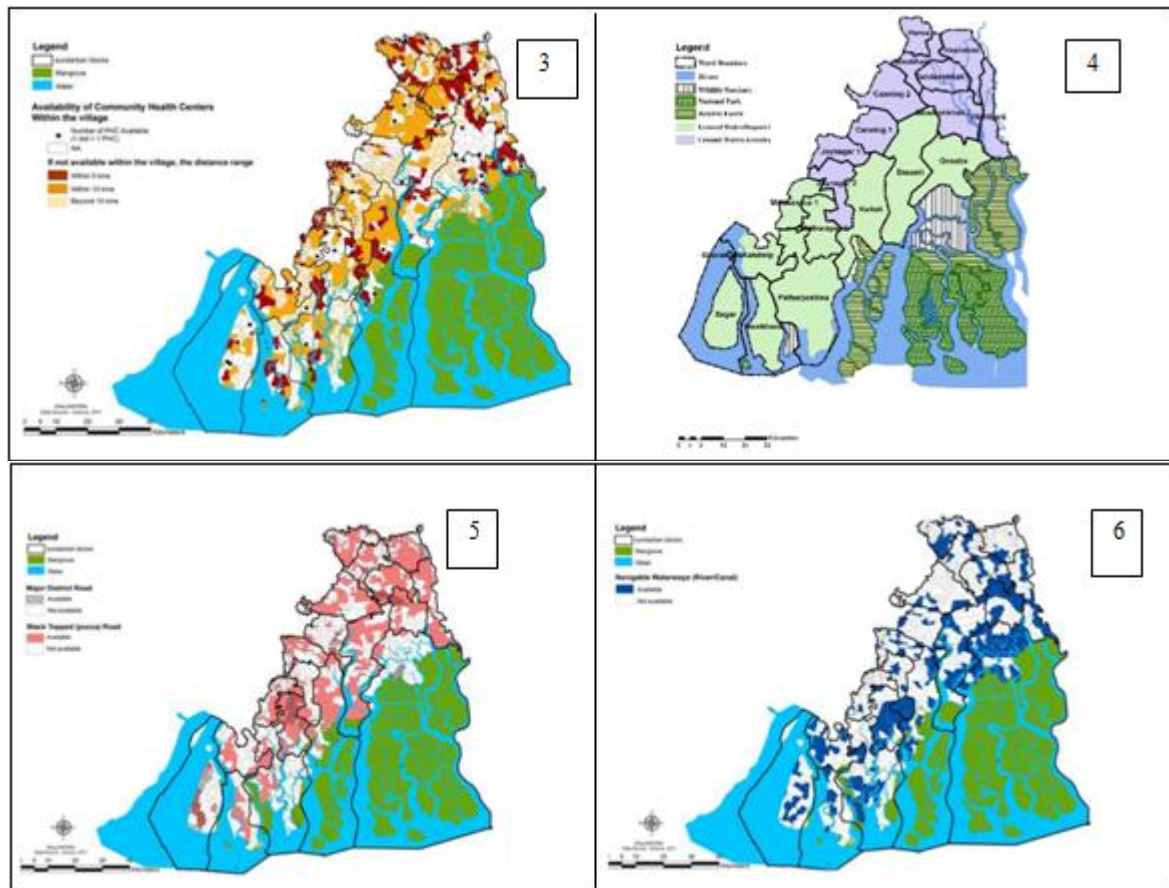


Figure 1, 2 and 3 shows the availability of healthcare facility in the region. Figure 4 shows the available ground water and figure 5 and 6 shows the available transportation present.

Source: Figure 1, 2, 3, 5, 6 [18]; Figure 4: Author

### 3. Discussion

There is a huge lack of healthcare infrastructure as per Health care Infrastructure Index. In the analysis of Healthcare Infrastructure it is observed that Canning - II, Haroa and Gosaba are having very poor infrastructure perhaps due to lack of proper availability of transport connectivity and isolation issues where as Canning - I, Jaynagar - I, Mathurpur - II have comparatively moderate level of healthcare infrastructure. The situation in Gosaba is extremely alarming [19]. As we know availability of safe drinking water is a necessity for livelihood there is a serious issue of the same in the region. With the areas like canning 1 and canning 2, Sandeshkhali, Hasnabad, Joynagar 1 and Joynagar 2 has persistent arsenic drinking water issues and places like Sagar Island, Ghoramara, Patharpratima has few chemical substances present in the drinking water. Sandeshkhali 1 and Sandeshkhali 2, Hasnabad, Higoiganj areas are extremely susceptible to flood and also belongs to waterlogged area. There are services of mobile health clinic is available but during situation of natural calamities like flood or cyclone, these areas becomes completely isolated from the other parts. With the rising sea level, it seems that areas like Haora, Hasnabad, sandeshkhali 1, Higoiganj, Basanti, parts of Canning 2, Gosaba will be completely submerged in the sea or be permanently be waterlogged which will make the community even more vulnerable. Haora, Gosaba, Sandeshkhali 2 are the regions which are having extremely susceptible in terms of healthcare infrastructure as well as constant threat to climatic changes

calamities as few parts in the region are neither connected by roadways nor by waterways.

### 4. Conclusion

UNDP defines good health is essential to attain sustainable development of a community. Health and development is intricately connected. It should be noted that good health induces good economic growth. Availability of good drinking water is very crucial along with availability of good healthcare facility. The present study has focuses on the climate induced inequality in the region due to unavailability of poor healthcare infrastructure due to the cause of ongoing climate changes. Efforts have been made in the research focusing on the identification of the susceptible area to flood by Land Use Land Cover map of 2017 and 2022, distance from the river analysis. After the identification of the susceptible area of the flood prone region furthermore identifying the availability of the healthcare facility in terms of mobile health clinic and community centres in the region and availability of metal road and water transportation system. The study then analysis the most vulnerable areas which gets totally disconnected due to unprintable high tides and natural calamities which gives rise to inequality and disparity of these regions.

The main result of this research is the identification of the regions having disparity and inequalities in terms of shortage of healthcare infrastructure which are the outcome of the climate changes like rise in high tidal levels, sea level rise,

and constant waterlogged areas in the Sundarbans. These findings can be used further for achieving resilient planning approach by the Governments to reduce the inequalities faced by the vulnerable communities and to opt for site specific coping and adaptation planning approaches.

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