

# Disatrous Challenge due to Climate Change in Bihar, Developing State of India

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**Abstract—** Available evidence shows that there is high probability of increase in the frequency and intensity of climate related natural hazards due to climate change and hence increase in potential threat due to climate change related natural disasters in India, and Bihar is no exception to this. It is highly vulnerable to hydro-meteorological natural disasters, with North Bihar in general being highly flood-prone, and South Bihar being highly drought prone.

As detailed in the Vulnerability Atlas of India, 27 districts in Bihar are fully affected by high-speed winds of 47 m/s intensity. The area of districts—Banka, Jahanabad, Arwal, and Nalanda is nearly 90 percent affected. Other districts of South Bihar except Nawada are partly affected by high-speed winds of 44 m/s. In all 86 percent of the total area of Bihar is prone to high-speed winds of 47 m/s intensity and only 14 percent of the area prone to high-speed winds of lesser intensity. In order to mitigate the above disaster we have to minimise the ill effects considering the factors causing the climatic change.

**Index Terms—** Climatic change, Natural Disaster, Earthquake, Flood, Drought, Cyclone, mitigation.

## 1 INTRODUCTION

Climate change will have wide-ranging effects on the environment, and on socioeconomic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity and coastal zones. Changes in rainfall pattern are likely to lead to severe water shortages and/or flooding. Melting of glaciers can cause flooding and soil erosion. Rising temperatures will cause shifts in crop growing seasons, which affects food security, and changes in the distribution of disease vectors putting more people at risk from diseases such as malaria and dengue fever. Temperature increases will potentially severely increase rates of extinction for many habitats and species (up to 30 percent with a 2° C rise in temperature). A rise in extreme events will have effects on health and lives as well as associated environmental and economic impacts.

## 2 BACKGROUND

Because of the speed at which change is happening due to global temperature rise, it is urgent that the vulnerability of developing countries to climate change is reduced and their capacity to adapt is increased and national adaptation plans are implemented. Future vulnerability depends not only on climate change but also on the type of development path that is pursued. Thus adaptation should be implemented in the context of national and global sustainable development efforts. The international community is identifying resources,

tools and approaches to support this effort. Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes. There are many options and opportunities to adapt. These range from technological options such as increased sea defences or flood-proof houses on stilts, to behaviour change at the individual level, such as reducing water use in times of drought and using insecticide sprayed mosquito nets. Other strategies include early warning systems for extreme events, better water management, and improved risk management, various insurance options and biodiversity conservation.

### 2.1 THE NATIONAL CONTEXT

India's economy and a majority of its population are highly dependent on climate sensitive sectors such as agriculture, animal husbandry, fisheries, tourism, etc. Since climate change is expected to impact natural and human systems adversely by inducing changes these systems, India can be considered highly vulnerable. Climate change is only likely to exacerbate India's already high physical exposure to climate-related disasters (65 percent of India is drought prone, 12 percent flood prone and 8 percent susceptible to cyclones). As a consequence, climate change is highly likely to impact livelihoods by disrupting social, cultural, economic, ecological systems, physical infrastructure, and human assets, accentuating health risks, and as such, posing severe risks to the development of the country. Since climate change impacts are felt at multiple levels from the global to the local, responses to climate change too need to be at multiple levels, calling for strategic Interventions at local, sub-national, national, and global

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### 2.3 THE BIHAR CONTEXT

Available evidence shows that there is high probability of increase in the frequency and intensity of climate related natural hazards due to climate change and hence increase in potential threat due to climate change related natural disasters in India, and Bihar is no exception to this. It is highly vulnerable to hydro-meteorological natural disasters, with North Bihar in general being highly flood-prone, and South Bihar being highly drought prone. In the (relative) absence of state level climate models and/or vulnerability studies, as well low community awareness, Bihar is potentially more sensitive and vulnerable to the climate change and its impacts

### 3.0 CLIMATE CHANGE IN BIHAR

The term climate change is often used interchangeably with the term global warming, but climate change is preferred to global warming because it helps convey that there are other changes in addition to rising temperatures. Climate change refers to any significant change in measures of climate such as temperature, precipitation, or wind lasting for an extended period (decades or longer). Climate change may result from: natural factors, such as changes in the sun's intensity or slow changes in the Earth's orbit around the sun; natural processes within the climate system (e.g. changes in ocean circulation); human activities that change the atmosphere's composition (e.g. through burning fossil fuels) and the land surface (e.g. deforestation, reforestation, urbanization, desertification, etc.)

### 4.0 CAUSES OF CLIMATE CHANGE

We see climate changing rapidly now as the general warming of the earth has been characterized as "global climate change" meaning the general weather everywhere isn't going to "be like it used to" in the near future. Climate may change in a single region or across the whole planet. There are various causes of change which can be brought about by a variety of factors. These include natural external factors, such as changes in solar emission or slow changes in the earth's orbit; or natural internal processes of the climate or earth system such as volcanic activity; or, as has occurred recently, human-induced (anthropogenic) factors.

In the past the conversion of most of the temperate forest zones into agricultural land changed the ecology and the local climate. After the Industrial Revolution, industrialization, urbanization and population growth have caused the spread of enormous pollutants effecting the deliberate modification of the climate. Combustion of a great amount of fossil fuels has caused an increase in the concentration of greenhouse gases resulting in global warming and climate change. This has altered the wind, cloud and precipitation pattern. The land use

has also an effect on the climate such as deforestation, agricultural work and urbanization.

### 4.1 CLIMATE PROFILE AND VULNERABILITY AND CLIMATIC CONDITIONS IN BIHAR

The cold weather commences early in November and comes to an end in the middle of March. The climate in the cold weather is pleasant. The days are bright and warm and the sun is not too hot. As soon as the sun sets the temperature falls and the heat of the day yields a sharp bracing cold. The mean temperature in Bihar varies from 10 C to 18 C. January is the coldest month in Bihar. Light fog occurs occasionally during daytime especially in the month of January. Some times Bihar gets light winter showers in December-January. The hot weather sets in the end of March and lasts until the middle of June.

The highest temperature is often registered in May, which is the hottest month in the state. Like the rest of the northern India, Bihar also experiences dust storms, thunder-storms and dust raising winds during the hot season. Dust storms having a velocity of 48-64 km/Hour are most frequent in May and with second maximum in April and June. The hot winds (loo) of Bihar plains blow during April and May with an average velocity of 8-16 km/hour.

This hot wind greatly affects human comfort during this season. Soon after Mid June the monsoon season commences and continues till the end of September, the beginning of this season occurs when a storm from the Bay of Bengal passes over Bihar. The commencement of monsoon begins as early as the last week of

May or as the first or second week of June. The rainy season begins in June. The rainiest months are July and August. The rains are the gifts of the southwest monsoon. There are two distinct areas in Bihar where rainfall exceeds 1800mm. These lie on northern and north-western wings of the State. The southwest monsoon normally withdraws from Bihar in the first week of October.

An important feature of the retreating monsoon season in Bihar is the invasion of tropical cyclones originating in the Bay of Bengal at about 120 N latitude. Bihar is also influenced by the typhoons originating in the South China Sea. The maximum frequency of the tropical cyclones in Bihar is during September-November especially during the asterism called hathiya. These cyclones are essential for the maturing of paddy, and are required for the moistening of the soil for the cultivation of rabi crops.

### 5.0 EARTHQUAKE IN BIHAR

Being located in the high seismic zone perched on the boundary of the tectonic plate joining the Himalayan tectonic plate near the Bihar-Nepal Border and having six subsurface fault

lines penetrating through its Gangetic planes in four directions, Bihar is vulnerable to the worst kind of disaster caused by earthquake of near maximum intensity.

In all 21.1 percent of the total area of Bihar falls in Zone III. Thus, Bihar has suffered ten earthquakes in a span of 247 years. Earthquakes ranging from 5.5 to 8.3 on the Richter scale has rocked and wrecked Bihar. The latest earthquake was reported on 18th Sept. 2011 at 6.12 pm on 6.8 Richter scale with epicentre being in Sikkim – Nepal region. Only 10 deaths were reported in the state. The worst of these was in 1934, one in which more than 25,000 persons lost their lives. Bhatgaon in Nepal and Munger in Bihar were completely ruined. Large part of Patna and Kathmandu in Nepal and Motihari, Muzaffarpur and Darbhanga in Bihar were also destroyed along with innumerable villages in between.



Figure 2: Cyclonic storm vulnerability zone-wise

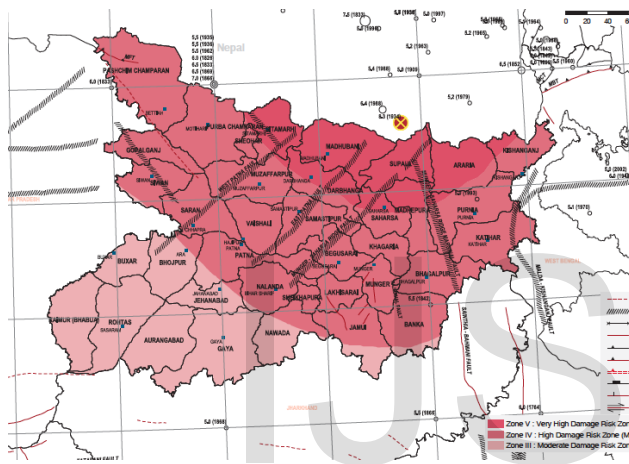


Figure 1: Earthquake vulnerability zone-wise.

## 6.0 CYCLONIC STORMS (HIGH SPEED WINDS)

Among the natural hazards of the surface cyclones (High Speed Winds) are by far the most devastating both by causing loss of life as well as loss in terms of socio-economic development.

As detailed in the Vulnerability Atlas of India, 27 districts in Bihar are fully affected by high-speed winds of 47 m/s intensity. The area of districts—Banka, Jahanabad, Arwal, and Nalanda is nearly 90 percent affected. Other districts of South Bihar except Nawada are partly affected by high-speed winds of 44 m/s. Nawada In all 86 percent of the total area of Bihar is prone to high-speed winds of 47 m/s intensity and only 14 percent of the area prone to high-speed winds of lesser intensity.

## 7.0 CONCLUSION

Climatic change of Bihar and adjoin developing state of India compelled us to mitigate the issues relating to disasters in the State include the recurring nature of the main event categories – Earthquake, floods and droughts. The Kosi River is the main cause of recurrent floods in north Bihar. The river runs through a steep gradient in Nepal. Rainfall in the Kosi catchment in Nepal overloads the barrage compelling release from the Barrage, which causes floods and waterlogging in north Bihar. The heavy discharge from the Barrage causes downstream Bagmati, Burhi Gandak, and Ganga rivers to inundate. In addition, the discharge carries enormous amounts of sandy silt that gets deposited over arable land and renders it fallow.

Additionally, disasters, as and when they occur, are exacerbated by a number of factors; some of these include:

- High population decadal growth rate;
- Illiteracy in general and Female illiteracy in particular, and therefore, low awareness levels;
- Low per capita income;
- Rural roads in poor condition;
- Scarce health infrastructure;
- Sand casting and changes in land use due to sand casting;
- Lack of adequate tree/green cover and resultant soil erosion;
- Debris disposal;
- Damage to water management resources;
- Damage to plantations;
- Increasing salinity due to poor drainage;
- Pressure on environmental resources in areas receiving the out-migration; and
- Environmental degradation due to pollution caused by reconstruction

**ACKNOWLEDGMENT**

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