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## **A STUDY ON ECONOMIC IMPACT OF CLIMATIC CHANGE IN THE METROPOLITAN CITIES: WITH SPECIAL REFERENCE TO MUMBAI**

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### **ABSTRACT:**

Mumbai is the financial capital of India. Millions of people come here across the country in search of jobs. It has an economic growth of 7% per year, according to the economic survey of 2022-23. It is the largest economy of Maharashtra so far, but also at risk of developing natural and climatic changes due to global warming, like as flooding, major health issues for the population, and changes in the topology with dwindling land mass, and property loss on the other.

Some of the effects can be of rise in deaths from communicable diseases, floods, and sea-level rise, which have been shown as an economic loss for the years 2025 and 2050. The economic costs of the rise in seawater level in terms of loss of infrastructure along the coastal line have also been projected from 2025 to 50. The costs arising due to the increase in malaria, diarrhoea, and other vector-borne disease outbreaks have been shown till 2050. Tourism has also been badly affected due to climatic change in Mumbai.

Majorly in Metropolitan cities, a large amount of the population uses air conditioners, refrigerators, televisions, etc. Automobiles and home appliances use a lot of energy and some of them release CFCs and other greenhouse effect gases into the atmosphere, which makes the population sick and less productive. This also leads to economic loss in the country.

### **INTRODUCTION:**

#### **GEOGRAPHICAL LOCATION**

Mumbai is located on the western coast of Maharashtra state in western India, at the border of the Arabian Sea. The city is on a narrow peninsula (a piece of land that is almost entirely surrounded by water but is connected to the mainland on one side) on the southwest of Salette Island, which lies between the Arabian Sea to the west, Thane Creek to the east and Vasai Creek to the north.

#### **WHAT IS THE REGIONAL IMPORTANCE OF MUMBAI?**

3 million people commute from surrounding areas to Mumbai for work. The population of Mumbai is constantly growing, taking the young workforce from neighbouring cities. It is the most populated city in the world.

The city contributes 40% of the state income of the whole Maharashtra.

The Hi-tech industry is growing call centres, online banking, and software development also increased the employment opportunities in Mumbai.

### **WHAT IS THE NATIONAL IMPORTANCE OF MUMBAI?**

Mumbai is one of India's dominant urban centres and is one of the world's largest and most densely populated cities.

Mumbai is India's commercial and financial capital, contributing around US \$310 bn to its economy. It is responsible for 70 per cent of India's maritime trade and is responsible for 25 percent of its industrial output.

Mumbai contributes 33% of all income tax and 60% of all customs duty from trade.

### **WARNING TO MUMBAI**

Roxy Mathew Koll, a climate scientist from the Indian Institute of Tropical Meteorology, agreed that short-duration heavy rainfall is rising in Mumbai and Western Ghats.

He pointed out that the 'confidence' level of total rainfall prediction in the IPCC report was 'not high'.

Under Representative Concentration Pathway (RCP) 8.5 — [worst emission scenario possible](#) that may lead to a 3-4 degree Celsius global temperature rise — the total rainfall may increase a substantial 20.5 per cent during 2021-2040; 32.7 per cent during 2041-2060; and 61.2 percent during 2081-2100.

Mumbai's total rainfall rise is the highest in the country, followed by Delhi with about 50 percent among metro cities.

The rainfall during 1850-1900 was considered a benchmark for these assessments as anthropogenic emissions started to influence global temperature beyond the period.

### **ECONOMIC STUDY ON CLIMATE CHANGE IN MUMBAI**

According to the National Climatic Data Centre (NCDC), Mumbai has a high exposure level to such changes due to population density, and its major industrial and financial installations. Furthermore, the major proportion of its reclaimed land is in low-lying areas and the high population of its urban poor has limited capacity to face the consequences of climate change. Many slum areas are located near the coastal areas. According to an earlier estimate of a study conducted 10 years ago, the economic damage to Mumbai, the country's financial capital, as a result of climate change could amount to over Rs 2 lakh crore. However, since then, urbanization and investments have only gone up in Mumbai. According to the Intergovernmental Panel on Climate Change (IPCC), the sea level is expected to rise at the rate of 3 millimetres (mm) i.e., 7% per year in India. By the middle of the century, the rise will be 40 centimetres (cm). This would inundate low-lying areas, drown coastal marshes and wetlands, erode beaches, exacerbate flooding, and increase the salinity of rivers, bays, and groundwater.

### **ECONOMIC IMPACT**

An increase in temperature will lead to an increase in rainfall intensity and frequency. Extreme

precipitation is likely to increase substantially over the western coast and west central India.

Overall, the summer monsoon rainfall will show a 20% increase over the present rate; the increase will be seen in all the states except Punjab, Rajasthan, and Tamil Nadu. Simulations with climate models and observations indicate that rainfall extremes such as the Mumbai deluge of 2005 could become more frequent in India under the impact of climate change. Both 2005 and 2006 had spells of excessive rainfall that normally would have occurred once in about 100 years. It has been observed that till 1989 the average rainfall of Mumbai was 2129 mm<sup>5</sup>. However, in 2005-2006 the average annual rainfall was found to be 3214 mm, an increase of 50%. Besides the rainfall-related issue, energy consumption will also be a major issue. An increase in rainfall and a rise in the mean sea level (MSL), in addition to the poor drainage of the city will increase the frequency of floods. Almost one-fourth of Mumbai comprises low-lying areas (below or at MSL). Therefore, low-income groups and poor residents living in vulnerable locations (accounting for nearly 50% of Mumbai's population) will be affected more.

Frequent floods and salt-water intrusion will affect the structural stability of high-rise buildings, which are mushrooming at an increasing rate. Floods, especially in the low-lying areas of the city, will result in dislocation of people and also deaths.

Human health is another major area where the impact of climate change could be very severe. Such an impact would translate mainly into three major illnesses – diarrhoea, malaria and leptospirosis. The tourism sector will also be hit by climate change. It is likely to suffer a loss of Rs 2,00,000 crores by the year 2050.

An economic analysis has been performed to understand these impacts with a view to plan out adaptability strategies for the city for the period up to 2050. These cost considerations take into account the most conservative figures with regard to the period of impact, population affected, loss of earnings and material damage.

Computations for economic losses due to climate change have been summarized in the table below. The first four types of costs indicated are for likely impacts of extreme events. The other two costs are for losses likely to be witnessed by the year 2050. The latter could turn out to be much higher if the frequency of occurrences of extreme events and their duration increase over the period considered in this analysis. Besides the frequent disease outbreaks, heat stress caused by the rising mercury would also affect the workforce of the city. Episodes of heat cramps, heat exhaustion and heat stroke would affect the population, primarily the large poor section of the society. As the immune system weakens due to heat stress, susceptibility to diseases would further increase. The resulting increase in expenses on health care by individuals would escalate leading to greater stress. Hence, this vicious cycle would lead to the depreciation of human resources. Besides human beings, heat stress would not even spare the cattle sheds. It has been found that cattle are more sensitive to heat stress; this could impact milk production from cattle sheds in Mumbai. The effect of raised body temperature is an adaptive depression of the metabolic rate associated with reduced appetite. Factors such as water deprivation, nutritional imbalance, and nutritional deficiency may exacerbate the impact of heat stress.

**Estimated economic losses due to the impact of climate change in Mumbai**

Type of impact	Type of costs and period of impact	Cost in rupees (crores)
Flooding of low-lying areas - every five years till 2050*	Overall costs over the period 2005–2050	425
Property damages every five years till 2050*	Overall costs over the period 2005–2050	6700
Deaths due to flooding – every five years till 2050*	Overall costs over the period 2005–2050	3800
Disability-adjusted life years (DALYs) lost due to vector-borne diseases	Overall costs over the period 2005–2050	3020
Industrial damages for the period till 2050 due to sea-level rise***	Cost estimate for the year 2050	160240
Less Tourist visiting Mumbai****	Cost estimate for the year 2050	20458

**Note:** \*When the water comes through floods, it damages the low-lying areas the most. Especially the slums situated near the coastal areas. There is a lot of construction by cutting trees in Mumbai, which in turn results in the greenhouse effect. This will result in acid rain and floods in the city. The drainage system of Mumbai is also very weak, especially on the southern side of Mumbai.

\*\*Increase in Vector-borne disease affects the productivity of employees. They take sick leaves, which hamper the working or production of the company. Less production will lead to low exports of the products, which will result in low foreign capital in the country. Normally, ¼ population in Mumbai falls sick during monsoon season. By 2050 the cumulative income loss due to vector-borne diseases, calculated on the basis of DALYs will be 160000 and 2500 crores, respectively. The calculation of DALYs is based on the World Health Organization (WHO) guidelines 8,9 and income levels prevalent for Mumbai.

\*\*\*Due to water-level rise, there is a loss of property due to dampening. The seawater will go inside the building and loss the property, in the sense that the money which the company can indulge in increasing the production has to be imposed on the renovation of the building to protect it from sea water., calculations have been made showing the monetary loss due to buildings getting affected in the region near the shore.

\*\*\*\* This calculation is based on the Tourism Statistics of India. Overall Future costs have been calculated using the average gross domestic product (GDP) growth rate of India. It also takes the current rates of 6% and 13% increase respectively in domestic and foreign tourism per year into account.

**RESPONSES NEEDED**

Though there are indications of the impacts of climate change and global warming that could be

felt. There is a need for Mumbai to understand the economic implications of these impacts and to deal with them effectively.

The following could be some of the responses based on anticipated climate changes:

- Intense planning for developing an effective drainage system is needed.
- Building experts and other related experts will need to detail the steps to be taken for new building construction practices in order to reduce the salt content of building materials. For older buildings, an assessment and remedial plan will need to be prepared. Buildings very close to the seashore also need to be examined from the point of view of the stability of the land due to erosion (near Dadar and Juhu).
- Greater investment in the health sector will be needed to treat people affected by climate change. More healthcare facilities and health infrastructure will be needed.
- Anti-erosion measures will need to be put in place at beaches and seafronts.

The protection plan for mangroves and other wetland areas needs to be implemented.

- Energy conservation measures at all levels (appliances, building design, energy use pattern and alternative sources of energy, etc.) need to be instituted.
- An urban ecosystem enhancement (creation of more open spaces, greenery, parks tree-lined roads, etc.) needs to be undertaken.

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