



## Disaster dossier: The impact of climate change on Orissa

By Richard Mahapatra

For over a decade, Orissa has been teetering from one extreme weather condition to another: from heatwaves to cyclones, drought to floods. The state has been declared disaster-affected for 95 of the last 105 years. Why is this happening? Is it the result of global warming and climate change? **Richard Mahapatra**, who has been awarded the CCDS-InfoChangeIndia Fellowship for development reportage, explores these questions in the first of a series of articles

☒ Long before Gunadhar lost his father to a heatstroke in early spring last year, and a devastating cyclone swept through nine coastal districts of Orissa for 25 hours, six years ago, the state of Orissa had already begun to show symptoms of climate change.

Gunadhar knew it, though he was only in the second standard when his father died. His father, a regular migrant to Raipur in Chhattisgarh after chronic drought rendered his land uncultivable, had explained to Gunadhar during the long train journey back to the village, once the monsoons set in, that there were six seasons. And that the *koel* in the mango tree in the backyard sang throughout the day during the monsoons.

But Gunadhar can count only three seasons (summer, monsoon and winter -- the transition period between the rains and the summer). And the *koel* no longer sings during the monsoons; it sings in winter. As the winters have begun to warm up, people say it sings during summer too.

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? [Death of the seasons](#)

For old-timers, the state's new profile of seasons is confusing. Most farmers have always used the traditional *panjika* to forecast weather. The system bases its forecast on the assumption that 120 days of rain are normal, spread over six seasons. "However that is not the case now. The number of rainy days has come down to around 90 days," says Artabandhu Mishra, a life scientist who has studied the indigenous method of weather forecasting.

Caught between the past and an uncertain future, life for the ordinary Oriya is a puzzle. Besides the disasters that strike the state with frightening frequency, the change in climate is stark, affecting everything from the economy to when marriages are held.

### **The disaster dossier**

☒ For over a decade, Orissa has been teetering from one extreme weather condition to another: from heatwave to cyclone, from drought to flood. The state has been declared disaster-affected for 95 years out of the last 105 years: floods have occurred for 50 years, droughts for 32, and cyclones have struck the state for 11 years. Since 1965, these calamities have not only become more frequent, they are striking areas that have never experienced such conditions before. For instance, a heatwave in 1998 killed around 2,200 people -- most of the casualties were from coastal Orissa, a region known for its moderate climate. Since 1998, almost 3,000 people have died due to heatstroke.

The 1999 super cyclone affected places like Bhubaneswar and Nayagarh, which were never traditionally cyclone-prone. While the 2001 drought parched fields in coastal districts, the unprecedented floods of 2001 submerged 25 of the state's 30 districts. Many of these areas had never witnessed floods before. Orissa has experienced around 952 small and big cyclones and 451 tornadoes between 1891 and 1970. From 1901 to 1981 there were 380 cyclones, of which 272 resulted from depressions in the Bay of Bengal. Twenty-nine of these cyclones were devastating.

A conservative study of the effects of natural disasters reveals that between 1963 and 1999, Orissa experienced 13 major disasters, which killed 22,228 people (state government figure; non-government figure puts the toll at around 40,000), and rendered 34,21,000 people homeless.

During the Ninth Plan period (1997-2002), Orissa was in the grip of a series of disasters. On the eve of the Tenth Plan (2002-03), the entire state was going through a severe drought. The total loss of livelihood and damage to capital stock due to calamities between 1998-99 and 2001-02 stands at Rs 13,230.47 crore, according to the Tenth Plan document, Government of Orissa. This is close to 60% of the state's total plan outlay of Rs 19,000 crore for the Tenth Five-Year Plan.

Natural calamities have seriously affected livelihoods in the state and the income level of households. An important fallout has been the serious setback suffered by the capital formation process in the economy. Consequently, the state's Gross Domestic Product (GDP) has been substantially depressed, says the **State Human Development Report** of 2003.

The impact of disasters on Orissa's economy is evident. The state's per capita income declined fast in the second half of the 1990s, disaster-wise the worst phase. It is now half the national average. An average of 900,000 ha of agricultural production are lost every year due to disasters. Similarly, between 1980 and 2000, agriculture's contribution to the state GDP fell by 16%.

Such disasters have resulted in a type of poverty known as 'conjectural poverty'. Vaidyananth Mishra, an Orissa-based economist, says: "Disasters have made Orissa the poorest state. What is more disheartening is that nobody cares to study this."

### Highlights

**Floods:** Between 1834 and 1926, floods occurred at an average interval of 3.84 years. Between 1961 and 2000, floods became an annual affair.

**Drought:** During the 1950s only three districts were drought-prone. By the 1980s, the whole of western Orissa, consisting of five districts, became drought-prone. During the 1990s, 25 of the 30 districts became drought-prone.

**Cyclones:** During the 1970s and 1980s only two severe cyclones hit the state. During the 1990s, two severe cyclones hit the state and the number of cyclonic conditions rose. With 13 severe cyclones in the last 100 years, Orissa is the worst-affected state in India.

### Economic disaster

Economic losses due to disasters are steadily increasing. Figures indicate that disasters have not only become more frequent, they are striking new areas. In 30 years, the average annual loss due to disasters has gone up 27 times.

Period	Average annual property lost and damaged due to disasters (in Rs crore)
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1970s	14.18
1980s	67.33
1990s	383.50
<b>Source:</b> State Human Development Report, 2003	

### **Climate's present tense**

Why is this happening? Is there an emerging pattern in this cycle of destruction?

There is evidence that suggests that the state's ecology and weather conditions have undergone a dramatic change. A section of scientists and climatologists believe that Orissa's extreme weather conditions and their frequent occurrence are a dress rehearsal for the meteorological mayhem that climate change, induced by global warming, will cause on the earth. On the other hand, the state's ecological degradation could well be facilitating the global impact.

Gunadhar's generation has inherited a sharply contrasted ecology to that which is officially endorsed and is still written about in textbooks and tourism brochures. Orissa's seasons have all but vanished, its trees have altered their flowering time, its birds have changed their mating habits, and people are resorting to strange measures to cope with these changes. The global focus on climate change has awakened the feeling that the people of Orissa could be paying the price for it. "The linkage between macro climatic changes and global climate change is definite in people's perception. Scientists have to prove it," says Manoj Pradhan of the Council of Professional Social Workers, a research and advocacy organisation in Bhubaneswar that brings out the ***State of Orissa's Environment***.

Of late, every season in Orissa has seen some abnormality. The rains are erratic; winters have become warmer; and the summers longer. In 2005, it rained for 15 days in October causing major flooding in all the rivers. Meanwhile, the monsoon arrived 20 days late. Summer temperatures in the western part of the state touched 50 degrees Celsius, killing 113 people. For almost 20 days, the average temperature in many places stayed above 40 degrees. During January this year, the temperature in Bhubaneswar climbed to 37 degrees. During 1999-2005, Orissa's average summer temperature was 42 degrees.

After March, the state government virtually declares a state of emergency. Schools and

colleges finish their sessions by the end of March; offices open early; hospitals stock more ice sheets than medicines; all employment-generation schemes begin early in the morning and stay closed during the day; brick kilns are shut down during summer. People have begun holding marriage ceremonies during winter. Although the government brushes aside talk of any marked change in climate, the lives of the people of Orissa have definitely changed.

Analysis of the state's rainfall data and temperature variations reveals that the summers are getting longer. "The state is definitely heating up," says Murari Lal, a lead author of the Inter-governmental Panel on Climate Change (IPCC), the global scientific body studying climate change. Lal has concluded that Orissa's weather conditions are warnings of global warming. "Abnormal weather conditions are already a reality but nobody admits it," he says.

Going by the key parameters of climate, such as temperature and rainfall, things in Orissa could very well worsen. "The full impact of climate change does not show up immediately. It triggers change slowly but certainly," says Lal. Scientist and professor A P Mitra of the National Physical Laboratory says: "It might be difficult to prove a direct link with global climate change, but Orissa stands out as a phenomenon that needs to be studied."

The state's mean daily maximum temperature is also gradually rising, as also the mean daily minimum temperature. According to data from the weather department, in the last 50 years the state's average temperature has gone up by 1 degree. The Titilagarh and Koraput belt comprising south and west Orissa has witnessed an exceptional increase in daily maximum and minimum temperatures. Even the coastal areas have recorded high temperatures. K L Pujari, a soil scientist who has studied heatwave conditions in coastal Orissa, agrees: "Climate change is definitely a reality. Earlier, western Orissa was a known calamity hotspot. But now the coastal areas are also experiencing heatwaves. Bhubaneswar now has a temperature above 40°C, which is equal to interior Sambalpur." "The sharp difference between mean day and night temperatures is a recent trend in Orissa's climate. The winters are gradually warming," says Radha Mohan, a scientist studying desertification in western Orissa.

Interestingly, and for the first time, in 1999, Indian Meteorological Department (IMD) officials acknowledged that there was something seriously wrong with Orissa's climate. "Perhaps the extreme weather condition is because of climatic changes or due to a general change in the behaviour of climate," said S R Kalsi, former deputy director general, IMD (cyclone warning). This is a virtual U-turn for the IMD, which, during the heatwave of 1998, brushed aside the international surmise that the heatwave was an indication of climate change. Immediately after it, in 1998, the World Meteorological

Organisation (WMO) suggested that the extreme weather conditions could be linked to the El Niño phenomenon, which was active at that time.

A team of scientists led by Michael E Mann of the University of Massachusetts, USA, noted that the 20th century was the warmest on record in 600 years, and that its warmest years -- 1990, 1995 and 1997 -- were the hottest since the Middle Ages. One of the conclusions of Mann's team was that the warming was a result of increased emissions of greenhouse gases like carbon dioxide. In 1998, the average global temperature was marginally higher than in 1997, according to the US National Oceanographic and Atmospheric Administration.

Interestingly, Orissa faced extreme weather conditions in all the above three years. "Current global warming trends show that conditions like El Nino will be more frequent, thus cause for concern. Orissa's extreme weather, related closely to temperature rises, is an indicator of that," explains Lal.

A close look at district-wise rainfall in Orissa since the beginning of the 20th century indicates that rainfall was less erratic before the 1950s. Most years prior to the 1950s received normal or above normal rainfall. Rainfall has become much more erratic since the 1960s; most years recorded below-normal rainfall. "This is true of all districts," says the ***State of Orissa's Environment*** report that analysed the rainfall data. Before 1957, between 67-90% of years recorded normal or above normal rainfall for the various districts, while after 1957, only 32-68% of years recorded normal or above normal rainfall for these districts.

Similarly, rainfall showed a rising trend from the beginning of the century to the end of the 1950s. It then declined from the 1960s onwards. The percentage of years with normal or above normal rainfall has gone down from 90 in 1957 to 45 in 1996, in Koraput; and 88 in 1957 to 45 in 1996 in Sundergarh. In 2002, 25 districts had less than normal rainfall. Similar rainfall deficiency is also being experienced in Pulbani, Mayurbhanj and Dhenkanal.

Still, the Orissa government's department dealing with disasters continues to downplay the suggestion that Orissa is bearing the brunt of global increases in temperature even as its official documents admit changes in the state's ecology and weather conditions. These changes were mentioned in a white paper on the drought of 1992-93. The paper said: "For the last few years, sudden changes in the ecology are contributing to multiple occurrences of these tragedies every year, creating more and more problems for our people in the matter of relief and rehabilitation." The white paper on the drought of 1998-99 observes: "It has been our experience in a number of years that late onset and/or early withdrawal of the monsoon, erratic and inadequate rainfall and absence of

soil moisture are the main reasons of drought."

The **State Human Development Report** puts it more starkly: "...The recent super cyclone in Orissa... was not simply a natural disaster...Rather it was part of an emerging crisis of unpredictable climatic change resulting from atmospheric pollution. This has disturbed the ecosystem leading to increasing frequency and increasing scale of droughts, floods, hurricanes and cyclones. Predictions of an increase in temperature from 1.3 to 6.3 degrees by 2010 (**Newsweek** 2000) have resulted in the linear trend of increases in temperature in Orissa from 37 degrees in 1950 to 41 degrees in 1996."

### **Orissa's role in global warming**

The Washington-based Institute of Policy Studies, an advocacy group critical of multilateral institutions like the World Bank, says that Orissa is emitting close to 3% of total greenhouse gases (GHGs) emitted in the world in 2005. GHGs are the main culprits of global warming. "Orissa's industries and coal-fired power plants will be emitting 164 million tonnes of carbon dioxide annually by the year 2005, or the equivalent of about 3% of the projected growth in man-made greenhouse gases anticipated globally over the next decade," says the report. In addition, Orissa's industrialisation will release toxic and potent global warming agents, tetrafluoromethane and hexafluoroethane (by-products of aluminium smelting) equivalent to 8 million tonnes of carbon dioxide emissions, which, because they are long-lasting, will contribute to a "perpetual change" in the earth's atmosphere.

But the important question is: Why has Orissa been affected the most? Explains Lal: "Orissa is placed at the head of the Bay of Bengal where weather is formed. So even a slight change in the sea's behaviour can have an immediate impact on the coast." The bay becomes the centre of low pressure, bringing heavy rain and cyclones to the sub-continent, especially in Orissa. These cyclones and depressions involve circulations of over thousands of kilometres and form links between Orissa's atmosphere and the entire planetary circulation system.

A report prepared by Lal, explaining the impact of climate change on India, underlines: "Records suggest that there has been a rising trend in all-India mean surface air temperature." Rain is caused by a depression formed over the Bay of Bengal. So even a small change in a parameter like temperature will have a huge impact on Orissa. Research shows that a change of 0.5°C can change the character of the monsoons. One striking abnormality will be fewer depressions in the Bay of Bengal, causing less rainfall over the state. This is based on a scientific analysis of sea behaviour during

1890 and 1990, says Lal.

Lal suggests that an increase in sea surface temperature will be accompanied by a corresponding increase in cyclone intensity. A possible increase in cyclone intensity of 10-20% against an increase in sea surface temperature of 2-4°C is very likely to happen. "Data strongly suggests that an increase in the intensity of cyclones is certain," he says. In a data analysis of cyclones hitting Orissa in the past century, Lal has found that the intensity and frequency of cyclones have gone up in coastal Orissa.

### **Vulnerability to climate change**

Developing countries like India have low adaptive capacities to withstand the adverse impacts of climate change, due to the high dependence of a majority of the population on climate-sensitive sectors like agriculture and forestry, poor infrastructure facilities, weak institutional mechanisms and lack of financial resources. There are vast sectoral and regional variables in India that affect the adaptive capacity of the country to climate change. For instance, irrigation coverage is above three-fourths of total cultivated area in Punjab, while in Orissa it is less than a quarter. Farmers in Orissa are more dependent on the monsoon than others, thus more vulnerable to climate change.

In the case of Orissa, the impact of climate change is proving critical as its environment is already degraded and stressed due to over-dependence on natural resources. Close to 80% of the state's population depends on these resources to survive.

While the debate on whether climate change causes calamities in Orissa rages on, nobody denies the fact that environmental degradation in the state has let loose a chain of problems, accelerating the impact of such changes.

Today, 52% of the state's land suffers erosion due to deforestation. With mangrove forests being cleared, more and more areas have come under the effect of cyclones. Rivers flood more areas due to siltation. Almost 490,000 ha of fertile lands are waterlogged, salinated and sandcasted in coastal Orissa as a result of cyclones and floods.

Massive deforestation in west Orissa is not only destroying the livelihoods of the local people but also silting up riverbeds, causing floods in downstream coastal Orissa. Studies show that forest cover in the state has declined to 4.72 million ha from around 6.8 million ha in 1960-61. Of the existing cover, only 2.73 million ha of forests have a density higher than 40%. Barren hills lead to heavy runoff of rainwater resulting in flash floods in the local area and more floods in Orissa's low coastal areas. According to state agriculture department statistics, about 4.33 million ha of Orissa's 7.2 million ha of agricultural land suffer severe erosion and declining fertility. The 2.9 million ha



uplands, belonging mostly to tribal and very poor farmers, are degraded and barren. With little or no efforts to harvest rain, the state loses around 80% of its rainwater as runoff from these barren lands, leading to water scarcity. This causes drought even when rainfall has been only slightly deficient. According to K L Pujari, in the last few decades, due to erratic rainfall, Orissa has experienced frequent droughts.

Similarly, in coastal areas, a slight rise in sea level makes the region extremely vulnerable as the protective mangrove forests have vanished. Satellite pictures of the 1999 cyclone show that mangrove forests helped reduce the impact of the super cyclone. Ersama, in Jagatsinghpur district of coastal Orissa, that has no mangroves, reported 8,000 deaths during the cyclone as tidal waves ingressed 10 km into the land. The coastal district of Kendrapara, which had some mangroves left, suffered comparatively less damage. From the 1960s, Orissa has lost 45% of its mangrove forests.

***(Richard Mahapatra has been awarded this year's CCDS-InfoChangeIndia Research Fellowship for reportage on issues related to sustainable development and social justice. His research is on the impact of climate change in Orissa. This is the first article in a series. Mahapatra has been reporting on environment and development issues for several years. He has written extensively for journals such as Down to Earth.)***

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