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POLICY

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Mangroves - A Natural Defense against Cyclones: An investigation from Orissa, India

In October 1999, the state of Orissa in India was battered by a super cyclone that killed almost 10,000 people and caused a massive loss of livestock and property. Following this disaster there was a great deal of controversy over whether the high levels of mangrove forest destruction in the area had increased the impact of the cyclone. Many argued that the loss of human life caused by the storm was directly linked to the removal of the natural defenses provided by mangroves.

To highlight the role that mangrove forests play in protecting coasts, a SANDEE study reports on what happened in Orissa's Kendrapada district. The study examines the role of mangroves alongside all the other factors that affected the impact of the storm. It finds that mangroves provide incredibly important protection from storms – if mangrove forests had not been destroyed in the past then over 90 percent of all deaths in Kendrapada due to the cyclone may have been avoided. The protection provided by mangroves has a significant economic value to society. The benefits from conserving an existing hectare of mangroves are nearly twice the 'site' value of land cleared for other development. Thus, there is a strong argument for re-establishing mangroves along the coast of Orissa and other coastal areas threatened by cyclones.

THE 1999 SUPER CYCLONE

A super cyclone battered the coastal state of Orissa in October 1999 with winds that reached velocities of over 256 kmh⁻¹. It created a tidal surge and torrential rains, which flooded villages many kilometers inland. Large numbers of homes were washed away and millions of people were left homeless. Alongside the human casualties, there were also over 440,000 livestock deaths, almost two million damaged houses and over 1.8 million hectares of damaged crops. In all, 12 districts in the state were devastated by the cyclone.

Saudamini Das, from the Swami Shradhanand College, University of Delhi, studied of the role of mangroves during the cyclone. Her work examines the extent to which mangroves protected people, livestock and residential buildings from the storm. She concludes that mangrove

forests can act as 'development infrastructure' and reduce cyclone calamities.

To get a true picture of the importance of mangroves in storm protection Saudamini Das re-constructed the situation in Kendrapada district — one of the key areas hit by the 1999 cyclone. The super cyclone had its landfall 20km south west of Kendrapada and the entire district was battered by cyclonic wind and rain. Five of its eight tehsils (local government areas) were affected by storm surge and there were human casualties in all but one tehsil.

Kendrapada is poor and a predominantly agricultural district. It has seen significant mangrove loss in the last half century like other coastal regions of Orissa. In 1950, 80 percent of the district's coastline was covered with over 300 sq. km of mangroves, which had a width of nearly 10 kilometers. When the storm hit in 1999, only about 50% of these mangroves remained. Yet, areas protected by mangroves suffered fewer losses than other areas. This intriguing fact led Saudamini to explore the connection between mangroves and storms.

This policy brief is based on a forthcoming SANDEE working paper: 'Valuation of the Storm Protection Services of the Mangroves of Orissa' by Saudamini Das, Swami Shradhanand College, University of Delhi, Delhi. This work is part of an on-going Ph.D. at the Institute of Economic Growth. The full report is available at www.sandeeonline.org



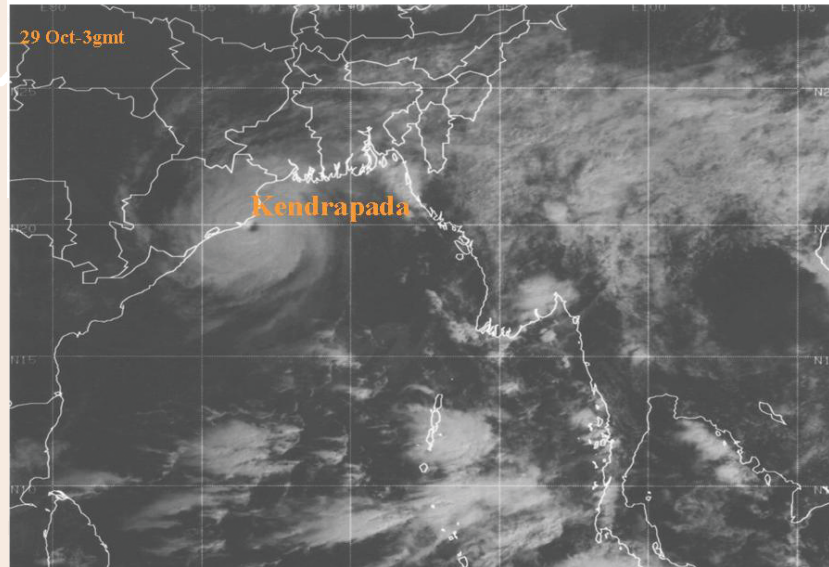
WHY MANGROVES MATTER

Mangroves provide a wide range of benefits. They are a source of firewood and forest products to local communities and act as nurseries for fish. Mangroves also trap sediment in their roots, creating shallow shorelines that slow oncoming waves and dissipate wave surge. Their leafy canopies shelter land from high cyclonic winds. Although widely recognized, these protective functions have not been well researched. Even less is known about the extent of the economic benefits provided by these functions. Partly because of this lack of information on mangrove eco-system services, vast stretches of mangroves have been lost to degradation, coastal development and shrimp farming.

ISOLATING THE PROTECTIVE ROLE

Mangroves provide protection from storm surge and wind. However, the impact of cyclones also depends on factors such as the distance of a village from the sea and elevation above sea level. People's social status and wealth also affect their chances of being harmed. Thus, to assess the protective role of mangroves, researchers have to simultaneously examine all the factors that influence a cyclone's impacts. Saudamini does exactly this. By using data about the super cyclone's casualties, historical data on mangrove presence, coastal maps, and carefully developed models about how the cyclone may

Figure 1: The 1999 Super Cyclone hitting Kendrapada



have hit the coast, she is able to isolate the storm protection provided by mangroves.

MANGROVES AND LIVES SAVED IN KENDRAPADA

Based on careful statistical analyses, Saudamini establishes that mangrove forests significantly reduced the number of human casualties from the super cyclone. If the mangrove forests that had existed in the year 1950 were still in place, only 31 people would have died in the study area as opposed to 392 who actually lost their lives in 1999. In other words, 92 percent of the deaths would have been avoided. Moreover, if the present mangrove forests hadn't been there, the death toll would have been 54 percent higher than it actually was — an additional 211 people would have died.

It should be noted that village location is critical to how mangroves protect human life. In particular, the height of villages above sea level has a big effect in reducing human casualties. Mangrove protection is less effective in villages built in cleared areas that were previously mangrove forests and in villages lying on the path of the cyclone eye.

KEY FINDINGS RELATING TO HOMES AND ANIMALS

Mangroves were able to significantly lower the degree of house damage in areas within 10 kilometers of the coast. Mangroves also contributed to reductions in the death of animals such as buffaloes and cattle, but were less effective in protecting smaller animals like goats and poultry.



Figure 2: Mangrove Forest Cover in 1950 and the Cyclone path

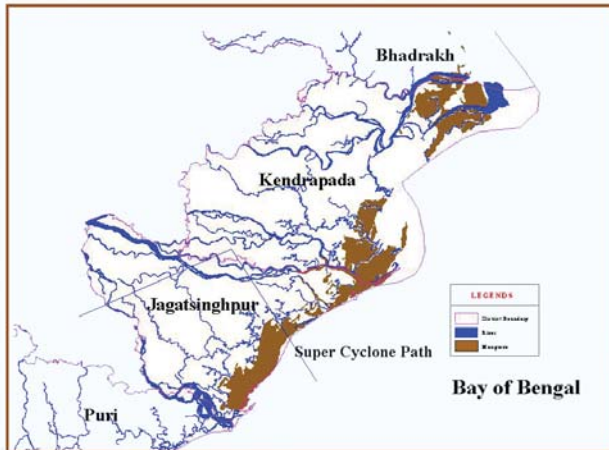
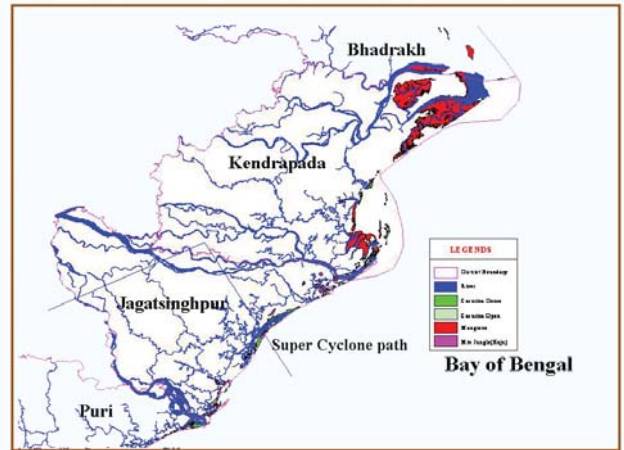


Figure 3: Mangrove Forest Cover in 1999 and the Cyclone path



Interestingly, and in contrast to popular belief, the cyclone did not kill more poor people relative to the rich. This is probably because people with immovable assets were reluctant to leave their homes unguarded.

TABLE: AVERTED HUMAN DEATHS DUE TO MANGROVES IN KENDRAPADA STUDY AREA

| | |
|---|-----|
| Actual deaths during 1999 super cyclone | 392 |
| Predicted deaths if there were no Mangroves | 603 |
| Predicted deaths if current mangroves were at 1950 level | 31 |
| Predicted deaths if current mangroves were at 1950 level and villages established after clearing the mangrove forest were not located there | 17 |

three decades. Based on this, the value of a hectare of land with intact mangrove forests is Rs. 3.6 lakhs (USD 8,670). Currently, a hectare of land after mangroves are cleared sells at Rs 2 lakhs (USD 5,000) in the market. In other words, if we leave a hectare of forests intact and do not clear it, then the value we get from it is about twice what we would get if we cleared and sold the 'site' for building houses or hotels.

So, should we increase coastal forests by regenerating mangroves in coastal areas? Does this make economic sense? The answer is 'yes'. The cost of regenerating one hectare of mangroves is approximately Rs. 4500 (USD 110) — many times lower than the benefits that would occur (Rs 3.6 lakhs). Furthermore, the cost of constructing a cyclone shelter by the state of Orissa is Rs. 30 lakhs, about ten times more than the benefits offered by mangroves.

VALUING MANGROVE PROTECTION

While mangroves can clearly minimize storm impacts, what is the economic value of these protection services? Saudamini's careful estimates reveal that a hectare of mangrove forestland stopped damage worth Rs.18 lakhs (USD 43,352) in the district during the super cyclone. But severe storms don't occur all the time. Thus, in order to estimate the value of mangroves, Saudamini multiplies this number by the probability of occurrence of very severe storms in Orissa over the last



SANDEE

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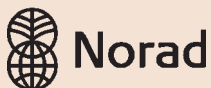
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FOUR KEY MESSAGES

Saudamini Das's research shows that the protective role of mangrove forests is no longer up for debate. There are four key lessons from this study:

- Mangroves act as a natural barrier against severe storms and significantly reduce death, livestock loss and property damage.
- In areas affected by storms and cyclones, the protection benefits of a hectare of land with mangroves can be nearly two times higher than the value of 'cleared' land. Thus, mangrove conservation is an economically appropriate policy option.
- In villages that are either in the eye of cyclonic storms or at low locations, mangroves offer less protection — here evacuation is crucial.
- Deaths are caused partly by people's reluctance to leave their homes. Thus, coastal property insurance is another important policy option.

With climate change, cyclones and other extreme events are only going to increase in intensity and frequency — we need to act now to protect and extend mangroves.

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