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Private Initiatives for Managing Embankments in the Indian Sundarbans

Human activity on the 54 inhabited islands of the Sunderbans is made possible by river embankments that protect land from tidal surges. These embankments, public property that safeguards private livelihoods, require regular maintenance. However, who is to manage the up-keep of these embankments and what is the best strategy to sustain them in the long run? To shed light on these issues, this Brief analyses the links between property rights, productivity and private contributions to maintaining embankments in the Indian Sundarbans.

This Brief is based on the work of Prasenjit Sarkhel from the Department of Economics at the University of Kalyani, West Bengal. He finds that households whose principal occupation is aquaculture commit more resources to embankment maintenance than those in engaged in agriculture because the returns from aquaculture are much higher than those from agriculture. However, there is evidence that some aquaculture farmers (particularly those in canal based aquaculture) 'free ride' and let other farmers shoulder the expense of embankment maintenance. The study also finds that public intervention in embankment maintenance may be crowding out private efforts. It therefore recommends that, in primarily agricultural areas, productivity-enhancing policies rather than public investments in maintenance may be a more efficient way to ensure the long term sustainability of embankments.

The Indian Sundarbans

The Indian Sundarbans is comprised of an archipelago of 102 islands, of which 54 are inhabited. The region is interspersed with a complex network of tidal rivers leading to the Bay of Bengal, which is located on its southern flank. The river embankments in the region were first erected in the late 18th century (during the British colonial period) when land reclamation for agriculture began. In the last four decades many paddy fields, particularly in the northern Sunderbans, have been converted into aquaculture ponds.

Damage to the river embankments in the northern part of the Sundarbans is generally caused by tidal surges which breach and overtop the structures. The embankments are also affected by a number of extreme weather events. The Side bar provides further details on the Sundarbans' river embankments and the threats they face. The responsibility for the maintenance and repair of the embankments is still officially with the Department of Irrigation and Waterways (DIW) of the Government of West Bengal. However, it is beginning to be gradually transferred to local level institutions such as the panchayats. This is being done under the aegis of the wage employment program called the Mahatma Gandhi National Employment Guarantee Act (MGNREGA). With increasing pressure on public finances, the state's role in regular repair and maintenance work is expected to gradually reduce.

Testing the link between protection and private productivity

The study addresses two specific questions: Does private contribution towards river embankments depend on differences in land productivity? What are some other factors that may influence household contribution to embankment maintenance?

Historically, while land-owners have been expected to participate in embankment maintenance, their participation has been inadequate and embankments

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The full report is available at: www.sandeeonline.org

Embankments and Land Use in the Sundarbans

The erection of mud embankments in the Indian Sundarbans began in 1770 in tandem with land reclamation. The aim of the work was to protect agricultural fields from the threat of tidal inundation. The Permanent Settlement Act of 1793 stipulated that landholders participate in embankment maintenance, but private participation was generally inadequate. Subsequently, maintenance of the Sundarban embankments was recognized as public works by the Bengal Embankment Act of 1873 and responsibility passed on to the state.

The importance of maintaining the mud embankments is underlined by the recent challenges. Sea-level rise has triggered the erosion, and subsequent collapse, of more than 100 square km of the embankments in the last three decades. Since the region is interspersed with tidal rivers, disasters occur when settlements are inundated by tidal surges that either topple protecting dykes or breach them.

The region is also frequently affected by catastrophic events - it has faced 31 severe cyclones between 1961 and 2000, with the majority of these having a velocity greater than 100 km/hr and at least five exceeding a velocity of 200 km/hr. Cyclone Aila in May, 2009 was one such extreme weather event. When this cyclone hit, almost 500 km of embankment were washed away. Aila affected nearly 7 million people and killed 137 people in the North 24 Parganas and South 24 Parganas districts of West Bengal.

Embankment Damage in Indian Sundarbans after Cyclone Aila.

have been poorly conserved. The reluctance of private landholders to maintain embankments may stem from uncertainty regarding returns from agriculture. Under such circumstances, landholders can be expected to consider reallocation of agricultural land to other uses with higher returns. The conversion of paddy fields into brackish water aquaculture in the Indian Sundarbans started as early as the 1930's, although the process accelerated after the seventies. Today, the total area of brackish water aquaculture stands at about 42,000 hectares. While aquaculture farmers initially combined both paddy cultivation and fish culture in the same plot, this approach was gradually replaced by perennial fish ponds, where aquaculture is practiced all year round.

Agriculture and aquaculture households in the Sundarbans

The study was conducted in two areas where a substantial amount of land has been transformed from agriculture to aquaculture: Sandeshkhali II in North 24 Parganas and Basanti in South 24 Parganas. Eleven villages were picked from these areas, from which 534 households were randomly selected for a household survey.

Table 1 presents some socio-economic information about the households in the region. As the Table shows, the average household has six members and only about 14% of all household members have a secondary education. The likelihood of an embankment breach in the previous three years is nearly 100%. Aquaculture plots are much larger than agriculture plots.

Aquaculture farms in the area are of two types: (i) farms that are connected to many plots through feeder canal networks that supply brackish water (multiple source plots) and (ii) households that have their own inlet of brackish water to feed their ponds (single source plots). Among the aquaculture households, 65 percent had plots that were connected to the feeder canal network, while six percent had both plots that drew water from their own inlet and plots connected to the feeder canal network.

Table 1: Socio-economic information on surveyed households

Household Characteristics	Mean (Std. Deviation)
Household size	5.61 (2.12)
Percentage of household members completing secondary school (12 years of schooling)	14 (20)
Plot size of agricultural households (bigha)	3.67 (3.23)
Plot size of aquacultural households (bigha)	14.04 (40.10)
Frequency of embankment breach in last 3 years	.91 (1.22)
Frequency of public intervention in last 3 years	.45 (.69)

1 bigha=0.1338 hectare

The household survey also collected data on expenditures on embankment maintenance (see Figure 1). Private contributions towards embankment maintenance were measured as the sum of a household's own labor contributions and/or its monetary contributions towards hired labor. Where relevant, raw material costs (such as bamboo shacks and bricks for paving the slope and base of the embankments) were also taken into account.

Returns to land a key factor in embankment maintenance

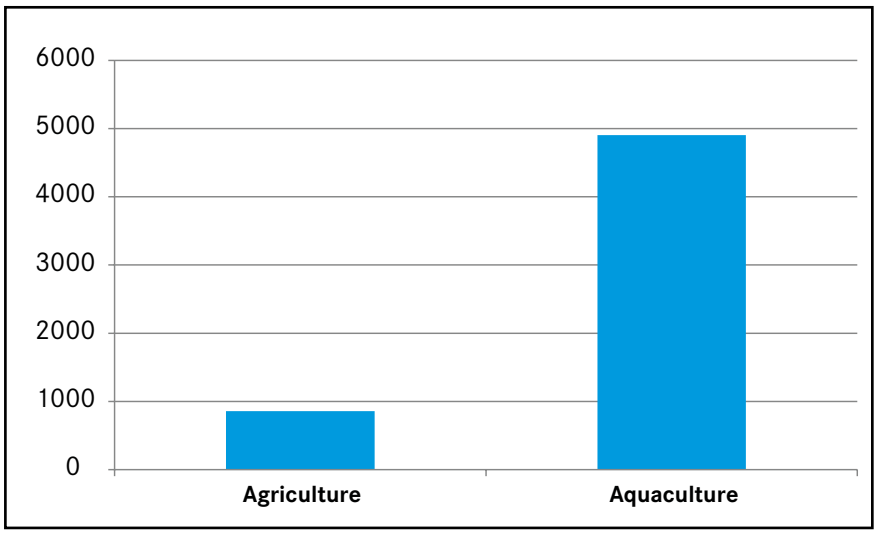
Based on careful statistical analysis, the study finds that households owning aquaculture plots are more likely to contribute to embankment maintenance relative to households with only agricultural plots. The reason for the larger contribution of aquaculture households becomes clear if net returns to the two occupations are compared. The mean net revenue from paddy cultivation is INR 2,387 (USD 44) per-bigha (local unit of land) per year. This is almost eight times less than the average annual net return from aquaculture. At the same time, for the sample as a whole, the average household embankment maintenance cost is INR 2,753 (USD 50) per year.

For the group of households whose major occupation is agriculture, average maintenance expenditure constitutes almost 64 percent of the net revenue from their agricultural land. For households with aquaculture as the major source of income, embankment maintenance expenditures are at 10 percent of annual net revenues. Clearly, for aquaculture households average returns are far in excess of average maintenance expenditure. It is therefore not surprising that these households are more likely to contribute to embankment maintenance than households with agricultural plots.

Bigger aquaculture farmers spend more

The study's second major finding is that, the size of aquaculture plots significantly influences private maintenance expenditure. This is to be expected because farmers with larger plots have higher returns. This is the case even when the aquaculture plots are far away from an embankment. However, no such consistent relationship is seen in the case of agricultural plots, whether they are distant to or adjoin embankments. Most agricultural plots adjoining embankments are much smaller than aquaculture plots near embankments; thus, these owners have little incentive to incur costs for maintaining embankments. Further, in aquaculture-dominant areas, distant agricultural plots are inevitably bordered by aquaculture plots – again reducing any incentives for agricultural farmers to bear embankment related costs, irrespective of their size.

Figure 1: Average Expenditure on embankment maintenance across sample agricultural and aquaculture households (INR/annum)



Head-enders free ride on tail-enders – social hierarchy may matter

Aquaculture households that own plots at the head of the feeder canal, near the embankment inlets, contribute less toward embankment maintenance compared to those at the tail-end of such feeder canals. In fact, the tail-enders spend on average almost 2 percent more per bigha of land than head-enders near the embankments (even though the latter are at higher risk of inundation). This raises the possibility that households with plots near embankments are free riding on the effort of the tail-enders or interior households.

Understanding this phenomenon of free-riding requires a closer examination of the size and ownership of canal based fishery plots. The average size of feeder plots near embankments is significantly larger than plots at the tail end. Thus, wealthier households have plots near the embankments. What's more, households with land near embankments are better connected socially, able to claim kinship with panchayat leaders and are well-linked to local networks such as religious groups and neighborhood clubs. Thus, it is possible that these households are able to impose informal sanctions on interior tail-enders. This suggests that social hierarchy can dominate and force farmers to act in a certain fashion even if it is costly to them.

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The study's last key finding is that, when agricultural and aquaculture households are taken together, there is some evidence that public intervention in embankment maintenance crowds out private efforts.

Policy implications

These findings have implications for public policy with regard to embankment maintenance in the Indian Sundarbans. The state has to make a choice between direct expenditures on embankment maintenance or investments in productivity enhancement. This study suggests that an increase in productivity would encourage individual conservation efforts and that direct subsidization might lead to a crowding out of private contributions in general. Public subsidies might also lead to perpetual in-action, particularly on the part of agricultural plot holders. Coastal zone regulations that restrict the conversion of land from agriculture to shrimp cultivation in the coastal and tidal areas would also further discourage private embankment maintenance efforts.

There is currently a lot of debate on coastal zone management in India. This study points to the complexity of issues at hand and how different social relations and incentives need to be taken into consideration in managing the land-water interface.

Map 1: Administrative Map of the Indian Sundarbans

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