Sand Deposition and Poverty Among Farm Households in North-eastern Assam

In floodplain areas around the world, farmers use the silt deposits that floods bring as a traditional way to upgrade soil quality. However, floods can also cause a sandy layer to be deposited, which can have long-term impacts on soil fertility. This problem is particularly significant in Dhemaji District in north-eastern Assam where sand deposition is making it difficult for many farmers to make a living. The average rice yield in the state of Assam between 1990-91 and 2009-10 was 1,433 kg per hectare. But, in the sand-deposited villages of Dhemaji District, the average yield is 315 kg of rice per hectare. Why is this the case and what are the costs borne by poor farmers as a result of sand deposits?

A SANDEE study asks these questions and tries to assess the damages caused by flood-induced sand deposition. The study is the work of Kalyan Das from the OKD Institute of Social Change and Development, Guwahati, India. Kalyan estimates the farm households in his study area are losing the equivalent of 26-71% of their current farm income due to sand deposits. Overall, annual losses due to sand deposition in Dhemaji District amount to between INR 8 to 21 million (approximately US $150–400,000). There is a clear need for more effective implementation of rural development and employment programs to ameliorate the rural distress in this region. Development programmes need to be assessed how best to improve paddy productivity. Further research is also needed to identify other factors that may be responsible for the decline in paddy productivity.

Sand deposition in the Dhemaji valley

Dhemaji is a narrow valley district surrounded by the steep slopes of the Arunachal Himalaya to the north and the east, and by the Brahmaputra River to the south. The district, once considered the rice bowl of Assam, has been transformed into a virtual desert due to sand deposition caused by flooding from the Himalayan tributaries of the Brahmaputra River. Floods in the year 2000 affected about 330,000 people in 810 villages, damaging 11,331 hectares of standing crop. The floods of 2011 affected a population of 154,000 and an area of 28,300 hectares in 261 villages in the district.

The floods have clearly ravaged agriculture production. Between 1992 and 2004–5, net sown area in the district decreased by about 11%. Furthermore, fallow and uncultivated land increased by 35%. Average paddy productivity in Dhemaji District is now much lower than the state average. (For more on the region’s soils see the side bar.)

The Government Response

Shifting cultivation, rampant tree felling for commercial purposes and the extraction of boulders in the upstream mountain valleys are possible reasons for the accelerated rate of flooding and sedimentation.

In response, the Government of Assam spends millions of rupees annually on disaster avoidance. The money is spent primarily on the construction of embankments, relief operations and mitigation activities. To date, 40

This policy brief is based on SANDEE working paper No. 73-12, ‘Farm Productivity Loss due to Flood-Induced Sand Deposition: A Study in Dhemaji, India’ by Kalyan Das, OKD Institute of Social Change and Development, Guwahati, India. The full report is available at: www.sandeeonline.org
Soils, floods and sand deposits

A wide range of studies show that soil quality is an important factor in explaining farm productivity. Although farm size, labor and other inputs such as fertilizer and mechanization are important factors that must be considered in any explanation of variability in output, soil quality is also significant.

Although detailed historical records on the condition of the soil in the Dhemaji study area are not available, there are indications that not so long ago the soil of this flood-affected area was conducive to high rice productivity. Indeed, the issue of severe flood damage and land degradation in the study area only came into focus in the late 1990s. Since then, the problem has grown.

Studying the soils in the study region indicates that the soils are poorly textured with a significant presence of sand and silt, which is acidic in nature having a poor organic content. The average soil pH level below 6 inhibits the process of nitrification while low organic carbon indicates low nitrogen content in the soil.

The researcher tested for the availability of nitrogen, phosphorus and potassium for the five dominant categories of soil (sandy, loamy sand, sandy loam, loam and silt loam) in 81 sampled plots in the study area. The tests revealed that all five categories of soil, irrespective of the dominance of sand or silt in the soil, showed poor nutritional content.

The poor quality of the soil is reflected by the poor returns to agriculture. Forty-three percent of the sample plots recorded zero returns. In fact, in the year 2009, 76 out of the 346 sampled plots were not tilled by the farmers. The farmers cited floods as the reason for zero returns in 36 of these plots and sand as the reason in the case of the other 112 plots. Overall it is clear that the deposition of finer silt during floods has failed to ensure the nutritional content in the soil. While the beneficial effects of flooding are temporary, sand deposition has a longer term impact.

embankments and dykes have been constructed in the district while another six have been sanctioned at a combined cost of INR 1,016.38 million.

Studying Sand Deposition

Kalyan’s study aimed to inform policymakers about the scale of the sand deposition problem in Dhemaji and so guide future responses. A study area was chosen between the twin-rivers of Kumotia and Jiadhal in five flood-affected Gram Panchayats. Satellite imagery indicates that this area has been significantly affected by sand-deposits. Fifteen villages were selected randomly from the 93 villages in the area.

Data was collected in two stages. In Stage 1, the researcher undertook a census of households in the study villages (1,059 households in all). Information was collected on various aspects of agricultural land, including paddy yield, land transactions and land quality. Paddy yield was measured in the kilogram return per hectare. In Stage 2, 10 households per village were randomly selected and interviewed to get detailed information on household characteristics, agricultural operations, access to credit, migration and the extent of state support.

To assess the extent of sand deposition, soil samples were collected from 346 agricultural plots. The texture of the soil, its sand concentration, its pH factor, organic carbon and its nutritional content were all measured.

Farming households in the area

The average land-holding in the study area is 1.4 hectares per family. The mean monthly return from agriculture, as estimated by the study, was INR 305 per household. This return is distressingly low and not adequate to ensure even the 30 kg of rice required for a family of five per month.

Low agricultural incomes seem to be pushing people to seek certain non-farm jobs. There is large scale migration to distant places such as the plywood and rubber factories of Kerala and private security service jobs in Tamil Nadu. In more than 90% of households, agricultural income constituted less than 30% of the total household income.

Affected villages had been able to secure some livelihood support under Government programs such as the National Rural Employment Guarantee Act and Indira Awas Yojana (the housing program for the poor). The support received from the state in the form of foodgrains is generally sufficient for about two months, given the average Assamese household of five.

Some households in the district have shifted from paddy to mulberry plantations and pisciculture as an adaptation strategy. However, pisciculture is not very profitable in the acidic soils of the region. Few farmers adopt land improvement measures such as the application of chemical fertilizers. One explanation for this is poverty. The other explanation might be that the farmers have little motivation to invest in the poorly textured, flood-ravaged soils they cultivate.
Soil quality and productivity

Nearly 83% of the total paddy acreage in the 15 sampled villages faced some form of sand deposition problem. The average farm plot had a concentration of 54% sand in its soils, while 39% of paddy plots had sand concentrations of more than 70%.

The average paddy productivity in the sampled plots was low (467 kg/ha). Statistical analyses confirm the significant negative effect of sand on paddy yield. The study estimates the productivity loss for a one-unit increase in sand concentration to be in the range of 2.36 kg to 6.39 kg.

Statistical analyses also show that the further a plot is from the riverside, the lesser the impact of sand. This makes sense since plots near to the river get repeated deposition of sand while those further away have a better chance of increasing organic concentration over time and recovering soil productivity.

The cost of sand deposition

In order to put a value on the damage caused by sand deposition, an assessment was made of paddy yields for ‘normal’ soils with a sand concentration of 15.7% (this is the ‘normal’ proportion of sand in the wider region’s soils). Normal yields were then compared with current yields in order to estimate the decline resulting from sand deposits. The sand deposit induced decline in yield is in the range of 92 kg to 246 kg of paddy per hectare per year (based on two different model estimates).

Considering that one kg of paddy costs INR 7.5 and approximately 11,331 hectares in the district have been affected by sand, the overall annual losses due to sand deposition in the Dhemaji District is estimated to lie between INR 8 to 21 million (approximately US$ 150-400,000). The average loss per hectare lies between INR 690 to 1845 (approximately US$ 13-35 using an exchange rate of USD 1=INR 53.5) or between INR 966 to 2583 (US$ 18-48) per household. These losses constitute 26 to 71% of the total farm income currently derived by the affected households and 2 to 5% of the total annual incomes earned from all sources at present after adapting to the situation. Farm productivity loss has made the families food dependent on external sources.

In addition to the productivity losses, there is also concern about possible biodiversity losses. Dhemaji District produces numerous indigenous varieties of paddy that may disappear as paddy yield declines. In the 15 villages covered under this study, 13 indigenous varieties of paddy were recorded.

Are sand deposits the whole story?

It is noteworthy that the average yield of rice in the state of Assam between 1990-91 and 2009-10 is 1,433 kg per hectare. The current average yield in Dhemaji District is 1,165 kg rice. In the sand-deposited study villages of Dhemaji District, however, the average yield is 315 kg of rice per hectare. This is far lower than the yield, for instance, in the flood ravaged Dhubri District in lower Assam, which has an average yield of 1,304 kg of rice per hectare.

About 50% of the farmers in the study indicated that sand deposits were the main reason for low yields from their farm plots. Thus, it is clear that sand deposits do have a significant impact on productivity and are perceived by farmers as a major problem. However, the variation in output due to sand is not fully sufficient to explain the variation in output between villages with sand deposits and those without (both within Dhemaji District and in other areas). Overall, this means that other factors may be contributing to the difference in productivity between the study villages and other areas of the state.

Conclusions and policy implications

Conditions in the Dhemaji area put into stark relief the need to strengthen the social security of the poor. The study recommends that more effective implementation of rural development and employment programs by the government might be one way to ameliorate rural distress in the region.

It also recommends that any attempt to improve water management would be helpful to farmers. However it cautions that state expenditure on the construction and reinforcement of embankments (which has been the main strategy to control floods) has not been as beneficial as it might be because of frequent breaches in embankments.

Sand deposition is only a partial explanation for the decline in paddy productivity in the region, and there is a need for further research to identify other factors that are also responsible for this decline. In addition, it would be extremely useful to understand how better management of upstream areas may result in lower sand deposits in paddy fields.
SANDEE

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Figure 1: Sand deposited area of Dhemaji district, 2002
(Courtesy, ASTEC, Guwahati)

Figure 2: Trend of yield of Rice in Dhemaji district, Sibsagar (high performing district) and the State of Assam (1990-91 to 2009-10)

Table 1: Estimates of losses per hectare from increased sand intensity

<table>
<thead>
<tr>
<th>Estimate</th>
<th>Per hectare paddy production with normal soils (Sand average 15.7% in paddy plots)</th>
<th>Per hectare paddy production with sand-deposited soils (Sand average 54.2% in paddy plots)</th>
<th>Loss of paddy per hectare in kg</th>
<th>Loss per hectare in INR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model I*</td>
<td>680</td>
<td>588</td>
<td>92</td>
<td>690</td>
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<tr>
<td>Model II</td>
<td>428</td>
<td>182</td>
<td>246</td>
<td>1845</td>
</tr>
</tbody>
</table>

*The two models represent different econometric models.