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Tackling Water Scarcity in Bangladesh – A Lesson from the Country's Rice Fields

In many parts of Bangladesh water scarcity is a seasonal problem. To look at how best to deal with this challenge, SANDEE associate Nasima Tanveer Chowdhury, assessed whether water is being used efficiently for the cultivation of one of the most important food crops in the country, *boro* rice.

The study finds that water is not being used efficiently for the cultivation of Bangladesh's *boro* rice crop. It therefore recommends that the government should encourage farmers to grow other less water-intensive food plants. It also shows how the government could help farmers use water in more efficient ways. Since food security and employment generation are still major development challenges for Bangladesh, this study should have important policy implications for agricultural water use and the selection of crops.

THE WATER SCARCITY CHALLENGE

In Bangladesh, agriculture is the economic sector that uses the most water. While Bangladesh is generally not known for its water scarcity problems, agricultural water scarcity is faced in the southwestern and northwestern regions of the country during the dry winter season (for more information see the side bar).

To address regional agricultural water scarcity, there are many government-run canal irrigation projects in the country. These have recently been leased out to Water User Groups (mainly medium and large farmers) and this has led to a potential conflict of interests between small and larger farmers. For this reason, amongst others, the government's approach to solving the water scarcity problem is currently not as effective as it could be.

To try and help improve the government's approach, Chowdhury examines whether farmers who cultivate dry-season *boro* rice in Bangladesh use irrigation water efficiently. To do this, she assesses how various inputs – including irrigation water - affect rice outputs.

RICE AND RICE CULTIVATION

A remarkable feature of Bangladesh's rice production is the increase in the use of the irrigated high yielding variety (HYV) *boro* rice that is the subject of this study. *Boro* is the leading rice crop – it contributes about 55% of the total rice production. The next most important type of rice are *aman* (40% of total crop) and *aus* (5%).

Data from the International Rice Research Institute (IRRI) is used to look at the efficiency of water use in *boro* rice production. IRRI has collected data on how much farmers spend on agricultural inputs (including irrigation water) and the returns they get on their investments. This data has come from a nationally representative sample of farm households. This sample was drawn from 62 villages belonging to 57 of the 64 districts in Bangladesh. This is a very rich data set, particularly in terms of the information it contains on the returns to different types of agricultural labour and other inputs.

To make her assessment Chowdhury used a sub-sample of the IRRI survey. This sub-sample covers 724 farm households from seven regions that cultivated dry season *boro* rice in 2004.

This policy brief is based on SANDEE working paper No. 49-10, 'The Relative Efficiency of Water Use in Bangladesh Agriculture by Nasima Tanveer Chowdhury from the Department of Economics, Gothenburg University, Gothenburg, Sweden. The full report is available at www.sandeeonline.org

AGRICULTURE, CLIMATE AND IRRIGATION IN BANGLADESH

Agriculture in Bangladesh is governed by the distribution of rainfall throughout the year. Rainfall is largely dependent on the presence and duration of the monsoon. The average annual rainfall varies from 1,200 mm in the extreme west to over 5,000 mm in the northeast. About 80% of the total rainfall occurs during the monsoons from June to September.

Only 10% of the annual rainfall is available during the combined post-monsoon and winter periods, while the rainfall is extremely unreliable in the subsequent pre-monsoon period.

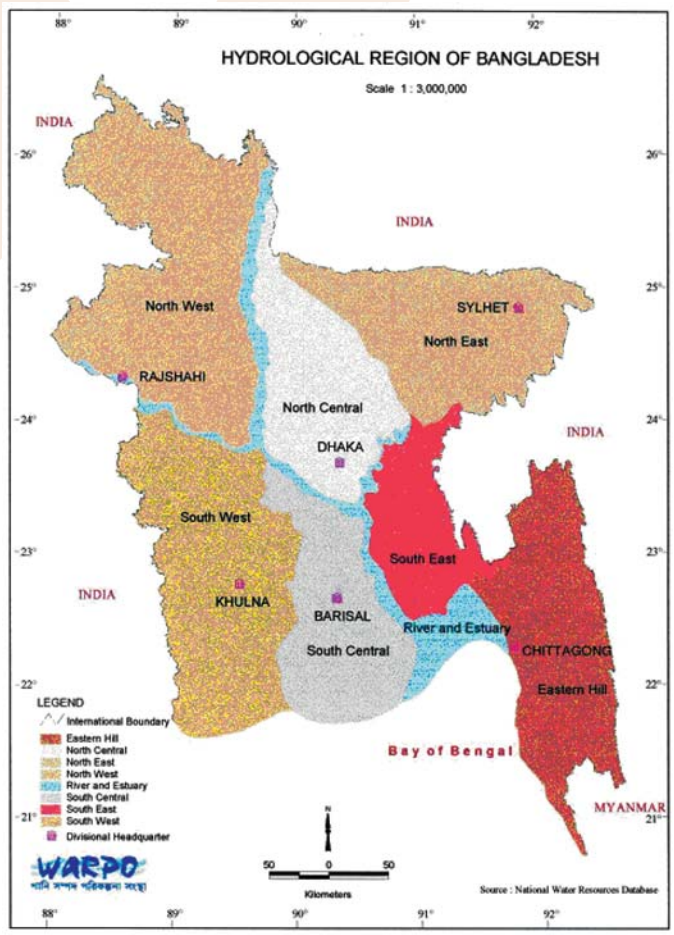
Water shortage is regional as well as seasonal. Water is very scarce in the south and northwest regions of Bangladesh during winter. The southwest region of Bangladesh, which has an inland zone and a coastal zone, is the Ganges-dependent region. It suffers from both dry season water shortage and arsenic contamination. In the coastal zone, water salinity is also widespread. The northwest region is highly developed agriculturally and has the largest irrigated area of agricultural land; this is mainly watered by shallow tube wells. However, seasonal water table decline is widespread. The southern part of this region is also flood-prone.

HOW MUCH WATER IS USED?

Although the IRRI data is comprehensive, direct quantitative information on the agricultural inputs used in Bangladesh was only available for seeds and fertilizer. For most other inputs, such as pesticides and manure, only information on expenditure was available and this was used to estimate how much of each was actually used.

For irrigation water this calculation was complicated by the fact that farmers in Bangladesh do not pay for using water as such; instead they pay for pumping water. Farmers use low lift pumps to pump water from surface water sources and shallow and deep tube wells to pump water from aquifers and groundwater sources. Water pumping costs include expenditure on energy (fuel, diesel or electricity) and for hiring pump mechanics as and when they are required. Electricity and diesel costs make up 40 to 75% of the average cost of irrigation, while the monthly wage of the pump mechanic makes up the rest.

Figure: Hydrological Region of Bangladesh



WATER IS BEING WASTED

The study finds that the marginal return on one ha land put into *boro* rice production is BDT 18,320. The value of one ha land is BDT 11,425, which is one-third of the value of output. This shows that agricultural land in Bangladesh is very productive. Different inputs affect *boro* rice yields in different ways. For example, the marginal return on ploughing with a power tiller is BDT 3.44. That is, for every BDT increase in expenditure on ploughing with a power tiller, farmers get an increase in *boro* rice output of BDT 3.44. The marginal return on fertiliser is BDT 12.42 per kg; with the average price of 1 kg fertiliser is BDT 10.04.

In comparison, the marginal return on irrigation water is only 0.05. This means that a one BDT increase in irrigation expenditure raises rice output by only BDT 0.05. What is more, the percentage increase in the value of *boro* rice output is only 1% of the increase in irrigation expenditure. This means that a 10% increase in irrigation expenditure leads to an increase in rice output of only 0.1%. This finding points to the conclusion that Bangladeshi *boro* rice farmers are using water inefficiently. Overall, Bangladeshi farmers are more efficient in their use of land, labour, fertiliser, and ploughing with power tiller than in their use of irrigation water. Moreover, medium land farmers are more efficient compared to the highland and very lowland farmers when it comes to irrigation water use.

Table: Yield Elasticites for *Boro* rice and Marginal Returns to Inputs

Input	Elasticity	Marginal Return
Land	0.54	18,319.97
Very low land	0.54	19,270.61
Medium land	0.6	19,846.16
High land	0.59	18,795.94
Labour	0.21	52.41
Ploughing with power tiller	0.18	3.44
Irrigation	0.01	0.05
Fertiliser	0.13	12.42

Note: Marginal returns are at Sample Mean in BDT

IS PUMPING THE PROBLEM?

As said, the irrigation picture is quite complex due to the lack of information on actual water usage. This means that any increase in irrigation expenditure may not be due to an increase in the volume of irrigation water used, but from an increase in the use of diesel for pumping water. It is noteworthy that diesel is more expensive than electricity and irrigation from diesel-run pumps costs almost double that from electric pumps. Irrigation expenditure is also increasing because the groundwater table is falling in the north-west and the north-central regions of Bangladesh.

To look into this inefficiency issue in more depth, Chowdhury assessed whether increasing irrigation expenditure increases rice output for diesel pump users. To do this she looked at a sub-sample of 260 households who had no electricity connection. There was no evidence that increasing irrigation expenditure led to an increase in output. This result further reinforces the conclusion that water is being used inefficiently.

CHEAPER IRRIGATION ENCOURAGES WASTE

Further analysis shows that the inefficient use of water is more likely in the case of farmers who are using government-owned deep tube wells, public (canal) irrigation projects and traditional irrigation systems. These are much cheaper modes of irrigation than low lift pumps, shallow tube wells, and privately owned deep tube wells irrigation. The low efficiency of water usage found amongst these farmers may be due to the flat rate paid by user groups for irrigation water for surface water.

Although farmers using privately-owned shallow tube wells and low lift pumps are more efficient than farmers using canal irrigation projects and government-owned deep tube wells, some of them may still be using more water than is required. The overuse of water in the private sector may be partly due to the flat seasonal fee that is charged (one-fourth of the crop share is the irrigation payment method normally used) and also due to the shared use of tube wells.

SANDEE

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Leila Mead/IISD

HOW TO TACKLE WATER WASTAGE

These findings are very important because they have great significance for the cost of food. Increasing diesel prices are increasing irrigation expenditure and driving up food prices. This means that any steps that can be taken to reduce the use of irrigation water should help reduce inflationary pressures on food prices.

One key step forward would be to introduce rice and other crop varieties that require less water for irrigation per ha. In general *boro* rice production requires three times more water than wheat or maize. Incentives or price support for wheat and maize production would encourage farmers to diversify crops and reduce water use per hectare. Agricultural extension activities will also play a very important role in bringing about more efficient water use.

One other policy option is to encourage the use of pumps that run on electricity. This will reduce farmers' irrigation expenditure and bring down the overall expense on cultivation dramatically. However, this would require that rural power supply be increased and made more stable. In addition, the government would need to charge farmers full price for using electricity in order reduce water wastage.

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