Editor’s note

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Climate change and development in Bangladesh

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Context

Adaptation to climate change in Bangladesh needs to be seen in the context of the country's overall development needs. Bangladesh's population is now ca 150 million. It is increasing at more than 2 million a year. The urban population is expanding rapidly: 27 percent of the country's population was classified as urban in 2008 versus 15 percent in 1981. Foodgrain production in the past 30 years has increased roughly in parallel with the growing population. That was largely due to the expansion of irrigation in the dry season, and dry-season rice production now exceeds production in the wet season. None-the-less, because of greatly-increased investments in industry, services and communications, the agriculture sector now provides only 19 percent of GDP versus 37 percent in 1989-90; (the agriculture sector includes forestry, fisheries and livestock as well as crop production).

The rapid changes taking place in Bangladesh present major challenges, regardless of climate change. There is still scope to increase agricultural production via more efficient use of irrigation water and fertilisers, and breeding crop varieties adapted to a wider range of environmental stresses. Average rice yields (all varieties) are only 2.6 tons/ha compared with potential yields of 5.5−7.5 t/ha with new HYVs and 7.0−8.5 t/ha with modern hybrids (Hossain et al., 2009). However:

- about 30 percent of the country is too deeply flooded to grow HYVs of rice in the monsoon season, and another 10 percent is occupied by steep hills in high-rainfall areas (2000−>5000mm) that are unsuitable for intensive food-crop production;
- it is estimated that 1 percent of agricultural land is being lost annually to urban and industrial development;
- the average farm size in 2005 was 0.59 ha, and 87 percent of farm holdings were 1 ha or less (Asaduzzaman, 2009);
- the easily-available surface-water and groundwater resources are nearing full exploitation, and salinity and arsenic contamination affect supplies in some areas; and
- monsoon-season crop production remains exposed to flood, cyclone and drought hazards, and the rapid growth of Bangladesh's population and economy means that many more people and much greater economic assets are exposed to such hazards than in the past.

The government of Bangladesh elected to power in late-2008 committed itself to achieving national self-sufficiency in foodgrain production by 2013, and to providing full flood protection, dredging of the rivers and surface-water irrigation. However, the feasibility of providing these measures remains both technically and financially uncertain: for the past twenty years, donor governments and agencies have been reluctant to fund major water development projects because of environmental concerns and problems of governance (i.e., constipated institutions, and corruption).

Climate change

Most (but not all) of the Global Circulation Models (GCM) considered in the IPCC 2007 report predicted a slight (<10 percent) increase in rainy-season rainfall by 2040 over most of the Ganges-Brahmaputra-Meghna (GBM) catchment area affecting Bangladesh (Cruz et al., 2007). More recent estimates suggest <5 percent increase in monsoon rainfall by 2050 (Hu et al., 2010). Predicted temperature increases seem more likely to have significant effects on agriculture, and it is generally assumed that the frequency of floods, cyclones and drought will increase. Estimates (mainly conjectural) of the area affected by a 1m rise in sea-level range between one-tenth and one-third of the country, with 10−30 million people displaced. The recent World Bank-funded study (Hu et al., 2010) estimated that the combined effects of changes in temperature, rainfall, flood and cyclone frequency, and sea-level rise by 2050 could reduce monsoon-season rice production in Bangladesh by 1.5−3.5 percent annually and dry-season rice production by 5.5 percent.

Uncertainty

These predicted outcomes of climate change are highly uncertain. The IPCC 2007 report acknowledged that the GCMs on which regional predictions were made are still crude. Existing models cannot yet predict the Indian monsoon satisfactorily. A recent DFID-supported report on the impacts of climate change on Bangladesh illustrates the scale of this uncertainty (Farquharson et al., 2007). Monsoon rainfall simulated by the four GCM models used ranged between ca 150 and 350 mm lower than the observed mean July rainfall averages for 1979−99, and rainfall was higher by 5-50 mm per month in the dry season. Simulated temperatures in the models differed from actuals by between -8^0 and $+13^0$C in the dry season and between -10^0 and $+4^0$C in the monsoon season.

If the models are so far out in trying to model the existing climate and there are such big differences between model outputs, what reliance can be placed on predictions of future climate? The present uncertainties regarding the direction and magnitude of possible changes do not provide a reliable basis for planning. Additionally, it might be asked, how realistic is it to plan for 2050 and beyond? How realistic would plans based on the Club of Rome predictions in 1970 have been?

Status quo v. dynamics

Those considering the potential impacts of climate change on Bangladesh apparently assume a static environment and a passive people. But the GBM delta in Bangladesh is dynamic, and so are the government and people of Bangladesh. Bangladesh is not helpless against climate change and sea-level rise. That does not mean that the country might not need technical and financial help to withstand the projected climate and sea-level changes. But help can (or should!) only be given where it is actually needed. It should not be based on uncertain model outputs and armchair assumptions.

The combined GBM rivers are estimated to bring down ca 1 billion tons of sediment to the Meghna estuary each year. Analysis of satellite images shows that sediment deposition in that estuary created 451 km^2 of new land (net gain of accretion over erosion) in the 24 years between 1984 and 2007; (data awaiting publication). Elsewhere, there was a net loss of 53 km^2 of coastal land west of the estuary during the same period (mainly at the western, Indian end of the delta front), and neglible change on the Bangladesh coast east of the estuary. The changes in land area and distribution in the Meghna estuary since about 1950 are well seen on Google Earth images; (the date of the map outline of Bangladesh on those images is uncertain, but the land boundaries in the estuary approximately represent the situation shown on 1949 airphotos seen by the author). Given the large amounts of sediment delivered annually to the Meghna estuary, net land accretion is likely to continue with sea-level rise. None-the-less, the distress caused by erosion along estuary channels and the coast must not be discounted: families displaced by land erosion do not necessarily benefit from new land formation; new 'raw' alluvium is not of the same quality for crop production as older, developed soils that are eroded; the land is still exposed to seasonal floods before it is embanked and to storm surges even after it is embanked; and groundwater is saline, so is unsuitable for drinking.

Much of Bangladesh's coastal area is protected by embankments that created polders between tidal rivers. These embankments, built in the 1950s and 1960s, were designed to keep out salt water at high tide. If properly managed, there is no reason why these embankments should not keep out rising sea-levels for at least the next 50 years. Proper management would include measures to raise embankment heights, to repair breaches speedily after damage by storm surges and to enable sedimentation from tidal rivers to build up land levels inside polders (a technique known as warping) in parallel with rising sea and river levels. Where warping might be insufficient, pump drainage could be installed. Parts of the Netherlands are >6m below sea-level. Bangladesh must emulate the Dutch in fighting the sea. There is much that the government and people can do themselves. But since Bangladesh does not have the economic and financial resources of the Netherlands, they will also need external support in order to protect their land.

Nor must it be idly assumed that Bangladesh's agricultural scientists and farmers will remain passive as environmental conditions change. The dynamism of agriculture in Bangladesh is shown by the three-fold increase in rice production since 1971 as the population tripled. Plant breeders produced many new higher-yielding crop varieties during that period, including salt-tolerant rice varieties that are widely grown in coastal areas. They are currently working on rice varieties to tolerate a wider range of environmental stresses such as flood submergence, drought and soil arsenic contamination. Additionally, Bangladeshi farmers are highly resilient. They are opportunistic and entrepreneurial. They have generations of experience of coping with environmental and market stresses.

Climate variability

Table 1 shows how minimum and maximum temperatures varied between 1964 and 2008 at Rajshahi in the drier west of Bangladesh. With global warming, one would expect that the last date of low winter temperatures would become earlier with time and that there would be an increasing number of days with extremely high temperatures in the hot season. The data in Table 1 provide no conclusive evidence that such changes have occurred over the 45 years of record. The end-date of the cool winter season has fluctuated over time, and was similar at the end of the period to what it was 40−45 years ago. Counterintuitively, the average number of days per year with extremely high temperatures actually decreased over the 45-year period. Similar changes also occurred at other places in the NW region of Bangladesh.

The author conjectures that the reduced number of extremely hot days per year − significant because they interfere with pollination of rice − reflects the change from the former dry-season fallow land to widespread irrigated boro rice cultivation in the dry season in the past two-three decades. That change in land use could also have advanced the end-date of the cool winder period; so also could the 'heat island' effect of urban warming: (the majority of meteorlogical stations in Bangladesh are in cities/towns that have expanded immensely in the past two decades). These findings and observations provide a salutory warning that global warming is not the only factor that can change local climates.

Table 2 shows the variations of annual rainfall at Rajshahi between 1964 and 2008, while Table 3 shows how rainfall in June (the first month of the monsoon season) varied. The great variability from year to year means that farmers have to be prepared for drought or excessive rainfall every year. The drought that occurred in 2009 was widely interpreted as evidence of climate change. However, Table 3 shows that low rainfall in June is a recurring phenomenon. The average rainfall at Rajshahi in the dry winter season (December–February) is 31.5 mm, so a 10 percent decrease with climate change would have no practical impact: there have been many years with zero rainfall in one or more of these months in the past 45 years.

The great year-to-year variability makes it difficult to identify any change in annual rainfall or in rainfall patterns that might be linked with global warming. A recent analysis of daily temperature data for eight stations also showed great inter-annual variation and the lack of a consistent pattern of temperature changes with time. Table 4 illustrates the variability at Rajshahi during the 45-year period of temperature records and the lack of evidence for increasing maximum temperatures with time. Together, Tables 1 to 4 provide no evidence that temperatures or rainfall at Rajshahi have become more variable over the past 45 years. It may be added that there is no evidence that the frequency of floods or cyclones in Bangladesh has increased during that period; there were, in fact, many more cyclones between 1960 and 1970 than in any subsequent period of similar length. That does not mean that changes may not occur in future. What it means is that there is no conclusive evidence at present for the climate trends predicted by existing GCM outputs.

Conclusions

What does the above mean for adaptation to climate change in Bangladesh? It means that the government of Bangladesh and the Bangladeshi people have much more urgent matters to worry about at present than climate change.

If global mean annual temperatures increase by 2^0C during the 21st century, that is at an average rate of 1/50th of a degree a year. Global sea-level is currently estimated to be rising at 3.4mm a year (Allison et al., 2009). But even if the rate were gradually to double in the next 20 years, that would increase sea-level by only about 10 cm (4 inches) over the next two decades. Those rates of temperature change and sea-level rise are unlikely to affect farmers' lives and livelihoods significantly during the next 20 years.

But Bangladesh is already badly exposed to recurrent natural disasters. The government and the people have to be prepared for the risks of flood, cyclone and drought every year. And the increasing pressure of population on the land, the growing scarcity of water for irrigation and other uses, increasing salinisation of rivers and soils in the south-west due to abstraction of water upstream, arsenic contamination of soils and rice in some areas, and the increasing costs of fertilisers and fuel are affecting farmers' lives and livelihoods now. The growing number of people unable to make a living from the land because of population increase means there are increasing numbers of economic migrants from rural areas that need to find employment or relief in urban areas or abroad. Those are problems of more immediate importance than climate change.

The present focus of international agencies, NGOs and the Government of Bangladesh on climate change is distracting attention from development issues that ought to be addressed now. The neglect of current problems threatens the lives of many millions of people. That is apparently true also for other developing countries: other TAA members may care to provide factual information for countries they are familiar with.

This does not mean that climate change can be ignored, in Bangladesh or elsewhere. What it does mean is that climate change needs to be seen and addressesd in the perspective of overall development needs. Fortunately, most of the measures needed by the government and people of Bangladesh to adapt to projected levels of climate change and sea-level rise are required anyway to deal with the country's existing problems:

- measures to increase security of lives and livelihoods against floods, cyclones, drought, salinity in coastal areas and a variable climate;
- agricultural research to increase the range of crops tolerant of existing environmental stresses and to increase efficiency of irrigation and fertiliser use;
- assessment of the extent and severity of arsenic contamination of soils, and research on practical mitigation methods;
- strengthening of agricultural extension and support services to farmers;
- continued provision of support prices and/or input subsidies to assure farmers of profitable returns from the risky production investments they must make;
- education and skills development together with employment generation to enable the growing urban population to contribute productively to the national economy; and
- measures to reform governance and institutions, so as to provide an enabling environment for international donor funding.

These are matters that deserve the attention and support of donor governments, international agencies and NGOs as much as by the government of Bangladesh. A similar balanced review of needs and opportunities in other developing countries is recommended.

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Table 1. Changes in minimum and maximum temperatures at Rajshahi 1964−2008 by pentad

Pentad	Mean last date of minimum <15^0C	Mean No of days per year with maximum >40^0C
1964−68	9/3	11.4
1969−73	13/3	20.0
1974−78	17/3	3.0
1979−83	15/3	10.0
1984−88	14/3	9.0
1989−93	15/3	6.6
1994−98	16/3	6.8
1999−03	14/3	1.6
2004−08	8/3	2.4

Note. There were no data for 1969−1971 and 1982.

Table 2. Annual rainfall at Rajshahi by pentad 1964-2008

Period	No of years with records	Mean mm	Lowest mm	Highest mm
1964−68	5	1419	1139	1958
1969−73	3	1467	944	2060
1974−78	5	1604	1062	2006
1979−83	3	1890	1758	2071
1984−88	5	1467	1252	1575
1989−93	5	1408	839	1765
1994−98	5	1489	1142	2062
1999−03	5	1550	1363	1862
2003−08	5	1533	1145	2018
Mean 1964-2008		1522		

Table 3. June rainfall at Rajshahi by pentad 1964−2008

Period	No of years with records	Mean mm	Lowest mm	Highest mm
1964−68	5	248	26	447
1969−73	5	340	209	614
1974−78	5	327	77	557
1979−83	4	224	65	289
1984−88	5	273	175	407
1989−93	5	241	85	455
1994−98	5	229	92	291
1999−03	5	279	222	348
2003−08	5	269	92	507
Mean 1964-2008		271		

Table 4. Rajshahi maximum temperature analysis by pentad 1964−2008

Pentad	No of years with records	No of days per year with >40^{0}C		Annual absolute maximum (^{0}C)	
		Mean	Range	Mean	Range
1964−1968	5	11.4	3−25	42.7	41.7−43.3
1969−1973	2	20.0	12−28	43.5	41.9−45.1
1974−1978	5	3.0	0−7	40.0	37.1−42.2
1979−1983	4	10.0	0−20	41.0	36.8−44.4
1984−1988	5	9.0	0−14	42.2	41.5−42.5
1989−1993	5	6.6	0−18	41.1	39.4−43.7
1994−1998	5	6.8	2−16	42.2	40.2−43.3
1999−2003	5	1.6	0−5	40.4	39.2−41.8
2004−2008	5	2.4	0−8	41.0	39.8−42.8