

## Weather Matters in Bangladesh

Bangladesh is a nation where catastrophic **weather** events are so common that it's fair to say such events have become a part of everyday life--continually testing the resiliency of a resilient people. That's why the introduction of satellite technology and computerised assessments, which are designed to provide and analyse detailed information about **weather** patterns and potential **weather**-related impacts, have become such a welcome addition to the nation's long-standing battle against nature's fury.

One of the pioneers of this effort has been Abdul Musawwir Choudhury, a former **ICTP** Regular Associate (1981-1994), who has served as director of research and chairperson of the Space Research and Remote Sensing Organization (**SPARRSO**) since 1980. SPARRSO is a government-sponsored research organisation specialising in remote sensing and computer modelling. With a staff of 150 (including about 50 research scientists), SPARRSO, headquartered in the capital city of Dhaka, works closely with other governmental agencies responsible for water, forestry, fishery and land-use management.

"A unique confluence of circumstances--both natural and human-made--has placed social and environmental well-being in Bangladesh at risk year-in and year-out," says Choudhury.

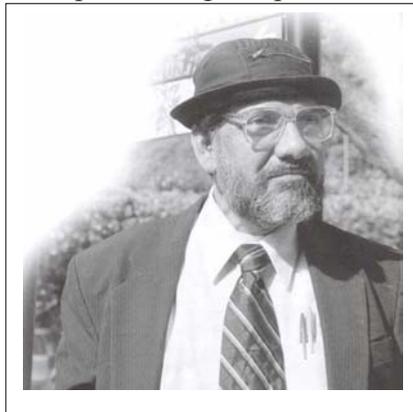
"First, Bangladesh sits on a broad delta plain--a sea of silt--built by soil deposits from the Ganges and Brahmaputra rivers. While this gives the nation potentially some of the most fertile soil on Earth, it also makes it vulnerable to flooding. In fact, half of the nation's land mass is less than 25 meters above sea level. Think of Bangladesh as The Netherlands of the Asian subcontinent."

While Bangladesh may look like The Netherlands in terms of topography," Choudhury adds, "the size of its land mass is comparable to England, but with a population 2.5 times as large." That makes Bangladesh, with a total of about 130 million people, one of the most densely populated nations on Earth.

And, as endless news stories and research reports have noted, the people of Bangladesh are poor. The World Bank estimates that the annual gross national product per capita is about US\$350 and that 75 percent of the population lives on less than US\$2 a day. That makes Bangladesh one of the poorest countries on Earth.

"Simply put," notes Choudhury, "geography has created natural hazards for Bangladesh; poverty has made it difficult for the nation to respond effectively."

There is one additional factor, however, that makes the experience of Bangladesh even more unique than the experience in other poor, overcrowded coastal nations in the developing world. That factor is the monsoons, seasonal winds that often carry heavy, sometimes torrential, rainfalls between May and September each year, and, at the same time, are one of the prime forces behind such catastrophic **weather** events as cyclones and tornadoes. Bangladesh receives 85 percent of its annual rainfall (which can total more than 5 metres a year) during the monsoon season--and suffers most of its **weather**-related catastrophes during this period as well.



*Abdul Musawwir Choudhury*

Choudhury explains: "In southeast Asia, land covers 60 percent of the area; in the rest of the world, land cover averages 20 percent with the rest submerged in water. Since water tends to absorb a much higher percentage of the sun's radiative heat, regions with large water masses tend to have cooler, more temperate, climates.

"In Bangladesh," he continues, "temperature differences between the land and the sea can sometimes reach 10°C. Such differences generate variations in pressure that kick up the seasonal monsoon winds and supply the energy that fuels cyclones and tornadoes."

Put another way, the vast Eurasian land mass dominated by the Himalayan Mountains and Tibetan Plateau and encircled by the Indian and Pacific oceans provide an ideal, one-of-a-kind, geographical setting for the spawning of monsoons.

Bangladesh, as a result, is no stranger to devastating natural events. In 1970, a cyclone left 300,000 dead and millions homeless in one of the worst natural disasters in human history. In 1991, another catastrophic cyclone left 100,000 people dead. And in 1998, two-thirds of the country was inundated by flood waters that rose some 20 metres above normal in some places, forcing more than 20 million people to evacuate their homes.

But that's not all. Shifts in monsoon winds can sometimes cause rains to cease or not arrive at all.

As a result, Bangladesh, a land noted for too much rain, also periodically suffers from too little rain. In 1770, the great Bengal drought wiped out an estimated one-third of the population. In 1943, drought took the lives of one-fifth of the population. More recently, droughts in 1973, 1979 and 1994 left millions of Bangladeshis without access to adequate supplies of food.

But the news of late is not all bad. Improved irrigation systems and agricultural practices have raised the level of food production in Bangladesh, helping to mitigate the adverse, life-threatening, impact of droughts. Moreover, recent **weather**-related catastrophes in Bangladesh have not caused as much havoc and death as in the past, in part because both citizens and government officials have been able to respond more effectively to the risks posed by natural disasters. For example, Bangladesh experienced two weeks of floods in September 2000 but the loss of lives and the extent of property damage were minimal compared to previous floods. In fact, less than 1000 people died—a catastrophe in its own right but of a much lesser dimension than in the past.

One reason for the thankfully limited impact of the storms in 2000 was the fact that the most intense rain storms were confined to the southwest quadrant of the country. Another reason, however, lies in significant improvements that have taken place in Bangladesh's disaster management programmes, which are better funded and more sophisticated than in the past. In fact, Bangladesh's disaster management strategy has moved increasingly from post-disaster response (cleaning up the mess after it takes place) to preparedness (trying to anticipate potential disasters before they occur and putting plans in place to minimise their potential damage).

That's where the work of Choudhury and SPARRSO comes into play. For more than two decades, SPARRSO, with the help of satellite and computer technologies, has been assembling detailed statistical profiles of Bangladesh's **weather** and climate. More recently, it has begun to develop computer models that have become increasingly adept at anticipating rain and temperature patterns throughout the country.

The government of Bangladesh has found such information invaluable in addressing a host of vital environmental problems ranging from its annual projected levels of water-irrigation releases for farmland (which helps boost agricultural productivity) to anticipated changes in water quality (which help improve the management of the nation's fish industry, an important source of nutrition for many people) to projected levels of rain associated with monsoons (which is instrumental in devising effective strategies for risk management).

One of the most important insights provided by SPARRSO has to do with the development of a computer model that can accurately project whether a particular monsoon season will result in moderate or heavy rainfall. The model, which draws on information related to barometric pressure readings across the globe, has proven instrumental in anticipating the impact of *El Niño* and *La Niña* on rain levels in Bangladesh, thus helping to determine whether a particular monsoon season is likely to leave excessive flooding in its wake. The conclusion of these studies, in their most

simple form, is this: *El Niño* tends to blunt the force of monsoon rains. *La Niña*, meanwhile, tends to fuel the quantity and intensity of rainfall during monsoons, making a dangerous situation even more dangerous.

Choudhury recently visited **ICTP** to give a lecture during the Course in Inverse Methods in Atmospheric Science. But this was by no means the first time that he has been to Trieste. Indeed Choudhury's affiliation with the Centre dates back to the late 1970s when he attended an international workshop on monsoon dynamics in Dhaka, which was jointly organised by **ICTP** in cooperation with the World Meteorological Organization (WMO) and the Canadian International Development Agency (CIDA). His participation in Centre-sponsored activities accelerated after 1981 when he was appointed an **ICTP** Associate. As a result, in the early 1980s, Choudhury attended Trieste-based training and research activities related to numerical **weather** prediction, geophysics, applications of physics to meteorology, geomagnetism and mathematical ecology. "While other organisations--for example, the US National Aeronautics and Space Administration (NASA)--provided staff at SPARRSO with access to satellite data that made it possible for us to conduct research at home, **ICTP** provided the training and know-how to effectively use this information in ways that addressed compelling national needs. This is an untold story of how **ICTP** has helped put physics and math to work to deal with one of Bangladesh's most critical problems--**weather**-related disasters."

"Despite our recent modest measures of success, we still have a long way to go," says Choudhury. "Nevertheless, we should be proud of the science-based progress that has recently been made in dealing with the inevitable risks that Bangladesh experiences due to an unusual mix of natural and social conditions that, in turn, have created an unusual set of challenges for a nation struggling to improve the quality of life for its people."

*For additional information about the Bangladesh Space Research and Remote Sensing Organization (SPARRSO), please contact **A.M. Choudhury**, [sparrso2@bangla.net](mailto:sparrso2@bangla.net).*