

# **Space Technology Applications in Disaster Monitoring and Management in Bangladesh**

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## **Abstract:**

This paper describes the use of space technology and GIS technique in Disaster Monitoring and Management for sustainable development in Bangladesh. Bangladesh is a densely populated country with a small area & limited natural resources. Moreover she often faces natural calamities & disasters such as, cyclones, storm surges, droughts, floods, etc. So the Government of Bangladesh in all her development efforts is giving emphasis on proper disaster monitoring and management and judicious utilization of all natural resources keeping proper balance of the ecosystem.

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## **1. Introduction**

For the monitoring & management of natural or man made disasters sequential information on the changes of nature and the environment is essential. Now a days space technology integrated with GIS has emerged as a most sophisticated information related technology & useful tool in the monitoring and management of environment and natural disaster and hence helps in taking proper measures for pre & post disaster management.

Application of remote sensing technology & GIS is gearing up rapidly in this country. Bangladesh Space Research And Remote Sensing Organization (SPARRSO) being the focal agency for all remote sensing and space activities has been utilizing the Space Technology and Geographic Information System (GIS) for various natural disaster management and environmental monitoring studies in different fields such as meteorology, agriculture, water resources, floods, forestry, fisheries, geology , oceanography, climate change, etc.

Severity of an event either natural or man-made that causes unbearable harm to the people and goes beyond their capacity to remedy the loss may be termed a disaster.

Disasters are of a wide variety depending on the location of a country on the globe. Cyclones, floods, droughts, earth quakes, volcanic eruptions, forest fires, landslides, erosions etc are among the important natural disasters while there are human induced epidemics like environmental degradation, diseases, war etc. Remote sensing owes much to the satellite technology due to its synoptic, repetitive and multi-spectral nature in observing the surface of the earth be it in connection with the resources or the disasters occurring any where on it. With the advent of satellites cloud movement and formation of cyclones can be monitored, floods can be mapped, agricultural crops can be estimated alongside assessment of damages. The resource survey satellites carry onboard sensors that are capable of providing information on every natural feature that prevails on the surface of the earth. The Geographical Information System (GIS) is another versatile tool added to the new technology which make the data acquired either through remote sensing satellites, aerial photographs or through physical surveys carried out for a purpose to be more useful to the decision makers and the planners. These technological provisions have made planning and development activities more handy towards achieving sustainable development and successful disaster management. Bangladesh, although a resourceful country, has been beset with various types of disasters because of its geographical location and other physical conditions.

## **2. Disasters in Bangladesh**

Bangladesh being situated in a region of the floodplains of the mighty rivers the Ganges-Padma, Brahmaputra-Jamuna and the Meghna commonly known as G-B-M is predominantly a flat terrain except for the fringes along the north, north-eastern and the eastern regions along with the pleistocene terraces of Barind tract and the Modhupur tract. The Bay of Bengal bounds the country's 750 km coastline in the south. The funnel shaped size of the Bay of Bengal and the low elevation of the coastal region induces the cyclones hit Bangladesh with more vigour than usual. The major trans-boundary rivers, G-B-M, drain all its water from about 88% of its catchment area lying outside the country. This along with the heavy rainfall area outside makes the country vulnerable to flash floods, high floods and at times prolonged floods.

The cyclones formed in the Bay of Bengal often leave trails of devastation along the coastal region of Bangladesh. It damages the lives and properties including crops and infrastructure in the area. These cyclones (March-May & Oct-November) are being monitored through the satellites taking images several times a day. The cyclones generate surges up to a height of several meters which sweep through the flat coastal region killing people, animals and destroy other fauna and flora. The surge height can also be estimated from the satellite analysis. Tornadoes often formed at different placed, however are difficult to be located ahead of occurrence because of their small size and short duration.

The monsoon clouds (July-October) are being traced from the satellite images and the rainfall is being predicted in and around the country. The high downstream flow of the major rivers from the catchment area during monsoon adds to the misery of the people by causing flood. At times there are heavy downpours along the hilly region and the sudden onrush of water causes flash flood. The coincidence of high downstream flow in all the three major rivers along with the local (in-country) rainfall causes devastating floods. Droughts cause delay in agricultural processes and sometimes inflict heavy loss of production. The floods and the droughts are somehow related to the El- Nino La- Nina situations.

Erosion is another disaster that prevails much in Bangladesh. About 75 rivers are continuously eroding banks and depositing silt and sand along their courses. The river erosion play havoc in certain areas where dwelling houses, fertile agricultural lands and infra-structure are all taken into the river. This renders the affected people to absolute destitution. Remote sensing techniques is being applied to monitor the vulnerable areas for erosion and predictions is also being made. These erosions occur predominantly along the major rivers and the coastal region of Bangladesh. Landslide is another event that causes lives and damages properties particularly during the monsoon. The hilly regions are often cleared of their vegetation and forest for economic reasons. Inconsiderate cutting down of the hills causes landslides in the Sylhet and Chittagong region of the country. These activities can also be monitored from temporal analysis of satellite data. The environmental changes thus caused by human actions, deforestation, landuse changes

etc. can also be detected from such analyses. Salinity intrusion is another hazard in Bangladesh which hinders agricultural productions.

Earth quakes in minor forms have been happening in the hilly regions particularly in the Chittagong area that threatens Bangladesh of an impending disaster. The Government of Bangladesh have been extremely alert and actions are being taken to establish sismological stations at different places in the country. Forest fire has not yet posed serious problems here except for the Magurcherra incident.

### **3. Effects of Disasters**

#### **3.1 Economic and social**

The erosion cause serious impact on our economy. The valuable lands, houses and agricultural crops are lost due to erosion. Infrastructure are also equally affected both in the rural and urban areas of the country. About three thousand houses are destroyed every year due to river erosion in the country and approximately 15000 to 18000 people become shelterless (Ghani 1999). The people along the river banks in the vulnerable areas of the country pass their days in serious mental agony for obvious reasons. The threat of erosion is even more dangerous than fire hazard. Because, even if the fire burns the belongings (although never desirable) of the people into ashes they are left with the plot of land at least to rebuild their abode, with much difficulty though. But when the river erodes a household the owner is left with nothing and becomes an absolute destitute. The ravaged people find it utmost difficult to migrate to a safer place. About 90% of the affected people are farmers. They are compelled to leave their profession in search of a new livelihood elsewhere making the list of unemployed people even longer. The women folk are most hard hit at this loss due to erosion. The poorer section of the women then depend much on the mercy of their kith and kin. Among innumerable problems they become shattered and live a nomadic life till a fortunate few find some alternatives to live on. They are compelled under pressing circumstances to commit social vices. This tale of vagaries are only important items in the columns of news papers but little do they serve to redress the sufferings of the victims.

Floods and cyclones have however secured important places in the list of hazards or disasters. The river erosion because of its slow process and scattered incidences could not draw our attention successfully. So, it is time that we take a stock of erosional havocs and take care of our own people to serve the humanity.

#### **3.2 Geographical**

Geographically we lose vast areas of scarce land into the rivers and the ocean due to erosions. Among many rivers the Meghna, Padma, Tista, Dharla, Brahmaputra, Jamuna, Arial kha, Gorai, Karnafuli, Surma & Kushiara erode their banks at many places to make thousands of people homeless. The geographical changes that occur due to erosion takes a long time to be recorded in the maps. The result of the erosion is another factor that changes the geographical conditions of the localities. Sedimentation is the other process

given rise by the erosions. The newly built/accreted land within the channels or in the coast again cannot be owned by the victims of erosion. The changes occurring due to erosion may initiate ecological and environmental changes in the localities. Floods and cyclones also damage fauna and flora indiscriminately. Floods although makes land fertile often cause harm by depositing sand onto some of them.

#### 4. Role of remote sensing and GIS in mitigation measures

Nature cannot be tamed so easily but attempts may be made to reduce the extent of its damage and impact on the economy and the society. Thus, management of the disaster events is primarily important. In order to better manage the event, one essential aspect is the availability of information relevant to the disaster event on real or near-real time basis. Remote sensing and GIS can play a very important role in this context. Some of the applications of remote sensing and GIS in monitoring the disaster events are given in the following.

##### 4.1 Cyclone

Since early 1980s, remote sensing has been being used for monitoring the cyclone events in the country. Based on GMS and NOAA- AVHRR data, formation of cyclones in the Bay of Bengal have been monitored, intensity and extent of the cyclones as well as its track have been estimated and the intensity of the accompanying storm surges have been predicted. Based on these information an early warning system has been established in the country. Besides a good number of cyclone shelters have been built in the districts along coastal region. All these effectively reduces the damage to the life and property due to cyclones (Table -1).

Table-1 : Life claimed by cyclones

Cyclone	12 November, 1970	29 April, 1991	19 May, 1997
Wind Speed, Km/H	223	225	232
Surge height, m	6-9	3-6	4-5
Life claimed	About 5,00,000	About 1,38,800	155

## **4.2 Primary Impacts of the Farakka Barrage on the river Padma (Ganges)**

The river Padma constitutes the most important aquatic ecosystem in the southwest region of Bangladesh. It contributes to a great extent to the economy and to the facilities of about a third of the population of Bangladesh. Since 1975, after the Farakka Barrage was put into operation, the Padma has been losing gradually large water area due to withdrawal of the dry season flows at Farakka. This has resulted in the drastic decrease of surface and ground water levels in the region. The primary impacts of the barrage are the physical changes in the form of water level/water area in the dry season, occurrence of siltation in the river bed and shifting of bank changes. Remotely sensed data and GIS are being used to estimate directly some of these physical changes.

## **4.3 Flood**

In the recent years flood has been monitored using RADARSAT data. Methodology has been developed for estimating the extent of flood and the damage caused by it based on RADARSAT data. One example of the application of remote sensing data for monitoring flood event is the ever-devastating flood event in 1998 when about 60% of the area in Bangladesh was affected. A set of five RADARSAT data was successfully used to track the flood event. Statistics on upazila-wise flood affected areas was derived and the damage to the crops was estimated. The government of Bangladesh used this statistics for the management of the flood event particularly for ensuring the food security in the country during the post-flood period.

## **4.4 Erosion on river and coastal areas**

A number of studies have been carried out to reveal the geo-morphological changes occurred in river and coastal areas based on remote sensing data. Extent of erosion occurred in the past and on-going erosion phenomena were monitored. However, in order to mitigate the damage caused by the erosion, efforts are to be diverted to arrange forecasting of erosion along the vulnerable areas. It is really difficult to forecast the erosion because of limited capability of observation. However, remote sensing methods may be employed to identify vulnerable areas along the riverbanks (Hoque & Tanaka 2001) and to forecast the imminent erosion.

## **4.5 Drought**

Application of remote sensing data for monitoring drought event in the country on operational basis is limited so far. However, In the recent years, considerable progress has been made for monitoring the extent and intensity of drought based on remote sensing data. Progress has also been made in developing methodology for studying the processes of desertification in some part of the country. It is expected that within a couple of years, remote sensing methods would be used on operational basis for monitoring the drought condition and the damage caused by it in the country.

## **5. Remote Sensing and GIS activities in other Organisations:**

Dissemination of information and transfer of technology achieved through seminars and collaborative projects involving user agencies in the country could create awareness about the potential uses of the remote sensing technology and GIS. SPARRSO is playing very important role in these regard. SPARRSO being the focal point of national space and remote sensing activities has been providing educational and training support to students as well as professionals of various organizations. The Universities like Dhaka University, Jahangirnagar University, Bangladesh University of Engineering and Technology, Khulna University, Chittagong University, Rajshahi University and some others are offering courses in remote sensing and GIS. These institutions get support in carrying out post graduate research works in collaboration with SPARRSO. The Government is keen on producing skilled manpower in the country.

SPARRSO disseminates remote sensing activities and related information through its publications in the form of research reports, newsletters, annual report, Journals, periodicals etc. It also provides training and arranges visit of its facilities to students to imbibe in them the idea and nature of space technology applications in the country.

There are several Government and autonomous organisations such as Department of Forest, Department of Fisheries, Bangladesh Local Govt. Engineering Bureau, Bureau of Statistics, Bangladesh University of Engineering and Technology etc. are using this technology in their respective fields. Some NGOs are also participating in the applications of this technology in various development activities towards ecological development. Bangladesh Meteorological Department (BMD) has a modern forecasting system for weather forecast. Disaster Management Bureau is playing very important role to create awareness among the people for disaster preparedness and mitigation.

## **6. Some Recommendations**

**6.1** The international organisations and the developed countries could help the developing countries by transferring the Space technology for the better management of the Disaster of their own and for the world as a whole.

**6.2** A fund should be raised to provide scholarship/award for the young scientists of the developing countries for the post graduate research study working in the field of remote sensing sectors.

**6.3** To create awareness among the students compulsory subjects on ecosystem, space and remote sensing science should be introduced in the curriculum.

**6.4** Training programs should be developed for teachers, administrators, rural women, journalists and media personal in environmental education.

**6.5** There is still a gap between the planners/decision makers and remote sensing technologists. To narrow the gap ways and means should be found out. In this respect professional planners at all level should be made aware about the potential usefulness and capability of remote sensing and GIS in planning and development activities of a nation.

**6.6.** Man-made disaster caused by unwanted war among nations which render a nation to miserable sufferings should be strongly condemned and discouraged unitedly by all other nations irrespective of cast and creed.

## **7. Conclusions:**

The present world is now a world of information superhighway. High-tech communication system brings everyone very close to each other. It revolutionizes the field of data & information transfer. Disaster management becomes a global issue and of great concern to every nation. So it is now time to launch campaign for greater and consolidated cooperation and collaboration among the countries in this earth.

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