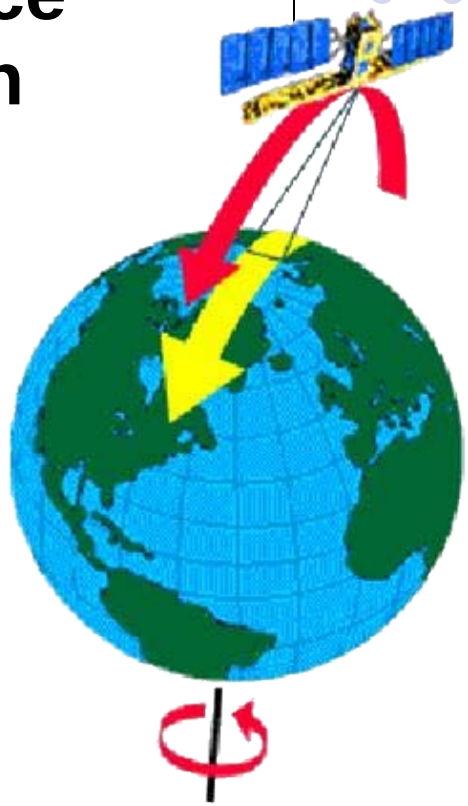
Disaster Management Based on Space Technology: Perspective Bangladesh



By

Ministry of Disaster Management and Relief

Disasters in Bangladesh

Bangladesh is prone to Natural Disasters

- Geographic Location
- Unplanned Urbanization
- Dense population
- Global warming

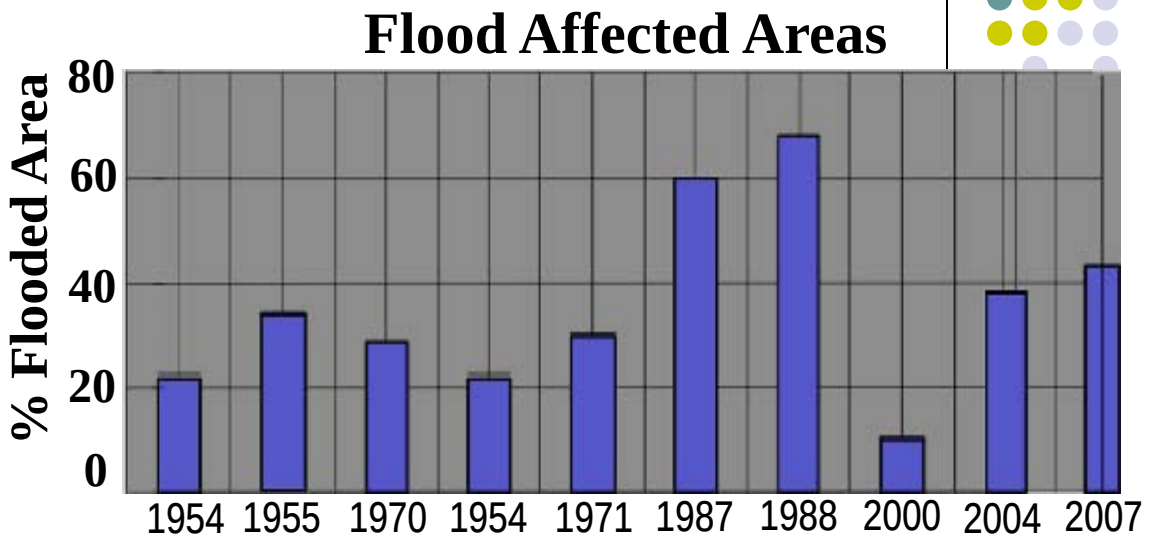
Context of the Presentation

- Bangladesh is one of the most disaster-prone highly populated countries of the world.
- Disasters like flood, cyclone, storm surge, river erosion, drought water-logging etc. often cause significant losses of lives and damages of properties.
- Together with phenomena of climate change, global warming etc., crisis of food, degradation of environment impose great challenges.
- Remote sensing technology is being utilized in the country for the last four decades for acquiring Geoinformation in the country.

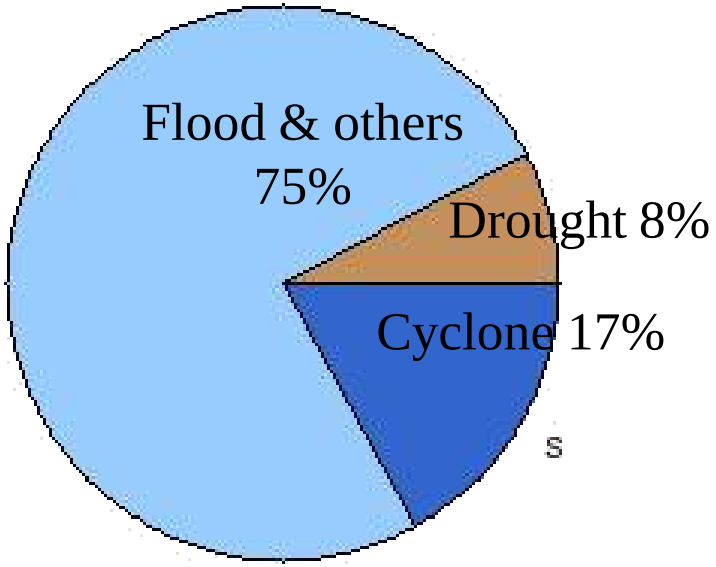
Major Disasters in Bangladesh

Major Disasters over the last three decades:

Year	Disaster	Death
1988	Flood	1517
1988	Cyclone	5704
1989	Drought	-
1991	Cyclone	138868
1994-95	Drought	-
1996	Tornado	545
1997	Cyclone	550
1998	Flood	918
2000	Flood	200
2001	Flood and Tornado	85
2004	Flood	747
2005	Tornado	56
2007	Flood	3000
2007	Cyclone	3500
2009	Cyclone	172



Relative distribution of major disasters events in Bangladesh



Water-logging has become permanent disaster in some part of the country

Source: website

Hazards and Risk Profile of Bangladesh

Hazard Type	Flood	Flash Flood	Drought	Cyclone, tidal surge, salinity	Earthquake
	%	%	%	%	%
Vulnerable land area	61	23	46	32	70%
Vulnerable population	71	24	46	27	80%

EVOLUTION OF DISASTER MANAGEMENT IN BANGLADESH

70's	**Response oriented disaster management:** ● **1970 Gorkey Cyclone, 300,000 people killed** ●**1972 Cyclone preparedness program established**
80's – 90's	Emerging DM approaches: ● 1987 -88 huge flood, FAP formulated ●1991 cyclone, 138000 people killed, shifting from disaster response to preparedness ●1993 constitution of Disaster Management Bureau ●1997 Drafting of standing order on disasters (SOD) ●1998 prolonged flood
2000 +	Forward towards a comprehensive system including Risk Reduction ●2000 Comprehensive Disaster Management program formulated and launched in 2004 ●2005 Ministry of Food and Disaster Management renamed with new DM vision ● 2006 Revised AoB for MOFDM ●2010 Revised SOD, National Plan for Disaster Management ● DM Act 2012, MoDMR

VISION

The disaster management vision of the Government of the People's Republic of Bangladesh is :

to **reduce the risk** of people, especially the poor and the disadvantaged,

from the effects of natural, environment and human induced hazards to a manageable and acceptable humanitarian level and

to have in place an **efficient emergency response management system** capable of handling large scale disaster.

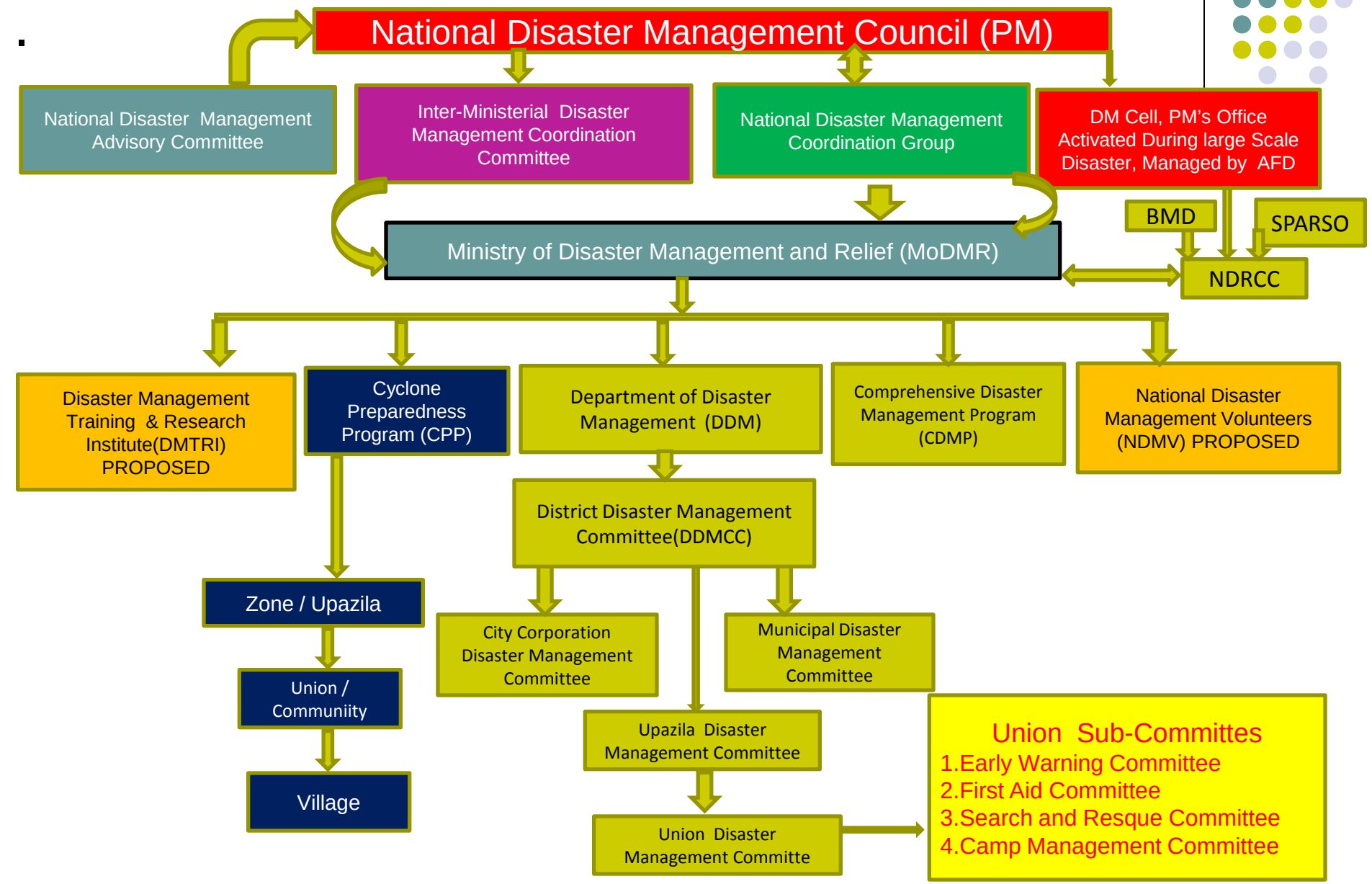
Mission

To achieve a ***paradigm shift*** in disaster management

from conventional response and relief practice to a more comprehensive **risk reduction** culture, and

to ***promote food security*** as an important factor in ensuring the resilience of communities to hazards

D M Institutions in Bangladesh



Space Technology in Bangladesh: Present

SPARRSO -The National Space Agency

- LGED
- GSB
- SOB
- BBS
- BMD
- Department of Forest
- Department of Fisheries
- Forest Research Institute
- Fisheries Research Institute
- Disaster Management Bureau
- Bangladesh Water Development Board
- Universities
- …….

- CEGIS
- IWM
- CDMP
- NGOs

Space Technology in Bangladesh: Present

Organizations using space technology for disaster monitoring and management

SPARRSO

BMD

Department of Disaster Management

Bangladesh Water Development Board

CEGIS

IWM

CDMP

Some other organizations have been using RS technology for studying specific events of disaster

Status of Space Technology based Monitoring of Disasters in Bangladesh

Disaster	Player		Space based operational system
	Govt.	Non-Govt.	
Cyclone	SPARRSO, BMD		SPARRSO, BMD
Flood	SPARRSO	CEGIS	SPARRSO*
Erosion and Bankline shifting	SPARRSO	CEGIS	Under development by SPARRSO
Drought	SPARRSO		
Water-logging	SPARRSO		

Some other organizations have been using RS technology for studying specific events of disaster

Divisions of SPARRSO

16 Divisions

Agriculture Division

Agro & Hydro Meteorology Division

Atmospheric Physics Division

Cartographic Division

Fisheries Division

Forestry Division

Geology Division

Oceanography Division

Water Resources Division

……

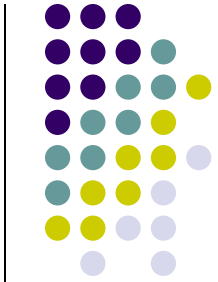
Facilities at SPARRSO

- Advanced photographic laboratory
- Ground survey equipment
- GIS laboratory
- Image processing Laboratory
- Digital cartographic laboratory

Skilled Manpower

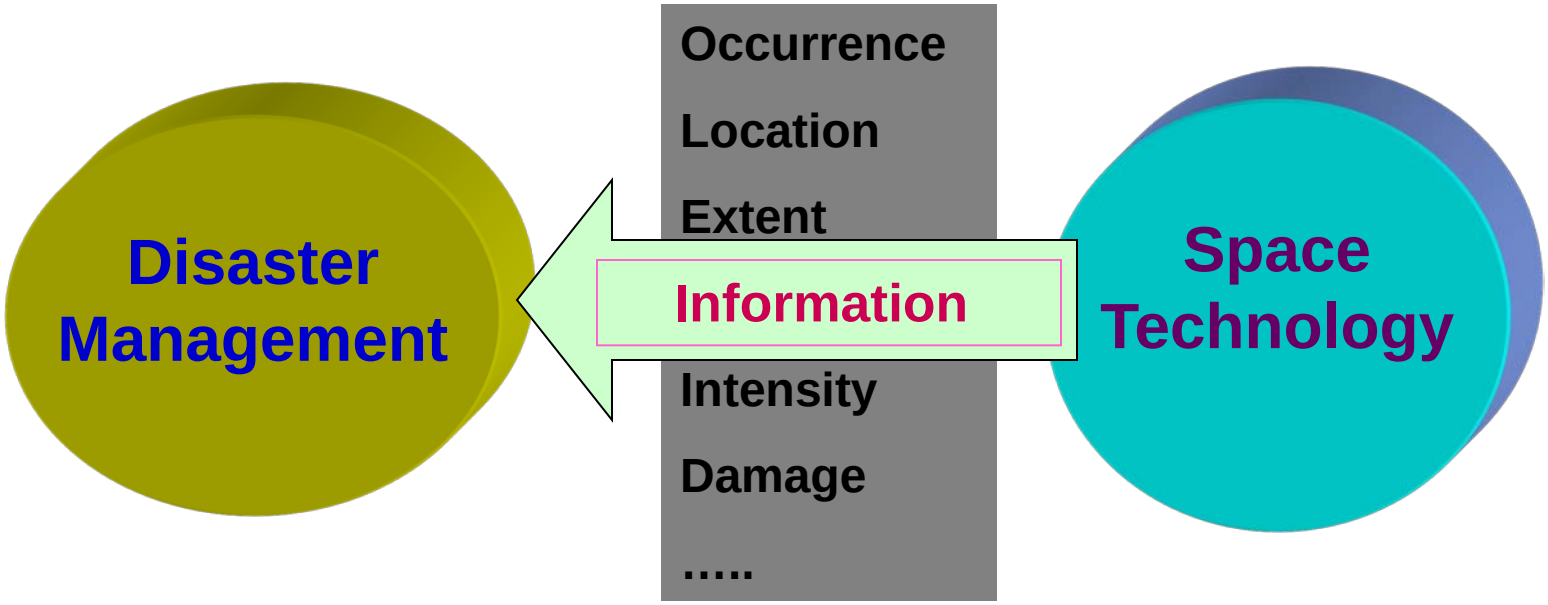
- **Four ground receiving station**
- NOAA satellite ground station
- MODIS satellite ground station
- MTSAT satellite ground station
- Digital Video Broadcast via Satellite (DVB-S) technology (**FY-2D, FY-2E)**

Internationals Connectivity of SPARRSO

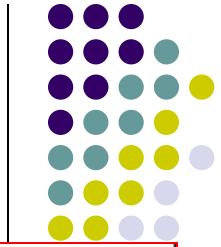


- **Asia Pacific Regional Space Agency Forum (APRSAF)**
- **Asian Institute of Technology (AIT)**
- **Asia-Pacific Multilateral Cooperation in Space Technology and Application (AP-ACSTA)**
- **Asia-Pacific Space Cooperation Organization (APSCO)**
- **Canadian International Development Organization (CIDA)**
- **Centre of Space Science and Technology Education in Asia and the Pacific (CSSTE-AP)**
- **Food and Agriculture Organization (FAO)**
- **Inter-Islamic Network on Science and Technology (ISNET)**
- **Indian Space Research Organization (ISRO)**
- **Japan Aerospace Exploration Agency (JAXA)**
- **Japan International Cooperation Agency (JICA)**
- **National Aeronautics and Space Administration of USA (NASA)**
- **United States Agency for International Development (USAID)**
- **United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP)**
- **United Nations Development Programme (UNDP)**
- **United Nations Fund for Population Activities (UNFPA)**
- **ICIMOD**

Disaster Management and Space Technology



Possible Applications of Space Technology & GIS in Disaster Management in Bangladesh

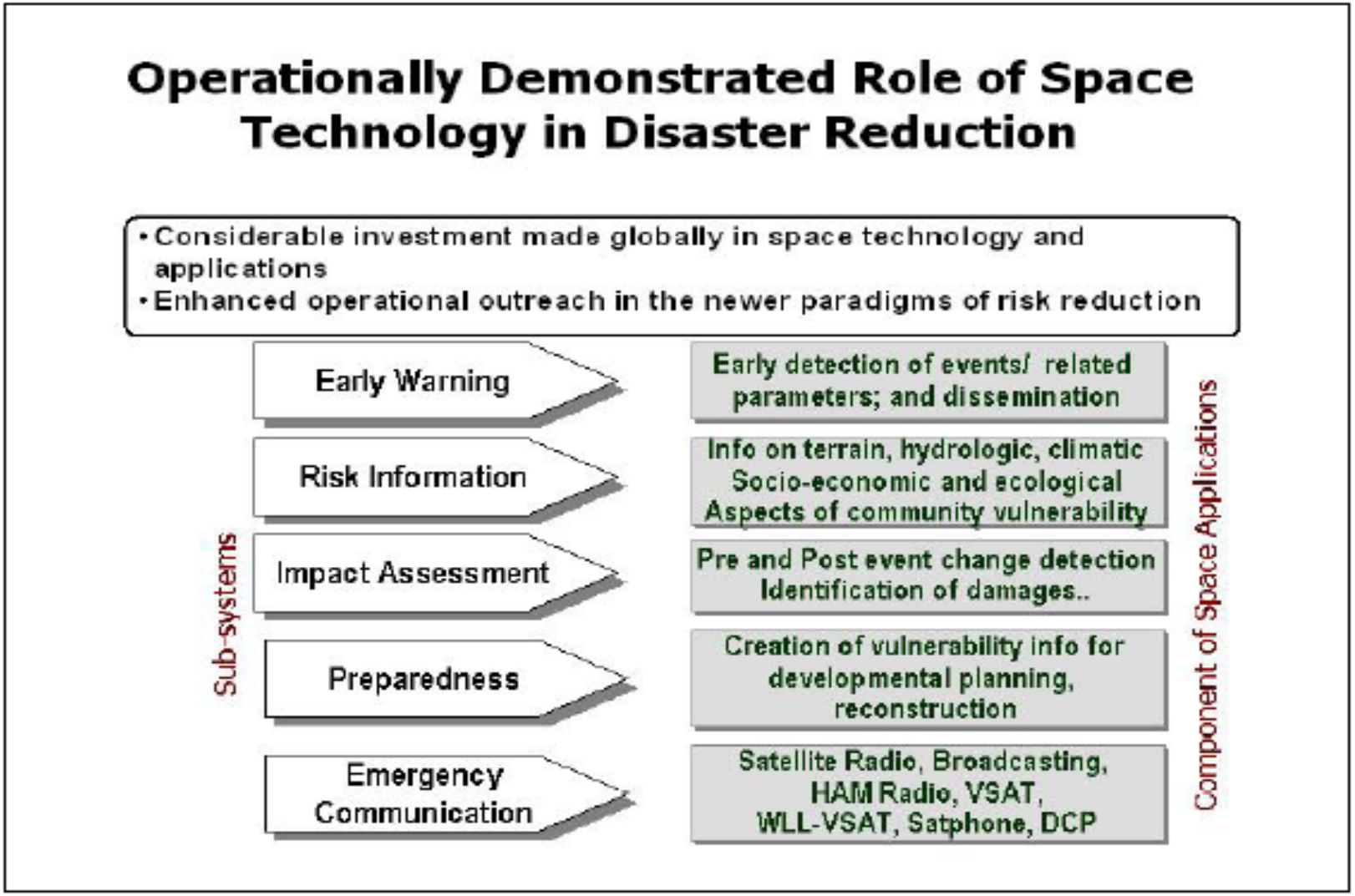


Disaster	Mitigation	Preparedness	Response	Recovery
Cyclone	Risk modelling Vulnerability analysis	Early warning (track and intensity) Storm surge predictions Long-range climate modelling	Identifying escape routes Identify areas for providing relief/aid Crisis mapping Impact assessment Cyclone monitoring Inundation monitoring	Damage assessment Spatial planning
Drought	Risk modelling Vulnerability analysis Land and water management planning	Weather forecasting Vegetation monitoring Crop water requirement mapping Early warning and drought bulletins	Monitoring vegetation Damage assessment	Informing drought mitigation

Disaster	Mitigation	Preparedness	Response	Recovery
Earthquake	Building stock assessment Hazard mapping	Measuring strain accumulation Identifying Earthquake precursors Micro-seismic zonation	Planning routes for search and rescue Damage assessment Evacuation planning Deformation mapping	Damage assessment Identifying sites for rehabilitation
Fire	Monitoring fuel load Risk modelling	Mapping fire-prone areas Fire detection Predicting spread/ direction of fire Early warning	Coordinating fire-fighting efforts	Damage assessment
Flood	Delineating flood-plains Land use mapping	Mapping flood-prone areas Flood detection Early warning Rainfall mapping	Flood mapping Evacuation planning Damage assessment Identify areas for providing relief/aid	Damage assessment Spatial planning

Disaster	Mitigation	Preparedness	Response	Recovery
Landslide	Landslide hazard zonation Risk modelling	Monitoring rainfall and slope stability Early warning models Digital elevation models	Mapping affected areas Identify routes for providing relief/aid	Damage assessment Spatial planning Suggesting management practices

Operational Aspects of Space Technology in Disaster Reduction



Disaster Management Based on Space Technology (Source: SPARRSO)

Space Technology Based Activities

- Acquisition of appropriate and timely data
- Data processing
- Data analysis & interpretation
- GPS-based Mobile RS Ground Validation
- Retrieval of Geo-statistics & Geoinformation

Information sharing, dissemination & communication

Functionalities

- Prediction & early warning
- Monitoring & assessment
- Damage assessment

National Organization Dealing with Disasters

Decision-making: Natural disaster

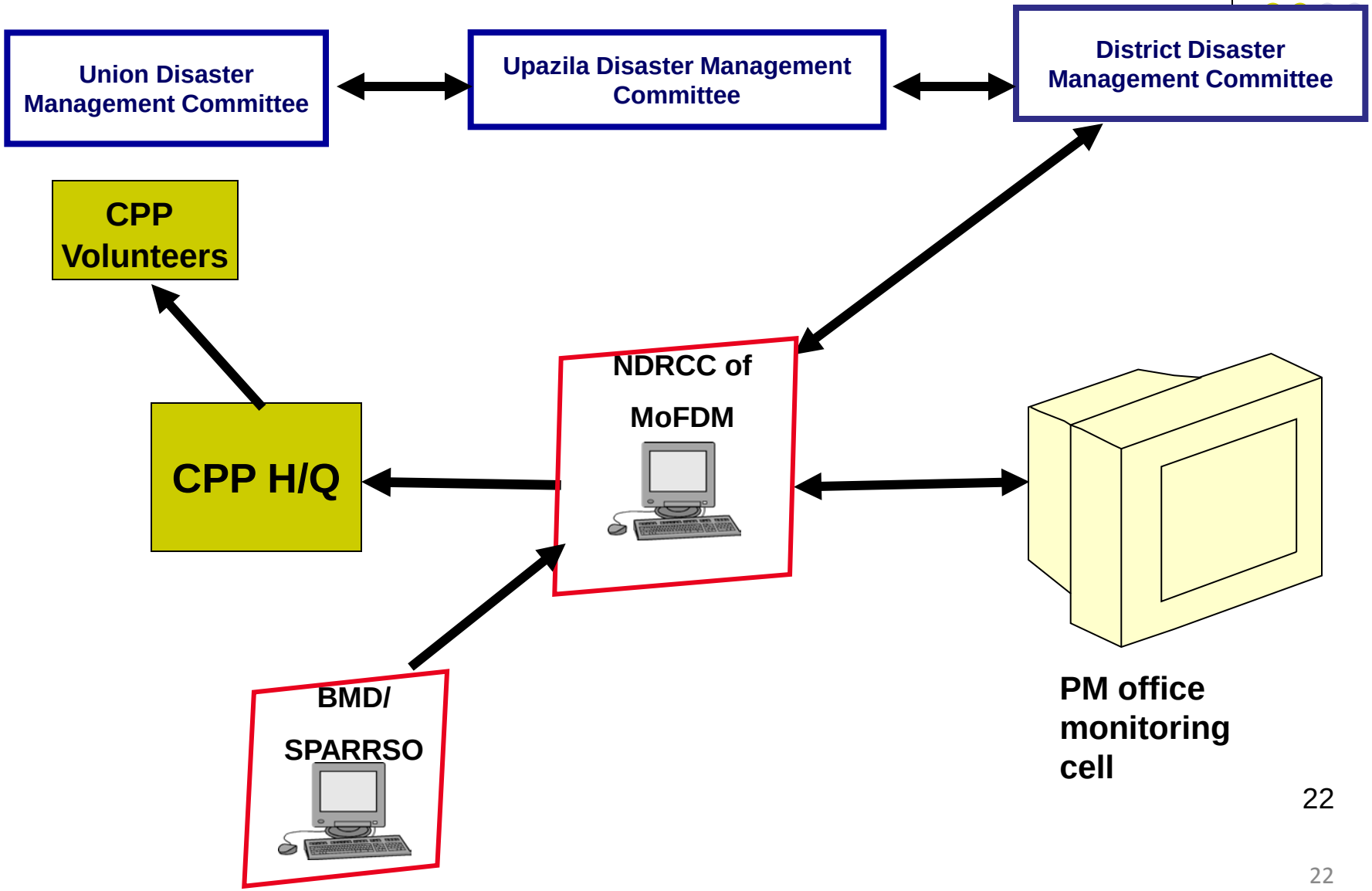
- Effective participation of all stakeholders
- Disaster risk reduction
- Reconstruction & rehabilitation

Geospatial Disaster Database in GIS

Regional Supportive Programs to Disaster Management:
UN ESCAP, UN SPIDER, WINDS Sentinel Asia, APSCO

Insitu & Radar-based Meteorological Observation

Information Flow during Emergency Response



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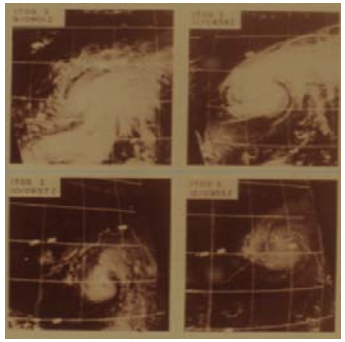
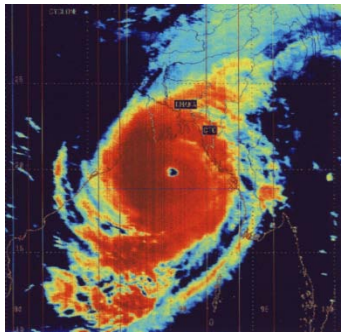
Application of Space Technology for Cyclone Monitoring: **A story of success**

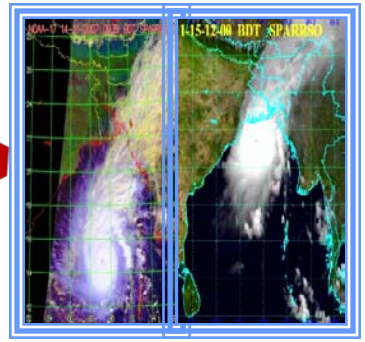
Devastating cyclone of 1970



Devastating cyclone of 1991

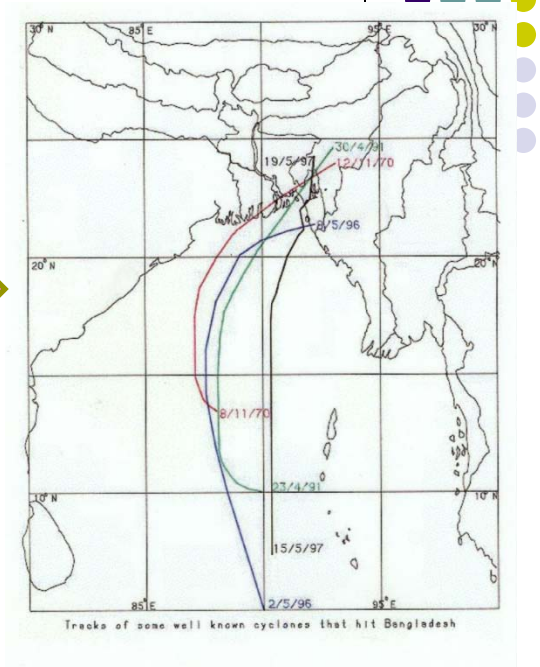


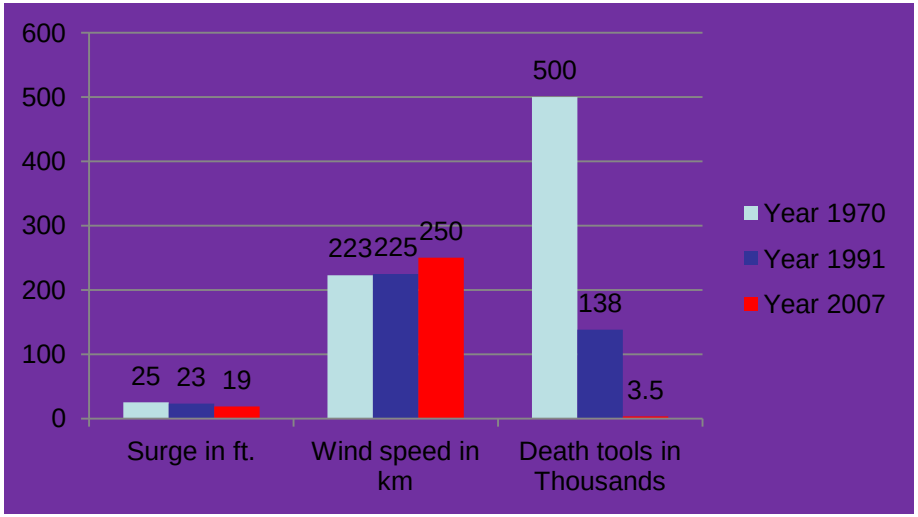
Devastating cyclone of 2007



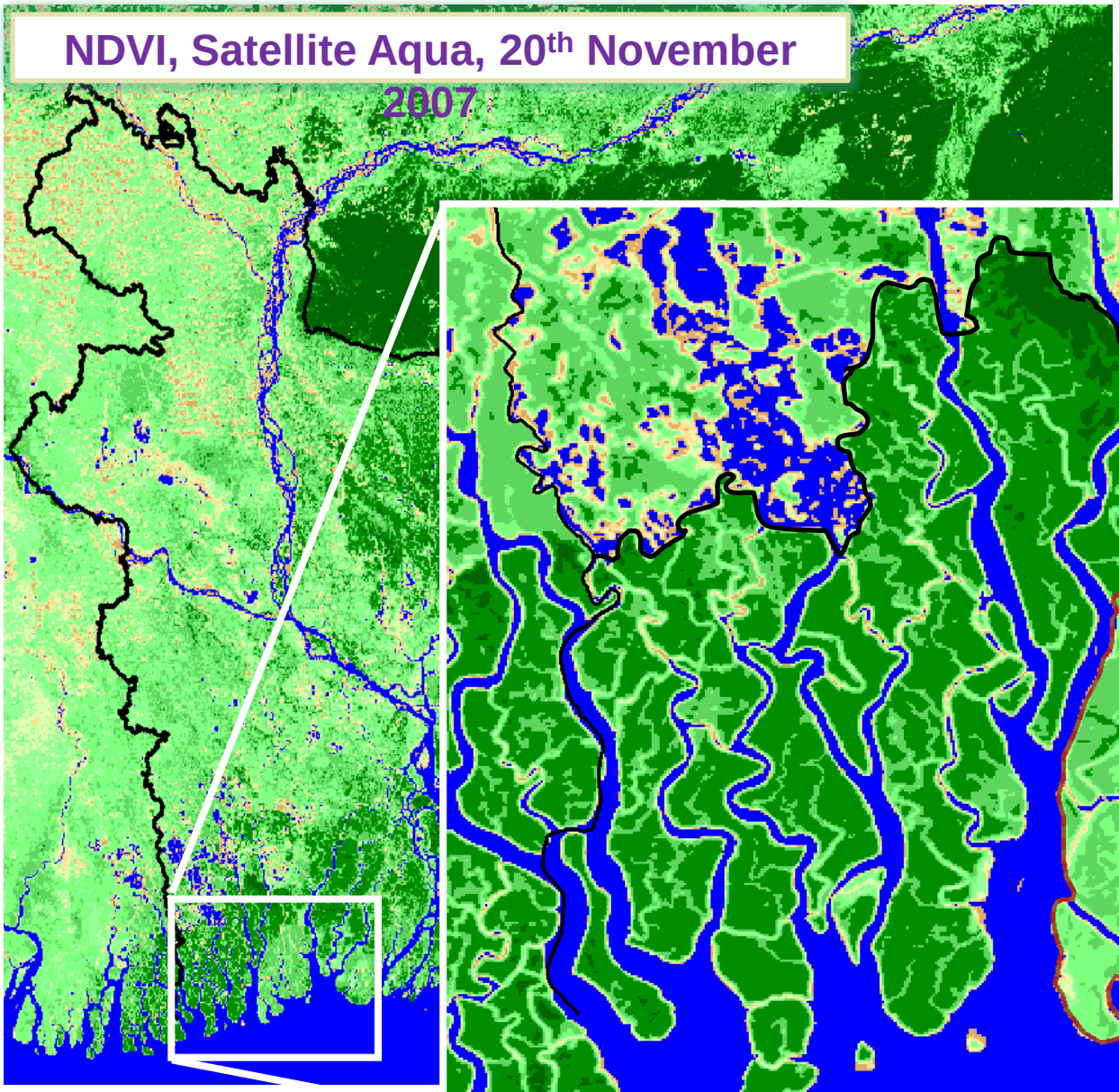
Sidr: the last devastating cyclone in Bangladesh

SPARRSO introduced satellite based monitoring in 1985





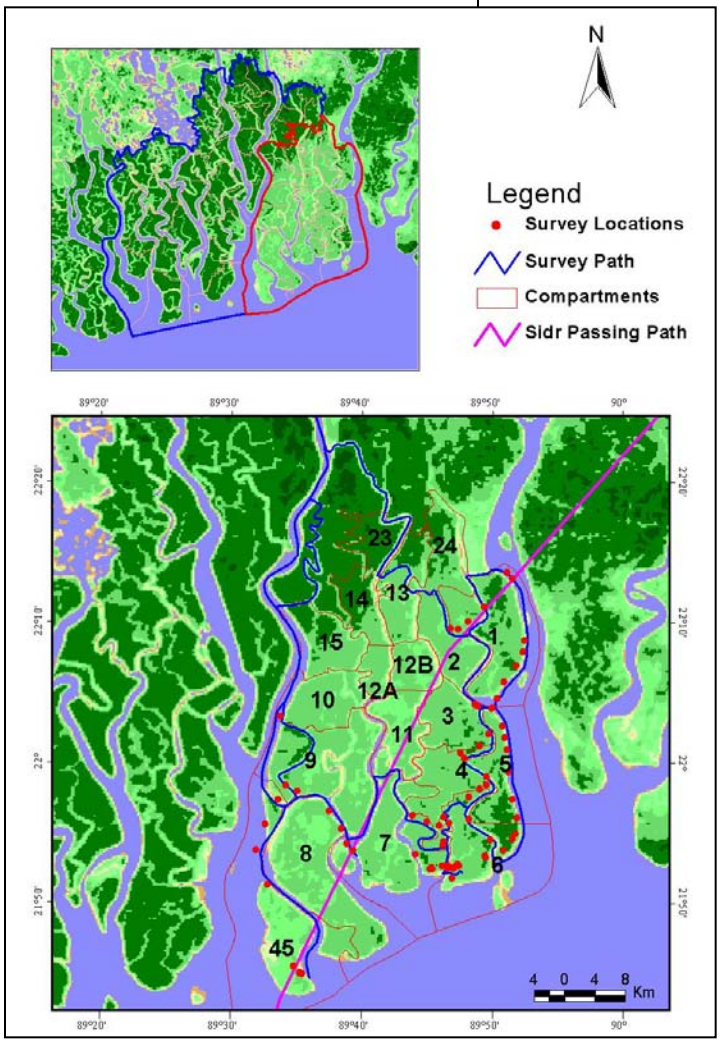
Assessment of Cyclone Damages



Assessment of Sundarbans Forest Resources Damages

Impact

- Visual impact 21% of Sundarbans
- 32% of the affected area and about 6% of the total area experienced major damage
- Major damage happened within 300 m from river banks
- Damage types include uprooted, broken/twisted and leaf burnt of plants
- Forest fire may occur
- Rejuvenation of kewra observed during field survey
- Regeneration of the important species may hamper;
- Sand carpeting on pneumatophore observed in Kochikhali, Kotka, Dubla
- 100% forest infrastructures, facilities and logistics such as offices, guard posts, water crafts, and equipments damaged
- Tourism of Sundarbans has been decreased significantly

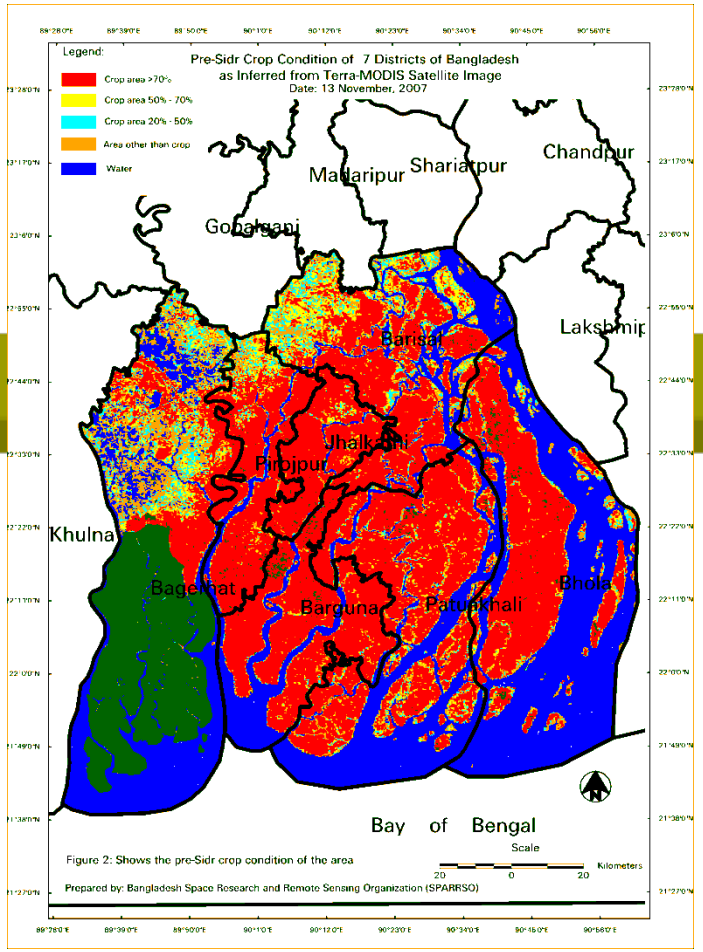


The satellite image (MODIS) indicates that the most affected area is the eastern Sundarbans

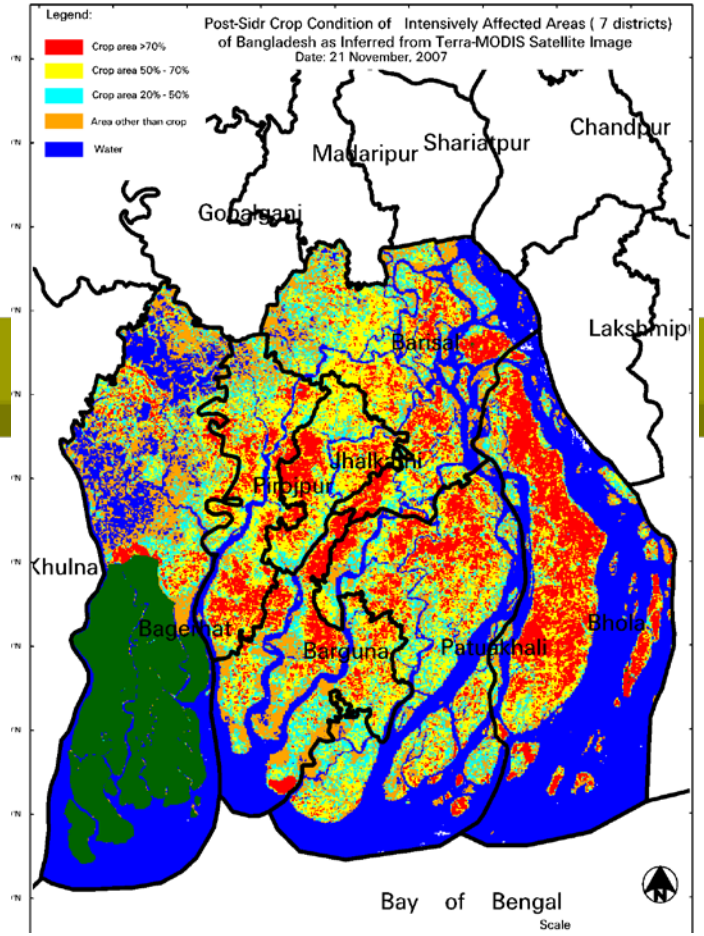
Aman Crop Damage Assessment using MODIS Data

Affected seven districts by Cyclone Sidr (2007)

Before Sidr



After Sidr



Total production loss: 51%

Application of Space Technology: Flood

Monitoring extent of flood:

Year	Area affected, % of total area
1954	24.8
1955	26.2
1974	35.4
1987	38.6
1988	52.4
1998	61.7
2004	38.4
2007	42.2

Latest nation-wide flood

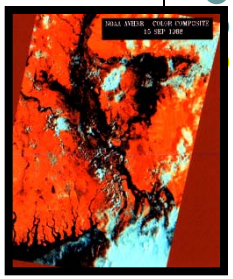
Visual interpretation of NOAA-AVHRR Image

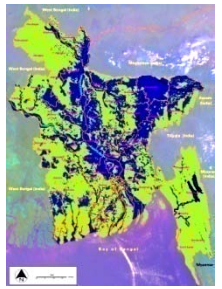
SPARRSO introduced satellite based monitoring in 1988

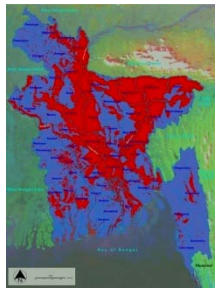
Digital processing of RADARSAT Images

Digital processing of RADARSAT and NOAA-AVHRR Image Images

Digital processing of NOAA-AVHRR Image Images

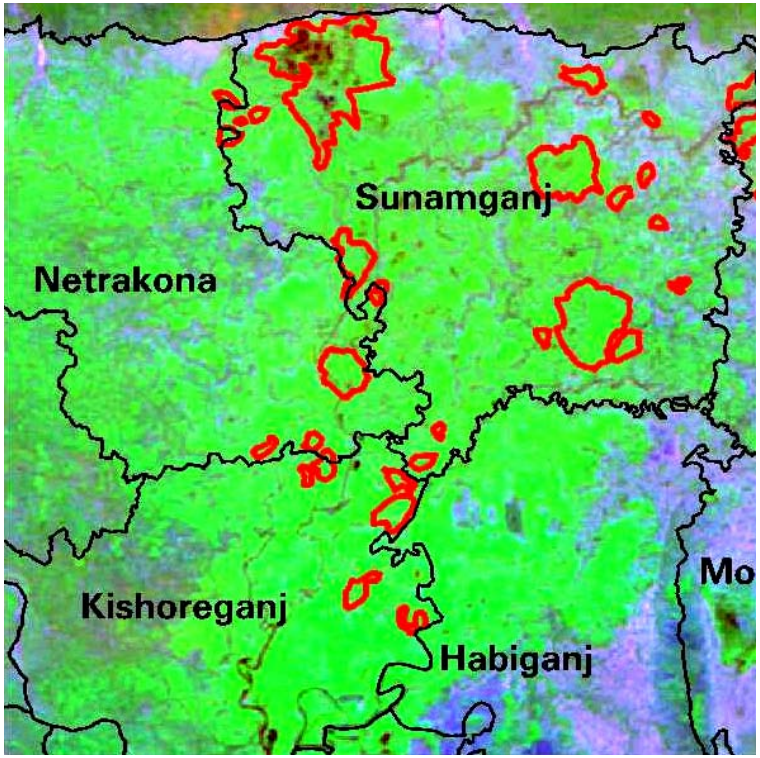




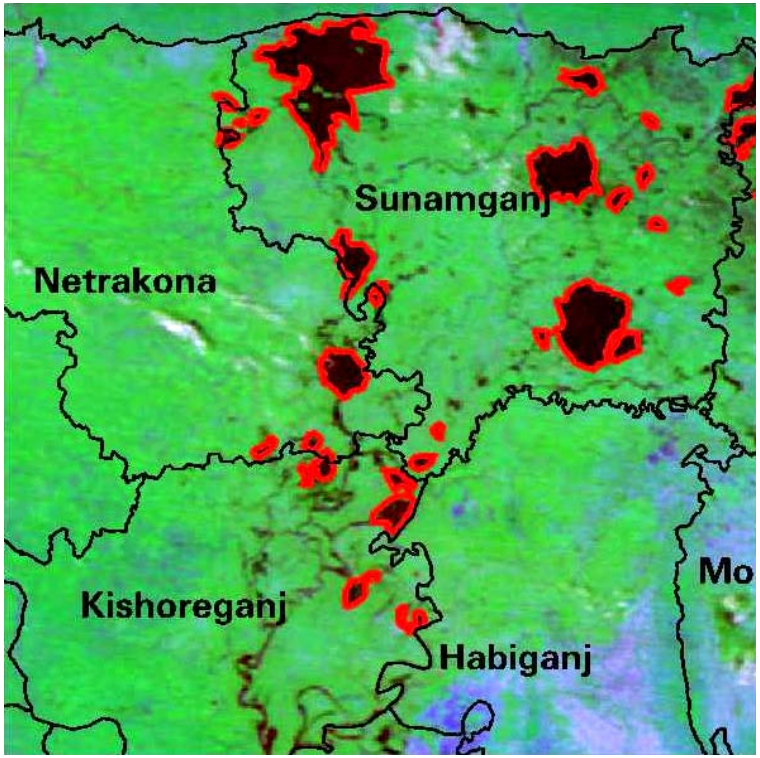


Space-based Information for Assessment of Crop Damages:

50,500 hectare Boro rice was damaged by flash flood in April 2010.



MODIS Pre-flood Image

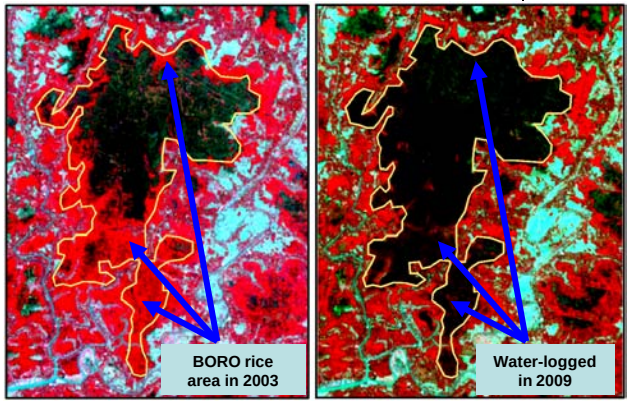


MODIS Post-flood Image

Application of Space Technology: Water-logging

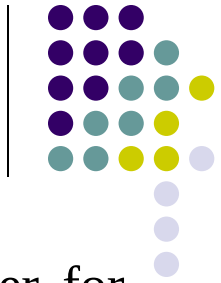
A silent disaster in Bangladesh

Monitoring of Water-Logging in Bhutiar Beel of Khulna District Using Remote Sensing and GIS Technique



Study area: 8000 Hec.
Aman damage: 3540 Hec. (83.37 % of the Aman cultivable area)
Boro damage: 3267 Hec. (81.80 % of the Boro cultivable area)

Approaches for Capacity Building in Space Technology through international connectivity



1) **Regional Server for WINDS**

Under Sentinel Asia program, SPARRSO establishes Regional Server for "WINDS" – a satellite system for receiving satellite data free of cost during emergency disaster period.

2) **Launching Applied Earth Observation Satellite**

SPARRSO participating in the Applied High Resolution Satellite Launching initiative of Asia Pacific Space Cooperation Organization (APSCO). Feasibility study has already been completed.

3) **UN-ESCAP Regional Drought Monitoring Working Group**

SPARRSO playing an important role in the UN-ESCAP Regional Drought Monitoring Working Group to utilize space technology for monitoring.

4) **Collaboration Research with ICIMOD**

SPARRSO signed an MOU with ICIMOD to initiate researches on remote sensing application in various geo-disciplines including disaster.

Utilization of Sentinel Asia (SA) and International Disaster Charter (IDC) for Emergency Mapping.

To receive satellite imagery during disasters, WINDS satellite ground station has been established at SPARRSO under the initiative of SA. The system is not fully operational now.

lesson learned using satellite data for disaster monitoring

- Real /near real time satellite data is essential for application on disaster monitoring.
- Microwave data is needed for monitoring the extent of disasters like flood, storm surges etc.
- High resolution satellite data is needed for post-disaster damage assessment.
- Joint research opportunities with the advanced countries on the specific issues of disaster monitoring may impart valuable role for effective management of disaster in the country.

Limitations of utilization of satellite data

- For addressing the issues of monitoring a disaster, multi-satellite and multi-sensor data is needed which are not available in real/near real time basis.

- For preparing useful products using satellite data some baseline GIS data layers (roads, settlements area, etc.)of the whole country are needed but not available.

Proposal for Improvement

- WINDS satellite system needs to be fully operational so that satellite data can be made available during disasters.
- More activities for expert and policy level exchanges may impart valuable role for establishment/strengthening the national disaster monitoring systems.
- Joint research programs may be undertaken with the advanced countries for addressing specific issues of disaster monitoring in the country.

Conclusion

Space technology becomes an integral part of disaster management, especially given the country's geographical location that makes it prone to frequent flooding , cyclones and other hazards.

Useful Information retrieval using space technology for disaster monitoring depends on the availability of real/near real time RS data, particularly microwave data. Bangladesh needs to develop a mechanism to acquire such data either through establishment of a ground receiving station or cooperating with relevant international organizations.

Recommendations

The recommendations focus on the challenges and opportunities in the following specific areas:

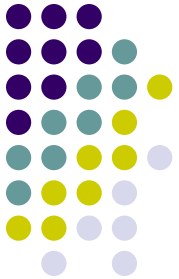
- **Policy and coordination,**
- **Capacity building and awareness raising,**
- **Information management and sharing,**
- **Data and access**
- **Emergency communication**

Way Forward

1. Different scale remote sensing satellite images with high and medium spatial resolution images, high and medium resolution radar data.

2. Regional capacity-building efforts on disaster reduction techniques, databases, hardware and software, mapping and knowledge creation .

3. Further improvement is needed among the operational & institutional arrangements with satellite service provider and the users like remote sensing service users, weather forecasting organizations, disaster management authorities. Services have to be standardized, and delivery channels must be incorporated with relevant disaster response plans.



Thanks