ANNUAL REPORT

July 2016 – June 2017

SPARRSO

Bangladesh Space Research and Remote Sensing Organization (SPARRSO)

Agargaon, Sher-e-Bangla Nagar

Dhaka 1207, Bangladesh

October 2020

ANNUAL REPORT

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SPARRSO

Editorial Committee

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Published by:

Bangladesh Space Research and Remote Sensing Organization
(SPARRSO) Agargaon, Sher-e-Bangla Nagar

Dhaka 1207, Bangladesh

Phone: 88-02-913 1741
Fax: 88-02-9122473
E-mail: admin@sparrso.gov.bd
Website: www.sparrso.gov.bd

Foreword

It is my great pleasure to present the Annual Report on the development activities, research work and achievements of Bangladesh Space Research and Remote Sensing Organization (SPARRSO) carried out by the authority and thematic Research divisions for the financial year of July 2016 to June 2017. It is also regretted that for being not published the Annual Report in time though it had many reasons for being late. But we are committed to publish the Annual Report in time in regular manner.

By using and applying the most advanced satellite-based application of Remote Sensing, Geographical Information System (GIS) and Global Navigation Satellite System (GNSS) and other space research techniques, tools and methodologies, SPARRSO has been substantially contributing to environmental, climate change & global warming issues, national disaster preparedness programs and predominantly contributing to diversified earth-resources, management and monitoring functions over the years. It provides accurate, valid and reliable data to the government and relevant organizations to facilitate their decision making process.

In accordance with its national research mandates, SPARRSO continues to develop a greater scale of collaboration and connections with partners and research organizations in Bangladesh and abroad to advance its capabilities in the fields of Agriculture, Fisheries, Water Resources, Oceanography, Atmospheric Research, Climate change, Land-use and land related space research areas.

I would particularly like to acknowledge the continued support of the Ministry of Defence and we are also looking forward enthusiastically, the same to the years to come. The Board of Directors and I continue to be inspired by the scientists, engineers and support-staff of SPARRSO, who work tirelessly for the progressively development of this organization maintaining a high global standard for space science.

SPARRSO continues to improve a broad array of programs of space based observation, research and analysis of the Earth's land, oceans and atmosphere to achieve national goals, desired outcomes and to develop implementation and response strategies for the country.

I thank the Editorial Committee and my colleagues for their effort in publishing this report.

Mizanur Rahman
Chairman (Additional Secretary)
SPARRSO

Editorial Note

I am delighted to introduce the Annual Report of Bangladesh Space Research and Remote Sensing Organization (SPARRSO) that briefly accounts the activities of the organization performed during the fiscal year, July 2016 to June 2017. The technological advancements of space science and technology including Geographic Information System (GIS) and Global Positions System (GPS) are now available to facilitate research activities in a better way for the benefit of the mankind. This report gives a consecutive overview idea about the applications and usefulness of the mentioned technologies for surveying and mapping of natural resources and monitoring of natural hazards in the country, including a selective base of earth resources observation and production of relevant valuable data-sets. This report also brings to light the various achievements of SPARRSO and its participation at national, regional and international events. These are highlighted to promote the use of the advanced earth observation techniques for the greater benefits and welfare of the people of Bangladesh and access to the knowledge of country's resources on a national, regional and global comparative scale.

It is a great pleasure for the Editorial Committee to express the heartiest gratitude to the Chairman of SPARRSO and the members of its Board for their advice and cordial cooperation. Special thanks to all SPARRSO scientists, engineers, officers and staff for their passion, support and contribution in preparing their respective divisional activities, which are the main contents of this report.

The editorial committee apologizes for any inconsistency in the document and being late in bringing this publication to light. Constructive criticism, suggestion, advice and personal recommendation from anyone for further improvement in preparing our future reports will be highly appreciated and sincerely considered.

Muhammed Azam
Member, SPARRSO
&
Convenor, Editorial Committee

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CHAPTER 1

INTRODUCTION

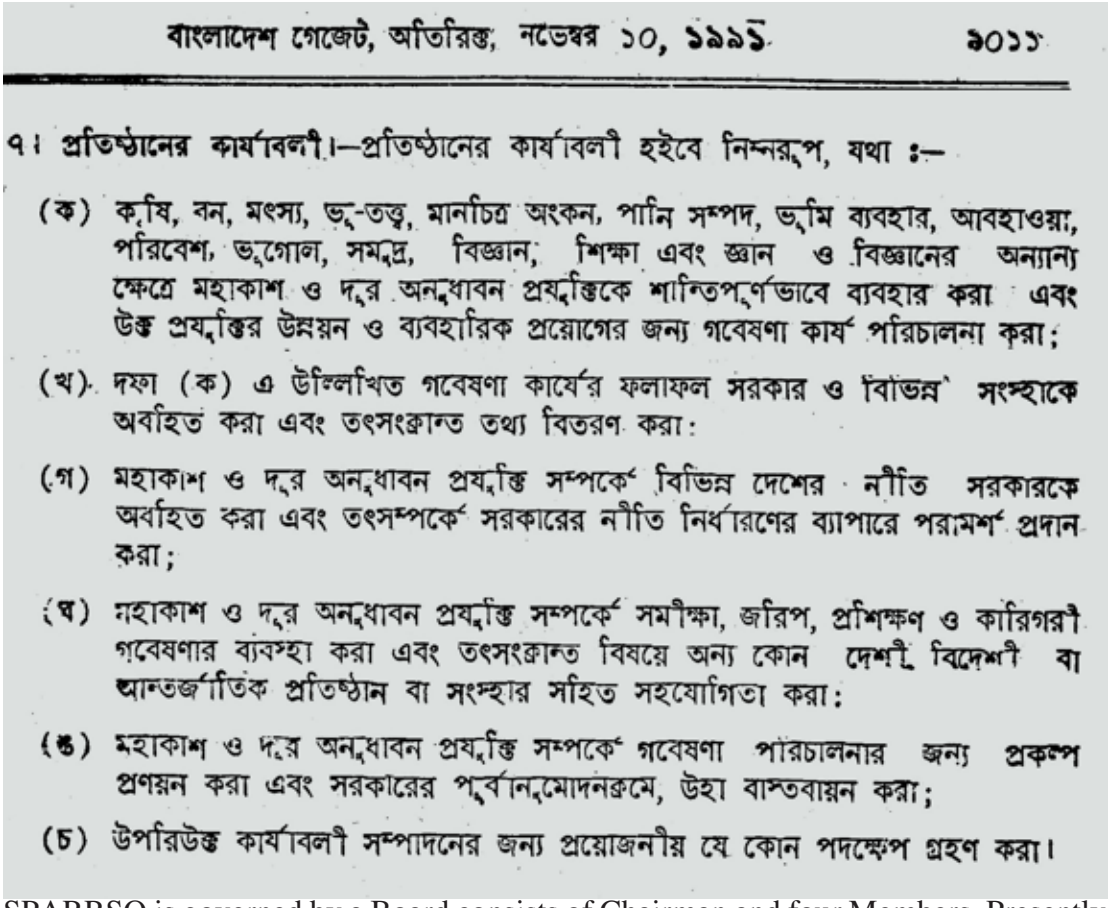
Bangladesh Space Research and Remote Sensing Organization (SPARRSO) is a multi-disciplinary statutory organization in Bangladesh which was established by the Act 29 of 1991. It has been working for the peaceful application of space technology for the benefit of nation. It carries out research works in various geo-disciplines that includes atmospheric science, agriculture, forestry, fishery, water resources, environmental sciences etc. SPARRSO has a ground receiving station where it receives and processes low to moderate resolution satellite data.

The organization is a statutory body under the Ministry of Defence of the Government of the People's Republic of Bangladesh. It is governed by the direct instructions and guidelines of its Board. SPARRSO is a focal organization of Asia Pacific Space Cooperation Organization (APSCO) under which it is implementing various programs on space science research, space technology development and space technology application domains.

As its regular course of duties, SPARRSO produces required database, information and map which are supplied to different Ministries, i.e., Agriculture, Food & Disasters Management, Environment & Forest, Land, Fisheries & Livestock, Defence and others. It also disseminates information to different departments and organizations, such as Bangladesh Meteorological Department, Bangladesh Bureau of Statistics (BBS), Department of Agriculture Extension (DAE), Forest Department, Department of Disaster Management (DDM) etc. If there is any specific requirement from any government or private organizations to provide necessary information by applying space technology, it will do so for ensuring human safety and security and finally contributing towards national development.

This annual report for the fiscal year of 2016- 2017 briefly describes the research, study and operational activities implemented during the reporting period. In addition, it also includes the participations of the officials in trainings, conferences and meetings organized both in home and abroad. The list of publications of the officials for the reporting period is also included in this report.

1.1 Functions of SPARRSO



বাংলাদেশ গেজেট, অতিরিক্ত, নভেম্বর ১০, ১৯৯১ ৯০১১

৭। প্রতিষ্ঠানের কার্যাবলী।—প্রতিষ্ঠানের কার্যাবলী হইবে নিম্নরূপ, যথা :—

(ক) কৃষি, বন, মৎস্য, ভূ-তত্ত্ব, মানচিত্র অংকন, পানি সম্পদ, ভূমি ব্যবহার, আবহাওয়া, পরিবেশ, ভূগোল, সমুদ্র, বিজ্ঞান, শিক্ষা এবং জ্ঞান ও বিজ্ঞানের অন্যান্য ক্ষেত্রে মহাকাশ ও দূর অনুধাবন প্রযুক্তিকে শান্তিপূর্ণভাবে ব্যবহার করা এবং উক্ত প্রযুক্তির উন্নয়ন ও ব্যবহারিক প্রয়োগের জন্য গবেষণা কার্য পরিচালনা করা;

(খ) দফা (ক) এ উল্লিখিত গবেষণা কার্যের ফলাফল সরকার ও বিভিন্ন সংস্থাকে অবহিত করা এবং তৎসংক্রান্ত তথ্য বিতরণ করা;

(গ) মহাকাশ ও দূর অনুধাবন প্রযুক্তি সম্পর্কে বিভিন্ন দেশের নীতি সরকারকে অবহিত করা এবং তৎসম্পর্কে সরকারের নীতি নির্ধারণের ব্যাপারে পরামর্শ প্রদান করা;

(ঘ) মহাকাশ ও দূর অনুধাবন প্রযুক্তি সম্পর্কে সমীক্ষা, জরিপ, প্রশিক্ষণ ও কারিগরী গবেষণার ব্যবস্থা করা এবং তৎসংক্রান্ত বিষয়ে অন্য কোন দেশী বিদেশী বা আন্তর্জাতিক প্রতিষ্ঠান বা সংস্থার সহিত সহযোগিতা করা;

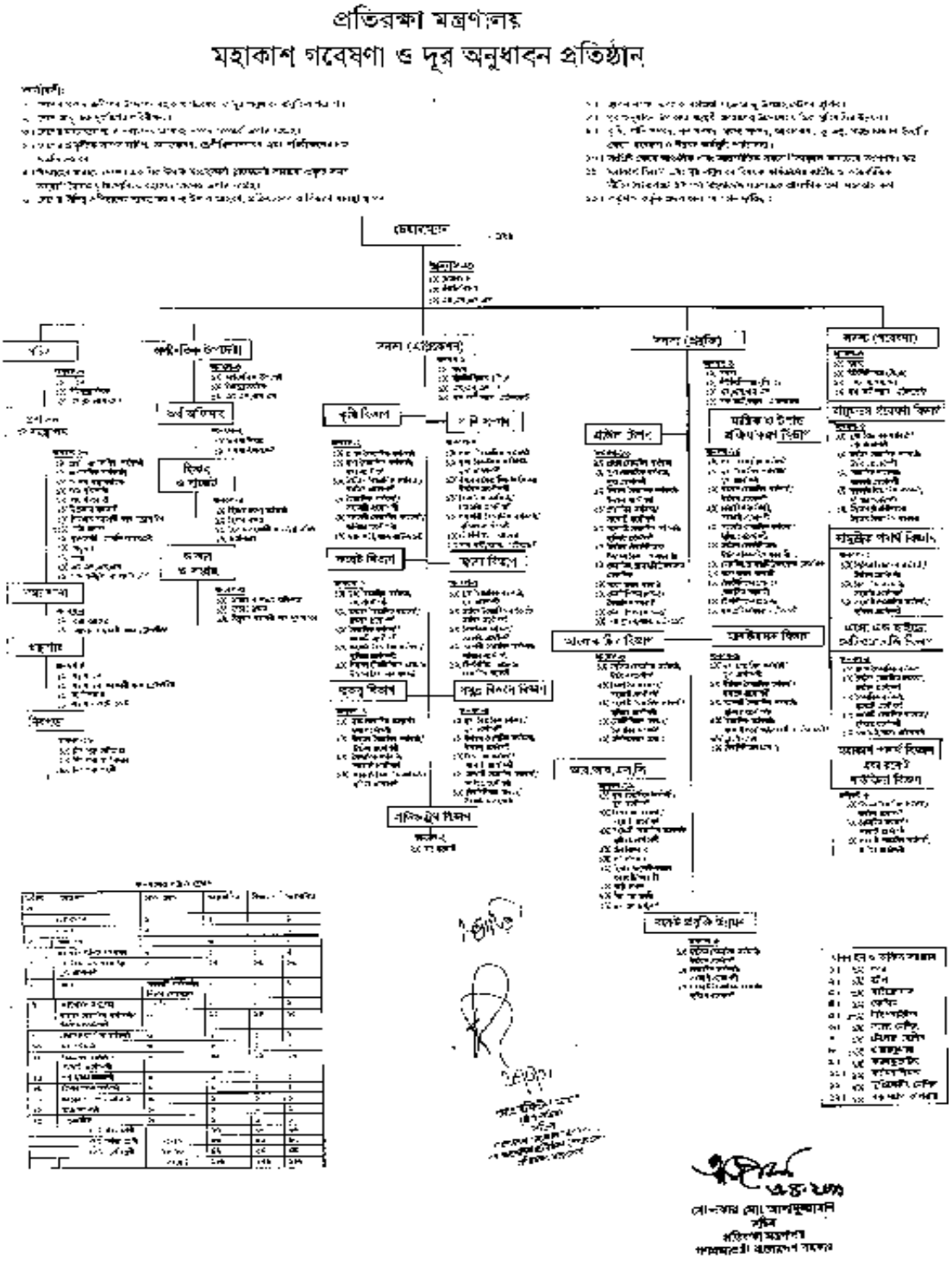
(ঙ) মহাকাশ ও দূর অনুধাবন প্রযুক্তি সম্পর্কে গবেষণা পরিচালনার জন্য প্রকল্প প্রণয়ন করা এবং সরকারের পূর্বানুমোদনক্রমে, উহা বাস্তবায়ন করা;

(চ) উপরিউক্ত কার্যাবলী সম্পাদনের জন্য প্রয়োজনীয় যে কোন পদক্ষেপ গ্রহণ করা।

SPARRSO is governed by a Board consists of Chairman and four Members. Presently (31 December, 2017), the members of SPARRSO Board are as follows:

Name	Position in Board
Md. Dilwar Bakth	Chairman
Md. Khalilur Rahman	Member
Ajit Kanti Das	Member
Dr. Hafizur Rahman	Member
A. Z. Md. Zahedul Islam	Member

1.3 Organogram



Each scientific division is responsible for conducting research in peaceful application of space and remote sensing technology in their respective sector

1.4 Manpower (Existing)

List of existing Employees of SPARRSO are enumerated below (updated 30 June 2017)

Sl No.	Name	Designation	Telephone (off)	E-mail
1	Md. Dilwar Bakth	Chairman	88-02-9131741	admin@sparrso.gov.bd
2	Md. Khalilur Rahman	Member (Research)	88-02-9116217	admin@sparrso.gov.bd
3	Ajit Kanti Das	Member (Application)	88-02-9125495	ajitjs3530@gmail.com
4	Dr. Hafizur Rahman	Member (Technology-1)	88-02-9139028	hafiz1961@yahoo.com
5	A. Z. Md. Zahedul Islam	Member (Technology-2)	88-02-9126623	azmd_zahed@yahoo.com
6	Md. Khairul Alam	Financial Advisor	88-02-9125319	mdkhairulalam@yahoo.com
7	Md. Zafar Ullah Khan	Secretary	88-02-9141601	khanmzu@yahoo.com
8	Suraiya Begum	Chief Scientific Officer	88-02-9113964	bsuraiya89@yahoo.com
9	S. M. Mizanur Rahman	Principal Scientific Officer	88-02-9113956	mizan.sparrso@yahoo.com
10	Mostafizur Rahman Akhand	Principal Scientific Officer	88-01552373547	akhand2@yahoo.com
11	Sukumar Dutta	Principal Scientific Officer	88-02-9141627	duttasukumar@yahoo.com
12	S. M. Humayun Kabir	Principal Scientific Officer (on-lien)	88-02-9121541	smhkabir1962@gmail.com
13	Dr. Mahmudur Rahman	Principal Scientific Officer	88-01913510107	mahmud@sparrso.gov.bd
14	Dr. Md. Abdus Salam	Principal Scientific Officer	88-02-9137886	salam@sparrso.gov.bd
15	Nur Hossain Sharifee	Principal Scientific Officer	88-01819110129	nhsharifee@yahoo.com
16	Md. Hashem Uddin	Principal Scientific Officer	88-01718590354	hashem_uddin@yahoo.com
17	Abu Mohammad	Senior Engineer	88-01921569389	abumd2@yahoo.com
18	Md. Shahjahan Ali	Principal Scientific Officer (C.C.)	88-01956197784	shopanali65@yahoo.com
19	Kazi Shahjahan	Finance Officer	88-02-9134006	kazi1960@yahoo.com
20	Md. Abu Taleb Pramanik	Senior Scientific Officer	88-01819008046	atpramanik@yahoo.com
21	Md. Abdullah Yousuf Imam	Senior Scientific Officer	88-01686526456	ayimam92@gmail.com
22	Md. Abdul Kader	Senior Scientific Officer	88-01711711802	imrankadir@sparrso.gov.bd
23	B. M. Refat Faisal	Senior Scientific Officer	88-01919491335	refatfaisal@yahoo.com
24	Md. Firoz Molla	Assistant Engineer	88-01818447661	firoz_62@yahoo.com
25	Shyamal Baran Saha	Assistant Engineer	88-01718592484	shyamalsaha33@gmail.com

26	Mir Haris Ali	Assistant Engineer	88-01914159617	mir_ali68@yahoo.com
27	Md. Abdul Awal	Librarian	88-01715888187	awalbd2007@yahoo.com
28	Sumangal Chakma	Assistant Engineer	88-01715283067	schakma@hotmail.com
29	Md. Saheb Ali	Assistant Engineer	88-01959494846	sahabali2@gmail.com
30	Nasrin Sultana	Scientific Officer	88-01813364918	nasrin@sparrso.gov.bd
31	Mohammmad Imrul Islam	Scientific Officer	88-01918406462	imrul_islam@sparrso.gov.bd
32	FarhanaTazneen	Scientific Officer	88-01911054737	farhana@sparrso.gov.bd
33	S. A. M. Arif-Ul-Haque	Scientific Officer	88-01730312195	sam_arif@sparrso.gov.bd
34	S M Ahsan Habib	Scientific Officer	88-01827022780	ahsan@sparrso.gov.bd
35	Sunity Kumar Chakma	Store & Procurement Officer	880-2-9141604	sskumar1960@yahoo.com
36	Rubel Kanti Dey	Information Officer	88-01722185718	rubelkanti@sparrso.gov.bd
37	Md. Mahmudul Haque	Administrative Officer	88-02-9119301 01922213186	mahmud.du20@gmail.com
38	Md. Manirul Islam Khandaker	Accounts Officer	88-02-9113966	kmi.salim1965@gmail.com

CHAPTER 2

RESEARCH AND APPLICATION ACTIVITIES

The research and application activities of SPARRSO have been providing valuable inputs for the food security and disaster management of the nation. The information on the early warning of various natural disasters reduces the death and casualties caused by the disasters. Post-disaster damage assessment conducted by the organization helps the government for planning relief distribution, rehabilitation programs and reconstruction activities. SPARRSO also generates information on the monitoring and assessment of paddy crops for the country which is helpful for the Ministry of Agriculture for their planning purposes. The information on floods and water-logging is also generated by SPARRSO which can help the people to cope with these disasters. The organization also provides various services to different sectors like meteorology, agriculture, oceanography, disaster, agro and hydro meteorology, forestry, fisheries, land use, water resources etc. using remote sensing and GIS technology on request. Some of these activities are briefly described in the following sections.

2.1 ATMOSPHERIC RESEARCH DIVISION

2.1.1 Meteorological Application

Bangladesh is one of the most disaster prone countries in the world. The disasters including cyclones, floods, drought, nor'wester, tornado, cold wave and persistent fog often hit different parts of the country, which create negative impact on the live and livelihood of the people.

SPARRSO provides a daily weather reports to the SPARRSO website (www.sparrso.gov.bd) to disseminate the information on the weather condition derived from satellite images. The information is helpful to the relevant departments of the Government of Bangladesh for disaster management in the country. SPARRSO also provides seasonal and long-time forecasting reports on meteorological phenomena of the country if there is a request from the Government.

2.1.2 Monitoring of Cyclone 'KYANT'

Bangladesh is often affected by various natural disasters including tropical cyclones, which is the most common and destructive one. Cyclone is a tropical storm or atmospheric turbulence involving circular motion of winds that frequently occurs in the Bay of Bengal and the Indian Oceans. Some of these are turned into severe or even up to super cyclones.

Tropical cyclone 'KYANT' was formed on October 2016, which was under continuous observation by the scientists of SPARRSO since its formation. The images of geo-stationary meteorological satellites namely FY-2E/G & TERRA MODIS and AQUA MODIS received at SPARRSO ground station were processed to monitor the formation and evolution of cyclone 'KYANT' on real time basis.

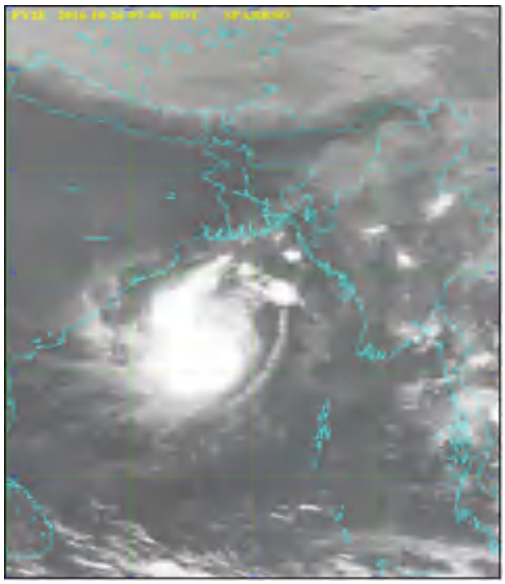


Figure 1: Cyclone "KYANT"

A low was formed in the Central Bay of Bengal on 24 October, 2016, which was turned into deep depression at midnight of 24 October and stayed near latitude 16.7□N and longitude 92.5□E. The deep depression over the central Bay and adjoining area moved slightly west-northwest wards and concentrated into a cyclonic storm, 'KYANT' over the same area near latitude 16.9□N and longitude 91.3□E at 9 AM on 25 October. The cyclonic storm was about 595 km south of Chittagong port and 640 km south-southeast of Mongla port. The cyclonic storm, 'KYANT' moved slightly south-southeast direction and was centered near latitude

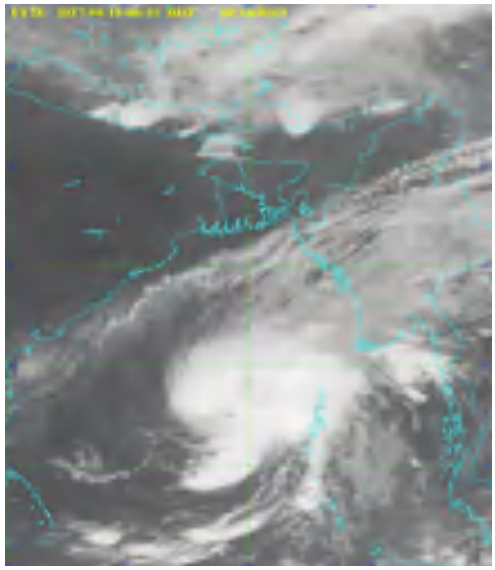
16.7□N and longitude 89.9□E at 6 AM on 26 October about 645 km south-southwest of Chittagong port and 645 km south of Mongla Port (Figure 1)

At 6 AM on 27 October, the cyclonic storm 'KYANT' moved westwards over the same area stay near latitude 16.1□N and longitude 86.5□E about 900 km southwest of Chittagong Port and 785 km southwest of Mongla Port. The cyclone moved further west and southwest direction and weakened into a depression and stayed near latitude 15.3□N and longitude 83.8□E at 6 PM on 27 October, which was centred around 1,175 km southwest of Chittagong Port and 1,035 km southwest of Mongla Port.

The depression was moved further west and southwest direction and weakened into well marked low over the west central Bay of Andhra Pradesh coast at 6:00 AM on 28 October 2016. It moved further west and southwest direction and weakened gradually.

2.1.3 Monitoring of Cyclone 'MAARUTHA'

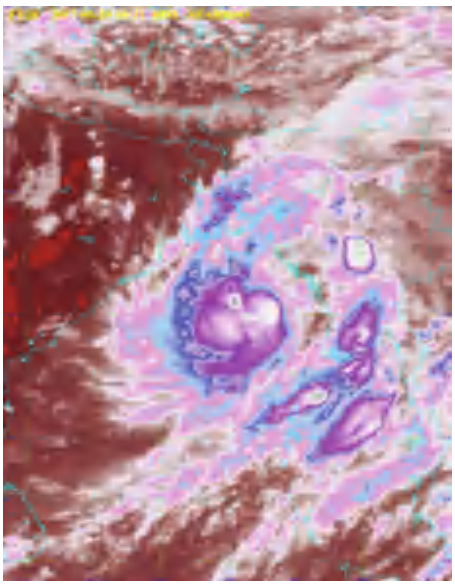
The Cyclone named MAARUTHA was formed in the Bay of Bengal near the Andaman Sea in April, 2017. It was first originated as a low and then turned into a depression over the east central Bay. It was moving north-west direction with a speed of 26 km/hr. It was gradually intensified and turned into a cyclonic storm near Nicobar Island on 15 April (Figure. 2), centred at Latitude 15.3° N & Longitude 91.0° E.



The system was further intensified and moved towards north and north-east direction and crossed Myanmar coast in between Sittwe & Sandway on 17 April, 2017 at early morning. Squally wind with a speed of 60-70 km/hr prevailed and heavy rainfall occurred near the Andaman Island & adjoining areas. Sea became very rough and fishing boats were advised to keep closer to the coast and move very carefully.

2.1.4 Monitoring of Severe Cyclonic Storm 'MORA'

Cyclone "MORA" originated as a depression over the Southeast Bay. It then started moving east-northeast direction with a speed of 40 km/hr. It was centred at east central Bay near Latitude 14.5° N & Longitude 89.5° E at 09:01 BDT and near Latitude 15.2° N & Longitude 90.6° E at 12:00 BDT on 28 May, 2017. It was about 790 km south- southwest of Chittagong port and 710 km south- southwest of Cox'Bazar port. Maximum sustained wind speed within the centre was about 40-50 km/hr. It gradually intensified into a deep depression over the east-central Bay and adjoining area near Latitude 15.4° N & Longitude 90.6° E at 15:00 BDT on the same day and about 770 km South- southwest of Chittagong Port and 690 km South-southwest of Cox'Bazar Port, 790 km South of Mongla Port and 735 km south of Payra Port. Maximum sustained wind speed within 48 km of its centre was about 50 km/hr rising to 60 km/hr. With the blowing wind sea became rough. It started moving further towards northerly direction.



The depression then intensified into cyclonic storm ‘MORA’ with central pressure 996 hpa over east-central Bay and adjoining area on 29 May at time 06:00 BDT (Figure - 3) . It was then centred at Latitude 17.1° N & Longitude 91.2° E and located at about 570 km South- southwest of Chittagong Port, 490 km South- southwest of Cox’Bazar Port, 620 km South of Mongla Port, 555 km south of Payra Port. Maximum sustained wind speed within 54 km of its centre was about 62 km/hr rising to 88 km/hr in gust/squalls. Sea became rougher. The cyclone then started moving towards north-northwest direction slightly afterwards. Under the peripheral influence of cyclonic storm, the coastal districts started experienced heavy rain with squally cyclonic wind.

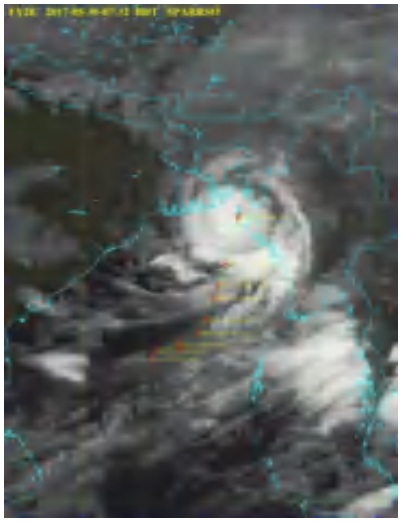


Figure 4: Track of Cyclone ‘MORA’ on FY-2 satellite image

The cyclonic storm intensified further and turned into a severe cyclonic storm ‘MORA’ with central pressure 990 hpa over the North Bay on 29 May at time 18:00 BDT and moving towards northerly direction. At that time, it was centred at Latitude 18.8° N & Longitude 91.3° E and lying about 385 km south of Chittagong Port, 305 km south of Cox’Bazar Port, 450 km South-southeast of Mongla Port and 370 km south-southeast of Payra Port. Maximum sustained wind speed within 64 km of its centre was about 89 km/hr rising to 117 km/hr and more in gust/squalls. Sea became very rough. ‘MORA’ then started crossing Cox’Bazar- Chittagong coast near Kutubdia at 06:00 BDT on 30 May, 2017 and weakened gradually. Figure-4 shows the track of severe cyclonic storm ‘MORA’.

During passage of the severe cyclonic storm 'MORA', the coastal districts started experienced very heavy rain with squally severe cyclonic wind. The low lying areas of coastal districts and offshore islands were inundated by storm surge of about 4-5 ft. height above normal astronomical tide.

SPARRSO monitored severe cyclonic storm 'MORA' and made 24 hours observation on real time basis using remote sensing technology and satellite data. It provided early warning and space based information timely to relevant organization/Department as well as to SPARRSO web-site to save the people and minimize the losses due to cyclone towards disaster management and sustainable development of the country.

2.2 WATER RESOURCES DIVISION

2.2.1 Establishment of Water Logging Monitoring System based on Geospatial Techniques

Water logging has created impact on the livelihood of the people living in certain regions of Bangladesh since quite a long time. However, over the last three decades it has been gradually aggravated and has become a disaster in this country. Particularly, the south-western part of Bangladesh has been facing the water logging problem increasingly. Agricultural lands are being lost due to water logging, which ultimately deteriorating the socio-economic condition of the people living in the vicinity of the area. Reliable information on the extent/intensity of water logging and its damages is not available in the country. Currently, Bangladesh does not have an operational water logging monitoring system. Water logging is a silent disaster and because of the absence of an operational water logging monitoring system, it is not possible to identify the occurrence of water logging at the initial stage. If water logging is identified at the earlier stage of occurrence, the remedial measures can be undertaken easily within a shorter period of time and in a cost effective manner. Therefore, it is important to establish an operational water logging monitoring system in the country.

Table 1: Year-wise statistical information on water-logged areas in the south-western Bangladesh during 1973-2016

Year	Name of affected Upazila	Gross water-logged areas (Hectare)
1973	Phultala, Keshabpur, Dumuria, Abhaynagar, Khan Jahan Ali	6,279
1975	Phultala, Keshabpur, Dumuria, Abhaynagar, Monirumpur, Khan Jahan Ali	8,539
1978	Phultala, Keshabpur, Dumuria, Abhaynagar, Monirumpur, Khan Jahan Ali	7,578
1984	Phultala, Dumuria, Abhaynagar, Monirumpur, Khan Jahan Ali	12,212
1989	Phultala, Keshabpur, Dumuria, Abhaynagar, Monirumpur, Khan Jahan Ali, Tala	22,215
1991	Phultala, Keshabpur, Dumuria, Abhaynagar, Monirumpur, Khan Jahan Ali.	13,335
1994	Phultala, Keshabpur, Dumuria, Abhaynagar, Monirumpur, Khan Jahan Ali, Tala	23,450
1997	Phultala, Keshabpur, Dumuria, Abhaynagar, Monirumpur, Khan Jahan Ali, Tala.	33,397
2000	Keshabpur, Monirumpur.	2,725
2001	Keshabpur, Monirumpur, Tarakhada.	7,790
2004	Keshabpur, Monirumpur, Tarakhada.	5,857
2006	Phultala, Keshabpur, Dumuria, Abhaynagar, Monirumpur, Khan Jahan Ali, Jessore Sadar, Tarakhada, Tala, Sathkhira Sadar, Kalaroa.	50,024
2009	Keshabpur, Abhaynagar, Monirumpur, Tarakhada, Tala, Sathkhira Sadar, Kalaroa.	21,673
2011	Keshabpur, Abhaynagar, Monirumpur, Tarakhada, Tala, Sathkhira Sadar, Kalaroa.	24,393
2013	Keshabpur, Monirumpur, Tarakhada, Tala, Sathkhira Sadar, Kalaroa.	30,107
2014	Keshabpur, Monirumpur, Tarakhada, Tala, Sathkhira Sadar, Kalaroa.	29,315
2015	Keshabpur, Dumuria, Abhaynagar, Monirumpur, Tala, Sathkhira Sadar, Kalaroa, Tarakhada.	35,272
2016	Keshabpur, Dumuria, Abhaynagar, Monirumpur, Tala, Sathkhira Sadar, Kalaroa, Tarakhada, Jessore Sadar.	47,143

Bangladesh has some specific contexts for the monitoring of water logging. As an example, identification of water-logged area on satellite images is not simply identification of water area. In the areas of prolonged water logging, as exists in Bhutiar Beel of Tarakhada upazila under Khulna district, submerge and surface coverage of aquatic vegetation grown in the water makes difficulty in the identification of water logged area using conventional digital image interpretation and processing techniques. SPARRSO has completed several research works addressing these issues for the establishment of a remote sensing based operational water logging monitoring system in the country. Based on the output from the system, half-yearly reports on the situation of water logging in the country are being prepared and supplied to the relevant stakeholders.

In order to establish the water logging monitoring system, a comprehensive water logging database has been generated from satellite (Landsat, RADARSAT and Sentinel 1) images. This database includes seasonal and temporal dynamics of water logging for the duration of 1972-2016 and depicts a complete scenario of the extent of water logging and damages caused by it.

Table 1 shows the year-wise statistical information on water logged areas during 1973-2016. It is noticed that starting from 1973, water logging has been gradually increasing, which was reached to 33,397 hectares in Phultala, Keshabpur, Dumuria, Abhaynagar, Monirumpur, Khan Jahan Ali and Tala upazilas in 1997. Water logged areas in 1997 was about 18 % of the total areas of the affected seven upazilas. After 1997, application of Tidal River Management (TRM) reduced the extent of water logging in the areas which had been continued till 2005. In 2006, water logging reached to the highest extent when 50,024 hectares of land in the eleven upazilas of Khulna, Satkhira and Jessore districts were affected. This area was about 17 % of the total area of the affected upazilas. Since 2006, Jessore Sadar, Sathkhira Sadar and Kalaroa upazilas were water logged and Tala upazila was affected massively. Gross water logged area in the country in 2016 was about 47,143 hectares. In this year, water logging in Keshabpur and Monirumpur upazilas reached to the highest extent when about 37 % and 29 % of the upazilas had been affected, respectively. Figure 5 shows the temporal and seasonal status of water logging in the eleven affected upazilas of the Khulna, Satkhira and Jessore districts.

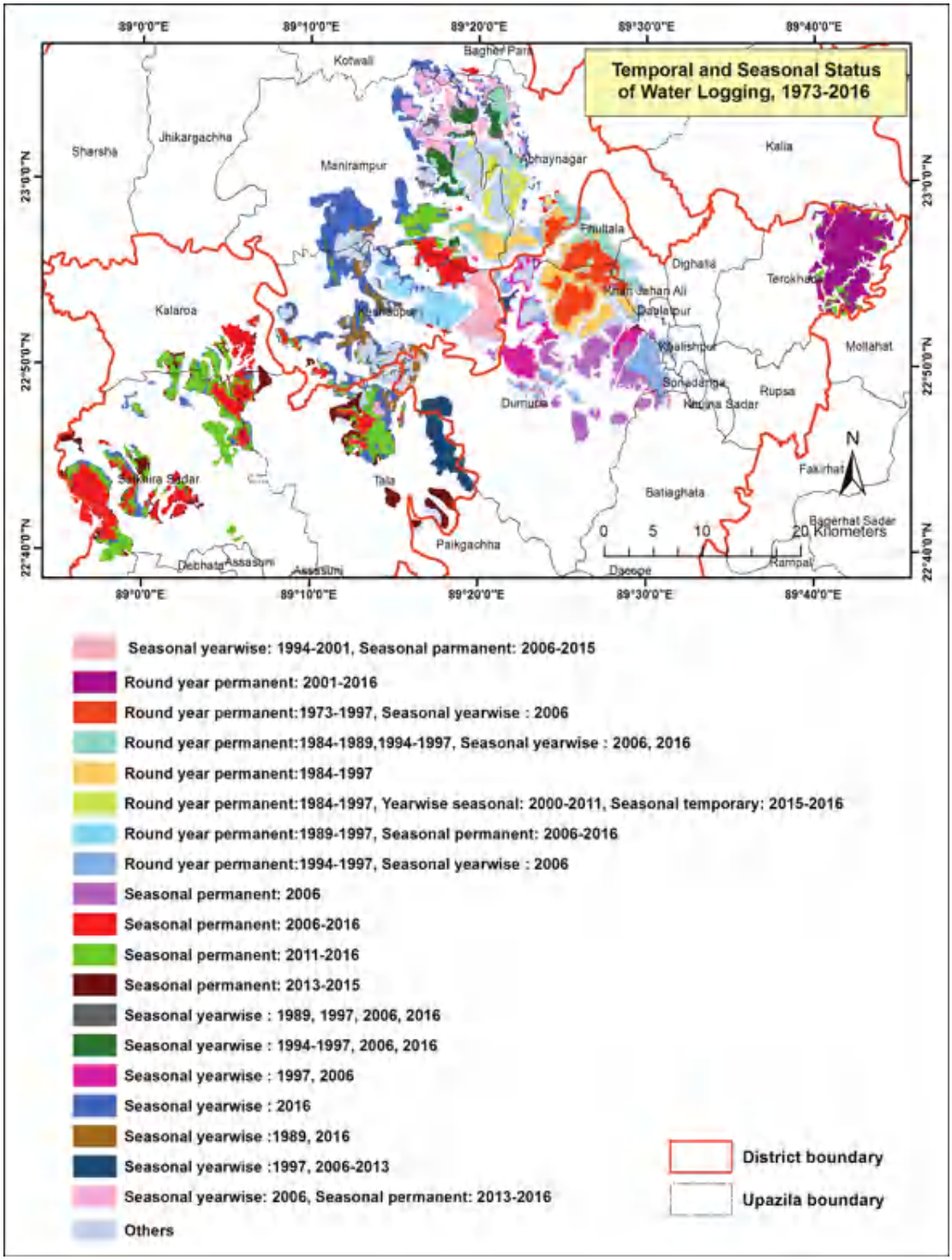


Figure 5: Temporal and seasonal status of water logging in the eleven affected upazilas of the Khulna, Satkhira and Jessore districts

2.2.2 Monitoring of Flash Flood in April, 2017

Due to heavy rainfall over Sylhet Division and adjacent Indian regions, flash flood with severe extent occured in Sylhet, Sunamganj, Maulvibazar, Habiganj, Netrakona and Kishorganj districts. Figure 6 shows satellite observation of heavy rainfall (300-400 mm in 27 hour starting from 4:30 am on 02 April, 2017) in the north-eastern region of Bangladesh and adjacent areas outside the country. Starting early in the first week, flood continued up to the last week of April, 2017 and damaged huge amount of Boro crop. Using the images of the Landsat-8 and Sentinel-1 satellites, SPARRSO monitored the dynamics of the flood extent and estimated the flood affected Boro crop areas. The flood inundated areas have been increased from 4, 46,879 hectares on 7 April to 6,64,446 hectares on 24 April, 2017. During this period the most of the damages to Boro crop was reported. Estimated flood affected areas of Boro crop was 2, 79,960 hectares which was approximately 33.86 % of the total Boro cultivated areas of the six flood affected districts as mentioned above. Table 2 shows the district-wise estimates of Boro crop areas affected by flash floods. Example of the extent of flood and flood affected Boro crop area is shown in Figure 7.

Table 2: District-wise estimation of Boro crop areas affected by flood

District	Flood affected Boro area	
	Area (hectare)	% of cultivated area
Sylhet	32,173	38.73
Sunamganj	1,32,775	59.31
Maulvibazar	16,036	30.00
Habiganj	19,222	16.50
Kishorganj	33,096	20.00
Netrakona	46,657	25.31
Total	2,79,960	33.86

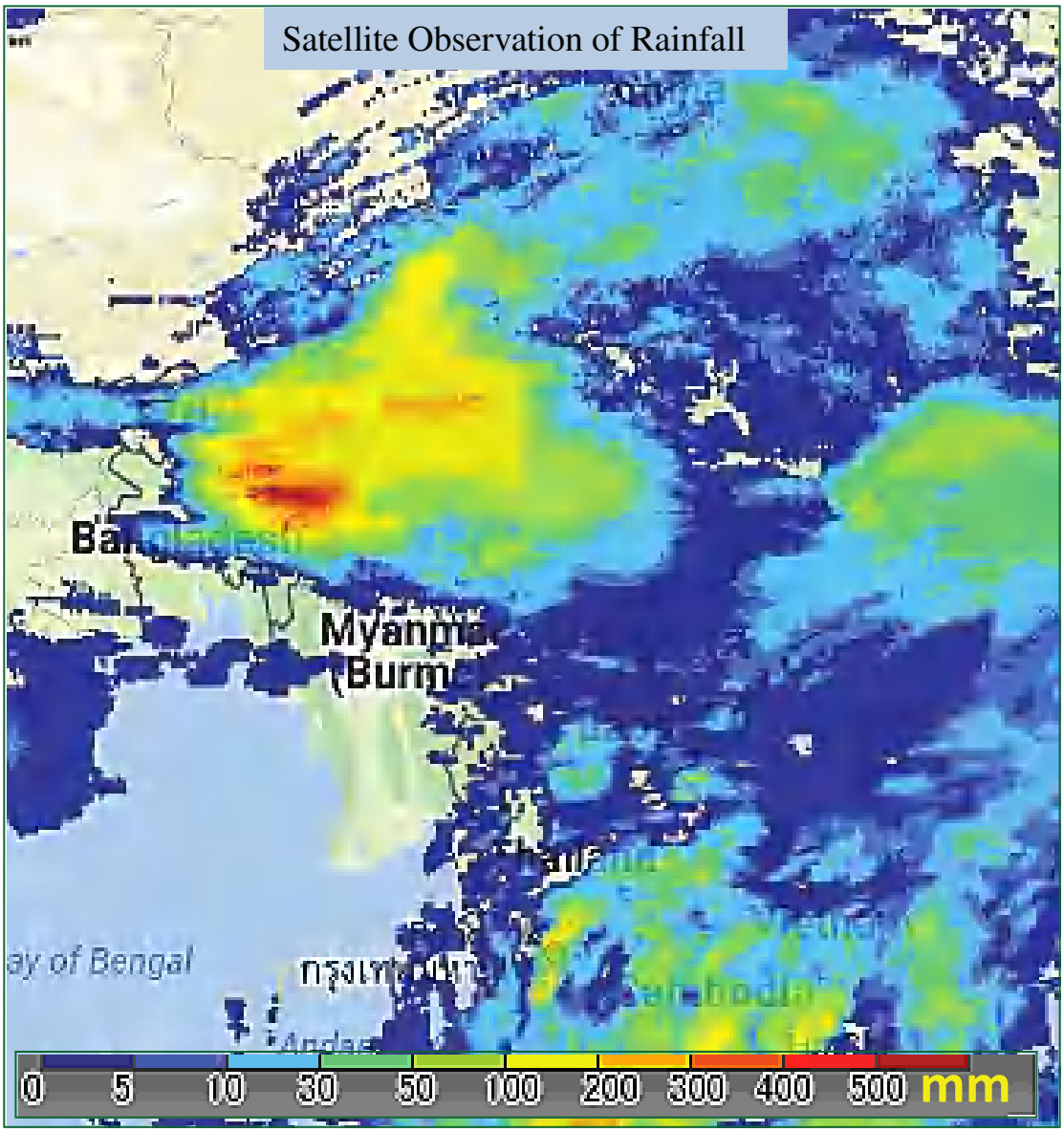


Figure 6: Satellite observation of heavy rainfall in the north-eastern region of Bangladesh and adjacent areas outside the country.

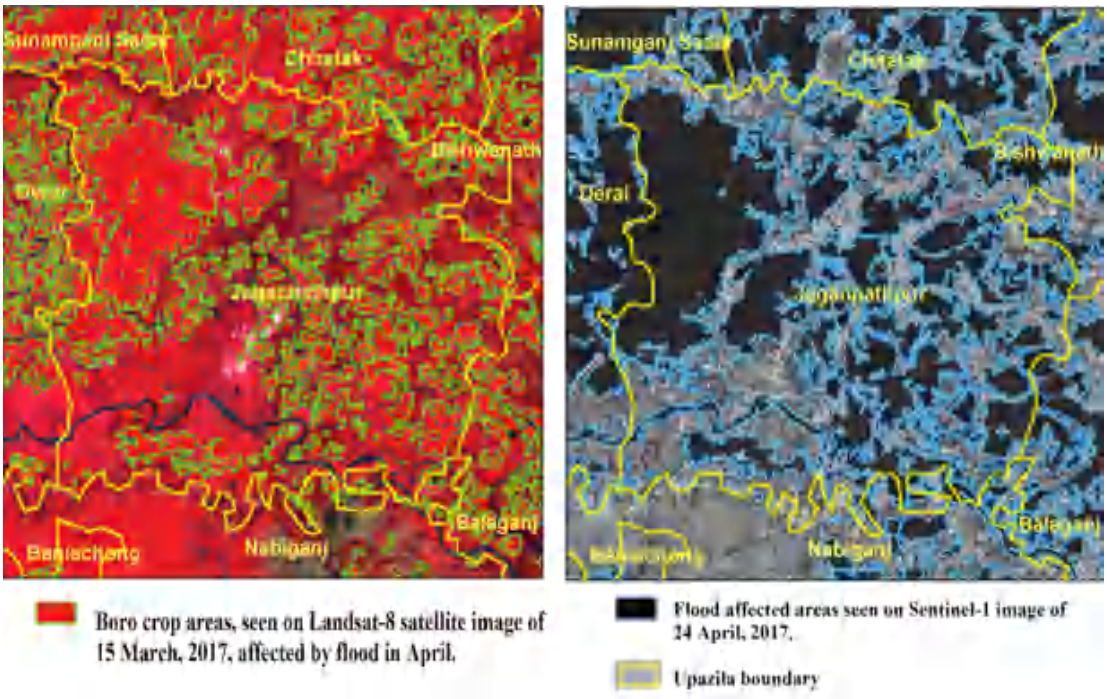


Figure 7: Extent of flood and flood affected Boro crop areas in Jagannathpur upazila of Sunamganj district.

2.3 AGRICULTURE DIVISION

2.3.1 Low Cost Emergency Land Observation and Monitoring System using Drone-UAV for Disaster-Induced Damages and Agricultural Crop

This study includes a study on the integrated application of remote sensing sciences, geo-information technology and Unmanned Arial Vehicle (UAV) technology (locally made QuadCopter) for emergency land observation over an area under critical constraint. The number, geographical locations as well as areas under each individual class categories of interest have been considered as a deceive factor in determining the number and locational spots for sample data collection and field observation. Such areas are under focused attention with an emphasis on the evolving biophysical and geo-environmental conditioning therein. Accordingly, necessary functional steps have been undertaken as a supplement to remote sensing operation employing the correction and validation steps. Primary surface features principally soil, vegetation and water are taken to be as the major category of surface features. The UAV utilized in the study is actually a locally made QuadCopter. The QuadCopter is guided through a GPS-supported mission plan covering the given disaster affected area. The purpose is to facilitate the emergency information retrieval process in the remote area where monitoring through land vehicle is time consuming and difficult. Using the software, we can perform mission planning by specifying the way point of the area to be monitored and the QuadCopter will be instructed to cover that area and acquire images using a high resolution digital camera mounted in the QuadCopter.

After acquisition of a series of digital images as specified in the mission plan, all the individual images are geometrically corrected, geo-referenced and finally digitally mosaicked to produce a single image block. At this stage, a dedicated computer program has been developed through computer coding of widely used radiative transfer algorithm SMAC (Simplified Method of Atmospheric Correction) to perform necessary atmospheric correction of the acquired images. The developed software performs necessary atmospheric correction of acquired images which are affected by external factors like atmospheric aerosol and other gaseous constituents in the atmosphere. Subsequently the corrected images were geo-referenced using ERDAS Imagine software. The remaining operation of information retrieval has been made through a model-based approach using spatial modeller language available in the professional Image Processing Software ‘ERDAS Imagine’. Information on surface features particularly on agricultural crop, damaged areas, exposed soil has been obtained based on the acquired images.

2.3.2 Study on the Geo-Environmental Consequences of Climate Change Extremity due to Cyclone Aila 2009 in the South-western Part of Bangladesh using Remote Sensing and GIS

The coastal areas of Bangladesh are particularly disaster prone because of their geographical location, land characteristics and the proximity to the funnel-shaped feature (which reduces the width and increases the height of storm induced waves) of the northern Bay of Bengal. The adverse effects of Climate Change – especially high temperature, sea-level rise, increase frequency and occurrence of cyclones and storm surges, salinity intrusion, heavy monsoon downpours etc. has aggravated the overall economic development scenario of the country to a great extent. Cyclone Aila hit Koyra and Dacope upazila of Khulna district of southwest coastal region of Bangladesh on 25 May 2009 with wind speed of up to 90 km per hour. This study focuses on the geo-environmental and ecosystem changes and their possible consequences on the livelihood and food security in the coastal areas of Bangladesh by the Cyclone Aila.

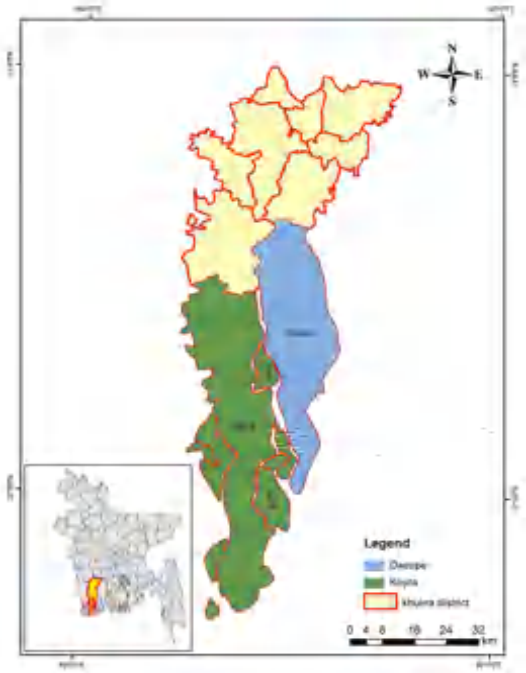


Figure 8: Location of the study area

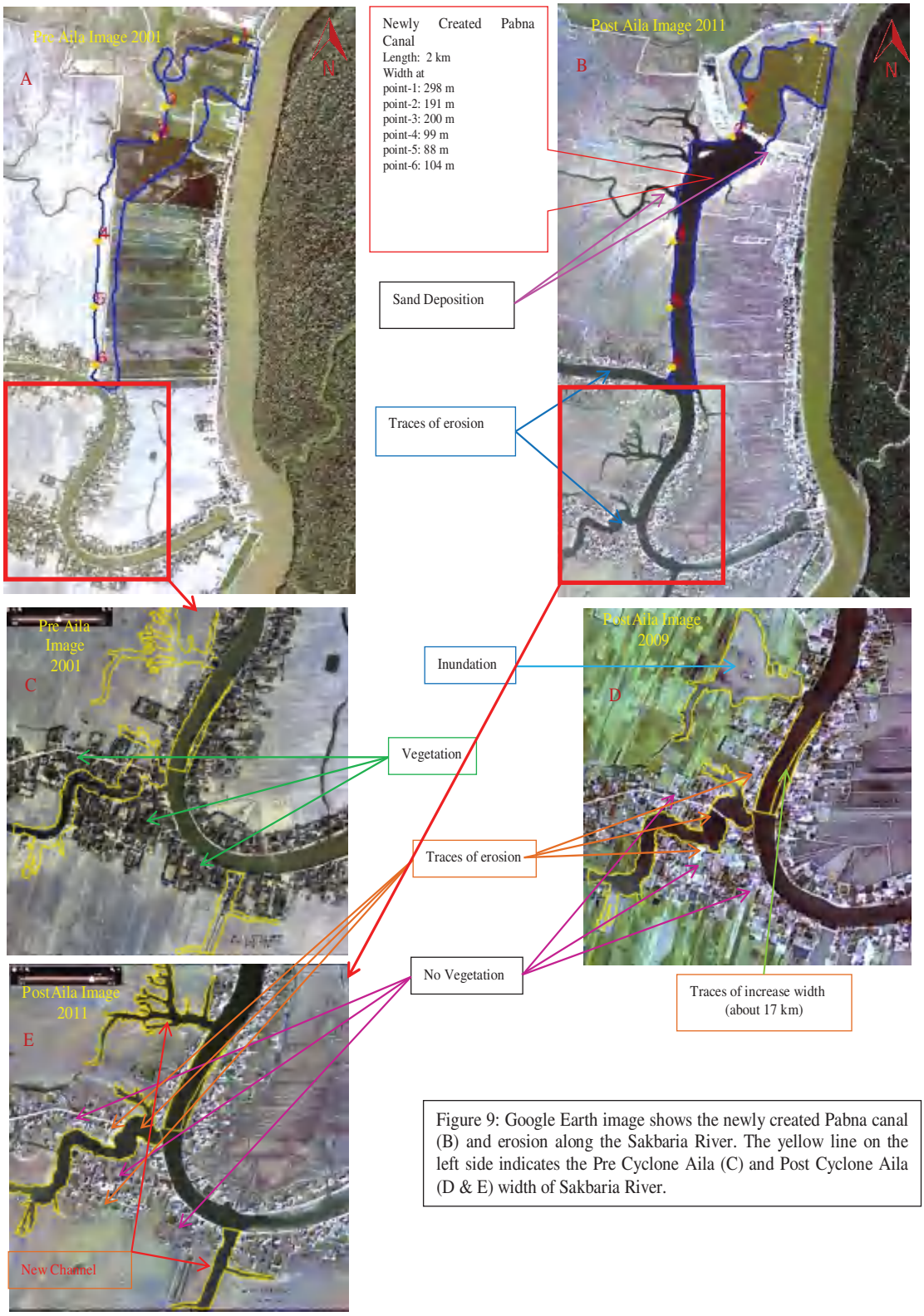
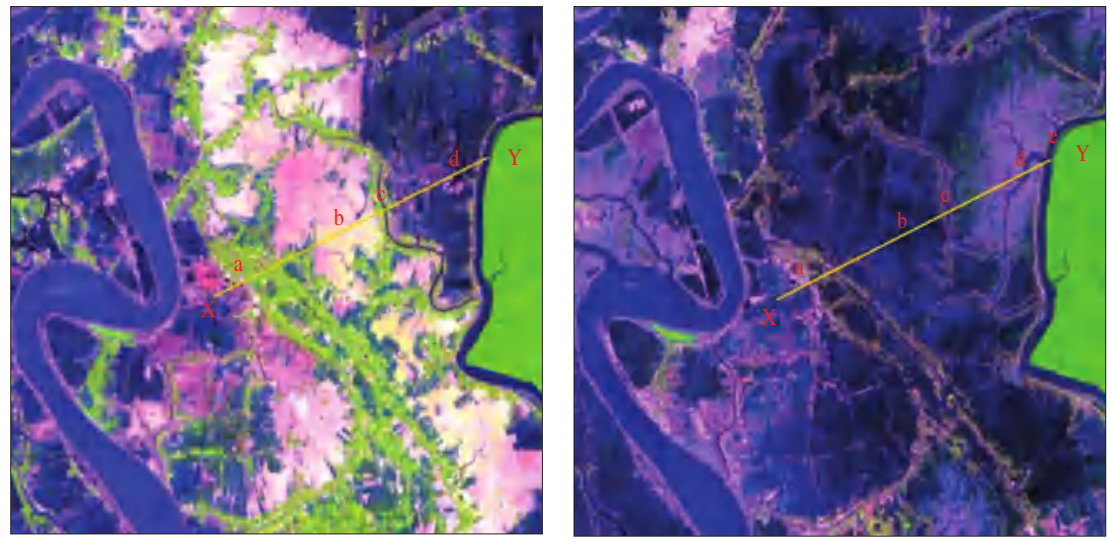


Figure 9: Google Earth image shows the newly created Pabna canal (B) and erosion along the Sakbaria River. The yellow line on the left side indicates the Pre Cyclone Aila (C) and Post Cyclone Aila (D & E) width of Sakbaria River.

Image dated 3 Feb 2009 (Pre Aila)

Image dated 6 Feb 2010 (Post Aila)



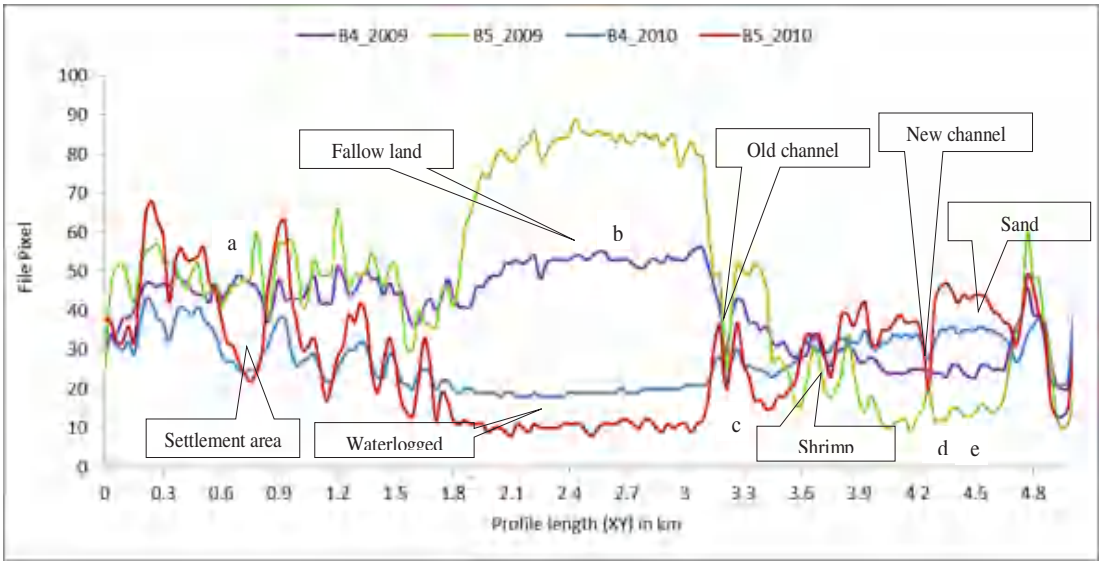


Figure 10: Landsat Tm spectral colour images of February 3, 2009 and 6 February, 2010 representing pre-Aila and post-Aila situation, respectively in the Koyra upazila under Khulna district with linear spatial profiles corresponding to three spectral bands (5, 4, and 3) on the two different dates as mentioned.

Landsat 5 Thematic Mapper at a resolution of 30 m of 2008, 2009 and 2010 along with Google images of 2001, 2009 and 2011 have been analysed to study geo-environmental consequences due to cyclone Aila in the area under investigation. ArcGIS 10.3.1 software is used to prepare location map of the study area. Finally, the obtained information was analysed to assess the impacts of extreme events on the study area.

Cyclone Aila introduced dynamic changes in the geo-environmental configuration and composition of surface features over the study area with different cascading effects of parameters and processes. Analysis of time series satellite data indicate that devastating Cyclone Aila bleached nearby embankments, roads and settlements, damaged shrimp-farms and agriculture fields, increased the widths and depth of channels, developed new channels.

Comparison of Figure 9 A, B, C, D and E provide certain differences in surface feature configuration over the area. Figure 9 A indicates the presence of vegetation and trees as textured elements distributed around the settlement areas. While most of the vegetation area disappeared on the post Aila images of 2009 and 2011 (Figure 9 D and E). Moreover, the settlement areas also disappeared on the post Aila image.

In post Aila image of 2011 (Figure 9 B), a newly created canal named Pabna Canal is appeared. The length of the canal is about 2 km and width varies from place to place along canal length.

It is also observed sand deposition along both banks of the Pabna Canal from post Aila image of 2011 (Figure 9 B). After hit of the cyclone Aila inundation of large area is observed from the upper part of the post Aila image of 2009 (Figure 9 D). Eventually this inundated area turned into the newly created Pabna Canal (Figure 9 B). Erosion occurred along the Sakbaria River and River width was increased about 17 km along its right bank (Figure 9 D & E).

Beside this, two other narrow canals observed in the middle left and lower part of (Figure 9 C) become wider and cause extensive erosion of settlement and barren land (Figure 9 D & E). Vegetation of these areas swept away and still almost remains as non-vegetated. Dynamic variation in reflectance values along the profiles on two dates have been interpreted in terms of surface category, its condition and transformation into another category. From (Figure 10) location ‘a’ corresponding to settlement area in 2009 was affected by Cyclone Aila and presence of flood water is visible in 2010 after the cyclone Aila. Thus the spectral value corresponding to position ‘a’ dropped down significantly in 2010 as compared to that in 2009 prior to the cyclone Aila. Location ‘b’ represents fallow land in 2009 with high reflectance value, while, the value significantly dropped down in 2010 due to water logging in the area causing high absorption of radiative value. Location ‘c’ represents old channel in 2009 with low reflectance value, while, the value dropped down a little in 2010 due to water

logging in the area causing more absorption of radiative value. Location'd' represents new channel in 2010 with low reflectance value, while, the value in 2009 indicate presence of mixed environment of sand and water. Again the increasing trend of radiative value represents sand deposition in 2010, while low radiative value in 2009 represents presences of water.

This study indicates that the devastating Cyclone Aila had created adverse impact for long time on the geo-environment of this area and caused significant damages to the ecosystem. Hope that findings of this study will help decision and policy makers as well as stakeholders to take timely and effective steps to cope up with the devastating situation of this area.

2.4 AGRO and HYDROMETEOROLOGY DIVISION

2.4.1 Monitoring and Mapping of Land Use and Newly Formed Islands at the Confluence of the Feni River from 1974 to 2016 using RS and GIS Techniques

The Bay of Bengal drains the combined discharges of the Ganges, Brahmaputra, Meghna (GBM) rivers amounting on the average to 35 000 m3/s (Magnus 1999). These three rivers drain about 80 % of the total volume of water brought into Bangladesh. These are distinct seasonal in fluctuations inflow with extreme discharge in the monsoon. The average annual sediment load carried by the GBM Rivers to the Bay of Bengal is around 2 billion tons annually. Heavy sediment load coming from GBM and high tidal flow resist the sediment to go directly to the Bay of Bengal may a factor for accretion of inner rivers and confluence of the island

The objectives of the study were:

i) Monitoring newly formed Island at Feni River Confluence in the Bay of Bengal from 1974-2016 and

ii) Land use mapping especially Agriculture, Fish Culture, Settlement, Mangrove Forest and others.

The study area was located at Urirchar (Char Balua, Char Umead, Char Ramjan, Char Gazi, Char Amzad, Char Seraj are all together called Urirchar), an island in the Bay of Bengal

(Figure 11). Its coordinate is in between 22°38' N and 22º46' N Latitude, 91°16' E and 91º24' E Longitude.

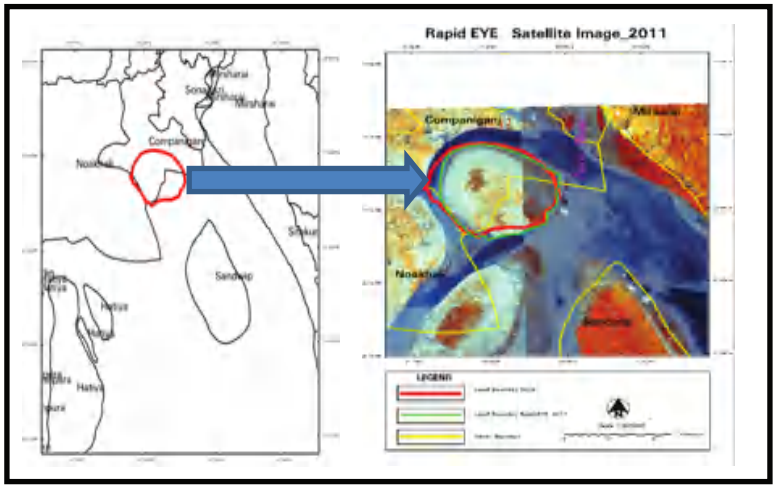


Figure 11: Location of the study area on DLR map and Rapid Eye Image

The present study demonstrated the application of Remote Sensing and GIS for identifying and evaluating of major land use parameters in Urir Char Island. Landsat images of 1974,1978,1988,1989 and 2016 have been used (Table 3) for identifying the major land use like settlement, water bodies, agriculture and mangrove forest in the island. Visual interpretation along with on-screen digitization techniques have been applied for identifying the area of different land use. GIS have been used to identify the land use area and change analysis.

Table 3: List of satellite data used in the study

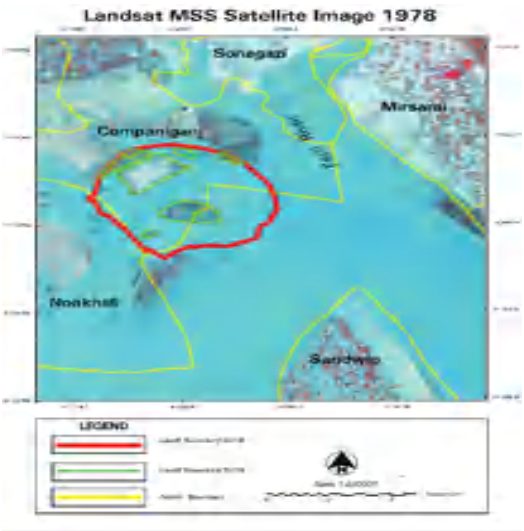
Satellite Sensor	Data acquisition (Year)	Tidal Condition	Remarks
Landsat MSS	1974	Low Tide	High tide data not Available
Landsat MSS	1978	High Tide	
Landsat TM	1988	Medium High Tide	
Landsat TM	1989	Low Tide	
TM	2016	High Tide	
Rapid Eye	2011	Low Tide	
Spot	2016	High Tide	

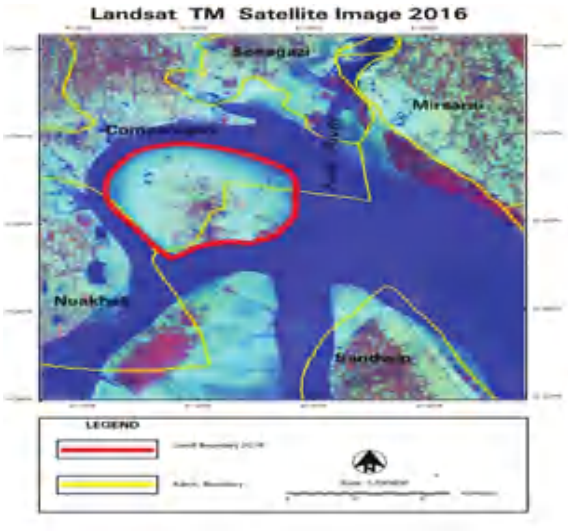
The following classes of the land features were finally identified:

- Forest and vegetated land area
- Agriculture and other land types
- River and other water areas and
- Settlement

By the processing and interpretation of various images and incorporating the relevant data, it was revealed that accretion rate was higher than the rate of erosion. In some cases, a significant variation in land use parameters specially, settlement/homestead, water-body mangrove forest, agriculture land areas was found. Information collected through ground truth mission was used to correct the discrepancy in mapping. Finally, using the base information with subsequent data of satellite imagery, detail base maps of the area were prepared.

Only three Landsat scenes collected for the study period were almost in high tide condition, while the remaining Landsat images were in low and medium tide condition. But we considered calculated accreted land area during high tide and medium high tide condition.





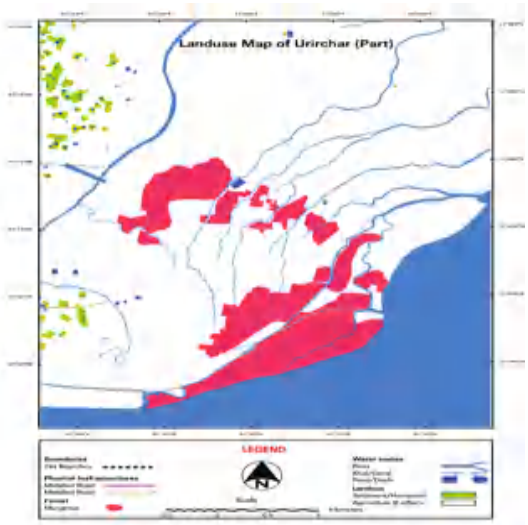


Figure 13: Land use map of Urirchar showing Mangrove Forest

Different elements of visual interpretation techniques like tone, texture, shape and colour of the images were used to identify different land uses in different time period. Figure 12 shows the mosaic of Landsat images (MSS and TM data; Band 4, 3 and 2 in RGB colour combination. In this band combination, homestead forest shows in red colour, mangrove forest in deep red colour, water area in blue colour and agriculture and bare land in white colour. During the study period, the islands are found in different shapes in different seasons due to the continuous process of erosion and accretion. We have studied how many ha of lands had been accreted during 1978 to 2016 in high tide condition; the total amount of land gained during the study area was 9,834 ha during last 38 years. The study revealed that settlement areas have been detected in an increasing trend during 1974-2016 and found that the island increased about 9,834 ha during the last 38 years.

We have found the following results in our study:

- The continuous land strip with mangrove plantation will provide protection to lives and properties against cyclones and tidal surges;
- The width of canal between Urirchar and Noakhali was found only two kilometres in 2016. So, there is a possibility to integrate Noakhali mainland with Urirchar through direct road communication. There will also be a possibility to construct electricity, telecommunication and gas transmission systems in Uririchar.
- Newly accreted lands can be used for agriculture, homestead, forestry etc.

2.5 FORESTRY DIVISION

2.5.1 Automated Tree Crown Detection from VHR Satellite Imagery (Phase 1)

The coastal areas of Bangladesh located at the northern part of the Bay of Bengal are often affected by severe cyclones with storm surges. With a view to protect the inland habitat form this disaster, Bangladesh Forest Department initiated mangrove afforestation on the outside of the protective coastal embankments in 1966, which was accelerated with the World Bank assisted projects in the 1980s. In order to strengthen the monitoring activities of the plantation, this project aims to develop individual tree detection and delineation algorithm for planted mangrove in the coastal belts of Bangladesh using Very High Resolution (VHR) satellite imagery. The study area was located in Nijhum Deep, located at the

southern part of Hatiya Island. The major species of the plantation is Keora (Sonneratia apetala). At present, the extent of mangrove in the island is lower than the half of the islands (Figure 15)

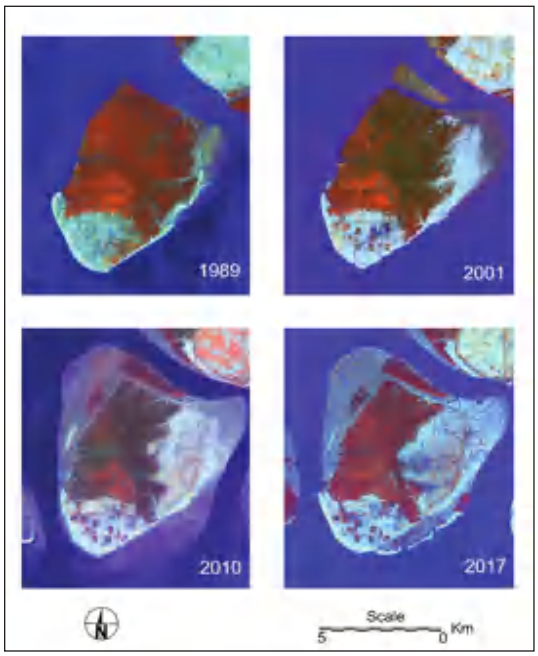


Figure 15: Mangrove forest change in Nijhum Deep Island over the last few decades

One field visit was conducted during the first phase to collect ground measured data containing geo-location of identifiable objects. In the first phase of the project 12 ground sample plots were collected. In addition, there were few samples dedicated to collect ground control points were also recorded. Tree composition and structural parameters of forest were measured by locating 10m×10m ground sample plots. Diameters at breast height (Dbh) and heights of all the trees in the plot were measured. Name of the species was recorded. Camera photographs of all the sample plots were acquired. The next phase (Phase II) will dedicate to carry out two more sampling missions under which at least 20 more samples are planned to be collected.

One algorithm, local maximum filtering, has been applied to WorldView-3 panchromatic image in order to enhance the visual detection of individual tree crown. The method was applied to both panchromatic and multispectral WorldView-3 images. Panchromatic images with higher spatial resolution show better discrimination of individual tree crown. Figure 16 shows how filtering on panchromatic images enhanced the detection and delineation of individual tree crowns on VHR satellite image.

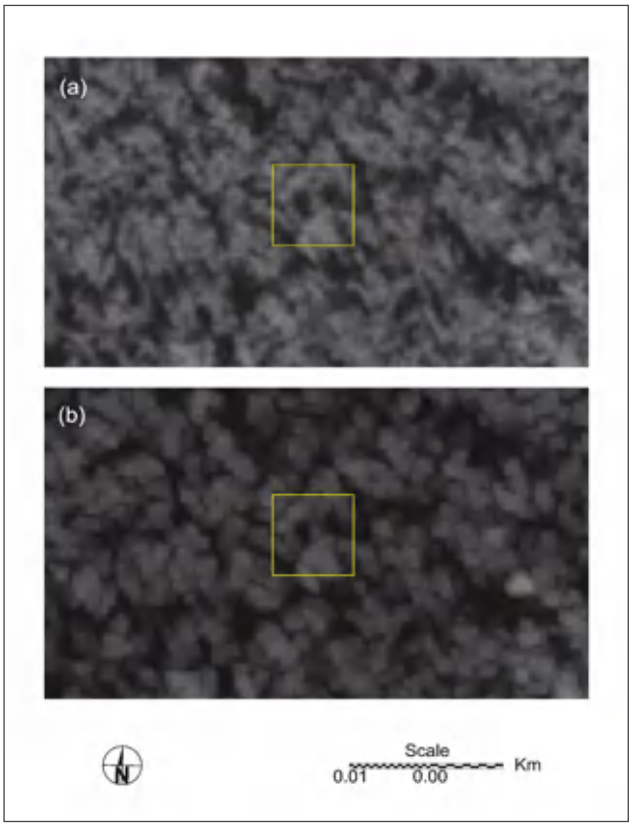


Figure 16: Enhancement of individual crown detection on VHR satellite image by using 3×3 local maximum filtering

After completion of ground data collection, crown detected on VHR satellite imagery will be modelled and validated. Finally, a map of tree crown will be prepared for Nijhum Deep Island.

2.5.2 Mapping Trees Outside of Forests (TOF) Using Remote Sensing

Trees excluded from the forest and other wooded lands are defined as "Trees outside of forests (TOF)". TOF are mostly located on farmlands and built-up areas of rural and urban regions. Remote sensing with its unique capability of synoptic viewing, real time and repetitive nature offers a potential tool for monitoring and evaluation of Earth's natural resources. Forestry is one of the most important disciplines in which remote sensing technology is being used over a considerably long time period from the early stage of its development. Remote sensing technology has been successfully employed in various studies like forest inventory, monitoring of forest cover changes, forest damage assessment.

outside of forests by using the freely available moderate resolution satellite remote sensing data in the Barisal Division of Bangladesh excluding the Jhalokati District. Landsat 8 OLI (Operational Land Imager) data of 2016 and Landsat ETM+ (Enhanced Thematic Mapper Plus) data of the year 2000 have been used for this purpose. A comparison of TOF has also been done in the five Upazillas of Barguna District between the year 2000 and 2016. Driving forces behind the changes of TOF has also been investigated through GPS (Global Positioning System) based ground verification and interview with the people living in the locality.

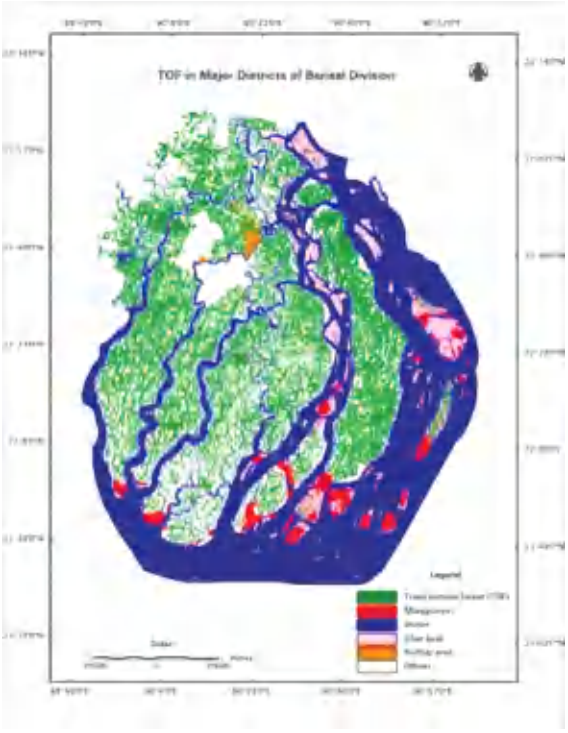


Figure 17. Map of Trees Outside Forest (TOF) in the Barisal Division of Bangladesh in 2016

Trees outside of forest (TOF) in the study area have been increased as a significant amount of area during 2000 to 2016. The main reason was the population growth and as a result fragmentation of joint family and turned into new families with their new settlements. Although the cropping land is under tremendous pressure through building the new settlements but the green vegetation had been increasing a lot and the equilibrium point was still unknown. The thematic layer representing TOF is a challenging vegetation layer while working on the crop monitoring and land use mapping. The output of this research may be helpful for the other researcher in those regards.

the oceans. The ocean extends from the shallow estuarine areas to the deeper locations of the ocean. Generally, the division is responsible for the applications of space and satellite based remote sensing technology in coastal, offshore and open sea for the exploration and exploitation of available resources therein.

In the Oceanography Division from July 2016 to June 2017, research on land-related changes on three important offshore islands has been conducted. The islands are Sandwip, Hatiya and Manpura. The details of the study of the three islands are given as below:

(i) Sandwip:

Table 04: Land erosion and accretion of Sandwip (2010-2015)

Description of Analysis	Area (ha)
Land of 2010	19388
Land of 2015	21047
Common Land	18525
Accretion in 2010 to 2015	2522
Erosion in 2010 to 2015	863

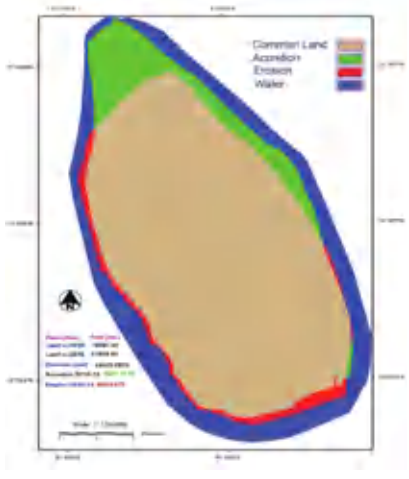


Figure 18: Land erosion and accretion of Sandwip (2010-2015)

In Figure 18, changes in the extent of the island have been presented from 2010 to 2015.The results of the research are shown in Table 4.

(ii) Hatiya

In Figure 19, changes of the land have been presented from 2010 to 2015.The results of the research are shown in Table 5.

Table 05: Land erosion and accretion of Hatiya (2010-2015)

Description of Analysis	Area (ha)
Land of 2010	42470
Land of 2015	48699
Common Land	41051
Accretion in 2010 to 2015	7648
Erosion in 2010 to 2015	1419

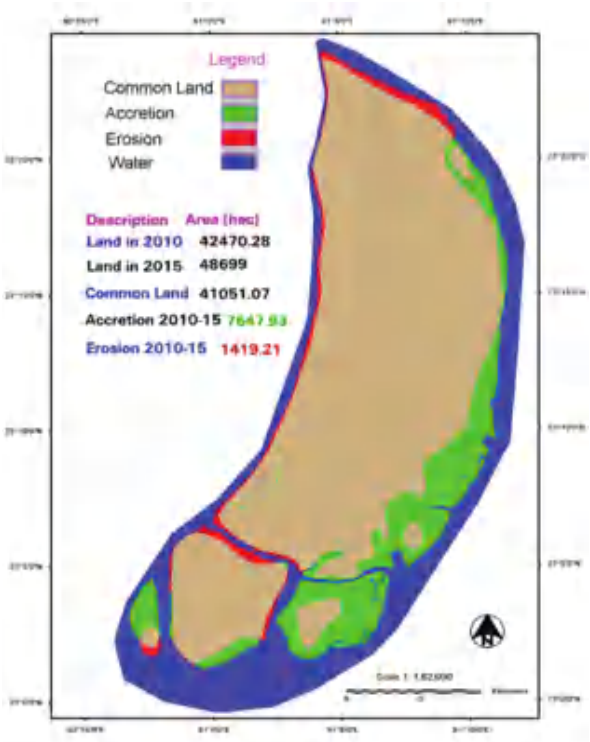


Figure 18: Land erosion and accretion of Sandwip (2010-2015)

(iii) Manpura

In Figure 20, the land changes in Monpura between 2015 and 2015 have been presented. The results of the research are shown in Table 6.

Table 06: Land erosion and accretion of Manpura (2010-2015)

Description of Analysis	Area in Hector
Land of 2010	12036.69
Land of 2015	11728.07
Common Land	11216.47
Accretion in 2010 - 2015	416.20
Erosion in 2010 - 2015	820.21

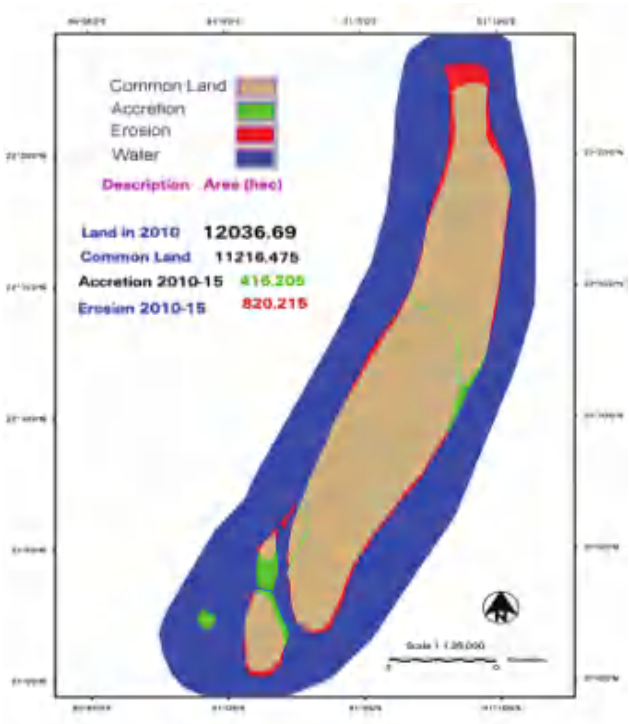


Figure 20: Land erosion and accretion of Monpura (2010-2015)

2.7 GROUND STATION DIVISION

Receiving and processing of satellite data from the satellite receiving ground station is the main task of the division. The division has established the Express Feeder line at SPARRSO, which facilitates the uninterrupted supply of electricity. Other tasks of this division include the operation and maintenance of 800 KV Substation, 275 KVA Diesel Generator and air-conditioning facility of SPARRSO for smooth functioning of all kinds of satellite-based remote sensing and GIS activities at SPARRSO.

2.7.1 IGMA Project of APSCO

International GNSS Monitoring and Assessment Project (IGMA) of APSCO is an important international cooperation work, which aims to deepen GNSS technology cooperation within the APSCO Member States. The goal of the project is to develop BDS/GNSS monitoring and assessment on the basis of IGMA proposal. The project system consists of stations distributed in different Member States and a data centre that is located in China.

GNSS (Global Navigation Satellite System) is a world-wide position, velocity, and time determination system. The system includes one or more satellite constellations, receivers, and system integrity monitoring. It is augmented, as necessary, to support the required navigation performance for the actual phase of operational GNSS that includes Core Constellations such as GPS, Galileo, Glonass and Beidou.

2.8 PHOTOGRAPHY DIVISION

Satellite imagery is often required for different research and mapping activities. This division is responsible for providing remotely sensed data and products to the universities and various user-agencies for conducting studies and project works.

2.8.1 Land Use and Land Cover Change Mapping in Nachole Upazila of Chapai-Nawabgang District: A RS and GIS Approach

This study has been carried out to determine the changes in land use patterns in Nachole Upazila of Chapai Nawabganj District. Satellite images were analysed to detect the changes in land use and land-cover in the last 34 years in the Barind Tract of Nachole Upazila.

The increases of vegetation cover and changes in land use pattern have been investigated using remote sensing satellite data. Table 07 shows remote sensing data used in the present study. The area is constituted by two major physiographic divisions: Barind Tract and Ganges River Floodplain. The Ganges floodplain soil is on the western side of the upazila covering 9% and the 91% of the area that is occupied by Barind soil.

Table 07: Remote sensing data used in the current study

No	Types of Data	Resolution	Year
1.	Aerial IRC	1 m	1983
2.	Goggle Image	0.6m	2016

Remote sensing data was geo-referenced to Transverse Mercator projection system using Linear Transformation Matrix with Nearest Neighbourhood re-sampling method. Pre-processed data was classified using on-screen digitization technique. Land use changes were determined for the last 34 years from 1983 to 2016. The schematic representation of methodology is presented in Figure 21.

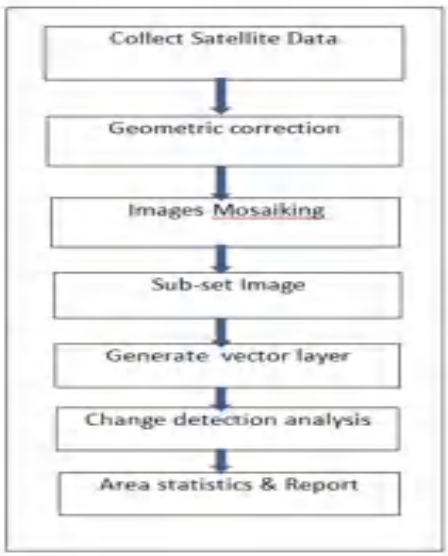


Figure 21: Flow chart of methodology used for processing images.

The increase of vegetation cover and changes in land use pattern have been investigated using remote sensing digital images of IRC Aerial Photo 1983 and Google Earth Image of 2016. Figure 22 shows the Land Use and Land Cover (LULC) map of 1983 and LULC map of 2016 of Nachole Upazila.

This study investigated the changes in land-use in the past 34 years of Nachole Upazila Table 08 shows the status of land-use patterns of Nachole Upazila. The data obtained from the satellite image showed that the garden area was 2,830 hectares in 1983 and it was increased to 29,315 hectares in 2016. We found that garden area was more than ten times higher in 2016 than that that was found in1983. From the image analysis we found that water body area in 1983 was 9,358 hectares and in 2016 it was increased to 10,116 hectares which was 758 hectares higher than that was obtained in 1983. Again we found that settlement area was 18,374 hectares in1983 and it was 23,681 hectares in 2016. So, settlement area had been increased 5,306 hectares in between 1983 to 2016.

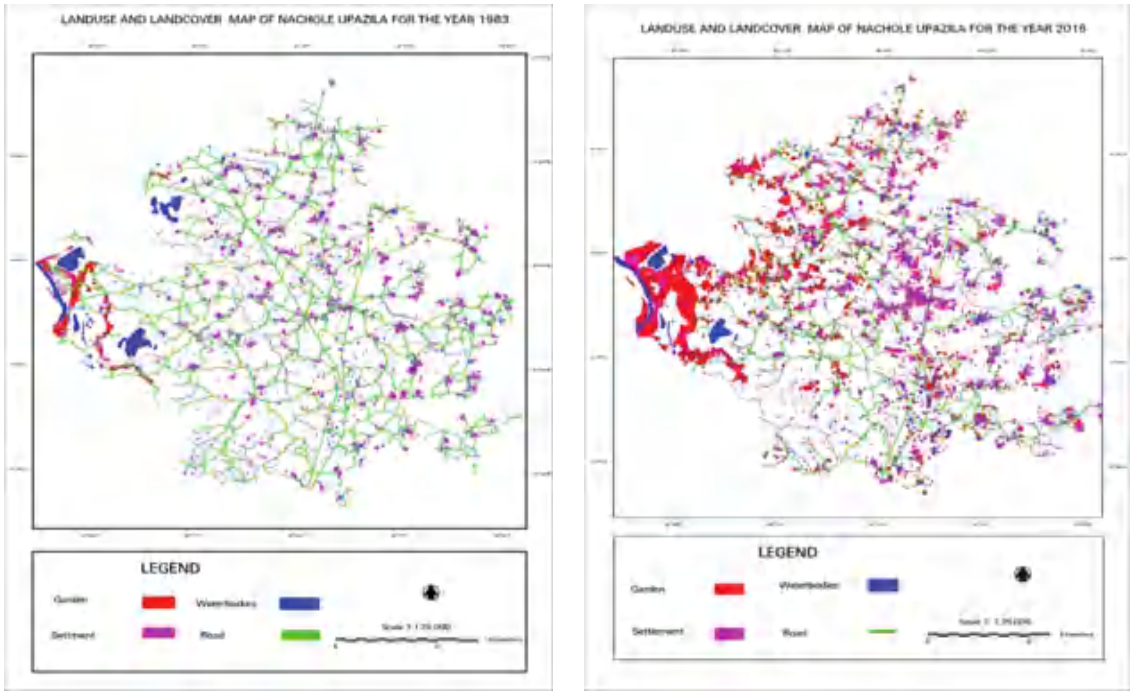


Figure 22: Land use and land cover maps of 1983 and 2016 of Nachole Upazila.

In the investigation, we found that garden area was increased 26,485 hectares, water bodies 758 hectares and settlement area 5,306 hectares during 1983 to 2016. In the report published by Bangladesh Bureau of Statistics (BBS), it was reported that mango, banana and other fruits cultivation area has been gradually increasing in the Upazila over time.

Table 08: Status of land use of Nachole Upazila, Chapai Nawabgong District

Class Name	Area (ha)		
	1983	2016	1983-2016
Garden	2829.6	29,314.5	26,484.9
Settlement	18,374.1	23,680.9	5306.4
Water bodies	9358	10115.8	757.8

Table 09: Area and production of Rice crops, Mango and Banana for the year of 2009-2010 and 2010-2011 in Nachole Upazila (Source: BBS report)

Years	Mango		Papaya		Guava		Jackfruit		Banana	
	Area (Acre)	Production (Ton)	Area (Acre)	Production (Ton)	Area (Acre)	Production (Ton)	Area (Acre)	Production (Ton)	Area (Acre)	Production (Ton)
2009 -2010	145	4335	21	147	17	156	06	44	47	293
2010 -2011	162	4410	24	170	19	151	08	57	57	354

The results of this study will be helpful for the sustainable development and management of the uncontrolled and unplanned use of natural resources in Nachole Upazila. Proper planning and management of human activities (Unplanned settlement, land use, deforestation and underground water use etc.) can accelerate the way to achieve sustainable development in the region.

2.9 FISHERIES DIVISION

2.9.1 Remote Sensing and Geographic Information System (GIS) for Surveying and Mapping of Ponds and other Water Bodies of the selected Upazila in Bagerhat District

Objectives of the study

- To survey of water bodies for fisheries development with special emphasis on shrimp farming areas;
- To prepare land use maps;
- To determine the costs and returns of Bagda farming;
- To identify the factors affecting yield and economic return; and
- To suggest some policy guidelines

Result and Discussion

- By the processing and interpretation of various satellite images and incorporating relevant data, land use maps were prepared. Information collected through ground truth mission was used to correct the discrepancy in mapping. Comparative assessment of land use feature was delineated in maps.
- Finally using all the information with subsequent data of satellite imagery, base maps of six upazila, Bagerhat Sadar, Fakirhat, Mollahat, Mongla, Morrelganj and Rampal were prepared. Figure 23 shows the prepared land use maps of Fakirhat Upazila. Calculated water area of the above six upazila is given in Table 10.
- Comparison statistics of fish farm (Gher) areas is presented in Table 11: the area statistics derived from satellite image versus information obtained from Fishery Department is presented in the table.

Table 10: Upazila wise calculated area of different targeted fisheries resources features.

Name of Upazila	Fish farm area(Gher) in acres	Pond area in acre
Bagerhat Sadar	20,833	1,793
Fakirhat	48,674	694
Mollahat	39,378	971
Mongla	19,012	1,712
Morrelganj	46,651	1,220
Rampal	25,076	247

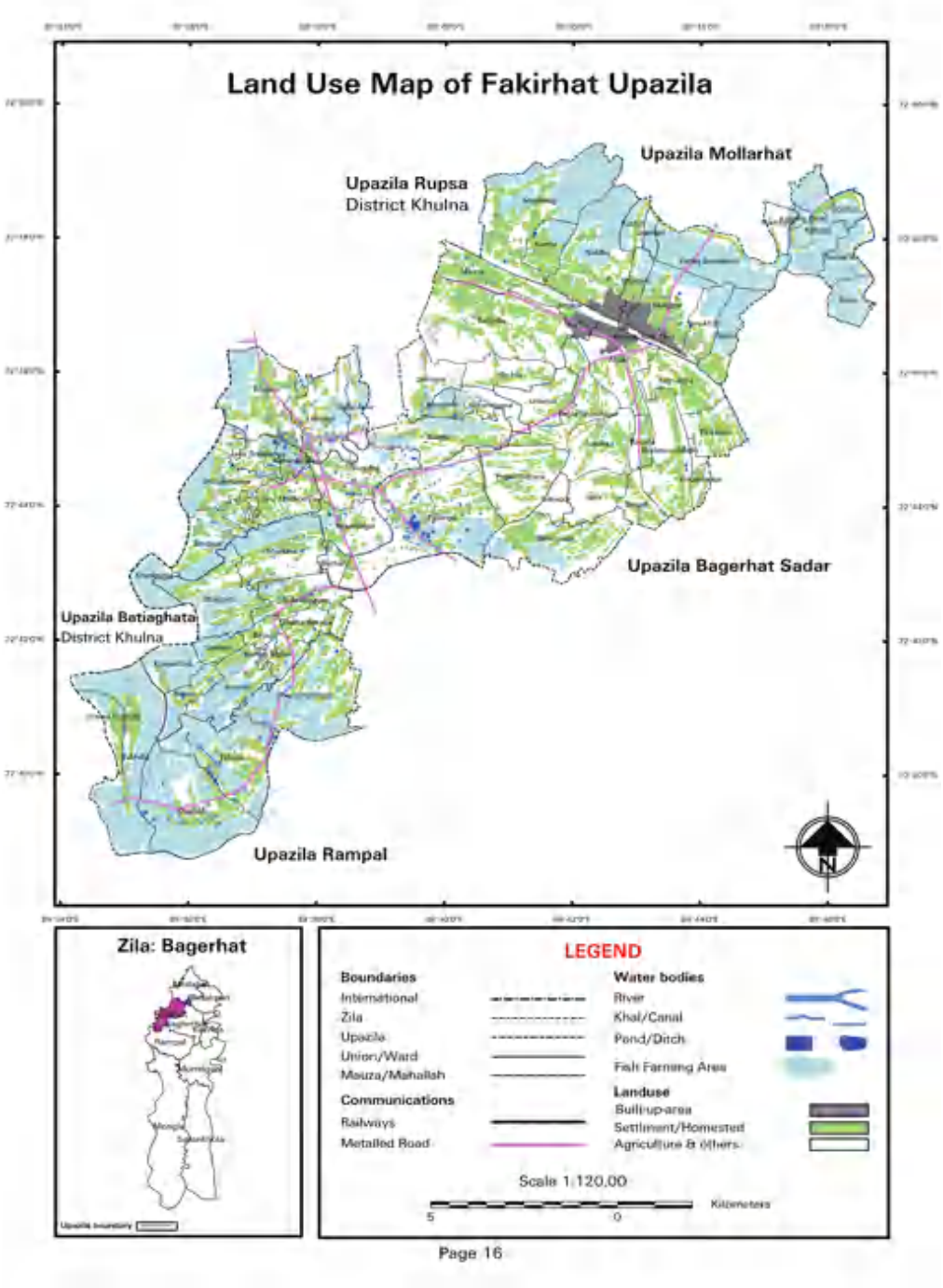


Figure 23: Land use map of Fakirhat Upazila

Table 11: Comparative statistics of fish farm (Gher) areas (Information derived from satellite image versus information obtained from Fishery Department).

Name of Upazila	Fish Farm (Gher) (area in acres)		Deviation(%)
	Computed from satellite image	Derived from Fishery Department	
Bagerhat Sadar	20,833	18,478	+12.77
Fakirhat	48,674	44,995	+8.17
Mollahat	39,378	39,504	-1.26
Mongla	19,012	17,336	+9.66
Morrelganj	46,651	43,515	+7.20
Rampal	25,076	22,877	+9.61

2.10 Research Projects in the Financial Year of 2016-2017

A number of research projects is carried out within the approved budget of SPARRSO every year. The approved and funded research projects in the Financial Year of 2016-2017 are presented in Table 12.

Table 12: Research Projects in the Financial Year 2016-2017

SL. No.	Name of Research Pr ojects	Budget (In Taka)
1	Preparation of Maps and Digital Database of Water-Logged Areas of Bangladesh.	1,00000/-
2	Establishment of Remote Sensing based Integrated River Monitoring System.	3,15,000/-
3	Renovation of Model for Estimation of Population Affected by Flood.	3,45,000/-
4	Establishment of Remote Sensing based Drought Monitoring System.	1,20,000/-
5	Integrated Application of Satellite Remote Sensing & Mobile RS Ground Equipment Technology for Identification & Monitoring of Potato & Wheat Crop Areas in Bangladesh for Food Security Application. (2nd Phase).	3,00,000/-
6	Mapping Trees Outside of Forests (TOF) Using Remote Sensing (RS).	2,20,000/-
7	Monitoring Land Use and Mapping of the Newly Formed Island at Confluence of the Feni River in the Bay of Bengal from 1974-2016	1,97,000/-

	using RS and GIS Techniques.	
8	Remote Sensing and Geographic Information System (GIS) for Surveying and Monitoring ponds and other water bodies of Bagherhat District (Selected upazila).	1,85,000/-
9	Identify of Settlement Area, Causes and Mitigation Strategies of Landslides in Chittagong City Using Remote Sensing and GIS Techniques.	1,50,000/-
10	Land Use and Land Cover Changes and their Geo-Environmental Impacts in Nachole Upazila under Chapai- Nawabganj District of Bangladesh: A Season-based RS-GIS Approach.	80,000/-
11	Automated Tree Grown Detection and Forest Composition Assessment from VHR Satellite Imagery (Phase-1).	2,00,000/-
12	Update and Mapping of Urban Extension/Growth of Sylhet City Corporation (Ward No. 08 & 09 with surrounding area) using RS and GIS (Phase-1).	1,30,000/-
13	Generation of Perennial Flood Water Digital Data Layer of Bangladesh Using Optical and Micro-Wave Remote Sensing Datasets.	1,00,000/-
14	Combined Application of Low-Cost Drone and satellite Technology for Enhanced Emergency Land Observation, Research and Analysis (Elora) of Disaster Effects and Crop Damage (Phase-1)	2,00,000/-

CHAPTER 3 (upto 04-12-2018)

USER SERVICES

3.1 Delivery of Satellite Image

- Satellite Image Hard copy Map was delivered to Gaibandha O & M Division, BWDM, Gaibandha.
- Satellite Image Hard copy Map was delivered to Eden Collage master's final year student for her research Work.

3.2 Digital World 2016

SPARRSO participated in the exhibition 'Digital World 2016', which was held from 19-21 October, 2016 at Bashundhara International Convention Centre (BICC), Dhaka. The exhibition was organized by ICT Division and the co-organizers were Bangladesh Association of Software and Information Services (BASIS), Bangladesh Computer Council (BCC) and Access to Information (a2i). The aim of the exhibition was to provide the latest development and the importance of digital technology to the citizen's doorsteps; make them aware of the digital e-services; encourage and promote the current best practices of digital technology in public service delivery; share and replicate these practices across the government organizations; and set a tone of healthy competition among the government ministries and agencies. A stall had been allotted in the Exhibition where past and present activities of SPARRSO were displayed, and a Power Point presentation was shown on the latest activities and technological development of organization. The slogan of the Exhibition was "Future is Here". This exhibition was helpful to disseminate the information on the services that can be provided by SPARRSO to different users upon request.

3.3 Development Fair 2016

SPARRSO participated in three days long 'Development Fair 2016', which was held from 9 to 11 January 2017 at Shilpakala Academy, Dhaka, arranged by the Dhaka District Administration. A stall had been allotted in the Fair where past and present activities of SPARRSO were displayed, and a Power Point presentation was shown on the recent activities of SPARRSO. This Development Fair was helpful to disseminate information on the services that can be provided by SPARRSO to different users upon request.

CHAPTER 4

TRAININGS, SEMINARS, SYMPOSIA, CONFERENCES AND MEETINGS

4.1 Human Resources Development of SPARRSO

4.1.1 Foreign Participation

The following officers, scientists and engineers participated in foreign training, workshop, seminar, symposium, conference, meeting and study tours during July 2016 – June 2017:

Mr. Md. Dilwar Bakth, Chairman participated in the 9th Administrative Heads Meeting of APSCO, China, 12-14 July, 2016.

Dr. Md. Abdus Salam, Principal Scientific Officer participated in the 9th Administrative Heads Meeting of APSCO, China, 12-14 July, 2016.

Mr. Md. Arif-ul- Haque, Scientific Officer Officer participated in the Workshop on "Mission Design and Project Planning on Student Small Satellite Project", Iran, 25 July to 02 August, 2016.

Mr. Sukumar Dutta, Principal Scientific Officer participated in the Establishment of National Agricultural and Rural Survey Calendar based upon Integrated Planning of Agricultural Census and Surveys Program, Thailand, 30 July to 05 August, 2016.

Dr. Md. Abdus Salam, Principal Scientific Officer participated in the 10th Council Meeting of APSCO, Turkey, 06 to 08 September, 2016.

Mr. Md. Manzur Morshed, Financial Advisor attended in the 6th UN-SPIDER Beijing Conference, China, 19 to 27 September, 2016.

Mr. S. M. Humayun Kabir, Principal Scientific Officer attended in the 6th UN-SPIDER Beijing Conference, China, 19 to 27 September, 2016.

Mr. Md. Dilwar Bakth, Chairman attended in the Power, vulnerability and agency in disaster risk reduction: A knowledge-exchange for sustainable development in Asia, Thailand, 20-21 September, 2016,

Mr. Ajit Kanti Das, Member participated in the APSCO 8th International Symposium on Space Technology and Applications, Peru, 03-06 October, 2016.

Mr. A. Z. Md. Zahedul Islam, Chief Scientific Officer participated in the APSCO 8th International Symposium on Space Technology and Applications, Peru, 03-06 October, 2016.

Mr. Md. Abu Mohammad, Senior Engineer participated in the Kick-off Meeting on the International GNSS Monitoring and Assessment Project (IGMA), China, 11-13 October, 2016.

Mrs. Nasreen Sultana, Scientific Officer participated in the 1st APSCO and ISSI-BJ Space Science School on design a Space Science Mission, Thailand, 17-26 October, 2016.

Dr. Md. Abdus Salam, Principal Scientific Officer participated in the Intermediate Progress Meeting and First Training of APSCO Joint SMMS Constellation Program, China, 27 October - 03 November, 2016.

Mr. S. M. Mizanur Rahman, Principal Scientific Officer (cc) participated in the Intermediate Progress Meeting and First Training of APSCO Joint SMMS Constellation Program, China, 27 October - 03 November, 2016.

Mr. Md. Arif-ul- Haque, Scientific Officer participated in the Navigation and Positioning Satellite System Design, China, 31 October - 08 November, 2016.

Mr. Md. Dilwar Bakth, Chairman attended in the 20th Session of the Intergovernmental Consultative Committee (ICC) on the Regional Space Applications Program for Sustainable Development (RESAP) India, 31 October - 01 November, 2016.

Mr. Firoz Molla, Assistant Engineer attendedm in the Navigation and Positioning Satellite System Design, China, 31 October - 08 November, 2016

Mr. Md. Haris Ali, Assistant Engineer attended in the Navigation and Positioning Satellite System Design, China, 31 October - 08 November, 2016.

Mr. Md. Dilwar Bakth, Chairman attended in the Asia-Pacific Space Leaders Forum, India, 02 November, 2016.

Dr. Hafizur Rahman, Chief Scientific Officer participated in the Second Workshop on the Application Pilot Projects for APSCO Data Sharing Service Platform, Thailand, 15 -18 November, 2016.

Mr. A. Z. Md. Zahedul Islam, Chief Scientific Officer participated in the Second Workshop on the Application Pilot Projects for APSCO Data Sharing Service Platform, Thailand, 15 -17 November, 2016.

Mr. Sukumar Dutta, Principal Scientific Officer participated in the Second Workshop on the Application Pilot Projects for APSCO Data Sharing Service Platform, Thailand, 15- 17 November, 2016.

Dr. Hafizur Rahman, Chief Scientific Officer participated in the Final Review Meeting on the Application Pilot Projects for APSCO Data Sharing Service Platform, Thailand, 15-18 November, 2016.

Mr. Md. Khalilur Rahman, Member attended in the APSCO Working Group Meeting, China, 05-09 December, 2016.

Mr. Md. Zafar Ullah Khan, Secretary attended in the APSCO Working Group Meeting, China, 05-09 December, 2016.

Mr. Md. Shah Alam, Chief Scientific Officer participated in the Advisory Committee Meeting of the Governing Board of RCSSTEAP (China), China, 06-07 December, 2016.

Mr. Mostafizur Rahman Akand Principal Scientific Officer (cc) participated in the APSCO Development and Demonstration of Application of Compatible GNSS Terminals for Emergency Management and Disasters Rescue (EMDR) Project Critical Design Review (CDR), China, 13-16 December, 2016

Mr. A. Z. Md. Zahedul Islam, Member participated in the First Technical Session of the Framework for Researches on Application of Space Technology for Disaster Monitoring Project, Thailand, 19 -24 Janurary 2017.

Mr. Md. Dilwar Bakth, Chairman participated in the Professional Development Program was hed in Duke University of North Carolina, USA. The course is designed for the Additional Secretaries of the Government under the Project of Strengthening Government through Capacity Development of the BCS Cadre Officials of Public Administration Ministry, 5-18 March 2017.

Mr. Md. Khalilur Rahman, Member participated in the Professional Development Program was hed in Duke University of North Carolina, USA. The course is designed for the Additional Secretaries of the Government under the Project of Strengthening Government through Capacity Development of the BCS Cadre Officials of Public Administration Ministry, 5-18 March 2017.

Mr. Md. Khairul Alam, Financial Adviser participated in the Audit Commission of APSCO meeting for year 2016, China, 27-31 March 2017.

Mr. Md. Ziauddin Ahmed, Accounts Officer participated in the Audit Commission of APSCO meeting for year 2016, China, 27-31 March 2017.

Dr. Hafizur Rahman, Member participated in the 3rd Expert Group Meeting on Development Plan of Space Activities of APSCO, China, 11-14 April 2017.

Dr. Md. Mahmudur Rahman, Principal Scientific Officer participated in the 3rd Expert Group Meeting on Development Plan of Space Activities of APSCO, China, 11-14 April 2017.

Mr. A. Z. Md. Zahedul Islam, Member participated in the 2nd Technical Session of the Framework for Researches on Application of Space Technology for Disaster Monitoring Project, China, 17-22 April 2017.

Mr. Md. Shah Alam, Chief Scientific Officer participated in the 2nd Technical Session of the Framework for Researches on Application of Space Technology for Disaster Monitoring Project, China, 17-22 April 2017.

4.1.2 Local Participation

The following officers and scientists participated in local training, workshop, seminar, symposium and conference during July 2016 to June 2017:

Local Participation in e-GP Training

Five officers and staff of SPARRSO participated in the Procuring Entity (PE) user training on e-GP at Engineering Staff College Bangladesh (ESCB), was held from 8-10 March 2017, Gazaria, Munshigonj.

Senior Staff Course (SSC) at BPATC

The Secretary of SPARRSO, Mr. Md. Zafar Ullah Khan participated in 81st Senior Staff Course (SSC) at Bangladesh Public Administration Training Centre (BPATC) from 30 April to 13 June, 2017.

Figure 24: SPARRSO Official participated in Senior Staff Course at BPATC

Senior Staff Course is designed for the Joint Secretaries to the Government and equivalent officers in defence services covering the topics on Public Management, Policy Analysis, Macroeconomic Management, E-Governance, Negotiation Techniques etc.

Meeting in Bangladesh Secretariat

22nd February 2017, Bangladesh Secretariat, Dhaka, Meeting of the Board for Cyclone Preparedness Program (CPP), participated by Mrs. Suraiya Begum, Chief Scientific Officer.

Workshop on Innovation in Public Service

Three officers of SPARRSO participated in the Workshop on Innovation in Public Service under the a2i Project, Prime Minister's Office, which was held during 11-15 June 2017, NAEM, Dhaka.

Training Workshop in BBS

16-18 April, 2017, Bangladesh Bureau of Statistics (BBS), Dhaka, Expert Group Workshop on Statistical Templates and Tabulation Plan for compiling "Compendium of Bangladesh Environmental Statistics 2017", participated by Dr. Md. Abdus Salam, Principal Scientific Officer.

15-17 May, 2017, Bangladesh Bureau of Statistics (BBS), Dhaka, Training Workshop on "Strengthening Capacity Building of Environmental Statistics", participated by Dr. Md. Abdus Salam, Principal Scientific Officer.

08 - 11 August, 2016, Dhaka, Training Program on Reporting and Dissemination of Crop Monitoring and Production Forecasting, participated by Farhana Tazneen, Scientific Officer

04 - 08, 21, 22 and 24 September, 2016, Dhaka, Training Program on GIS and Remote Sensing Based Agriculture Marketing System, participated by Farhana Tazneen, Scientific Officer

28 December, 2016, Dhaka, National Seminar on Information Service of BANSDOC for the Advancement of Science and Technology Research, participated by Farhana Tazneen, Scientific Officer

CHAPTER 5

PUBLICATIONS, SEMINAR PAPERS, LECTURES AND REPORTS

The scientists and engineers of SPRRSO delivered lectures at SPARRSO on remote sensing and GIS technology and also made some publications both in national and international journals. They also presented papers on specific topics in the national and international seminars and symposia. Some of them are mentioned below:

5.1 Published Papers in Journal

A. Z. Md. Zahedul Islam, Mohammed Nur Hossain Sharifee, S. M. Humayun Kabir, Sukumar Dutta and Md. Abu Taleb Pramanik, 2015. Combined Application of Optical and Microwave Satellite Technology for Inventory of Water Bodies and Study of the Dynamics of Surface Water in Relation to Climate Change, Bangladesh Research Publications Journal, Vol. 11, Issue 01, 2015 (Published in 2016).

Md. Iqbal Sarwar, Mohib Billah, Alak Paul and A. Z. Md. Zahedul Islam, 2016. Analysis of Urban Land Use Change Using RS and GIS in Chittagong City, Bangladesh. Jagannath University Journal of Life and Earth Sciences, Vol. 1, No. 1, 2015 (Published in 2016).

H. Rahman et al., 2016, Application of Multitemporal Directional Remote Sensing Measurements for Monitoring Phenological Development of Wheat Crop. Journal of Atmosphere, Bangladesh Meteorological Department, Bangladesh.

S. Rahman, H. Rahman, S. Shahid, R. U. Khan, N. Jahan, Z.U. Ahmed, R. Khanum, M.F.Ahmed, and M. Mohsenipour, 2016, The Impact of Cyclone Aila on the Sundarban Forest Ecosystem. International Journal of Ecology and Development (in press).

H. Rahman et al., 2016, A Quantitative Approach through Mathematical Inversion of a Radiative Transfer Model to Retrieve Biophysical Parameters of Vegetation Canopy using Remote Sensing Technique. Dhaka University Journal of Earth and Environmental Sciences (in press)

CHAPTER 6

6.1 VISITORS TO SPARRSO

Following officers, teachers and students from different organizations visited SPARRSO during the reporting period:

Table 13: List of Visitors

Sl. No.	Organizations	No. of Visitors	Date
1.	Naval Wing, DSCSC, Mirpur Cantonment, Dhaka.	47	24-07-2016
2.	National Defence College, Mirpur Cantonment, Dhaka.	35	27-07-2016
3.	FCTU Bangladesh Air Force, Dhaka Cantonment.	5	02-08-2016
4.	Academy for Planning and Development (NAPD), Ministry of Planning, 3/A, Nilkhet, Dhaka-1205.	44	31-08-2016
5.	Department of Farm Power and Machinery, Bangladesh Agricultural University Mymensingh.	12	21-11-2016
6.	Delegation of the European Commission (EC)	1	04-12-2016
7.	Fighter Controller Training Unit (FCTU) Bangladesh Air Force, Dhaka Cantonment.	5	20/02/2017
8.	Bangabandhu Sheikh Mujibur Rahman Science and Technology University (BSMRSTU), Gopalganj.	42	13/03/2017
9.	Artillery Centre and School, Halishahar, Chittagog.	23	30/03/2017
10.	School of Military Intelligence, Comilla Cantonment.	35	03/05/2017
11.	Physics Department, Comilla University.	37	18/05/2017
12.	Signal Training Centre & School, Jessore Cantonment.	22	25/05/2017
13.	FCTU, Bangladesh Air Force, Dhaka Cantonment.	32	21/06/2017

Figure 25: Demonstration of SPARRSO activities to the visitors.

Senior Secretary, Ministry of Defence Visited SPARRSO

Mr. Kazi Habibul Awal, Senior Secretary, Ministry of Defence, the People's Republic of Bangladesh visited SPARRSO on 30 August 2016. During his visit, a discussion meeting was held and it was presided by Mr. Md. Dilwar Bakth, Chairman of SPARRSO. All the officials and scientists of the organization attended the meeting. Exchange of ideas and

thoughts on the progress and development of this organization took place in the meeting. Before the meeting, Senior Secretary planted a seedling in the SPARRSO campus.

Figure 26: Tree planting at SPARRSO Campus by Mr. Kazi Habibul Awal, Senior Secretary, Ministry of Defence

Figure 27: Officials and Scientists of the organization Meeting with Senior Secretary, Mr. Kazi Habibul Awal

CHAPTER 7

INTERNATIONAL COOPERATION AND COLLABORATION

7.1 Asia-Pacific Space Cooperation Organization (APSCO)

Asia-Pacific Space Cooperation Organization (APSCO) is an inter-goverorganization with full international juridical nature. The institution has been working for the peaceful exploitation of space technology in order to promote sustainable economic and social development among the member states and regional countries in the Asia-Pacific region. APSCO started its formal operation in December 2008 and has been granted the permanent observer status to the Committee on Peaceful Uses of Outer Space of United Nations since 2009. Currently, APSCO has eight Member States namely Bangladesh, China, Iran, Mongolia, Pakistan, Peru, Thailand and Turkey and one Signatory State namely Indonesia which is under respective domestic procedures of its ratification on APSCO Convention.

Bangladesh joined the Asia-Pacific Space Cooperation Organization (APSCO) to accelerate peaceful exploitation of space technology in order to promote sustainable economic and social development. Bangladesh signed APSCO Convention on 28th October 2005 and the Convention was ratified on 1 August, 2006. Since then Bangladesh has been actively participating different programs and events organized by APSCO.

Tenth Council Meeting of the Asia Pacific Space Cooperation Organization (APSCO) during 6-8 September, 2016, Istanbul, Turkey.

APSCO Council Meeting (CM) is the high level meeting of APSCO which is organized by the APSCO Secretariat to discuss and approved the recommendation made by the APSCO Administrative Heads Meeting (AHM) for implementation and necessary follow-up. The Tenth APSCO Council Meeting (CM) of APSCO was organized by the APSCO Secretariat during 6-8 September, 2016 in Istanbul, Turkey. Council Members from APSCO Member States led the delegation to the CM. Forty five delegates attended this meeting from eight Member States of APSCO: People's Republic of Bangladesh, People's Republic of China, Islamic Republic of Iran, Mongolia, Islamic Republic of Pakistan, Republic of Peru, Kingdom of Thailand, Republic of Turkey. Mr. Kazi Habibul Awal, Senior Secretary of Ministry of Defence led the

Bangladesh delegation to this meeting and accompanied by Dr. Md. Abdus Salam, Principal Scientific Officer, SPARRSO.

Figure 28: Bangladesh delegations attended the 10th Council Meeting of APSCO.

2.2.3 Bangladesh Leads APSCO Framework Project

Bangladesh is leading the project "Establishment of a Framework for Researches on Application of Space Technology for Disaster Monitoring in the APSCO Member States". The project is being implemented under the umbrella of the Asia-Pacific Space Cooperation Organization (APSCO). APSCO is an eight nation's international organization of Bangladesh, China, Iran, Mongolia, Pakistan, Peru, Thailand and Turkey. All the member states of the organization are taking part in the project. The objectives of the project are:

a) To establish a framework to facilitate joint research works on the application of space technology for disaster monitoring in the APSCO member states.

b) To enhance the technical knowledge of relevant manpower of APSCO Member States through researches/technology transfer and
c) To assist APSCO Member States to establish/strengthen space technology based operational systems for monitoring disasters.

Two technical sessions were arranged under the project, the first one in January, 2017 in Bangkok, Thailand and the second one in April, 2017 in Beijing, China, to identify and prepare Joint Research Projects (JRP) on Flood, Earthquake, Landslide/Avalanches and Drought. Five JRPs have been identified based on the particular issues of the APSCO member states. The JRPs are now being carried out by the group of experts from the APSCO member states. SPARRSO is the lead organization of this project.

Figure 29: Photograph of the 1st technical session of the Framework Project of APSCO held in Thailand in January, 2017

CHAPTER 8

ADMINISTRATION AND FINANCE

8.1 ADMINISTRATION

The administration of SPARRSO operates the administrative activities of this organization in carrying out research and development activities utilizing space science and technology. SPARRSO functions under the Ministry of Defence, the administrative ministry and takes the prior approval of the government to perform various activities whenever necessary. Administration also makes liaison with other government departments and ministries in various collaborative tasks related to geo-spatial information generation and mapping activities. This section also provides various administrative supports in order to organize national and international trainings and symposia, and participate in various related events.

Personal database management of the employee of SPARRSO is also managed by this section.

8.1.1 Obituary

Mr. Abdul Mannan, Driver died on 17 March 2017 at last night. He joined SPARRSO on 16 March 1977 and retired on 10 February 2016. During this long period of time he served the organization with great dedication utmost sincerity and served the organization near about 39 years. He left behind his wife, four sons and one daughter.

8.1.2 Post Retirement Leave (PRL) and Retirement

Mr. Akteruzzaman Manzu, Assistant Engineer has gone to PRL on 03 December, 2016. He joined SPARRSO on 16 March, 1977 and served the organization for more than 39 years.

Mrs. Mehrunnesa, Chief Scientific Officer, SPARRSO has gone to retirement with effect from 5 July, 2016. She joined at SPARRSO on 03 April 1982 and served the organization near about 33 years.

Mr. Md. Humayun Kabir, Senior Technician, SPARRSO has gone to retirement with effect from 11 September, 2016. He joined at SPARRSO on 1 January, 1983 and served the organization near about 32 years.

Mr. Nurul Haque, Office Attendant, SPARRSO has gone to retirement with effect from 30 September, 2016. He joined at SPARRSO on 1 August, 1983 and served the organization near about 32 years.

Mr. Abu Shahid, Chief Administrative Officer, SPARRSO has gone to retirement with effect from 12 October, 2016. He joined at SPARRSO on 23 April, 1979 and served the organization near about 36 years.

Mr. Ashraf Siddiqui, Senior Scientific Assistant, SPARRSO has gone to retirement with effect from 21 October, 2016. He joined at SPARRSO on 9 January, 1983 and served the organization near about 32 years.

Mr. Abdus Salam Khan, Senior Engineer, SPARRSO has gone to retirement with effect from 24 October, 2016. He joined at SPARRSO on 24 April, 1985 and served the organization for more than 30 years.

Mrs. Afroja Nasrin Ahmed, Principal Scientific Officer, SPARRSO has gone to retirement with effect from 14 November, 2016. She joined at SPARRSO on 21 April, 1985 and served the organization for more than 30 years.

Mr. Abul Kashem Ali, Technician-1, SPARRSO has gone to retirement with effect from 23 November, 2016. He joined at SPARRSO on 1 August, 1983 and served the organization for more than 32 years.

Mr. Mozammel Haque Sarkar, Principal Scientific Officer, SPARRSO has gone to retirement with effect from 28 November, 2016. He joined at SPARRSO on 1 January, 1983 and served the organization for more than 32 years.

Mr. Shah Mohammad Moniruzzaman, Assistant, SPARRSO has gone to retirement with effect from 31 December, 2016. He joined at SPARRSO on 1 August, 1983 and served the organization for more than 32 years.

Mr. Md. Sirajul Islam, Cataloguer has gone to Post Retirement Leave (PRL), which was affected from 15 June, 2017. He joined at SPARRSO on 20 April 1985 and served the organization for more than 32 years.

Mr. Md. Ziauddin Ahmed, Accounts Officer has gone to Post Retirement Leave (PRL), which was affected from 29 June, 2017. He joined at SPARRSO on 18 January, 1985 and served the organization for more than 32 years.

8.1.3 Promotion

During the reporting period the following officers and employees have been promoted:

1. Mr. S. M. Mizanur Rahman promoted to Principal Scientific Officer, which has been effected from 02 March, 2017.

2. Mr. Md. Mostafizur Rahman Akhand promoted to Principal Scientific Officer, which has been effected from 02 March, 2017.

3. Mr. Md. Hashem Uddin promoted to Principal Scientific Officer, which has been effected from 02 March, 2017.

4. Mr. Md. Ashraful Haque Buiyan promoted to Technician-1, which has been effected from 02 March, 2017.

5. Mr. Md. Asadul Haque promoted to Plumber, which has been effected from 02 March, 2017.

8.1.4 Recruitment

During the reporting period five officers & six employees were recruited:

Table 14: List of newly recruited officials joined at SPARRSO

Sl. No	Name	Designation	Joining Date
01	Abdullah Yousuf Immam	Senior Scientific Officer	14/02/2017
02	Md. Abdul Kader	Senior Scientific Officer	06/02/2017
03	B. M. Refat Faisal	Senior Scientific Officer	09/02/2017
04	Md. Mahmudul Haque	Administrative Officer	08/02/2017
05	Rubel Kanti Dey	Information Officer	06/02/2017
06	Md. Zikrul Islam	Stenographer	26/01/2017
07	Sukanto Biswas	Accountant	29/01/2017
08	Md. Harun Or Rashid	Draftsman	26/01/2017
09	Md. Shameem Kamruzzaman	Office Assistant-cum-Computer Typist	23/02/2017
10	Md. Ashraful Islam	Security Habilder	02/03/2017
11	Md. Zakirul Islam	Library Attendant	29/06/2017

8.2 Library and Documentation

Bangladesh Space Research and Remote Sensing Organization (SPARRSO) has a rich library that contains valuable books, journals, periodicals, pamphlets, newsletters, bulletins,

reports and proceedings of workshop, symposia and conference etc. covering different thematic areas of space science and remote sensing. It is an automated library which was self-developed library management software, namely Microsoft Access Database that supports circulation control, reference service, and readers' guidance service, literature search facility by author, title, publisher, subject, accession number, ISBN number and issuing reminder letters to the users for retuning the library materials. The new library database management system avoids duplication of the work by introducing computerized library management system and it helps to improve the existing services.

At present, there are about 16,000 books, journals and reports covering a large number of fields such as remote sensing, space science, agriculture, biology, cartography, chemistry, computer science, ecology and environmental science, electronics and instrumentation, engineering sciences, fisheries, forestry, geography, geology, GIS, hydrology, mathematics, meteorology, oceanography, photogrammetry, photography, physics etc. in the library. Besides, the library has religious and other reference books, government and non-government publications and other departmental collections.

During the reporting period of July 2016 to June 2017, books, journals and reports were procured. The category-wise numbers are listed below:

Table 15: List procured books, Journals and Reports

Description	Number
	July 2016 to June 2017
Books	121
Journals/Magazines (issues)	23
Reports/Proceedings of Seminar and Workshop	12
Newsletters/Bulletins/Reprints/Off prints etc.	35

8.2.1 Readers/Users

All the employees of SPARRSO are entitled to use the library. Besides, students & teachers of different educational institutions and scientists, engineers, research workers & policymakers of government and non-government organizations can use the library with the permission of the authority. Approximately 10-15 scientists, engineers and other officials of

SPARRSO use the library for their study and research purpose in every working day. During the reporting period, 47 users used the library facilities from different government, non-government organizations and colleges & universities of the country other than the officials of SPARRSO.

8.2.2 Library Hours

SPARRSO library remains open from 9:00 am to 5:00 pm in all working days (Sunday to Thursday) and it remains closed on all government holidays.

Contact Numbers: +88-02-9113957, Cell Phone: +88-01715888187
Address: Bangladesh Space Research and Remote Sensing Organization (SPARRSO), Agargaon, Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh.
Email: awalbd2007@yahoo.com

8.3 FINANCE

8.3.1 Budget and Accounts

SPARRSO meets its recurring expenditure from the revenue budget of the Government. It also earns revenues through selling of products like maps, photographic prints, providing services and project works on payment basis. The revenue budget and the expenditure for the financial year July 2016 to June 2017 are given below:

Financial Year	Revised Budget (BDT)	Expenditure (BDT)
July 2016 – June 2017	18,49,53,000	16,77,92,988

CHAPTER 9

MISCELLANEOUS

9.1 SPARRSO (Amendment) Act, 2016

On 21 June 2016, President approved SPARRSO (Amendment) Act, 2016, which was earlier passed by the National Parliament. The act reconstitutes its board through increasing the number of members. The board will be formed with a full-time chairman and four full-time members instead of the existing three members and two members of the board will have to be appointed from the Chief Scientific Officers working in the organization on the basis of seniority and competence.

9.2 APSCO Distance Training Course

APSCO (Asia-Pacific Space Cooperation Organization) Distance Tainting Course on Space Life and Micro-gravity was held on 30 August 2016, which was organized by APSCO Education and Training Centre (ETC), SPARRSO. Mr. Kazi Habibul Awal, Senior Secretary, Ministry of Defence, the People's Republic of Bangladesh was present as the Chief Guest and inaugurated the training course.

ঋরমঁৎব ৩০: ওহধঁমঁৎধঃরড়হ ড়ভ অচঝঈঙ উরংঃধহপব ঞৎধরহরহম ঈড়ঁৎংব

9.3 National Mourning Day at SPARRSO

A discussion meeting and 'Doa Mahfil' was arranged on the occasion of National Mourning day, the 15 August 2016, at SPARRSO Auditorium, which was presided by the Chairman of

SPARRSO, Mr. Md. Dilwar Bakth. All the officials of SPARRSO were present in the occasion. Different aspects of the life of Bangabandhu were discussed in the meeting. Finally a 'doa' (prayer) was conducted for the peace of departed soul.

Figure 31-32: National Mourning Day at SPARRSO

Figure 33: Inauguration of E-Filing Training at SPARRSO

9.4 E-Filing Management Training Course

An E-Filing Management Training Course was held in SPARRSO ON 22-28 November, 2016.

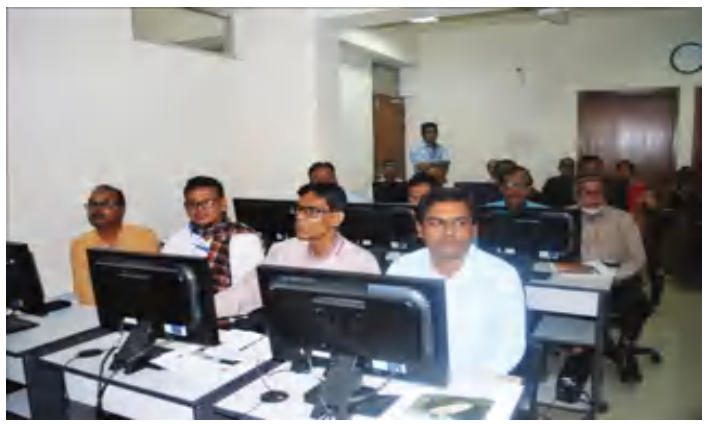


Figure 34: SPARRSO Officers and Staff are particpated in an E-Filing Training

About 45 officers and staff of SPARRSO participated in the training course. After the completion of the course, SPARRSO started its filing activities through E-filing Management System since December, 2016 (Figure 7).

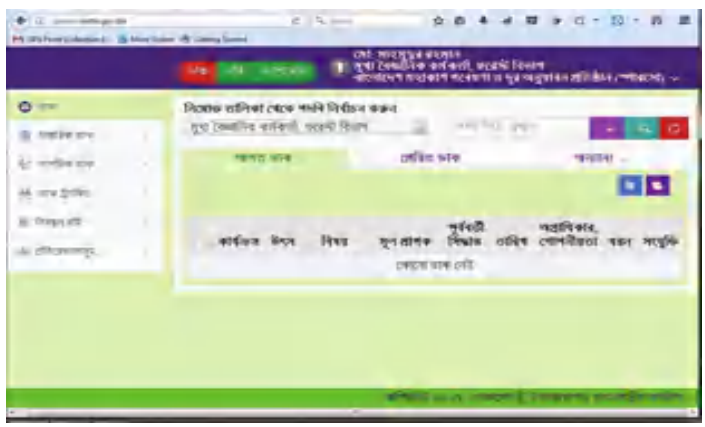


Figure 35: E-filing on the website

9.5 First Meeting of Reconstituted Board

First meeting of the reconstituted SPARRSO Board was held on 30 November, 2016 with the presence of Mr. Kazi Habibul Awal, Senior Secretary, Ministry of Defence. This was the first meeting after joining new members to SPARRSO Board followed by enacting

SPARRSO (Amendment) Act, 2016. Senior Secretary gave his valuable suggestion and guidance to direct the board with the new formation.

ঋরমঁৎব ৩৬: ঋরৎংঃ সববঃরহম ড়ভ ঃযব ৎবপড়হংঃরঃঃবফ ঝচঅজজঝঙ ইড়ধৎ

9.6 New Members to SPARRSO Board

The Government of the People's Republic of Bangladesh has deputed Mr. Md. Khalilur Rahman, Additional Secretary as a Member of SPARRSO Board. He joined in this organization on 14 July 2016. The Government has also appointed two members from the Chief Scientific Officers of SPARRSO; after amendment of SPARRSO Act 1991. The amended act was passed by the National Parliament on 16 June 2016. Dr. Hafizur Rahman and Mr. A. Z. Md. Zahedul Islam, Chief Scientific Officer of SPARRSO joined in this position on 20 November, 2016.

Md. Khalilur Rahman, Member

Mr. Md. Khalilur Rahman obtained B.Sc (Hon's) in Agriculture and M.S in Agricultural Extension from Bangladesh Agricultural University, Mymensingh. He completed PGD (Post Graduate Diploma) in Development Planning from National Academy of Planning and Development. He is a Member of BCS (Administration) Cadre.

Mr. Rahman worked as Assistant Commissioner & Magistrate in Narayongonj District. He served as Assistant Commissioner (Land) in Jaintiapur, Sylhet and Upazila Magistrate in Ramu, Cox's bazar. He also worked as Upazila Nirbahi Officer in Balagonj, Sylhet & Additional Deputy Commissioner in Mymensingh.

Mr. Rahman was the Chief Executive Officer, Sirajgonj Municipality & Chief Estate Officer in Dhaka City Corporation. He worked as Senior Assistant Secretary in Economic Relations Division (ERD), Ministry of Home Affairs & Ministry of Establishment as well as Deputy Secretary in Ministry of Education. He was the Deputy Commissioner of Naogaon and Rajshahi districts. He also worked as Director, Implementation Monitoring and Evaluation Division (IMED), Ministry of Planning. Before joining SPARRSO he was Additional Divisional Commissioner (Joint Secretary) of Chittagong Division.

Dr. Hafizur Rahman, Member

Dr. Hafizur Rahman has been appointed as a Member of SPARRSO Board vide memo no 23.00.0000.020.22.070.14-412 dated on 13 November 2016, Ministry of Defence. He has been serving as Chief Scientific Officer and Head of Agricultural Division of SPARRSO.

Dr. Rahman obtained the B.Sc. (Hon's) degree in 1981 securing 1st class third position and M.Sc. (Thesis) degree in 1982 securing 1st class first position both from the Department of Applied Physics and Electronics under University of Rajshahi. He joined SPARRSO in 1986 as Scientific Officer. As a part of higher specialization, he obtained the following university degrees

(i) DESS (one-year post Masters University study program on specialized field leading to active professional life) in Remote Sensing Technology from the University of Paris VI, France.

(ii) Ph.D. in Remote Sensing Technology from the University of Paul Sabatier in Toulouse, France.

(iii) DEA (one-year post Masters university study program on specialized fields through research) in Physics and Chemistry of Environment from the Institute of Fluid Mechanics in Toulouse, France.

Dr. Rahman has more than 30 years of professional experiences of scientific researches on space-based remote sensing (RS), geographic information system (GIS) and other geo-information technology. He supervised the research works of a good number of M.S., M.Tech. and Ph.D. students of different universities.

Dr. Rahman has developed a good number of internationally reputed and widely used remote sensing (RS) algorithms and radiative transfer models introducing new techniques for quantitative retrieval of geo-information on the coupled land-atmosphere system using space-based technology. Algorithms and Radiative Transfer Models developed by Dr. Rahman et al. have been introduced as topics in university level books in Europe, USA etc.

Dr. Rahman has been serving as enlisted referee for a number of important national and international scientific journals. He has been awarded French Government Scholarship for higher studies in France from 1987 to 1992. He received Group Achievement Award from National Aeronautics and Space Administration (NASA), USA in 1986.

Dr. Rahman has about 60 research papers in his credit published in the international and national journals and proceedings. His research articles have also been published in reputed journals like Journal of Geophysical Research of USA and International Journal of Remote Sensing, UK.

A. Z. Md. Zahedul Islam, Member

Mr. A. Z. Md. Zahedul Islam has joined as a Member of SPARRSO Board on 20 November 2016. Before joining as the Member, Mr. Islam worked as a Chief Scientific Officer and Head of the Water Resources Division of SPARRSO. Mr. Islam obtained his B.Sc. and M.Sc. degrees in 1981 and 1982 respectively from the Department of Applied Physics and Electronics of University of Rajshahi. He obtained his DESS in Remote Sensing Method and Application from the University of Paris VI, France in 1989. He received professional training from a number of international bodies like Centre Nationale d'Etude Spatiale (CNES), Toulouse, France, 1988, Geoinformatics Center, Asian Institute of Technology (AIT), Bangkok, Thailand, 2003, Geoscience Australia, Canberra, Australia, 2008, The

Center for Coastal and Ocean Mapping (CCOM), University of New Hampshire, USA, 2008, Grid-Arendal, Norway, 2009 and National Oceanographic Centre (NOC), Southampton, UK, 2010.

Mr. Islam joined SPARRSO as a Scientific Officer in 1986 and has been serving the organization since then. He has carried out more than twenty research projects and fifteen application projects as Working Scientist and Principal Investigator. He is presently the lead scientist of the "Framework Project" of the eight nations Asia-Pacific Space Cooperation Organization (APSCO). Mr. Islam has 27 research papers published in the international and national journals and proceedings. He has also 51 papers presented in seminars and conferences.

Mr. Islam received Group Achievement Award from National Aeronautics and Space Administration (NASA), USA in 1986. He is a member of the Working Group on "1-Km Land Cover Database of Asia" (LCWG), Asian Association on Remote Sensing, JAPAN.

9.7 New Financial Advisor to SPARRSO

The Government of Bangladesh deputed Mr. Md. Khairul Alam as Financial Advisor of SPARRSO. He joined in this Organization on 19 October, 2016. He is a Deputy Secretary to the Government of the People's Republic of Bangladesh. He obtained BSS (Hon's) and MSS in Sociology from Dhaka University. He joined Bangladesh Civil Service (BCS) as a member of Audit and Accounts Cadre of 9th Batch.

Md. Khairul Alam, Financial Advisor

He served in different ministries like Works, Education, Local Government, and Finance. Last five years he was deputed in Bangladesh Embassy, Riyadh as a Counsellor of Consular Wing. He visited different countries, i.e., India, Malaysia, USA, UAE, Oman, Nepal and China for official and training purposes.

9.8 In-house Training

SPARRSO arranged E-Filing management training 22-24 November 2016. A total of 31 officers and staff of this organization participated in the training course.

SPARRSO arranged E-Filing management training from 27- 28 November 2016. 14 senior officers of this organization participated in the training course.

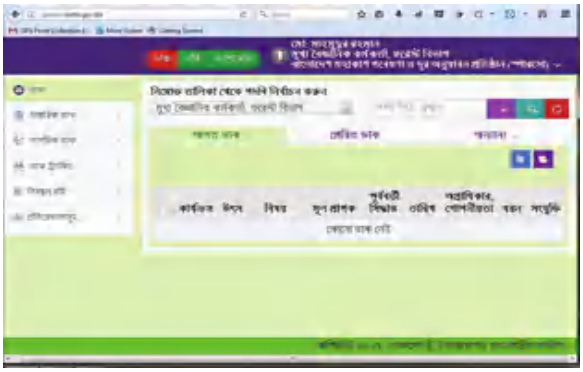


Figure 37: E-filing on the web

9.9 National Seminar on Water Logging at SPARRSO

Bangladesh Space Research and Remote Sensing Organization (SPARRSO) organized "National Seminar on Water Logging in Bangladesh" on 30 April, 2017.

Dr. Kamal Abdul Naser Chowdhury, Principal Secretary to the Honorable Prime Minister inaugurated the seminar as Chief Guest. Mr. Akhter Hussain Bhuiya, Honorable Secretary of Ministry of Defence was present as Special Guest in the Seminar. The Seminar was presided over by Mr. Md. Dilwar Bakth, Chairman, Bangladesh Space Research and Remote Sensing Organization (SPARRSO). Different aspects of a research work conducted at SPARRSO on "Establishment of Remote Sensing Based Water Logging Monitoring System in Bangladesh" was presented by Mr. A. Z. Md. Zahedul Islam, Member, SPARRSO in the Seminar.

Figure 38: National Seminar on Water Logging in Bangladesh at SPARRSO

Fifty Five higher officials from different government and non-government organizations, universities actively participated in the discussion.

9.10 In-house Training

a) A Training Course on Strengthening Capability of the Manpower of SPARRSO for Cyclone Monitoring, Weather Prediction held on 11-13 June 2017.

b) Training Courses on Office and Financial Management held on 5-9 February and 22-25 May 2017.

Figure 39: Participants of Office & Financial Management Training Course.

c) APSCO Distance Training Course on Space Antennas held from May 16-17, 2017, organized by APSCO Education and Training Centre (ETC), SPARRSO.

Figure 40: Participants of Distance Training Course on Space Antennas.

d) An E-Filing Management Training Course was held in SPARRSO on 03-04 April, 2017. Nine officers and staff of SPARRSO participated in the training course. SPARRSO started its filing activities through E-filing Management System since December, 2016.

ABBREVIATION AND ACRONYMS

ALOS	Advanced Land Observing Satellite
APSCO	Asia-Pacific Space Cooperation Organization
AVHRR	Advanced Very High Resolution Radiometer
BBS	Bangladesh Bureau of Statistics
BFD	Bangladesh Forest Department
BSCIC	Bangladesh Small and Cottage Industries Corporation
BUET	Bangladesh University of Engineering and Technology
CAO	Chief Administrative Officer
CNSA	China National Space Administration
CSO	Chief Scientific Officer
DEM	Digital Elevation Model
DDM	Department of Disaster Management
DSM	Digital Surface Model
DTM	Digital Terrain Model
DTCL	Development Technical and Consultants Ltd.
ETM+	Enhanced Thematic Mapper Plus
FAO	Food and Agriculture Organization
FY	Feng Yun
FCTU	Fighter Controller Training Unit
GCP	Ground Control Point
GEOSS	Global Earth Observation System of Systems
GFOI	Global Forest Observations Initiative
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
Go	Government of Bangladesh
GOFC-GOLD	Global Observation of Forest Cover and Land Cover Dynamics
GPS	Global Positioning System
GSB	House of Consultants Ltd.
FCC	False Color Composite
ICIMOD	International Centre for Integrated Mountain Development

IPCC	Intergovernmental Panel on Climatic Change
IWM	Institute of Water Modeling
JAXA	Japan Aerospace Exploration Agency
JICA	Japan International Cooperation Agency
LGED	Local Government Engineering Department
LNB	Low-Noise Block
MGD	Methods and Guidance Document
MoCHTA	Ministry of Chittagong Hill Tracts Affairs
MODIS	Moderate-Resolution Imaging Spectroradiometer
MSL	Mean Sea Level
MSS	Multi-Spectral Scanner
MTSAT	Multi-Functional Transport Satellite
NOAA	National Oceanic and Atmospheric Administration
OLI	Operational Land Imager
PALSAR	Phased Array type L-band Synthetic Aperture Radar
PRL	Post Retirement Leave
PSO	Principal Scientific Officer
RADARSAT	Radar Satellite
RESTEC	Remote Sensing Technology Center of Japan
RPC	Rational Polynomial Coefficients
RRSC	Regional Remote Sensing Center
RS	Remote Sensing
SAARC	South Asian Association for Regional Cooperation
SE	Senior Engineer
SMAC	Simplified Method of Atmospheric Correction
SMMS	Small Multi-Mission Satellite
SoB	Survey of Bangladesh
SPARRSO	Space Research and Remote Sensing Organization
SSA	Senior Scientific Assistant
TM	Thematic Mapper
TOF	Trees Outside Forest
UAV	Unmanned Arial Vehicle
UN-ESCAP	United Nations Economic and Social Commission for Asia and the Pacific

UN-SPIDER	United Nations Platform for Space-based information for Disaster
UPS	Uninterruptible Power Supply
USA	United States of America
USAID	United States Agency for International Development
WARPO	Water Resources Planning Organization

-THE END-