

**MONITORING ENVIRONMENTAL PROBLEM USING
GIS AND REMOTE SENSING TECHNOLOGY:
A CASE STUDY OF SHAMNAGAR UPAZILA, BANGLADESH
BY**

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This Report Presented in Partial Fulfillment of the Requirements for the
Degree of Masters of Science in Computer Science and Engineering

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7 May 2018

APPROVAL

This Project/Internship titled “**Monitoring Environmental Problem Using GIS and Remote Sensing Technology: A Case Study of Shamnagar Upazila, Bangladesh**”, submitted by Md. Zakib Uddin Khan to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of M.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 07 May 2018.

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I hereby declare that, this Research has been done by me under the supervision of **Dr. Syed Akhter Hossain, Professor and Head, Department of CSE**, Daffodil International University. I also declare that neither this Research nor any part of this Research has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

Development of shrimp for the most part in impromptu way has been considered as one of the major natural fiascos of Shamnagar Upazila (Sub-region), People's Republic of Bangladesh. Villagers encompassing the waterways are chiefly required with angle (shrimp) development. Along these lines, ripe farming area has been changed over to shrimp development. Ordinary techniques for gathering this data are moderately tedious. Oppositely, Remote Sensing satellite perception with its remarkable capacity to give financially savvy bolster in ordering the most recent data about the common assets. RS, in conjunction with GIS, has been generally connected and been perceived as a capable and successful apparatus in distinguishing land utilize and arrive cover changes. RapidEye and Landsat8 pictures were utilized to distinguish arrive utilization of the region amid the period 2008 and 2015. Google pictures were utilized to recognize the smaller scale level land utilize highlights of a similar period. Multi-phantom groupings utilizing unsupervised and directed order were done and comes about have been looked at in view of the field examination . The investigation uncovers that amid the period 2008 to 2015 farming practice has been lessened from 34.5% to 21.5% and shrimp development territory expanded from 38% to half. Because of the effect of high saltiness and salt water interruption agrarian exercises is diminished and agriculturists have been changed over to different practices, subsequently shrimp cultivating is picking up prevalence in the region. Rustic settlement has been marginally expanded and entomb tidal territory has additionally been expanded to 02% because of the impact of twister.

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CHAPTER 1

Introduction

1.1 Introduction

Shyamnagar is an Upazila (sub-region) of Satkhira District. It is a standout amongst the most helpless upazila of People's Republic of Bangladesh drift. Debacles like violent wind and rainstorm storm surges, saltiness interruption, waterway bank disintegration, debasement of wetland biological systems, extension of settlement, foundation and businesses are the real condition issues tended to in the upazila. Saltiness in the waterway framework increments consistently from December through February, achieving most extreme in the late March and early April. This is the high time for shrimp development. For the most part, development of shrimp for the most part in spontaneous route in Shyamnagar Upazila has been considered as one of the major ecological fiascos that essentially happened on account of its acquaintance pointing with incite increment the economy of the nation. In any case, lamentably, this has been drilled in an unregulated way as it happened to Shyamnagar, the shrimp development field ought to be left undisturbed for 10-15 years permitting adequate time for the renewal of soil and recovery of vegetation in the region. Unexpectedly, exorbitant human weight does not permit this day and age (10-15 years). Subsequently, shrimp development has been recognized as a noteworthy reason for ecological lopsidedness in Shyamnagar. Villagers encompassing the waterways are mostly required with angle development. Along these lines, prolific agribusiness arrive has been changed over to shrimp development. Agribusiness arrive was likewise changed over into brickfields. Change of agribusiness land to other utilization is a typical yet intense issue for arrive assets of the nation. Along these lines arrive debasement, common asset preservation and shrimp development with agrarian practice ought to be done plannedly which can secure normal biological system and enhance socio-monetary state of the nearby individuals of Shyamnagar.

Customary strategies for gathering this data are moderately exorbitant and tedious. Conversely, Remote Sensing (RS) satellite perception with its extraordinary ability to give efficient and financially savvy bolster in accumulating the real data source

separating common highlights in scene more than once [11]. RS strategy has capacity to speak to of land utilize/arrive cover investigation by methods for advanced order procedure of multispectral satellite picture [2].

GIS is a PC upheld framework to effectively catch, store, refresh, control and break down of spatial data for arrive cover include recognizable proof lastly create maps of all factors were joined to extricate data for better understanding [1,14]. Satellite remote detecting, in conjunction with GIS, has been broadly connected and been perceived as an intense and powerful apparatus in recognizing land utilize and arrive cover changes. It is a potential device to examine change in arrive cover, woods thickness, beach front morphology, status of reef and biodiversity of islands regardless of whether, situated in remote place.

A few kinds of satellite pictures have been gathered to produce the land utilize changes utilizing RS, GPS and GIS advancements. A blend of land utilize information of various day and age got from a few satellite pictures and field level land utilize data are utilized to arrive utilize and arrive cover changes. In this examination RapidEye satellite pictures fills in as a noteworthy data source extricating common highlights in arrive utilization of Shyamnagar Upazila. Dry period of RapidEye pictures were utilized to recognize arrive utilize and arrive front of the territory amid the period 2008 and 2015. Various direct determination satellite pictures, for example, Landsat8-OLI (Operational Land Imager) were utilized to portray the winter crops; Sentinel-MSI (Multi Spectral Imager) pictures were utilized to comprehend expansive trimming example and occasional land cover like Monsoon Crop (Aman) and Google pictures were utilized to recognize the smaller scale level land utilize highlights of same period.

In the present examination, an endeavor has been made to recognize the major ecological components of Shyamnagar Upazila's gotten from remote detecting, GIS, GPS advancements and individuals participatory approach amid the period 2008 to 2015.

1.2 Motivation

Land uses of Bangladesh are very diverse. Landform of the country ranges from low altitude coastal plain to high elevation mountain area. There are diverse setting of low elevation coastal land, char land, haor-baor-bill area, floodplain, water-logged area, dense river network, mangrove-sal-hill forests, Barind tract, Madhupur tract, tea-estate, vast

area of agriculture field, offshore island, coral reef, etc. land covers. Land uses of the country are even diverse. Significant parts of land of the country have been used as agriculture field. Rapid growing number of population cause express demand of food from the agriculture field. However, the area of agriculture field is decreasing at an alarming rate. Foundation of new settlement for quick developing populace, framework improvement, quickly expanding number of brickfields, quickly developing urbanization, and so forth factors are making the transformation of farming area different employments. Backwoods and wetlands are additionally changing quick. Keeping in mind the end goal to shield farming area from being changed over, National Land Zoning Project has built up a stock of present land employments of the nation. Land Zoning Maps of the nation have additionally been created. Readiness of Land Zoning Map and their suggestion would go about as helpful device to protect the earth and resolve irreconcilable situations between the client gatherings and the line organizations.

Real issues tended to are disintegration, backwoods debasement, surge and water logging, dry spell, soil saltiness, stone and sand extraction, tobacco development, moving development (Jhum development), slope cutting, brickfields in farming area, regardless improvement of settlement and infrastructural, biological system devastation and environmental change. There are gigantic possibilities of utilizing land assets and biological system administrations of the nation. The nation ought to keep up a Land Degradation Neutrality (LDN) rehearse. A superior entomb office coordination is fundamental for the execution of land zoning. Rustic settlement is in charge of critical offer of the change of horticulture land to different employments. Block businesses are additionally extending quickly that destruct rich horticulture arrive. Debasement of horticultural land ought to be captured for generation of sustenance of countless of the nation. Bombing in ensuring agribusiness land may bring about sustenance emergency in the region.

1.3 Rationale of the Study

Land zoning is a device for the legislature to empower, encourage and direct the land assets of the nation covering entertainment, horticulture, ranger service, industry, vitality creation, settlement, fisheries and water catchment and so on. People's Republic of

Bangladesh is a thickly populated nation. Expanded populace forces high weight on farming area. Also, fast populace development causes transformation of horticulture arrive into settlement, modern zone and urban zone. Transformations of rural land are essential in a few occurrences, however regularly are avoidable. Inappropriate land utilize causes different types of land corruption coming about lessening of horticulture generation. Aimless land transformation will force risk to national sustenance security. Besides, uncalled for arrive utilizes influence greenery living space and consequently affect environment and biodiversity.

The first phase of Land Zoning Project started in 2006 covering mainly the Coastal area of People's Republic of Bangladesh and completed land zoning of 152 Upazila in 2011. Later on, National Land Zoning project (2nd phase) commenced in July 2012 covers 301 plain land Upazilas of the country leaving out 26 Upazilas of CHT area. This CHT occupy 10% of the total area of Bangladesh and Ministry of Chittagong Hill Tracts Affairs (MOCHTA) consented to include this huge area under zoning, since, land zoning in plain land was appreciated from all corners. Therefore, a similar study on Chittagong Hill Tracts (CHT) would help for a better understanding of natural resources and land uses of remaining hilly areas of People's Republic of Bangladesh.

1.4 Expected Output

Land uses and land cover by the upazila is mostly dominated by agriculture land, rural settlement, wetland, mangrove forest etc. Agricultural land of the upazila is decreasing at a faster rate.

- Preventing the unplanned conversion and degradation of land.
- Planned urbanization and development initiatives.
- An assessment of climate change impacts on environment.

1.5 Report Layout

The following description is given to understand which section covers which themes furthermore, their relevant discussions.

- In the section “Introduction”, the fundamental guideline and reason for this thesis is described.
- In the section “Background”, relevant researches and works which have been studied will be briefly described.
- In the section "Research Methodology", a brief discussion will be made on how the Thesis has been conducted.
- In the section “Analytical Results and Discussion” a brief discussion on Comparative Analysis, Visual Analysis, Geographic Information System (GIS) Analysis and many other Causes will be briefly described.
- In the section “Conclusion, Recommendation and Limitation” try to discuss how to develop our natural environment system and my limitation.

CHAPTER 2

Background

2.1 Introduction

Land is a scarce resource for People's Republic of Bangladesh. The Country has got a high population density having 1252 person per sq.km [17]. characterizing the lowest land man ratio in the world which is estimated to be 0.059 hectares per person. The situation is likely to be cleterioted with the growing population. At present the country is facing challenge to produce food for 160 million people and providing food security with the land under cultivation. There is growing demand for using this scarce land for the purpose of human settlement, developing infrastructure, establishment of mills, factories, institution. The existing agricultural lands are being diverted to those uses. Forest land is depleting. So the country is facing an alarming situation which calls for judicious and planned use of the scarce land resource.

Atmosphere and an unnatural weather change will have affect on farming generation. It is relied upon to increment by 5.8°C to 1.6°C toward the finish of this century. The normal temperature of the earth surface have risen 0.6°C amid the most recent century. The ocean level may ascend by one meter amid this period causing flooding in the waterfront area, beach front disintegration and expanding saltiness in water. 33% of the nation might be helpless because of ascent of the ocean level influencing fisheries and farming [15].

Considering the above mentioned aspects, the Ministry of Land formulated Land Use Policy, 2001 for planned and judicious use of the land resources of the country with a view to protecting agricultural land, Land Zoning was emphasized in the Land Use Policy.

2.2 Related Works

The historical backdrop of remote detecting innovation in People's Republic of Bangladesh goes back to 1968 when the primary Automatic Picture Transmission station was set up on the premises of the Atomic Energy Center, Dhaka, for accepting continuous climate pictures straightforwardly from meteorological satellites. The space

and Atmospheric Research Center was made at the People's Republic of Bangladesh Atomic Energy Commission in 1972 and APT ground station was retained among SARC. With NASA's dispatch of the Earth Resource Technology Satellite (ERTS-1), People's Republic of Bangladesh took up the ERTS Program in 1973. The Bangladesh ERTS Program was one of 35 Principal Investigator Programs around the world. Therefore ERTS was renamed as Bangladesh Landsat Program. A noteworthy movement of BLP incorporated the age of the primary land cover guide of the whole nation utilizing Landsat MSS information of 1979. Amid this period, GMS and NOAA ground accepting stations were introduced. The Space Research and Remote Sensing Organization (SPARRSO) was built up in 1980 by blending SARC and BLP.

In the vicinity of 1980 and 1983, a LANDSAT/SPOT ground getting station alongside a VIPS computerized picture handling framework was set up under French help. In 1983, under the UN/ESCAP Regional Remote Sensing Program, SPARRSO turned into the national point of convergence for space and remote detecting exercises in People's Republic of Bangladesh. Under the Agro-Climatic Environmental Monitoring Project (ACEMP) supported by USAID in the mid eighties, SPARRSO gained finish advanced picture preparing framework including the important equipment and programming. Researchers and designers were prepared in equipment, programming support and picture handling systems. The utilization of GIS application in People's Republic of Bangladesh began in 1991 by Irrigation Support Project for Asia and the Near East for the Flood Action Plan-19 venture. Under this task the Environment and Geographic Information System (EGIS) was outfitted with GIS establishments. Toward the starting, the greater part of the GIS establishments were contributor upheld and worked by outside specialists with constrained nearby staff. Presently matters has changed, assortment of government and non-government associations have put in GIS and are worked by local expert. The correct number of GIS establishments couldn't be found out because of absence of data accessible. Be that as it may, the accompanying associations have been recognized to have GIS/RS/GPS establishments. The sites are incorporated with the rundown so intrigued people can visit the sites for itemized data.

Government Organizations having Geographic Information System Installations

- National Land Zoning Project (NLZP), Ministry of Land
[www.landzoning.gov.bd]
- Asiatic Society of Bangladesh / Banglapedia Project [www.banglapedia.org]
- Directorate of Land Records and Surveys (DLRS)/Ministry of Land (MoL)
[www.minland.gov.bd]
- Capital Development Authority (Rajdhani Unnayan Karttripakkha (Rajuk)
[www.rajukdhaka.gov.bd]
- Bangladesh Agricultural Research Council (BARC) [www.barc.gov.bd]
- Bangladesh Bureau of Statistics (BBS) [www.bbs.gov.bd]
- Academic Universities / Institutions
- Institute of Water Modeling (IWM)/Surface Water Modeling Centre (SWMC)
[www.iwmbd.org]
- Soil Resources Development Institute (SRDI) [www.srdi.gov.bd]
- Centre for Environmental and Geographic Information Services (CEGIS)
[www.cegisbd.com]
- Roads and Highways Department (RHD) [www.moc.gov.bd]
- Water Resources Planning Organization (WARPO) [www.warpo.gov.bd]
- Forest Department/Ministry of Environment and Forest [www.bforest.gov.bd]
- International Centre for Diarrhea Disease Research, Bangladesh (ICDDR,B)
- Local Government Engineering Department (LGED) [www.lged.gov.bd]
- Survey of Bangladesh (SOB) [www.sob.gov.bd]

Government Organizations having Remote Sensing and Geographic Information System Installations

- Bangladesh Meteorological Department (BMD) [www.bmd.gov.bd]
- Geological Survey of Bangladesh (GSB) [www.gsb.gov.bd]
- Space Research and Remote Sensing Organization (SPARRSO)
[www.sparrso.gov.bd]

Private Organizations having Geographic Information System Installations

- Natural Resources Programmers (NRP)
- Geographical Solutions Research Centre Ltd. (GSRC)
- Bangladesh Centre for Advanced Studies (BCAS) [www.bcas.net]
- CIPROCO Computers Ltd.
- Development Design Consultants (DDC)
- GEOSERV Ltd.

International Development Partners having Geographic Information System Installations in Dhaka

- Japan International Cooperation Agency (JICA)
- Danish International Development Agency (DANIDA)
- Cooperation of American Relief in Everywhere (CARE)

The literary works demonstrate that Remote Sensing and Geographic Information System innovations are connected for an extensive variety of regions in different areas. The Table 01 speaks to some normal fields and zones of Sensing/Geographic Information System applications by the administration and private associations [13].

TABLE 1: MOST IMPORTANT FIELDS AND AREAS OF GIS/RS APPLICATIONS IN PEOPLE'S REPUBLIC OF BANGLADESH [13]

Fields	Areas of Remote Sensing /Geographic Information System Applications
Agricultural Resources	Agricultural planning and management, National Agro-Ecological Zone (AEZ) database, soil resources database, soil survey, soil data analysis, characterization of soil, soil erosion assessment and prediction, climate change impact on agriculture
Land Resources	Land use planning, land inventories, land survey, land use and land cover mapping
Forest Resources	Planning and management, forest inventory, afforestation, climate change impact on forests
Weather	Monitoring and recording of weather data - rainfall, temperature, humidity,

Fields	Areas of Remote Sensing /Geographic Information System Applications
	etc.; weather forecasting and warning
Protection and Conservation	Habitat and ecosystem, wetlands, wildlife, protected areas, National parks and World heritage sites, ecotourism development
Climate Change	Climate change studies/research, climate change impact assessment, vulnerability assessment, adaptation to climate change
Regional/Local Planning	Development of plans, maintenance, management; infrastructure development programmed, land registration
Transport	Planning and management, rural road development (Planning, project preparation, construction, monitoring and maintenance), road network mapping
Water Resources	Water resources management, watershed analysis, fisheries resources development planning, river bank erosion and accretion, monitoring morphological changes and hydrology of rivers, navigation and dredging, construction and maintenance of embankments, flood forecasting and management, water pollution
Coastal Zone Resources	Management and development planning, land erosion, construction and maintenance of embankments, salinity, water logging, shrimp culture, marine fisheries, Sundarban mangrove forest, coastal afforestation, sea level rise
Environment	Monitoring, modeling and management of land degradation; weather and climate modeling, prediction and forecasting; river and coastal erosion modeling; flood management
Disaster	Disaster management, disaster forecasting, disaster risk management, cyclone recovery and restoration, cyclone shelter management, assessment and monitoring of damage, flood risk and vulnerability assessment
Health	Spatial distribution of different diseases in relation to environmental factors- dengue, malaria and diarrhoea diseases, arsenic contamination in drinking water, GIS mapping of anthrax and avian influenza outbreaks
Urban Planning	GIS maps of urban areas, cities and municipalities, infrastructure development planning, industrial development planning
Social Studies	Demographic studies and development analysis, population census, demographic database

2.3 Research Summary

It has been observed that many countries in the world have completed various types of zones long ago. According to the different requirements of the zoning will be various type. In 1916, the first zoning program was started in New York City of America. After that, many countries of the world have zoned in accordance with their purpose. Such as United State of America, Canada, United Kingdom, New Zealand, Singapore, Japan, China, Sri Lanka, India.

2.4 Scope of the Problem

In June 2006, the Zoning program was first started in the Coastal Land Zoning Project, Ministry of Land in Bangladesh. The area covered by it was 167 Upazilas of Coastal 19 Districts and 16 Upazilas of 02 Districts of Plain Land. Later, through the National Land Zoning Project, Ministry of Land, zoning activities started in 2012 from 308 Upazilas in 40 Plain Land Districts, 26 Upazilas of CHT 03 Districts and revisit 10 Upazilas of Costal District. Though it was conducted in Bangladesh before but it was repeated to monitor the changes at present.

2.5 Challenges

I have to face many challenges in order to do the right thing, they are described below:

- Satellite image is expensive.
- It is very difficult to find out previous satellite image and other data from the archive of the Coastal Land Zoning Project, Ministry of Land.
- It is difficult to classify land use features extracted from Satellite Images.
- It is difficult to collect series of satellite image etc.

CHAPTER 3

Research Methodology

3.1 Introduction

Shyamnagar Upazila (Satkhira District) space 1968.24 sq kilometer (counting 1485.13 Sundarbans and 483.11sq.km territory, i.e. contemplate zone), arranged inside the south-western a piece of People's Republic of Bangladesh in the vicinity of 89°00' and 89°19' east longitudes and in the middle of 21°36' and 22°24' north scopes. It is limited by Kaliganj and Assasuni Upazilas (Satkhira District) on the north, the Bay of Bengal on the south, Koyra Upazilas (Khulna District) on the east, West Bengal province of India on the west. Figure 01 demonstrates the examination upazila in People's Republic of Bangladesh regulatory guide and Figure 02 demonstrates the investigation region including sundarbans of Shyamnagar upazila, Satkhira District.

Shyamnagar, the most vital Upazila of Satkhira District People's Republic of Bangladesh in regard of zone, appeared as a Thana (Police Station) in 1897 and was moved up to Upazila (Sub-region) in 1982. Sundarbans, the greatest single square tidal mangrove timberland inside the world lies in Shyamnagar Upazila. It is an UNESCO world Heritage site perceived and legitimately secured by global bargains as an all around ensured zone. Sundarban is moreover named as ECA because of it keeps on agony from over-abuse and amerceable infringement.

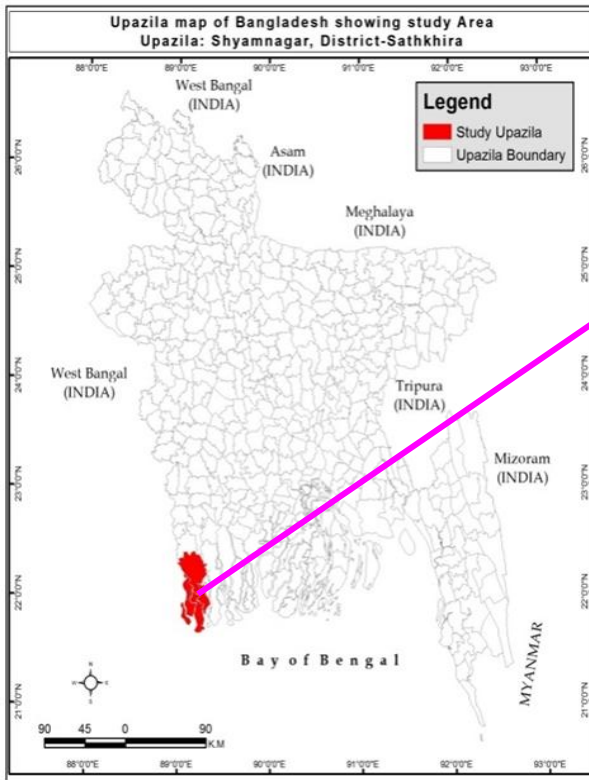


Figure 1: Study Upazila in People's Republic of Bangladesh

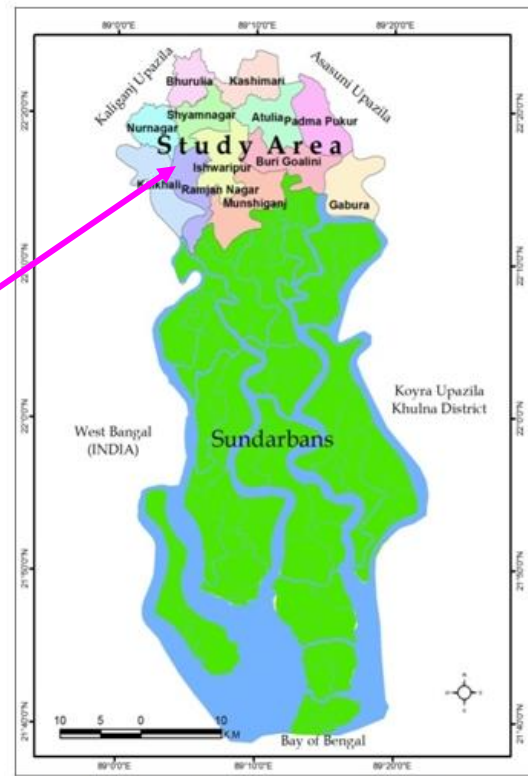


Figure 2: Study Area in Shyamnagar Upazila of Bangladesh

To control the common habitat and surroundings, ten kilometer space incorporating Sundarbans has been confined as Ecologically Critical Area by the People's Republic of Bangladesh in venture with this notice seventieth space of Shyamnagar Upazila, Sathkhira District has fallen beneath Ecologically Critical Area.

3.2 Materials

3.2.1 Data Processing

Land utilize and arrive cover changes includes information pre-handling (Geo-referencing, Sub-setting, and so on.), topical layer age (Land utilize classes), information investigation, field approval, orchestrate workshop lastly create arrive utilize changes of the examination time frame.

3.2.2 Geo-referencing

Numerous Geo-referencing ways are utilized to Geo-reference multi-phantom satellite symbolism (ERDAS envision client manage). one of the ways is grouping of Ground Control Point from ponder zone utilizing Global Positioning System. In this technique GCP gathered from contemplate territory and changed this geological organize to Multi-ghostly Satellite Image (same zone pictures) by utilizing geometric model of ERDAS envision programming. In geo-referencing/re-testing strategy Bangladesh Transverse Mercator (BTM) projection framework was utilized. Second request polynomial strategy and closest neighbor picture re-examining calculation was connected for the geometric revision of satellite pictures. The Root Mean Square mistake of the was in a scope of 0.45-0.1 pixels.

3.2.3 Data Generation

The multi satellite and multispectral symbolism has been utilized which helps recognizable proof of perpetual and regularly differing highlights of land-utilize. The RGB false shading composite has been set up for picturing the land highlights. For surface, visual elucidation tone, shape, example and size have been considered.

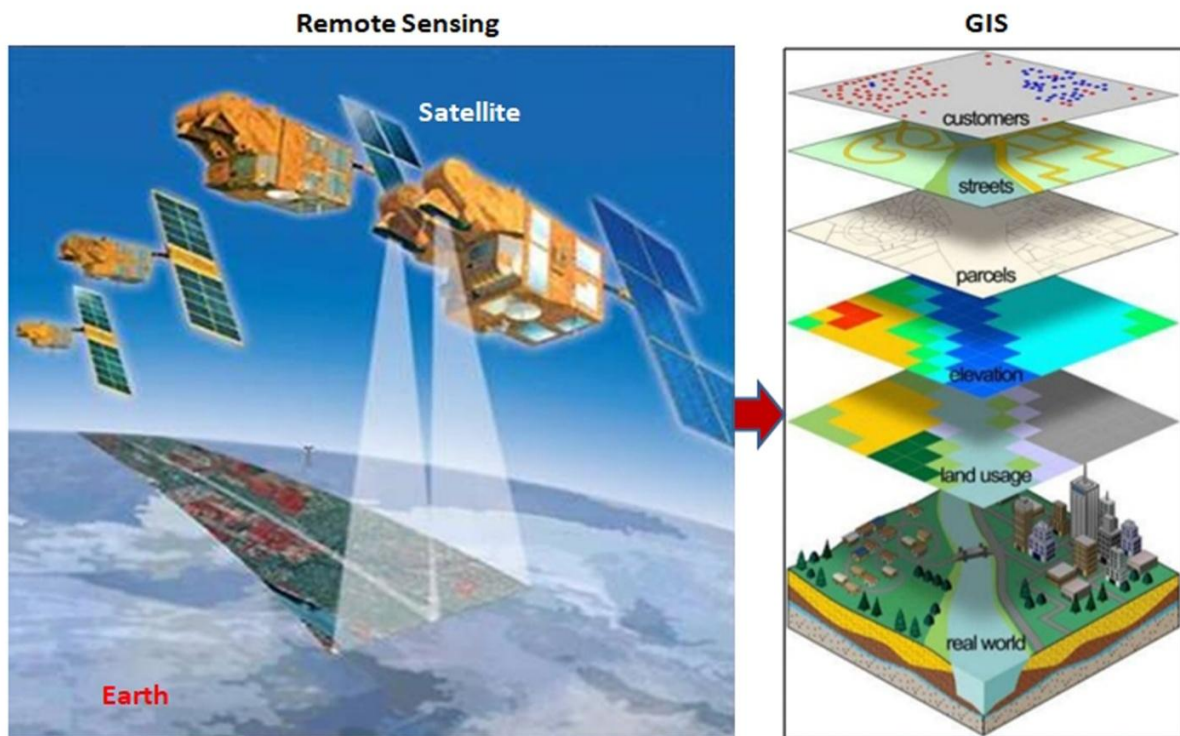


Figure 3. Remote Sensing & GIS [15]

At that point the multi-unearthly arrangement utilizing unsupervised (ISODATA) and directed order (Parallelepiped and Maximum Likelihood procedures) were done and comes about have been analyzed. In light of the field examination and optional information, the whole investigation region had been ordered in subtle elements into a few topical layers/highlights. A short time later, the topical layers were bunched into following classes appeared in Table: 2.

TABLE 2: GENERATED AND CLUSTERED THEMATIC LAYERS USED IN THE STUDY AREA

Feature Type	Generated Thematic Layers	Feature Type	Clustered Thematic Layer
Polygon	(i) Aman (ii) Aman and Boro (iii) Aman and Robi (iv) Baor (v) Boro (vi) Brick-field (vii) Canal (viii) Ditch (ix) Gher (x) Important Place (xi) Industrial Area (xii) Inter Tidal Area (xiii) Marsh Land (xiv) Pond (xv) River (xvi) Rural Settlement with Homestead Vegetation (xvii) Seasonal Water Body (xviii) Built up Area	Polygon	(i) Agriculture (ii) Other Land Use (iii) Gher (iv) Important Place (v) Water Bodies (vi) Rural Settlement with Homestead Vegetation (vii) Built up Area
Line	Transport Network	Line	Transport Network
Point	Administrative Head Quarters, Growth Centre, Tourist/ Historical Place	Point	Administrative Head Quarters, Growth Centre, Tourist/ Historical Place

The managed grouping utilizing most extreme probability gives best outcomes to arrive utilize. The significant classes, for example, woodland, settlement, urban/developed territories and yield lands have been recognized through elucidation of the characterized symbolism. Field data, information gathered from BBS and visual understanding of SPOT, Google, IKONOS pictures and elevated photos. Diverse strides of information ages are appeared in Figure 04.

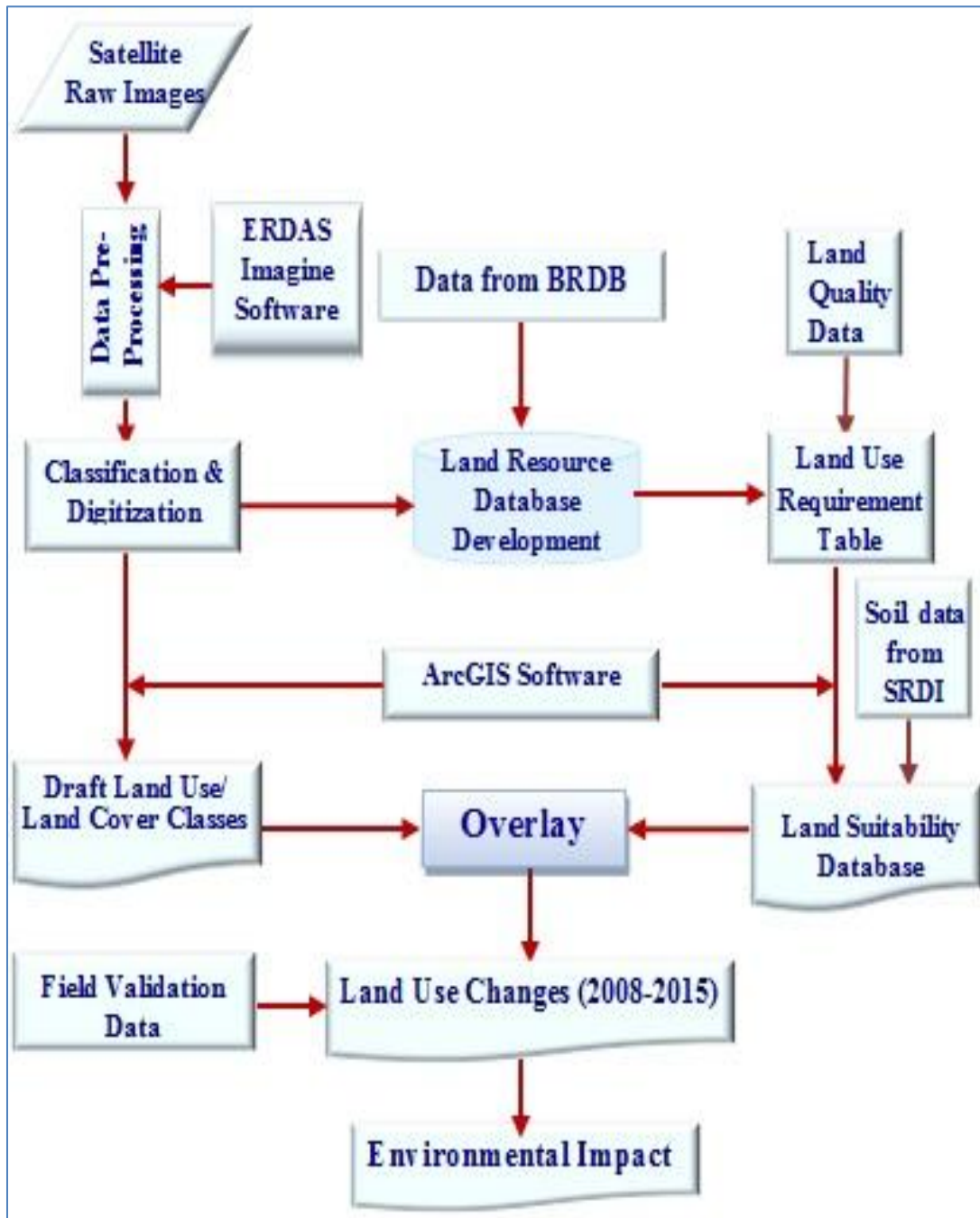


Figure 4: Data Generations Steps for this work

3.3 Data Collection Procedure

A stock and examination of Shyamnagar Upazila, Satkhira District has been led all through the sum 2008 and 2015. amid this period arrive utilize example, ecological evaluations and social are led up to the association level (little managerial unit). The associations lying under the more extensive zones and sub-zones were differentiated. Evaluation and individuals participatory examination of information gathered from various angles. Both subjective and quantitative sorts of information were additionally gathered. Gathering of information are part into two noteworthy composes to be specific Primary and Secondary information. Brief information accumulation steps are given beneath:

3.3.1 Primary Data

- Satellite Imageries.
- Global Positioning System data collected during field survey.
- Exchange views with the BRDB for land use of agriculture, fisheries and forestry and environment departments officials of district, upazila and union level.

3.3.2 Secondary Data

- Administrative boundaries collected & use from the CEGIS.
- Soil map/information collected from SRDI, People's Republic of Bangladesh.

3.4 Implementation Requirements

3.4.1 Satellite Images

A few sorts of satellite pictures have been gathered to create the land utilize changes utilizing Remote Sensing, Global Positioning System and Geographic Information System innovations. A mix of land utilize information of various day and age got from a few satellite pictures and field level land utilize data are utilized to arrive utilize and arrive cover changes.

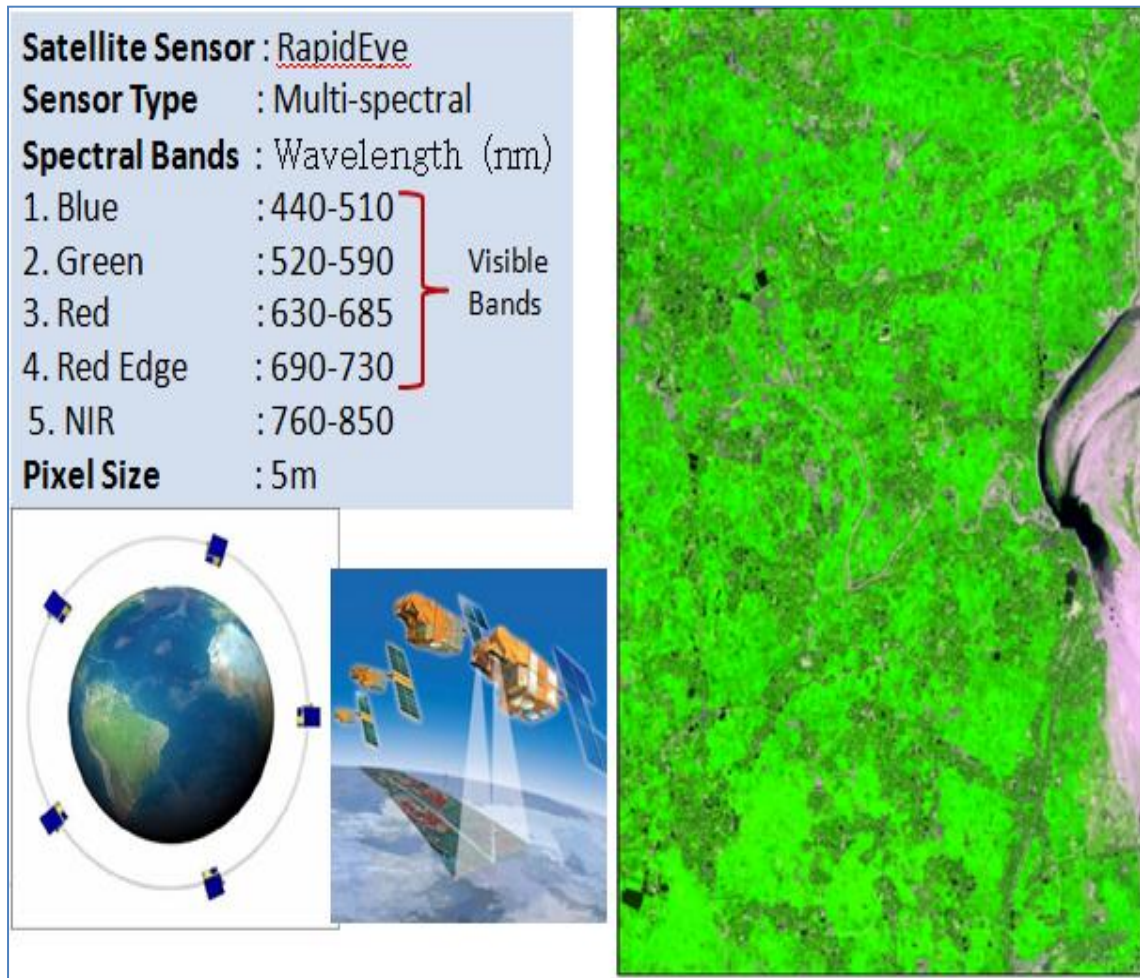


Figure 5: Technical Specification and Product of RapidEye Satellite [15]

In this investigation RapidEye satellite pictures fills in as a noteworthy data source separating common highlights in arrive utilization of Shyamnagar Upazila, Satkhira District. Dry period of RapidEye pictures were utilized to distinguish arrive utilize and arrive front of the region amid the period 2008 and 2015.

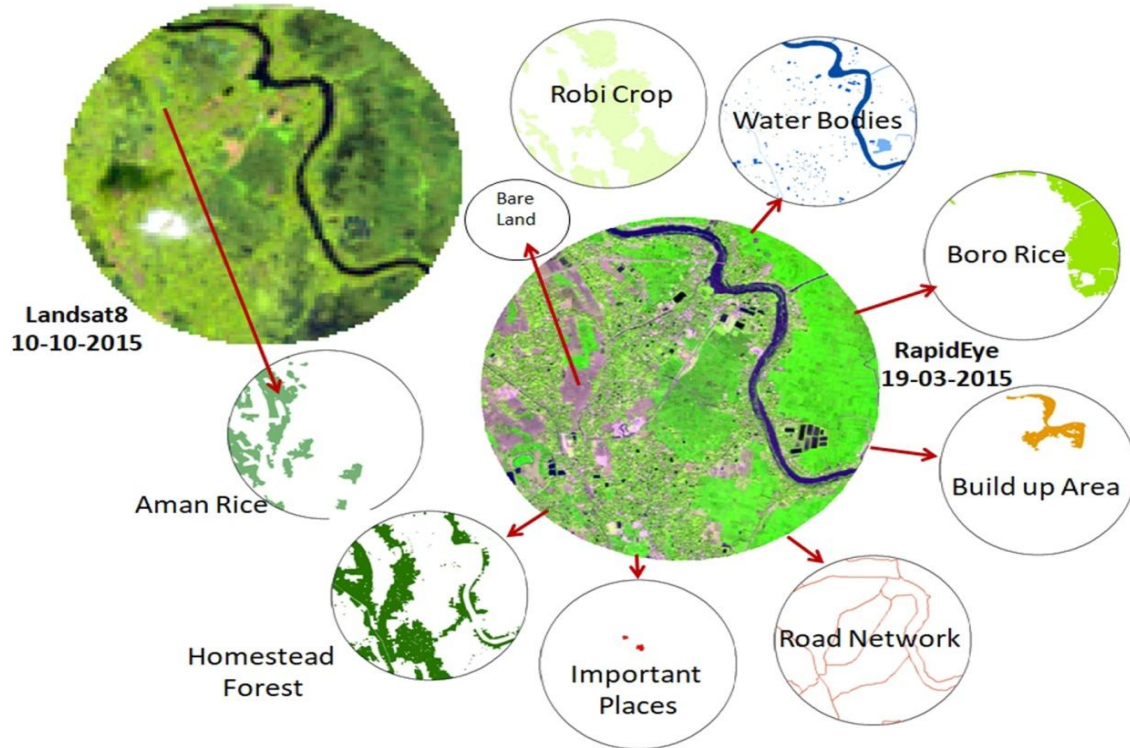


Figure 6: Land Use Features Extracted from Satellite Images [15]

Various direct determination satellite pictures, for example, Landsat8-OLI (Operational Land Imager) were utilized to outline the winter crops, Sentinel-MSI (Multi Spectral Imager) pictures were utilized to comprehend expansive editing example and regular land cover like Monsoon Crop (Aman) and Google pictures were utilized to recognize the miniaturized scale level land utilize highlights of a similar period appear in Table 3.

TABLE 3: USED IN THE STUDY SATELLITE IMAGES AND ITS CHARACTERISTICS

Satellite Name	Sensor	Resolution	Spectral Bands	Data Frame/ Acquisition Date	Potential Applications Used in this Study
RapidEye	MSI	5 m	5	Mostly Dry Season (January-March, 2008 & 2015)	Identification of Winter Crop (Boro & Robi), Permanent Vegetation, Water Bodies, etc.
Landsat5	TM	30 m	7	Time Series (October-March, 2008 & 2015)	Identification of Boro & Aman Rice, Wheat, Sugarcane, Robi Crops, etc.
Landsat8	OLI	15-30 m	9	Time Series (January-March, 2015)	Identification of Boro Rice, Wheat, Sugarcane, Robi Crops, etc.
Sentinel	MSI	10-60 m	13	October-December 2008 & 2015	Identification of Aman Rice, Robi Crops, etc.
Google Images (SPOT, IKONOS, etc.)		1-5 m		Dry Season	Settlement, Brick-field, Industry, Betel vine, Banana, Pineapple, Mango, Garden, Roads, etc.

3.4.2 Global Positioning System (GPS) Data

GPS is a United State of America space-based route framework that gives solid situating, route, and auspicious administrations to overall clients consistently in all climate, day and night. It additionally gives three-dimensional areas in addition to exact time [16]. In this examination a handheld Global Positioning System (Germin) was utilized to gather the GCP for geo-referencing the remotely detected information and in addition field check of land utilize information translation. Effortlessly identifiable focuses, for example, street crossing, end of a scaffold, corner of a building, and so forth were utilized as reference focuses. Other use of Global Positioning System was to find the topographical position of the Important/Tourist puts and additionally authoritative home office and so forth of the

examination zone. Corrected pictures and the point information gathered from GPS were then incorporated into a Geographic Information System Database Figure 7 demonstrates the reconciliation of Global Positioning System, Remote Sensing and Geographic Information System.

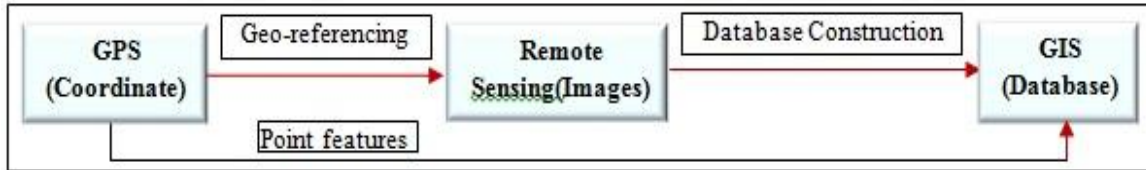


Figure 7: Integration of Global Positioning System, Remote Sensing and Geographic Information System

CHAPTER 4

Analytical Results and Discussion

4.1 Introduction

Seaside territory People's Republic of Bangladesh has been encountering more awful effect ashore assets because of characteristic cataclysms like tornado, tidal surge, immersion and saline water interruption. This region is influenced via ocean level ascent because of effect of a worldwide temperature alteration and change of atmosphere. The satellite information and other field based information utilized as a part of the above investigation is presently around seven to eight year old. Parcel of advancement exercises are additionally done in the zone by the legislature and other non government organizations. To comprehend these progressions between the past circumstance and the present difference in arrive utilizes as a part of most recent seven years must be distinguish and comprehend the progressions that has occurred if there should arise an occurrence of land use in the waterfront zone amid last 7-8 years.

4.2 Comparative Analysis

Both managed and unsupervised grouping strategies have been connected for the picture of 2008 and 2015 in light of ERDAS envision 2011. The region of farming/T.Aman (Transplantation Aman) is discovered 16103 hectare and 16080 hectare in the year 2008 both managed and unsupervised order separately. In rate it is 35% and 34%. It is relatively comparable in both the strategies. In the year 2015 discovered agribusiness territory around 9752 hectare (21%) and 9718 hectare (22%). It is additionally relatively comparative. If there should be an occurrence of shrimp (Gher) is discovered 17301 hectare (38%) and 17311 hectare (38%) in the year 2008 both regulated and unsupervised order separately. In rate it is 35% and 34%. In the year 2015 discovered shrimp culture territory around 22816 hectare (half) and 22810 hectare (half). It is very comparative. In different classes discovered little changes. Table 4 demonstrates the significant land utilize changes amid the period 2008 to 2015.

TABLE 4: MOST IMPORTANT LAND USE DURING THE PERIOD 2008 AND 2015

Land Use	Supervised Classification Area in Hectare and Percent (%)		Un-Supervised Classification Area in Hectare and Percent (%)		Remarks (Supervised Classification) Area in Hectare
	2008	2015	2008	2015	
Agriculture Land/T.Aman	16103 (35%)	9752 (21%)	16080 (34%)	9718 (22%)	Agricultural Land Decreased Around 6351
Built up Area (Urban Area)	32.03 (0.07%)	32.03 (0.07%)	32.03 (0.07%)	32.03 (0.07%)	No Changed
Gher/Shrimp Area	17301 (38%)	22816 (50%)	17311 (38%)	22810 (50%)	Gher/Shrimp Increased
Rural Settlement	7016 (15%)	7281 (16%)	7009 (15%)	7286 (16%)	Increased
Water Bodies	5299 (12%)	5084 (11%)	5299 (12%)	5084 (11%)	Decreased

4.3 Descriptive Analysis

4.3.1 Visual Analysis

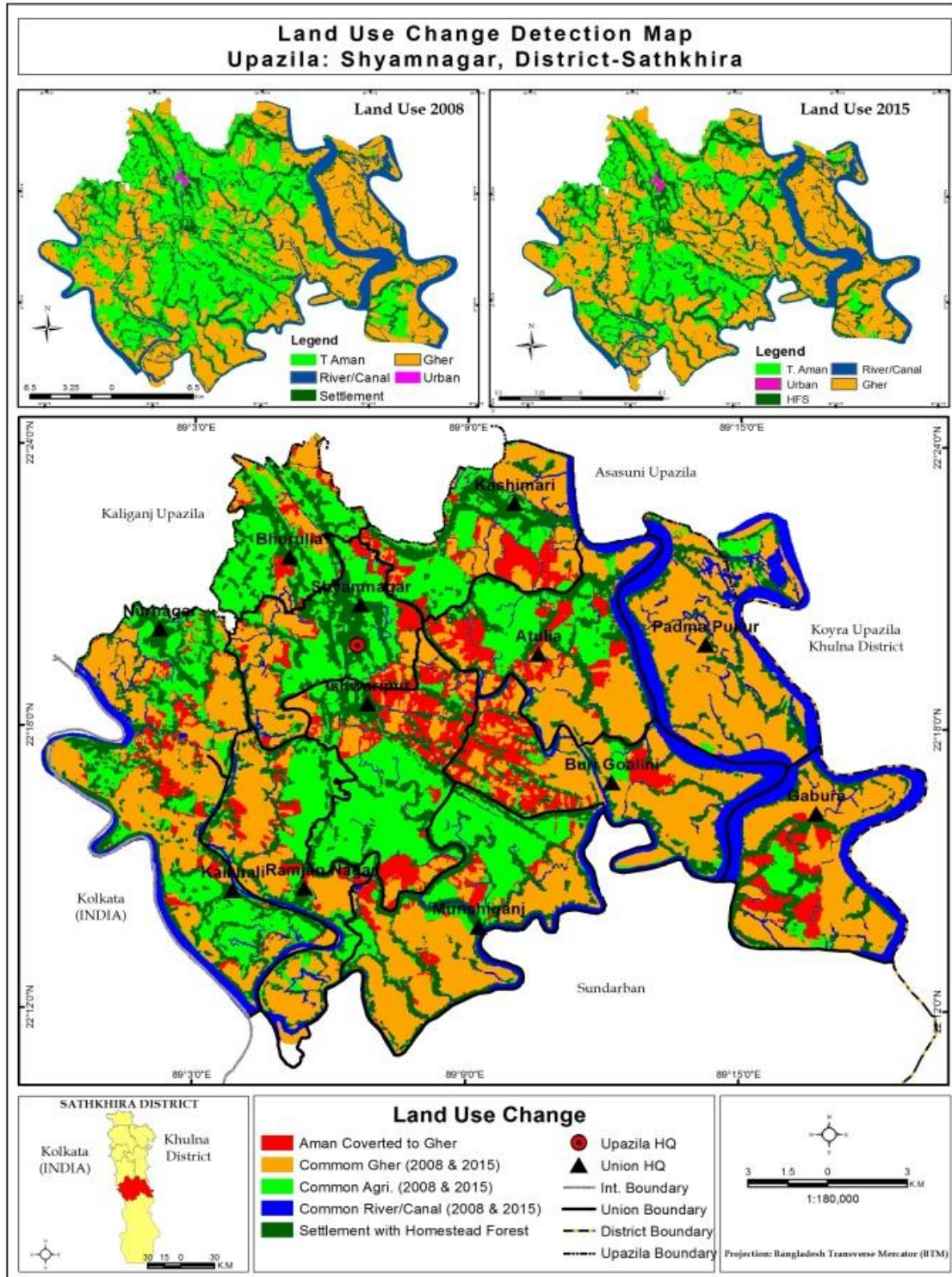


Figure 8: Land Use Transform Map During 2008 to 2015

In visual investigation of Figure 8 (upper left), it is obviously observed that land utilization of T.Aman (green shading) indicates more territories in 2008 contrast with arrive utilize 2015 (upper right). Then again shrimp territories (maroon shading) demonstrates less in 2008 (Figure 8, upper left) contrast with 2015 (Figure 8, upper right). In base picture of Figure 8 (red shading) indicates T. Aman (storm rice) changed over to Shrimp (Gher) culture in 2015.

4.3.2 Geographic Information System (GIS) Analysis

The characterized pictures of 2008 and 2015 which were ordered in ERDAS envision changed over to ArcGIS 10.3.2 condition for examination. It is plainly observed from the Figure 8 and Table 4 that the agribusiness arrive zone found in normal both the characterizations about 16091.5 hectare (34.5%) and 9735 hectare (21.5%) in the year 2008 and 2015 separately. Amid the period 2008 to 2015 agribusiness zone have been diminished around 6351 hectare (13%). Then again shrimp (Gher) culture found in normal both the characterizations around 17301 hectare (38%) and 22816 hectare (half) in the year 2008 and 2015 separately. Amid the period 2008 to 2015 shrimp culture exercises have been expanded around 5515 hectare (12%). In different classes discovered little changes (Table 4 and Figure 8). From change discovery examination (Figure 8) it is plainly observed that natural effect have been identified because of increment of shrimp culture exercises. Be that as it may, subsequent to surveying present land utilize, arrive type, soil attributes and considering diverse other criteria specified to indentified for Shyamnagar Upazila, Satkhira District (Table 5).

TABLE 5. UNION-WISE DATA DURING THE TIME 2008 AND 2015 [15]

Union Name	BBS Total Area Hectare	Type of Land Hectare	Soil Texture	Soil (pH)	Soil Salinity (Ds/m)	Land Use 2008 (%)	Land Use 2015 (%)
Atulia	4103	HL-250 MHL-3179 MLL-00 LL-00	Clay Loam	5.0- 6.0	8-12	Agriculture = 37 Shrimp Area = 33 Settlement = 13 Water Body = 17	Agriculture = 23 Shrimp Area = 50 Settlement = 16 Water Body = 10
Bhurulia	2406	HL-223 MHL-1728 MLL-00 LL-00	Silt to Clay Loam	5.0- 6.0	8-12	Agriculture = 57 Shrimp Area = 19 Settlement = 22 Water Body = 02	Agriculture = 37 Shrimp Area = 34 Settlement = 26 Water Body = 03
Buri Goalini	4264	HL-00 MHL-3357 MLL-480 LL-00	Clay Loam	3.8- 5.0	15-25	Agriculture = 22 Shrimp Area = 48 Settlement = 11 Water Body = 18	Agriculture = 06 Shrimp Area = 63 Settlement = 11 Water Body = 03

Union Name	BBS Total Area Hectare	Type of Land Hectare	Soil Texture	Soil (pH)	Soil Salinity (Ds/m)	Land Use 2008 (%)	Land Use 2015 (%)
Gabura	3938	HL-175 MHL-3840 MLL-00 LL-00	Clay	3.8-5.0	15-25	Agriculture = 17 Shrimp Area = 45 Settlement = 11 Water Body = 26	Agriculture = 06 Inter Tidal = 03 Shrimp Area = 52 Settlement = 14 Water Body = 24
Ishwaripur	2774	HL-525 MHL-2250 MLL-55 LL-00	Clay	4.5-5.5	10-15	Agriculture = 63 Shrimp Area = 14 Settlement = 19 Water Body = 04	Agriculture = 40 Shrimp Area = 39 Settlement = 15 Water Body = 24
Kaikhali	4464	HL-200 MHL-1835 MLL-00 LL-00	Clay Loam	4.5-5.5	10-20	Agriculture = 38 Shrimp Area = 39 Settlement = 12 Water Body = 12	Agriculture = 24 Inter Tidal = 03 Shrimp Area = 42 Settlement = 15 Water Body = 16
Kashimari	3339	HL-220 MHL-2000 MLL-00 LL-00	Clay Loam	5.0-6.0	8-12	Agriculture = 41 Shrimp Area = 30 Settlement = 17 Water Body = 12	Agriculture = 27 Shrimp Area = 48 Settlement = 19 Water Body = 06
Munshiganj	4913	HL-665 MHL-3795 MLL-452 LL-20	Clay Loam to Clay	4.5-5.5	10-20	Agriculture = 34 Shrimp Area = 42 Settlement = 15 Water Body = 09	Agriculture = 25 Inter Tidal = 02 Mangrove Forest = 01 Shrimp Area = 47 Settlement = 16 Water Body = 09
Nurnagar	2723	HL-125 MHL-1900 MLL-697 LL-00	Sil to Clay Loam	5.0-6.0	8-12	Agriculture = 31 Shrimp Area = 45 Settlement = 19 Water Body = 06	Agriculture = 21 Inter Tidal = 01 Shrimp Area = 58 Settlement = 15 Water Body = 05
Padma Pukur	6096	HL-50 MHL-3751 MLL-00 LL-00	Clay	3.8-5.0	15-25	Shrimp Area = 67 Settlement = 11 Water Body = 22	Agriculture = 02 Inter Tidal = 03 Shrimp Area = 65 Settlement = 08 Water Body = 22
Ramjan Nagar	3710	HL-649 MHL-2098 MLL-00 LL-00	Clay Loam to Clay	4.5-5.5	10-20	Agriculture = 33 Shrimp Area = 45 Settlement = 16 Water Body = 06	Agriculture = 22 Inter Tidal = 02 Shrimp Area = 54 Settlement = 15 Water Body = 07
Shyamnagar	3031	HL-414 MHL-2655 MLL-00 LL-00	Sil to Clay Loam	5.0-6.0	8-12	Agriculture = 47 Shrimp Area = 27 Settlement = 18 Water Body = 05 Urban Area = 03	Agriculture = 32 Shrimp Area = 39 Settlement = 24 Water Body = 04 Urban Area = 01

- Clay (c)
- High Land (HL)
- Low Land (LL)
- Medium High Land (MHL)
- Silty Clay (Sic)
- Silty Clay Loam (Sicl)
- Silt Loam (Sil)

4.3.3 Cyclone and Tidal Surge

Shyamnagar Upazila, Satkhira District is greatly in danger of typhoon and tidal surges because of its geographic area on the seafront aspect of the locale. Since 1770, no less than 25 noteworthy twisters arrived in this belt bringing about critical loss of lives and properties. Extreme violent wind Sidr hit the beach front region on 15 November 2007 made genuine harm the life and properties of this upazila. Sidr influenced

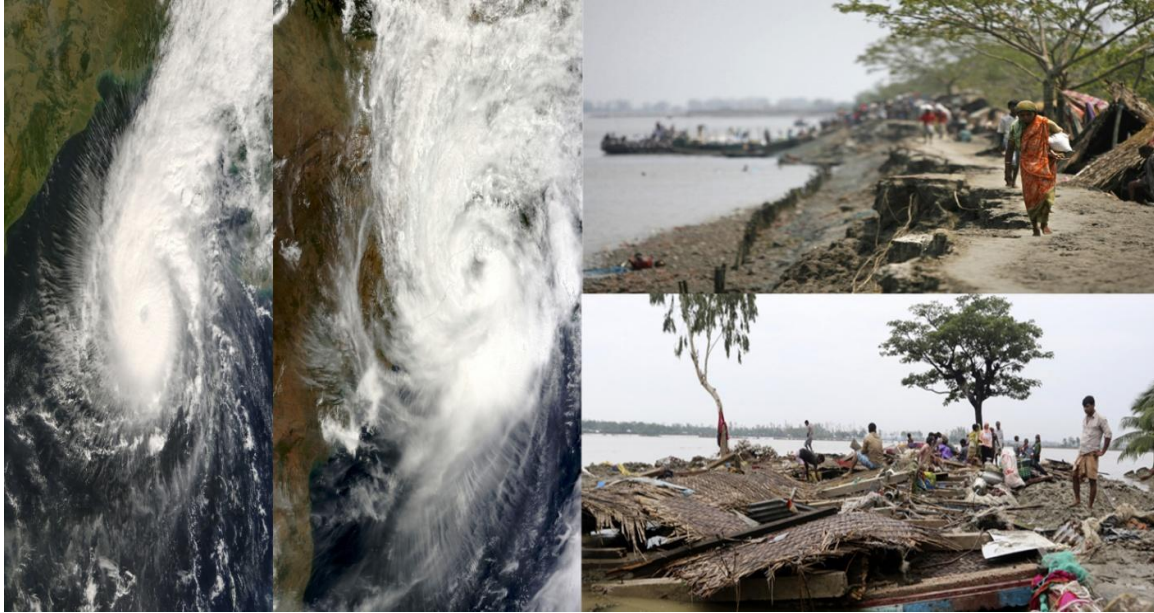


Figure 9: Photographs of Sidr, Aila and Devastating Cyclone [18]

landfall on the People's Republic of Bangladesh to drift on 15 November 2007 [3,8]. It was a class 4 violent wind of 1,000 km distance across with twist speed of 240 km/hour that assaulted the southwest seaside zone. Shyamnagar Upazila, Satkhira District was very influenced the violent wind. Twister Aila additionally influenced the southwest bank of People's Republic of Bangladesh on 25 May 2009. The most extreme maintainable breeze speed inside 54 km of the tempest focus was around 80 KPH ascending to 100 KPH in windy and squirrel twist on 25 May 2009. 110 KPH (03-minute supported) and 120 KPH (01-minute maintained) amid crest power [7].

No less than 172 men were murdered (UNB) by the impact of violent wind Aila. The Aila in the costal belt washed away dikes at in excess of 150 focuses along the drift. The greater part of the low-lying zones of the beach front regions including Satkhira District of Shyamnagr Upazila were immersed by storm surge of tallness 06-10 feet higher than

conventional galactic tide. A huge number of individuals living in seaward islands, burns and remote zones of Khulna, Barisal, Patuakhali, Bagerhat, Borguna, Satkhira, Barisal, Bhola, Pirojpur, Jhalokathhi, Laxmipur, Noakhali, Feni, Chandpur, Chittagong and Cox's Bazaar were caught by tidal water. Tests of annihilating photos are appeared in Figure 9 in Shyamnagar Upazila, Satkira District.

4.3.4 Salinity

Saltiness interruption could be a noteworthy downside in Shyamnagar Upazila, Satkira District. More profound and landward interruption of saline water occurs through different tidal streams inside the drift. With the tidal outcome, saline water go into within a piece of the zone through Arpangachia, Chuna, Kobadak, Kholpetua, Kalindi, Madar, Malancha, Hariabhanga and Raymangal waterways [5] and their tributaries and eventually soil of the territory move toward becoming saltiness influenced. Saltiness interruption in water is occasional which ends up exasperated in the dry season. The water saltiness is regularly flushed amid storm, yet soil saltiness can't be completely expelled. The effects of saltiness on condition of the zone are high. Individuals experience the ill effects of drinking water inaccessibility.



Figure 10: Photographs of Salinity

4.3.5 River Bank Erosion

The vast majority of the segments of the beach front zone of People's Republic of Bangladesh are disintegration inclined [9,6]. Waterway bank disintegration is a characteristic issue of the Shyamnagar Upazial, Satkira District. The principle waterways of the region are the Chuna, Kalindi, Kholpetua, Kobadak and Malancha. A difference in stream limit is the fallout of waterway bank disintegration. It effectsly affects human settlement and rural land. There are relocation and financial effect because of stream bank disintegration as well. The most influenced associations are Burigoalini, Gabura, Munshiganj and Padmapukur contrast with disintegration status in 2009. Disintegration along the banks of the waterways causes a diminishment in complete zone of cultivable land, bringing about a lessened farming generation. Dissolved soil settles down on the bed of the streams, causing siltation.



Figure 11: Photograph of River Bank Erosion

4.3.6 Flood

Shyamnagar Upazila, Satkira District is surge inclined zone. Flood inside the Chuna, Kalindi, Kobadak, Kholpetua and Malancha Rivers cause surge in the locale. By and large, surge here stay inside middle of as far as possible, yet infrequently, it might be profoundly destroying. When all is said in done storm, immersion happens each year at

close-by stream side territory. Now and again, drawn out surge occurs in 2/3 years. It impactsly affects yields, domesticated animals and fisheries. It influences the general advancement exercises. In actuality, sedimentation from the surge water elevates to expand trim creation. Surge influences farming products, as well as lodging, street arrange, instructive organizations and wellbeing foundations. Shyamnagar Upazila, Satkira District was experiencing obliterating surges inside the time of 1988, 1998, 2004 and 2010.



Figure 12: Photographs of Flood

4.3.7 Degradation of Wetland Ecosystems

Wetlands bolster fisheries and amphibian biodiversity of the Shyamnagar Upazila, Satkira District. It goes about as regular reproducing ground for angle and other oceanic life forms. It additionally gives methods for water transportation amid blustery season. Wetland biological systems of the Shyamnagar Upazila, Satkira District are diminishing step by step. Significant segments of pulverization square measure siltation, building foundation with insufficient departure offices, saltiness interruption, decimation of mangrove woods, wetland filling, water plant, extraction of wetlands and so on. Moreover, individuals are changing over low lying regions of the upazila for multipurpose business employments. Transformation of characteristic wetland into different employments of lodging, street system, industry or aquaculture is essential issues to be considered in arrive utilize. Saltiness interruption in the upazila has changed nature and biological communities of wetlands in Shyamnagar Upazila, Satkira District. Influenced natural surroundings have been devastated by saline water prompting loss of biodiversity.

4.3.8 Siltation

Siltation inside the informal lodging space of the Arpangachia, Chuna, Hariabhanga, Kalindi, Kobadak, Kholpetua, Madar, Malancha and Raymangal Rivers [5] could be a typical drawback of the region. Siltation in the waterway causes the raising of its bed that influences route and the stream of water itself. Over a couple of decades, there have been huge changes in physical highlights and nature of floodplains and waterways because of siltation. Beds of the waterways and adjacent trenches have been silted up that decreased water conveying limit of streams. Unreasonable silt loads are saved in the waterways and their tributaries that causes surge amid rainstorm and store dregs in adjoining low lying zones and wetlands of the Shyamnagar Upazila, Satkira District. All associations of the Shyamnagar Upazila, Satkira District have been influenced by various degrees of siltation.



Figure 13: Photographs of River Siltation

4.4 Major Anthropogenic Causes

4.4.1 Conversion of Agricultural Land into Shrimp Farm



Figure 14: Shrimp (Bagda) Culture Activities

Shrimp cultivating in People's Republic of Bangladesh has been perceived as an area of the Blue Revolution. Shrimp is the second biggest wellspring of acquiring remote cash. Beach front aquaculture is for the most part in light of shrimp development. In parallel with its extensive commitment to nearby and national economy, it has just made huge harms the neighborhood biological systems. Amid the past couple of decades shrimp aquaculture, fundamentally the dark Tiger Shrimp (Bagda) has been a critical part inside the improvement of our economy. Mangrove woods is considered as a home of vital beach front and marine biodiversity. It is a perfect rearing ground for fish and shrimp. These assets on southern segments of Shyamnagar Upazila, Satkira District territory unit being tidied up mainly because of the change of the land for shrimp development. Because of expanding request and fulfill the request quite compelling gathering of partners, both rural land and mangrove vegetation are changed over into unapproved extension of shrimp (*Penaeus monodon*) development.

There is an awesome danger of ecological corruption for moving this land utilize design, which misfortunes the dirt richness that won't not be reestablished in not so distant future regardless of whether the ranchers plan to backpedal for farming generation. Above all, the nature of seaside green belt is wrecked. Thus, the obstruction to normal dangers like violent winds, storm surges, and so forth would be at grave hazard Human intercessions, similar to fast and unapproved extension of shrimp cultivating are considered as genuine worry for natural corruption of the Shyamnagar Upazila, Satkira District. Shrimp culture exercises are appeared in Figure 14.

4.4.2 Expansion of Infrastructure, Settlement and Industries

Rustic settlements have been become quickly because of expanded populace weight. The vast majority of the rich farming area along the streets and the encompassing territories as of now been changed over into lodging, advertise, different settlements, and so on. Quick settlement and frameworks have been built up in most recent ten years in Shyamnagar Upazila, Satkira District. Due to popularity, the land esteem has been expanded massively, yet tragically, it couldn't keep this pattern of spontaneous employments of land. Settlement advancement is an incredible reason for arrive utilize transformation. The occupants neither mindful about arranged township nor they mind the natural

outcomes. Over that, streets and frameworks are bit by bit grown wherever inside the Shyamnagar Upazila, Satkira District. In this way, the land utilize design is evolving quickly. Quick and unpredictable extension of lodging is one of the considerable difficulties to shield horticulture arrive from being changed over.

4.4.3 Brick-fields

Blocks have been utilized for different infrastructural exercises in the Shyamnagar Upazila, Satkira District. With developing needs of lodging, business, workplaces, transport systems and other development exercises, the interest for blocks has been expanded at a speedier rate. So as to create requested blocks, a few brickfields were set up in Shyamnagar Upazila, Satkira District. There were just around 05 block fields in the upazila in 2009. Be that as it may, quantities of brickfields are around 12-14 of every 2015. Most elevated quantities of brickfields have been seen in Ishwaripur and Shyamnagar Unions. By and large, brickfields are built in medium high land close to the street side. These are rich agrarian land where agriculturists can grow a few yields in a year. Recently settled brickfields changed over ripe farming area to non-gainful region. Agribusiness arrive in quickly changing zone in Ishwaripur and Shyamnagar Unions have been changed over to block field. Block influencing businesses to cause arrive debasement for other farming field as well. Block fields are significant specialists for topsoil corruption and natural contamination. Blocks are made by gathering soils from a profundity of around 01 m to 02 m from farming area. With the expansion in block generation, the annihilation of rich best soil are occurring growing the influenced regions.



Figure 15: Agriculture Land Converted to Brick-field

An aggregate of 14 Brick-fields in the Shyamnagar Upazila, Satkira District consume in excess of 100 tons of kindling. This gigantic measure of wood consumed by block field cause expansive scales backwoods demolition. The groupings of ozone harming substances in the environment are expanded by outflows from block consuming. Developed warmth harms the woodland and vegetation encompassing the brickfields and eventually debases the common biological community. Block furnaces are additionally contaminating the air in rustic zone. Outflow of enormous measure of destructive parts from block furnaces is perpetrating genuine wellbeing risks. The block ovens radiate dangerous exhaust containing high convergence of carbon monoxides and oxides of sulfur. These substance mixes are hurtful to eye, lungs and throat of person. Smoke and tidy dirty the demeanor of the encompassing territories that influence human settlements, instructive organizations, office, commercial centers and so on.

4.4.4 Degradation of Coastal Forest

Tree cover is a vital land use subset in Shyamnagar Upazila, Satkira District. Indiscriminate felling of undersize trees declined tree cover. It exacerbates soil erosion and organic carbon loss. Increased population creates serious threat to forest resources. Tree cover destruction reduces carbon absorption and enhances global warming. Anthropogenic factors are mostly responsible for deforestation. Tree covers are cleared for the expansion of human settlements and construction of roads and infrastructures for other commercial uses. Native species of plants, bushes and village forest are being cleared off because of the unplanned expansion of human settlements, brickfields, roads and infrastructures and changes of land use pattern etc. Illegal cutting for timbers and firewood are major driving forces for declining forest resources. Other factors responsible for the destruction of the forests are the uses of forest products as fuel. Cutting of trees for timbers and firewood are major factors for declining the forest resources.

4.4.5 Improper Land Uses

Land is that the limited asset for some human exercises and agribusiness, industry, ranger service, vitality creation, settlement, amusement, and water catchment and capacity. The quick populace development and the procedure of urbanization have come about into changing area utilize design. Despicable land utilize straightly influences the vegetation

living space and along these lines impacts biodiversity. Shameful land utilize causes different types of land debasement bringing about a decreased agribusiness generation. Land is a key factor of creation and has been firmly combined with the monetary development. Land involving soil, water and related plants and creatures are valuable assets for the subsistence and survival of individual. Be that as it may, ideal yields from arrive assets can't be acquired as a result of disgraceful land employments. To upgrade the money related state of the domain while not all the more crumbling the bio-condition, all of the available land ought to be used in the first normal approach.

4.4.6 Sundarbans Impacts Zone (SIZ)

The Sundarbans is the biggest single lump of mangrove woods on the planet. The physiography of the woodland is commanded by deltaic arrangements that incorporate endless waste lines related with surface and subaqueous levees, spreads and salt marshes. There are additionally minimal swamps above mean tide level, tidal sandbars and islands with their systems of tidal channels, subaqueous distal bars and protodelta dirts and residue dregs. The floor of the Sundarbans shifts from 2.11 m to 0.9 m above ocean level. Shared between two neighboring nations, People's Republic of Bangladesh and Republic of India, the bigger half (62%) is situated inside the southwest corner People's Republic of Bangladesh. Shyamnagar Upazila, Satkhira District conjointly covers a segment of the Sundarbans (effectively outlined in think about region). Thinking about the significance for the insurance of the normal timberlands, a 10 km fringe cradle around the woods of Sundarbans has been pronounced as Ecologically Critical Area (ECA) by the Department of Environment (DoE) of People's Republic of Bangladesh Government in 1999 under the Environment Conservation Act 1995 [4]. All essentials of Burigoalini, Gabura, Kaikhali, Munshiganj and Ranjan Nagar associations and nuts and bolts of Atulia, Ishwaripur, Nurnagar and Padmapukur Unions of Shyamnagar make up this ECA. Be that as it may, this delicate territory keeps on torment due to over abuse of assets from the mangrove woods. The characteristic deplete inside the upstream regions, beside the most conduit channels, is all finished discouraged by escalated dikes and polders. The Sundarbans was initially estimated (around two hundred years back) to be of concerning 16,700 km². Presently it has dwindled to around 2/3 of the first size. The aggregate land

region today is 4,143 km² (counting Table 6: List of Rare Species in Shyamnagar Upazila, Satkhira District uncovered sandbars 42 km²) and the rest of the water territory of 1,874 km² includes waterways, little streams and channels. Waterways in the Sundarbans are meeting spots of salt water and freshwater. Along these lines, it's an area of change between the freshwater of the streams beginning from the Ganges River and furthermore the saline water of the Bay of Bengal [12].

4.4.7 Biodiversity

Shyamnagar Upazila, Satkhira District is extremely rich in biodiversity. Relatively every town of the upazila was commanded by a decent number of indigenous types of plants, creatures, feathered creatures, well evolved creatures, creatures of land and water and reptiles and so on. In any case, data gathered amid the meeting with the nearby individuals and field visit investigated that the biodiversity status of the upazila is in a decrease slant.

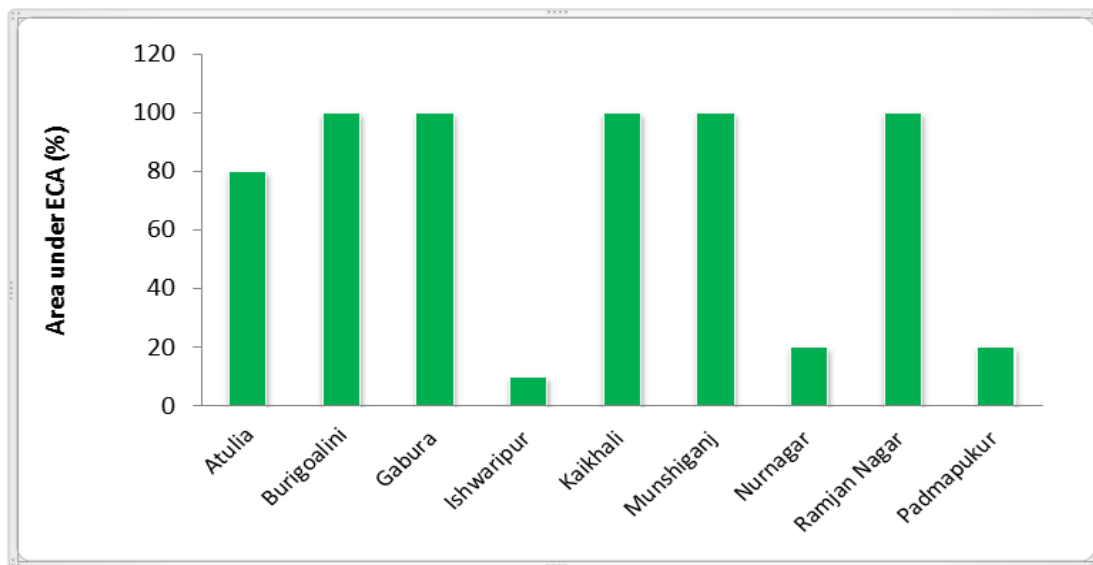


Figure 16: Union-wise Ecologically Critical Area (%)

The upazila was rich in different types of local and transitory flying creatures, in past decades. On account of condition debasement and nonattendance of characteristic timberland, enormous and medium estimated rapacious creatures are as of now lost; leaving various other littler creatures. They are again undermined for their survival and

steadily getting to be wiped out because of loss of their territories. The upazila effectively encountered the elimination of numerous critical widely varied vegetation while some of the rest of the others are powerless against eradication. Arrangements of uncommon species, showed by nearby individuals have been introduced in Table 6.

TABLE 6: LIST OF RARE SPECIES IN SHYAMNAGAR UPAZILA, SATKHIRA DISTRICT

Types	Name of Rare Species
Tree	Neem, Chalta, Jackfruit, Bamboo
Animal/Bird	Crocodile, Shark, Shishu, Vulture
Fish	Koi, Magor, Shing, Boal, Gozar

4.4.8 Environmental Factors at a Glance

The ecological factors, issues and contemplations that affect the Shyamnagar Upazila, Satkhira District are outlined. moreover, expound ecological variables, effects and part insightful spatial conveyance are appeared in Table 7.

TABLE 7: EXHAUSTIVE ENVIRONMENTAL FACTORS, IMPACTS & SECTOR WISE DISTRIBUTION

Environmental Factor	Very High	High	Moderate	Low
Water Salinity	√	√√		
Soil Salinity	√	√√		
Shrimp Gher	√√	√		
Strong Tide		√√	√	
Deforestation	√		√	
Loss of Biodiversity	√		√√	
Loss of Habitat		√	√√	
Mono Culture	√	√	√	
Arsenic Contamination				√√√
Orchard Farming			√	
Fish Cultivation	√√	√		
Chemical Uses			√√√	

Environmental Factor	Very High	High	Moderate	Low
Sand Expansion				√√√
Settlement Expansion		√	√√	
Siltation			√√	√
Nor'wester/Windstorm				√√√
Cyclone				√√√
River Bank Erosion		√√		√
Water Logging		√	√	√
Siltation		√√√		
Monsoon Flood			√√√	
Drought				√√√

4.4 Summary

Populace weight and time are observed to be significant main thrusts to decide arrive utilize changes in People's Republic of Bangladesh. As the nation is progressing towards improvement of industrialization and urbanization, changing over great rural land to non horticultural reason. To defeat the misfortunes endeavors wind up basic to ensure the important weight and spontaneous monetary advancement has prompted debasement of the common biological framework and an expansion in weakness of the waterfront zone. Other than change from normal timberland land and rice field to shrimp lakes is expanding and scattered lodging and business exercises are persistently possessing the farming area in the waterfront territory.

CHAPTER 5

Conclusion, Recommendation and Limitation

5.1 Conclusion

An atmosphere evaluation of Shyamnagar Upazila, Satkhira District was done upheld incorporated approach of Geographic Information System and Remote Sensing, people group meeting, field overview, discourse, key source meeting and writing audit. The investigation investigated different normal and anthropogenic risks or potentially catastrophes in the upazila. Significant issues tended to in Shyamnagar Upazila, Satkhira District are I) violent wind and tidal surges ii) saltiness interruption iii) waterway bank disintegration iv) surge v) siltation vi) wetland debasement vii) spontaneous extension of lodging, foundation and ventures in farming area viii) block field ix) corruption of Ecologically Critical Area and x) loss of biodiversity.

In Shyamnagar Upazila, Satkhira District, there square measure grand possibilities of utilizing ecological assets and biological system administrations. There are a unit wide extents of re-afforestation, transformation, maintainable rural practices, condition cordial shrimp development, and ecotourism. Moreover, archeological legacy of the Shyamnagar Upazila, Satkhira District is rich in verifiable models. In tending to ecological issues, key partners and groups can be sharpened with arrive utilize. A superior entomb organization coordination is basic for the usage of land utilize.

5.2 Recommendation

Land utilize is of prime significance for arrive appropriateness mapping and to counteract ecological corruption of profitable land assets and reestablish the debased land where conceivable. Arrangement of land utilize outline their suggestion would go about as helpful device to protect the earth and resolve irreconcilable situations between the client gatherings and the line offices. Earlier activity with preventive measure taken locally and in Government level can alleviate the ecological corruption. Land debasement could be turned away through an adjusted ecological administration design with individuals' support and appropriate land utilize.

5.3 Limitation

There were so many limitations. I think it is very beginning journey with this project for Bangladesh. We use 30m×30m resolution satellite image on 2008 and 5m×5m resolution satellite image on 2015. Both are not similar resolution. On the other hand we use collected series of Satellite Image for declarer agriculture, water body, etc.

All this reflects my limited experience and opinions. For this, we will appreciate any help and feedback.

APPENDIX

ACEMP	Agro-Climatic Environmental Monitoring Project
AEZ	Agro-Ecological Zone
APT	Automatic Picture Transmission
BLP	Bangladesh Landsat Program
BMD	Bangladesh Meteorological Department
BRDB	Bangladesh Rural Development Board
BTM	Bangladesh Transverse Mercator
c	Clay
°C	Degree Celsius
CARE	Cooperation of American Relief in Everywhere
CHT	Chittagong Hill Tracts
CSE	Computer Science and Engineering
DLRS	Directorate of Land Records and Surveys
DoE	Department of Environment
ECA	Ecologically Critical Area
EGIS	Environment and Geographic Information System
ERDAS	Earth Resources Data Analysis System
ERTS	Earth Resource Technology Satellite
GIS	Geographic Information System
GMS	Groundwater Modeling System
GPS	Global Positioning System
GSB	Geological Survey of Bangladesh
ha	Hectare
HL	High Land
km ²	Square Kilometer
KPH	Kilometers Per Hour
L	Loam
LDN	Land Degradation Neutrality
LGED	Local Government Engineering Department

LL	Low Land
m	Meter
MHL	Medium High Land
MOCHTA	Ministry of Chittagong Hill Tracts Affairs
MoL	Ministry of Land
MSI	Multi Spectral Imager
NLZP	National Land Zoning Project
NOAA	National Oceanic and Atmospheric Administration
NRP	Natural Resources Programmers
OLI	Operational Land Imager
pH	Negative Logarithm of Hydrogen Ion Concentration
RGB	Red-Green-Blue
RHD	Roads and Highways Department
RMS	Root Mean Square
RS	Remote Sensing
SARC	Space and Atmospheric Research Centre
Sic	Silty Clay
Sicl	Silt Clay Loam
Sil	Silt Loam
SIZ	Sundarbans Impacts Zone
SRDI	Soil Resources Development Institute
T. aman	Transplanted Aman
TM	Thematic Mapper
UNB	United News of Bangladesh
UN	United Nations
VIPS	Vax-based Image Processing System
WARPO	Water Resources Planning Organization

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