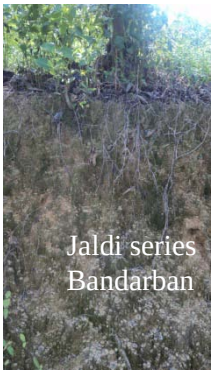
ANNUAL REPORT
2018-2019



SOIL RESOURCE DEVELOPMENT INSTITUTE
MINISTRY OF AGRICULTURE
MRITTIKA BHABAN, FARMGATE, DHAKA

Government of the People's Republic of Bangladesh

ANNUAL REPORT
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2019

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Foreword

Annual Report 2018-2019 reflects all the activities of Soil Resource Development Institute (SRDI) for the period of July 2018 to June 2019. Activities include both new programs and continuation of on-going programs, which are presented in simple and concise form for easy understanding of the users.

SRDI has the mandate to make land and soil resources inventory to make location specific database, land use planning, monitoring of soil fertility and salinity status, develop appropriate ameliorative measures for saline and other form of degraded soils, advice farmers on crop suitability, soil test and crop demand based balanced fertilizer use, and management and conservation of hill soils. SRDI also investigates soil physical, chemical, biological and biochemical processes and thereby develop primary soil resource database through soil survey, remote sensing and GIS technique.

SRDI has prepared Soil and Land Resource Utilization Guide (popularly known as UpazilaNirdeshika) for each Upazila of the country which is a unique database for local level agricultural development planning and a unique tool for local level extension workers. Subsequently, SRDI is preparing Union Sahayika on land type wise crops and fertilizer dose to be used at Union level. SRDI has innovated Online Fertilizer Recommendation System through which farmers' from any part of the country can know fertilizer requirement for different crops they want to cultivate. Saline soil management and sloping land management techniques have also been developed by SRDI.

In addition, this Institute provides support services to other NARS institutes, GO and NGO's by providing data, information, maps and reports on soil and crop loss by natural disasters like flood, drought, cyclone etc by using GIS technique.

I hope the findings and explanations presented under different heads in this report will be of great use to all concerned agencies and beneficiaries working in the field of agriculture.

I would like to extend my heartiest thanks to the officers involved in implementing the annual program for the year 2017-2018 with sincere efforts and to those who worked hard to make this report. Any suggestions or recommendation to develop the report would be highly appreciated.

(Bidhan Kumar Bhander)
Director

Contents

Executive Summary

During 2018-19 fiscal year Updated "Upazila Nirdeshika" survey was carried out at 50 Upazilas where remarkable changes in land use were observed in every Upazila and in some cases changes in land types were also found. It is observed that vegetables cultivation gaining popularity among the farmers. Fifty Upazila Nirdeshika was published.

Changes in soil fertility due to land use and management practices were observed in monitoring sites. In general soils are deficient in organic matter and nitrogen. Changes in

Phosphorus, Potassium, Calcium, Magnesium, Manganese, Sulfur and Boron were erratic. There is also, evidence of lower pH value in many Upazilas.

In Khulna region soil salinity in shrimp cultivated area gradually increased from 1990s. This salinization may be due to the effect of saline water flooding for long period, slow permeability, presence of highly saline ground water at shallower depth almost throughout the year and lack of flashing facility after shrimp harvest etc. River water salinity of Satkhira district is higher than that of Khulna and Bagerhat district. In Satkhira, river water salinity was found highest in May/June whereas in Khulna and Bagerhat it was highest in April/May. Different river water salinity in Khulna and Jashore district of 2019 has been decreased than that of 2018. River water remains saline during April-June as rainfall is low during this period. In Barisal both soil and water salinity was higher compared to previous year due to long droughty condition. During the dry season most of the DTW and STW water remains saline. Generally Barisal experiences lower rainfall during November to March. In Patuakhali, both soil and water salinity starts to increase in January/February attains its peak in March and starts to decrease in June/July at the onset of monsoon. In Chittagong soil salinity starts to increase in December attains its peak in March and then gradually decrease at the onset of monsoon. Water salinity starts to increase in January attains its peak in March-May. In greater Noakhali soil salinity starts to increase in January and attains its peak in March. The highest salinity is observed in Baraitala, Kabirhat over time followed by Abu Majhirghat, Companiganj and Chairman ghat, Hatiya. Water salinity starts to increase in November-December attains its peak in March/April and then gradually decreases. Noakhali canal at Baraitala (Kabirhat), Chhilania river estuary at Jagatpur (Daganbhuiya), little Feni river at Abu Majhirghat (Companiganj) and Chhilania river at Chhilania Bazar (Daganbhuiya) experiences highest salinity in dry season. 2

Some innovative technology for slopping hill soil management was generated by Soil Conservation and Watershed Management Centre (SCWMC), Meghla, Bandarban of which Development of Integrated Watershed Management, Management & Ecomomic value of Murtai Patibet, Selection of different species for controlling soil erosion,Bench Terrace for year round crop production, Gabion check dam for gully erosion control, Jute Geo-Textile for rehabilitating degraded land, Establishment of hedge rows in farmer’s field for soil erosion control are most important.

Some innovative technology for saline soil management was generated by Salinity Management and Research Centre (SMRC), Batiaghata, Khulna of which Maize trasnplanting & Dibbling cultivation under zero tillage, Flying bed for vegetable cultivation,

selection of different suitable vatrities cultivation in saline soil was proved worthy. This technique can be disseminated to other saline areas.

During 2018-19 Static Laboratories conducted soil analyses for both physical and chemical parameters, plant and water analyses for chemical parameters and fertilizer samples analyses under different programs. In Static Laboratories (Central and Regional Laboratories) 27,607 (23, 594 soil samples, 42 water samples, 51 plant samples and 3,920 fertilizer) samples were analyzed. Imparted training to the officers and scientists of SRDI, BARI, BRRI and BINA on Chemical Analyses of Soil and Fertilizers, Identification of Adulterated Fertilizers at Field Level and Soil Sample Collection and Balanced Fertilizer Applications.

Training was imparted to 1200 Officers of SRDI/DAE/CDB/NGO's on various aspects of soil management/capacity building & skill development; 10,470 farmers/fertilizer dealers/ SAAO's/Entrepreneurs of Union Information Center on the use of Upazila Nirdeshika/soil sample collection technique/identification of adulterated fertilizer etc. About 250 local public representatives were briefed on SRDI generated technology for soil health management. Departmental training was provided to nineteen newly recruited BCS (Ag.) cadre and non-cadre officers for 15 days.

Chapter 1: SRDI at a glance

1. Brief Introduction of Soil Resource Development Institute (SRDI):

The Soil Resource Development Institute (SRDI), an attached department to Ministry of Agriculture originated in 1961 as the East Wing Directorate of the Soil Survey Project of Pakistan under Ministry of Agriculture and Works of the then Government of Pakistan. After emergence of Bangladesh, the then east wing office of the Central Soil Resource Institute started functioning as Department of Soil Survey under Ministry of Agriculture and Forest, Government of the People's Republic of Bangladesh. In 1983, Soil Resource Development Institute (SRDI) was established under the Ministry of Agriculture and Forest by reorganizing the then Department of Soil Survey. From 1986 onwards through successful completion of several projects the activities of SRDI has increased manifold. It is now prepared to face the

challenges of future to make breakthrough in crop production through improved soil and nutrient management in Bangladesh.

Vision of SRDI:

The vision of SRDI is to ensure judicious and profitable use of scarce land and soil resources of the country and to protect the soil health.

Mission of SRDI:

The missions of SRDI are

- to inventory soil and land resources of the country,
- to classify them according to their potentiality,
- to generate a detail database on soil, land, water and agro-climate,
- to prepare guidelines (Nirdeshika, Shahayika and pustica) for the best uses of the natural resources,
- to identify and manage problem soils and finally
- to ensure active role in sustainable increase of crop production.

1.1. Functions of SRDI:

The functions of the Soil Resource Development Institute are as follows:

a) Reconnaissance Soil Survey of the whole country on the basis of aerial photo interpretation and field and laboratory investigation of soils;
b) Detailed/Semi-detailed soil surveys of development project areas and research farms for various beneficiary agencies;
c) Soil surveys to evaluate irrigation command areas and cropping potentials;
d) Soil surveys for locating areas of problem soils (e.g., toxic, saline, alkaline or peat soils), soil degradation and erosion (in watershed region) for planning reclamation or watershed management;
e) Correlation of soils conducted under various surveys;
f) Chemical analysis of soil, water and plant samples to verify and clarify the field observation;
g) Analysis of chemical and organic fertilizers to ensure the quality of fertilizers as backup for policy makers;
h) Interpretation of aerial photos, land sat imageries and topographic maps for soil and land use surveys;
i) Preparation of various maps and reports on the above-mentioned surveys for publication;

j) Services to the development agencies by providing basic data on soils, land capability and crop suitability for preparation of both short and long-term agricultural development plans;

k) Coordination with the beneficiary agencies at local, regional or national levels regarding planning and execution of land use development programs;

l) Guides on soils and agricultural development possibilities for each Upazila for agricultural extension and research workers;

m) Provision of soil data for planning irrigation, drainage and reclamation projects;

n) Selection of suitable sites for specific research/development activities;

o) Imparting in-service training to the newly recruited technical officers on soil survey, land use planning, cropping potential, etc. and refreshers training to keep the technical officers of the department apprised and acquainted with the up-to date knowledge;

p) Training of agricultural extension and research workers of various levels on proper utilization of soil survey information. Imparting basic training on various aspects of soils to the students of the agricultural institutions. (Source: Gazette Notification, October, 1983);

q) Render services to farmers and others by analyzing soil, plant, water and fertilizer samples and recommend location specific fertilizer doses on the basis of soil testing and crop requirements;

r) Provide assistance in regular monitoring of soil fertility and land productivity activities throughout the country;

s) Study in soil moisture characteristics to ascertain irrigation needs of different crops;

t) Launch a regular program for the training of field level extension workers regarding soil analytical results, 'Soil Health Card Program', Use of Upazila Guide for the recommendation of fertilizers on the basis of soil analytical data;

u) Investigate soil fertility degradation problem, nutrient related problems of crops, soil moisture stress and constraints in crop production etc.

1.2. Organogram of SRDI:

Earlier SRDI was headed by Director (Grade 2). Later on GoB has approved revised Organogram of SRDI. Accordingly SRDI is headed by Director General (Grade 2). The Institute has 3 wings 4 divisions and 2 research stations.

1.2.1 Field Services wing

Head of field Service wing is Director and under the control of this wing there are 7 Divisional offices and 33 Regional offices. Dhaka, Chittagong, Rajshahi, Khulna, Sylhet, Barisal and Rangpur Divisional Office headed by Chief Scientific Officer. Regional Office headed by Principal Scientific Officer. Regional offices are Tangail, Narshingdi, Munshiganj, Netrokona, Madaripur, Shirajganj, Naogaon, Chapainawabganj, Lalmonirhat, Gaibandha, Thakurgaon, Vhola, Brahamanbaria, Chandpur, Cox'sbazar, Moulvibazar, Sunamganj,

Cumilla, Noakhali, Mymensing, Jamalpur, Faridpur, Jinaidaha, Kushtia, Bogura, Pabna, Jashore, Rangamati, Patuakhali, Gopalgonj, Kishorgonj, Dinajpur.

1.2.1.1. Divisional Offices

Overall planning, co-ordination and supervision of the technical and administrative affairs of the Regional and District Offices. Co-ordination with the beneficiary agencies like NARS institutes, DAE, BADC, Cotton Development Board, etc. at regional level planning and execution of agricultural development programs by providing information on soils, land use, land capability, crop suitability, fertility status, etc. Maintaining liaison with Regional Technical Co-ordination Committee and other allied committee/bodies by providing technical assistance, advice, etc. on rational and sustainable use of soil and land resources.

1.2.1.2. . Regional Offices

Executing and implementing technical activities as per instruction from Head Quarters and Divisionall Office. Updating Upazila Nirdeshika with basic land and soil information for local level agricultural development planning and extension. Delivering farmers service through crops/cropping pattern based fertilizer recommendation. Technology transfer to farmers through block demonstration. Assisting beneficiary agencies like DAE, NARS institutes, BADC, Cotton Development Board, etc. with information and advice on matters related to sustainable land and soil resource utilization. Maintaining liaison with District Technical Co-ordination Committee and District Development Co-ordination Committee by providing information on soil and land resources for agricultural and other development planning.

1.2.2 Natural Resource Management Wing

Soil survey and Land Management Division, Land Resource informatics and support services division, training and communication division, Soil conservation and water shed management center (SCWMC) and Salinity management and Research Center (SMRC) are controlled by Natural Resource Management Wing.

1.2.2.1 Soil survey and Land Management Division

Soil survey and Land Management Division is headed by Chief Scientific Officer. This has three section, namely-Soil and land Classification survey section, Land use planning and Evaluation Section, Correlation Section are headed by Principal Scientific officer.

Function:

Soil Survey planning and co-ordination. Supervision of all technical programs and activities of the component sections. Co-ordination with allied GO/NGO’s in national level agricultural development planning. Correlation and classification of soil and land resources at national

and international level. Responsible for overall technical activities of the division and field investigation of problems related to soils.

1.2.2.2 Land Resource Informatics and Support Services Division

Cartography section, Data processing section and IT section are under Land Resource Informatics and Support Services Division.

Functions

Planning, co-ordination and supervision of all technical programs and activities of component sections. Review and/or editing all technical reports and maps prepared by using base materials and GIS technology. Co-ordination with allied GO/NGO's in research/investigations involving physical and chemical analyses as well as adaptive research activities relating crops and soils. Storage, analyses and regular updating of soil and land resource database. Maintenance and up scaling of Online Fertilizer Recommendation System (OFRS) and Website management. Responsible for overall technical progress of the division.

1.2.2.3 Training and communication division

Training and communication division is headed by Chief Scientific Officer. Human resource division and publication and record section are under this section.

1.2.2.4 **Soil Conservation and Watershed Management Center (SCWMC)** is located at Meghla, Bandarban and headed by Principal Scientific Officer. Responsible for generating technology on soil conservation and watershed management in sloping lands of Hilly areas and conducting research on sustainable hill farming.

1.2.2.5. **Salinity Management and Research Center** (SMRC) is located at Batiaghata, Khulna and headed by Principal Scientific Officer. Responsible for generating data- base on soil and water salinity, identify potential sources of irrigation water, screening of soil tolerant varieties of different crops, innovation of saline soil and water management technologies.

1.2.3. Analytical Services Wing

Soil Testing Division headed by Director(Non-cadre) and consists of 7 Divisional laboratories, 16 Regional Soil Testing Laboratories and 6 Fertilizer Quality Control Laboratories. 7 Divisional laboratories consist of Dhaka, Barishal, Rajshahi, Khulna, Rangpur, Chattagram and Sylhet Divisional Laboratories are headed by Chief Scientific Officer (non-cadre). Regional Soil Testing Laboratories are Cumilla, Noakhali, Mymensingh, Tangail, Jamalpur, Faridpur, Jinaidah, Kushtia, Bogura, Pabna, Jashore, Rangamati,

Patuakhali, Gopalgonj, Kishorgonj, Dinajpur are headed by Principal Scientific Officer(non-cadre).

Functions

Analyses of soil, water, plant and fertilizer samples to evaluate problems related to soil fertility, toxicity, salinity and quality control. Based on soil nutrient status and crop requirements farmers are provided with location specific fertilizer recommendation cards (FRC) through static and 12 mobile soil testing laboratories (MSTL). Analytical services are also provided to researcher/beneficiaries.

1.2.4 Administrative and Financial division

This division is consists of Administration Section, Financial Section, Store Section. Administration section is headed by Assistant Director, Financial section is headed by Accountant, Store Section is headed by Store Officer.

Beside this, Planning and Evaluation section, Upazila Nirdeshika cell is directly controlled by Director General, SRDI.

Chapter 2. Activities of Different Sections of Head Quarters

2.1. Soil and Land Classification Survey Section

2.1.1 Preparation of Kazipur Upazila Soil and Land form Map.

Rationale:

- Popularize the use of soil and landform data among Stakeholders
- Enhance upazila level agricultural development planning with land and soil resource data base.
- Support in planning upazila agricultural rehabilitation program

Methodology

- Upazila Soil and Landform Maps (1:50,000) was digitized.
- Topology for each feature class was done.

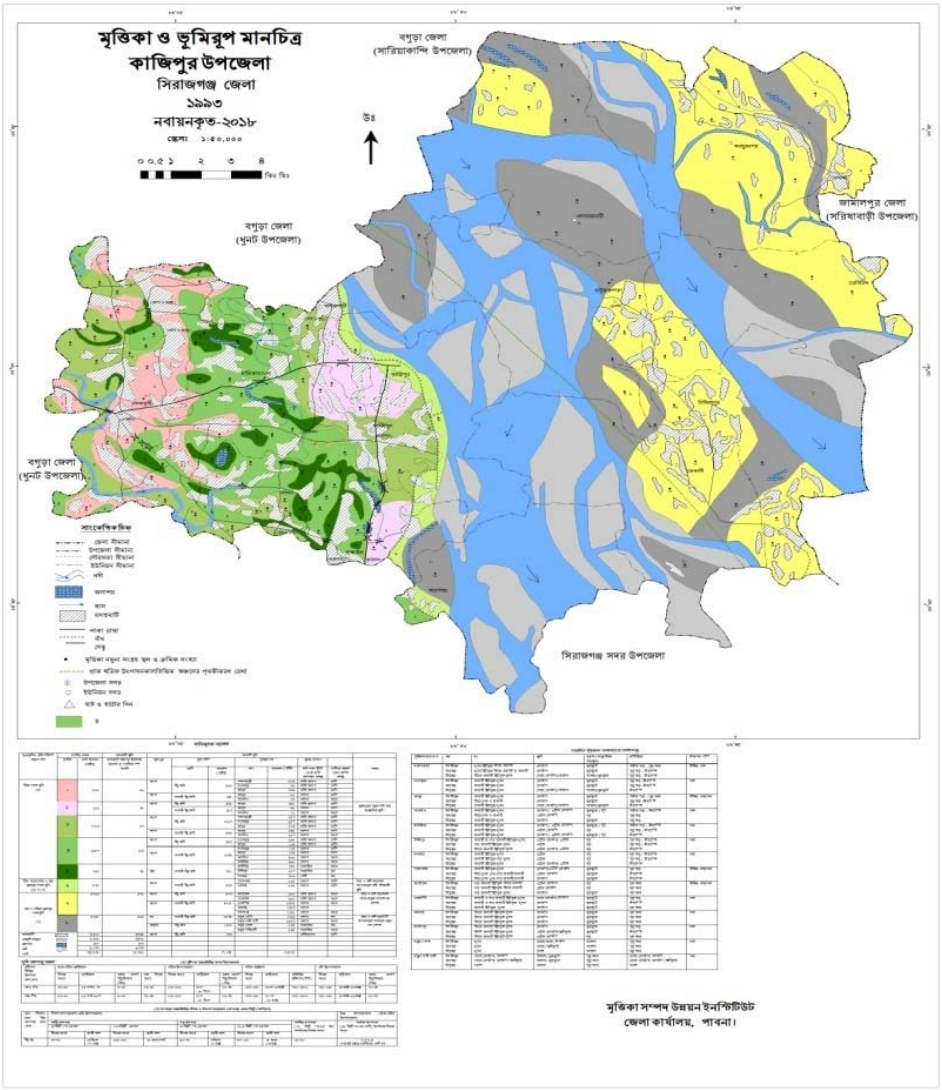


Figure1. Digitized map of Kazipur upazila, Sirajganj

Major Change in Land Types:

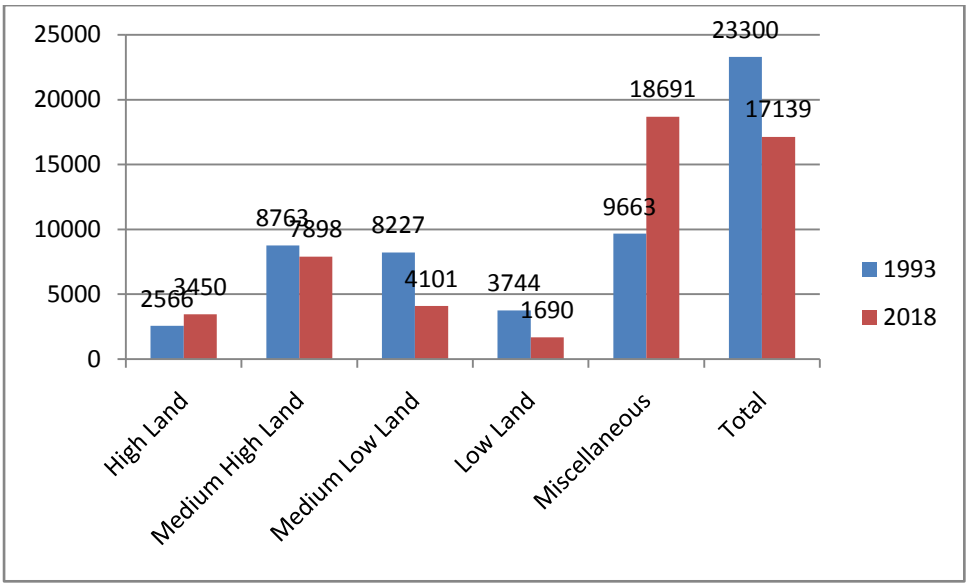


Figure 2. Land type Changes in Kazipur Upazila over time

2.1.2 Preparation of Land and Soil utilization guide of Kazipur Upazila

2.1.2 Execution of Technical Project.

Transfer of Agricultural Technologies to Farmers Level for Increasing Farm Productivity (SRDI Component-6)

Objectives:

- Popularize SRDI's updated Land and Soil Resources Utilization Guide (Upazila Nirdeshika) based balanced fertilizer application in Boro-Fallow-T. Aman pattern to farmer's level.
- Duration: From July 2018 to December 2020
- Total approved budget BDT 26,10,000.00

Technical Progress (July 2018-June 2019)

1. Principal Scientific Officer, Senior Scientific Officer of SRDI and Deputy Director, Upazila Agriculture Officer, Sub Assistant Agriculture Officers of DAE in Cumilla and Tangail districts were contracted and briefed about the methodology and activities of PBRG Sub-Project.
2. Four trial sites were selected with the help of DAE personnel and SRDI scientists. Focus Group Discussions were arranged. Baseline data of 24 farmers of 4 Upazilas (Cumilla Sadar Dakshin, Burichong, Tangail Sadar and Bhuapur) of Cumilla and Tangail districts have been collected.

Table:1 Yield of BRRIdhan58 in four Adaptive Trial plots

Upazila	Soil and Land	Yield (t/ha) (BRRI Dhan 58)	
		Adaptive trial	Control plot
Tangail District			
Tangail Sadar	Sonatala, MHL	8.2	7.1
Bhuapur	Sonatala, MHL	7.5	6.0
Cumilla			
Sadar Dhkshin	Pritimpasha, MHL	6.66	6.4
Burichong	Varella, MHL	6.1	5.8

2.1.3 Execution of Foreign-aided Projects

"Establishing National Land Use and Land Degradation Profile Toward Mainstreaming SLM Practices in Sector Policies (ENALULDEP/SLM)" Project

and "Decision Support for Mainstreaming and Scaling up of Sustainable Land Management (DS-SLM)" Project.

Soil Resource Development Institute (SRDI) is working with the two projects for Land Degradation Assessment in Bangladesh. Department of Environment is the leading Organization for the both project. SRDI is engaged with DS-SLM project to evaluate and prepare a benchmark Land Degradation Map for 2000 in collaboration with FAO and SRDI will make Land Degradation Map for 2015 in collaboration with UNEP and DoE. So far, methodology has been established, benchmark map has almost been prepared and hotspot basis land degradation information has been gathered by the institute.

2.2 Soil Survey Interpretation Section

2.2.1 Responsibilities

1) Soil Survey Interpretation Section is responsible for planning, supervision and execution of soil survey interpretation activities for various beneficiaries engaged in agricultural development
2) Generating basic data on soils, land capability and crop suitability for preparation of short and long term agricultural development plans/projects.
3) Interpretation of soil database for location specific crop suitability assessment and processing of soil survey data for developing and updating GIS based data bank.

2.2.2 Achievements (2018-19) are shown under following heads

Updating Soil Survey program
Upazila Land & Soil Utilization Guide Preparation
Sustainable Land Management
Documentation of SLM technologies through WOCAT software
Annual Performance agreement
NIS (National Integrity strategy) related Activities

Sustainable Development Strategy
Technical Specification Activities
Innovation Activities
Other Activities

2.2.3 Conducting Field Survey for Updating Upazila Nirdeshika

Land and Soil utilization guide of Shahrasti Upazila and Sadar Dakshin Upazila (Cumilla) has been prepared.

2.2.4 APA activities

Drafting and finalization of APA 2019-20 as per format supplied by MoA/CD, GOVT. of BD.

Supervision of Drafting and finalization of APA 2019-20 for field offices.

Three (3) Quarterly, One(1)Half yearly Monitoring Progress report of APA 2018-19 submitted to MoA.

Document collection, preservation and submission to MoA as well as Expert pool of MoA as evidence of activities performed according to APA 018-19 during Half yearly performance evaluation by Expert pool of MoA.

1st, 2nd ,3rd & final draft of APA for 2019-20 submitted to MoA.

One day training programme is being arranged for the field officers on Drafting APA 2019-20.

Attended the meeting & Lab training at MoA/CD on regular basis as focal point of SRDI APA.

2.2.5 National Integrity Strategy (NIS) Activities

Drafting and finalization of NIS work plan 2018-19 as per format supplied by MoA/CD.

Supervision of Committee formation, Drafting and finalization of NIS work plan 2018-19 as per format supplied by MoA/CD for field offices.

Three (3) Quarterly Monitoring Progress report of NIS 2018-19 submitted to MoA.

one day training programmed is imparted for the field officers on NIS.

Drafting of NIS work plan for 2019-20 is progressing on.

Attended the meeting & training at MoA regularly as focal point of SRDI NIS Committee.

2.2.6 ICT Activities

Updating SRDI Website regularly.

E-filing : Worked as Master trainer and helping implementation of e-filing in SRDI Head office.

E-GP : Working for implementation of E-gp in SRDI.

Attending ICT related training program organized by ITC cell MoA, ICT Division, Access to Information (a2i), PMO.

Performing ICT related administrative job.

2.2.7 Technical Specification Activities

Specification for Chemicals, Glassware's, Lab equipment, Office equipment, Office Furniture, Vehicles are prepared for the year 2017-18 as per demand given by the Director, SRDI and PD of Projects/ Programs.

2.2.8 Innovation Activities

Performing secretarial job for Innovation team of SRDI

Participating Innovation training/ workshop conducted by a2i, MoA, CD

Other activities:

Preparation of Monthly Progress Report of SRDI & send it to MoA in due time.

Preparation of Annual Progress Report of SRDI 2017-18.

Preparation of IPoA Quarterly Progress Report and send it to MoA in due time.

Preparation of Opinion of SRDI on Review of Agricultural Sector Performance under the Sixth Five Year Plan and send it to MoA in due time.

Progress on SDGs Action Plan

Preparation of Monthly Progress Report on SDGs Action plan of SRDI & send it to MoA in due time.

Preparation of Annual Progress Report on SDGs Action Plan of SRDI upto December 2018 & send it to MoA in due time.

Participation in workshop/seminar etc. on SDGs implementation organized by BARC, GED, SRDI, BENBAIS, National Planning & Training Academy etc.

2.3 Soil Correlation Section

2.3. 1 Function of Soil Correlation Section

1. Planning, supervision & execution of soil series & other taxonomic units
2. Maintenance of uniform standard of methodology on soil survey works and & records of soil information
3. Correlation of soil surveys done by another agencies / consultancy
4. Development & maintenance of the soil museum

2.3. 2 Achievements

Display of Newly Collected Seven Soil Monoliths:

Monoliths were originally collected and funded by “Climate Change Impact Study in Seven Mouzas of Bangladesh Project.”

Physiography: Tista Meander Floodplain
AEZ: 3
Soil Series: Gangachara
Place ofcollection: Joyrampur, Mithapukur, Rangpur.

Physiography: Brahmaputra Floodplain
AEZ: 8
Soil Series: Melandaha
Place of collection: Kamta, Dhankara, Manikganj

Figure: 3 Monoliths of Gangachara, Melandaha Soil Series

Physiography: Meghna Estuarine Floodplain
AEZ: 18
Soil Series: Chandina
Place of collection: Aliswar, Sadar Dakshin, Cumilla

Physiography: Surma- Kusiyara floodplain
AEZ: 20
Soil Series: Balaganj
Place of collection: Mollargaon, Dakshin Surma, Sylhet

Figure 4. Monoliths of Chandina, Balaganj Soil Series

Physiography: Barind Tract
AEZ: 27
Soil Series: Amnura
Place of Collection:
Gopalpur, Paba Rajshahi

Figure: 5. Monolith of Amnura Soil Series

Figure 6. Processing of Soil Monoliths in Soil museum, SRDI

2.3.3 P reparation of Upazila land and soil resource utilization guide

Table 2. Facts and figures in 'Land and Soil Utilization Guide of Juri Upazila, Moulvibazar

Findings:

Land form	Land type	Land slope class	Area (ha)	%
Low hill	High land	very steep	9507	40
Low hill	High land	steep	794	3
Terrace	High land	moderate/gentle slope	871	4
Ridge	Medium High land	nearly level	4420	19
Basin	Medium High land	nearly level	1176	5
Basin	Low land	nearly level	1778	8
Basin	Very low land	nearly level	1124	5
Homestead	High land	level	227	1
	Miscellaneous	-	3459	15
		Total	23356	100

Table 3. Area and extent of land type wise soil group

Physiography	**Land type**	**Soil Series**	**Area (ha)**	**%**
Northern and Eastern hills	High land	Baralekha	7563	32.4
	High land	Khadimnagar	2738	11.7
	High land	Srimangal	871	3.7
North–Easten Piedmont Plain	Medium High land	Bijipur	710	3
	Medium High land	Pritimpasha	3047	13
	Medium High land	Manu	663	2.8
	Medium low land	Pritimpasha	337	1.4
	Medium low land	Manu	554	2.4
	Medium low land	Juri	113	0.5
Surma- Kusiyara Flood Plain	Medium low land	Goainghat	86	0.4
	Medium low land	Fagu	86	0.4
	Low land	Fagu	1778	7.5
	Very Low land	Terchibari	375	1.6
	Very Low land	Hakaluki	749	3.2
Hometead	High land	-	227	1

Miscellaneous	-	-	3459	15
	total		23356	100

2.4 Training Section

Training Section usually arrange various types of local training for human resource development for the officers and staffs of different levels. This includes in-service training of the newly recruited officers on various aspects of technical activities of the institute, training on administrative matters, office management, ICT and financial management for officers and staffs. This section made arrangement of foundation training for newly recruited officers also made arrangement for the officers and staffs of SRDI to take part in different training programs of local and international level as well as in different workshops and seminars for a number of occasions held in different organizations upon their invitations. Training section mainly provided logistic and technical support for smooth functioning of those training programs. A good number of officers participated at Radio talk in different agricultural programs of Bangladesh Betar. Training Section communicated with Bangladesh Betar and proposed names of officers with titles of radio talk to be broadcasted in collaboration with AIS and DAE.

In-house Training Plan & Achievement-2019

Grade	No. of Officers & Staff	Target		Achieved (up to May, 18)	% of Achievement against target to May'18
		Per person	Total		
2-9	*150	60	8,220	7,891	96
10-12	18	60	1,080	982	91
13-17	212	60	12,720	11,956	94
18-20	135	60	8,100	7,614	94

Activities done by the Training Section for the year 2018-2019

(i) Higher Education

Sl. No.	Degree	No. of Officers					Remarks
		On-going	Obtained Scholarship	Received permission	Requested for permission	completed	
1	PhD	12	1	1	0	5	-

(ii) Foundation Training for 4/6 Months

Sl. No.	No. of Trainees		
	BCS (Ag.) Cadre	Non-Cadre	Total
1	1	4	5

(iii) Special Training Arranged by Training Section

Sl. No.	Courses	No.	Duration
1	Departmental Training for newly recruited officers	25	15days
2	Training on Innovation in Public Service	60	2 days
3	Training on Innovation in Public Service	22	5 days
4	E-filling (End user & Admin)	52	3 days
5	Training on NIS & APA	30	2 days
6	Using Google Map through GIS Software	40	1 days
7	Climate change impact assessment on AEZ and crop production	35	1 days

In-house Training Topics

- The Public Employee's Discipline (Punctual Attendance), 1982
- The Govt. Servants (conduct) Rules, 1979
- The Govt. Servants (Discipline and Appeal)
- The General Provident Fund Rules, 1979.
- Keeping Service Records
- Store Management
- Public transport purchase, maintenance and repairing
- Use of office equipment and other electronic items
- Cleanliness and dress-up
- Office Security
- Drafting letters and notes with special emphasis to Promito Bangla Bananer Nyom)
- National Integrity Strategy
- Administrative Tribunal Act, 1980 & Rule, 1982
- Digital filing
- Foreign Tour, Lien
- Fundamental right as per constitution and service rule
- Liveries, allocation and conditions
- Food Based Nutrition
- APA, Citizen Charter
- Maintenance and repairing of vehicles, driving rules and regulations
- Delegation of Financial Power
- Different types of advances.
- General Principles of Seniority
- ACR
- Treatment facilities for Govt. Servants

(v) Training/Seminar attended abroad

Sl.No.	Courses	No.	Duration	Country
1	Climate smart Agriculture	1	12 days	Philippines
2	Second lab manager' meeting of the South-East Asia Laboratory NETwork (SEALNET 2.0)–Quality improvement in Asian laboratories: towards standardization and harmonization of soil analysis and their interpretation'	1	5 days	India
3	Soil and Water Management	1	45 days	Egypt
4	Integrated Nutrient Management for Improving Soil Health and Crop Productivity	2	5 days	India
5	International Conference on Earth Science and Geo Science 2018	1	2 days	Netherlands
6	Training Course on Hybrid Rice Technology for Bangladesh	2	60 days	China
7	Asia-Oceania GEOSS Netwark for Capacity Building and Regional Sustainable Development : Agriculture and Disaster Monitoring in Hindu Kush Himalaya	1	5 days	Nepal

(v) Local Training Programs attended by officers

Sl.	Courses	No.	Duration	Institute
1	Advanced ICT Management	4	15 days	NATA
2	Climate Smart Agriculture	2	5 days	
3	Commercial Farm Management	1	5 days	
4	Development Management	1	5 days	
5	Eco-Friendly Plant Protection Techniques	2	5 days	
6	Food Security	4	5 days	
7	Good Governance	1	5 days	
8	Human Resource Management	1	5 days	
9	Innovation In Public Service	1	5 days	
10	Integrated Water Resource Management in Agriculture	1	5 days	
11	Modern Office Management	1	10 days	
12	Project Appraisal and Formulation of Development Project	2	5 days	
13	Public Financial Management	2	5 days	
14	Public Procurement Procedure	2	15 days	
15	SDG, NIS and APA	2	5 days	
16	Soil Health Management	4	5 days	
17	ToT on Teaching Method	4	5 days	
18	Budget Management Specialist (BMS)	2	19 days	Public Finance Bangladesh
19	iBAS++	2	1days	

Sl.	Courses	No.	Duration	Institute
20	Diploma in Project Planning Development and Management	1	120 days	Ministry of Planning
21	WOCAT	2	3 days	DOE
22	(TIBAS)-32	1	12 days	FIMA
23	Internal Audit	1	5 days	
24	Training for Accounts Staff of Executives	3	5 days	
25	Financial Management	4	6 days	BIM
26	Financial Management & Public Procurement	2	6 days	
27	Project development and Management	4	5 days	
28	Public Procurement Management	4	6 days	
29	Agronomic Research and Technology Development of Major Crops	1	5 days	
30	Farm Mechanization and Conservation Agriculture	1	5 days	BARI
31	Production and Post Harvest Management of Horticulture Crops	1	5 days	
32	Production Technologies, Storage and Processing of tuber Crops	2	5 days	
33	Soil Fertility and Nutrient Management of Major Crops	4	6 days	
34	Awareness Building on Act and Policies of Bangladesh Agriculture	2	3 days	BARC
35	Climate change, Carbon Sequestration and Adaptation Strategies	3	3 days	
36	Intellectual Property Right	1	2 days	
37	Project development and Management	1	5 days	
38	Research Methodology	1	12 days	
39	Technical Report Writing and Editing	2	5 days	
40	Training on Climate Smart Agriculture	1	2 days	
41	Training on Forestry and Agroforestry	1	2 days	
42	Use of Fertilizer Inspection Manual	1	3 days	
43	Food based Nutrition	4	5 days	BIRTAN

(vi) Local Training Programs attended by staffs

Sl.	Courses	No.	Duration	Institute
1	Fundamental training courses	10	14 days	RPATC
2	Fundamental training courses	9	21days	
3	Office Management & ICT	3	12 day	
4	Information & Communication Technology (ICT)	1	12 days	
5	Behavior & Discipline	2	5days	
6	E-nothi Course	2	5day	

Sl.	Courses	No.	Duration	Institute
7	Financial Management	2	12 days	

(vii) Local Workshop/Seminar attended

Sl.	Title	No.	Duration	Institute
1	Technical workshop on the accuracy assessment and quality checking of land cover change from 2000 to 2015	1	5 days	Department of Forest
2	Principle and application of GIS in Agriculture Planning and decision making	1	4 days	BARC
3	sustainable land Management	1	2 days	FAO
4	Project development and Management	1	5 days	BARC
5	Research Review and Planning workshop on soil Management program NARS institute 2018	1	3 days	
6	Asia open Access	1	2 days	

Other Activities Done by Training Section

- Preparing DPP and all corresponding works of the projects submitted to MoA
- Successful implementation of E-Filing Program
- APA & SDG Action Plan Activities
- Preparing different Reports, Booklets, and Directory etc.
- Innovation activities of SRDI
- Execution of PM's commitment
- Procurement work of SRDI
- Organogram, recruitment rules, different cases etc.

Training Plan

- Making arrangement of all types (mentioned earlier) of local and foreign trainings as per instruction of authority
- Strengthening training activities
- Arrangement of in-service training for the newly recruited officers
- Arranging short training course on Establishment Manual-2008, Jatio Shuddhachar, ICT, Nutrition, Office Management etc.
- Arranging some refreshers course

Arrangement of radio talks on different topics related to soil fertility, soil management etc. for Bangladesh Betar, BTV and other

2.5 Data Processing and Statistical Section

Activities of DPSS

- Engaged in-Planning, organizing and execution of GIS related works
- Digitizing, preparation and printing of different types of thematic maps.
- DPSS is responsible for storage, maintenance and security of database on soil and land resources and other information's.

Major type of works done by DPS Section

1. GIS related
2. ICT related
3. Others

1. **GIS related**
   - Preparation of geo-referenced and geo-projected database
   - Map Preparation & Printing

2. **ICT related**
   - Server management
   - Data processing & uploading
   - Others

3. **Others**

   Server & LAN management
   - Proper monitoring, maintenance and troubleshooting of the server and internet related devices (server, router, bandwidth controller, switch etc.) of SRDI.
   - At present there are 96 internet connections in SRDI Head office.

   Data Processing & Uploading
   - Soil Chemical data are generalized, processed and prepared for uploading
   - This uploaded data is used for Online Fertilizer Recommendation System (OFRS) software.

   Others Support
   - Hardware maintenance and trouble shooting for different computer of SRDI Head office.
   - Take part with proper logistic support in different agricultural fair.
   - Technical assistance and necessary support provided to prepare different on demand report of MoA, BARC and others.
   - Technical assistance and necessary support provided for sharing GIS meta data and developing the website (www.gis.gov.bd) for Bangladesh Geographical Information System Platform (BGISP) organized by BBS.
   - Final report with digital map of Kaliakair upazila survey has been done.
   - Upazila survey of Munshiganj Sadar is being carried out by one officer of DPS section.

- Report for Woman Development has been prepared and send to MoA.
- Involved in the innovation activities of SRDI.
- Technical assistance provided to the students, scientists and other visitors for research purpose.

Map Preparation & Printing

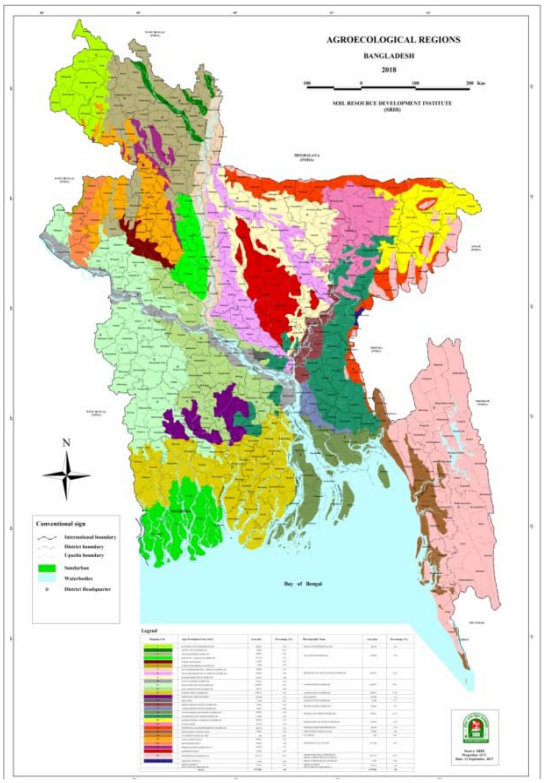


Figure 7. AEZ & Physiography area

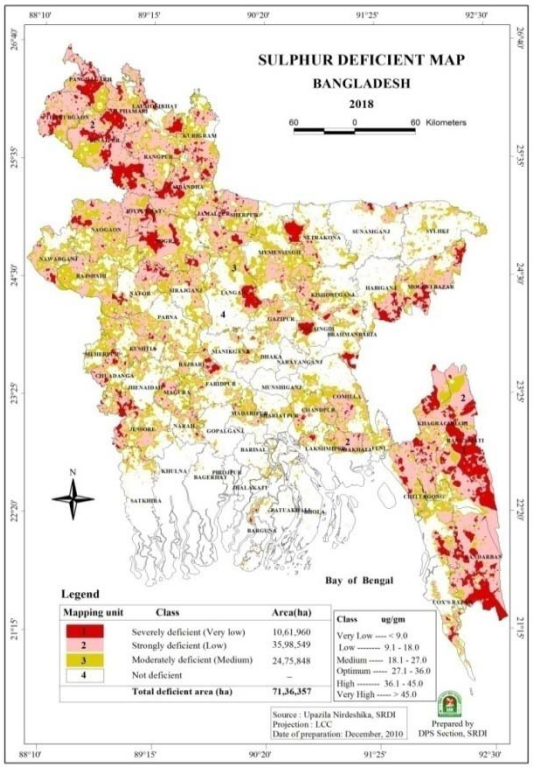


Figure 8. Sulphur Deficient Area

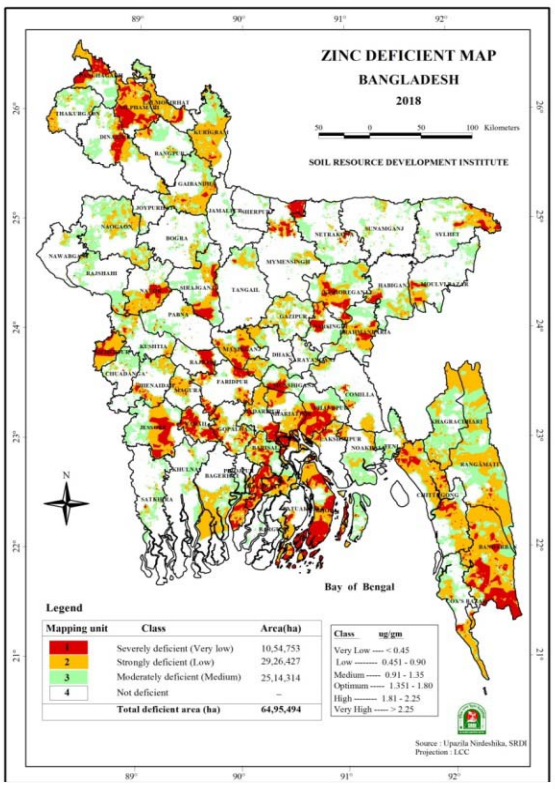


Figure 9. Zinc Deficient Area

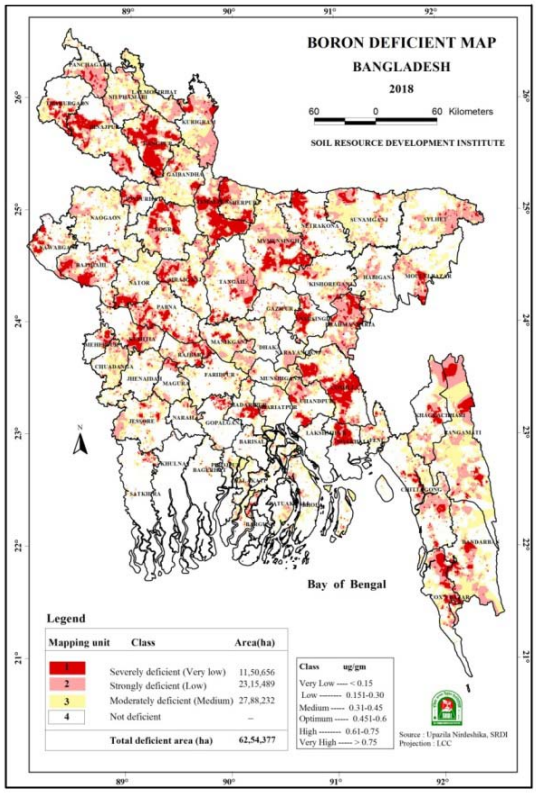


Figure 10. Boron Deficient Area

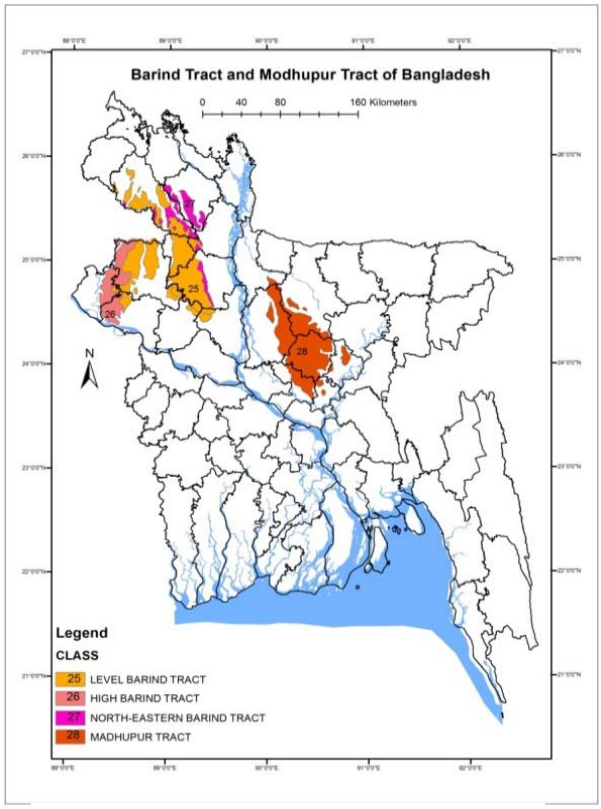


Figure 11. Partial AEZ Map

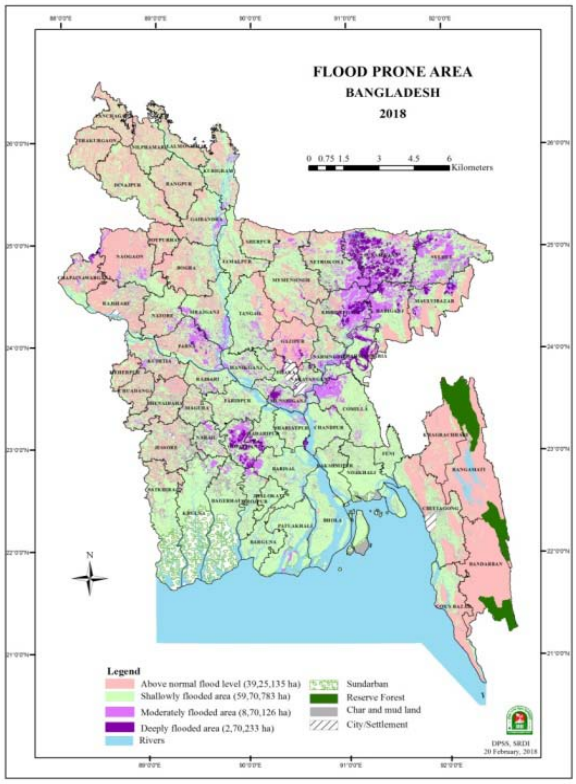


Figure 12. Flood Prone Area (on land type)

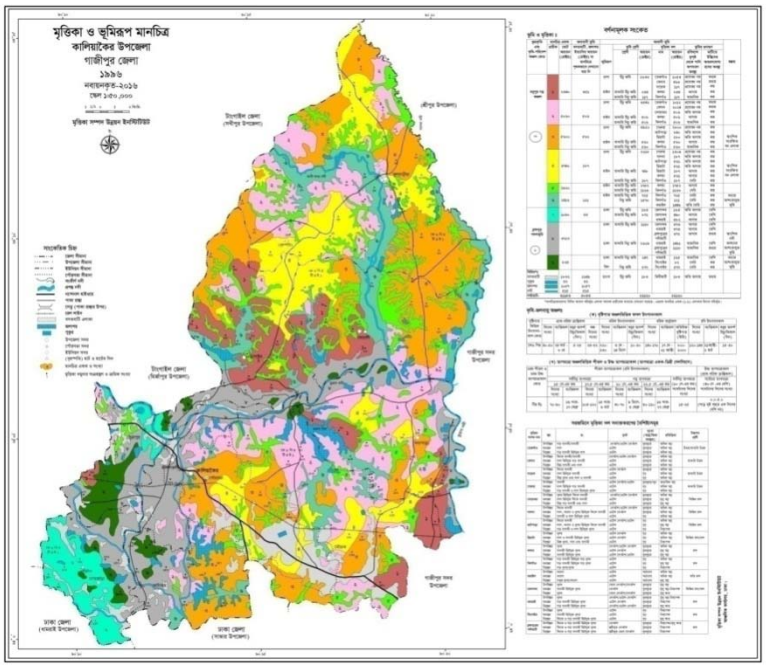


Fig:13. Digitized map of KaliakoirUpazila

Data processing & uploading for OFRS (APA target 50 Updated upazila/ year)

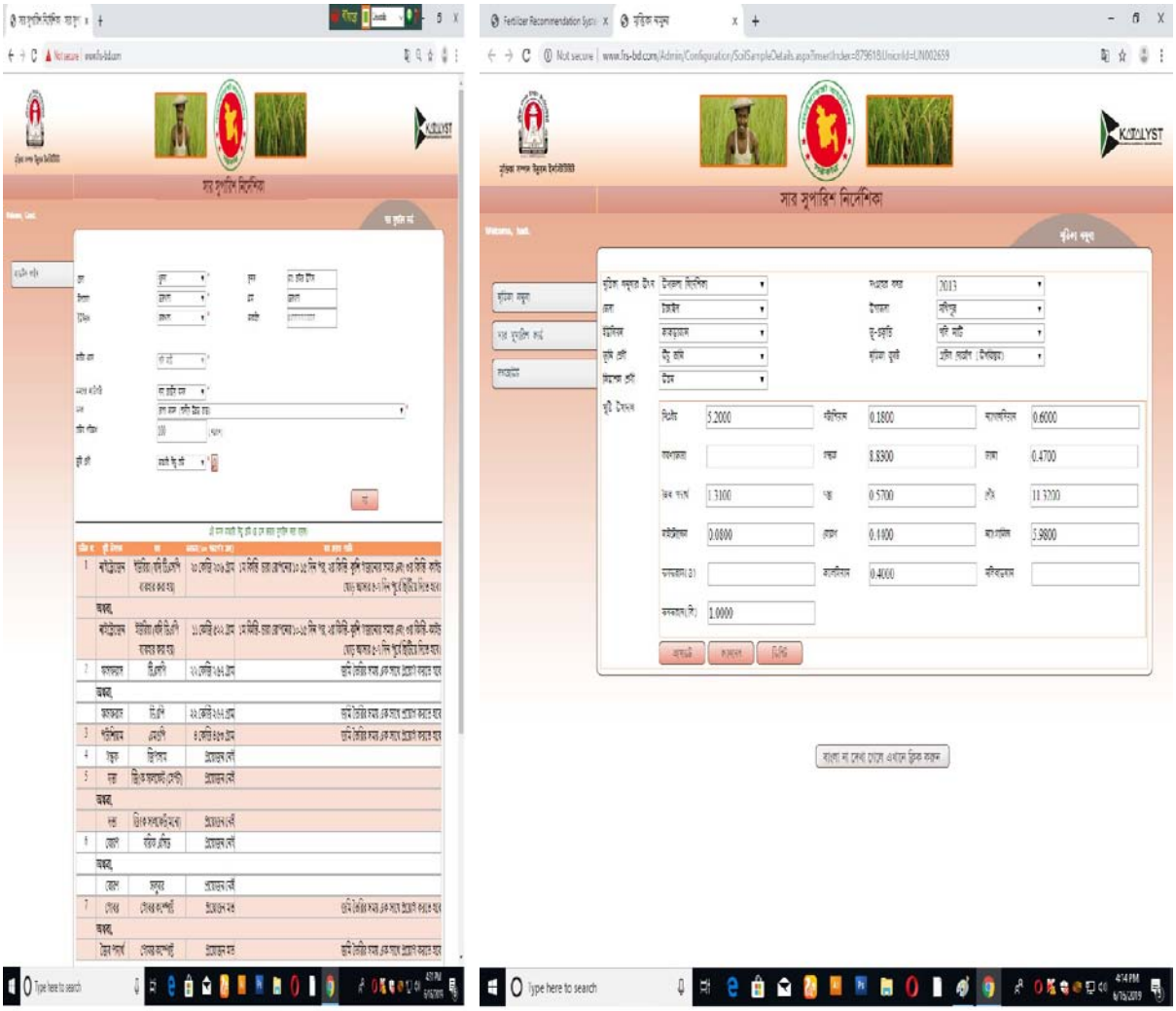


Figure 14. Data processing & uploading to OFRS

2.6 Activities of Cartography Section

2.6.1 Map Digitizing:

Name of map	Division/District/Upazila Name	Map Scale	Nos.
a) Soil and Land type Map	Bijoynagar, Kurigram Sadar, Sreepur, Sirajdikhan, Kaukhali, Alfadanga, Shahrasti, Palash,	1:50000	17

	Amtali, Madhukhali, Monpura, Kathalia, Homna, Kaliakair, Kaligang, Juri & Dhamrai Upzila		
b) Mouza Wise Upazila Map	Bijoynagar, Kurigram Sadar, Sreepur, Sirajdikhan, Kaukhali, Alfadanga, Shahrasti, Palash, Amtali, Madhukhali, Monpura, Kathalia, Homna, Kaliakair, Kaligang, Juri & Dhamrai Upzila	1:50000	17
c) Index Map	Bangladesh	1:1000000	1

2.6.2.Map Tracing:

Name of map	Upazila/union/Mouza Name	Map Scale	Nos.
a) Soil and Land type Map	Bijoynagar, Kurigram Sadar, Sreepur, Sirajdikhan, Kaukhali, Alfadanga, Shahrasti, Palash, Amtali, Madhukhali, Monpura, Kathalia, Homna Kaliakair, Kaligang, Juri & Dhamrai Upzila	1:50000	17
b) Mouza Wise Upazila Map	Bijoynagar, Kurigram Sadar, Sreepur, Sirajdikhan, Kaukhali, Alfadanga, Shahrasti, Palash, Amtali, Madhukhali, Monpura, Kathalia, Homna, Kaliakair, Kaligang, Juri & Dhamrai Upzila	1:50000	17

2.6.3. Map Checking & Correction:

Name of map	Upazila/ Union	Map Scale	Nos.
Various Map	Various Upazila andUnion Map	1:50000	35

2.6.4. Map Printing:

Name of map	Upazila/ Union	Map Scale	Nos.
Soil and Land form Map	Various Upazila and Union Map	1:50000	180

2.6.5.Map Colouring

Name of map	Upazila/Union	Map Scale	Nos.

Upazila and Union	Soil and Landtype Map of VariousUpazila&Union.	1:50000	115

2.6.6.Area Calculation

Name of map	Upazila Name	Map Scale	Nos.
Soil and Landtype Map	Various Upazila and Union Map	1:50000	22

2.6.7.Collection of base materials from SOB

Name of map	Upazila Name	Photo scale	Nos.
a) Topo Map	Collected from SOB	1:25000	460
d) Do	Latest Topo Map Collection from SOB under processing	1:25000	500

2.6.8. Provide Cartographic Support to the (SRDI) activities, beneficiary Organization, Research Institute and Universities.

2.7. Publication and record section

Publication and Record Section of the Technical Support Services Division is responsible for printing, publication and distribution of soil survey and other technical reports and their overall maintenance, to keep liaison with outside agencies for the above mentioned purpose and to assist the authority in technical & administrative support on different aspect.

2.7.1 Achievements:

a) Sale of publications (2018-2019):

Title	Name of the organization		Quantity	Purpose
Land & Soil resources Utilization guide.	Govt.	LUDEP/SLM, Dept. of Environment,	33	Research
		CRDP,LGED	09	,,
		DAE, Jessore	03	,,
	Autonomous	IWFM, BUET	03	Academic
		Bangladesh Tea Board	04	Research
		MIST, Mirpur	02	Academic
		BAU, Mymensingh	06	,,

		NATP, BARC	01	,,
	Non Govt.	Hellen Keller International	06	Research
		ACI Formulation	01	,,
		IRRI	03	,,
	Personal		64	,,
		Total =	135	

2.7.2 Collection:

Book/Bulletin/Report 85 copies
PhD Thesis 01copy
Training calendar 01 copy
Bangladesh Economic Review 2017, MoF, 01 copy
Prepare Proposal of Nomination for Bangabandhu National Agriculture Award, Ekushe Award, Independent Award, Begum Rokea Award etc.

2.7.3 Distribution:

Annual Report 2013-14 ,10 copies
Best Practices and Case Studies of Disadvantaged Agro-ecological Zones June 2014, 10 copies
Soil Salinity in Bangladesh 2000, 05 copies
Land & Soil resources Utilization guide 10 copies
Union Shohayeka 10 copies
Shohoz Krishi Projukti Hat Boi 0 5 copies
Shorojomine Vejal Shar Shonaktokoroner Poddoti 10 copies
Matir Nomuna Shongroho Poddoti 20 copies
Sharer Man Shonkranto Protibedon 20 copies
Khamar Pokur Projukti 230 copies
SRDI Poster10 copies
Digital Poddotite Shar Shuparish 80 copies
Vrammoman Mrittika Porikhagar Shorboda Krishok Shebay Niyogito 80 copies
Matir Shastho Valo Holay Foshol Bare Odhik Hare 80 copies
Porikolpitovabe Paharer Dhalu jomi bebohar Korun 80 copies

Reader Services-Provided library services for 160 readers
Book Purchased 271 Copies

2.8 Achievements of Central Laboratory

Central Laboratory is operated under the Support Service Division at the Headquarter of Soil Resource Development Institute. Central Laboratory conducts physical and chemical analyses of soil samples collected by the survey team of SRDI and also the samples sent by different beneficiary organization including farmers, DAE, NARS organizations, universities, entrepreneurs and NGOs. Central Laboratory also conducts chemical analyses of water, plant and fertilizer samples.

Goal:

Ensure judicious and profitable use of scarce land and soil resources of the country and keep environmental pollution related to agrochemicals at zero level.

Objectives of Central Laboratory:

1. To evaluate soil fertility status and recommend balanced fertilizer doses for different crops based on soil analytical results and crop requirements through static laboratory.
2. To analyze soil samples for preparing different soil use guides (Upazilla Land and Soil Resources Utilization Guide, Union Sahaika etc).
3. To popularize soil test based fertilizer application, to build awareness about the benefits of using balanced fertilizer and to advertise the facilities for soil testing and fertilizer recommendation through MSTL.
4. To analyze water and plant samples received from different organizations.
5. To analyze fertilizer samples in order to assist the agricultural system to control adulteration of fertilizers.

Program of Central Laboratory:

6. Analyses of soil, water, plant and fertilizer samples.
7. Supply Fertilizer Recommendation Cards to the farmers
8. Research Program
9. Publications
10. Training
11. Quality control of fertilizers
12. Advisory service to the farmers

Soil, water and plant sample analyses in fiscal year 2018-2019

Central Laboratory analyzed a total of 2929 soil samples having 24498 elements, 27 water samples having 103 elements, 32 plant samples having 72 elements under different programs namely Farmer's Service through Static Laboratory and Mobile Soil Testing Laboratory, Preparation of Land and Soil Resources Utilization Guides and supporting research activities of different institutes. To evaluate the fertility status of soil samples both macro and micro nutrient elements as well as pH and organic matter content of the soil were determined. Analyses of water and plant samples were done accordingly.

Worldwide established standard methods were followed to analyze different nutrient elements. e.g. Micro Kjeldahl method for nitrogen determination, Bray and Kurtz method (if pH is <7.0) or Olsen method (if pH is >7.0) for phosphorus determination, Turbidimetric method for sulfur determination, Ammonium acetate extraction method using Flame photometer for potassium determination, Walkley and Black Wet Oxidation method for organic matter determination etc.

Table 4: Analytical progress of soil, water and plant samples in Central Laboratory

Name of Program	Soil		Water		Plant	
	Samples	Elements	Samples	Elements	Samples	Elements
Upazilla Nirdeshika	574	8610	-	-	-	-
Farmers service	432	2433	1	2	-	-
SRDI	39	398	-	-	-	-
Government Organizations	761	4239	20	91	32	72
Others	319	2386	6	10	-	-
MSTL	804	6432				
Total	2929	24498	27	103	32	72

Division wise soil samples analyzed in the fiscal year 2018-2019

Central laboratory of SRDI analyzed 818 soil samples having 5395 elements in Dhaka division, 67 soil samples having 306 elements in Rajshahi division, 44 soil samples having 391 elements in Khulna division, 117 soil samples having 1350 elements in Chattogram division, 24 soil samples having 175 elements in Barishal division, 91 soil samples having 346 elements in Rangpur division, 40 samples having 431 elements in Sylhet division and 350 samples having 1062 elements in Mymensingh division under three different categories namely Farmer (Category–1), Government and autonomous organizations (Category-2) and Non-government organizations (Category-3).

Table 5: Division wise distribution of analyzed soil samples with elements under three different categories

Name of Divisions	Farmer (Category-1)		Government & Autonomous Organizations (Category-2)		Non-Government Organizations (Category-3)		Total	
	Samples	Elements	Samples	Elements	Samples	Elements	Samples	Elements
Dhaka	125	1015	483	2777	210	1603	818	5395
Rajshahi	6	48	10	30	51	228	67	306
Khulna	36	327	-	-	8	64	44	391
Chattogram	27	221	85	1094	5	35	117	1350
Barishal	20	143	-	-	4	32	24	175
Rangpur	9	72	73	202	9	72	91	346
Sylhet	12	111	-	-	28	320	40	431
Mymensingh	197	496	149	534	4	32	350	1062

Farmers Service (Fertilizer Recommendation Card) through MSTL

Through this program 794 soil samples having 6352 elements were analyzed in the fiscal year 2018-2019. 390 soil samples of 8 upazilas were analyzed in Rabi-2018 and 404 soil samples of 8 upazilas were analyzed in Kharif-2019.

Table 6: Name of Upazila and number of samples analyzed

Season	Upazila(District)	Number of Samples	Number of Elements
Rabi	Atpara (Netrokona)	52	416
	Nagarpur (Tangail)	67	536
	Dhonbari (Tangail)	49	392
	Modon (Netrokona)	40	320
	Gafargaon (Mymensing),	44	352
	Hossainpur (Kishoreganj),	49	392
	Araihazar (Narayanganj),	39	312
	MunshiganjSadar (Munshiganj)	50	400
Kharif	Singair (Manikganj)	50	400
	Gazaria (Munshiganj)	50	400
	Monohordi (Narsingdi)	51	408
	Delduar (Tangail)	53	424
	Gopalpur (Tangail)	50	400
	Tarakanda (Mymensingh)	50	400
	NetrokonaSadar (Netrokona)	50	400
	Karimganj (Kishoreganj)	50	400
Total		794	6352

Soil sample analyses under Land and Soil Resources Utilization Guide updating program:

Preparation of Upazilla wise Land and Soil Resources Utilization Guide is one of the most valued program of SRDI. SRDI created huge database on soil chemical data through this program. Soil nutrient maps, Online Fertilizer Recommendation System are developed based on the database created through this program. This is very popular and wide accepted by the agricultural community of Bangladesh and these guides are used as day to day toll by the extension.

Objectives: 1. To find the nutrient status of different soil groups of an upazila.
2. To observe the changes in soil fertility status over the time.

Table 7: Total analyzed samples under Land and Soil Resources Utilization Guide (UpazilaNirdeshika) updating program

Name of Upazilla	District	Division	No. of samples
Kalihati	Tangail	Dhaka	106
Dhamrai	Dhaka	Dhaka	133
Dewanganj	Jamalpur	Mymensingh	98
Kaliakoir	Gazipur	Dhaka	154

Sirajdikhan	Munshiganj	Dhaka	83

Soil Fertility status of five Upazilas was determined in Central Laboratory in the fiscal year 2018-2019. Among them comparative fertility status of Kalihati Upazila (1998-2018) is discussed in the report.

Change in soil fertility status of Kalihati Upazila from 1998-2018

A comparative study on the change of fertility status of soil of Kalihati Upazila during 1998 and 2018 was done by Central Laboratory.

Table 8: Change in soil fertility status (pH, OM, N, P) of Kalihati Upazila during 1998-2018

Nutrient elements												
Soil Group	**Land type**	**pH**		**OM**		**Change in Percent**	**N**		**Change in Percent**	**P**		**Change in Percent**
		1998	**2018**	**1998**	**2018**		**1998**	**2018**		**1998**	**2018**	
Tejgaon	HL	5.3	5	1.5	0.9	-40	0.003	0.05	1567	20	0.36	-98
Sonatola	HL	6.3-7.9	4.6-5.2	0.76	1.83	141	0.007	0.09	1186	10	1.98	-80
Sonatala	MHL	5.6-8.0	4.2-5.7	1.13	1.94	72	0.006	0.1	1567	23	2.6	-89
Melandaha	HL	6.2-8.0	4.8-5.2	1.01	1.54	52	0.006	0.08	1233	21	4.07	-81
Melandaha	MHL	-	5-5.7	-	1.8	-	-	0.09	-	-	2.74	-
Silmondi	HL	-	4.6-5.1	-	2.46	-	-	0.12	-	-	2.16	-
Silmondi	MHL	6.1-7.9	4.7-5.6	1.3	2.73	110	0.006	0.14	2233	22	3.42	-84
Silmondi	MLL	5.0-7.0	4.8-5.4	1.3	2.7	108	0.007	0.14	1900	19	2.43	-87
Dhamrai	MHL	5.3-7.8	6.1-6.3	1.6	2.57	61	0.006	0.13	2067	18	2.51	-86
Ghatail	MLL	-	4.8-5.4	-	2.69	-	-	0.14	-	-	2.11	-
Ghatail	LL	5.2-6.7	4.5-5	1.5	2.75	83	0.007	0.14	1900	20	1.7	-92
Savar Bazar	LL	5.8-6.7	4.9-5.4	1.8	3.25	81	0.006	0.16	2567	26	7.74	-70
Balina	VLL	6	4.9	4.8	2.25	-53	0.007	0.11	1471	20	1.73	-91
Brahmaputra Jamuna sandy alluvium	MHL	7.7-7.9	6.4	0.3	0.4	33	0.003	0.02	567	17	3.04	-82
Brahmaputra Jamuna sandy alluvium	MLL	7.6-7.7	6.7-6.8	0.4	0.37	-8	0.004	0.02	400	13	6.43	-51
Brahmaputra Jamunasilty alluvium	MHL	7.4-8.1	6.4-6.5	1	1.25	25	0.006	0.06	900	17	6.93	-59
Brahmaputra Jamunasilty alluvium	MLL	7.8-8.4	6.5-6.7	0.9	1.11	23	0.005	0.06	1100	20	12.19	-39

The soil pH of Kalihati upazila declined significantly in almost all soil groups except Tejgaon high land.

During this period positive change in soil organic matter status was observed in Sonatala highland and medium highland, Melandaha highland, Silmondi medium highland and medium lowland, Dhamrai medium highland, Ghatail low land, Savar Bazar low land, Brahmaputra-Jamuna sandy alluvium medium highland, Brahmaputra –Jamuna silty alluvium medium high land and medium low land whereas negative change was observed in Tejgaon highland, Balina very lowland and Brahmaputra -Jamuna sandy alluvium medium lowland.

It was observed that positive change in soil nitrogen status occurred in all soil groups of Kalihati Upazila. (Table-8)

Negative change in soil phosphorus status is observed in all soil groups of Kalihati Upazila.

Table 9: Change in soil fertility status (K, S, Zn, B,) of Kalihati Upazila during 1998-2018

Nutrient elements													
Soil Group	**Land type**	**K**		**Change in Percent**	**S**		**Change in Percent**	**Zn**		**Change in Percent**	**B**		**Change in Percent**
		1998	**2018**		**1998**	**2018**		**1998**	**2018**		**1998**	**2018**	
Tejgaon	HL	0.13	0.17	31	3	8.53	184	3.9	1.47	165	0.25	0.45	-40
Sonatola	HL	0.25	0.13	-48	21	8.13	-61	3.4	1.51	125	0.29	0.24	141
Sonatala	MHL	0.26	0.11	-58	31	7.09	-77	2.7	1.6	69	0.51	0.21	72
Melandaha	HL	0.25	0.11	-56	29	1.54	-95	3.4	0.78	336	0.98	0.46	52
Melandaha	MHL	-	0.13	-	-	1.84	-	-	0.74	-	-	0.45	-
Silmondi	HL	-	0.11	-	-	7.63	-	-	1.24	-	-	0.1	-
Silmondi	MHL	0.25	0.13	-48	36	9.86	-73	3	1.35	122	0.56	0.26	110
Silmondi	MLL	0.28	0.15	-46	50	13.34	-73	2.4	1.12	114	0.54	0.16	108
Dhamrai	MHL	0.28	0.15	-46	40	3.44	-91	3	0.9	233	0.92	0.71	61
Ghatail	MLL	-	0.11	-	-	16.08	-	-	0.92	-	-	0.14	-
Ghatail	LL	0.27	0.14	-48	79	10.6	-87	4.6	1.49	209	0.4	0.15	83
Savar Bazar	LL	0.23	0.14	-39	118	5.29	-96	2.6	1.26	106	0.1	0.46	81
Balina	VLL	74	0.16	-100	94	21.73	-77	2.7	1.65	64	0.82	0.38	-53
Brahmaputra Jamuna sandy alluvium	MHL	0.22	0.05	-77	7	0.64	-91	2.5	0.41	510	1.24	0.67	33
Brahmaputra Jamuna sandy alluvium	MLL	0.18	0.05	-72	15	0.16	-99	1.5	0.31	384	0.86	0.28	-8
Brahmaputra Jamunasilty alluvium	MHL	0.24	0.16	-33	22	12.18	-45	2	0.52	285	0.42	0.73	25
Brahmaputra Jamunasilty alluvium	MLL	0.32	0.17	-47	67	11.26	-83	2.7	0.48	463	0.63	0.37	23

It is observed that negative change in soil potassium status occurred in all soil groups except Tejgaon high land.

Negative change in soil sulphur status is observed in all soil groups of Kalihati Upazila except Tejgaon high land.

Positive change in soil zinc status occurred in all soil groups of KalihatiUpazila.

During this period positive change in soil boron status is observed in Sonatala high land and medium high land, Melandaha high land, Silmondi medium high land and medium low land, Dhamrai medium high land, Ghatail low land, Savar Bazar low land, Brahmaputra-Jamuna sandy alluvium medium high land, Brahmaputra-Jamunasilty alluvium medium high land and medium low land whereas negative change is found in Tejgaon high land, Balina very low land and Brahmaputra-Jamuna sandy alluvium medium low land.

Table 10: Change in soil fertility status (Ca, Mg, Cu, Fe, Mn) of Kalihati upazila during 1998-2018

Nutrient elements															
Soil Group	Land type	Ca		Change in Percent	Mg		Change in Percent	Cu		Change in Percent	Fe		Change in Percent	Mn		Change in Percent
		1998	2018		1998	2018		1998	2018		1998	2018		1998	2018	
Tejgaon	HL	4.7	12.3	162	1.67	2.92	75	2.9	1.57	-46	143	111.64	-22	35.4	19.6	-45
Sonatola	HL	6.2	17.53	183	0.88	2.75	213	3.9	2.64	-32	44	128.72	193	35.3	57.4	63
Sonatala	MHL	7.8	18.08	132	1.62	2.78	72	7.3	2.95	-60	130	130.26	0	40.8	59.5	46
Melandaha	HL	8.8	17.23	96	1.55	1.92	24	6.7	2.76	-59	149	76.39	-49	44.4	24.1	-46
Melandaha	MHL	-	18.35	-	-	1.96	-	-	2.99	-	-	59.47	-	-	17.42	-
Silmondi	HL	-	25.03	-	-	2.44	-	-	3.77	-	-	131.95	-	-	35.67	-
Silmondi	MHL	8.5	19.38	128	1.75	3	71	9.8	4.47	-54	149	144.11	-3	53.5	20.8	-61
Silmondi	MLL	11.1	14.41	30	2.17	1.88	-13	14.1	6.63	-53	193	154	-20	60.5	25.1	-58
Dhamrai	MHL	10.5	23.86	127	2.36	4.62	96	13.3	4.75	-64	153	56.32	-63	57.5	16.1	-72
Ghatail	MLL	-	15.75	-	-	2.03	-	-	5.48	-	-	184.61	-	-	63.91	-
Ghatail	LL	12.3	17.97	46	2.58	2.32	-10	21.8	7.17	-67	241	200.52	-17	67.8	18.7	-72

Savar Bazar	LL	11.2	23.5	110	1.94	2.11	9	14.8	4.27	-71	343	187.75	-45	100.9	22.5	-78
Balina	VLL	19.2	9.6	-50	4	1.53	-62	18.4	4.42	-76	199	191.26	-4	100	31.1	-69
Brahmaputra Jamuna sandy alluvium	MHL	5.5	3.74	-32	0.8	0.37	-54	3.3	0.15	-95	15	5	-67	16.7	4.64	-72
Brahmaputra Jamuna sandy alluvium	MLL	3.8	5.84	54	1.21	0.64	-47	3.7	0.12	-97	21	6.62	-68	16.4	4.86	-70
Brahmaputra Jamunasilty alluvium	MHL	6.9	17.23	150	1.28	2.11	65	5.5	3.1	-44	23	24.67	7	29	5.18	-82
Brahmaputra Jamunasilty alluvium	MLL	9.5	15.82	67	1.08	1.89	75	7.6	3.18	-58	38	18.74	-51	25.5	7.25	-72

Positive change in soil calcium status is observed in all soil groups except Balina very lowland and Brahmaputra-Jamuna Sandy alluvium medium highland.

Positive change in soil magnesium status is observed in Tejgaon highland, Sonatala highland and medium highland, Melandaha highland, Silmondi medium highland, Dhamrai medium high land, Savar Bazar low land, Brahmaputra-Jamuna silty alluvium medium highland and medium lowland whereas negative change is observed in Silmondi medium lowland, Ghatail lowland, Balina very lowland and Brahmaputra-Jamuna Sandy alluvium medium highland and medium lowland.

Negative change in soil copper status is observed in all soil groups of Kalihati Upazila.

It is observed that negative change occurred in soil iron status in all soil groups except Sonatala highland and medium highland and Brahmaputra-Jamuna Silty alluvium.

Negative change in soil manganese status is observed in maximum soil groups of Kalihati Upazila except Sonatala high land and medium highland.

FERTILIZER QUALITY ASSESSMENT IN CENTRAL LABORATORY

INTRODUCTION

Fertilizer is one of the most important and cost worthy agricultural input. Agriculture of the country is moving subsistence to commercial agriculture. During the last 30 years the agricultural sector of the country has developed significantly, from traditional to intensive system, production is also much higher than the previous years; poverty level decreased remarkably and all other development indicators are in positive trend. However, there has been pressure on natural resources, particularly on soil fertility. Degradation of soil quality in terms of losing its base materials and nutrient content is a serious threat in this aspect. Cropping intensity increased 2-3 folds in the last 3 decades. Now it is impossible to grow crops without chemical fertilizers. Organic fertilizer along with chemical fertilizers may be a good tool to protect nutrient mining due to high cropping intensity. Use of chemical fertilizers is increasing day by day. In 1988-1989only 11,35,062 tons Urea; 4,15,993 tons Phosphates; 94,172 tons MOP; 60,745 tons Gypsum; 2,800 tons Zinc fertilizers were used where as in 2016-2017 fiscal the amount of Urea, Phosphates, MOP, Gypsum and Zinc fertilizers were used 23,65,000 tons; 13,49,000 tons; 7,81,000 tons; 2,50,000 tons and 57,000 tons respectively (FRG, 2018). The use of Urea increased almost 2 folds but other fertilizers like Phosphates, MOP, Gypsum and Zinc increased almost 4, 8, 4 and 20 folds by last three decades. So there creates a huge chemical and organic fertilizer market in Bangladesh. A group of vested people make this valuable agricultural input adulterated in various ways to get more benefit which negatively impacts on our agricultural production. To ensure quality of fertilizers to the farmers level Government of the People's Republic of Bangladesh has taken initiatives by giving the responsibility of testing fertilizer quality through some designated organizations including Soil Resource Development Institute (SRDI). SRDI is playing a vital role to ensure quality of fertilizer with the assistance of DAE, law and order enforcing agencies. In this case Central Laboratory of SRDI has played the major role in fertilizer quality control activities by analyzing and providing report to the stake holders like DAE and other law and order enforcing agencies. Fertilizer adulteration may be one of the causes for yield decreasing and lack of farmer confidence in fertilizer recommendations. The fertilizer recommendations made by NARS using FRG are based on pure and appropriate concentration of N, P, K, S, B, and Zn; but adulterated fertilizers might not provide expected results to the farmers, thus the farmers are deprived of the satisfactory yield of a crop and farmers have to buy and apply more fertilizers to their field for yield maximization. Moreover continuous application of adulterated fertilizers may have adverse effect on soil nutrient balance which affects soil fertility. Quality of fertilizers played an important role to ensure desirable crop yield as well as crop quality. Considering the above perspectives Central Lab of SRDI determined the nutrient content and other physical properties of different fertilizers in 2018-2019 fiscal year received from different Government, Projects and Private organizations for ensuring the quality of fertilizers. Based on the testing of different fertilizers the study have been made to quantify the degree of adulteration of different fertilizers in 2018-2019; to determine the nature of adulteration and to determine the rate of adulteration among the different stake holders.

MATERIALS AND METHODS

Most of the fertilizer samples were collected by the Department of Agriculture Extension (DAE) personnel's for ensuring quality fertilizers at field level following the protocol of Fertilizer Inspection Manual, 2003 and sent to the Central laboratory for quality audit. Generally the fertilizer inspectors of DAE collected those samples of fertilizers were suspected to be adulterated. DAE also sent fertilizer samples to the laboratory from ports to ensure the quality of imported fertilizers. For new registration and renewal of registration DAE also sent fertilizer samples to the Central laboratory. Central laboratory of SRDI also determine the fertilizer quality under some research program, private organization, law and order enforcing agencies etc. The nutrient content of Fertilizer samples were determined SRDI labs following methods recommended by Ministry of Agriculture (Manual for Fertilizer Analysis, 2003) and provided the fertilizer quality report to the respective stake holders.MS Excel software was used to analyze the data.

RESULTS AND DISCUSSIONS

It was observed that almost all major fertilizers were quality fertilizer. It was found that in 2018-2019 fiscal year among macronutrient fertilizers like Urea, Sulfate of potash (SOP), Ammonium sulfate, Mono ammonium phosphate (MAP)fertilizers were 100% standard as per government specification. On the other hand other macronutrient fertilizers like TSP, DAP, MOP, Gypsum, Magnesium sulfate, Dolomite and NPKS fertilizers were 89 %, 96%, 99%, 92%, 99%, 94% and 52% standard as per government specification. It was observed that the nutrient content of all the strait macronutrient adulterated fertilizers like TSP, DAP, MOP, Gypsum, Magnesium sulfate, Dolomite were almost up to the Government approved specification except NPKS but the presence of unwanted toxic materials like cadmium (Cd), lead (Pb), Nickel (Ni), Chromium (Cr) made them adulterated to some extent. The highest adulteration was found in NPKS mixed fertilizer (48%) at different degrees of adulteration. The total number of macronutrient fertilizers received and analyzed in 2018-2019 fiscal year was 752. The highest number of individual fertilizer received and analyzed was Magnesium sulfate which was 171 followed by DAP which was 138 (Table 11). It was found that micronutrient fertilizers were more adulterated compare to macronutrient fertilizers. In case of micro nutrient fertilizer only 19 % Zinc sulfate mono hydrate, 32 % Zinc sulfate heptahydrate was quality fertilizers. Here the adulteration was observed not only in nutrient content but also the contamination of toxic materials like cadmium (Cd), lead (Pb), Nickel (Ni), Chromium (Cr). It was not mentioned the level of adulteration of fertilizer in this report. Nutrient content of fertilizers below the Government approved specification were termed as adulterated. On the other hand, 74 % Chelated zinc, 95 % Solubor boron, 78% Boric acid, 88% Fertibor, 68 % Organic fertilizers and 93% Compound fertilizers like Nutraphos N, Nutraphos-24, Silvamix, Silvagen etc. were standard fertilizers. The total number of micronutrient fertilizers received and analyzed was 570. The highest number of individual micronutrient fertilizer received and analyzed was Zinc sulfate monohydrate which was 202 followed by Organic fertilizer which was 105 (Table 12). Other than Zinc sulfate mono hydrate and Zinc sulfate heptahydrate all other micronutrient fertilizers quality was improved than the previous years. It is mentionable that except registration, only suspected and

imported fertilizers are sent to laboratory for testing its quality by the stake holders. It is also note worthy that for performing the quality control activities by the government through SRDI, DAE and other law and order enforcing agencies the rate of adulteration in major fertilizers is almost absent. Moreover, Government has given about 9 thousand crore taka as subsidy in Urea, TSP, DAP and MOP fertilizers in 2018-2019 fiscal years (Bangladesh Economic Review, 2019). The huge amount subsidy helped in reducing the price of fertilizers that indirectly helped in ensuring quality fertilizers at field level.

Table 11: Macronutrient fertilizer quality and quantity in 2018-2019analyzed at Central Laboratory

Fertilizer	**Quality**	**Adulterated**	**Total**	**Quality (%)**	**Adulterated (%)**
Urea	73	0	73	100	0
TSP	73	9	82	89	11
DAP	132	6	138	96	4
MOP	81	1	82	99	1
SOP	19	0	19	100	0
NPKS	17	16	33	52	48
Ammonium sulfate	31	0	31	100	0
Mono ammonium phosphate (MAP)	7	0	7	100	0
Dolomite	15	1	16	94	6
Gypsum	92	8	100	92	8
Magnesium sulfate	170	1	171	99	1
Total	**710**	**42**	**752**	**-**	**-**

Table 12: Micronutrient fertilizer quality as analyzed in 2018-2019 in Central Laboratory

Fertilizer	Quality	Adulterated/ Sub standard	Total	Quality (%)	Adulterated/Sub standard (%)
Zinc sulfate	39	163	202	19	81

(monohydrate)					
Zinc sulfate (heptahydrate)	19	41	60	32	68
Chelated Zinc	31	11	42	74	26
Solubor	69	4	73	95	5
Boric acid	40	11	51	78	22
Fertibor	7	1	8	88	13
Compound fertilizer	27	2	29	93	7
Organic	71	34	105	68	32
Sub Total-2	**303**	**267**	**570**	-	-

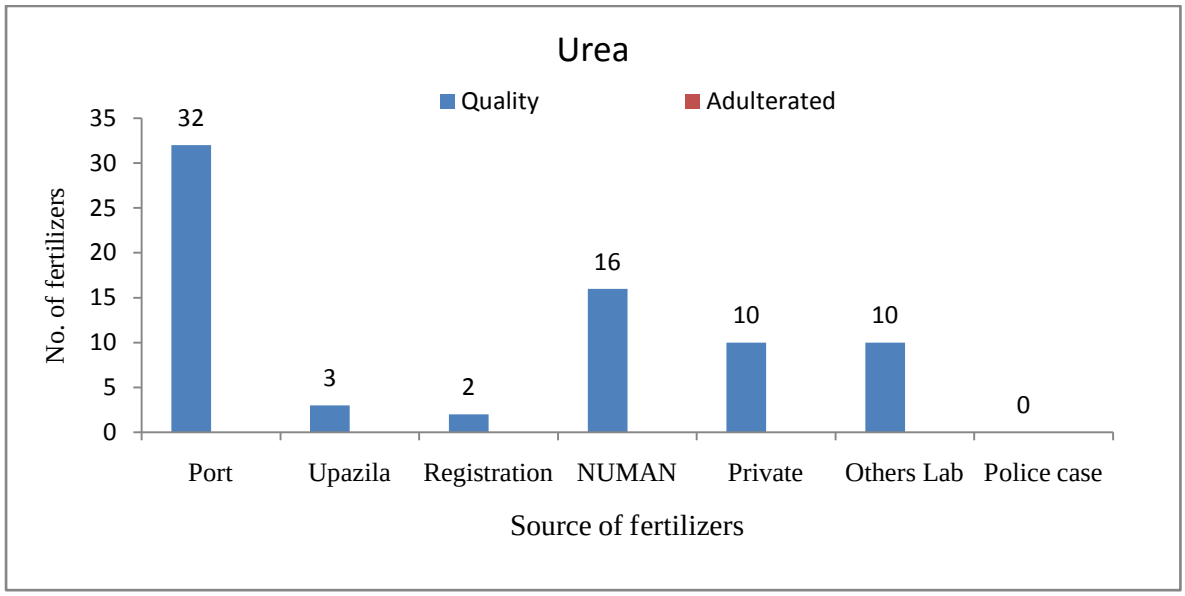


Figure 15: Urea fertilizer quality as tested from different stake holders' sample (2018-19)

Source wise individual fertilizer sample and quality

The total number of urea fertilizer analyzed was 73 in 2018-2019 (Table 11). The highest number (32) of urea fertilizer was received from Chittagong port. Irrespective of different sources there was no adulteration was observed (Figure 15) in urea fertilizer. The total number of TSP fertilizer analyzed was 82 in 2018-2019 (Table 11). The highest number (46) of TSP fertilizer was received from Upazila. There was no adulteration found in TSP fertilizer samples from Upazila and research program (NUMAN). In case of registration of 8 TSP fertilizer samples were found adulterated out of 11 samples which were the maximum due to heavy metal content and in private samples only one TSP fertilizer sample was adulterated out of 7 samples (Figure 16). The total number of DAP fertilizer analyzed was 138 in 2018-2019 (Table 11). No adulteration was found in DAP fertilizer samples from field level, NUMAN research program, private entrepreneur and Ministry of Agriculture (MoA). The highest adulteration in DAP was found in case of registration. For registration out of 13 samples 4 samples were adulterated and only one imported and others Lab sample was adulterated (Figure 17). The total number of MOP fertilizer analyzed was 82 in 2018-2019 (Table 11) and the highest number of MOP fertilizer samples was received from Upazila which was 34. Only one MOP fertilizer sample was adulterated found from field level sample (Figure 18). The total number of SOP fertilizer analyzed was 19 in 2018-2019 (Table 11). The highest number (13) of SOP fertilizer was received from Chittagong port. Irrespective of different sources there was no adulteration was observed in SOP fertilizer (Figure 19).

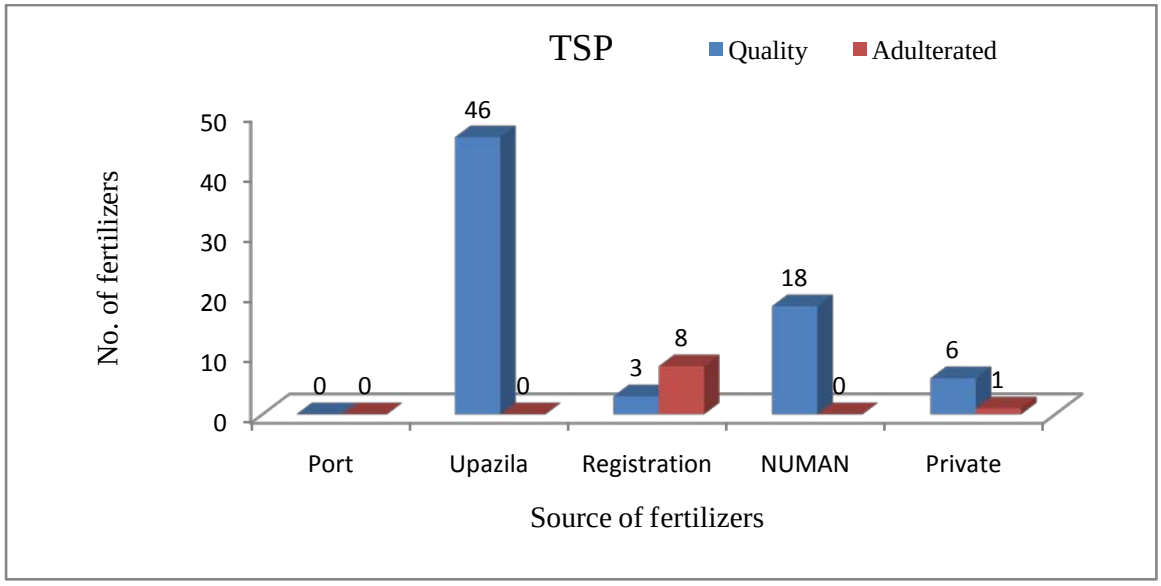


Figure 16. TSP fertilizer quality as tested from different stake holders sample (2018-19)

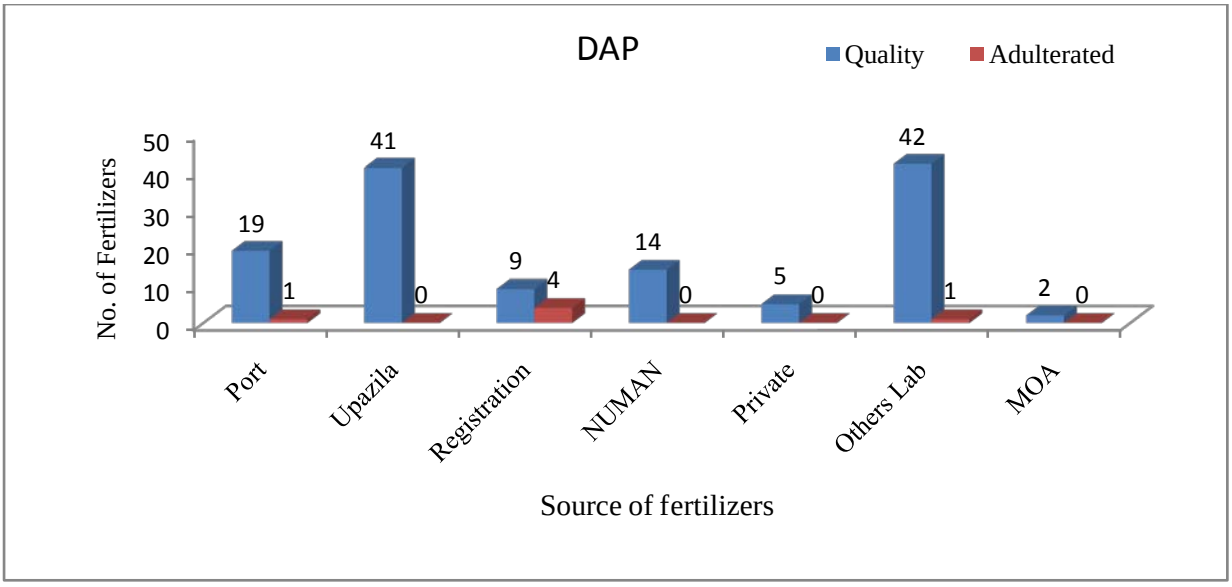


Figure 17. DAP fertilizer quality as tested from different stake holders' sample (2018-19)

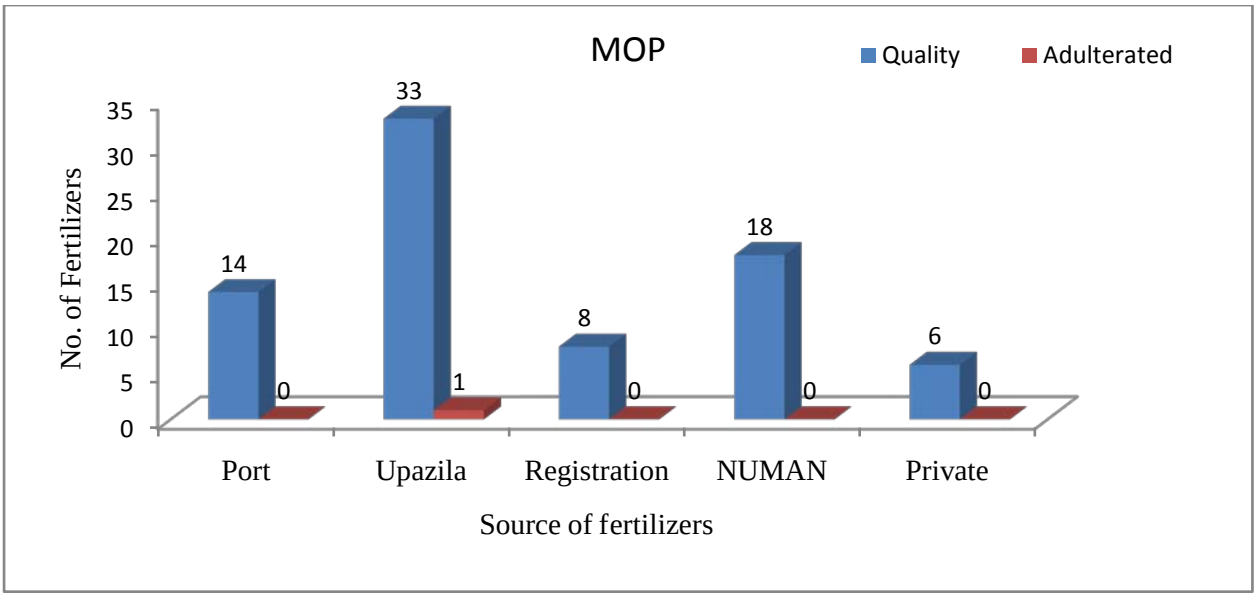


Figure 18. MOP fertilizer quality as tested from different stake holders samples (2018-19)

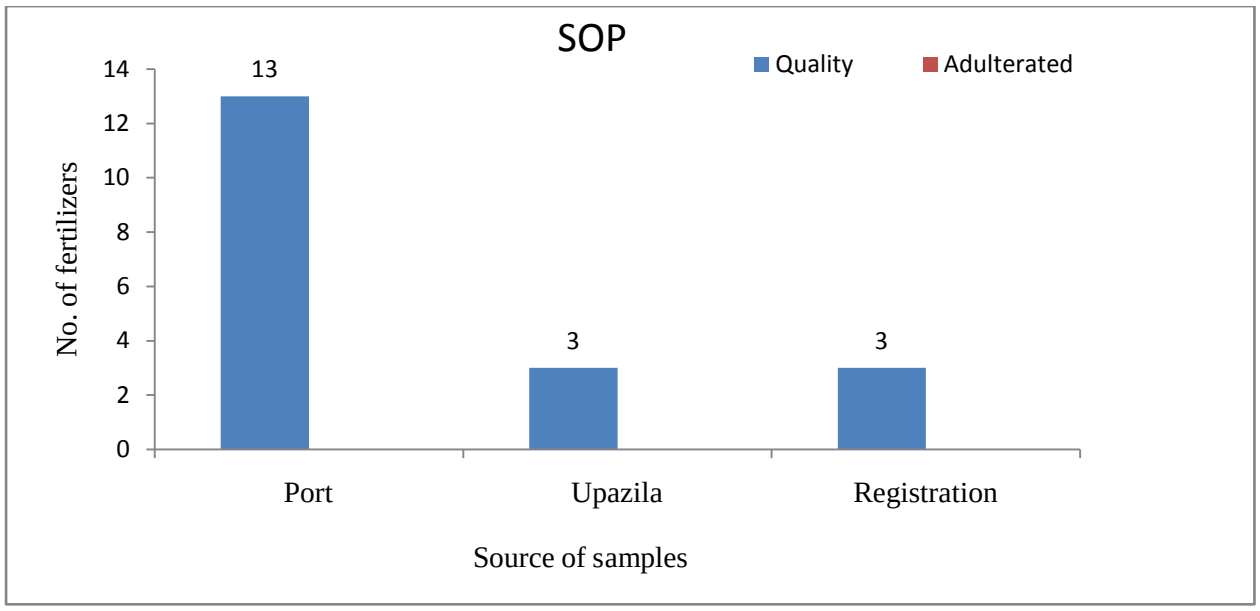


Figure 19. SOP fertilizer quality as tested from different stake holders sample (2018-19)

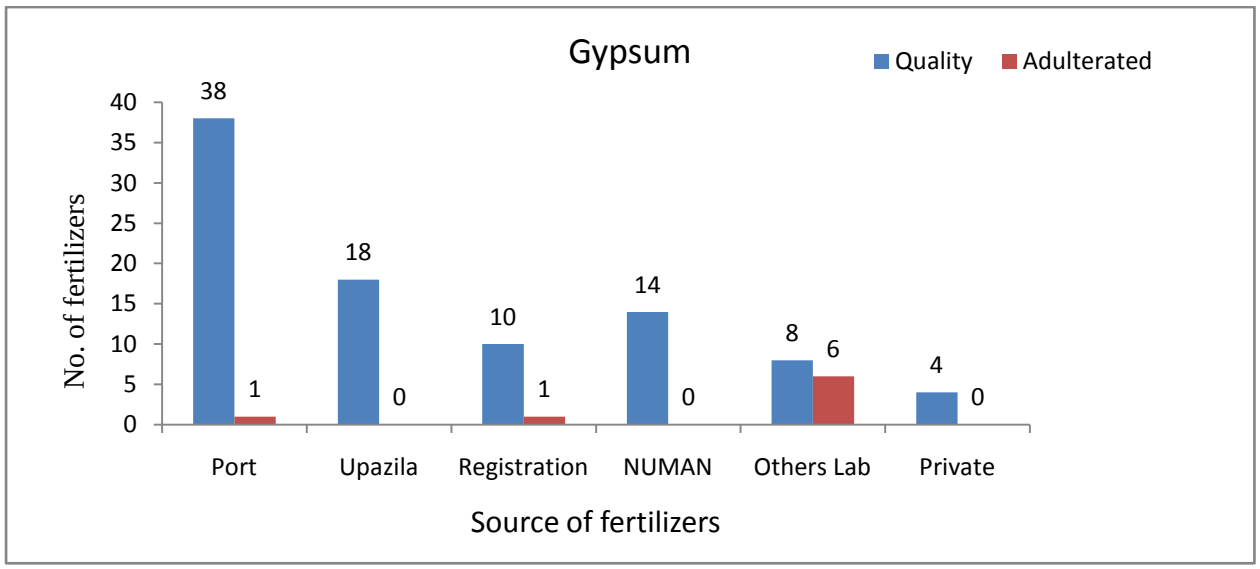


Figure 20. Gypsum fertilizer quality as tested from different stake holders samples (2018-19)

The highest number (39) of Gypsum fertilizer was received from Chittagong port and out of 39 imported Gypsum fertilizer samples only one Gypsum fertilizer sample was found adulterated and out of 11 registration purpose Gypsum sample only one sample was adulterated. The highest number of adulteration was observed in Gypsum samples from other laboratories of SRDI where 6 gypsum samples were found adulterated out of 14 samples. No Gypsum adulteration was found in the samples from field level, NUMAN research program and private entrepreneur (Figure 20) In case NPKS mixed fertilizers the highest number of samples (15) received from other laboratories of SRDI where 7NPKS samples were adulterated out of 15 samples. The maximum adulteration was observed in field level samples where 8 NPKS fertilizer samples were adulterated out of 12 samples. There was no adulteration found in the NPKS fertilizer samples from registration and private entrepreneur (Figure 21). It was observed that the nutrient content of all the strait macronutrient

adulterated fertilizers like TSP, DAP, MOP, Gypsum, Magnesium sulfate, Dolomite were almost up to the Government approved specification except NPKS but the presence of unwanted toxic materials like cadmium (Cd), lead (Pb), Nickel (Ni), Chromium (Cr) made them adulterated to some extent. There was no adulteration found in case of magnesium sulfate fertilizer. The highest number (92) of magnesium sulfate fertilizer received from port for importing which was followed by field level samples (Figure 22).

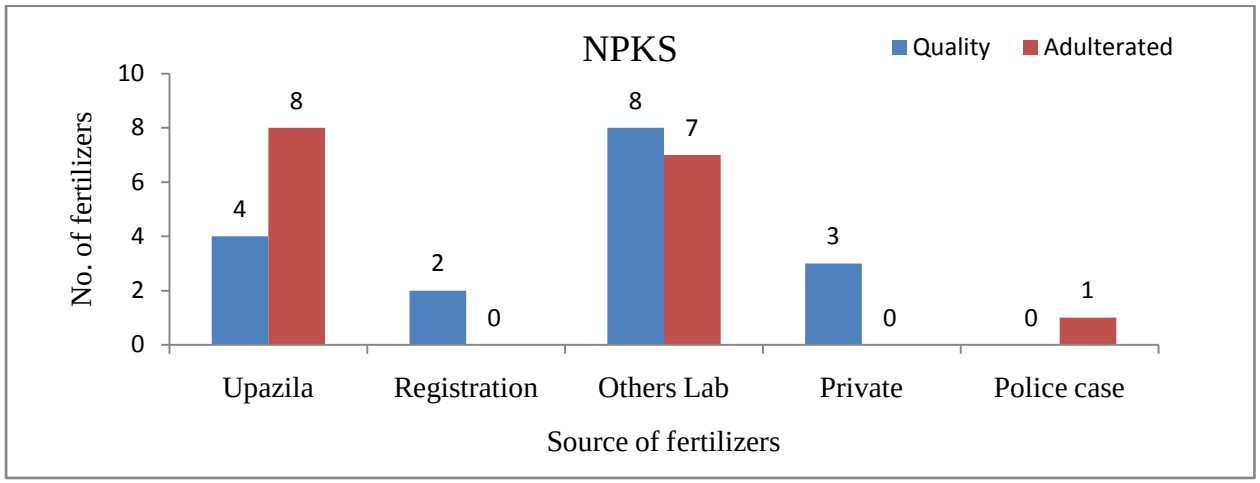


Figure 21. NPKS fertilizer quality as tested from different stake holders sample (2018-19)

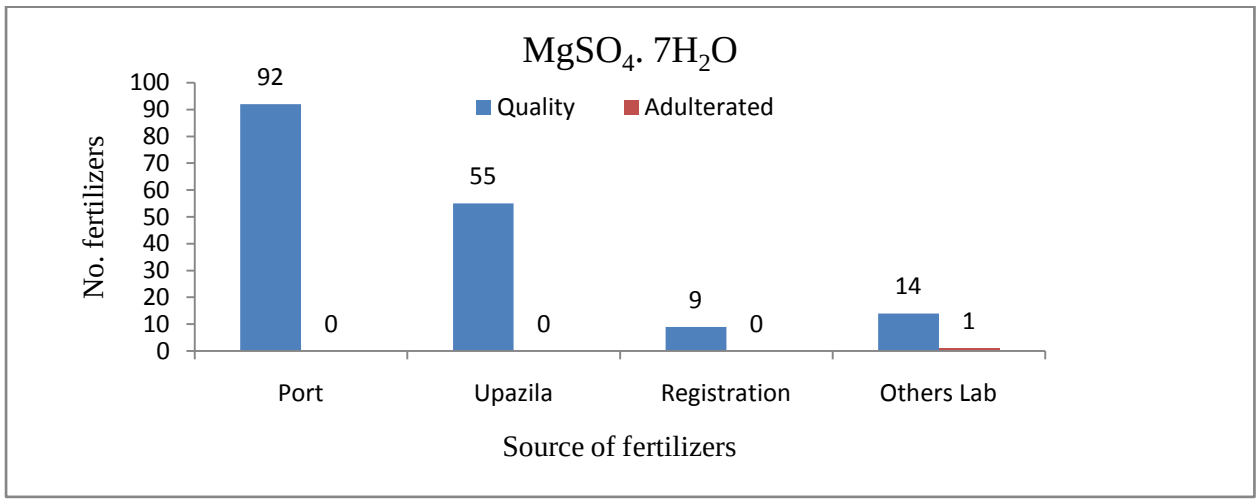


Figure 22. Magnesium sulfate fertilizer quality as tested from different stake holders sample (2018-19)

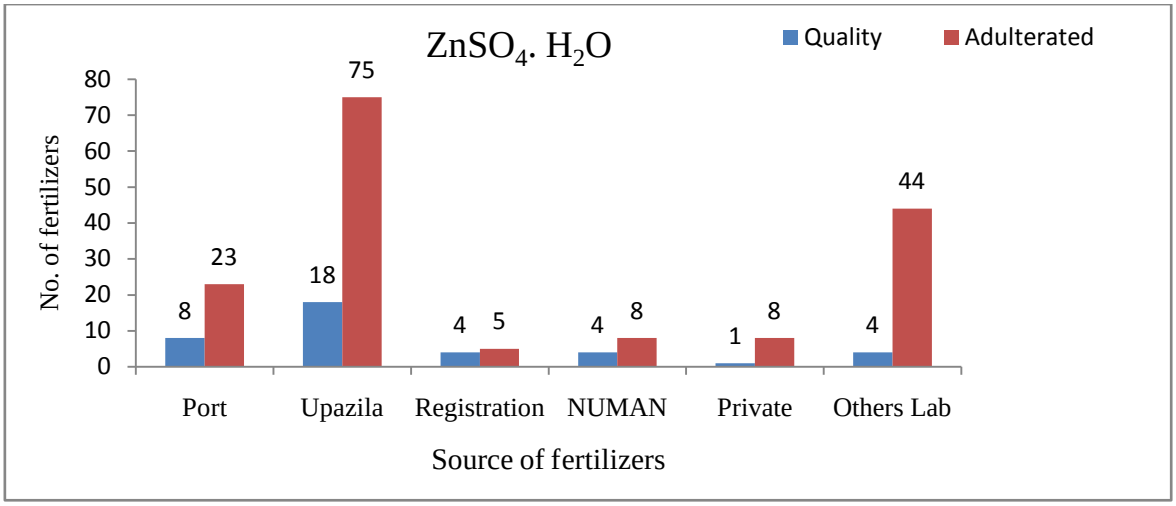


Figure 23. Zinc Sulfate (mono hydrate) fertilizer quality tested from different stake holders sample (2018-19)

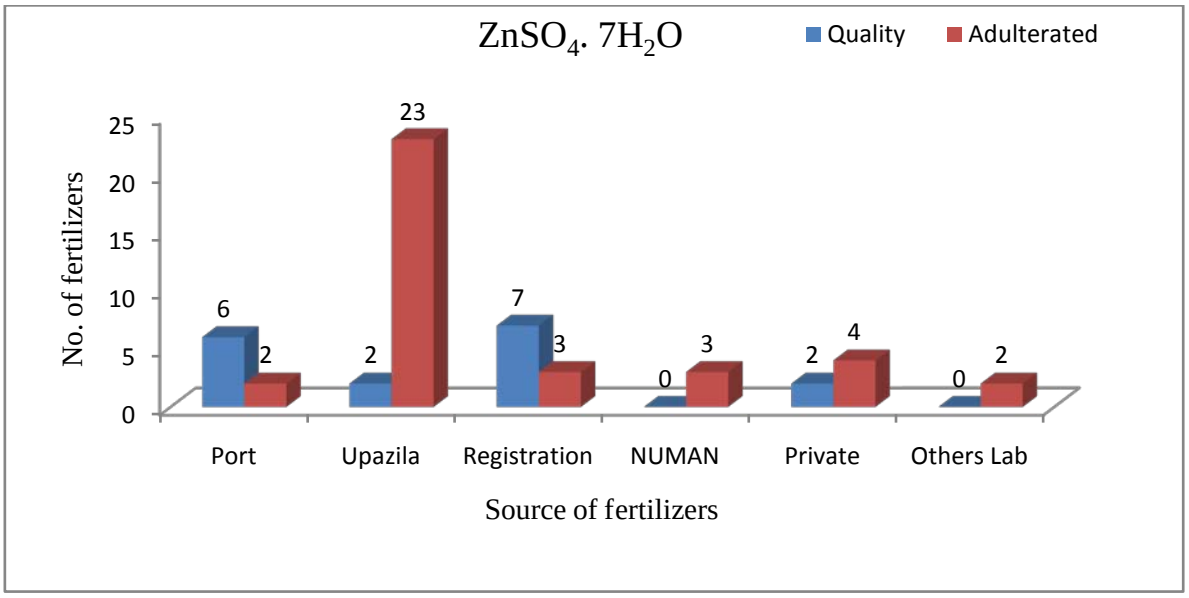


Figure 24. Zinc Sulfate (hepta hydrate) fertilizer quality as tested from different stake holders samples (2018-19)

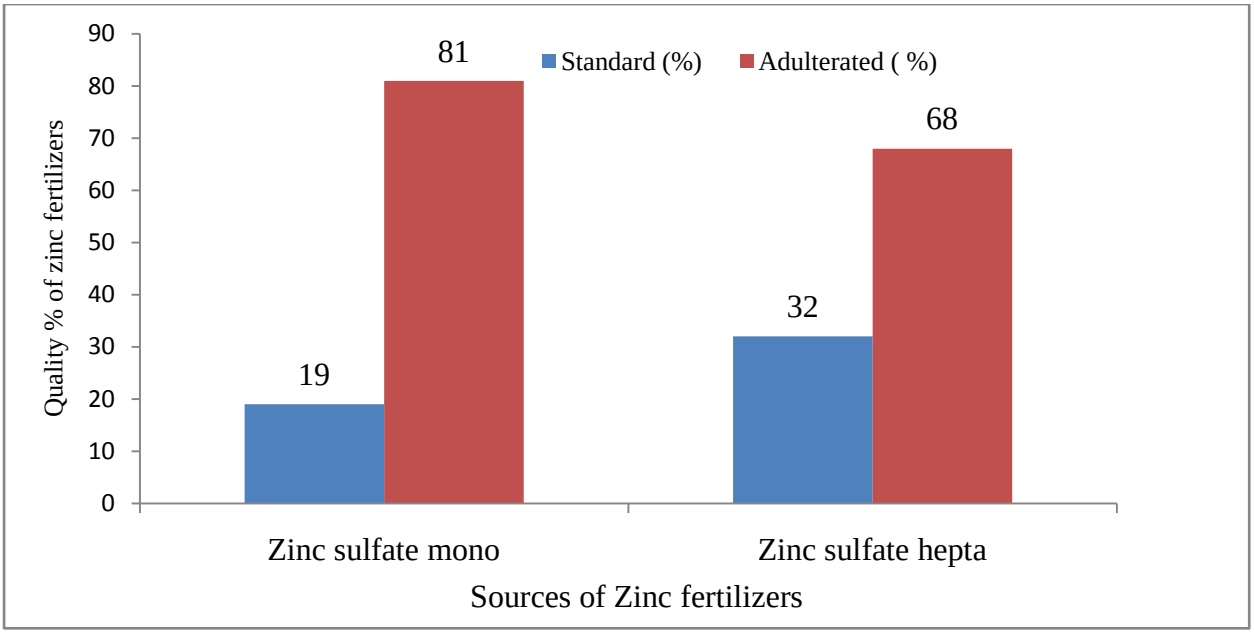


Figure25. Qualities of two types of Zinc fertilizers as tested in 2018-19

Irrespective of different sources of stake holders it was observed that 81 % Zinc Sulfate mono hydrate fertilizer was adulterated where 68 % Zinc Sulfate heptahydrate fertilizer was adulterated (Figure 35). It was observed that almost all the zinc sulfate heptahydrate fertilizers were granular. This issue is very important for discussion. Zinc sulfate heptahydrate fertilizers ($ZnSO_4.\ 7H_2O$**)** is a purely chemical compound fertilizer which contains seven molecules of water ($7H_2O$). A chemical compound contains seven molecules of water never be a granular form rather it will be definitely a crystalline form. But in the Government specification of $ZnSO_4.7H_2O$ the physical properties i.e. physical form is mentioned as granular which is not scientifically correct. So crystalline form of Zinc sulfate heptahydrate does not contain more than 22.64% Zn and 11.22% S according to its chemical formula. But in some cases the findings of the study shows that Zinc Sulfate heptahydrate analyzed in the Central Laboratory contain more than 22.64% Zn and 11.22% S which are actually sub-standard Zinc sulfate mono hydrate. Therefore the granular form of Zinc Sulfate heptahydrate is not an actual $ZnSO_4.7H_2O$ rather it might be a lower grade Zinc Sulfate mono hydrate fertilizer. If the specification of $ZnSO_4.7H_2O$ is revised by including its physical form i.e. crystalline form which will help a lot to minimize the adulteration of $ZnSO_4.\ 7H_2O$ and ultimately helps the farmers to purchase quality Zinc fertilizers.

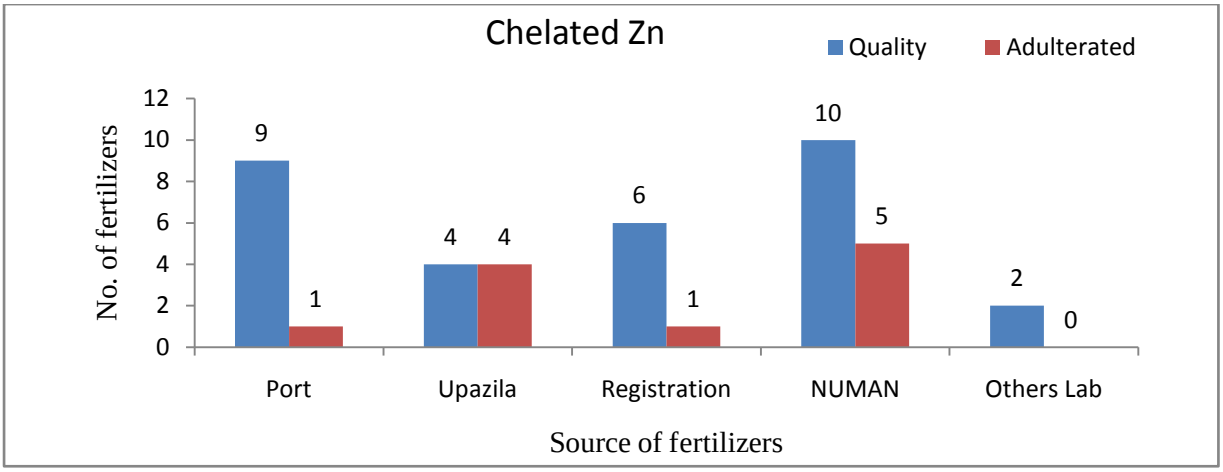


Figure 26. Chelated Zinc fertilizer quality as tested from different stake holders samples (2018-19)

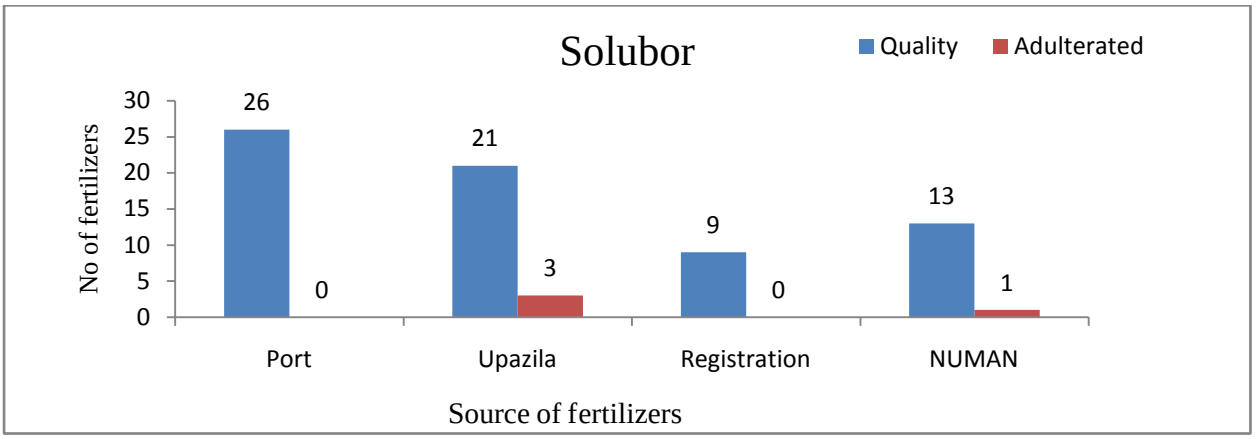


Figure 27. Solubor fertilizer quality as tested from different stake holders samples (2018-19)

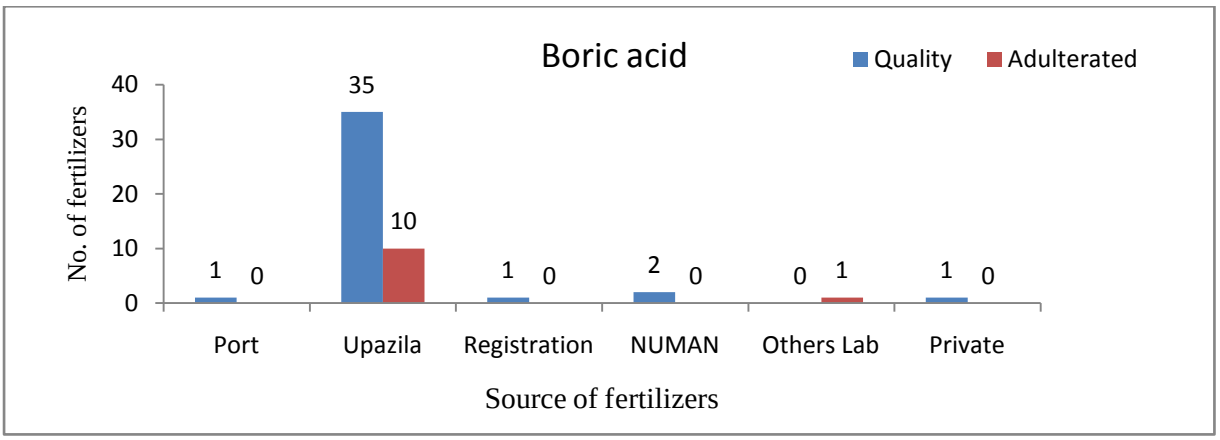


Figure 28. Boric acid fertilizer quality as tested from different stake holders samples (2018-19)

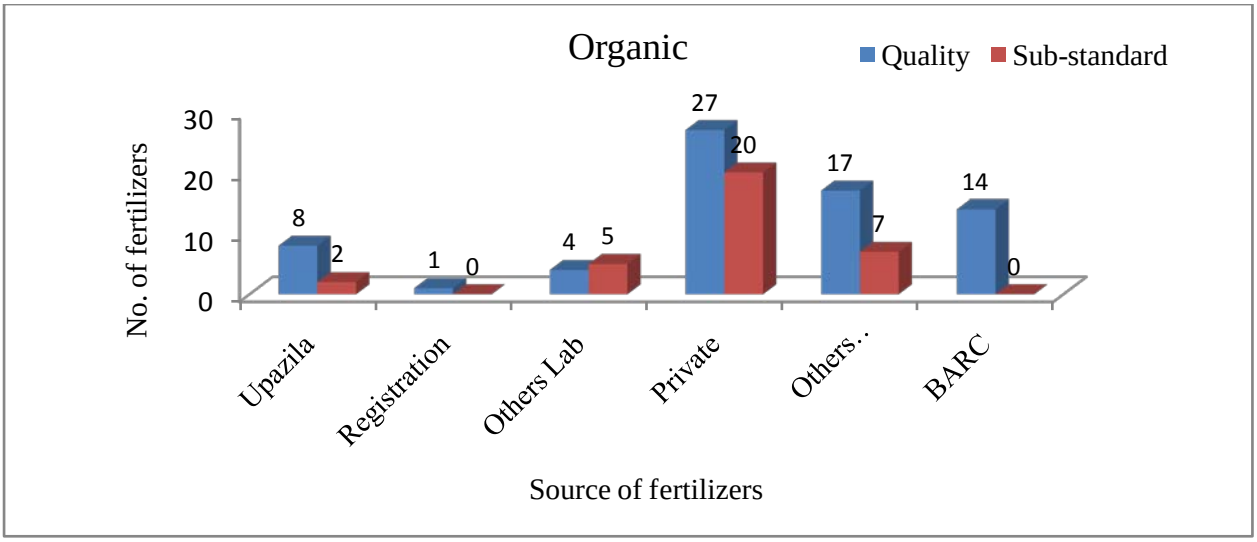


Figure 29. Organic fertilizer quality as tested from different stake holders samples (2018-19)

The total number of Zinc Sulfate mono hydrate ($ZnSO_4.H_2O$) fertilizer analyzed was 202 in 2018-2019 (Table 12) and the highest number of $ZnSO_4.H_2O$ fertilizer samples was received from Upazila which was 93. In case of $ZnSO_4.H_2O$ there was not a single source where adulteration was not occurred. The adulteration percent of $ZnSO_4.H_2O$ from Port, Upazila, Registration, NUMAN research program, Private sector and other Labs were 74.19%, 80.65%, 55.55%, 66.66%, 88.88% and 91.66% respectively (Figure 23). Total number of Zinc Sulfate hepta hydrate ($ZnSO_4.7H_2O$) fertilizer analyzed was 60 in 2018-2019 (Table 12) and the highest number of $ZnSO_4.H_2O$ fertilizer samples was received from Upazila which was 25. In case of $ZnSO_4.7H_2O$ there was not a single source where adulteration was not occurred. The adulteration percent of $ZnSO_4.7H_2O$ from Port, Upazila, Registration, NUMAN research program, Private sector and other Labs were 25%, 92%, 30%, 100%, 66.66% and 100% respectively (Figure 24). Total number of chelated Zinc fertilizer analyzed was 42 in 2018-2019 (Table 12) and the highest number of chelated Zinc fertilizer samples was received from NUMAN research program which was 15. Irrespective of source it was found that 10% sample from port, 50% sample from Upazila, 85.71% from registration, 33.33% from NUMAN research program was found adulterated and no adulteration was observed from the chelated Zinc samples received from other Lab sample (Figure 26). Total number of solubor boron fertilizer analyzed was 73 in 2018-2019 (Table 12) and the highest number of solubor boron fertilizer samples was received from port which was 26. There was no adulteration was found in the solubor fertilizer imported through port and sample received for registration. Irrespective of source it was found that 12.5 % sample from Upazila, 7.14 % sample from NUMAN research program was found adulterated (Fig. 13). Total number of boric acid fertilizer analyzed was 51 in 2018-2019 (Table 26) and the highest number of boric acid fertilizer samples was received from Upazila which was 45. No adulteration has been found in the boric acid received from port, NUMAN research program and private entrepreneur. Irrespective of source it was found that 22.22 % sample from Upazila, and only one sample received from another Lab was adulterated (Figure 28). Total number of organic fertilizer analyzed was 105 in 2018-2019 (Table 12) and the highest number of organic fertilizer samples was received from private entrepreneur which was 47.

There was no adulteration found in the organic fertilizer from BARC and sample for registration which have been collected by BARC Team and Extension Department. Irrespective of source it was found that 20% sample from Upazila, 55.55% sample from other Labs, 42.55% sample from private entrepreneur and 29.16 % sample received from others organizations were found sub-standard (Figure 29). Sub-standard organic fertilizers have been identified due to over moisture content, lack of organic carbon content as well as plant nutrient deficient as per government specification. An encouraging eagerness of private sector was observed to come forward producing organic fertilizer and to consider the organic fertilizer as a commodity in the eye of entrepreneurship.

Conclusions

It was found that in 2018-2019 fiscal year among macronutrient fertilizers like Urea, Sulfate of potash (SOP), Ammonium Sulfate, Mono Ammonium Phosphate (MAP)fertilizers were 100% standard as per government specification. Other macronutrient fertilizers like TSP, DAP, MOP, Gypsum, Magnesium sulfate, Dolomite and NPKS fertilizers were 89 %, 96%, 99%, 92%, 99%, 94% and 52% standard as per government specification. It was observed that the nutrient content of all the strait macronutrient adulterated fertilizers like TSP, DAP, MOP, Gypsum, Magnesium Sulfate, Dolomite were almost up to the Government approved specification but the presence of some unwanted materials made them adulterated to some extent. The highest adulteration was found in NPKS mixed fertilizer (48%) at different degrees of adulteration. The total number of macronutrient fertilizers received and analyzed in 2018-2019 fiscal year was 752. The highest number of individual fertilizer received and analyzed was Magnesium Sulfate which was 171 followed by DAP which was 138. In case of micro nutrient fertilizer only 19 % Zinc Sulfate mono hydrate and 32 % Zinc Sulfate heptahydrate was quality fertilizers. Here also the adulteration was observed not only in nutrient content but presence of unwanted materials made the fertilizers adulterated. Nutrient content in fertilizers below the Government approved specification were termed as adulterated but the level of adulteration was not mentioned here.

On the other hand, 74 % Chelated Zinc, 95 % Solubor boron, 78% Boric acid, 88% Fertibor, 68 % Organic fertilizers and 93% Compound fertilizers like Nutraphos N, Nutraphos-24, Silvamix, Silvagen etc. were standard fertilizers. The total number of micronutrient fertilizers received and analyzed was 570. The highest number of individual micronutrient fertilizer received and analyzed was Zinc Sulfate monohydrate which was 202. Other than Zinc Sulfate mono hydrate as well as Zinc Sulfate heptahydrate and all other micronutrient fertilizers quality was improved than the previous years. It may be mentioned here that except registration, only suspected and imported fertilizers are sent to laboratory for testing its quality by the stake holders. It is worthy to mention due to quality control activities by the government through SRDI, DAE and other law and order enforcing agencies the rate of adulteration in major fertilizers is almost absent. Moreover, Government provided about 9 thousand crore taka as subsidy in Urea, TSP, DAP and MOP fertilizers in 2018-2019 fiscal year. As the price of major fertilizers are reduced it helped in ensuring fertilizers quality in the field level.

Chapter 3: Activities of Field Offices

Program 1. Updating Upazila Land and Soil Resource Utilization Guide (Upazila Nirdeshika) through Semi-detailed Soil Survey

(a) Introduction: Upazila Land and soil Resource Utilization Guide (Upazilla Nirdeshika) is being used as a tool for agricultural development activities at Upazila level. Beginning from 1986 all the 459 Upazilla Nirdeshika publication was completed by June 2002. With passing of time changes in edaphic properties, land use and fertility status of soil are being observed along with physical changes due to population growth, rapid industrialization and urbanization, deforestation, unplanned construction of roads, culverts, dams, blocking of upstream flow of rivers, indiscriminate use of chemical pesticides & fertilizers, global warming etc. These changed scenarios need to be incorporated in the Nirdeshika. That is why it becomes imperative to update the existing Upazilla Nirdeshika to enrich the database and make the Nirdeshika more useful to the field level users with the following objectives.

(b) Objectives

- To update the land, soil and land use database for local and regional level agricultural development planning.
- To update the soil fertility database.
- To accommodate the changes due to infrastructure developments (roads, homestead, embankments etc.).
- To include executive summary of the whole text for the decision maker and to make it user friendly.

(c) Methodology

Base Materials: Existing Upazila Soil and Landform Map (1:50,000), aerial photographs of approximate scale of 1:25,000 of 1:30,000, topographic maps (1:50,000), DLR maps (1: 63,360) are used as field base maps.

Methods: Based on recent aerial photo interpretation a photo interpretative Soil and Landform Map is prepared with help of existing one. The map consists of legend depicting soil mapping unit(s), land type, Mrittika Dal (Soil group).

A planned ground truthing is made by checking catena wise soil, mapping unit boundary following regular traverse and grid as needed in semi-detailed survey.

Soils are examined as often as necessary along traverse lines. For each 200 hectares of land, one soil sample is collected on the basis land type and Mrittika Dal. The sampling intensity is increased as and when necessary, according to the complexity of Mrittika Dal.

Composite soil samples are collected from adjacent to or possibly nearer point of previous sampling sites with GPS reading so as to compare the changes of nutrient status due to

intensive cultivation of modern varieties of different crops with imbalanced application of chemical fertilizers.

Mini pits are described by digging shallow pits (where necessary) along each traverse. Soil samples are taken in correlation boxes (if necessary) from Mrittika Dal for correlation

During soil sample collection, information on inundation depth, cropping pattern, constraints for agricultural development etc. are collected from the farmers.

Collected composite soil samples are analyzed in the laboratory and updated Upazila Nirdeshika is prepared incorporating land, soil resource and fertility data.

Table 13: Progress of Upazila Nirdeshika Updating

District	Field Survey		Map finalization		Draft Report Preparation		Final Report Preparation	
	Target	**Achievement**	**Target**	**Achievement**	**Target**	**Achievement**	**Target**	**Achievement**
Regional Office, Dhaka								
Dhaka	Gazaria	Gazaria	Sirajdikhan	Sirajdikhan	Bajitpur	Bajitpur	Sirajdikhan	Sirajdikhan
	Kapasia	Kapasia	Dhamrai	Dhamrai	Nawabgonj	Nawabgonj	Dhamrai	Dhamrai
	Munshigonj Sadar	Munshigonj Sadar	Kaliakoir	Kaliakoir			Kaliakoir	Kaliakoir
Tangail	Pakundia	Pakundia	Gopalpur	Gopalpur	Kalihati	Kalihati	Madhupur	Madhupur
			Shibaloy	Shibaloy			Nagorpur	Nagorpur
Faridpur	Damudda	Damudda	Damudda	Damudda	Bhanga	Bhanga	Kashiani	Kashiani
	Gosairhat	Gosairhat			Kotwalipara	Kotwalipara		
	Naria	Naria			Kalkini	Kalkini		
	Shibchar	Shibchar						
Jamalpur	Barhatta	Barhatta	Barhatta	Barhatta	Barhatta	Barhatta	Dewanganj	Dewanganj
	Pakundia	Pakundia			Pakundia			
Mymensingh	Haluaghat	Haluaghat	Bhaluka	Bhaluka	Kotiadi	Kotiadi	-	-
	Dhobaura	Dhobaura	Mithamoin	Mithamoin	Atpara	Atpara		
Chattogram Regional Office, Cumilla								
Cumilla	-	-	Banchrampur	Banchrampur	Sadar Dakshin	Sadar Dakshin	Bijoynagar	Bijoynagar
			Homna	Homna	Banchrampur	Banchrampur	Shahrasti	Shahrasti
					Homna	Homna		
Noakhali	Nangolkoat	Nangolkoat	Hatiya	Hatiya	Hatiya	Hatiya	Hatiya	Hatiya
			Debidwar	Debidwar	Kachua	Kachua	Kachua	Kachua
					Noakhali Sadar			
Chattogram	Ramu	Ramu	Raojan	Raojan	Satkania	Satkania	Kutubdia	Kutubdia
	Moheshkhali	Moheshkhali	Karnafuli	Karnafuli	Lohagara	Lohagara	Satkania	Satkania
					Karnafuli			

District	Field Survey		Map finalization		Draft Report Preparation		Final Report Preparation	
	Target	Achievement	Target	Achievement	Target	Achievement	Target	Achievement
Rangamati	Ruangchari	Ruangchari	Ruangchari	Ruangchari	Ramgar	Ramgar	Ramgar	Ramgar
	Akhaura	Akhaura	Akhaura	Akhaura	Naniarchar	Anwara	Anwara	Anwara
					Anwara	Ukhiya	Ukhiya	Ukhiya
					Ukhiya			
					Rajosthali			
Regional Office, Rajshahi								
Rajshahi	Gurudaspur	Gurudaspur	Gurudaspur	Gurudaspur	Naldunga	Naldunga	Chapainawabgonj Sadar	Chapainawabgonj Sadar
	Tanore	Tanore	Tanore	Tanore	Shibgonj	Shibgonj	Gomostapur	Gomostapur
	Natore Sadar	Natore Sadar	Natore Sadar	Natore Sadar			Badalgachi	Badalgachi
							Dhamoirhat	Dhamoirhat
Dinajpur	Debigonj	Debigonj	Debigonj	Debigonj	Pirgonj	Pirgonj	Chirirbandar	Chirirbandar
	Tetulia	Tetulia	Tetulia	Tetulia	Phulbaria	Phulbaria	Khansama	Khansama
	Boda	Boda	Boda	Boda				
Bogura	Bogura Sadar	Bogura Sadar	Bogura Sadar	Bogura Sadar	Shajahanpur	Shajahanpur	Sarikandi	Sarikandi
	Joypurhat Sadar	Joypurhat Sadar	Joypurhat Sadar	Joypurhat Sadar	Panchbibi	Panchbibi	Nandigram	Nandigram
	Kalai	Kalai	Kalai	Kalai	-	-		
Rangpur	Aditmari	Aditmari	Aditmari	Aditmari			Gaibanda sadar	Gaibanda sadar
	Kaligonj	Kaligonj	Kaligonj	Kaligonj			Razibpur	Razibpur
	Gabindaganj	Gabindaganj	Gabindaganj	Gabindaganj			Lalmonirhat Sadar	Lalmonirhat Sadar
Pabna	Ishurdi	Ishurdi	Ishurdi	Ishurdi	-	-	Raygonj	Raygonj
	Atghoria	Atghoria	Atghoria	Atghoria				
	Sujanagar	Sujanagar	Sujanagar	Sujanagar				
Regional Office, Khulna								
Khulna	Shyamnagar	Shyamnagar	Shyamnagar	Shyamnagar	Paikgacha	Paikgacha	Tala	Tala
	Assasuni	Assasuni	Assasuni	Assasuni				
	Koyra	Koyra	Koyra	Koyra				

District	Field Survey		Map finalization		Draft Report Preparation		Final Report Preparation	
	Target	**Achievement**	**Target**	**Achievement**	**Target**	**Achievement**	**Target**	**Achievement**
Jessore	Mohammadpur	Mohammadpur	Mohammadpur	Mohammadpur	Saronkhola	Saronkhola	Kaligonj	Kaligonj
	Sharsha	Sharsha	Sharsha	Sharsha	Mongla	Mongla	Shalikha	Shalikha
	Lohagora	Lohagora	Lohagora	Lohagora	Morelgonj	Morelgonj	Monirampur	Monirampur
	Sreepur	Sreepur	Sreepur	Sreepur	Horinakundu	Horinakundu	Debhata	Debhata
	Moheshpur	Moheshpur	Moheshpur	Moheshpur				
Kushtia	Chuadanga Sadar	Chuadanga Sadar	Chuadanga Sadar	Chuadanga Sadar	-	-	Jibonnagar	Jibonnagar
	Mirpur	Mirpur	Mirpur	Mirpur				
Regional Office, Barisal								
Barisal	Banaripara	Banaripara	Banaripara	Banaripara	Manpura	Manpura	Khawkhali	Khawkhali
	Hizla	Hizla	Hizla	Hizla	Charfashion	Charfashion	Kathalia	Kathalia
	Nalchiti	Nalchiti	Nazirpur	Nazirpur	Nazirpur	Nazirpur		
	Pirojpur Sadar	Pirojpur Sadar						
	Lalmohan	Lalmohan						
Patuakhali	Rangabali	Rangabali	Galachipa	Galachipa	Galachipa	Galachipa	Patharghata	Patharghata
							Betagi	Betagi
Regional Office, Sylhet								
Sylhet	Jagannathpur	Jagannathpur	Jagannathpur	Jagannathpur	South Sunamganj	South Sunamganj	Chhatak	Chhatak
	Bishwamborpur	Bishwamborpur	Bishwamborpur	Bishwamborpur				
Moulvibazar	Madhabpur	Madhabpur	Madhabpur	Madhabpur	Nabiganj	Nabiganj	Bahubal	Bahubal
	Chunarughat	Chunarughat	Chunarughat	Chunarughat				

(d) Findings:

Major Findings of Barhatta Upazila
(i) Increase in Population in Barhatta Upazila over time

Barhatta Upazila	
Previous Survey (1998)	Present Survey (2019)
1,42,174	1,80,449

(ii) Changs in Settlements, Ponds, Water bodies etc:

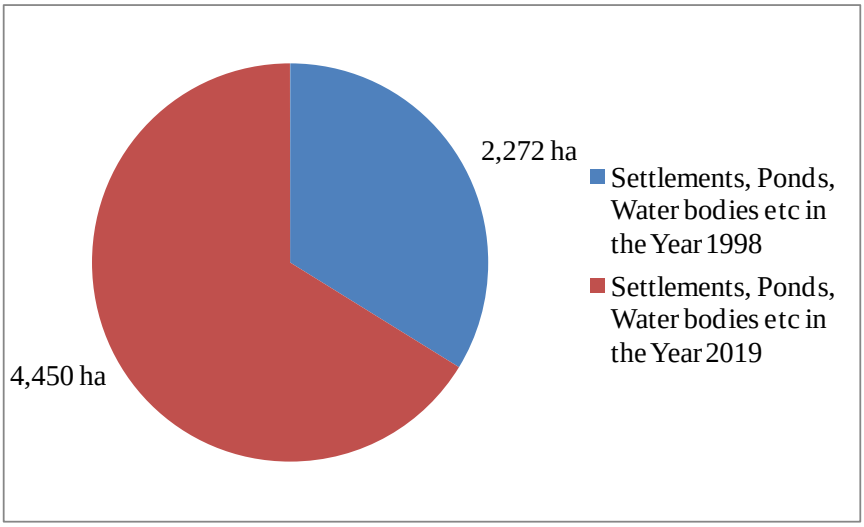


Figure 30. Increase of Settlements, Ponds, Water bodies etc. in Barhatta Upazila over time

(iii) Changes in Land Type: Medium highland and Medium Lowland increased lowland decreased over time in Barhatta Upazila

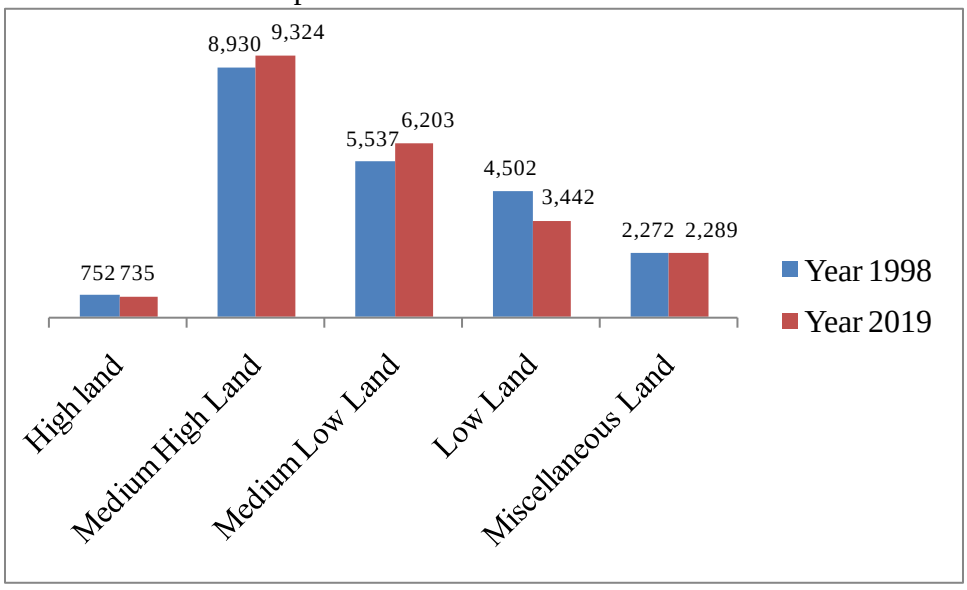


Figure 31. Land type Changes in Barhatta Upazila over time

(iv) Changes in Land Use:

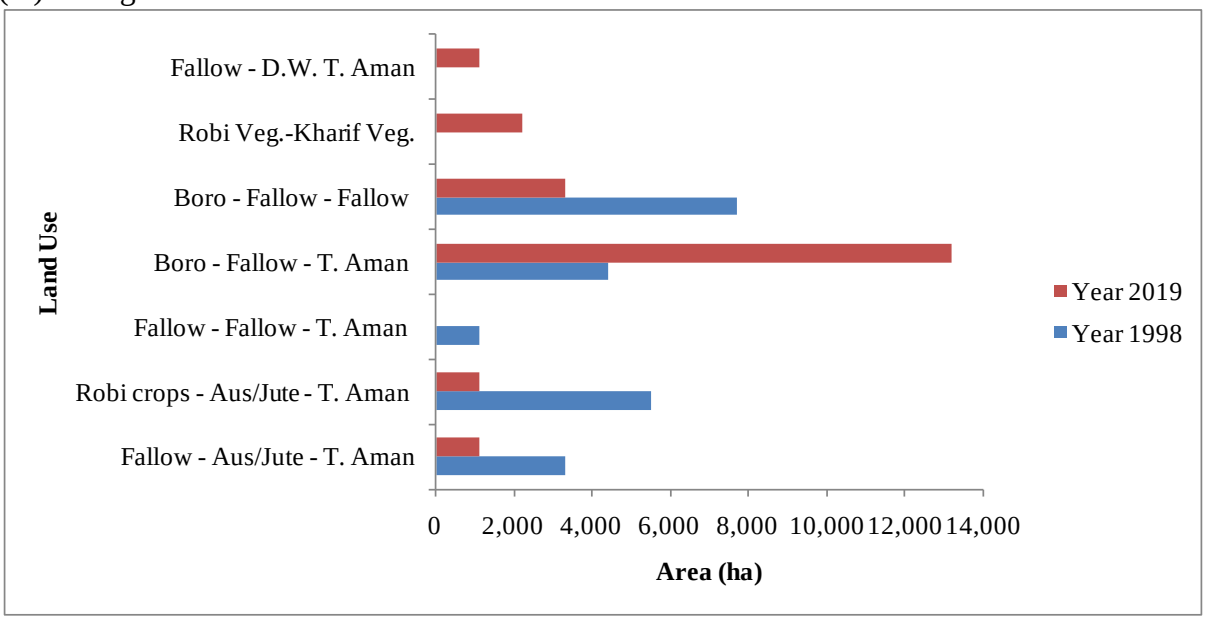


Figure 32. Changes in Land Use Areas (ha) in Barhatta Upazila over time

Major Findings of Nangalkot Upazila

Physical Parameters

(i) Changes in Population as per 2011 census:

Nangalkot Upazila	
Previous Survey (1997)	Present Survey (2019)
2,75,585	3,73,987

(ii) Changs in Settlements, Ponds, Water bodies etc:

Previous Survey (1997)	Present Survey (2019)
Area (ha)	Area (ha)
4095	4450

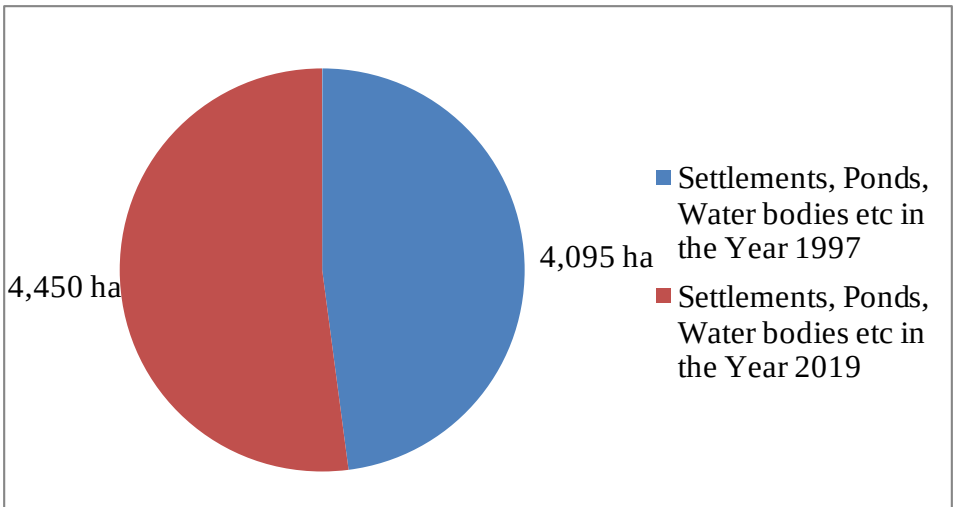


Figure 33. Changes in Settlements, Ponds, Water bodies etc. of Nangalkot Upazila over time.

(iii) Changes in Land Type

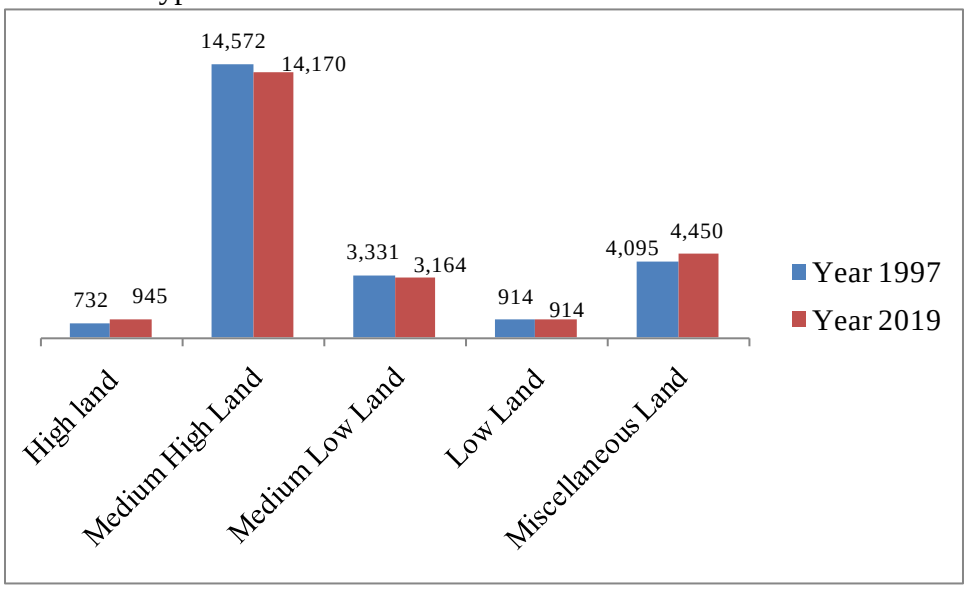


Figure 34: Land type Changes in Nangalkot Upazila over time

(iv) Changes in Land Use:

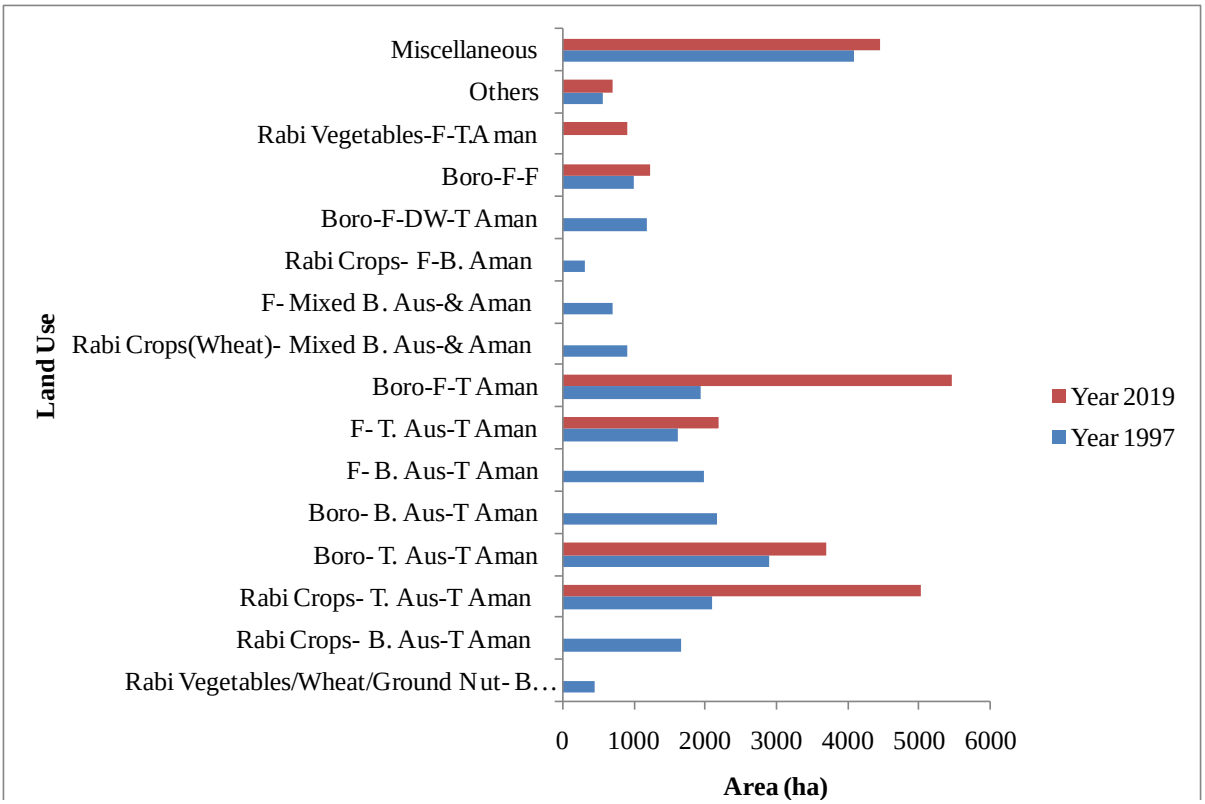


Figure 35: Changes in Land Use Areas (ha) in Nangalkot Upazila over time

Major Findings of Naogaon Sadar Upazila

Physical Parameters

(i) Changes in Population in Naogaon Sadar Upazila over time

Naogaon Sadar Upazila	
Previous Survey (1992)	Present Survey (2019)
2,60,117	4,05,148

(ii) Changs in Settlements, Ponds:

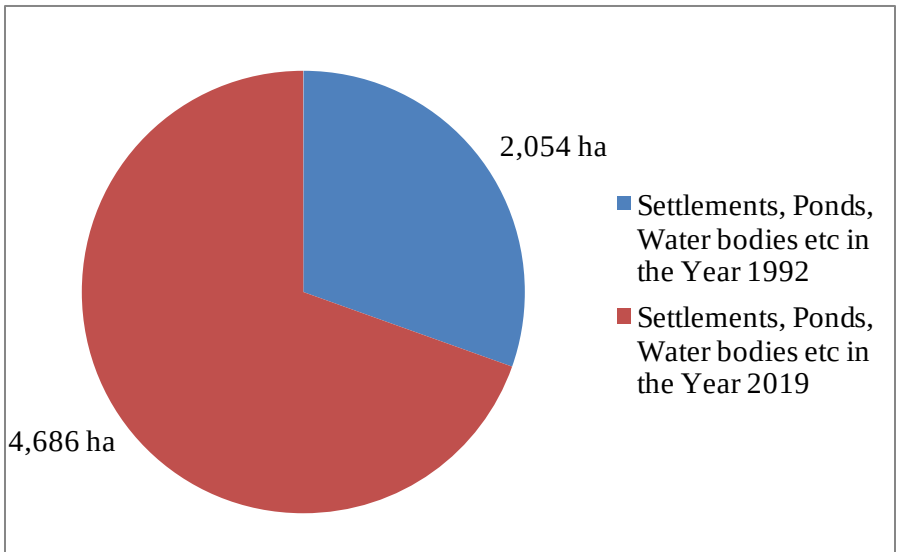


Figure 36: Changes in Settlements, Ponds, Water bodies etc. of Naogaon Sadar Upazila over time.

(iii) Changes in Land Type

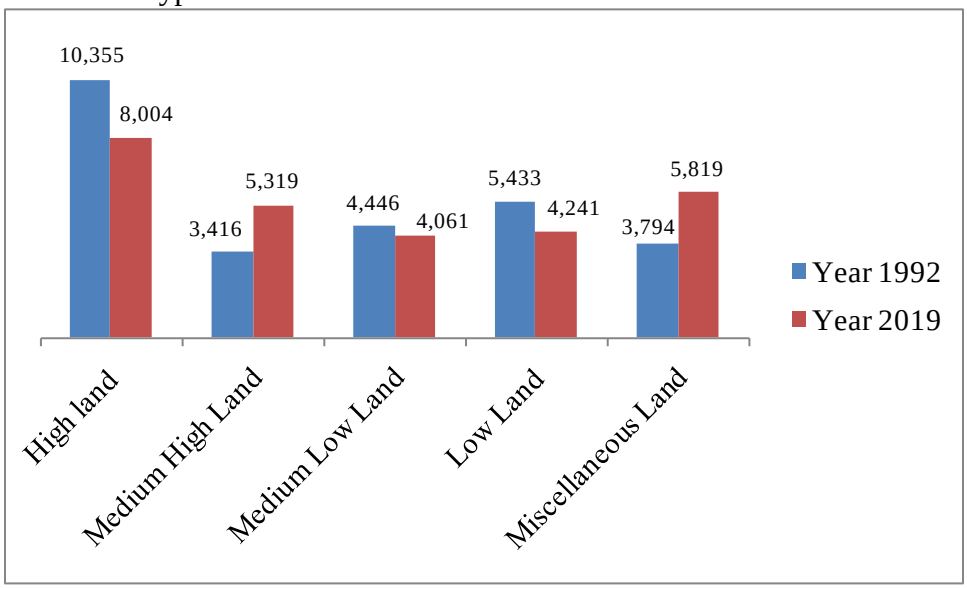


Figure 37: Land type Changes in Naogaon Sadar Upazila over time

(iv) Changes in Land Use:

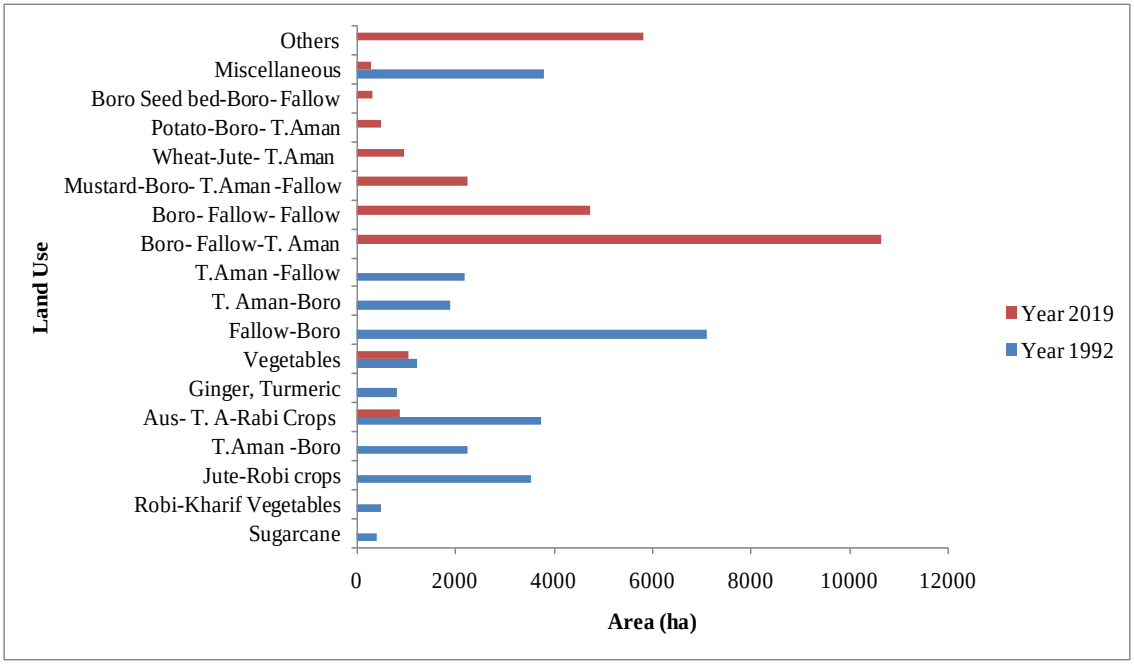


Figure 38: Changes in Land Use Areas (ha) in Naogaon Sadar Upazila over time.

Major Findings of Sreepur Upazila

Physical Parameters

(i) Changes in Population in Sreepur Upazila over time

Sreepur Upazila	
Previous Survey (1995)	Present Survey (2019)
1,44,471	1,66,749

(ii) Changs in Settlements, Ponds, Water bodies etc:

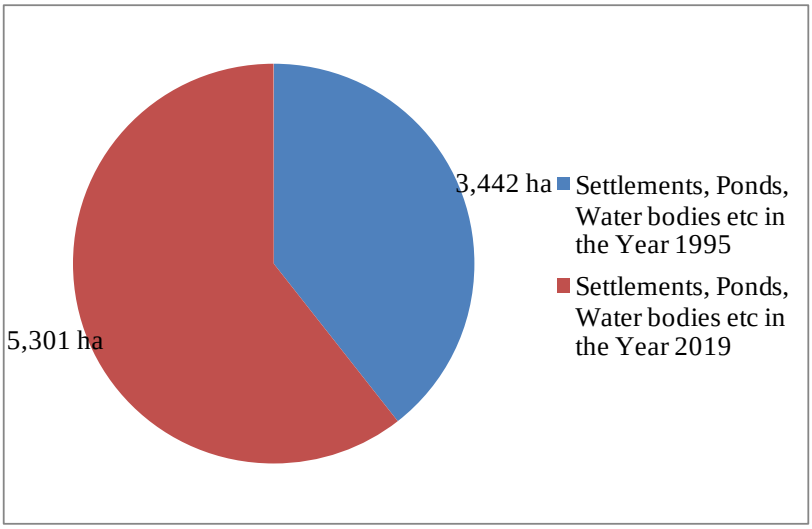


Figure 39: Changes in Settlements, Ponds, Water bodies etc. in Sreepur Upazila

(iii) Changes in Land Type

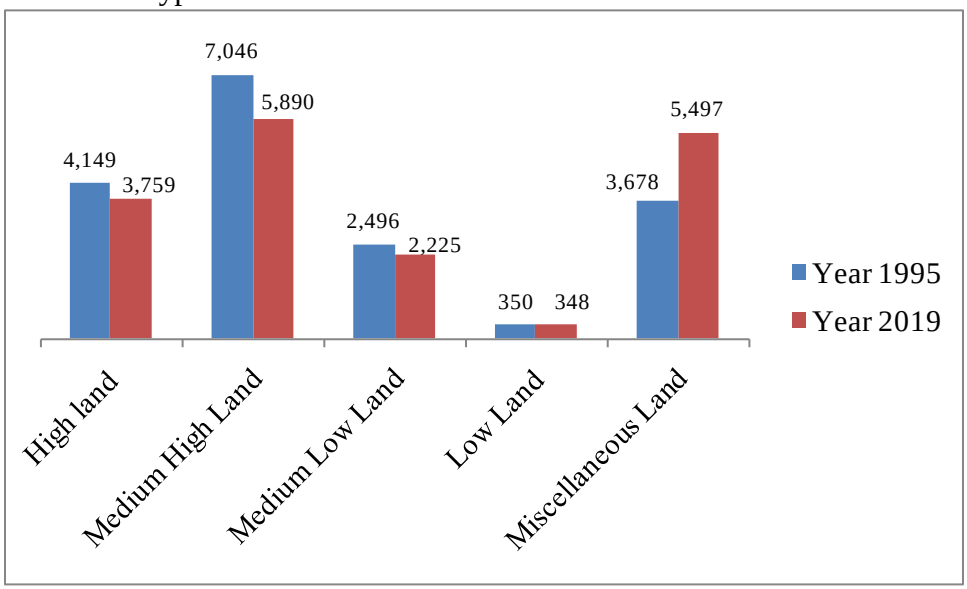


Figure 40: Land type Changes in Sreepur Upazila over time

(iv) Changes in Land Use:

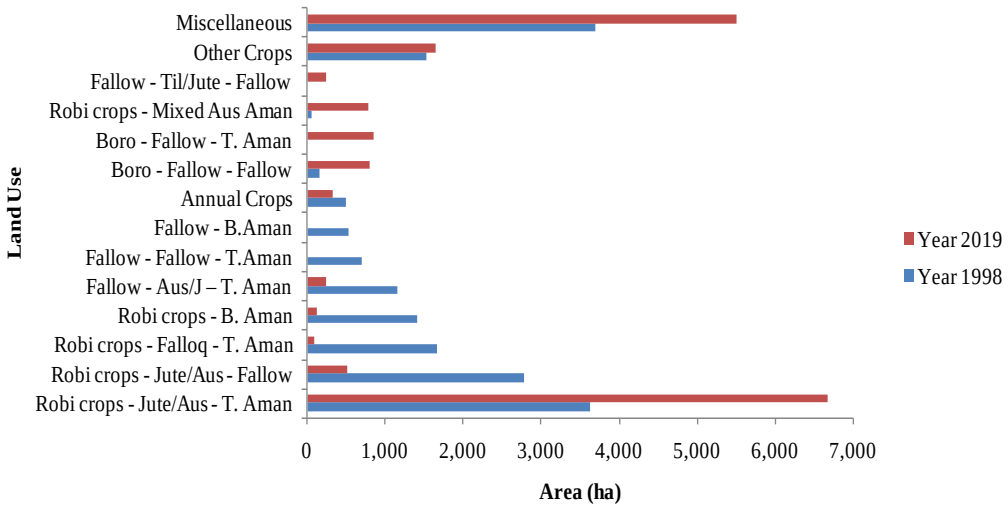


Figure 41: Changes in Land Use Areas (ha) in Sreepur Upazila over time.

Major Findings of Hizla Upazila

Physical Parameters

(i) Changes in Population in Hizla Upazila over time

Hizla Upazila

Previous Survey (1998)	Present Survey (2019)
1,66,265	1,46,077*

* River bank erosion hazard area. Population decrease due to migration of the people from affected area.

(ii) Changes in Settlements, Ponds, Water bodies etc:

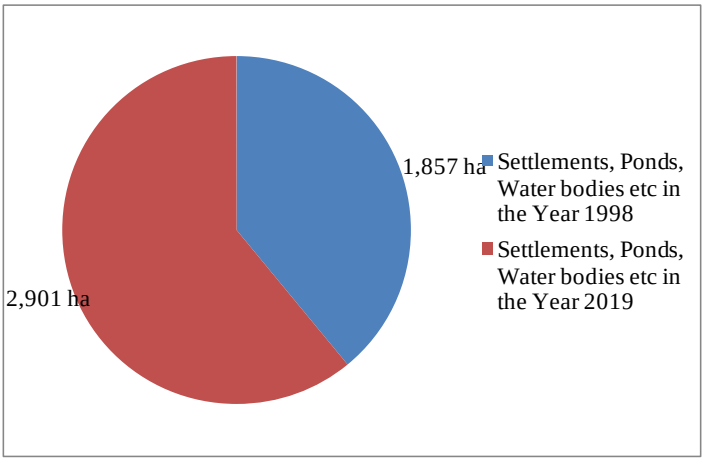


Figure 42: Changes in Settlements, Ponds, Water bodies etc. of Hizla Upazila over time.

(iii) Changes in Land Type

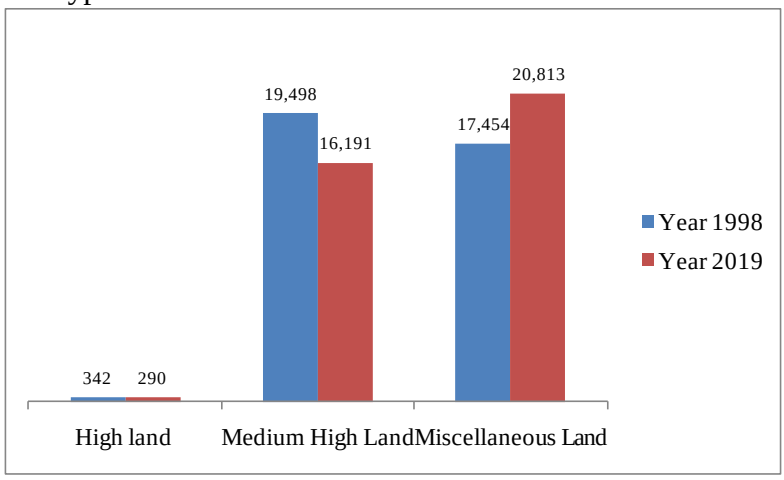


Figure 43: Land type Changes in Sreepur Upazila over time

(iv) Changes in Land Use:

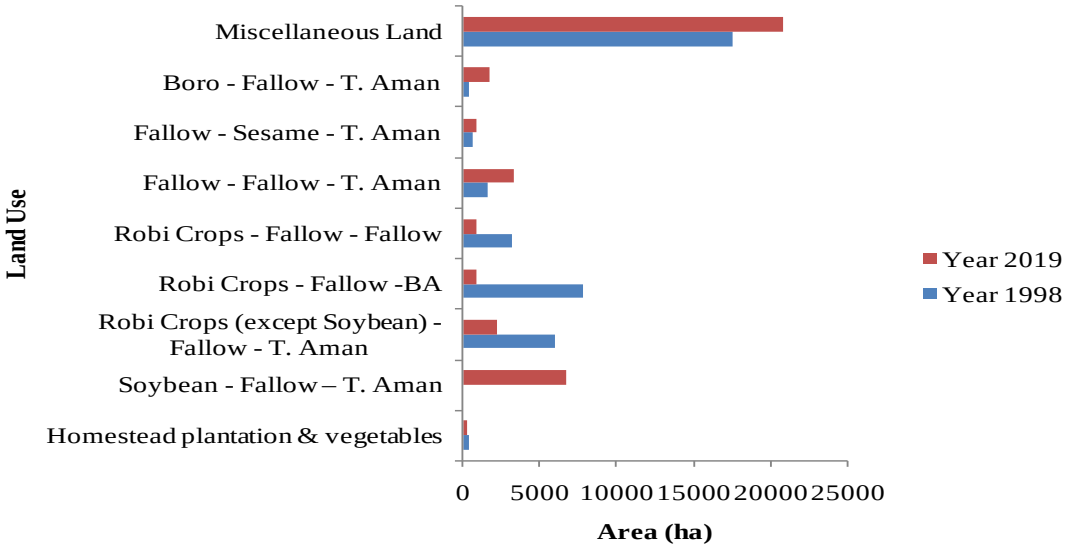


Figure 44: Changes in Land Use Areas (ha) in Hizla Upazila

Major Findings of Jagannathpur Upazila

Physical Parameters

(i) Changes in Population Jagannathpur Upazila over time

Jagannathpur Upazila	
Previous Survey (1995)	Present Survey (2019)
1,88,139	2,59,490

(ii) Changs in Settlements, Ponds, Water bodies etc:

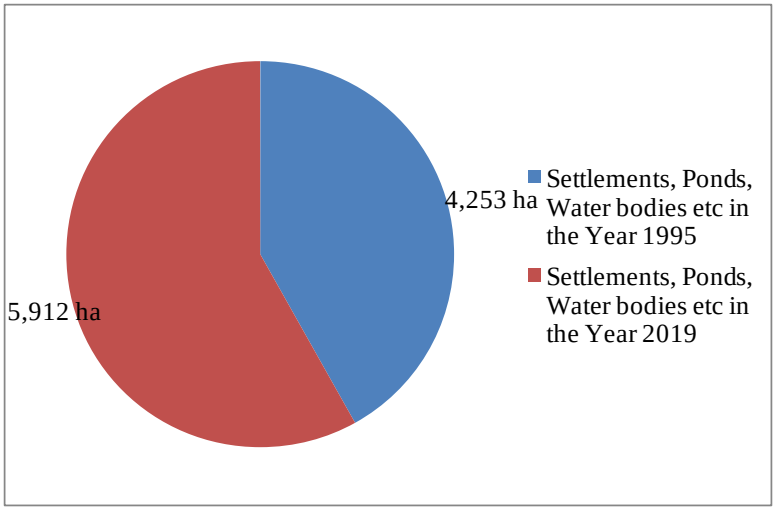


Figure 45: Changes in Settlements, Ponds, Water bodies etc. of Jagannathpur Upazila over time

(iii) Changes in Land Type

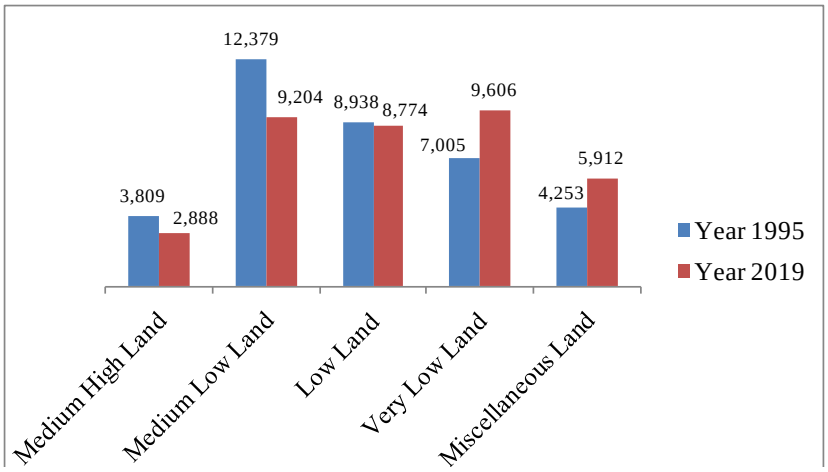


Figure 46: Land type Changes in Jagannathpur Upazila over time

(iv) Changes in Land Use:

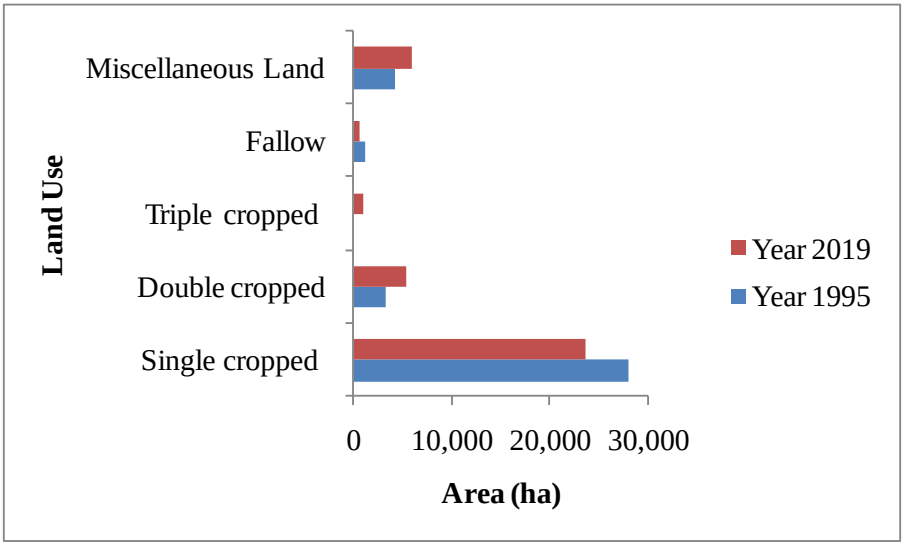


Figure 47: Changes in Land Use Areas (ha) in Jagannathpur Upazila over time

(e) Conclusion: Updating Upazila Land and Soil Resource Utilization Guide (Upazila Nirdeshika) through Semi-detailed soil survey is a vital program for understanding the changes in land use and soil fertility status of a specific area over time. This guide can be used as a modern tool for the transfer of the agricultural technology in national agricultural development.

Program 2. Union Land, Soil and Fertilizer Recommendation Guide (Union Sahayika) Preparation

(a) Introduction: Union Land, Soil and Fertilizer Recommendation Guide (Union Sahayika) is being used as a tool for agricultural development activities at Union level. It is used to provide the existing information of Upazila Land and Soil Resource Utilization Guide (Upazila nirdeshika) to the farmers at Union level more intensely. From this guide, farmers can get land and irrigation information for their particular union and place based fertilizer recommendations for the specific crops cultivated in that union. That is why it becomes imperative to make the Sahayika more useful to the farmers with the following objectives.

(b) Objectives

- To produce union level soil and land use database for local level agricultural development planning.
- To ensure the use of soil test based fertilizer recommendation at union level.
- Provide crop suitability and balanced fertilizer use related information to grass root level.

(c) Methodology

Base Materials: Existing Updated Upazila Soil and Landform Map (1:50,000).

Methods: Field survey is done at dry season. Base map (Upazila Soil and Landform Map) is divided into several grids and ground checking of each grid is done to verify changes. Land use data with other information is recorded in the profile card. Composite soil samples are collected and sent in the laboratory in the laboratory. After completing the survey map is prepared and with the result of soil analysis, Union Sahayika is prepared.

(d) Results and Discussion:

Table 14: Name of Union Sahaika prepared

Name of Regional/District Office	No. of Union Sahayika Prepared
Dhaka	6
Tangail	5
Faridpur	6
Jamalpur	6
Mymensingh	5
Cumilla	5
Noakhali	5
Chattogram	5
Rangamati	3
Rajshahi	5
Rangpur	5
Dinajpur	5
Pabna	10
Bogura	10
Khulna	5
Jashore	5
Kushtia	5
Barishal	-
Patuakhali	5
Sylhet	5
Moulvibazar	5
Total	111

(e) Conclusion: Union Sahayika is one of the important tools for using balanced fertilizer at union level. The Department of Agricultural Extension may play significant role in its extensive use.

Program 3. Monitoring & Evaluation of Farmers' Service through Mobile Soil Testing Laboratories (MSTL)

(a) Introduction: Soil Test Based (STB) fertilizer use may be one of the ways to minimize the yield gap. The farmers in our country are not yet fully aware of the benefit of the STB fertilizer use in crop production. Moreover Static Laboratories are scanty & distant from farmers reach. The Government of Bangladesh has taken steps to provide analytical services at farmer's doorstep through MSTL. SRDI launched this program through two MSTL Program at block levels for specific location and yield goal basis fertilizer recommendation for crop based on STB

since 1996. At present there are 10 MSTL for serving the farmer's of the country with soil testing facilities at Upazila level in Rabi and Kharif season every year.

(b) Objectives

- To create awareness among the farmers on benefit of using balanced fertilizer on the basis of STB and crop requirements.
- To serve the farmers with balanced fertilizer recommendation on the basis of STB & crop requirements by analyzing the soil samples at Upazila Sadar.
- To evaluate effect of soil test based fertilizer application on crop production.

(c) Methodology

About 180 farmers were selected for monitoring & evaluation under this program. The SRDI district offices monitor the activities of farmers and collect yield data with the help of DAE personnel. Yield was assessed by comparing the yield of the plots where fertilizers were applied following MSTL supplied Fertilizer Recommendation Cards (FRC) with adjacent plots having same crops and variety in the same season. The farmer's applied fertilizer dose is also recorded.

(d) Result and Discussion

In 2018-19, soil analytical service through MSTL was provided to 112 Upazila of the country and provided 5,600 farmers with Fertilizer Recommendation Cards (FRCs) (Table 2).

Table 15: Name of the Upazila and number of soil samples analyzed through MSTL under Farmer's Service Program during Rabi 2018 season and Kharif 2019 season

Sl. No	Upazila	District	No. of Soil Samples Analyzed	Upazila	District	No. of Soil Samples Analyzed
Rabi 2018				Kharif 2019		
1	Savar	Dhaka	44	Gazaria	Munshigonj	50
2	Araihazar	Narayangonj	52	Monohordi	Narsingdi	53
3	Munshigonj Sadar	Munshigonj	50	Singair	Manikgonj	50
4	Basail	Tangail	60	Tangail Sadar	Tangail	54
5	Delduar	Tangail	40	Bhuapur	Tangail	66
6	Jamalpur Sadar	Jamalpur	50	Sharishabari	Jamalpur	50
7	Islampur	Jamalpur	50	Islampur	Jamalpur	50
8	Jhinaigati	Sherpur	50	Jhinaigati	Sherpur	50
9	Sreebardi	Sherpur	50	Nalitabari	Sherpur	50
10	Nalitabari	Sherpur	50	Nandail	Mymensingh	43
11	Nakla	Sherpur	50	Purbadhola	Netrokona	33
12	Mymensingh Sadar	Mymensingh	53	Kotiadi	Kishoregonj	50
13	Barhatta	Netrokona	42	Kachua	Chandpur	52
14	Nikli	Kishoregonj	50	Madhukhali	Faridpur	69
15	Shaharasti	Chandpur	50	Sadar	Madaripur	46
16	Boalmari	Faridpur	50	Baliakandi	Rajbari	53
17	Sadar	Rajbari	50	Tungipara	Gopalganj	63

Sl. No	Upazila	District	No. of Soil Samples Analyzed	Upazila	District	No. of Soil Samples Analyzed
Rabi 2018				Kharif 2019		
18	Muksudpur	Gopalganj	50	Adarsha Sadar	Cumilla	48
19	Naria	Shariatpur	54	Bancharampur	B. Baria	50
20	Chandina	Cumilla	50	Fulgazi	Feni	136
21	Akhaura	B-Baria	50	Noakhali Sadar	Noakhali	59
22	Subarnachar	Noakhali	50	Ramgonj	Lakshmipur	49
23	Raipur	Lakshmipur	49	Raojan	Chattogram	50
24	Daganbhuyan	Feni	50	Rangunia	Chattogram	50
25	Sitakund	Chattogram	50	Ramu	Cox’s Bazar	50
26	Mirsarai	Chattogram	50	Ukhiya	Cox’s Bazar	50
27	Moheshkhali	Cox’s Bazar	50	Kaptai	Rangamati	51
28	Chakoria	Cox’s Bazar	50	Lakshmichari	Bandarban	51
29	Rowangchari	Bandarban	50	Horipur	Thakurgaon	50
30	Rangamati Sadar	Rangamati	52	Parbatipur	Dinajpur	78
31	Tetulia	Panchagor	50	Gobindagonj	Gaibandha	50
32	Dinajpur Sadar	Dinajpur	50	Kaliganj	Nilphamari	50
33	Mithapukur	Rangpur	76	Joldhaka	Nilphamari	50
34	Patgram	Lalmonirhat	50	Sariakandi	Bogura	56
35	Domar	Nilphamari	50	Khetlal	Joypurhat	50
36	Sonatola	Bogura	51	Vangura	Pabna	50
37	Akkelpur	Joypurhat	51	Ullahpara	Sirajgonj	50
38	Chatmohor	Pabna	50	Godagari	Rajshahi	54
39	Shahzadpur	Sirajgonj	50	Sadar	Chapainawabgonj	61
40	Charghat	Rajshahi	50	Niamotpur	Naogaon	50
41	Naldunga	Natore	50	Mongla	Bagerhat	51
42	Gurudashpur	Natore	50	Morelganj	Bagerhat	51
43	Fultala	Khulna	51	Sharankhola	Bagerhat	52
44	Rupsa	Khulna	50	Kaliganj	Jhenaidah	51
45	Bagerhat Sadar	Bagerhat	51	Keshobpur	Jashore	51
46	Jhikargacha	Jashore	50	Abhaynagar	Jashore	48
47	Monirampr	Jashore	51	Veramara	Kushtia	50
48	Narail sadar	Narail	51	Meherpur Sadar	Meherpur	50
49	Damurhuda	Chuadanga	50	Muladi	Barishal	50
50	Jibannagar	Chuadanga	50	Mathbaria	Pirojpur	50
51	Gournadi	Barishal	50	Patuakhali Sadar	Patuakhali	50
52	Jhalakathi Sadar	Jhalakathi	50	Bamna	Barguna	50
53	Dumki	Patuakhali	50	Kanaighat	Sylhet	68
54	Taltali	Barguna	50	Sadar	Sunamgonj	50
55	Fenchugonj	Sylhet	50	Rajnagar	Moulvibazar	39
56	Jagannathpur	Sunamgonj	51	Madhabpur	Habigonj	50
57	Juri	Moulvibazar	50			
58	Baniachong	Habigonj	50			
		Total	2,929		Total	2,986

Table 16. Comparative yield between FRC based fertilizer crop and farmer’s practice in Rabi 2018

Sl. No.	Name of Upazila	District	Crop & Variety	Average yield (t/ha)		
				Farmer's field	Demon-stration plot	Yield increase
1	Savar	Dhaka	Boro BRRI dhan29	7.5	6.0	25
2	Savar	Dhaka	Boro BRRI dhan29	7.3	5.9	24
3	Nagarpur	Tangail	Boro BRRI dhan29	6.9	7.8	13
4	Dhanbari	Tangail	Boro BRRI dhan29	7.2	8.1	12
5	Jamalpur Sadar	Jamalpur	Boro BRRI dhan29	6.5	7.8	22
6	Jamalpur Sadar	Jamalpur	Boro BRRI dhan28	6.1	7.5	25
7	Mymensingh Sadar	Mymensingh	Boro BRRI dhan29	4.6	5.8	26
8	Mymensingh Sadar	Mymensingh	Boro BRRI dhan29	4.5	5.6	24
9	Shaharasti	Chandpur	Boro BRRI dhan29	6.6	8.3	26
10	Chandina	Cumilla	Boro BRRI dhan28	5.1	6.1	20
11	Dhaganbhuyian	Feni	Boro BRRI dhan29	6.5	8.1	25
12	Subarnachar	Noakhali	Boro BRRI dhan28	5.0	6.0	20
13	Naldanga	Natore	Boro BRRI dhan 58	7.20	6.80	5.55
14	Naldanga	Natore	Boro BRRI dhan 29	7.50	7.0	6.66
15	Kaliganj	Satkhira	Pointed gourd	15	17	13.3
16	Jhikargacha	Jashore	Boro BRRI dhan 28	4.8	5.7	18.8
17	Jhikargacha,	Jashore	BARI sorisha-16	1.9	2.1	10.5
18	Jhikargacha	Jashore	BRRI dhan-28	5.3	5.6	5.7
19	Doulatpur	Kushtia	Boro BRRI dhan 58	4.65	5.25	12.90
20	Meherpur Sadar	Meherpur	Boro BRRI dhan 28	6.47	7.29	12.67
21	Gournadi	Barishal	Boro BRRI dhan 29	5.0	6.0	20
22	Jhlakathi Sadar	Jhalakathi	Boro BRRI dhan 28	4.20	5.3	26
23	Dumki	Patuakhali	Mungbean (Bari Mung6)	0.90	1.2	33
24	Taltali	Barguna	Boro BRRI dhan 47	3.80	4.5	18

Conclusion

In each Upazila, 5 farmer's practices were monitored. Yields of Rabi crops over famers' practice increased from 10.5 – 33 percent. Motivation activities may help farmers in using balanced fertilizers following Fertilizer Recommendation Cards provided by MSTL. This in turn will increase crop production in the country.

Program 4. Soil and Water Salinity Monitoring

(a) Introduction: The total area of Bangladesh is 147, 570 km^2. The coastal area covers about 20% of the country and over thirty percent of the net cultivable area. It extends inside up to 150 km from the coast. Out of 2.85 million hectares of the coastal and offshore areas about 0.83 million hectares are arable lands, which cover over 30% of the total cultivable lands of Bangladesh. A part of the coastal area, the Sundarbans, is a reserve natural mangrove forest covering about 4,500 km^2. The remaining part of the coastal area is used in agriculture. The cultivable areas in coastal districts are affected with varying degrees of soil salinity. The coastal and offshore area of Bangladesh includes tidal, estuaries and river floodplains in the south along the Bay of Bengal. Agricultural land use in these areas is very poor, which is roughly 50% of the country's average (Petersen & Shireen, 2001). Tidal and estuarine floodplains cover almost 98% of the coastal area. Small areas (2%) with river floodplains and peat basins are found in the northern part of the coastal area. Tidal floodplains occur in Satkhira, Khulna, Bagerhat, Pirozpur, Jhalukhati, Barisal, Patuakhali, Chittagong and Cox's Bazar district. They cover a total of 18,65,000 ha or about 65% of the coastal area. Estuarine floodplains occur in Noakhali, Bhola and Patuakhali districts and in the north-western part of Chittagong district. They cover about 9,37,000 ha or about 33% of the coastal area. Saline soil contains an excess of soluble salts, especially sodium chloride. In other words, soils that develops under the influence of the electrolyte of sodium salts, with a nearly neutral reaction. Dominant salts are sodium sulphate and sodium chloride, but seldom sodium nitrate, magnesium sulphate, or magnesium chloride. They are non-sodic soils containing soluble salts in such quantities that they interfere with the growth of most crop plants. The pH of the saturated saline soil is usually less than 8.3. These soils are geographically associated with arid, semi-arid, sub-humid and humid areas as well. The estimates indicate that Bangladesh has about 2.8 million ha (Chanratchakool, 2007) of land affected by salinity and poor quality water. The total area includes deltaic floodplains and offshore islands. This comes to about one-fifth of the total areas of Bangladesh and lies around the northern apex of the Bay of Bengal. The saline soils are mainly found in Khulna, Barisal, Patuakhali, Noakhali and Chittagong districts of the coastal and offshore lands (Figure 1). Due to a number of environmental factors the coastal soils are slightly moderately saline on the surface, and highly saline in sub-surface layers and substrata.

According to SRDI (2012) out of 2.86 million hectares of coastal and off-shore lands about 1.056 million hectares of arable lands are affected by varying degrees of salinity. Crop production in salt affected areas in the coastal regions differs considerably from non saline areas. Crops yields, cropping intensity, production levels and people's livelihood quality are much lower than that of other parts of the country (BBS, 2001). Many of the projected climate change impacts will reinforce the baseline environmental, socio-economic and demographic stresses already faced by Bangladesh. Therefore, it is imperative to regularly monitor the soil and water salinity.

(b) Objectives

- To determine the soil and water salinity round the year and to delineate area under different degrees of salinity.
- To determine the particular time frame in a year when surface water is suitable for irrigation.

- To record present land use and crop response to soil salinity.
- To provide necessary data base for developing appropriate technology to deal with the changed situation.

(c) Methodology

Field data is being collected from strategically representative sites of the coastal area. Soil samples at variable depths (0-10cm, 10-30cm and 30-60cm), water samples from surface (river, canals, ponds and water bodies), underground water (Hand Tube Well, Shallow Tube Well and Deep Tube Well) are collected twice in every month. Salinity of soils and water is determined by EC meter

Target and Achievement: Under Noakhali District Office, soil sample collection from 6 sites. Under Khulna Regional and District Office, soil sample collection from 12 sites, water sample collection form 13 sites and deep tube well water sample collection form 4 sites. Under Barishal Regional and District Office, water sample collection from 26 sites. Under Patuakhali District Office, water sample collection from 15 sites. EC determination of those samples recording, report preparation and sending to the Head office of SRDI regularly. A report of river/ khal water irrigation suitability is sent regularly to the Deputy Directors of Department of Agriculture of Khulna, Bagerhat and Satkhira districts.

Noakhali District Office

i) Site specification of the soil sample collection sites

Site no.	Name of site	Location	Soil series	Land type	Land Use	Physiography
1	Nabagram	Kobirhat	Hatia	MHL	Boro-F-T.A	MEF*
2	Charclark	Subarnachar	Ramgoti	MHL	Watermelon-F-T.A	MEF
3	Baroitola Bazar	Companiganj	Ramgoti	MHL	F-F-T.A	MEF
4	Milestone Chartorabali	Subarnachar	Hatia	MHL	Felon-F-T.A	MEF
5	Muhammadpur, Board Office,	Subarnachar	Hatia	MHL	F-F-T.A	MEF
6	Hemayetpur Bazar, Charlaxmi	Subarnachar	Ramgoti	MHL	Felon-F-T.A	MEF

**MEF= Meghna Estuarine Floodplain, MHL= Medium High Land, F= Fallow, T.A= T.Aman*

Khulna Regional and District Office

i) Site specification: Soil sample collection sites

Site no.	Name of site	Location	Soil series	Land type	Land Use	Physiography
			Khulna			
14A	Krishnanagar	Krishnanagar Batiaghata, Khulna	Bajoa	MHL	F-TA	GTF*
14B	Do	Krishnanagar Batiaghata, Khulna	Dumuriya	MHL	F-TA	GTF
15A	Lebubunia	Lebubunia	Bajoa	MHL	F-TA	GTF

Site no.	Name of site	Location	Soil series	Land type	Land Use	Physiography
		Dumuriya ,Khulna,				
15B	Do	Lebubunia Dumuriya ,Khulna	Dumuriya	MHL	F-TA	GTF
16A	Kismat Fultala	Kismat Fultala Batiaghata, Khulna	Bajoa	MHL	F-TA	GTF
16B	Do	Kismat Fultala Batiaghata, Khulna	Dumuriya	MHL	F-TA	GTF
17A	Fultala	Fultala Batiaghata, Khulna	Bajoa	MHL	F-TA	GTF
17B	Do	Fultala Batiaghata, Khulna	Dumuriya	MHL	F-TA	GTF
18A	Digraj Biddarbann	Digraj Biddarbann Mongla, Bagerhat	Barisal	MHL	F-TA	GTF
18B	Do	Digraj Biddarbann Mongla, Bagerhat	Barisal	MHL	F-TA	GTF
19	Paikgachha	Paikgachha HQ Khulna	Barisal	MHL	F-TA	GTF
20	Morrellganj	Morelganj Ferryghat Bagerha	Barisal	MHL	F-TA	GTF
			Jashore			
3	Narail	Narail Sadar	Gopalpur	HL	RV-KV	GRF
4	Baroipara	Kalia	Gopalpur	MHL	RV-KV	GRF
5	Kalna	Lohagora	Sara	HL	RC-F-TA	GRF
7	Sagordari	Keshobpur	Amjhupi	MHL	Boro-F-TA	GRF
9	Noapara	Abhoynagar	Gopalpur	HL	Banana Orchard	GRF
10	Tularampur	Narail Sadar	Sara	HL	Banana Orchard	GRF
12	Gobra	Narail Sadar	Gopalpur	MHL	RC-F -TA	GRF
13	Borodia	Lohagora	Gopalpur	MHL	RC-J-F	GRF
26	Sheikhhati	Narail Sadar	Sara	HL	RV-KV	GRF

**GTF= Ganges Tidal Floodplain, GRF= Ganges River Floodplain, HL= High Land, MHL= Medium High Land, KV= Kharif vegetables, RC= Rabi Crops, TA= Transplanted Aman, F=Fallow.*

ii) Site specification: Water collection sites

Site no.	Name of river/HTW	Location	Remarks
		Khulna	
1	Madhumati	Mollahatferryghat, Mollahat , Bagerhat	

Site no.	Name of river/HTW	Location	Remarks
2	Rupsa	Rupsa ferry ghat, Metro, Khulna	
9	Shibsa	Paikgachha HQ Paikgachha, Khulna	
10	Kazibachha	Fultala Batiaghata, Khulna	
11	Pasur	Mongla Port, Mongla, Bagerhat	
12	Daratana	Daratana ferry ghat , Bagerhat	
13	Panguchi	Morrellganj HQ Morrellganj ,Bagerhat	
14	Hand tubewell	Koiya Bazar , Batiaghata, Khulna	
15	Hand tubewell	Fultala (South) , Batiaghata, Khulna	
16	Hand tubewell	Fultala (North) , Batiaghata, Khulna	
17	Hand tubewell	Hogladanga , Batiaghata, Khulna	
		Jashore	
3	Chitra River, Narail Ferry Ghat	Narail Sadar	
4	Noboganga River, Baroipara Ferry Ghat	Kalia	
5	Modhumati River, Kalna Ghat	Lohagora	
7	Kopotakkho River, Sagordari	Keshobpur	
9	Voirab River, Noapara	Ovoinagar	
10	Afra River, Tularampur	Narail Sadar	
12	Chitra River, Gobra	Narail Sadar	
13	Madhumoti River, Borodia	Lohagora	
26	Afra River, Sheikhati	Narail Sadar	
		Patuakhali	
1	Payra	Taltali	
2		Amtali	
3		Payrakunja	
4	Bishkhali	Patharghata	
5		Baroitala, Barguna	
6		Bamna launch ghat	
7		Betagi launch ghat	
8	Baleswar	Charduani, Patharghata	
9		Baramachhua, Mathbaria	
10	Andermanik	Kalapara	
11	Galachipa	Galachipa ferry ghat, Galachipa	
12	Kazal	Panpatti launch ghat, Galachipa	
13	Lohalia	Boga launch ghat, Bauphal	
14	Tetulia	Dashmina launch ghat,Dashmina, Patuakhali	
15	Kalaiya	Kalaiya Bandar, Bauphal, Patuakhali	
		Barishal	
16	Baleswar	Pirojpur bridge	
17		Raghunathpur, Sekhmatia, Nazirpur	
18	Kacha	Bekutia ferry ghat	
19		Charkhali ferry ghat	
20	Panguchi	Indurkani	
21	Meghna	Ilisha ghat, Bhola Sadar	
22		Daulatkhan, Bhola	
23		Tazumuddin, Bhola	
24		Betua, Charfashion	
25	Tetulia	Bhola kheya ghat	
26		Bheduria launch ghat, Bhola	

(d) Results and Discussion:

Khulna Region

Soil Salinity

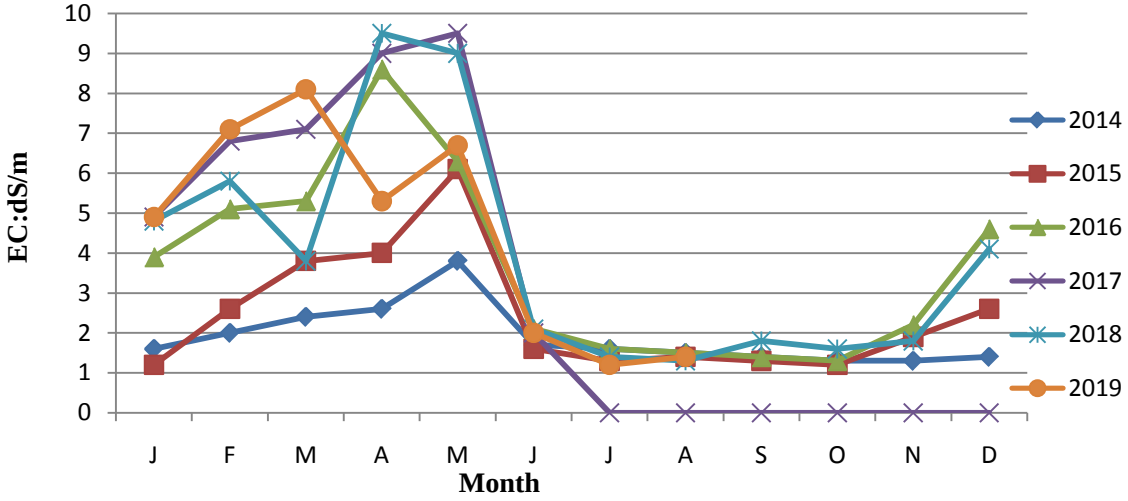


Figure 48: Salinity in Bajoa series, MHL over time at Krishnanagar, Batiaghata

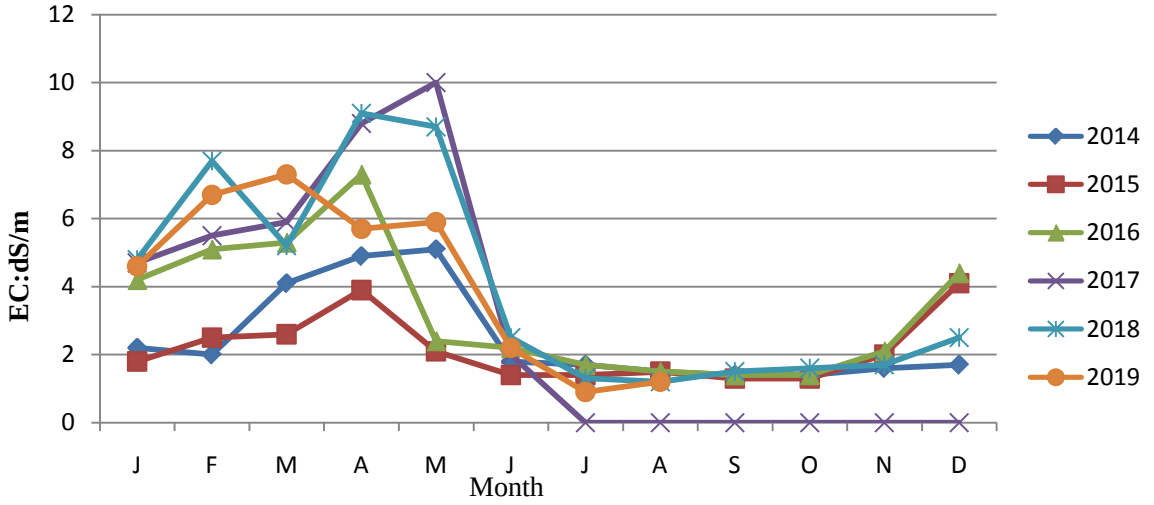


Figure 49. Salinity in Bajoa series, MHL over time at Ghutudia, Dumuria

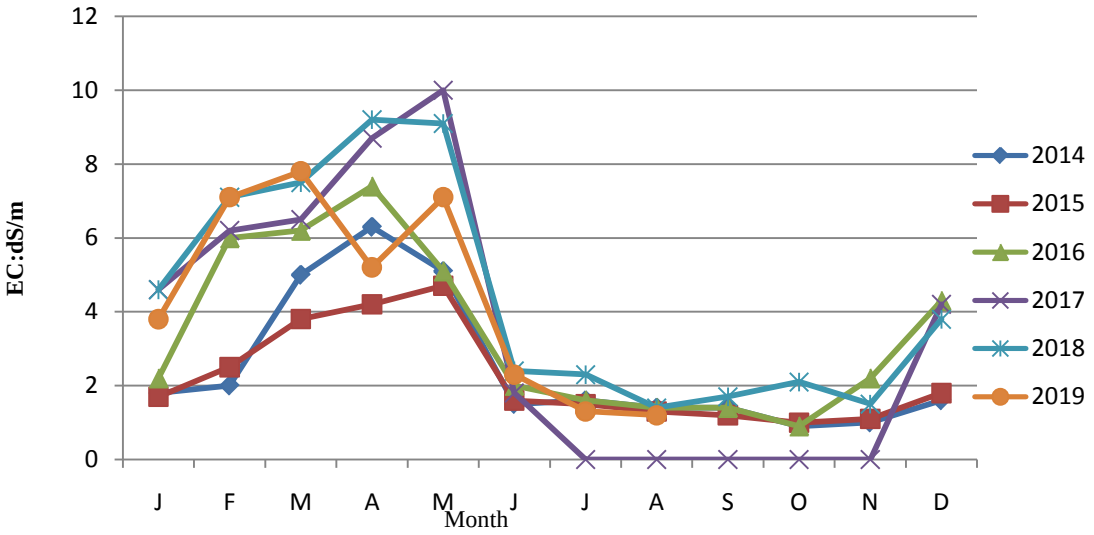


Figure 50: Salinity in Bajoa series, MHL over time at Fultala, Batiaghata

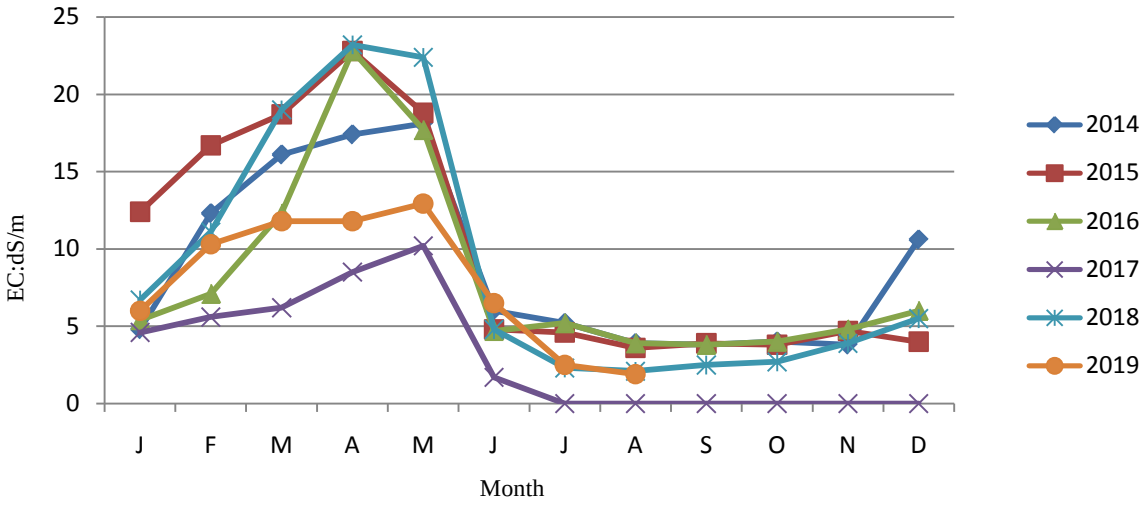


Figure 51: Salinity Barisal series, MHL over time at Digraj Biddarbaon, Mongla

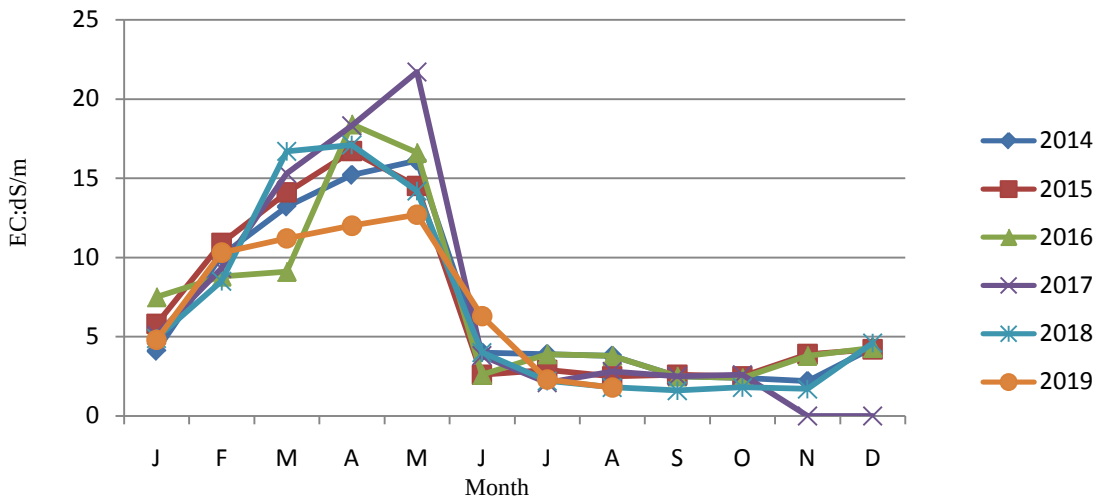


Figure 52: Salinity Barisal series, MHL over time at Shibbari, Paikgacha

Observations:

a) Water salinity:

- River water salinity of western pert i.e.Satkhira district is more than that of eastern part i.e. Khulna and Bagerhat district.
- In western part river water salinity was found highest in May/June where as in the eastern part it was in April/May.

b) Soil salinity:

- ECe is less in the upper part of the catena than that of the lower part.
- Duration of salinity in the lower part of catena is more than that of the higher part.
- In shrimp cultivation area soil salinity gradually increased from 1990. This salinization may be due to the effect of saline water flooding for long period, slow permeablility,presence of highly saline ground water at shallower depth (<1.0m) almost throughout the year and lack of flashing facility after shrimp harvest etc.

c) Hand tube well water salinity:

- In long term monitoring it is evinced that a slowly increasing tendency of water salinity was observed in ground water aquifer in dry season.

Comments:

- Water salinity of western side river is more than eastern side.

- Water salinity of same stream is less in upper stream and higher in down stream.
- Most of the river water remains saline throughout the year and not suitable for irrigation.
- Few of the river water remains non-saline from August to October and suitable for irrigation.

Barishal Region

Water Salinity

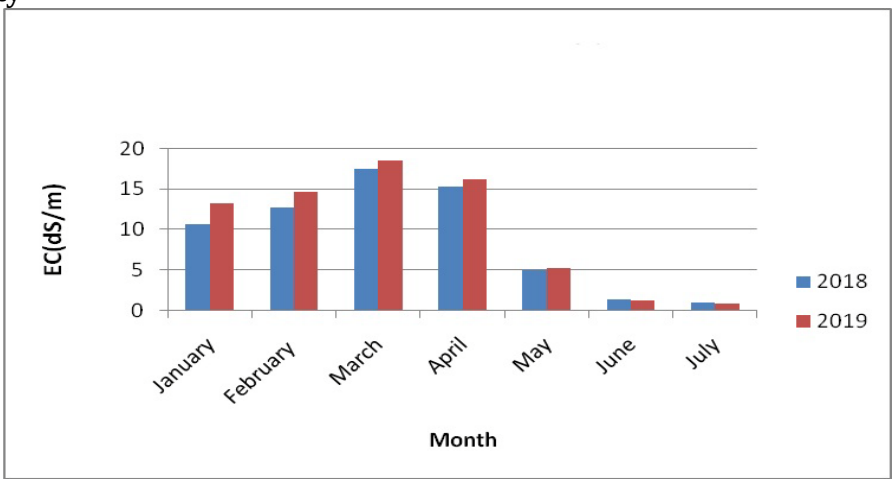


Figure 53: Water Salinity of Meghna river at Betua, Charfashion, Bhola

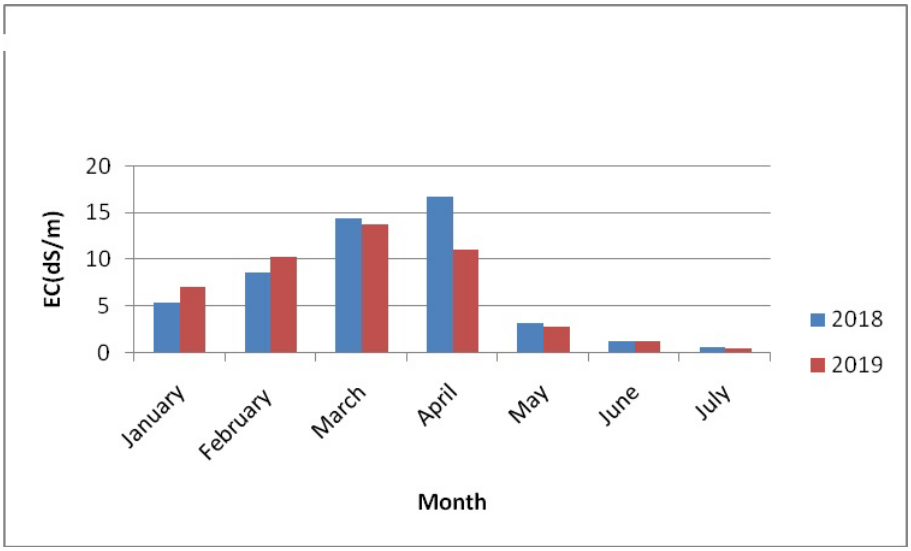


Figure 54: Water Salinity of Meghna river at Tazumuddin, Bhola

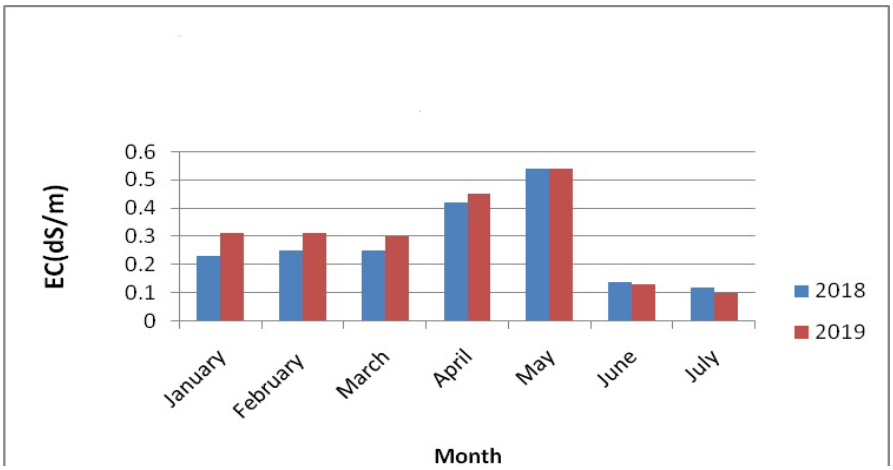


Figure 55: Water Salinity of Tetulia river at Bheduria, Bhola Sadar

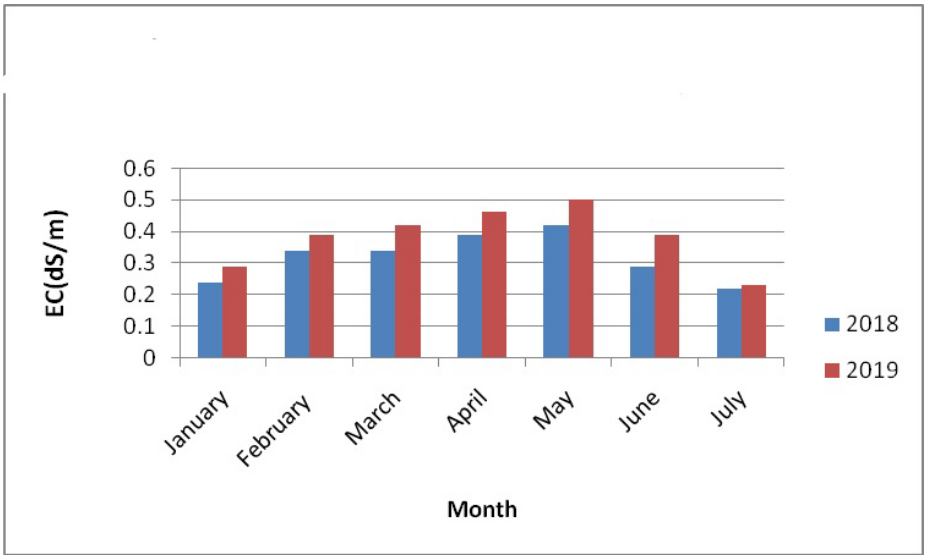


Figure 56: Water Salinity of Kacha river at Bekutia ferryghat, Pirojpur Sadar

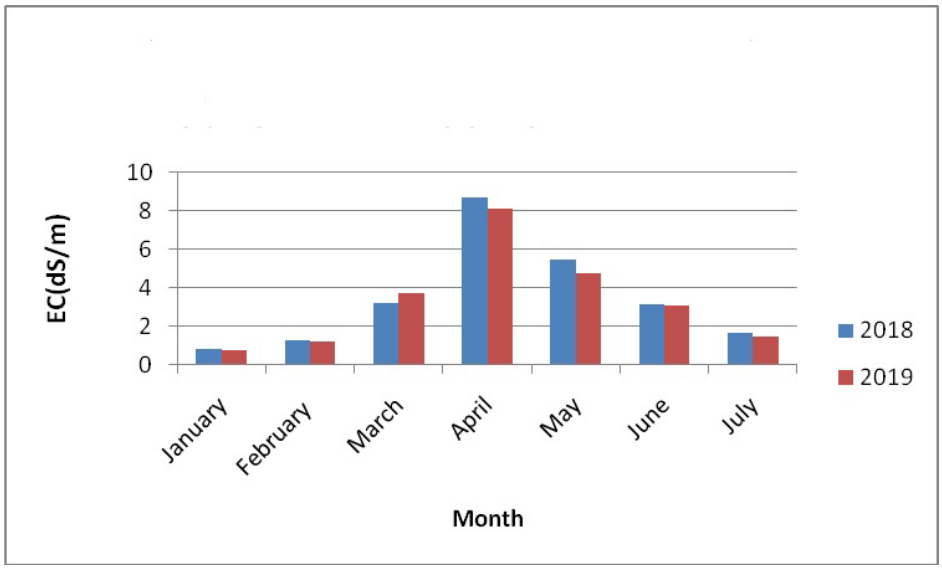


Figure 57: Water Salinity of Panguchi river at Balipara, Indurkani, Pirojpur

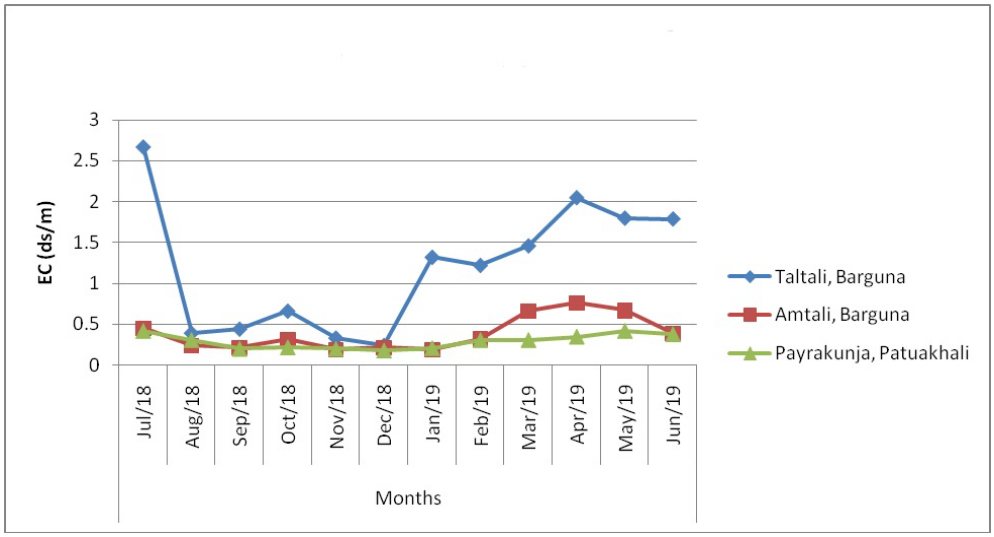


Figure 58: Water Salinity of Different Points of the Payra River during 2018-2019

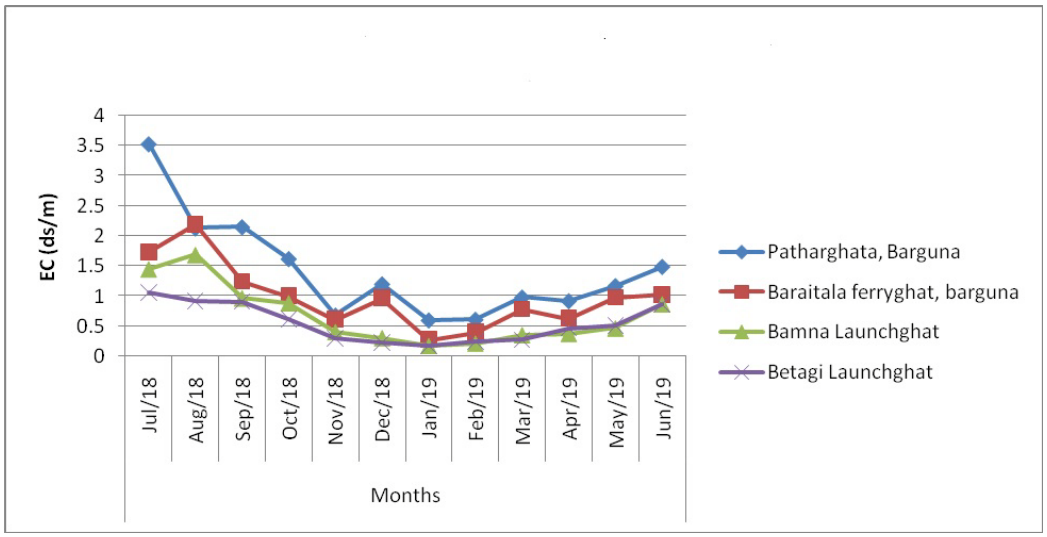


Figure 59: Water Salinity of Different Points of the Bishkhali River during 2018-2019

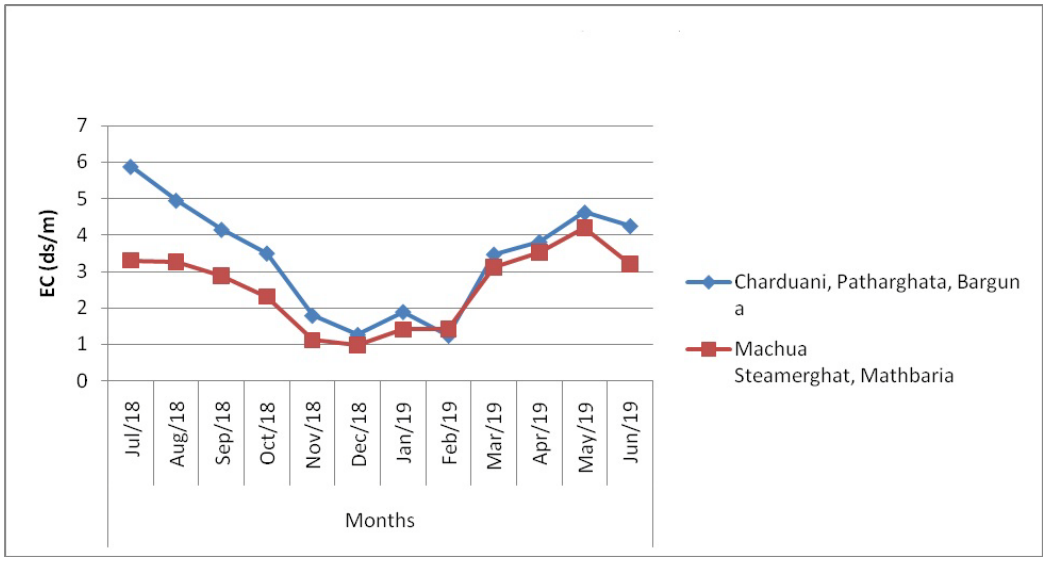


Figure 60: Water Salinity of Different Points of the Baleshwar River during 2018-2019

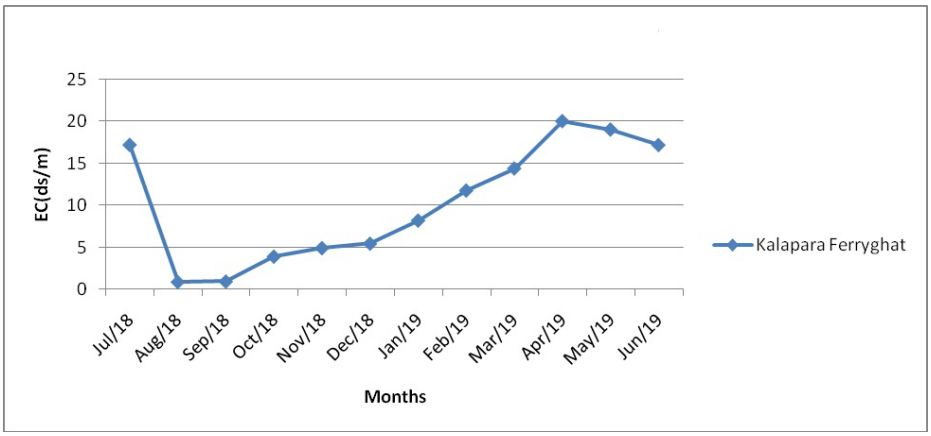


Figure 61: Water Salinity of Different Points of the Andharmanik River during 2018-2019

Table 18: Major trend of river water salinity

Name of River	Location	Safe Period for irrigation	Period not safe for irrigation
Panguchi	Ballipara ferry ghat, Indurkani, Pirojpur	-	Almost round the year
Kacha	Bekutia, Pirojpur Sadar	Round the year	-
	Charkhali, Bhandaria, Pirojpur	Round the year	-
Baleswar	Sekhmatia, Nazirpur, Pirojpur	July-September	October-June
	Pirojpur bridge, Pirojpur Sadar	-	Almost round the year
	Baramachhua, Mathbaria, Pirojpur	-	Almost round the year
	Chardwani, Patharghata		Almost round the year
Bishkhali,	Bamna, Barguna	Round the year	-
	Betagi, Barguna	Round the year	-
Bishkhali,	Barguna Sadar	Round the year	-
	Patharghata	Almost round the year	-
Payra	Pyrakunja,Mirzaganj, Patuakhali	Round the year	-
	Amtali, Barguna	Almost round the year	-
	Taltali, Barguna	-	Almost round the year
Meghna	Ilisha ghat, Bhola sadar	May-January	February-April
	Daulatkhan, Bhola	May-January	February-April
	Tazumuddin, Bhola	-	Almost round the year
	Betua, Charfashion, Bhola	-	Round the year
Tetulia	Bhola kheya ghat, Bhola Sadar	Round the year	-
	Bheduria launch ghat, Bhola Sadar	Round the year	-
Andermanik	Kalapara bridge, Kalapara, Patuakhali	-	Round the year

Chattogram Region

Table 19: Salinity monitoring (soil)

Sl. No.	Place	Dec'17		Jan'18		Feb'18		Mar'18		Apr'18	
		EC results ds/m									
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
U1	Patenga	-	0.09	0.70	0.75	1.23	1.85	-	2.4		
U2		-	1.0	-	1.9	-	1.5	-	7.0		
U3		-	0.80	-	2.5	-	8.0	-	9.0		
U1	Anwara	-	0.60	0.94	1.5	1.74	3.2	-	3.17		
U2		-	0.22	0.17	2.25	1.6	3.5	-	5.4		
U3		-	6.0	-	5.21	7.5	8.5	7.3	9.8		
U1	Banskhali	-	0.85	-	1.25	2.0	2.25	-	2.8		
U2		-	3.0	-	2.25	3.25	4.45	8.5	7.45		
U3		-	3.1	-	2.50	7.25	6.5	9.4	12.0		
U1	Shitakunda	-	2.09	-	2.70	-	2.8	4.5	4.9		
U2		-	4.40	-	4.60	-	4.8	6.4	9.7		
U3		-	3.59	-	8.9	-	12.8	15.2	15.9		

Table 20:Salinity monitoring (Water)

Sl. No.	Place`	Dec'17	Jan'18	Feb'18	Mar'18	Apr'18
		EC results ds/m				
1	Naval academy	29	32	35	34	40
2	Amanat Shah Bridge	2.9	5.5	11.8	15.1	7.1
3	Kalurghat	0.5	0.2	0.3	0.3	0.4
4	Sikalbaha	0.4	0.5	0.6	0.3	0.1
5	Santirhat, Kusumpur, kolagao	0.1	0.3	0.4	0.2	0.1
6	Boalkhali shakpura Lalarpool	0.3	0.25	0.3	0.2	0.2
7	Boalkhali khal, Main pool	0.6	0.7	0.5	0.3	0.2
8	Anwara, chatori Brahmaner khal	0.6	0.4	0.5	0.4	0.25
9	Anwara khal	0.2	0.4	0.4	0.3	0.25
10	Hathazari maduna ghat	0.15	0.2	0.15	0.1	0.1
11	Anwara, Isakhali khal	0.5	0.5	0.7	0.4	0.4
12	Sangunadir Mohana	11.6	16.0	17.5	25.6	30.5
13	Patenga sea	34	33	35	36	35

Conclusion

Soil and water salinity is the major constraint for land use development in Barisal region like other coastal area of the country. Salinity build up in soil and water of this area is due to the influence of sea water. It is quite natural and a common feature of coastal environment. We cannot prevent this process rather we are to adapt with it. So management of salinity is the only option for agricultural development here. Monitoring activities need to be widened and strengthened to generate data base for setting future strategies to encounter the upcoming challenge of climate change and sea level rise.

Program 5. Technology Transfer through Adaptive Trials

Introduction

Judicious use of chemical fertilizers not only prevents misuse of valuable fertilizers but also reduces pollution of agricultural environment. Use of balanced fertilizers will ensure the sustainability of increased trend of crop yields. To popularize balanced fertilizer application among farmers to reduce crop production cost and environmental pollution adaptive trials are set up on the basis of Upazila Nirdeshika soil test results.

Objectives

- To demonstrate the benefit of using balanced fertilizer in crops according to Upazila Nirdeshika soil test results.
- To popularize the use of Upazila Nirdeshika among farmers.
- To motivate the farmers to conserve soil health through rationale use of chemical fertilizers.

Materials and Methods

Two different plots of farmer's are selected for setting up of adaptive trial at Upazila level. Land type and soil group of the plot is identified using Soil and Landform Map attached with Upazila Nirdeshika. Then fertility status is determined from data given Table Kha of the respective mapping unit (Chapter 2). Fertilizer dose is determined according to fertility status. All inputs are supplied by SRDI for both of the farmer's for 30 decimal lands. Recommended agronomic practices are followed in the trial plot. But the control plot is managed by the farmers according to their normal practice. Time to time visit and monitoring is ensured by the SRDI and DAE experts to provide timely suggestion. When crops are ready to harvest, a field day is arranged for crop cutting inviting farmers, GO/ NGO officials and public representatives.

Results and Discussion

After crop cutting from the trial plots in every District and Upazila it was observed that trial plot yield was higher from control plot (Table 21). Farmer's knowledge gap, resource constraint and lack of communication with resource persons are responsible for the yield.

Table 21. Comparative yield between FRC based fertilizer crop and farmer's practice in Rabi 2018.

Sl. No.	Name of Upazila	District	Crop & Variety	Average yield (t/ha)		
				Farmer's field	Demon-stration plot	Yield increase %
1	Gazipur Sadar	Gazipur	Bridhan 28	5.7	7.1	25
2	Dhamrai	Dhaka	BRRI dhan58	4.5	5.0	11
3	Kalihati	Tangail	BRRI dhan29	6.9	7.5	8
4	Mrizapur	Tangail	BRRI dhan29	7.2	8.1	11
5	Sherpur	Nakla	Hybrid Rice	5.36	7.10	32.5
6	Sherpur	Nalitabari	Hybrid Rice	6.35	8.25	29.9
7	Muksudpur	Gopalganj	BRRI dhan29	15.7	18.5	18

Sl. No.	Name of Upazila	District	Crop & Variety	Average yield (t/ha)		
				Farmer's field	Demon-stration plot	Yield increase %
8	Muksudpur	Gopalganj	BRRI dhan29	13.9	17.2	24
9	Muksudpur	Gopalganj	BRRI dhan29	14.9	17	20
10	Muksudpur	Gopalganj	BRRI dhan29	15.9	19	19
11	Muksudpur	Gopalganj	BRRI dhan58	14.9	17.7	19
12	Kashiani	Gopalganj	BRRI dhan29	16.2	18.7	16
13	Kashiani	Gopalganj	BRRI dhan58	15.7	18.7	19
14.	Kashiani	Gopalganj	BRRI dhan59	14.7	17.4	19
15	Kashiani	Gopalganj	BRRI dhan29	13.7	18.7	37
16	Kashiani	Gopalganj	Hybrid Hera	18.2	23	26
17	Rajbari Sadar	Rajbari	BRRI dhan29	18.7	25	34
18	Madhukhali	Faridpur	BRRI dhan28	15.3	19.7	26
19	Burichong	Cumilla	BARI Alu 7 (Daimont)	29.6	44.5	50
20	Cumilla Sadar South	Cumilla	BRRI dhan81	5.76	7.2	25
21	Begumganj	Noakhali	BRRI dhan59	5.6	6.9	23
22	Subarnachar	Noakhali	Watermelon (Hybrid- Glory)	36	45	25
23	Patiya	Chittagong	BRRI dhan74	6.7	7.8	16.4
24	Karnafuli	Chittagong	BRRI dhan28	6.5	7.2	10.7
25	Rangamati Sadar	Rangamati	BARI Alu- 7 (Daimont)	20.62	26.6	29.3
26	Rangamati Sadar	Rangamati	BARI Alu- 7 (Daimont)	18.4	22.8	23.9
27	Naldanga	Natore	BRRI dhan29	7.0	6.5	7.14
28	Shibganj	Chapainawab-gonj	BRRI dhan28	6.40	5.80	9.37
29	Naldanga	Natore	BRRI dhan58	7.20	6.80	5.55
30	Naldanga	Natore	BRRI dhan29	7.50	7.0	6.66
31	Natore Sadar	Natore	Jirashail	6.2	5.6	9.67
32	Natore Sadar	Natore	BRRI dhan29	7.60	6.90	9.21
33	Natore Sadar	Natore	BRRI dhan58	7.30	6.75	7.53
34	Natore Sadar	Natore	Hira 2	8.30	7.4	8.64
35	Gomostapur	Chapai-nawabgonj	Jirashail	5.70	5.20	8.77
36	Natore Sadar	Natore	BRRI dhan28	6.6	6.40	7.57
37	Batiaghata	Khulna	Maize	7.43	8.64	16.28
38	Dumuria	Khulna	Cauliflower	27	30	11
39	Jashore Sadar	Jashore	BRRI dhan28	5.98	6.44	7.7
40	Jhikargacha	Jashore	BRRI dhan28	5.69	6.58	15.64
41	Barishal Sadar	Barishal	BRRI dhan74	4.4	5.3	20
42	Nalchiti	Jhalakati	BRRI dhan47	5.0	6.1	22
43	Pirojpur Sadar	Pirojpur	BRRI dhan74	5.0	6.0	20
44	Pirojpur Sadar	Pirojpur	BRRI dhan28	4.5	5.6	24
45	Nazirpur	Pirojpur	BRRI dhan74	5.2	6.1	17
46	Indurkani	Pirojpur	BRRI dhan28	4.5	5.6	24

Sl. No.	Name of Upazila	District	Crop & Variety	Average yield (t/ha)		
				Farmer's field	Demon-stration plot	Yield increase %
47	Nesrabad	Pirojpur	Bina dhan 10	4.7	5.8	23
48	Kawkhali	Pirojpur	Bina dhan 10	4.5	5.5	22
49	Kawkhali	Pirojpur	BRRI dhan74	4.3	5.2	21
50	Kawkhali	Pirojpur	BARI Mungbean6	0.9	1.2	33
51	Kalapara	Patuakhali	Bina dhan10	4.9	6.0	22
52	Barguna Sadar	Barguna	BRRI dhan47	5.4	6.2	15
53	South Surma	Sylhet	BRRI Dhan29	4.4	7.1	38
54	Sadar	Sylhet	BRRI Dhan29	4.7	6.8	30
55	Kamalganj	Moulvibazar	BRRI Dhan58	5.3	7.1	25
56	Rajnagar	Moulvibazar	BRRI Dhan29	5.2	7.3	24

Conclusion

Farmers were benefitted by using balanced fertilizer on the basis of Upazila Nirdeshika soil test results. It is a low/no cost technology through which farmers can get higher yield of crops. It is observed that farmers got about 10-38% higher yield in different crops and varieties in different locations.

Chapter 4: ACTIVITIES OF RESEARCH CENTERS

4.1 Soil Conservation and Watershed Management Centre (SCWMC), Bandarban

Program 1. Development of integrated watershed management in Bandarban

Objectives

a. To manage and utilize the rain & runoff water for irrigation, fishery, poultry & household purpose.

b. To protect, conserve and improve the slopping land of watershed, minimizing soilerosion hazard, sustained production and settled agriculture.

c. To improve and increase the production of food, fruits, fuel and fodder and to bring scattered inhabitants in clusters to ensure healthy & safe environment.

Materials and Methods

The experiment was conducted Soil Conservation and Water Management Centre, SRDI, Bandarban Hill District. Mechanical and biophysical conservation techniques were applied. Different horticultural fruit species has been planted along with hedge plant for minimizing erosion hazard. The experimental plots wereselected in such way that the area individually can be treated as a micro watershed and each plot has beenconsidered as a treatment. The area has beendivided into smaller parts depending on slope gradient and soil characteristics. Prior to plantation composite topsoil samples will collect from each site and physical, chemical and mineralogical analysis will done to compare the soil characteristics before and after cultivation.

The seedlings/saplings hasbeen planted in contour line (across the slope) with following plant spacing and row spacing on the basis of species. Preparation of land has beenstarted at suitable time. Intercultural operations have been done as and when required. Data on yield and yield contributing characters will take at harvest time and economic analysis will made following standard statistical procedure. Soil conservation measures of both the mechanical and bio-engineeringhas beenadopted. Mechanical measures have beenaccomplished with bench terracing, grassed waterways, contour trench, half moon terracing etc. Most degraded sites has already been reclaimed by using jute geo-textile. Biological method would be adopted by introducing different hedge species and which has beenplanted in contour lines.

Different horticultural crops like mango, Jujube (Kul) Orchard (Apple Kul& BOU Kul), Multi-fruit Garden and citrus species has beenplanted on adjacent to the watershed both on the flat & slopping lands following contour lines. Pits for seedlings would be drug in the month of April to May. Manures and fertilizers like cow dung, N, P & K will be applied as per recommendation. Planting of the seedlings has beendone in the month of June to July depending on rain. Intercultural operation will be done manually as when and where necessary. Half moon terrace has beenmade to conserve moisture before the end of the monsoon. Mulching has beendone in the half-moon terraced to keep the soil moisture, adding biomass & maintain the good health of the soil. Year round different seasonal vegetables will be grown in bench terraced area and irrigation would be provided from nearby multi-purposed dam water. Intercultural operations like weeding and earthling up of the soil will do equally in all treatments to get better results. Before sowing of seeds, a mixture of cow dung, N, P and K as urea, triple super phosphate and murate of potash will apply at different doses. Other management practices and preventive measures will take as and when need. Data on different attributes of different crops will record timely following standard procedures. Meteorological information's like rainfall, humidity percentage, daily maximum and minimum temperature, soil temperature in different depth will be collected.

Fishes has beenintroduced in the reservoirs. Experimental site also be selected near by the reservoirs. Irrigation for plants and seasonal crops would be done. Training & Demonstrations for various levels would be held on.

Results and Discussion

Table 22.Approximate cost and return (BDT) from experimental plots.

Activities done	Establishment Cost	Return in BDT		
		FY 2016-17	FY 2017-18	FY 2018-19
Fish Cultivation	93,000.00	20,000.00	30,000.00	45,000.00
Multi-fruit Garden Intercultural operation.	9,000.00	15,000.00	18,000.00	30,000.00
Mango orchard	32,000.00	500.00	1,700.00	2,000.00
Citrus orchard	10,000.00	12,800.00	14,200.00	16,400.00

Lichi garden Intercultural operation	15,000.00	60,000.00	40,000.00	55,000.00
Kul Orchard (Apple Kul & BOU Kul)	1,000.00	700.00	1,400.00	1,800.00
Coconut & battle-nut (Intercultural operation)	3,000.00	4,200.00	4,500.00	3,200.00

Soil loss from degraded land under different treatment for the year-2018 session is presented in Table 2. It was recorded that highest soil loss was recorded in control plot (**15.51** t/ha) where no geo-jute or jute mat was used, followed by plot managed by 500 GSm (**8.67** t/ha) and 700 GSm**(5.28** t/ha). As 700 GSm jute mat is denser than 500 GSm Jute mat, so it provides better soil cover than that of 500 GSm jute mat.On the other hand 500 GSm jute mat is better than 700 GSm jute mat for growing vegetation at primary stage as it is lighter than 700 GSm Jute mat.

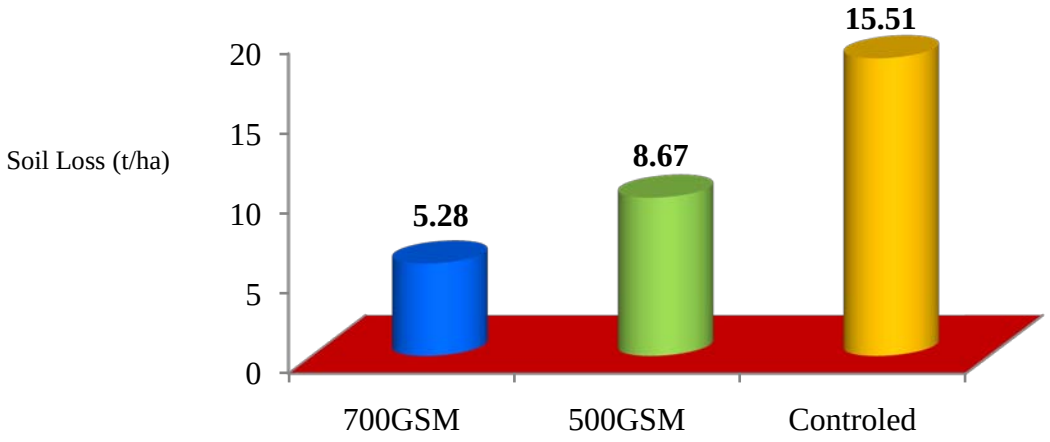


Figure 62. Soil loss compared under different mesh Geo-Jute

Run-off from degraded land under different treatment for the year-2016 throughout the rainy season was calculated and shown in Table-3. It was recorded that the highest runoff was recorded in controlled plot where there was no geo-jute or jute mat, followed by plot managed with 700 GSm& 500 GSm.

Table-23: Run-off from degraded land under different treatmentsin 2018

Month	Run-off (%)		
	700 GSM	500 GSM	Controlled
June/2018	27.89	29.52	36.63
July/2018	34.61	39.41	52.85
August/2018	45.41	48.62	64.68
September/2018	29.71	32.35	35.87
October/2018	34.26	36.72	41.66

Table-24: Initial soil nutrient status of the experimental site

Particulars	pH	OM %	K	Ca	Mg	TN (%)	P	S	B	Cu	Fe	Mn	Zn
		meq/100g soil					µg/g soil						
700-GSM Plot	4.5	3.36	0.36	3.43	2.08	0.40	6.70	11.3	0.20	0.76	68.8	25.2	1.50
500-GSM Plot	4.3	3.09	0.30	2.28	1.54	0.43	3.67	1.7	0.25	0.70	50.2	14.0	0.94
Control Plot	4.6	2.82	0.49	4.73	2.88	0.22	6.88	12.4	0.28	0.78	72.0	24.2	2.24

Table-25: Chemical properties of Soil under different jute-mat (After Two years)

Particulars	pH	OM %	K	Ca	Mg	TN (%)	P	S	B	Cu	Fe	Mn	Zn
		meq/100g soil					μg/g soil						
700-GSM Plot	5.9	3.77	0.39	9.08	2.71	0.19	3.28	1.11	0.03	0.69	77.05	7.23	1.48
500-GSM Plot	5.9	3.36	0.35	11.56	3.37	0.18	2.83	0.27	0.23	0.85	80.22	6.81	1.57
Control Plot	5.2	2.98	0.30	8.75	2.47	0.17	2.96	3.67	0.18	0.63	51.5	5.3	1.02

Most of soil nutrientswere observed to be increased after setting the jute geo-textile.

Conclusions

This program needs to be continued for observing sustainable effect of the practices.

PROGRAM 2. STUDY ON MANAGEMENT AND ECONOMIC VALUE OF *SCHUMANNIANTHUSDICHOTOMA*(*MURTA*/PATIBET) IN HILLY JHIRI LAND AT BANDARBAN

Objectives

i. To study the suitability and yield or productivity of Murta in Hilly Region of Bangladesh.
ii. To ensure the fallow lands of hilly Jhiri in to productive and minimize soil erosion hazard.
iii. To strengthen the economical efforts of the hill dwellers by increasing off farm activities & to supplement the traditional Jhum Practices.

Materials and Methods

The study has been introduced in 2016-2017. A suitable field situated in a Jhiri locating of the South-south-east side of the SCWMC administrative Building has been selected for cultivation of *Patibet.*For testing the adaptability with the climatic condition of this region, in the primary stage about 500 rhizomes covering an area of 85'-0" x 20'-0" = 1700.00 sft has been planted in rows maintaining contour lines. Rhizomes were collected from nearby Upazila of Chittagong district. The field in where the *Schumannianthusdichotoma (Patibet)* is cultivated under this Research is almost a table top plain land in cross sectional abuts a sloping land in longitudinally. The elevation difference from upper end to lower end is 3'-0". The field is divided in to three plots. Elevation difference from upper plot to middle plot is 1'-9" and from middle plot to lower plot is 1'-3". The plots are located in the valley land in between two hills which is locally known as Jhiri. This type of land generally remains abandoned all the times (years after years). Soil moisture varies for its difference of elevation. The moisture content of soil of the lower part of the hill is generally higher than that of higher. *Schumannianthusdichotoma*(*Murta*/Patibet) is widely grown in wetland areas. No additional soil is added to the rows of Murta plants as it can interrupt the natural surface flow during the rainy season. Intercultural operation including applying inorganic fertilizer has been done as per recommendation. Growth of plants and number of plants per Culm were observed closely. No irrigation is done in the draught season.

Results and Discussion

It was found that there is a significant difference in growth of plants and number of plants per Culm of Murta in different plots. Plants height was also different in difference plots. Plants height of the lower plot is higher than that of immediate upper plot. Plants of Murta in the upper most plot are thin and pale (average height 1'-6" to 2'-0") where the plants growth of the second plot is satisfactory and green in colour (average height 3'-0" to 4'-0"). The plants of the lower plot were healthier and vigorous than second plot with dark green in colour (average height 4'-0" to 5'-0"). On the other hand the number of plants per Culm in upper, middle and lower plot was on an average 7 to 9, 10 to 14 and 12 to 16 respectively.

Table 26:Comparative growth & return of the plants in different plot indifference elevation

Plot No	Year	Appearance	Av. plant Height	Av.plants Diameter	Av. Leaf per plant	Av. Plants per Culm	Return (in BDT) 2018-19
1. (Upper)	2017-18	Yellowish green	1'-6" to 2'-0"	4 to 6 mm	4 to 6	7 to 9	-
	2018-19	Green	3'-6" to 6'-6"	8 to 20 mm	8 to 12	12 to 16	300.00
2. (Middle)	2017-18	Green	3'-0" to 4'-0"	5 to 8 mm	5 to 9	10 to 14	-
	2018-19	Green	4'-0" to 7'-0"	10 to 22mm	8 to 14	15 to 20	700.00
3. (Lower)	2017-18	Dark green	4'-0" to 5'-0"	7 to 12 mm	9 to 14	12 to 16	-
	2018-19	Dark Green	4'-0" to 7'-0"	12 to 22 mm	10 to 16	20 to 22	1250.00

Conclusions

*Patibet*can play a vital role in the economy and environment CHT of Bangladesh. It can easily be cultivated in hilly Channel/Jhiri that remain fallow and remain wet even in the dry season. These lands are not suitable for cultivation of other cash crops. The cultivation of *Patibet*is inexpensive and does not conflict with the production of agricultural crops. This program will minimize soil erosion hazard in Chittagong Hill Tracts. This study will ensure income generating crops instead of harmful jhum cultivation and safe hill environment. It is necessary to develop effective propagation methods which will lead to higher production; these must be user-friendly so that farmers can adopt them easily. Adequate training and motivation is required to encourage people to cultivate *Patibet*elsewhere in Bangladesh, and infrastructure should be developed to support *Patibet*based cottage industries and community based marketing facilities, complemented by access to adequate knowledge and information, to ensure that the economic and environmental benefits to the rural people are maximized.

After successful completion of the Research, the cultivation of Patibet would be taken to the Farmer's field as transferable technology through adequate training and motivation. The cultivation of*Schumannianthusdichotoma*at SCWMC, Bandarban is in the initial /growing stage. More research is needed for further result.

Program 3. Studying soil loss and yield performance of pineapple based jackfruit orchard on hill slope following contour line

Objectives

1. To introduce technique for effective land use in achieving food security as an alternative farming system.
2. To study the yield of pineapple as an intermediate crop with permanent horticulture.
3. To determine soil loss in peg method.

Materials and Methods

The research has been introduced in the financial year 2016-2017. Site was selected to the east side of the farm shed at SCWMC Research station, SRDI, Bandarban. Area of the selected site is 61.0 m x 21.0 m (200'-0" x 70'-0") likely about 0.32 acre. Average slope of the site is 35%. After selection of the plot, the jungle was cleaned by manual labour. Contour lines were selected at 0.50 meter vertical interval. Pineapple suckers were planted in the predefined contour with application of necessary manures and fertilizers. Pits for planting Jackfruit were dug before plantation of pineapples' sucker. Recommended dose of fertilizers and manure were applied in to the pits. Pineapple suckers were collected and planted during the month of May-2016. There are 14 rows of pine apple plantation. Saplings of Jackfruit were collected from horticulture centre. Jackfruit's saplings were planted in the pits maintaining plant to plant and row to row distance 25'-0" during the month of july-2016. There are 18 nos. of jackfruit sapling were planted in this plot. 21 number Color pegs were inserted in to a certain depth at a distance of 10.0 m. peg to peg and row to row before the rain. The pegs were 1'-6" long and were colored by red & white every 6". One third length of the peg were driven in the soil and two third were above the soil. Grounds RL near different pegs were recorded before the rain and after rain in each year. The Cumulative difference of the two depths is considered as the depth of transported soil.. Intercultural operations were done manually when necessary. Yield performance of pineapple is being studied. . It was found that near about 50% of the pineapple plans are on bearing stage.The pineapples will be destroyed when the jack fruits are being harvested.

Results and Discussion

Soil loss by peg method was studied for 2016-2017 and 2017-2018. There were three rows of peg in the plot in combination of seven pegs in each row. At first soil loss for seven pegs of upper, middle and bottom rows were determined by using leveling instrument. Then the average depth of transported for each row were calculated accordingly. It was found that the average depth of transported soil were 0.655 mm, 0.710 mm and 0.780 mm for the pegs of upper, middle and bottom lines respectively for 2016-2018. On the other hand, the average depth of transported soil for upper, middle and lower parts were 0.60 mm, 0.62 mm and 0.67 mm respectively during the period of

2017-2018. Then the average depths of soil loss for three rows were calculated and it was found 0.715 mm and 0.630 mm for the year 2016-2017 and 2017-2018 respectively.

Location of peg	Average soil loss in mm			Average of all rows (in mm)			Total soil loss(t/ ha)		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Upper row	0.655	0.60	0.51	0.715	0.63	0.56	9.796	8.631	7.672
Middle row	0.710	0.62	0.54						
Bottom row	0.780	0.67	0.62						

Finally the total soil loss soil loss was calculated assuming 1mm depth soil loss is equal to 13.70 t/ha and it was 9.796 t/ha and 8.631 t/ha per year. It was also found that both the main crop and the intermediate crops were growing satisfactory. A data for determination of soil loss is given below:

Table-27: Yield and return from pineapple based Jackfruit orchard on steep slope

Financial year	Yield (main and associated crop)		Economical return		Remarks
	Pineapple	Jack fruit	Pineapple	Jack fruit	
2016-2017	Initial stage	Initial stage	Initial stage	Initial stage	
2017-2018	Flowering stage	Growing stage	1000.00 (Expected)	Growing stage	
2018-2019	Fruiting stage	Primary fruiting stage	9,000.00	600.00	

Conclusions

Jack fruit, the main horticultural crop takes more time for its optimal stage than pineapple, the secondary crop.

Farmers can be financially benefited by using short term secondary crops with long term horticultural crops and erosion hazard is comparatively lessened than pure horticulture as the secondary crops interrupt the surface runoff when planted following contour line.

Program 4. Prospect of Broom Grass in Controlling Soil Erosion and Its Economic Value at Bandarban

Objectives

a) To find out a significant source of income.

b) To prevent frequent landslides, retain ground moisture and to increase soil fertility.

c) To provide green forage for livestock.

d) To rehabilitate the endangered animals and to keep ecological balance.

Materials and Methods

The research was conducted near multi-fruits garden situated by the side of multi-purpose dam at the Research Area of Soil Conservation and Watershed Management Centre (SCWMC), SRDI under BandarbanSadarupazila, Bandarban. The experimental plots were selected in such a way that the area individually can be treated as a micro watershed. Prior to selection of the plots, the area was cleaned. Jungles were removed. Slope percentage of the land was measured by Abney's level. To conduct the study, two plots of 100 m² (5m x 20 m) each were selected on a degraded land of steep slope having 48 % slope. Brick masonry plot boundary was constructed for each plot. Contour lines were marked maintaining 1.00 m. vertical interval from a distance of 0.50 m. from the upper plot boundary. A set of multi-slot devisor was set up in connection of each plot to determine the soil loss and runoff calculation.

Prior to plantation of broom's saplings (stump), composite topsoil samples were collected from each plot has been collected for physical, chemical and mineralogical analysis to compare the soil characteristics. There are two treatments. In one treatment, the saplings were planted maintaining plant to plant distance 0.50 m. and row to row distance 1.00 m. In another plot, the saplings were planted maintaining plant to plant distance 0.50 m. and row to row distance 2.00 m. there was 1.00 m distance in between two double rows for both plots. Saplings were planted just following minimum tillage system during June-2018. Extra fertilizer or manure has not been added to the pits before or during plantation of saplings. Jungles were cleaned around the year when it was necessary.

Results and Discussion

Prior to plantation of broom's saplings (stump), composite topsoil samples were collected from each plot has been collected for physical, chemical and mineralogical analysis to compare the soil characteristics. After cultivation of broom, composite top soil samples are being taken for analysis and the result were shown in table-15& 16.Soil loss and run-off data were collected after each and every shower. Total soil loss and runoff from 100.0 m² plot were presented in table-17 & 18. Average plant height and number of plans per clump was recorded after winter in each year.

Table-28: Initial fertility status and fertility status after broom cultivation

Parameter	Year	pH	OM (%)	N (%)	P	K	S	Zn	B	Ca	Mg	Cu	Fe	Mn
					meq/100g soil		µg/g soil			meq/100g soil		µg/g soil		
Broom 1 Meter	2017	4.6	4.24 H	0.212 M	2.65 VL	0.42 H	2.82 VL	1.87 H	0.29 L	5.54 O	1.98 VH	0.74 H	69.16 VH	14.27 VH
	2018	4.1	4.2 H	0.210 M	1.12 VL	0.53 VH	19.11 M	0.45 VL	0.58 O	6.16 M	2.57 VH	0.31 M	40.51 VH	15.53 VH
Broom 2 Meter	2017	5.7	4.64 H	0.232 M	0.34 M	0.54 VH	0.002 VL	2.22 H	0.34 M	7.28 H	2.35 VH	0.77 VH	81.17 VH	16.08 VH
	2018	4.1	3.8 H	0.190 M	1.05 VL	0.50 VH	17.44 M	0.28 VL	0.46 O	7.04 H	2.22 VH	0.27 L	38.68 VH	10.21 VH

note: VL=very low; L=low; M= medium; O=optimum; VH=very

Table-29:Soil loss under broom grass in hill different treatments-2018(t/h/year).

Particulars	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total Soil loss (t/ha)
Broom 1 Meter	_	_	_	_	_	3.24	3.97	2.90	1.98	2.34	_	_	14.43
Broom 2 Meter	_	_	_	_	_	4.16	4.78	3.56	2.47	3.68	_	_	18.65
Rainfall	3	0	0	67	207	607	691	256	249	266	_	14	2360

Table-30: Run off (%) under the cultivation of broom grass hill different treatments--2018.

Particulars	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total Rain fall(m/m)
Broom 1 Meter	-	-	-	-	-	28.87	42.38	38.46	40.12	39.56	-	-	-
Broom 2 Meter	-	-	-	-	-	31.7	45.37	43.56	41.36	44.25	-	-	-
Rain Fall (m/m)	3	0	0	67	207	607	691	256	249	266	0.0	14	2360

Table 31. Nutrient loss (tha^{-1}) from plots under different treatments, 2018

Particulars	N	P	K	S	Zn	B	Ca	Mg	Cu	Mn
Broom 1 Meter	4.3	0.00206	0.32844	0.00618	0.00082	0.00016	1.76	0.6048	0.0004	0.0173
Broom 2 Meter	4.3	0.00212	0.37536	0.1576	0.00164	0.00054	1.952	0.588	0.00086	0.0179

Table 32.Comparative growth of Broom grass under different treatments spacing

Treatment	No. of Sticks/Sheaf	Av. height of sticks(cm)	No. of flower
Treatment 1. (Row to row distance 1 m)	18.00 b	146.88	11.15 b
Treatment 2. (Row to row distance 2 m)	33.33 a	148.38	22.95 a
CV (%)	12.73	12.05	12.99

CD (0.05)	11.48	NS	7.79

NS- Non –significant, CV- Coefficient of Variation, CD – Critical Difference

In a column means having dissimilar letter(s) differ significantly as per 0.05 level of probability.

Statistical Analysis:

The collected data were statistically analyzed following the analysis of variance (ANOVA) using WASP 1.0 (Web based Agri Stat Package 1.0) program and means were separated by critical difference (CD) values at 5% level of significance.

Table-33: Yield and economic returnof broom grass under different spacing

Year	Treatment-1 (1.0 m. distance)			Treatment-2 (2.0 m. distance)			Total return in 200 m²	Return (BDT) per ha/year
	Nos. of sticks	Nos. of broom	Sale value	Nos. of sticks	Nos. of broom	Sale value		
2018-19	960	60	900.00	1440	90	1350.00	2,250.00	1,12,500.00

Conclusions

The planting of broom grass has a direct impact on preventing surface soil erosion on steep hillsides. Broom grass grows in clumps and has many tangled up roots that grow to about one meter below the ground. This makes it highly effective in preventing soil erosion on hillsides as the grass is less likely to fall compared to other plants. The roots and leaves of the plant slow down water drops and the flow of water after heavy rain by absorbing the water in the soil. It also increases the local biodiversity in the communities. Various journals prove that broom grass is a significant source of income for subsistence communities, primarily for the women who collect it to manufacture and sell them as brooms across Nepal. The grass also possesses numerous medicinal properties that are essential in subsistence communities. Broom Grass may open the door of enrichment for the poor hill dwellers' and be an important method for rehabilitation of land degraded by shifting cultivation or slush and burn agriculture.

Program5. Effect ofplantation of Bamboo for erosion control and its economical purposes

Objectives

1. Reclamation of gullied land by minimizing erosion hazard.
2. For environmental and ecological conservation,
3. To introduce handy craft as a part off-farm activities for livelihood.

Materials and Methods

Two indigenous types of bamboo were selected so that those can be surviving with the local climatic condition. Between two, one is locally called Paiya/Muli bamboo and another is called Ora bamboo whose scientific names are *Gigantochloarobusta* and *Fargesiarobusta.* The

experiment was carried out non replicable condition. Two experimental plots having area of 100 sq.m (5m x 20m) each on a degraded land (very steep to extreme steep slope) were selected in the SCWMC's Research area at BandardarbanSadarupazila, Bandarban. Bamboo seedlings were collected from the culms situated in the nearby areas and planted in the month of July- 2018 following contour lines maintaining row to row distance 2.0 m and plant to plant distance 1.0 m. Before plantation, jungles were cleaned and composite Top soil samples were taken for nutrient studying. Locally fabricated multi-slot devisor was installed at each plot for estimating Soil Loss and Runoff from those plots. The seedlings were planted by dibbling method. Only one seedling was planted in each pit. After plantation of the seedlings, intercultural operation has been done when necessary. No fertilizer and manure were applied to the seedlings.

Soil loss and run-off from each 100 sq.m (20 m. x 5 m.) experimental plot were measured after each shower throughout the rainy season. Daily and eventually monthly soil loss and run-off were estimated from each plot by processing aliquot of sample every day. Every morning (if rains previos day) amount of run-off water has been measured in multi-slot divisors and aliquot of about 2 litre of homogeneous sample has been collected from each tank. Suspended sediment in the sampled aliquot has been measured by simple lab. Filtering and oven drying. Corresponding rainfall was recorded by manual type and ordinary rain gauge installed in SCWMC meteorological station where climatic data like rainfall, temperature, humidity, evaporation etc. are being recorded regularly.

Results and Discussion

Table 34. Initial soil fertility status and fertility status after crop harvest

Parameter	Year	pH	OM (%)	N (%)	P	K	S	Zn	B	Ca	Mg	Cu	Fe	Mn
					meq/100g soil		µg/g soil			meq/100g soil		µg/g soil		
Payia Bamboo	2017	5.4	2.76 M	0.138 L	2.65 VL	0.41 H	66.69 VH	2.50 VH	0.56 O	7.72 VH	1.53 H	0.97 VH	97.80 VH	24.54 VH
	2018	4.1	5.5 H	0.275 O	1.03 VL	0.51 VH	26.01 O	6.99 VH	0.40 M	8.93 VH	2.81 VH	3.23 VH	77.68 VH	21.39 VH
Ora Bamboo	2017	4.8	3.09 M	0.155 L	2.05 VL	0.33 O	0.001 VL	2.03 H	0.29 L	5.26 O	1.04 M	0.92 VH	92.45 VH	17.68 VH
	2018	4.1	5.8 VH	0.290 O	0.96 VL	0.47 VH	36.08 H	7.05 VH	0.16 L	7.44 H	2.00 VH	4.25 VH	66.03 VH	20.71 VH

Note: VL=very low; L=low; M= medium; O=optimum; VH=very high

Table 35: Soil loss (t/ha/year)under Paiya/Muli bamboo and Ora bamboo *Gigantochloarobusta* and *Fargesiarobusta during* 2018-2019

Particulars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Payia Bamboo	-	-	-	-	-	2.35	6.93	6.97	2.81	4.22	-	-	23.28
Ora Bamboo	-	-	-	-	-	1.91	6.13	6.20	1.66	1.83	-	-	17.73

It was observed that the highest soil loss was recorded on Payia bamboo and lowest soil loss was recorded on Ora Bamboo plot.

Table 36. Nutrient loss (tha^{-1}) from plots under different land use in 2018

Particulars	N	P	K	S	Zn	B	Ca	Mg	Cu	Mn
Payia Bamboo	5.2	0.00266	0.71944	0.00604	0.00088	0.0005	2.716	0.7776	0.00042	0.02118
Ora Bamboo	4.9	0.00208	0.30498	0.014	0.00058	0.00036	1.912	0.6	0.00034	0.01974

Table 37:Run-off under Paiya/Muli bamboo and Ora bamboo *Gigantochloarobusta* and *Fargesiarobusta during* 2018-2019

Particulars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Paiya Bamboo	-	-	-	-	-	21.53	36.03	50.76	53.07	45.13	-	-
Ora Bamboo	-	-	-	-	-	21.47	33.86	58.84	50.27	38.27	-	-

Conclusions

Bamboo has evergreen leaves, dense canopy and numeral culms which can help to intercept considerable amount of rainfall. Falling raindrops change their direction and ways and reduce velocity, and therefore decrease soil erosion. Bamboo leaves can filter air pollutants, recycle CO_2 and replenish the atmosphere with Oxygen. Bamboo is also helpful against landslides and soil loss by preventing erosion. The soil and water bioengineering approach is combined with bamboo traits and mechanical properties. The existing accumulated experiences of using bamboo in soil and water bioengineering works, along with the existing standards and design guidelines, make bamboo species an essential and cost-effective material for erosion control and slope stabilization works.

Program 6. Studying Brushwood Check Dam for minimizing erosion hazard and reclamation of gullied land

Objectives

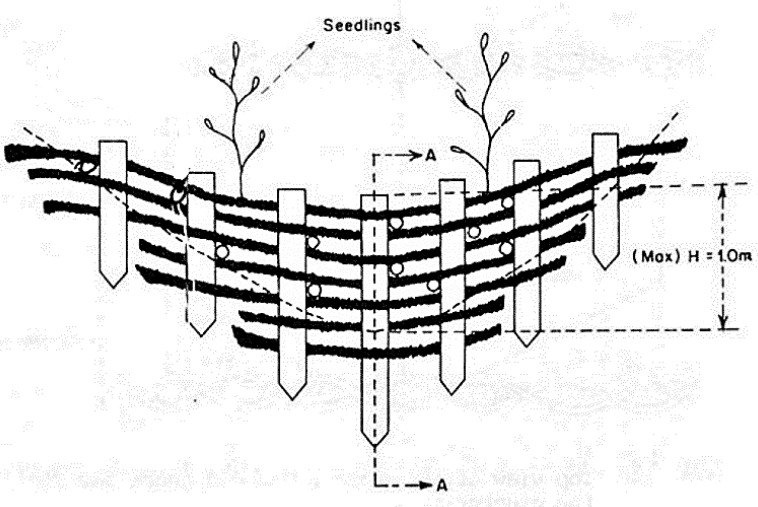
a) To reduce the velocity of run-off
b) To prevent deepening and widening of the gully.
c) To trap sedimentation and to recharge the water table.

Materials and Methods

The study has been introduce at SCWMC research area to minimize erosion hazard and reclamation of a gully formed by the South-east side of the Administrative Building of SCWMC, SRDI, Bandarban. The length of the gully is 16.50 m. and width was variable with 1.80 m. near head and 5 m. where the Brush-wood check dams were constructed. It is situated in between two small hills. Average width of the gully in front of upper check dam is 2.30 m. Its catchment area was nearly 0.12 hectares. The gully head was very adjacent to the Administrative Building which was increasingly extending towards the Administrative Building. So, it was a future threat for the stability of the Administrative Building.

Brushwood check-dams made up of posts and brushes are placed across the gully. The main objective of brushwood check-dams is to hold fine materials carried by flowing water in the gully. Small gully heads, no deeper than one meter, can also be stabilized by brushwood check dams. Brushwood check-dams are temporary structures and should not be used to treat ongoing problems such as concentrated run-off from roads or cultivated fields. They can be employed in connection with land use changes such as reforestation or improved range management until vegetative and slope treatment measures become effective. The main requirement of temporary gully control structures is that, they must be quick and easy to construct, should be made by using cheap and readily available material in nearby areas.

There are two types of brushwood check-dams: these are single row and double row brush wood check-dams. Following the principle for construction of Brush-wood check dam, a decision had been taken to construct two nos. double row brush-wood check dam across the gully bed in series to reclamation of this gully.



The construction of the dam started with an excavation in the floor and into the sides of the gully to a depth of 0.30 m to 0.50 m. Two rows of living posts 5-10 cm in diameter and 1-20 m in length were placed into the holes maintaining a distance from post to post 0.60 m across the floor of the gully to a depth of 0.50 m to 0.60 m. The spacing between two rows was 1.00 m for upper check dam and 0.70 m for lower one. The width of the upper and lower brush wood check dam was 1.10 m. and 0.80 m, and height was 1.20. Brushwood and branches are packed between the posts. The height of the posts in the center was kept in such a way that it should not exceed the height of the spillway so that the flow would be blocked and water may be forced to move to the gully sides. The distance between upper and lower check dam was 6.00 m.Deposition of eroded

soil from the catchment area is observed carefully. Before construction of the brush-wood check dam, the altitudes of the gully bed was were recorded in June-2018. Average RL of the gully was 94.102 m. After one rainy season the RL of the gully bed was observed and it was found 94.418m. in March-2019.

Results and Discussion

Average width and length of the gully was 2.30 m. and 16.50m. Adjacent to the upper Brush wood check dam. Soil deposited length in the gully was 8.20 m. and average width was 2.30 m. where the eroded soil was deposited in various depth. Soil deposition area was (8.20 m. x 2.30 m.) = 18.86 Sq.m. The Reduced Level (RL) of the gullied land wad measured by Theodolite Instrument. Before construction of the brush-wood check dam, the altitudes of the gully bed was were recorded in June-2018. Average RL of the gully was 94.102 m. After one rainy season the RL of the gully bed was observed and it was found 94.418m. in March-2019. It was found that the average deposition height (by eroded soil from the catchment area) was 0.316 m. Amount of deposited soil is shown in Table-27. Weight of deposited soil was assumed to be on average 1400 kg per cubic meter.

Table-38: Amount of soil deposited by Brush wood Check Dam.

Location		Length (m.)	Width (m)	Catchment area of the gully (check dam) in ha	RL of gully bed		Amount of deposited soil (m^3)	Deposited amount from the catchment (ton) each year	Deposited amount $tha^{-1}y^{-1}$
					June-18	March-19			
Upper check dam		8.20	2.30	0.12	94.102	94.418	5.96	8.344	69.53

Conclusions

In the hills of CHT, stone is not generally available everywhere, but brushes and unused trees are available Where stones are not readily available, Brushwood check dam can be constructed for slowly reclamation of the gullied land. Brushwood check dam increases absorption /infiltration of water into the soil. It also reduces the speed of runoff and therefore also reduces the erosive power of surface flows. Brushwood check dams allow for planting of crops once the dam is matured. It needs branches and plant materials/brushwood, ideally use of cuttings of trees that will strike fort the struts. Brushwood check dam can be build easily. But it needs for regular maintenance and repairing.

As the Research has been passed only one year, it is in on-going stage. Observation is going on. The result obtained from the first year indicated the conservation/rehabilitation potential of using Brush-wood check dam to manage gully. Only in one year, the gully bed has been raised up 0.316 m which proves that the check dam is capable to check 69.53 ton/hac/year sedimentation carried from the upper catchment area. Not only that, as the check dam interrupt surface run-off

velocity, it also increase the permeability of water in to the soil. It also very cost effective for using locally available materials which are cheap and effective to rehabilitate gully.

Program 7. Effect of indigenous &Zero Tillage cultivation methods of pineapple on soil erosion, run off, nutrient mining in hilly areas

Objectives

1) To estimate & compare soil loss, runoff and nutrient mining under indigenous and zero tillage cultivation systems of pineapple.
2) To calculate effect of soil loss on soil chemical properties.
3) To create awareness about soil conservation & watershed management among hill dwellers.

Materials and Methods

The experiment was carried out under non replicated condition. Four experimental plots of 100 sqm. (5 m x 20 m) on steeply (32%) were selected in the SCWMC, Bandarban. There are four treatments such as (1) Digging up across the slope (2) Digging up along the slope (3) Zero tillage across the slope and (4) Zero tillage across the slope. Pineapple suckers are inserted in double row. The distance between single row to row was 30 cm and double row to row was70 cm.Fertilizers were applied as per recommendation of soil test value. Cultural operations were done as usual in all the plots.Measurement of soil loss and run-off was carried out by established and locally fabricated multi-slot divisors. Soil loss and run-off from each 100sqm (5m x 20m) experimental plots were measured after each shower throughout the rainy season. Daily and eventually monthly soil loss and run-off were estimated from each treatment by processing aliquot of sample every day. Every morning (if rains previous day) amount of run-off water is measured in the multi-slot and aliquot of about 2 Litre is sampled from each tank. Suspended sediment in the sampled aliquot is measured by simple filtering and oven drying. Corresponding rainfall is recorded from the automatic and ordinary rain gauge of SCWMC. Climatic data like rainfall, temperature, humidity, evaporation etc. were recorded daily. Different agronomic practices were done when it was necessary.Nutrient loss was calculated in every experimental plot from eroded soil.

Results and Discussion

Table 39. Initial soil fertility status and fertility status after crop harvest

Parameter	Year	pH	OM (%)	N (%)	P	K	S	Zn	B	Ca	Mg	Cu	Fe	Mn
					meq/100g soil		µg/g soil			meq/100g soil		µg/g soil		
Digging Up Across	2017	5.1	3.56 H	0.18 L	9.82 L	0.39 H	0.001 VL	1.41 O	0.19 L	3.81 M	0.78 M	0.79 VH	65.00 VH	28.38 VH
	2018	4.0	4.2 H	0.21 M	1.05 VL	0.44 H	11.15 L	0.38 VL	0.53 O	4.30 O	1.15 O	0.33 M	47.27 VH	10.50 VH
Digging Up Along	2017	5.7	3.63 H	0.18 M	3.48 VL	0.37 H	0.002 VL	4.18 VH	0.17 L	3.60 M	0.77 M	0.83 VH	66.46 VH	34.02 VH
	2018	4.1	3.5	0.17	1.07	0.46	22.30	0.27	0.30	8.01	0.88	0.18	39.80	11.48

			H	L	VL	VH	O	VL	L	VH	M	L	VH	VH
Zero Tillage Across	2017	6.0	3.50 H	0.17 L	1.63 VL	0.36 O	0.001 VL	6.30 VH	0.15 VL	4.34 M	0.86 M	1.04 VH	65.00 VH	28.84 VH
	2018	4.0	4.3 H	0.25 L	1.21 VL	0.55 VH	18.53 M	0.50 L	0.60 O	6.52 H	1.59 H	0.25 L	37.55 VH	12.69 VH
Zero Tillage Along	2017	5.7	3.90 H	0.19 5 M	3.21 VL	0.42 H	1.15 VL	5.75 VH	0.26 L	5.18 O	0.93 M	0.84 VH	93.90 VH	33.84 VH
	2018	4.0	5.5 H	0.27 5 O	1.04 VL	0.52 VH	17.54 M	1.17 M	0.32 M	5.92 O	1.79 H	0.56 M	50.15 VH	18.18 VH

Note: VL=very low; L=low; M= medium; O=optimum; H= High,VH=very high

The highest soil loss was recorded in digging up along the slope (68.59 t/ha/yr) and lowest soil loss was recorded in zero tillage across the slope (8.69 t/ha/yr) according to Digging Up across the slope (52.04 t/ha/yr) and zero tillage along the slope (14.09 t/ha/yr)

Table 40. Total Soil Loss (t/ha/year)under Conventional& Zero tillage methods inpineapple

Particulars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Digging up Across	-	-	-	-	-	6.83	15.52	11.85	10.27	8.16	-	-	52.63
Digging up Along	-	-	-	-	-	7.71	19.83	16.25	14.83	9.97	-	-	68.59
Zero tillage Across	-	-	-	-	-	0.96	3.49	2.29	0.72	1.23	-	-	8.69
Zero tillage Along	-	-	-	-	-	1.4	6.22	3.57	1.76	1.53	-	-	14.48
Rainfall (mm)	3	0	0	67	207	607	691	256	249	266	0.0	14	2360

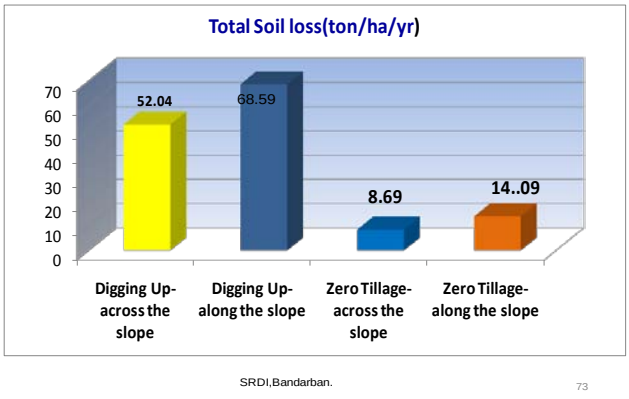


Figure-63: Total Soil Loss (t/ha/yr) under Conventional & Zero Tillage methods in pineapple

Table-41: Run off (%) under the Conventional & Zero Tillage methods in pineapple

Particulars	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total Rain fall (mm)
Digging up Across	_	_	_	_	_	29.48	61.10	61.12	63.39	63.36	_	_	_
Digging up Along	_	_	_	_	_	27.26	59.24	68.66	65.75	57.15	_	_	_
Zero Tillage	_	_	_	_	_	25.78	56.77	65.75	53.93	54.05		_	_
Zero Tillage Along	_	_	_	_	_	26.52	55.53	57.15	58.66	50.94	_	_	_
Rain Fall(mm)	3	0	0	67	207	607	691	256	249	266	0.0	14	2360.00

The impact of soil erosion on the productive potential of agricultural lands is well known (Pathak*et al*., 2004), but the magnitude depends on local circumstances. In the study areas, the organic matter depletion was also observed irrespective of land use. The loss of the essential plant nutrients (N, K, S, Zn, B, Ca, Mg and Mn) in association with the suspended sediments and runoff during the measurement period was remarkable.

Table 42. Nutrient loss (tha^{-1}) from plots under different land use (2018)

Particulars	N	P	K	S	Zn	B	Ca	Mg	Cu	Mn
Digging up Across	4.0	0.00384	0.2737	0.00264	0.00216	0.0007	1.912	0.4656	0.00096	0.0291
Digging up Along	4.4	0.00502	0.3128	0.0059	0.00224	0.00084	2.072	0.4752	0.001	0.03164
Zero tillage Across	3.0	0.00222	0.1955	0.00198	0.00064	0.00024	1.328	0.3072	0.00038	0.02242
Zero tillage Along	3.6	0.00284	0.24242	0.00258	0.00128	0.0004	1.64	0.4152	0.00062	0.022852

It was observed that highest nitrogen loss i.e. 4.4 tha^{-1}occurred from Digging up Along the plot and the lowest (3.0tha^{-1}) from Zero tillage Across the plot along with other nutrient elements. In case of Digging up Across and Zero tillage Alongthe plot nitrogen loss was 4.0 and 3.6 tha^{-1} along with other nutrient elements.

Conclusions

The conservation of soil and water is essential for sustainable production, environment preservation and balanced eco system. Loss of soil by water erosion on slopping lands adversely affects the physical, chemical and biological properties of soils, leading to low crop productivity, use of indigenous methods of pineapple cultivation has created negative effect on soil erosion.

This research improves soil healthy by reducing soil erosion hazard, enhances crop production and encourages the hill dwellers to adopt the cultivation system to losing zero tillage across the hill slope in contour.

Program 8. Effect of Natural vegetative strip (NVS) for minimizing soil erosion in cultivation of vegetables

Objectives:

To examine the effect of NVS on the maintenance of soil fertility and reducing soil erosion in moderate hill slope.

To examine the effect of NVS on vegetables productivity in hill slope.

Materials and Methods

The experiment was conducted in the experimental farm of the Soil Conservation and Watershed management Center (SCWMC); Soil Resource Development Institute (SRDI), Bandarban. The site was located in south-southeast hilly region of Bangladesh. The location of the site is between $22^0$09´16 to $22^0$10´32 north latitude and $92^0$11´17 to $92^0$11´34 east longitudes with an elevation 92-133 m above mean sea level (SRDI,2005).The experiments were set up on the 26% hill slope areas. The climate of the experimental site is sub-tropical characterized by heavy rainfall during May to September and scanty rainfall during rest of the year. The area has an erratic monsoon climate, with periodic flooding in the valleys and drought in the mountains, hot rainy summer and a pronounced dry season in the cooler months. January is the coolest month of the year and April is the warmest one. The detail records of air temperature, humidity and rainfall for the study period were collected from meteorological station of Soil Conservation and Watershed Management Center, Bandarban.The mean annual rainfall of the study site was 3000 mm and monthly mean air temperature ranged from 25 to 34 ^{0}c and mean relative humidity was 79.3%.

The test crops of the experiment were Okra and yard long bean. There were four treatments and these were as: T_1 = Okra in Natural vegetative strip, T_2 = Okra in control (no NVS), $T_{3=}$Yardlong bean in Natural vegetative strip, T4 = Yardlong bean in Control (no NVS).The experiment was laid out in Randomized Complete Block Design (RCBD) with 3 (three) replications. The treatments were randomly allotted in each block. The dimension of each plot was 20m x 5m (100 m^2).The seeds were sown in following dibbling method. Necessary agronomic management practices for all crops were followed. Plots were prepared manually. Intercultural operations like weeding and fertilizer application were done equally in all treatments to get better results. In every plot after 4 meter intervals a 1 m width NVS were made naturally. So, there were four NVS in each plot. In Natural Vegetative Strips area there were different types of shrubs and grasses, which were germinated and developed naturally. The area of NVS was kept just to leave the cultivated area in cropping time without cleaning.
Soil erosion was measured through Spike layout method. In every plot, four spikes were inserted-two were near upper side (top of the plot) and another two were near bottom side of the plots. The spikes were made by mule bamboo and these were colored by normal paints. These bamboo spikes were divided into two parts by using two different colors (red and white).

Different intercultural operations like –weeding, insect and disease control, harvesting was done properly and timely for successful completion of the experiments.
Composited Soil samples were collected and just before land preparation to determine the physical and chemical properties of the experimental field. Soil samples were also collected treatment-wise after the final harvest of the crop. The collected samples were air-dried, grained and passed through a 2 mm sieve for physical and chemical analysis. Soil samples were analyzed following standard analysis method in central laboratory of SRDI.

Results and Discussion

Table 43. Initial soil fertility status and fertility status after crop harvest

Parameter	Year	pH	OM (%)	N (%)	P	K	S	Zn	B	Ca	Mg	Cu	Fe	Mn
					meq/100g soil		µg/g soil			meq/100g soil		µg/g soil		
NVS Okra	2017	6.7	3.09 M	0.155 L	26.81 VL	0.30 O	0.003 VL	1.52 O	0.30 L	3.42 M	0.69 L	0.82 VH	80.62 VH	42.11 VH
	2018	6.1	3.6 H	0.180 L	30.57 VH	0.37 H	7.58 L	6.48 VH	0.30 L	2.78 L	1.11 M	2.77 VH	37.16 VH	18.50 VH
Control Okra	2017	6.3	3.16 M	0.158 L	17.9 O	0.38 H	0.30 VL	1.60 O	0.23 L	5.29 O	1.16 O	0.81 VH	67.90 VH	37.68 VH
	2018	4.0	3.6 H	0.180 L	5.20 VL	0.43 H	11.59 L	0.52 L	0.03 VL	2.67 L	1.39 O	0.40 M	40.45 VH	16.61 VH
NVS Yardlong bean	2017	6.1	3.50 H	0.175 LL	0.54 VL	0.54 VH	31.69 H	1.71 O	0.26 L	4.80 O	1.33 O	0.77 VH	63.90 VH	42.32 VH
	2018	4.0	4.0 H	0.200 M	2.02 VL	0.9 VH	4.38 VL	0.39 L	0.30 L	3.12 M	1.81 H	0.38 M	55.67 VH	17.23 VH
Control YardLong bean	2017	5.9	3.70 H	0.185 M	9.08 L	0.50 VH	7.99 L	1.91 H	0.35 M	4.21 M	1.25 O	0.73 H	66.23 VH	41.56 VH
	2018	4.0	4.2 H	0.210 M	1.73 VL	0.86 VH	3.60 VL	0.48 L	0.14 VL	3.36 M	1.94 VH	0.35 M	41.28 VH	13.37 VH

Note: VL=very low; L=low; M= medium; O=optimum; VH=very high

Soil erosion is considered as one of the most important parameters as well as the main constraints for crop production in slopping lands. In this study, the soil erosion parameter was assessed based on the soil losses or washed out (eroded) at a given (prefixed) location of the study area. The total soil erosion based on the loss of top soil (i.e depth created due to erosion) in the experimental treatments as shown in table 35& 36. The soil loss varied considerably with the use of NVS systems. The topsoil loss was the highest in Yard long bean in Control (29.22 t ha^{-1})which was significantly different from the NVS used plots. Among the NVS applied plots, soil erosion was the lowest in Okra in Natural vegetative strip plot (10.69 t ha-1).Soil loss from the Okra in control plot was **28.95**t $ha^{-1}$and Yard long bean in Natural vegetative strip plot was **11.03**t ha^{-1} This statement was supported by Paningbatan and Rosario (1990) who observed that alley cropping with mulching contouring and minimum tillage greatly reduced surface run-off and soil losses and erosion rates ranging from 36 to 200 t/ha on erosion plots cultivated up and down the slope. The surface cover crop barriers do not channelize runoff, as do engineered systems. Woo and Luk (1990) observed that if the vegetative cover decreases both the interception and infiltration decreases which increase the overland flow and soil loss.

Table 44: Soil loss under the cultivation of Okra in Natural vegetative stips

Treatments	Average soil loss in mm	Total soil loss (ton/ha)
Okra in NVS	0.8220 b	10.69 b
Okra in Control	2.227 a	28.95 a
CV (%)	26.04	2.98
CD (0.05)	1.40	4.79

In a column means having dissimilar letter(s) differ significantly as per 0.05 level ofprobability. CV-Coefficient of Variation, CD – Critical Difference

Statistical Analysis:

The collected data were statistically analyzed following the analysis of variance (ANOVA) using WASP 1.0 (Web based Agri Stat Package 1.0) program and means were separated by critical difference (CD) values at 5% level of significance.

Table 45: Soil loss under the cultivation of Yardlong bean in Natural vegetative strip

Treatments	Average soil loss in mm	Total soil loss (ton/ha)
Yardlong bean in NVS	0.8487 b	11.03 b
Yardlong bean in Control	2.248 a	29.22 a
CV (%)	11.32	5.31
CD (0.05)	0.62	8.67

In a column means having dissimilar letter(s) differ significantly as per 0.05 level of probability. CV- Coefficient of Variation, CD – Critical Difference

Statistical Analysis:

The collected data were statistically analyzed following the analysis of variance (ANOVA) using WASP 1.0 (Web based Agri Stat Package 1.0) program and means were separated by critical difference (CD) values at 5% level of significance.

Mean performance of NVS on yield & yield component of Okra

Fruit Length: All the treatments significantly influenced fruit length of Okra cultivation.The highestfruit length (18.60cm) was obtained in Okra in NVSmanaged plot. The lowest fruit length (14.47cm) was observed in Okra in Control managed plot.

Fruit Weight: All the treatments significantly influenced fruit weight of Okra cultivation.The heighest fruit weight (18.24gm) was obtained in Okra in NVSmanaged plot. The lowest fruit length (12.46gm) was observed in Okra in Control managed plot.

Table 46: Mean performance of NVS on yield & yield component of Okra

Treatments	Fruit length (cm)	Fruit weight (gm)	Fruit/plant	Plot Yield (kg)	Yield(t/ha)
Okra in NVS	18.60 a	18.24 a	16.10 a	59.76 a	8.993 a
Okra in Control	14.47 b	12.46 b	12.27 b	47.78 b	6.007 b
CV (%)	1.73	5.09	4.90	2.551	7.591
CD (0.05)	1.00	2.75	2.44	4.814	2.005

In a column means having dissimilar letter(s) differ significantly as per 0.05 level of probability. CV- Coefficient of Variation, CD – Critical Difference

Statistical Analysis:

The collected data were statistically analyzed following the analysis of variance (ANOVA) using WASP 1.0 (Web based Agri Stat Package 1.0) program and means were separated by critical difference (CD) values at 5% level of significance.

Fruit per Plant: The heighest fruit /plant (16.10) was obtained in Okra in NVSmanaged plot and thelowest fruit /plant (12.27), was observed in Okra in Control managed plot (Table 37).

Plot Yield (Kg): The Maximum plot yield (59.76 kg) was obtained in Okra in NVSmanaged plot. Thelowestplot yield (47.78 kg) was observed in Okra in Control plot.

Yield (t/ha): All the treatments significantly influenced yield of Okra cultivation. The highest yield (8.993 t/ha) was obtained in Okra in NVSmanaged plotand thelowestyield (6.007 t/ha), was observed in Okra in Control plot.

Mean performance of NVS on yield & yield component of Yard long bean

Pod Length: All the treatments significantly influenced pod length of Yard long beancultivation.The highestpod length (50.65 cm) was obtained in Yardlong bean in NVSmanaged plot. The lowestpod length (40.57cm), was observed in Yardlong bean in Control plot.

Pod diameter: All the treatments significantly influenced pod diameterof Yard long beancultivation.The highestpod diameter (0.9900 cm) was obtained in Yardlong bean in NVSmanaged plot.. The lowestpoddiameter (0.8967 cm), was observed in Yardlong bean in Control plot.

Table 47: Mean performance of NVS on yield & yield component of Yardlong bean

Treatments	Pod length (cm)	Pod diameter (cm)	Pod wt. (gm)	No. of pod/ plant	No. of seed/ Pod	Plot Yield (kg)	Yield (t/ha)
Yardlong bean	50.65 a	0.9900 a	18.91 a	20.17 a	19.00 a	66.20 a	9.593 a

in NVS							
Yardlong bean in Control	40.57 b	0.8967 b	13.53 b	14.00 b	12.67 b	54.86 b	6.606 b
CV (%)	3.35	0.26	3.64	1.13	2.09	1.94	2.206
CD (0.05)	5.38	0.01	2.07	0.67	1.17	4.13	0.625

In a column means having dissimilar letter(s) differ significantly as per 0.05 level of probability. CV- Coefficient of Variation, CD – Critical Difference

Statistical Analysis:

The collected data were statistically analyzed following the analysis of variance (ANOVA) using WASP 1.0 (Web based Agri Stat Package 1.0) program and means were separated by critical difference (CD) values at 5% level of significance.

Pod weight: The highestpod wt. (18.91 gm.) was obtained in Yardlong bean in NVSmanaged plot and thelowestpod weight (13.53 gm), was observed in Yardlong bean in Control managed plot (Table 38).

No. of pod/ plant: The highest No. of pod/ plant (20.17.) was obtained in Yardlong bean in NVSmanaged plot and thelowestNo. of pod/ plant (14.00), was observed in Yardlong bean in Control plot (Table-38).

No. of seed/pod: The highestNo. of seed/ pod (19.0) was obtained in Yardlong bean in NVSmanaged plot and thelowestNo. of seed/ pod (12.67), was observed in Yardlong bean in Control plot (Table-38).

Plot Yield (Kg): The Maximum plot yield (66.20 kg) was obtained in Yardlong bean in NVSmanaged plot. Thelowestplot yield (54.86 kg) was observed in Yardlong bean in Control plot (Table-38).

Yield (t/ha): All the treatments significantly influenced yield of Yard long beancultivation. The highest yield (9.593 t/ha) was obtained in Yardlong bean in NVSmanaged plotand thelowestyield (6.606 t/ha), was observed in Yard long bean in Control plot (Table-38).

Conclusions

Minimization of soil erosion through natural vegetative strip (NVS) is an indigenous technology which used by the hill dwellers since time immemorial.Use of natural vegetative strip (NVS) has created positive effect on the morphological and reproductive characteristics as well as at the yield of crops.Natural vegetative strip (NVS) always plays a vital role on plant growth, crops

productivity, fruit length & weight as well as minimizing of soil erosion. More yields were gained from the managed plots by NVS, though the number of total plant was comparatively less in those plots than the controlled one.The conservation of soil and water is essential for sustainable production, environment preservation and balanced eco system. Loss of soil by water erosion on slopping lands adversely affects the physical, chemical and biological properties of soils, leading to low crop productivity in this manner the experiment established to control soil erosion and sustain crop productivity and aware the people as well as the peoples who involved to develop the people of the remote area.

4.2 SALINITY MANAGEMENT AND RESEARCH CENTRE, BATIAGHTA, KHULNA

SELECTION OF SUITABLE MAIZE VARIETIES FOR TRANSPLANTING CULTIVATION UNDER ZERO TILLAGE CONDITION IN COASTAL SALINE SOIL

S. N. Biswas , A. Biswas, A. B. M.M.Hasan, S. N. Ratna

Abstract

Field experiments were conducted at SMRC, Batiaghata, Khulna during Rabi season of 2018-2019 to find out the effect of transplanting on different varieties of maize.Six varieties of maize namely BARI Hybrid Maize 7, BARI Hybrid Maize 9, BARI Hybrid Maize 12, BARI Hybrid Maize 13, Hybrid Maize (BM 518) and Hybrid Maize (Super 570) arranged in a randomized complete block design with three replications.25 days oldseedlingswas transplanted in the experimental field. Yield and yield attributes differed statistically while plant height at harvest date did not differ among the hybrid maize varieties.Highest plant height (211.41cm) observed from BARI Hybrid Maize 9 and lowest plant height obtained from Hybrid Maize (BM 518) (188.89cm). BARI Hybrid Maize 9 produced the highest length of cob (14.33 cm) and lowest length of cob (10.43cm) was obtained from BARI Hybrid Maize 13. Hybrid Maize (BM 518) produced the highest number of cobs m^{-2},where Hybrid Maize (Super 570) produced the lowest number of cobs m^{-2}. Higher number of cobs m^{-2}, number of grains cob^{-2}, 1000 grain weight possibly attributed to produce higher grain yield. Highest number of cobs m^{-2}, number of grains cob^{-1}, 1000 grain weight and the highest grain yield (t/ha) was obtained from the variety Hybrid Maize (BM 518).Therefore, it is suggested that Hybrid Maize (BM 518) may be recommended for coastal area.

Objective:
To find out the suitable maize variety for transplanting in coastal saline area.

Results and discussions

Yield and yield attributes

Yield and yield attributes differed statistically while plant height at harvest did not differ among the maize varieties (Table-2). Highest plant height (211.41cm) observed from BARI Hybrid Maize 9 variety followed by Hybrid Maize Super 570, BARI Hybrid Maize 7,BARI Hybrid Maize 13,BARI Hybrid Maize 12 and lowest plant height observed from Hybrid Maize BM 518(188.89cm).

BARI Hybrid Maize 9produced the highest length of cob(14.33cm) which was statistically similar with BARI Hybrid Maize 7, Hybrid Maize BM 518. Lowest length of cob(10.43cm) was obtained from BARI Hybrid Maize 13.

The results revealed that Hybrid Maize BM 518 produced the highest number of cobs m^{-2} and Hybrid Maize Super 570 produced the lowest number of cobs m^{-2}.

Hybrid Maize BM 518 produced highest number of grains cob^{-1}526.67whichwas statistically dissimilar with other varieties. Lowest number of grains $cob^{-1}$was obtained from BARI Hybrid Maize 13(410.67).

The results revealed that the highest 1000-grain weight and grain yield were obtained from the same variety Hybrid Maize BM 518, 331.45 g and 11.730 t/ha, respectively. Hybrid Maize (BM 518) produced highest 1000-grain weight (331.45 g) followed by Hybrid Maize Super 570(313.59g),BARI Hybrid Maize 9 (309.20g),BARI Hybrid Maize 12(297.19g) BARI Hybrid Maize 7(288.22g) and lowest1000-grain weight was produced by BARI Hybrid Maize 13 (286.05g) which was statistically similar with Hybrid Maize 7. Biswas et al. (2009) also reported that the crops of different seedling raising methods availed more grain filling duration compared to direct planting.

Higher number of cobs m^{-2}, number of grains cob^{-1}, 1000 grain weight possibly attributed to produce higher grain yield. The highest grain yield was obtained from the variety Hybrid Maize BM 518 (11.730 t/ha) followed by Hybrid Maize Super 570 (10.740 t/ha), BARI Hybrid Maize 9 (9.67 t/ha), BARI Hybrid Maize 12(9.007 t/ha) and lowest grain yield was produced by BARI Hybrid Maize 13 (9.67 t/ha).

Table -48: Yield and yield attributes of maize varieties

Varieties	Plant height at harvest(cm)	Length of cob (cm)	Number of cobs m^{-2}	Number of grains cob^{-1}	1000 grain weight(g)	Grain yield (t/ha)
BARI Hybrid Maize 7	202.78	**13.85 a**	5.40b	435.00bc	288.22c	8.630c
BARI Hybrid Maize 9	**211.41**	**14.33a**	5.58b	447.33bc	309.20b	9.677abc
BARI Hybrid Maize 12	195.64	12.36 b	5.30bc	441.00bc	297.19bc	9.007bc
BARI Hybrid Maize 13	198.37	10.43c	5.11bc	410.67c	286.05c	8.417c
Hybrid Maize (BM 518)	188.89	**13.98a**	**6.30a**	**526.67a**	**331.45a**	**11.730a**
Hybrid Maize	206.95	12.45b	4.88c	449.67b	313.59b	10.740ab

(Super 570)						
CV (%)	**12.09**	**5.87**	**5.11**	**4.68**	**3.13**	**11.90**

Conclusion

In Bangladesh, hybrid maize is an emerging high-value crop, having the highest average farm yields in Asia. Economically, hybrid maize is much more profitable than Boro rice, wheat, or most other competing Rabi crops.Transplanting hybrid maize crops may be harvested about 8-15 days earlier than the crops of direct seeded. Thus the crops may escape the damage from natural hazards like storms and rains. The farmers' income may also be increased due to higher market price of maize grain for early marketing.The south-western coastal areas of the country suffer from high salinity levels in the soil. These areas also have poor drainage facilities, excessive soil moisture, and scarcity of fresh water for irrigation. Thus most of the land here remains unusable during the dry season. Maize crops take four-to-five months to harvest. Now the farmers of the coastal area can harvest two crops on their land.The findings advocates that transplanted maize can be grown successfully even after late harvest of rice with minimum yield loss.

SELECTION OF SUITABLE MAIZE VARIETIES FOR DIBBLING CULTIVATION UNDER ZERO TILLAGE CONDITION IN COASTAL SALINE SOIL

S. N. Biswas , A. Biswas, A. B. M.M.Hasan, S. N. Ratna

Abstract

Field experiments were conducted at SMRC, Batiaghata, Khulna during Rabi season of 2018-2019 to find out the effect of transplanting on different varieties of maize.Six varieties of maize namely BARI Hybrid Maize 7, BARI Hybrid Maize 9, BARI Hybrid Maize 12, BARI Hybrid Maize 13, Hybrid Maize (BM 518) and Hybrid Maize (Super 570) arranged in a randomized complete block design with three replications.Highest grain yield (12.1 t/ha) was obtained from the variety Hybrid Maize (BM 518). Therefore, it is suggested that Hybrid Maize (BM 518) may be recommended for coastal area.

Objective:
To find out the suitable maize variety for dibbling in coastal saline area.

Results and discussions
Yield and yield attributes:
Yield and yield contributing characters of maize hybrid varieties are presented in Table -3.Yield and yield attributes differed statistically. Highest plant height (212.07 cm) obtained from BARI Hybrid Maize 9 variety.

Hybrid Maize (BM 518)produced the highest length of cob (14.0cm).Lowest length of cob(10.76cm) was obtained from BARI Hybrid Maize 13.

The results revealed that Hybrid Maize (BM 518)produced the highest number of cobs m^{-2}.BARI Hybrid Maize 7 produced the lowest number of cobs m^{-2}.

Hybrid Maize (BM 518) produced highest number of grains cob^{-1}(533.33)which was statistically dissimilar with other varieties. Lowest number of grains $cob^{-1}$was obtained from BARI Hybrid Maize 13(410.67).

The results revealed that the highest 1000-grain weight (g)and grain yield (t/ha) were obtained from the same variety Hybrid Maize (BM 518), 331.45 g and 12.10t/ha respectively. Hybrid Maize (BM 518) produced highest 1000-grain weight (g) (330.96 g) followed by Hybrid Maize Super 570(316.34g),BARI Hybrid Maize 9 (309.20g),BARIHybrid Maize 12(298.83g) BARI Hybrid Maize 7 (287.06g) and lowest1000-grain weight (g) was produced by BARI Hybrid Maize 13 (286.05g) which was statistically similar toHybrid Maize 7.

Higher number of cobs m^{-2}, number of grains cob^{-1}1000 grain weight possibly attributed to produce higher grain yield. The highest grain yield (t/ha) was obtained from the variety Hybrid Maize (BM 518)(12.10t/ha) followed by Hybrid Maize (Super 570)(11.41t/ha),BARI Hybrid Maize 9 (9.93t/ha),BARI Hybrid Maize 12(9.61t/ha) and lowest grain yield (t/ha)was produced by BARI Hybrid Maize 7 (8.56t/ha) which is statistically similar with BARI Hybrid Maize 13 (8.75t/ha).

Table - 49: Yield and yield attributes of maize varieties

Varieties	Plant height at harvest(cm)	Length of cob (cm)	Number of cobs m^{-2}	Number of grains cob^{-1}	1000 grain weight(g)	Grain yield (t/ha)
BARI Hybrid Maize 7	203.62	13.18ab	4.94c	433.00d	286.48c	8.56bc
BARI Hybrid Maize 9	212.07	12.23bc	5.38bc	441.00cd	309.20b	9.93b
BARI Hybrid Maize 12	196.48	12.37bc	5.12bc	455.00c	298.83bc	9.61bc
BARI Hybrid Maize 13	199.18c	10.76c	5.05bc	410.67d	287.06c	8.75c
Hybrid Maize(BM 518)	190.65	**14.0a**	**5.95a**	**533.33a**	**330.96a**	**12.1a**
Hybrid Maize (Super 570)	211.29	12.32bc	5.49ab	489.67b	316.34ab	11.41a
CV (%)	**11.75**	**7.00**	**4.91**	**4.6**	**3.17**	**6.67**

Conclusion:

In Bangladesh, hybrid maize is an emerging high-value crop, having the highest average farm yields in Asia. Economically, hybrid maize is much more profitable than Boro rice, wheat, or most other competing Rabi crops.Rabi season maize is considered to be a low risk and highly profitable crop, which is associated with high costs of inputs but very high output benefits.The farmers' income may also be increased due to higher market price of maize grain for early marketing.The south-western coastal areas of the country suffer from high salinity levels in the soil. These areas also have poor drainage facilities, excessive soil moisture, and scarcity of fresh water for irrigation. Thus most of the land here remains unusable during the dry season. Maize crops take four-to-five months to harvest. Now the farmers of the coastal area can harvest two crops on their land.The findings advocates that dibbling of maize can be grown successfully even after late harvest of rice without any yield loss.

STUDY ON THE PERFORMANCE OF BRINJAL UNDER DIFFERENT RATIO OF MANURE AND SOIL IN FLYING BED OF COASTAL SALINE AREA

S. N. Biswas, A. Biswas, A. B. M.M.Hasan, S. N. Ratna

Abstract

The experiment was conducted on flying bed at SMRC, Batiaghata, Khulna.During kharif-2 season of 2018-19 to find out suitable ration of organic matter and soil and yield of kharif-2 brinjal on flying bed in the coastal saline soil. The experiment was designed with 4 treatments viz.T_0: Control, $T_{1:}$ 20% OM (cowdung) + 80% soil, $T_{2:}$ 40% OM (cowdung) + 60% soil and T_3: 60% OM (cowdung) + 40% soil. The experiment was laid out in a Randomized Complete Block design (RCBD) with three replications. The highest yield (31.23 t/ha) was obtained from T_3 treatment which was statisticaly similar with T_2 (29.96 ton/ha).The lowest yield was obtained from T_0 treatment (14.71 ton/ha).

Objectives

To determine the suitable ratio of organic manure and soil in flying bed for brinjal.

Results and discussions
Yield and yield attributes

Yield and yield attributes differed statistically are presented in the following table. Highest plant height (114.94cm) observed from T_3treatment followed by T_2 and T_1 treatment and lowest plant height was (70.98 cm) from T_0 treatment.

The experiment results revealed that fruit length (8.37 cm) was obtained from T_3 treatment and lowest fruit length (7.68 cm) obtained from T_0 treatment.

The results also revealed that the higher number of fruit/plant, weight of fruit and fruit yield were obtained from the same treatment T_3.The highest fruit yield (31.23 t/ha) was obtained from T_3 treatment which was statistically similar with T_2 (29.36 t/ha).The lowest fruit yield was obtained from T_0 treatment (14.71t/ha).

Table-50: Yield and yield attributes of brinjal

Treatment	Plant height (cm)	Fruit length (cm)	**Number of fruit /plant**	Weight of fruit (g)	Fruit yield (t/ha)
T_0	70.98c	7.68	5.83c	91.03d	14.71c
T_1	104.57b	7.78	8.800b	106.07c	23.73b
T_2	106.97ab	7.87	10.580a	116.80b	29.96a
T_3	114.94a	8.37	11.513a	125.49a	31.23a
CV%	**4.10**	**8.93**	**5.65**	**3.42**	**6.22**

Conclusions and recommendations
Experiment may be continued for the next year for confirmation the result. After confirmation of the results, the technology may be recommended to the farmers for tidal and saline area.

STUDY ON THE PERFORMANCE OF YARD LONG BEAN UNDER DIFFERENT RATIO OF MANURE AND SOIL IN FLYING BED OF COASTAL SALINE AREA

S. N. Biswas , A. Biswas, A. B. M.M.Hasan, S. N. Ratna

Abstract

The experiment was conducted on flying bed at SMRC, Batiaghata, Khulna. During kharif-2 season of 2018-19 to evaluate the effect of Organic Matter (cowdung) on soil salinity and yield of kharif-2 yard long bean (Kashekanchon PG) on flying bed in high land of coastal saline soil. The experiment was designed with 4 treatments viz.T_0: Control, $T_{1:}$ 20% OM (cowdung) + 80% soil, T_2: 40% OM (cowdung) + 60% soil and T_3: 60% OM (cowdung) + 40% soil. The experiment was laid out in a Randomized Complete Block design (RCBD) with three replications. The highest yield (2.88 t/ha) was obtained from T_3 treatment followed by T_2 (2.57 ton/ha) and T_1 (2.04 ton/ha). The lowest yield was obtained from T_0 treatment (1.78 ton/ha).

Objectives:
To determine the best ratio of manure and soil in flying bed for yard long bean cultivation.

Results and Discussions

Yield and yield attributes of yard long bean

Yield and yield contributing characters of yard long bean (Kashekanchon PG) are presented in the following table. From the experiment yield and yield attributes differed statistically.

Highest pod weight of long yard bean gained from T_3 treatment that was (215.70 g m^{-2}) and lowest pod weight (154.68 g m^{-2}) was obtained from T_0 treatment.

The results showed that highest number of pod (19.86m^{-2}) was produced by T_3 treatment and the lowest number of pod (11.15 m^{-2}) was gained from T_0 treatment.

The results also revealed that highest length of pod (21.68 cm) obtained from T_3 treatment which was statistically similar to T_2 treatment (20.69cm) and lowest length of pod (14.38 cm) gained from T_0 treatment. The highest yield (2.88 t/ha) was obtained from T_3 treatment followed by T_2 (2.57 t/ha) and T_1 (2.04 t/ha). The lowest gain of yield was obtained from T_0 treatment (1.78 ton/ha).

Table 51: Yield and yield attributes of yard long bean

Treatment	Pod weight (g m^{-2})	Number of pod (m^{-2})	length of pod(cm)	Yield (t/ha)
T_0	154.68c	11.15d	14.38b	1.78d
T_1	161.59c	14.4c	16.20b	2.04c
T_2	193.11b	16.26b	**20.69a**	2.57b
T_3	**215.70a**	**19.86a**	**21.68a**	**2.88a**
CV%	**2.97**	**4.33**	**6.35**	**3.54**

Conclusions and recommendations:

Experiment may be continued for the next year for confirmation the result. After confirmation of the results, the technology may be recommended to the farmers for tidal and saline area.

SELECTION OF SUITABLE SWEET GOURD VARIETIES IN COASTAL SALINE SOIL

S. N. Biswas , A. Biswas, A. B. M.M.Hasan, S. N. Ratna

Abstract

The experiment was conducted at Salinity Management and Research Centre, Batiaghata, Khulna during kharif 2018-2019 to select suitable sweet gourd varieties namely Hybrid (Sweety), Hybrid (Black Stone), Hybrid (TLP 368), Hybrid (Sohagi), Hybrid (Sera), BARI Misti kumra-2for coastal saline soil. The highest yield (12.67 t/ha) was recorded from Sera variety followed by TLP 368 (12.27 t/ha), Shohagi (12.05 t/ha), Black Stone (8.85 t/ha), and Sweety (4.43 t/ha),whileBARI hybrid misti kumra-1 gave the lowest yield (2.94 t/ha). So, Hybrid (sera) may be a suitable variety for coastal saline soil.

Objectives:

a) To find outsalt tolerant sweet gourd varieties for coastal saline soil.

Results and discussions

Among the six hybrid varieties of sweet gourd Sera gave statistical highest yield (12.67 t/ha) followed by followed by TLP 368 (12.27 t/ha), Shohagi (12.05 t/ha), Black Stone (8.85 t/ha), and Sweety (4.43 t/ha)while BARI Misti kumra-2 gave the lowest yield (2.94 t/ha).

Table 52: Yield data of sweet gourd varieties in saline soil

Varieties	**Yield (t/ha)**
Hybrid (Sweety)	4.43c
Hybrid (Black Stone)	8.85b
Hybrid (TLP 368)	12.27a
Hybrid (Sohagi)	12.05a
Hybrid (Sera)	**12.67a**
BARI Misti kumra-2	2.94c
CV (%)	11.99

Table 53: Soil salinity of the experimental plot during cultivation period

Year	Month wise Soil salinity (EC: dS/m)				
2019	Jan	Feb	Mar	April	May
	11.79	10.52	3.8	6.21	6.80

Generally soil salinity was increased from the month of January to April. The highest soil salinity was recorded in January (11.79 dS/m), followed by February (10.52 dS/m), May (6.80 dS/m) and April (6.21 dS/m). The lowest soil salinity was observed in March (3.8 dS/m).

Concluion and recommendations

These Six hybrid varieties of sweet gourd Sera, Sohagi and TLP 368 may be recommended to farmer's field for cultivation in slightly to moderate saline soil in coastal area.

SELECTION OF SUITABLE MUSK MELON VARIETIES IN COASTAL SALINE SOIL

S. N. Biswas , A. Biswas, A. B. M.M.Hasan, S. N. Ratna

Abstract

The experiment was conducted at Salinity Management and Research Centre, Batiaghata, Khulna during kharif 2018-2019 to select suitable musk melon varieties namely Chinal, Rangila and Jarin for coastal saline soil. These three deshi musk melon varieties were cultivated in this study. Among the varieties statistically highest yield (16.19 t/ha) was obtained from Chinal followed by Rangila (13.68 t/ha) and Jarin (12.53 t/ha).The lowest yield was found from Jarinwhich was statistically similar with Rangila variety.

Objectives:

To find outsalt tolerant musk melon varieties in coastal saline area.

Results and discussions

Generally soil salinity was increased from the month of January to April. The highest soil salinity was recorded in the month of January (8.11dS/m), followed by February (6.46 dS/m).The lowest soil salinity was observed in the month of March, April, May (4.06 dS/m).

Table 54:Soil salinity status of experimental field

Year	Month wise Soil salinity (EC: dS/m)				
2019	January	February	March	April	May
	8.11	6.46	4.06	4.06	4.06

From the experiment statistically highest yield (15.35 t/ha) was obtained from the Rangila variety, followed by Chinal (14.26 t/ha) and Jarin (12.53 t/ha). The lowest yield was found from Jarinwhich was statistically similar with Rangila variety.

Table 55: Yield of Musk melon varieties

Varieties	Yield (t/ha)
Chinal	14.26 ab
Rongila	**15.35 a**
Jarin	12.53 b
CV (%)	8.45

Conclutions and recommendations

All the varieties Chinal, Rangila, and Jarin may be recommended to farmer's field for cultivation in slightly to moderately saline soil of coastal area.

SELECTION OF SUITABLE KHARIF BITTER GOURD VARIETIES IN COASTAL SALINE SOIL

S. N. Biswas , A. Biswas, A. B. M.M.Hasan, S. N. Ratna

Abstract

The experiment was conducted at Salinity Management and Research Centre, Batiaghata, Khulna during kharif 2018-2019 to select suitable Bitter gourd varieties namely Gangajolly (Debgiri Agro Product), Maxi ,Tuntuni, Bolder , BARI karola -2 for coastal saline soil. The highest yield (9.27 t/ha) was recorded from Tuntunivariety followed by Maxi (8.38 t/ha), Bolder (7.5t/ha) and Gangajolly (6.84 t/ha) while BARI karola -2 gave the lowest yield (2.36 t/ha)**.**

Objectives:

a) To find out suitable cucurbit crop varieties in coastal saline area

Results and discussions

Among the five varieties of Bitter gourd Tuntuni gave the highest yield (9.27 t/ha) followed by by Maxi (8.38 t/ha), Bolder (7.5t/ha) and Gangajolly (6.84 t/ha) .The lowest yield was obtained from BARI korola-2(2.36 t/ha).

Table 56: Yield data of bitter gourd varieties in saline soil

Varieties	Yield (t/ha)
Gongajoli	6.84b
Maxi	8.38ab
Tuntuni	**9.27a**

Bolder	7.5ab
BARI Karola-2	2.36c
CV (%)	14.56

Table 57: Soil salinity of the experimental plot during cultivation period

Year	Month wise Soil salinity (EC: dS/m)				
2019	Jan	Feb	Mar	April	May
	6.84	8.36	5.20	5.96	4.94

Generally soil salinity was increased from the month of January to April. The highest soil salinity was recorded in February (8.36 dS/m), followed by January (6.84 dS/m), April (5.96 dS/m), March (5.20 dS/m). The lowest soil salinity was observed in May (4.94dS/m).

Conclusion and recommendations

From these five varieties of Bitter gourd Tuntuni, Maxi, Bolder may be recommended to farmer's field for cultivation in slightly to moderately saline soil in coastal area.

SELECTION OF SUITABLE KHARIF RIB GOURD VARIETIES IN COASTAL SALINE SOIL

S. N. Biswas , A. Biswas, A. B. M.M.Hasan, S. N. Ratna

Abstract

A field experiment was carried out at Salinity Management and Research Centre, Batiaghata, Khulna during kharif 2018-2019 cropping year to select suitable rib gourd varieties in coastal saline soil. There were five hybrid Ribbed gourd varieties namely Hero (Laltirr Seed Limited), Sindabad (Getco Agro Vision Limited), Super moon (Northern Agri science Limited), Isha kha (Mollika Seed Company) and BARI Jhinga-02 were cultivated in this study. Among the varieties highest yield (10.41 t/ha) was obtained from Hero followed by Sindabad (9.39 t/ha), BARI Jhinga-02 (6.78 t/ha) and Super moon (6.00 t/ha). The lowest yield was found from Isha kha variety which was 4.09 t/ha**.**

Objectives:

a) To find out suitable rib gourd varieties for coastal saline area

Results and discussions

Generally soil salinity was increased from the month of January to April. The highest soil salinity was recorded in February (8.36 dS/m), followed by January (6.84 dS/m), April (5.96 dS/m) and March (5.20 dS/m). The lowest soil salinity was observed in May (4.94dS/m).

Table 58: Soil salinity status of experimental field

Year	Month wise Soil salinity (EC: dS/m)				
2019	January	February	March	April	May
	6.84	8.36	5.20	5.96	4.94

Highest yield (18.10 t/ha) was obtained from the variety Asim, followed by Hero (8.20 t/ha), Moghol Raja (7.02t/ha) and Rambo super (5.96 t/ha). The lowest yield was found from BARI Jhinga -2 (4.97 t/ha) which was statistically dissimilar with other varieties.

Table 59: Yield of rib gourd varieties

Varieties	Yield (t/ha)
Hero	8.20b
Asim	**18.10a**
Rambo super	5.96cd
Moghol Raja	7.02bc
BARI Jhinga -2	4.97d
CV (%)	9.01

Conclusion and recommendations

From these five varieties of rib gourd, Asim, Hero and Moghol Raja may be recommended to farmer's field for cultivation in slightly to moderately saline soil of coastal area.

SELECTION OF SUITABLE KHARIF SNAKE GOURD VARIETIES IN COASTAL SALINE SOIL

S. N. Biswas , A. Biswas, A. B. M.M.Hasan, S. N. Ratna

Abstract

A field experiment was conducted at Salinity Management and Research Centre, Batiaghata, Khulna during kharif 2018-2019 cropping year to select suitable snake gourd varieties in coastal saline soil. There were four hybrid snake gourd varieties namely Supirma , Barnali (Mollika seed Company), Tiptop, BARIChichinga -2 were cultivated in this study. The highest yield (19.71 t/ha) was recorded from Asa variety followed by Barnali (19.56 t/ha), Surma (18.43 t/ha) and BARIChichinga -1(17.87 t/ha) while Nagraj gave the lowest yield (6.98t/ha)**.**

Objectives:

To find out suitable snake gourd varieties for coastal saline area.

Results and discussions

Among the four varieties of Snake gourd Supirma gave the highest yield (17.36 t/ha) followed by Barnali (15.39 t/ha) and Tiptop (14.52 t/ha).The lowest yield was obtained from BARI Chichinga-1(8.96 t/ha).

Table 60: Yield data of snake gourd varieties in saline soil

Varieties	Yield (t/ha)
Hybrid (Supirma)	**17.36a**
Hybrid (Barnali)	15.39ab
Hybrid (Tiptop)	14.52b
BARI chichinga -2	8.96c
CV (%)	9.84

Table 61: Soil salinity of the experimental plot during cultivation period

Year	Month wise Soil salinity (EC: dS/m)				
2019	Jan	Feb	Mar	April	May
	6.48	8.36	5.20	5.96	4.94

Soil salinity was increased from January to April. The highest soil salinity was recorded in February (8.36 dS/m), followed by January (6.84 dS/m), April (5.96 dS/m), March (5.20 dS/m). The lowest soil salinity was observed in May (4.94dS/m).

Conclusion and recommendations
These three varieties of snake gourd namely Supirma, Barnali, Tiptop may be recommended to farmer's field for cultivation in slightly to moderately saline soil in coastal area.

SELECTION OF SUITABLE KHARIF CUCUMBER VARIETIES IN COASTAL SALINE SOIL

S. N. Biswas , A. Biswas, A. B. M.M.Hasan, S. N. Ratna

Abstract

A field experiment was carried out at Salinity Management and Research Centre, Batiaghata, Khulna during Kharif 2018-2019 cropping year to select suitable cucumber varietiesfor coastal saline soil. There were four hybrid cucumber varieties namely Sharnolata, Thiland, Suprim Plus, Bahadur-2 were cultivated in this study. Among the varieties statistically highest highest yield (11.27 t/ha) was obtained from the variety Suprim Plus, followed by Bahadur-2 (9.70 t/ha) and Thiland (8.35 t/ha). The lowest yield was found from Sharnolata variety which was 8.37 t/ha**.**

Objectives:
To find out suitable cucurbit varieties for coastal saline area

Results and discussions
Soil salinity was increased from the month of January to April. The highest soil salinity was recorded in the month of January (9.76 dS/m), followed by February (8.49dS/m), May (6.53 dS/m) and April (6.21 dS/m). The lowest soil salinity was observed in the month of March (4.69dS/m).

Table 62: Soil salinity status of experimental field

Year	Month wise Soil salinity (EC: dS/m)				
2019	January	February	March	April	May
	9.76	8.49	4.69	6.21	6.53

From the experiment statistically highest yield (11.27 t/ha) was obtained from the variety Suprim Plus, followed by Bahadur-2 (9.70 t/ha) and Thiland (8.35 t/ha). The lowest yield was found from Sharnolata (8.37 t/ha) which was statistically similar with Thiland-1 variety.

Table 63: The yield of cucumber varieties

Varieties	Yield (t/ha)
Sharnolata	8.37b
Thiland	8.85b
Suprim Plus	**11.27a**
Bahadur-2	9.70ab
CV (%)	8.26

Conclusions and recommendations
From these four varieties of cucumber, Suprim Plus, Bahadur-2 may be recommended to farmer's field for cultivation in slightly to moderate saline soil of coastal area.

Chapter 5: Activities of Regional Laboratories

Program1. Analysis of Soil, Water, Plant & Fertilizer Samples

Introduction

Productivity of limited land and soil resources of Bangladesh is gradually declining because of indiscriminate use of chemical fertilizers, inadequate soil and water management and overall irrational use of lands. Every year a considerable portion of agricultural land is being converted to non-agricultural land due to unplanned infrastructure developments. To ensure food security of ever growing population of Bangladesh only option left is to increase crop production per unit area per unit time. This can be attained by selecting crops/cropping pattern on the basis of land and soil qualities, agro-climate, and use of balanced fertilizer (both chemical & organic) on soil test and demand basis, ensuring proper crop management practices. Soil, water and plant samples were analyzed to fulfill the following objectives.

Objectives:

i) To recommend location specific balanced fertilizer doses based on soil test result and crop demand.

ii) To update soil physico-chemical databases in SRDI land and soil utilization guides.

iii) To provide analytical support in SRDI's regular soil fertility and salinity monitoring program.

Determination of different elements

The soil samples received were analyzed following standard methods to determine pH, EC, organic carbon, exchangeable acidity, texture, total N, available P, K, S, Mg, Zn, Cu, Fe, Mn & B. Fertility status of soil is calculated from analytical data.

Plant materials were analyzed for determining their total N, P, K, Ca, Mg, Na, Fe, Mn, Cu & B content following standard methods. Nutrient deficiencies/toxicities may be inferred from the analytical data.

Water samples are analyzed for determining their irrigation suitability.

Fertilizer samples are analyzed for determining their ingredients as specified by the manufacturers. This is important for quality control of fertilizers.

Achievements in the year 2018-19

Dhaka, Comilla, Rajshahi and Khulna laboratories altogether analyzed 66,548 ingredients of 7,217 soil samples, 26 ingredients of 15 water samples, 76 ingredients of 19 plant samples and 4,760 ingredients of 2,045 fertilizer samples (Table-67). During this period, a grand total of 71,410 ingredients of 9,296 thousand samples and were analyzed with earning non-tax revenue amounting to Tk.12,48,784.00 as analysis fee by the mentioned four laboratories (Table-67).

Other static laboratories located at Barisal, Dinajpur, Bogra, Jamalpur, Noakhali, Kushtia, Faridpur, Jhenaidah, Mymenshing, Sylhet and Chittagong altogether analyzed 98,866 ingredients of 13,448 soil samples (Table-8). During this period 7,917 Fertilizer Recommendation Cards were distributed to farmers (Table-71) with earning non-tax revenue amounting to Tk.6,09,572.00 (Table-72) by the mentioned eleven laboratories.

Table 64. Number of soil samples & ingredients analyzed in 4 Regional Laboratories

Sl No.	Program/ source of Samples	Target				Number of soil samples & ingredient analyzed							
		Dhaka	Comilla	Rajshahi	Khulna	Dhaka Regional laboratory		Comilla Regional laboratory		Rajshahi Regional laboratory		Khulna Regional laboratory	
						Samples	Ingre-dients	Samples	Ingre-dients	Samples	Ingre-dients	Samples	Ingre-dients
1.	Farmer's soil	700	800	600	700	618	3,730	321	1990	953	6,155	201	1,322
2.	SRDI's program												
	a) Upazilla Nirdeshaka (Updating), union sahayika	1100	850	1000	750	416	5,660	598	8,372	1,250	14,080	818	11,239
	b) Quality control	150	150	100	100	75	695	186	2172	42	168	24	111
	c) Other program	100	200	150	150	0	0	690	2827	0	0	78	861
3.	Other organization	200	300	200	200	358	2932	74	412	423	3,352	92	469
	Total	**2,250**	**2,300**	**2050**	**1900**	**1,467**	**13,017**	**1,869**	**15,773**	**2,668**	**23,755**	**1,213**	**14,002**

Note: Other Organization include GO's, NGO's, NARS organizations, educational institutes etc.

Table 65. Number of Water samples & ingredients analyzed in 4 Regional Laboratories

Sl No.	Program/ source of Samples	Target				Number of water samples & ingredient analyzed							
		Dhaka	Comilla	Rajshahi	Khulna	Dhaka Regional laboratory		Comilla Regional laboratory		Rajshahi Regional laboratory		Khulna Regional laboratory	
						Samples	Ingre-dients	Samples	Ingre-dients	Samples	Ingre-dients	Samples	Ingre-dients
1.	Farmer's												
2.	Other organization	100	50	100	40	0	0	0	0	9	17	6	9
Total		**100**	**50**	**100**	**40**	**0**	**0**	**0**	**0**	**9**	**17**	**6**	**9**

Note: Other Organization include GO's, NGO's, NARS organizations, educational institutes etc.

Table 66. Number of fertilizer samples & ingredient analyzed in 4 Regional Laboratories

Sl No.	Program/s ource of Samples	Target				Number of fertilizer samples & ingredient analyzed			
		Dhaka	Comilla	Rajshahi	Khulna	Dhaka Regional	Comilla Regional	Rajshahi Regional	Khulna Regional

						laboratory		laboratory		laboratory		laboratory	
						Samples	Ingre-dients	Samples	Ingre-dients	Samples	Ingre-dients	Sampl es	Ingre-dients
1.	Farmer's												
2.	Other organiza-tion	600	400	800	500	378	1260	760	1647	693	1152	214	701
Total		**600**	**400**	**800**	**500**	**378**	**1260**	**760**	**1647**	**693**	**1152**	**214**	**701**

Note: Other Organization include GO's, NGO's, NARS organizations, educational institutes etc.

Table 67. Number of plant samples & ingredient analyzed in 4 Regional Laboratories

Sl No.	Program/source of Samples	Target				Number of plant samples & ingredient analyzed							
		Dhaka	Comilla	Rajshahi	Khulna	Dhaka Regional laboratory		Comilla Regional laboratory		Rajshahi Regional laboratory		Khulna Regional laboratory	
						Samples	Ingre-dients	Samples	Ingre-dients	Samples	Ingre-dients	Samples	Ingre-dients
1.	Farmer's												
2.	Other organization	100	50	100	140	0	0	0	0	19	76	0	0
Total		**100**	**50**	**100**	**140**	**0**	**0**	**0**	**0**	**19**	**76**	**0**	**0**

Note: Other Organization include GO's, NGO's, NARS organizations, educational institutes etc.

Table 68. Number of samples & ingredients analyzed in 4 regional laboratories

Sl No	Number of soil samples & ingredient analyzed								Total		Non-tax revenue Income (BDT)
	Dhaka Regional laboratory		Comilla Regional laboratory		Rajshahi Regional laboratory		Khulna Regional laboratory				
	Samples	Ingre-dients	Samples	Ingre-dients	Samples	Ingre-dients	Samples	Ingre-dients	Samples	Ingredients	12,48,784.00
Soil samples	1,467	13,017	1,869	15,773	2,668	23,755	1,213	14,003	7,217	66,548	
Plant	0	0	0	0	19	76	0	0	19	76	
Water	0	0	0	0	9	17	6	9	15	26	
Fertilizer	378	1,260	760	1,647	693	1152	214	701	2,045	4,760	
Total	**1,845**	**14,277**	**2,629**	**17,420**	**3,389**	**25,000**	**1,433**	**14,713**	**9,296**	**71,410**	

Table 69. Number of soil samples and ingredients analyzed in 11 static laboratories

Sl. No.	Name of the Laboratory	No. of soil sample analyzed	No. of ingredient analyzed
1.	Regional Laboratory Barisal	1,182	8,435
2.	Regional Laboratory Bogra	1,673	12,264
3.	Regional Laboratory Chittagong	1,060	5,300
4.	Regional Laboratory Dinajpur	2,468	24,021
5.	Regional Laboratory Faridpur	861	3,438
6.	Regional Laboratory Jamalpur	1,210	4,335
7.	Regional Laboratory Jhenaidah	1,111	11,009
8.	Regional Laboratory Kushtia	824	6,077
9.	Regional Laboratory Mymenshing	425	2,198
10.	Regional Laboratory Noakhali	1,033	9,848
11.	Regional Laboratory Sylhet	1,601	11,941
	Total	**13,448**	**98,866**

Table 70. Number of FRC prepared and distributed among the farmers

Sl. No.	Name of the Laboratory	No. of FRC prepared and distributed

1.	Regional Laboratory Barisal	680
2.	Regional Laboratory Bogra	1,024
3.	Regional Laboratory Chittagong	897
4.	Regional Laboratory Dinajpur	1233
5.	Regional Laboratory Faridpur	859
6.	Regional Laboratory Jamalpur	705
7.	Regional Laboratory Jhenaidah	532
8.	Regional Laboratory Kushtia	322
9.	Regional Laboratory Mymenshing	350
10.	Regional Laboratory Noakhali	712
11.	Regional Laboratory Sylhet	603
	Total	**7,912**

Table 71. Non-tax revenue earned as soil analysis fee

Sl. No.	Name of the Laboratory	No. of soil sample analyzed	No. of ingredient analyzed
1.	Regional Laboratory Barisal	1,182	8,435
2.	Regional Laboratory Bogra	1,673	12,264
3.	Regional Laboratory Chittagong	1,060	5,300
4.	Regional Laboratory Dinajpur	2,468	24,021
5.	Regional Laboratory Faridpur	861	3,438
6.	Regional Laboratory Jamalpur	1,210	4,335
7.	Regional Laboratory Jhenaidah	1,111	11,009
8.	Regional Laboratory Kushtia	824	6,077
9.	Regional Laboratory Mymenshing	425	2,198
10.	Regional Laboratory Noakhali	1,033	9,848
11.	Regional Laboratory Sylhet	1,601	11,941
	Total	**13,448**	**98,866**

Program 2: Training

Table 72. Training imparted by regional laboratories

SL NO	Topic	Duration (days)	Participants
1	Importance of balanced fertilization, soil sample collection and simple techniques of recognizing good/adulterated fertilizers, introduction to different technologies of SRDI	1	2175
2	'PACE' প্রকল্পের আওতায় নিরাপদ পদ্ধতিতে উচ্চমূল্যের সবজি উৎপাদনে কৃষকের দক্ষতা উন্নয়নে প্রশিক্ষণ	1	200
		Total	2375

Table 73. Training received by regional laboratories

SL NO	Topic	Duration (days)	Organizer	Participants
Foreign training				

1	Acquiring practical knowledge on sustainable agriculture, land and soil management practices in Thiland	7	Department of agriculture, Thiland(SRSRF,SRDI)	2
2	Climate smart agriculture	12	Philippine association of research managers, Philippine(NATP2,BARC)	1
3	Training course on Hybrid rice technology for Bangladesh	60	Yuan long ping High-tech Agriculture Co. Ltd. China	2
In country training				
4	Advanced laboratory technologies and capacity building	5	SRDI	40
5	Use of upazilla nirdeshika	6	SRDI	2
6	Departmental training of SRDI newly joined officers	15	SRDI	11
7	Innovation for citizen service	5	SRDI	4
8	Innovation for citizen service	2	SRDI	13
9	Training on E-filing	2	SRDI	9
10	Training of focal point officers for achieving sustainable development goal(SDG) by undertaking specific activities	1	SRDI	4
11	Training on annual performance agreement (APA)	1	SRDI	7
12	National integrity strategy work plan	1	SRDI	2
13	In-house training	60 hours	SRDI	96
14	Teaching method and technology	5	NATA	2
15	Civil case, NSI, RTI, SDG, APA and management of agricultural rules and regulation	5	NATA	1
16	Integrated Water Resource Management in Agriculture	5	NATA	1
17	Climate smart agriculture	5	NATA	1
18	Advanced ICT management	15	NATA	1
19	Good governance	5	NATA	1
20	Food security	5	NATA	2
21	Soil health management	5	NATA	2
22	Public financial management	5	NATA	1

23	Disaster management in Agriculture	5	NATA	1
24	Fertilizer inspection manual	3	BARC	2
25	Foundation training course on NARS scientist	120	BARD(NATP2,BARC)	2
26	Administrative and financial management	13	BARD(NATP2,BARC)	1
27	Training on development management	5	BARD	1
28	Training on production technologies, storage and processing of tuber crops	5	BARI	2
29	Soil fertility and nutrient management for major crops	6	BARI	2
30	Training on applied Food based nutrition	5	BIRTAN	2
31	Financial management	6	BIM	2
32	4th Fundamental training course	5	RPATC, Khulna	1
			Total	221