ANNUAL REPORT
2024-2025

SOIL RESOURCE DEVELOPMENT INSTITUTE

MINISTRY OF AGRICULTURE

2025

Government of the People's Republic of Bangladesh

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Front Cover: Panoramic landscape view of the rolling hills bordering Naf River seen standing on a hilltop of Teknaf.

Back Cover: Dramatic transformation of submerged monsoon basin into vast green arable land in haor landscape of Khaliajuri, Netrokona

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Foreward

The Soil Resource Development Institute (SRDI) is entrusted with the generation, management and dissemination of soil and land resource information to support national agricultural development. In fulfillment of its institutional mandate and commitment to accountability and performance reporting, SRDI hereby presents its Annual Report for the fiscal year 2024–2025, prepared in alignment with the targets and indicators stipulated under the Annual Performance Agreement (APA).

Operating with the framework of National Agricultural Research System (NARS), SRDI remains committed to produce reliable soil and land resource information, promote sustainable soil health management, and develop innovative technologies for the rehabilitation and improvement of problem soils. These initiatives collectively contribute to strengthening evidence-based agricultural planning and enhancing productivity and safeguard environmental sustainability.

A core component of SRDI activities involves conducting semi-detailed soil surveys and preparing location-specific planning documents such as the Upazila Nirdeshika and Union Sahayika. These resources provide comprehensive information insights into soil characteristics, fertility status, land use pattern and agro-climatic conditions, thereby supporting informed decision-making at both grassroots and policy levels. They are widely used by officials of the Department of Agricultural Extension (DAE) for crop suitability assessment, land-use planning and the formulation of balanced site specific fertilizer recommendations.
To promote efficient and judicious use of fertilizers, SRDI implements various farmer-focused programmes, including soil-based fertilizer recommendation services, research trials, distribution of recommendation cards, and awareness-building activities. These efforts aim to reduce indiscriminate fertilizer application, minimize production costs, and protect soil health.

Laboratory-based analysis of soil, fertilizer, plant, and water samples constitutes another key function of SRDI. These services are delivered through an extensive network of divisional and regional laboratories, further strengthened by Mobile Soil Testing Laboratories (MSTLs). The mobile services play a significant role in expanding outreach, particularly by raising awareness among farmers about the importance of soil testing and balanced nutrient management practices.

Monitoring of soil and water salinity is also a priority area of interventions of SRDI. The data generated through systematic monitoring support the development of management strategies for saline-prone areas and provide a strong basis for targeted planning interventions in vulnerable areas.

In addition, SRDI conducts applied research through its specialized research centres, including the Soil Conservation and Watershed Management Centre (SCWMC) at Bandarban and the Salinity Management and Research Centre (SMRC) at Batiaghata, Khulna. These centres focus on developing sustainable management technologies tailored to hill and saline soils, addressing region-specific challenges in agricultural production.

Beyond its core mandates, SRDI extends technical support and data services to the Department of Agricultural Extension, NARS institutions, academic organizations, and other government and non-government agencies, thereby contributing to national agricultural development initiatives.

The successful implementation of SRDI's annual programme reflects the dedication and the collective efforts of its officers and staff across head office, divisions, field offices, laboratories, and research centres. Their professionalism and relentless efforts have been instrumental in achieving the targets set for the year.
I am confident that the information and insights presented in this report will serve as a useful resource for policymakers, researchers, extension professionals and all stakeholders engaged in soil resource management and sustainable agriculture.

I sincerely acknowledge the commitment and hard work of all officers and staff involved in implementing the programmes for 2024–2025. I also extend my appreciation to the project directors, programme directors, and members of the annual report preparation committee for their valuable contributions in bringing this report to completion.

Dr. Begom Samia Sultana
Director General
Soil Resource Development Institute

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Executive Summary

The Annual Report 2024–2025 of the Soil Resource Development Institute (SRDI) presents a comprehensive overview of the Institute's mandate, activities, achievements, and challenges in advancing sustainable soil and land resource management in Bangladesh. During the reporting year, SRDI continued to play a pivotal role in supporting national food security, climate resilience, and sustainable agricultural intensification in alignment with government priorities, the Perspective Plan 2050, the Delta Plan 2100, and the Sustainable Development Goals (SDGs).

As a government and NARS organization under the Ministry of Agriculture (MoA) Soil Resource Development Institute (SRDI) is responsible for making inventory on land and soil resources, conducting research on hill soils and salinity affected areas. SRDI provides soil and fertilizer testing services through static laboratories. It also renders motivational soil testing services at grass root level through Mobile Soil Testing Laboratory (MSTL). The Institute is also liable to conduct research on crucial soil and environment related problems. Providing advisory services to divergent stakeholders is another salient job of SRDI.

Updating of "Upazila Nirdeshika" through semi-detailed soil survey is a core programme of SRDI. In the fiscal year 2024-2025, updating soil survey programme was carried out in 50 Upazilas. Field level information on significant changes in land use, land type, fertilizer use and other relevant data as well as composite soil samples were collected for each and every case. Inclusion of vegetables and fruits as a high value crop has been noticed in some places. A number of fifty (50) Upazila Nirdeshika were published in the year. The findings of published Upazila Nirdeshika reveal that there is a significant increase in transformation of agricultural land to non-agricultural land due to urbanization, industrialization and rural settlements. Data also reveal that homestead forest covers a significant area under rural settlements of coastal areas. Change in land type classes has been observed in some cases. Soil pH as well as soil nutrient status have been decreasing or almost similar in different parts of the country. Reasons for declining soil pH or soil acidification are excessive and/ inappropriate use of nitrogenous fertilizers and removal of crop residues. Soils of intensive cropped area are found to be more exhausted in respect of soil fertility which is mainly due to unbalanced and less use of fertilizers along with minimum or without use of organic inputs.

Union based Land, Soil and Fertilizer Recommendation Guide (Union Sahayika) is being used as a local level tool for agricultural development planning and for advisory services. A number of 162 Union Sahayikas were prepared and published in the fiscal year 2024-2025.
SRDI has launched Online Fertilizer Recommendation System (OFRS) since 2009. The system aims at providing faster and easier delivery of fertilizer recommendation service which is a part of sustainable soil management. In FY 2024-2025, about 33,300 farmers/beneficiaries were

served through OFRS software. Number of farmers served on the basis of Upazila Nirdheshika and soil tests are 7,094 and 21,040 respectively.

SRDI's activities also involve GIS based data processing and map preparation. This endeavor is employed for utilizing GIS in storage, retrieval as well as visualization of land and soil related maps. Under this programme, proposed upazila for soil survey (semi-detailed soil survey of SRDI) maps were prepared in 2024-2025 fiscal year.

SRDI initiated the Soil Test Based (STB) Fertilizer Recommendation System through Mobile Soil Testing Laboratories (MSTL) in 1996. At present, SRDI operates 10 MSTL for providing farmers service through soil analysis at the user's end in two seasons (Rabi & Kharif) of the year. In 2024-2025, 6,186 farmers thoughout the country was given soil testing service and fertilizer recommendation cards through this programme.

SRDI is conducting salinity monitoring in coastal areas of the country to observe short term and long-term trends of salinity fluctuation. Data disclose that soil and water salinity was much higher in the south western part of the country than rest other parts. It is due to the non-functional river system because of reduced upstream flow. In Khulna division severe salinity affected districts are Bagerhat, Satkhira and Khulna. In Barishal Division mainly onshore areas are affected by salinity. Accordingly, higher degree of soil and water salinity was recorded in Barguna, Patuakhali, Bhola & Pirojpur Districts. Barishal Division is naturally more advantaged because of its active river network as well as affluent river flow. In recent years the Baleshwar River lost its upstream flow. Consequently, sea water intrusion occurs up to Pirojpur Sadar Upazila in dry season which means extension of saline area along the river Baleshwar and scarcity of irrigation water. In Bhola District, saline soils are easily managed because of its loamy texture. These coarse textured soils have low CEC. As a result, they can't hold salt elements with their poor electrostatic charge. This is the reason why desalination happens in these soils during monsoon through rain flashing if drainage provision is satisfactory. Soils of Hatiya and Swandip under Noakhali and Chattogram District as well as offshore part of Feni District also have the similar advantage. In Barishal Division saline soils could be more easily managed utilizing plentiful dry season river flow. Sweet water needs to be stored in October-November and utilized through a buried pipe irrigation network. This could be achieved through modern polder management. In Cox's Bazar District farmers use their lands as salt beds because of higher returns. This practice is detrimental to soil health and eventually may accelerate soil salinization. River water salinity of Noakhali and Bhola district is less than that of Khulna, Bagerhat and Satkhira districts. In Satkhira, river water salinity was found highest in May/June whereas in Noakhali and Barishal it was highest in April/May. River water remains saline during April-June as rainfall is low during this period. 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 start to increase in January/February, attains its peak in March and starts to decrease in June/July at the onset of monsoon. In Chattogram and

Cox's bazar soil salinity starts to increase in December, attains its peak in March and then gradually decreases at the start of monsoon. Water salinity starts to increase in January, attains its peak in April/May.

Salinity Management and Research Centre (SMRC), Batiaghata, Khulna has developed a number of technologies for saline soil management which have been found to be very effective in farmer's field. These technologies are: top soil carpeting technology for vegetable production on shrimp-gher bund, farm-pond technology, pitcher irrigation, dibbling and transplanting of maize under zero tillage, single- and double-layer mulching, flying bed culture for vegetable cultivation, and screening of suitable crop varieties for saline soils. Proper dissemination of these technologies is needed for crop intensification through optimum soil and water management in coastal areas of Bangladesh. Soil Conservation and Watershed Management Centre (SCWMC), Meghla Bandarban has developed some advanced technologies for hill soil management, among these hedge row technology, staggered trenching, half-moon trenching, slash and mulch system of agroforestry and Natural Vegetative

Strips (NVS) for controlling soil erosion in hill slopes are noteworthy. These technologies need to be disseminated through DAE for sustainable soil management in hill areas.

Government has to pay a cosmic amount of money for subsidies on fertilizers. It is an extra pressure on our national economy. For proper utilization of government support or incentive it is necessary to use balanced fertilizers by farmers. Farmers should be motivated for rational and balanced use of fertilizers. Minimum wastage of fertilizers is expected with respect to economic and soil health and environmental perspective. With a view to fulfilling the objective, SRDI has initiated an adaptive trial programme to popularize balanced fertilizer use among farmers. Basis of the fertilizer recommendation was direct soil test value and soil fertility data of Upazila Nirdeshika. This programme has been implemented throughout the country to visualize superiority of balanced fertilization over farmers' assumed dose. Besides yield increase, balanced fertilization helps to maintain soil health and a good environment. Altogether 66 adaptive trials were set up in the year 2024-2025. The yield data of Adaptive Trial plots revealed that farmers got 2.5%-46% higher yield in different crops and varieties in comparison to farmers' practices in different locations. The average yield increase was 17.7%.

Chemical analysis of soil, fertilizer, plant and water samples is one of the core functions of SRDI. This programme has been aimed at evaluating soil fertility status for updating of soil chemical databases of SRDI's Upazila Nirdeshika and recommendation of balanced fertilizer doses for different crops. Another objective of the programme is to analyze fertilizer samples for the purpose of quality control and to analyze water and plant samples for research needs of SRDI and other Government and non-Government organizations. During 2024-2025 Static Laboratories conducted soil analysis for both physical and chemical parameters, plant and water analysis for chemical parameters and fertilizer samples analysis under different programmes. In

Static Laboratories (Central and Regional Laboratories) 33,391 soil samples, 473 water samples, 275 plant samples and 8,297 fertilizer samples were analyzed. Central Laboratory conducted research on various aspects of soil and fertilizer management, sludge management, nutrient management and so on. In addition, 6,186 soil samples were analyzed by 10 MSTLs.

Building up resourceful manpower to cope with upcoming challenges SRDI is implementing a good deal of training programmes throughout the year. As a part of this, training was imparted to the officers and scientists of SRDI, DAE on chemical analyses of soil and fertilizers, Identification of adulterated fertilizers at field level, Soil sample collection technique and use of balanced fertilizer. Training was given to the Officers of SRDI/DAE on the use of Upazila Nirdeshika along with various aspects of soil management/capacity building & skill development and the Officers of SRDI on application of GIS Technology in Preparing maps, skill development on remote sensing, innovation in public service, E-filing, laboratory equipment maintenance and methodology, use of computer and software; farmers/fertilizer dealers/ SAAO's/ entrepreneurs of Union Information Center on the use of Upazila Nirdeshika/soil sample collection technique & use of balanced fertilizer/identification of adulterated fertilizer.

To mobilize field and laboratory activities SRDI has one project and one programme. The project is "Construction of building and Capacity Building of SRDI (CCBS)". The programme named "Acidic soil management and sustainable crop production & improvement of soil fertility by practicing climate smart agricultre in the Rajshahi & Rangpur Division including Madhupur Tract". Significant progress has been made with respect to yearly achievement of the institution. The activities performed by the project and programme have been included in this report precisely.

Chapter 1: SRDI at a glance

1.1 Brief Introduction of Soil Resource Development Institute (SRDI):

Soil Resource Development Institute (SRDI) is a designated organization for soil resource inventory as well as soil research for sustainable soil and land management with a view to ensuring food security. SRDI is an attached department to Ministry of Agriculture which was originated in 1961 as the East Wing Directorate of the Soil Survey Project of Pakistan with the assistance of FAO/UNDP. The institute aimed at quick inventory of soil and land resources to develop a sound database of soil and land especially for- Extension, Irrigation and drainage, Soil conservation and reclamation & soil fertility investigation and identification of problem soils.

After emergence of Bangladesh, the then East wing office of the Central Soil Resource Institute started functioning as Department of Soil Survey under the 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. An important landmark in the development of the Institute was the recent creation of 33 regional offices as well as 16 regional laboratories to flourish soil management services up to grass root level. It is now prepared to face the challenges of future to make breakthrough in crop production through improved soil and nutrient management in Bangladesh.

1.1.1 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 soil health.

1.1.2 Mission of SRDI

The mission of SRDI is to make inventories of soil and land resources, classify them according to their potentiality, prepare user-friendly guidelines and manuals for their optimum utilization, identification and management of problem soils and aid in developing and implementing sustainable plans for increased crop production in Bangladesh.

1.2 Functions of SRDI

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

a) Reconnaissance Soil Survey of the whole country has been done on the basis of aerial photo interpretation and field survey 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, acidic or peat soils), soil degradation and erosion (in hilly areas) for planning reclamation or watershed management;
e) Correlation of soils conducted under various surveys;
f) Conducting chemical, physical, mineralogical and microbiological study. 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 suiTableity 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 programmeme;
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 programme for the training of field level extension workers regarding soil analytical results, 'Soil Health Card Programme', 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.
v) Semi detailed soil survey for the preparation of Upazila Nirdeshika.

1.3 Organogram of SRDI

Soil Resource Development Institute (SRDI) is a government organization under the Ministry of Agriculture (MoA) which is working as a member of NARS system under the umbrella of Bangladesh Agricultural Research Council (BARC). The institute operates with 2 wings, 2 divisions and 11 Section. Field Services Wings consists of 7 divisional offices and 33 regional offices. Analytical Services Wings including 7 divisional laboratories, 16 regional laboratories and central laboratory. Survey and land management division consists of 3 sections namely (i) soil survey and land classification section (ii) land use planning section (iii) land evaluation and soil correlation. Training & Communication Division consists of 3 sections namely (i) Cartography section (ii) DPS & ICT section (iii) Human resource development section and (iv) Publication and record section. Central Laboratory consists of 3 sections namely i) Soil physics and Mineralogy ii) Soil chemistry iii) Soil Microbiology and Biochemistry. SRDI's two research centres namely (i) Soil Conservation and Watershed Management Center (SCWMC), Meghla, Bandarban and (ii) Salinity Management and Research Center (SMRC), Batiaghata, Khulna are controlled by central administration. Centrally controlled administration section includes: administrative branch, accounts branch and store branch. Besides, Upazila Nirdeshika Cell is directly controlled by the Director General's office.

Soil Resource Development Institute is headed by the Director General. Field Services Wing, Analytical Services Wing are headed by director. The divisions of head office, divisional offices, divisional laboratories and central laboratory are headed by Chief Scientific Officer (CSO) and the sections of head office, regional offices, regional laboratories and research center are headed by Principal Scientific Officer (PSO). The Cartography Section is headed by a Senior Cartographer and Publication & Record Section is headed by Publication & Liaison Officer.

1.3.1 Functions of Survey and Land Management Division

Planning, coordination and supervision of all technical programmemes and activities of the component sections. Review and/or editing of all technical reports prepared by the component sections. Coordination with allied Government, Autonomous/other agencies in national programmemes on soil and land resource evaluation and land utilization planning. Correlation of soils and soil and land classification surveys at national level. Responsible for overall technical progress of the Division. Field investigation of soil problems. Assistance to the Director General and technical administration of the division. This division has three sections.

1.3.1.1 Functions of Survey and Classification Section

Planning and supervision of soil surveys. Updating earlier surveys on soils, land use and land capability. Development of advanced methodology for soil surveys. Trials on adoption of latest global technology for soil survey, i.e., use of satellite image for preparing field maps through using remote sensing technique. Editing of soil survey reports.

1.3.1.2 Functions of Land use Planning Section

Planning, supervision and execution of soil survey data interpretation activities. Providing basic data on soils, land capability and crop suiTableity. Interpretation of soil data for locating areas suitable for extension and introduction of various crops. Processing of soil survey data for land use planning.

1.3.1.3 Functions of Land Evaluation and Soil Correlation Section

Planning and execution of an annual targeted programmeme. Managing correlation of soil series, organizing monoliths. Maintenance of uniform standard of methodology for soil survey. Development and maintenance of the Soil Museum with global experiences.

1.3.2 Functions of Training and Communication Division

Organizing all central training programs and coordinating other training of field offices and laboratories. implementing other services through three component sections under this division.

Coordination among the sections and administrative functions. Assisting Director General on various technical and administrative issues. This division comprises four sections.

1.3.2.1 Functions of Human Resource Development Section

Planning and execution of in-service training programmemes. Organizing refresher courses. Organizing training programmemes related to land, soil, water resources. Developing training modules. Preparation and collection of training materials. Planning, organizing and facilitating overseas training and higher Studies.

1.3.2.2 Functions of DPS and ICT Section

Planning and execution of an annual targeted programmeme. Review and/or edit all technical reports and maps prepared by using base materials and GIS technology. Storage, analyses and regular updating of soil and land resource databases. Maintenance and up scaling of Online Fertilizer Recommendation System (OFRS) and Website management. Responsible for overall technical progress of the division.

1.3.2.3 Functions of Cartography Section

Planning and execution of annual targeted cartographic activities. Procuring, managing and distributing all kinds of maps and aerial photographs. Liable for being a custodian of aerial photographs including base maps of different types.

1.3.2.4 Functions of Publication and Record Section

Collection of relevant books, journals, periodicals and management of SRDI library. Helping authority to conduct publication related activities is another responsibility of the section.

1.3.3 Functions of Nirdeshika cell

Technical supervision, accomplishment of final editing through editorial board and coordination & execution of all printing related activities for printing Upazila Land and Soil Resources Utilization Guide.

1.3.4 Functions of Field Services Wing

Planning, coordination and supervision of all technical programmemes and activities of the divisional and Regional Offices under the wing. Assisting allied government and autonomous bodies and NGOs for implementing local and national level programmemes on agricultural development. Assisting Director General on technical and administrative issues.

1.3.4.1 Divisional Offices

Implementation of the central technical programmeme through regular supervision and coordination with subordinate regional offices. Carry out administrative functions within the Jurisdiction. Maintaining liaison with the partner agencies like NARS institutes, DAE, BADC ettc. Contribute as a member of Regional Agricultural Technology Extension committee for developing agricultural development plans by providing soil and related data and information.

Conducting training programmemes for SAAOs, farmers, entrepreneurs, fertilizer dealers and NGOs' field workers. Providing advisory services to GOs/NGOs. Support also given to versity and college students to fulfill their academic needs. Preparing reports on crop damage caused by, flood, cyclone, flash flood, drought etc.

1.3.4.2 Regional Offices

Implementing technical activities under the guidance and supervision of head office and divisional office. Preparation of updated Upazila Nirdeshika through semi detailed soil survey, providing useful information on land and soil resources which is a tool for local level agricultural development planning. Delivering farmers service through OFRS and Upazila Nirdeshika and soil test-based fertilizer recommendation. Technology transfer through block demonstration. Assisting beneficiary agencies like DAE, NARS institutes, BADC etc. by providing information and advisory services required for sustainable use of land and soil resources. Contribute as a member of District Agricultural Technology Extension Committee, District Agricultural Rehabilitation Committee and District Development Coordination Committee laying down information on soil and land resources for agricultural and other development planning. Conducting training programmemes for SAAOs, farmers, entrepreneurs, fertilizer dealers and NGOs' field workers. Assistance given to university and college students to fulfill their educational needs. Preparing reports on crop damage caused by disasters like flood, cyclone, flash flood, drought etc.

1.3.5 Functions of Analytical Services Wing

Planning and implementation of annual programmemes through central laboratory, divisional laboratories and regional laboratories. Coordinating and supervising the activities of all laboratories. Managing support services including instrument maintenance and supply of chemicals, glassware etc. Planning and execution and coordination of Mobile Soil Testing Laboratory (MSTL) programmeme. Fulfilling research needs of SRDI and other research organizations through central and other laboratories. Assisting Director General on various technical and administrative issues.

1.3.5.1 Function of Central Laboratory

Central laboratory of SRDI has been mandated to perform multiple functions under soil chemistry, soil physics and clay mineralogy and soil microbiology section. The activities performed by soil chemistry section includes, quality control of analytical work of different Laboratories of SRDI; quality testing of imported fertilizers, registration of new fertilizer brand, renewal of fertilizer registration; analysis of plant and water samples received from different organizations; helping DAE through analyzing fertilizer samples in order to control adulteration of fertilizers and conducting research on contemporary soil and environmental issues. Soil physics and clay mineralogy section has performed determination of physical characteristics of Barind Tract soils that underwent a natural soil degradation process named ferro lysis. Soil microbiology section has launched a programmeme to conduct benchmark study on microbial population under different agro ecological regions of Bangladesh. Under the assistance of the

PARTNER project SRDI is going to establish a modern microbiological laboratory under the umbrella of the central laboratory.

1.3.5.2 Functions of Divisional Laboratory

Implementation of the annual targeted programmeme under the guidance and supervision of Analytical Services Wing. Analysis of soil, water and plant samples to evaluate soil fertility, diagnosis of salinity, acidity, nutrient mining for the purpose of providing services and research support. Analysis of fertilizer samples for the purpose of quality control. Distributing Fertilizer Recommendation Cards (FRC) among farmers on the basis of soil test results. Managing soil testing and fertilizer recommendation services by both static and Mobile Soil Testing

Laboratory (MSTL). Coordinating functions of regional laboratories and Mobile Soil Testing Laboratory (MSTL). Generating chemical data for updating Upazila Nirdeshika. Providing research support to research organizations and educational institutions. Conducting training programmemes for farmers, entrepreneurs, fertilizer dealers, NGOs field workers.

1.3.5.3 Functions of Regional Laboratory

Analyses of soil samples and providing fertilizer recommendation cards among farmers. Soil analytical services are also given to different organizations like DAE, NARS organizations and educational institutions. Assisting divisional laboratories for achieving annual targets. Participate in execution of Mobile Soil Testing Laboratory programmeme. Supporting regional offices of SRDI through soil and water analysis. Conducting training programmemes for farmers, entrepreneurs, fertilizer dealers, NGOs field workers.

1.3.6 Research Centers

1.3.6.1 Soil Conservation and Watershed Management Center (SCWMC):

Soil Conservation and Watershed Management Center is located at Meghla, Bandarban. SCWMC is responsible for generating technology on soil conservation and watershed management in sloping lands of Hilly areas through conducting research in hill areas. Organizing training programmemes for SAAOs, farmers and NGOs field workers for technology dissemination. Providing support to university students fulfilling their academic needs.

1.3.6.2 Salinity Management and Research Center (SMRC):

Salinity Management and Research Center is located at Batiaghata, Khulna. SMRC is responsible for generating databases on soil and water salinity, identifying potential sources of irrigation water, screening of soil tolerant varieties of different crops, innovation and validation of saline soil and water management technologies. Conducting training of SAAOs, farmers and NGOs field workers for technology dissemination. Supporting research organizations and educational institutions fulfilling their research needs.

Chapter 2. Activities of Different Sections of Head Quarters

2.1 Soil Survey and Land Management Division

Soil Survey and Land Management Division of 3(three) sections viz Soil Survey and Classification section, Land use Planning Section, Land Evaluation and Correlation Section. The core function of the Soil Survey and Land Management Division is to plan, coordinate and supervise all technical programmes and activities of the component sections.

Land degradation neutrality map: As per requirement of MoEFCC, progress of Land Degradation Neutrality (LDN) upto 2025 and work plan till 2030 including LDN Target 2015-2030 Map were prepared and sent to the ministry.

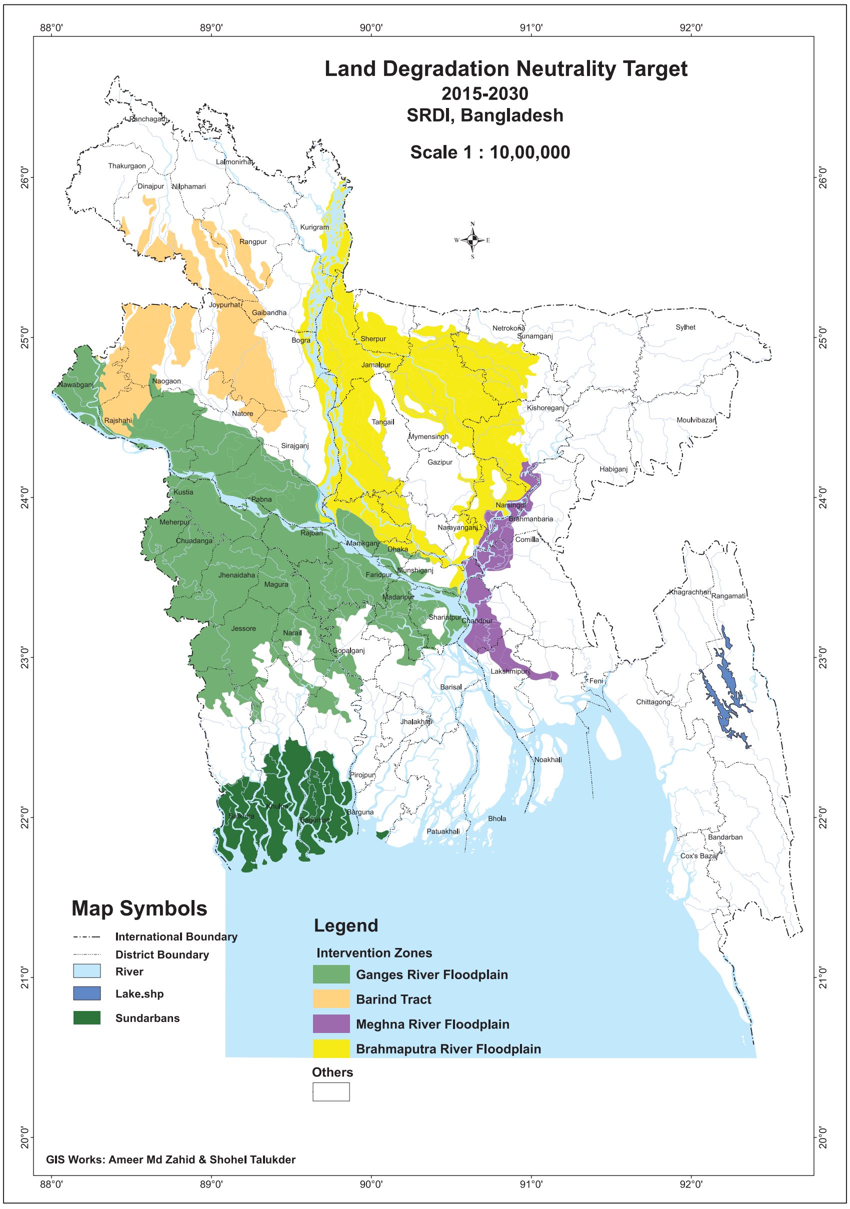


Figure 2.1: Land degradation neutrality map

2.1.1 Soil Survey and Classification Section

TECHNICAL WORK:

1. Updating survey:

a) Title of the Program

Updating Upazila Nirdeshika of Bijaynagar under Brahmanbaria district & Amtali Upazila of Barguna district

b) Objectives

- To prepare a digital interpretative map of Bijaynagar and Amtali Upazila for conducting semi-detailed soil survey at field level.
- To conduct semi-detailed survey to identify the changes in land and soil resources and changes in cropping pattern and crops grown over time in Bijaynagar and Amtali Upazila.
- Ground truthing and rectification of the draft digital map and preparing reports on the findings along with soil fertility status.

c) Methodology

Photo interpretation of Bijaynagar and Amtali Upazila:

Areial photographs, topographic maps, existing upazila soil and landform maps as well as DLR map have been used as base materials. The draft interpretative map of Bijaynagar and Amtali Upazila were preparaed using the ArcGIS technology. At first permanent features of the selected area such as roads, settlements, water bodies etc. were identified. Different land types were identified by analyzing Google images. During the updating soil survey program, changes of land type, land use, land cover, settlements, water bodies, roads, water recession, drainage class, soil and land degradation and GPS reading of sampling points have been recorded. By comparing land types and other visible features in the photo and relevant secondary data different soil mapping units were identified. Metaled and un-metaled roads were drawn from topographic maps. The interpretative soil and land form map is prepared at 1:50,000 scale.

Composite soil samples were collected with GPS reading to compare the changes of nutrient status of soil due to intensive cultivation of modern varieties of different crops with imbalanced application of chemical fertilizers and climate changes.

As a monitoring and supervising officer of the updating survey works, all kinds of technical assistances were provided to the survey teams throughout the survey works for successful completion of the updating survey of Bijaynagar under Brahmanbaria district & Amtali Upazila of Barguna district. The findings of these two upazila updating surveys have been given by respective officers responsible for reporting under divisional activities.

Updating soil Survey at Rajarhat upazila

2. Preparing draft report of updating survey of Guimara upazila, Khagrachari district:

The draft report of updating survey of newly formed Guimara upazila of Khagrachari district is finalized and scheduled to be published in 2024-2025 fiscal year. The reports consisted the remarkable and noticeable changes in soil, land and crop related information. The variable land types, cropping pattern, land use, soil nutrient status and organic matter content in the surveyed areas are presented in the formatted updating Upazila Nirdeshika report along with draft final Map. Preparation of draft updating survey report of Monohordi upazila is also in progress which is scheduled to be published in 2025-2026 Fiscal year. The draft updated map of Monohordi upazila of Narshingdi district is finalized. The two Updating survey soil and land form map of Guimara upazila and Monohordi upazila are presented below.

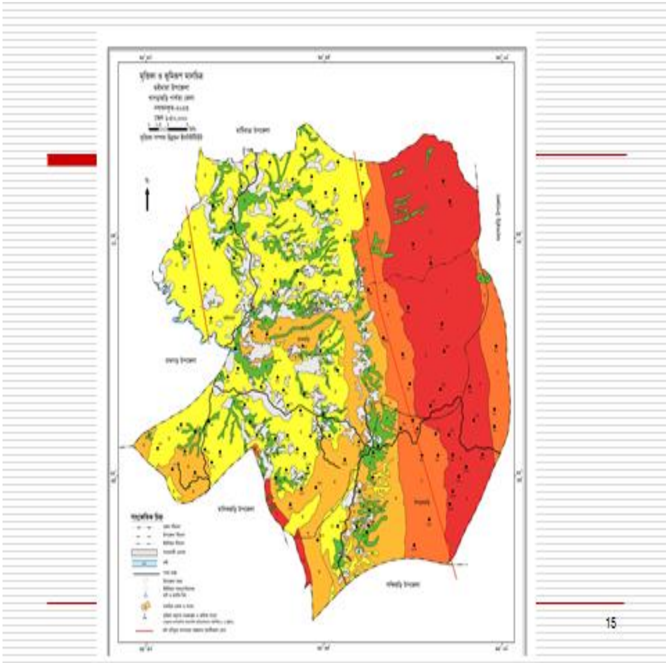


Fig 2.2: Soil and Landform Map of Guimara Upazila

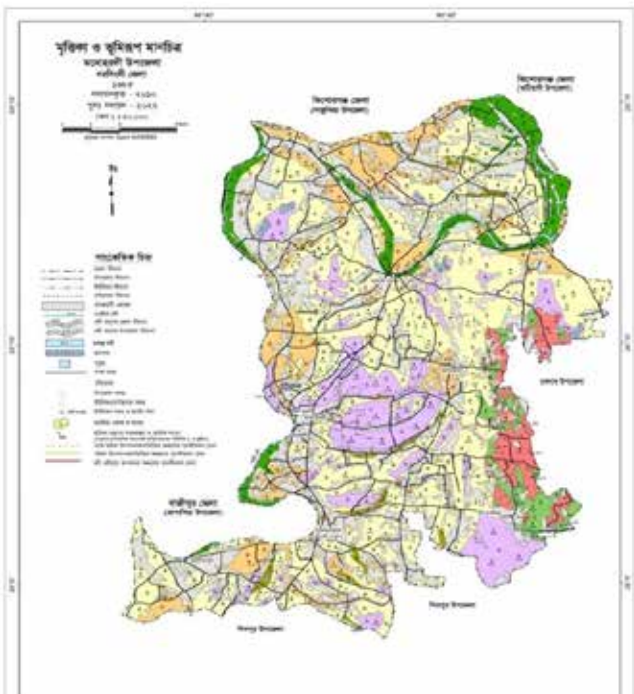


Fig 2.3: Soil and Landform Map of Monohardi Upazila

OTHER ACTIVITIES:

1. Report prepared to supply data and information for the Preparation of a combined BTR1 and NC4 to the UNFCCC under the project Bangladesh: Enabling Activities for the Preparation of a combined Initial Biennial Transparency Report and Fourth National Communication (BTR1/ NC4) to the United Nation Framework Convention on Climate Change (UNFCCC)

2. Preparation of Agricultural Land Protection Strategy, Bangladesh and submitted to Ministry of Agriculture.

3. Report Preparation on Implementation progress of the Roadmap for Increasing Agricultural Exports 2022

4. Activities on "Grievance Redress System (GRS)".

5. Preparation of draft report on updating gradation of 3rd and 4th class staffs of SRDI

6. Comments Prepared and submitted to Ministry of Agriculture on

- Vulnerability Index (Soil and Land)
- Draft Report of Land Zoning and Protection Ordinance, 2025
- Draft Report of Farmers' Smart Card Policy 2025
- Activities of National Target (1, 2, 7, 10, 11, 12, 20) of NBSAP (National Biodiversity Strategic Action Plan)
- Financial Management Guidelines for Protected Areas, 2017.

7. Draft of MoU Prepared and submitted to Ministry of Agriculture on

- SRDI & CIMMYT (Corrected)
- SRDI & JICA
- SRDI & HEIFER, Bangladesh

Comments on Vulnerability Index (Soil and Land)-SRDI

Comments on Indicator # 8 (Low Elevated Coastal Zones)

Salinization is a common phenomenon in Coastal Bangladesh. Out of 2.85 mha of coastal and offshore areas about 1.056 mha of land is affected by different degrees of salinity (Zahid et.al. 2022) depicting a rise of soil salinity from 0.833 million ha to 10.56 million ha between the year 1973–2009 amounting to about a 0.74% increase per year affecting 3.5% of the coastal land of the country. Within the Southern coastal zone, 93 upazilas under 18 districts out of 64 are found affected by different degrees of salinity. Khulna, Bagherhat, Satkhira, Pirojpur, Bhola, Patuakhali, Borguna, Laksmipur, Feni, Noakhali, Chattogram and Cox's bazar districts were reported to be salt affected since 1973. Later Jashore, Narail, Barishal, Jhalokhati, Gopalgonj, and Madaripur have been reported to be salinity affected in 2009 (Zahid et.al. 2022). By 2050, it is foreseen that the salinity situation in the coastal region will have to be worsen (Dasgupta et al.2015) which might cause a loss of food production of approximately 10% (Dey et al. 2023) The geographic location of the country, coastal morphology, and global climate change showing frequent natural hazards such as Sidr in 2007 and Aila at 2009, geo-environmental politics, cross-boundary river policy and national governance are the main driving forces of increasing salinity in Bangladesh. The intrusion of salt water into coastal inland areas primarily caused due to the upstream flow of river water. Water diversions in the dry seasons by neighboring countries especially by India from 25 rivers out of 54 sharply dropped the normal course of freshwater flow that allowed to intrude the seawater, the consequence is the increased salinization in the soil [Nuruzzaman et al., 2014 and Gain and Giupponi 2014). Salinization caused deterioration to soil physical, chemical and biological properties, leading to a loss of biodiversity and ecosystem activity. A considerable decline in growth yield and quality of crops due to incremental salinization has also been reported by various scientists (Mia el al. 2010, Habiba et al. 2013, Shameem et al. 2014).

References:

U. Habiba, M.A. Abedin, R. Shaw, A.W.R. Hassan, Salinity-induced livelihood stress in coastal region of Bangladesh, Community Environ. Disaster Risk Manag. 13 (2013) 139–165, https://doi.org/10.1108/S2040-7262(2013)0000013013/FULL/XML .

M.I.M. Shameem, S. Momtaz, R. Rauscher, Vulnerability of rural livelihoods to multiple stressors: a case study from the southwest coastal region of Bangladesh, Ocean Coast Manag. 102 (2014) 79–87, https://doi.org/10.1016/J.OCECOAMAN.2014.09.002.

G. Miah, N. Bari, A. Rahman, Resource degradation and livelihood in the coastal region of Bangladesh, Front. Earth Sci. China 4 (2010) 427–437, https://doi. org/10.1007/S11707-010-0126-1/METRICS

Ph and Three Climatic Variables, SSRN, 2023, https://doi.org/10.2139/SSRN.4437863.

A. Nuruzzaman, F. Rabbi, M. Mahmuduzzaman, U. Ahmed, A.K.M. Nuruzzaman, S. Ahmed, Causes of salinity intrusion in coastal belt of Bangladesh article in, Int. J. Plant Res. 4 (2014) 8–13, https://doi.org/10.5923/s.plant.2014 01.02.

A.K. Gain, C. Giupponi, Impact of the farakka dam on thresholds of the hydrologic flow regime in the lower ganges river basin (Bangladesh), Water 6 (2014) 2501–2518, https://doi.org/10.3390/W6082501, 2501–2518.

B. Dey, J. Ferdous, R. Ahmed, Machine learning based recommendation of agricultural and horticultural crop farming in India under the regime of npk, in: Soil Ph and Three Climatic Variables, SSRN, 2023, https://doi.org/10.2139/SSRN.4437863.

S. Dasgupta, M.M. Hossain, M. Huq, D. Wheeler, Climate change and soil salinity: the case of coastal Bangladesh, Ambio 44 (2015) 815–826, https://doi.org/ 10.1007/S13280-015-0681-5/FIGURES/4 .

Zahid, A.M., Kohinoor, N.A., Hossain, M.A., Ali, Dr.M.S and Shoaib J.U. 2022. Land degradation in Bangladesh 2020. DoE Coordinated and UNEP & GEF supported Research Report, SRDI, Dhaka. ISBN: 978-984-34-815-2 / 2023-02-02-07-03-aaef3a35b65e46054213bc39791726db.pdf
https://srdi.portal.gov.bd/sites/default/files/files/srdi.portal.gov.bd/page/0652dd9d_22d9_4de4_b3b8_e267788e9cbd/2023-02-02-07-03-aaef3a35b65e46054213bc39791726db.pdf

Comments on Indicator # 9 (Drylands)

Bangladesh is the most vulnerable place in the world to natural disasters because of its complex and varied geomorphology, low-lying terrain, hydrogeological conditions, and unpredictable weather. Nearly every year, the country is hit by significant and common severe weather events like droughts, floods, tropical cyclones, and storm surges that cause much damage and many casualties (Islam et al., 2017). Furthermore, the Intergovernmental Panel on Climate Change (IPCC) pointed out that Bangladesh is one of the countries most exposed to the effects of climate change (IPCC, 2022). Drylands mainly characterized by drought is a highly destructive natural phenomenon that consistently affects numerous parts of the north-western regions of Bangladesh especially in the Barind Tract are becoming increasingly vulnerable to repeated droughts in the foreseeable future (Sultana et al. 2023 and Rana and Moniruzzaman 2021). Degraded land with respect to drought is estimated to be around 1.54 mha amounting 10.4% of the geographical area of the country (Zahid et al. 2022). Every year, drought poses significant social and environmental threats, impacting the lives of millions, and has been found to negatively impact society, economy, water supplies, environment, and agriculture (Rahman and Lateh, 2016). Drought is often called a 'Silent Killer' of agricultural production. The drought, linked to soil moisture scarcity, occurs at different stages of crop growth, development and reproduction. Monsoon failure often brings famine to the affected region. A severe drought can cause greater than 50% damage to growing crops (Zahid et al. 2022). Implementing drought management strategies, including prevention, mitigation, and preparedness, is essential in mitigating the adverse effects of drought on society, the economy, and the environment (Liu et al., 2016). Key initiatives include providing financial support for smallholder farmers, enforcing agricultural policies, investing in social capital, and implementing government-backed infrastructure and technology enhancements, all crucial for building resilience against drought management.

References:

Islam, A.R.T., Shen, S., Hu, Z., Rahman, M.A., 2017. Drought hazard evaluation in boro paddy cultivated areas of western bangladesh at current and future climate change conditions. Adv. Meteorol. 2017 https://doi.org/10.1155/2017/3514381

IPCC. (2022). WGII Sixth Assessment Report. https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_FinalDraft_TechnicalSummary.pdf.

Sultana, R., Irfanullah, H.M., Selim, S.A., Budrudzaman, M., 2023. Vulnerability and ecosystem-based adaptation in the farming communities of droughtprone Northwest Bangladesh. Environmental Challenges 11, 100707. https://doi.org/10.1016/j. envc.2023.100707

Rana, M.M.P., Moniruzzaman, M., 2021. Transformative adaptation in agriculture: a case of agroforestation in Bangladesh. Environ. Challenges 2, 100026. https://doi.org/10.1016/j.envc.2021.100026

Rahman, M., Lateh, H., 2016. Meteorological drought in Bangladesh: assessing, zanalyzing and hazard mapping using SPI, GIS and monthly rainfall data. Environ. Earth Sci. 75 (12), 1–20. https://doi.org/10.1007/s12665-016-5829-5

Liu, H.L., Willems, P., Bao, A.M., et al., 2016. Effect of climate change on the vulnerability of a socio-ecological system in an arid area. Global Planet. Change 137, 1–9. https://doi.org/10.1016/j.gloplacha.2015.12.014

Zahid, A.M., Kohinoor, N.A., Hossain, M.A., Ali, Dr.M.S and Shoaib J.U. 2022. Land degradation in Bangladesh 2020. DoE Coordinated and UNEP & GEF supported Research Report, SRDI, Dhaka. 2023-02-02-07-03-aaef3a35b65e46054213bc39791726db.pdf https://srdi.portal.gov.bd/sites/default/files/files/srdi.portal.gov.bd/page/0652dd9d_22d9_4de4_b3b8_e267788e9cbd/2023-02-02-07-03-aaef3a35b65e46054213bc39791726db.pdf

Indicator #19: Lack of cropland

Bangladesh is principally an agricultural country, characterized by rice paddy agriculture dominated landscapes. Therefore, land resource is the major assets contributing wealth and livelihood in rural areas. Bangladesh is a deltaic country located in South Asia, with a relatively small land area (147,570 km^2) but with the 8th largest world population (161 million) and the 13th highest world population density. According to the medium variant UN projection (UN, 2015), Bangladesh' population will further increase to 186 and 202 million by the years 2030 and 2050, respectively. Crop land includes land under cultivated, cultivable waste and current fallow. Most land suitable for cropping in the country is already under cultivation. Arable land area is even decreasing over time due to increasing demand for residential and industrial use (Hasan et al., 2013). Total cropland was estimated 9761450 ha, 9439541 ha, and 8751937 ha in 1976, 2000 and 2010 corresponding to 67.38%, 64.96% and 60.04% of the total land area, respectively. This indicates that cropland decreased more rapidly during 2000-2010 compared to 1976-2000. Yearly average cropland decreased 13,413 ha (0.14%) during 1976-2000, 68760 ha (0.73%) during 2000-2010 and 42063 ha (0.30%) during 1976-2010 (Hasan et al. 2013). A general decrease in arable land for all crops in Bangladesh will decrease by 10% in 2030 and by 20% in 2050 relative to that of the base year 2010. These relative changes are based on the actual arable land area decreases between 2002 and 2012 to account for increases in residential housings, industries, roads, and aquaculture (Hasan et al., 2013). Bangladesh also suffers from periodic natural calamities such as drought, flooding, and cyclones. Due to its location in a delta, climate change and associated sea level rise is expected to increase risk for flooding and salinization of agricultural lands, especially near the southern coast (Hossain and Silva, 2013; MOA-FAO, 2012). Climate change studies have forecasted significant sea level rise in southern Bangladesh (IPCC, 2014; WARPO, 2006), possibly resulting in inundation and loss of land areas (Clark et al., 2015; MoA-FAO, 2012) and loss of crop production (Clark et al., 2015; Thomas et al., 2012) in future. Crop production in Bangladesh will be negatively affected by climate change due to its location in a delta, being prone to storms surges, sea level rise and flooding hazards (Thomas et al., 2012).

References:

Clark, D., Williams, S., Jahiruddin, M., Parks, K., Salehin, M., 2015. Projections of on-farm salinity in coastal Bangladesh. Evnviron. Sci. Process. Impacts 17, 1127–1136.10.1039/C4EM00682H

Thomas, T.S., Mainuddin, K., Chiang, C., Rahman, A., Haque, A., Islam, N., Quasem, S., Sun, Y., 2012. Agriculture and Adaptation in Bangladesh: Current and Projected Impacts of Climate Change. International Food Policy Research Institute, Washington (accessed July 2015. Available at). http://www.ifpri.org/publication/agriculture-andadaptation-Bangladesh.

Hossain, A., Silva, J.A.T., 2013. Wheat production in Bangladesh: its future in the light of global warming. AoB Plants 5, pls042. http://dx.doi.org/10.1093/aobpla/pls042.

MOA-FAO, 2012. Master Plan for Agricultural Development in the Southern Region of Bangladesh. Ministry of Agriculture (MoA, Government of Bangladesh) and United Nations Food and Agriculture Organization, Dhaka, Bangladesh (122 p). ISBN 978-984-33-7396-0 https://faolex.fao.org/docs/pdf/BGD214472.pdf

United Nations (UN), 2015. Unjted Nations Department of Economic and Social Affairs. World Population Prospects, the 2015 Revision. http://esa.un.org/wpp/unpp/panel population.htm

Hasan, M.N., Hossain, M.S., Bari, M.A., Islam, M.R., 2013. Agricultural Land Availability in Bangladesh. SRDI, Dhaka, Bangladesh (42 pp). ISBN: 978-984-33-6141-7/ https://srdi.portal.gov.bd/sites/default/files/files/srdi.portal.gov.bd/publications/459e2999_b735_4b81_b8b3_e0272e1d1848/Agricultural%20land%20availability%20in%20Bangladesh-monograph-1.pdf

WARPO, 2006. Coastal development strategy. Water Resources Planning Organization. Ministry of Water Resources, Govt. People's Republic of Bangladesh. https://faolex.fao.org/docs/pdf/bgd175355.pdf

PROJECT ACTIVITIES:

'Establishment of Microbiology Laboratory in SRDI'-Part of PARTNER Program, DAE, MoA

Objective: Capacity building of SRDI in Microbiological analysis and activities by establishing Soil Microbiological Laboratory.

Specific objectives:

1. Identification of soil microbial population and their diversity
2. Generating Benchmark database of soil microbes in major soil series of Bangladesh
3. Isolation and identification of effective strains of inoculums
4. Preparation, printing and distribution of soil health cards

Major activities:

(i) Renovation and remodeling for establishing Microbiology Laboratory in SRDI head quarter, Dhaka;

(ii) Procuring and installing machineries/instruments/ equipment

(iii) Arranging survey to collect, prepare and analysis of different series-based soil samples of different AEZs

(iv) Establishing 2 Lath house/Green house for isolation and growth of effective microbial strains

(v) Identification of soil microbial diversity and their population

(vi) Preparing, printing and distributing Soil Health Cards in a limited basis

Outcomes:

- ❑ Soil microbial population and their diversity identified
- ❑ 200 benchmark soil series wise database generated.
- ❑ 1000 Soil health Cards prepared, printed and distributed

Outputs:

- ❑ Laboratory established and functional.
- ❑ Soil series and cropping pattern-based benchmark Microbiology database developed.
- ❑ Polynet/Lath/Green house developed and some field and pot trials established (on the basis of further fund availability).
- ❑ Soil health cards were developed and distributed.

Achievements: (2024-25)

- ❑ Signing MoU with Director General, Department of Agricultural Extension (DAE)
- ❑ Formation of Project Establishment Committee for smooth functioning of the project and arranging meetings accordingly
- ❑ Procuring Field and Laboratory equipment, chemicals, filter papers and culture Media.
- ❑ Five days training on basic microbiological analysis for officers had been done
- ❑ Preparing ToR for recruiting Computer Operator and Laboratory Technician through outsourcing
- ❑ Remodeling of Laboratory rooms for Microbiology laboratory is going on
- ❑ Installation of microbiological instruments completed and soil microbial analysis are going on to some extent.

2.1.2 Land Use Planning Section

Responsibilities

1. Land Use Planning 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 suiTableity for preparation of short and long term agricultural development plans/projects.
3. Interpretation of soil database for location specific crop suiTableity assessment and processing of soil survey data for developing and updating GIS based data bank.

TECHNICAL ACTIVITIES:

- ❑ Compiled and prepared the final draft of the book named **'Land and Soil Statistical Appraisal Book of Bangladesh':**

  This book has been prepared with the objective of providing a comprehensive statistical overview of the country's land resources and soil characteristics. Drawing upon data from national surveys, satellite imagery and administrative records, this publication offers a detailed account of land type classes, soil textural classes, drainage condition, water recession and regional disparities. It aims to serve as a foundational reference for researchers, policymakers, planners, environmentalists, development practitioners and anyone engaged in land management or agricultural development.

- ❑ Participated in different technical training and workshop.

OTHER ACTIVITIES (REPORTING & MONITORING):

(i) **Annual Performance agreement (APA) activities:**

Annual Performance Agreement provides a summary of the most important results that a ministry/division expects to achieve during the financial year. This document contains not only the agreed objectives, but also performance indicators and targets to measure progress in implementing them.

Stages of Annual Performance Agreement (APA):

1. Preparation
2. Work plan for action
3. Signing
4. Implementation
5. Monitoring
6. Reporting
7. Evaluation

Basis of Annual Performance Agreement (APA):

1. Allocation of business
2. 8th five Year plan
3. SDG
4. Mid-term budgetary framework (MBF)
5. Election manifesto
6. Delta plan

Framework of Annual Performance Agreement (APA):
In order to facilitate the formulation of APA, a policy is formulated and software (APAMS) is prepared in the light of the policy. According to the policy the overall performance, preface, sections and attachments are mentioned below-

Section-1: Ministry/Division's Vision, Mission, Strategic Objectives and Functions.
Section-2: Final output/impact of different APA activities.
Section-3: Strategic Objectives, Priorities, Activities, Performance Indicators and Targets.
Annex-1: Abbreviation.
Annex-2: Description of Performance Indicators, Implementing Departments/Agencies and Measurement Methodology.
Annex-3: Dependence on other ministry /division's for achievement of APA target.

Major achievements of SRDI as per APA targets in 2024-25 fiscal year:

1. Field Survey for updating Upazila Nirdeshika: 50 Upazila.
2. Preparation of union sahayika: 160 unions.
3. Soil sample analysis in static laboratory: 33,391 samples.
4. Fertilizer sample analysis: 8,297 samples.
5. Soil sample analysis through MSTL: 6,186 samples.
6. Soil and water sample analysis for salinity monitoring: 1188 samples.
7. Field trial establishment: 88
8. Online fertilizer recommendation system data updating: 50
9. Training on soil sample collection technique and fertilizer application: 9,518
10. Distribution of Fertilizer Recommendation Card: 33,300

(ii) **National Integrity Strategy (NIS) Activities:**
The government of Bangladesh has taken the challenge of combatting corruption seriously as part of its election pledge implementation. Through a process of wide-ranging stakeholder consultations, the Government approved the National Integrity Strategy (NIS) October 2012. NIS has a in comprehensive set of goals, strategies and action plans aimed at increasing the level of independence, accounTableity, efficiency, transparency and effectiveness of the state and non state institutions to improve governance and reduce corruption in a holistic manner.

Monitoring is conducted to measure progress of activities listed in the NIS work plan. The Integrity Focal Point of SRDI collected necessary information and filled out the monitoring sheet on regular basis. He placed the progress in the Ethics Committee meeting. The Ethics Committee members checked the gap between the plan and actual progress and took necessary decision. As part of effective follow-up, progress of NIS implementation and the monitoring results was discussed in the coordination meeting.

(iii) E-governance and Innovation related activities:
Government innovation is a broad term that includes the overall process of initiating new steps, changing existing conditions, and accelerating the development orientation of the government. It can be defined as the effort by a government to find an optimal solution to problems it faces by undergoing a change within itself. Government innovation is a multifaceted process that depends on both internal (organizational culture) and external factors (stakeholder interests).

Monitoring is conducted to measure progress of activities listed in the E-governance and innovation workplan.

(iv) myGov. related activities:

Government's myGov. app is an umbrella for all the government online activities. Monitoring and reporting is conducted to measure progress of activities related to myGov.

OTHER ACTIVITIES (ADMINISTRATIVE WORK):

- ❑ Prepared draft of Perspective plan, 2050 (SRDI part) and submitted to Ministry of Agriculture.
- ❑ Budget management and monitoring:
  Prepared budget proposals, allocation funds to prioritise activities and ensure proper utilization throughout the year.
- ❑ Store management and monitoring:
  Actively involved in managing and monitoring the storage and supply of essential office materials, equipments and documents.

SOME PICTURES:




Photograph: Different activities organized by Land Use Planning Section

2.1.3 Land Evaluation and Soil Correlation Section

1. Function of Land Evaluation & Soil Correlation Section

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

2. Soil Information

1) 15 Physiography
2) 476 Soil Series (453 Soil series and 23 different river alluvium)
3) 50 Soil Monoliths (48 SRDI & 2 BARC)
4) 1178 Correlation Box
5) Recently collected 7 Soil Monoliths

3. Achievements

3.1 Execution of different activities in Soil Museum

- Processing and Preservation of soil monoliths.
- Technical Description and Labeling.
- Display Collected Soil Monoliths in Soil Museum.
- Processing and preservation of soil correlation boxes.
- Display correlation boxes in the Museum.
- Welcome visitors and help them in seeing and learning about the displayed materials in the museum.

3.2 Virtual Soil Museum

- Assistance was given to the Strengthening of Soil Research and Research Facilities Project for building a Virtual Soil Museum.

3.3 Upazila Land and Soil Resource Utilization Guide updating (semi-detailed) survey

Sl	Upazila & district	Assigned Officer	Role of section	Date
1.	Araihazar, Narayanganj	Md. Altaf Hossain, PSO	Technical assistance given	Dec, 2024
2.	Ghior Upazila, Manikganj	Premangshu Majumder, SSO	Co-Surveyor	Dec, 2024

3.4 Project / Program Plans Preparation

Sl.	Title	Year	Contribution
1	Advancing agro-ecological zone (AEZ) monitoring and information system to improve adaptation to climate change and food security in Bangladesh" Project	2024-25	Focal Person Md. Altaf Hossen, PSO
2	"Increase of Soil Fertility and Productivity Through Sustainable Soil and Land Management Technologies" project	2024-25	Contributor Premangshu Majumder, SSO

3.5 Workshop Presentation / Seminar

Sl.	Subject line	Responsibility	**Assigned Officer**	Organizer	Venue
1	Seminar on Citizens Charter	Delivered PPT presentation arranged by the authority	Md. Altaf Hossen, PSO	SRDI	SRDI, HQ, Dhaka

3.6 Miscellaneous

Sl	Work / Task / Program of action	Assigned Officer
1	Assistance with viewing and understanding the museum's exhibits provided to guests.	Md. Altaf Hossen, PSO
2	Assistance was given to 125 revenue post-recruitment	Premangshu Majumder, SSO

3.7 Rendered Services in Different Committees

Sl	**Work / Task / Program of action**	**Responsibility**
1	**SDGs related activities** Arranged meetings, stakeholders' meetings, workshops, lectures in training classes, attended meetings arranged by MoA and other allied departments.	Focal point officer (PSO)
2	**Citizen's Charter-related activities** Played a role in implementing and updating and monitoring of Citizen's Charter of the institute. Arranged quarterly meetings, stakeholders' meetings,	Focal point officer (PSO); Alternative Focal point officer (SSO)

	learning sessions, monitoring activities, and reporting to the Ministry of Agriculture and attended meetings arranged by MoA and other allied departments.	
3	Market price assessment committee	Market price assessment committee
4	Procurement and e-GP related committee	Chairman (PSO)
5	Innovation committee	Member (SSO)
6	E-governance committee	Member (SSO)
7	Web portal update related focal person	SSO
8	Web mail update related focal person	SSO
9	D-nothi related focal person	SSO
10	Social media related committee	Convener (PSO), Member Secretary (SSO)
11	RMS Software admin	SSO

4. Future program

4.1 Study on parent materials of Barind Tract, Madhupur Tract, Akhaura Terrace and Lalmai Hills to correlate the soils.

Physiography	Soils
Lalmai Hills	Khadimnagar, Lalmai, Salban and Kotbari
Akhaura Terrace	Pattan, Nidarabad, Sibna, Simrail and Rupa
Barind Tract	Kashimpur, Belabo, Tejgaon, Amnura, Nijhuri, Lauta, Gulta
Madhupur Tract	Kashimpur, Belabo, Tejgaon, Noadda, Chandra and Kalma

4.2 Renovation of Soil Museum in the new building.

4.3 Facilitating a Virtual Soil Museum Corner in Soil Museum

Activities in photography

Photograph: Citizens Charter related activities

Photograph: Ghior upazila updating survey

2.2 Training & Communication Division

2.2.1 Human Resource Management section (HRD)

The functions of Human Resource Development Section are planning and organizing of in-service training for SRDI officers and staff. Imparting training on soil management issues to technical officers and field staff of DAE, BARI, BRRI, BJRI BINA, BMDA, BADC and NGOs is the vital responsibility of the section. This section works on preparation and collection of training materials in terms of course syllabus such as audio-visual materials, soil monoliths. etc. The HRD section also works on the arrangement of theoretical and practical training for the students of different education institutions (e.g. BAU, DU, BSMRAU, SAU, KU, CU etc.) Research Centers & Academies, GO & NGOs on soil survey, soil classification and aerial photo interpretation, GPS, Upazila Nirdeshika as per their requirements and request. Arrangement of departmental training of newly recruited officers is another work of this section.

ACTIVITIES PURSUING THROUGH HRD SECTION

1. Arranging nomination for local and foreign training on fund availability and as per directives of the Ministries or other funding organizations or sponsors.
2. Arranging nomination for higher studies on fund availability & demand within the country & abroad.
3. Nomination for training on different subjects and topics by the sponsoring/ executing agencies (Like BPATC, RPATC, BARD, BARC, Planning & Development academy, AIS, DAE, NATA etc.) and Ministries.
4. Arrangement of Seminar/ symposium / workshop/conference etc. on different subjects on requirement basis.
5. Arrangement of theoretical and practical training for the student of different educational institutions (Like BAU, DU, BSMRAU, SAU, KU, CU etc.), Research Centers & Academies, GO & NGO's on soil survey, soil classification and aerial photo interpretation, Upazila Nirdeshika as per their requirements and request.
6. Arrange departmental training of newly recruited officers (as & when required).
7. Collection and compilation of radio and television talk and sent to concern offices.
8. Provide technical & administrative support to the authorities.
9. Searching scope for providing training on Soil survey and classification, analytical methodology etc. to different organizations in country and abroad.
10. As per direction of PSO, HRD Section of SRDI prepared In-house Training Plan for 2024-25
11. Sending Monthly progress on this plan summarizing that of all the field and regional offices including HQ and laboratories has been sending on cumulative achievement basis.

10-20 Grade Training Achievement (2024-25)

Grade	No. of Officers & Staffs	Target Per person hr*/day	Total	Achieved (up to June,25)	% of Achievement against target (up to June,25)
10-12	10	50	500	500	90
13-17	52	50	2,600	2,600	90
18-20	60	50	3,000	3,000	90
A 3-day Sanjeevani training was held for 75 officers/employees of grades 10-20.					

Higher Education

Sl.	Degree	No. of Officers					Remark
		Ongoing	Obtained Scholarship	Received permission	Requested for permission	Completed	
1.	PhD	3	3	3	-	-	-

Workshop and seminar attended by officers

Sl.	Topics	No.	Duration (Days)	Institute
1	Departmental Training (1st Batch)-ASW	25	1 Month	Soil Resource Development Institute, Dhaka
2	Departmental Training-FSW	23	1 Month	Soil Resource Development Institute, Dhaka
3	Departmental Training (2nd Batch)-ASW	31	1 Month	Soil Resource Development Institute, Dhaka
4	Annual Workshop-2025 (FSW)	350	1	Soil Resource Development Institute, Dhaka
5	Annual Workshop-2025 (ASW)	350	1	Soil Resource Development Institute, Dhaka
6	Human Resource Management	2	3	BARC
7	Training on “project Monitoring and Evaluation”	4	5	BARC
8	Training on OMS	2	2	MOPA
9	Expert Consolation Meeting on UNCCD Reporting	5	1	UNCCD
10	Departmental Training (1st Batch)-FSW	29	2 Month	Soil Resource Development Institute, Dhaka
11	Training on Enhancing Digital Government & Economy (EDGE)	12	5	MOIND
12	Training on Climate Change, Carbon Sequestration and Adaptation Strategies.	2	3	BARC
13	Training on The Art of Presentation Tools & Techniques	1	3	BARC
14	Awareness training on ISO 9001:2015 & ISO 45001:2018	1	5	BARC
15	Training on Remote Sensing (RS) & Geographic Information System (GIS)	2	5	BARC

16	Training on Food-based nutrition	4	5	BIRTAN
17	Training on Machine Learning Technique in Agriculture	2	5	BARC
18	Training on "Project Monitoring & Evaluation	3	5	BARC
19	Training of Trainer (ToT) on Agricultural Practices (GAP) for safe Fruits and Vegetables Production	1	5	BARC
20	Training of Validation	4	1	NATA
21	Basic training	17	120	NATA
22	Training on Public Private Partnership (PPP)	2	3	BARC
23	Training on "Training on Leadership in Agricultural Research and Development	3	5	BARC

OTHER ACTIVITIES DONE BY HUMAN RESOURCE DEVELOPMENT SECTION

- Preparing DPP and all corresponding works of the projects submitted to MoA
- Website update and maintenance
- Successful implementation of D-Nothi Program
- APA & SDG Action Plan Activities
- Preparing different Reports, Booklets, Directory etc.
- Innovation activities of SRDI
- Execution of PM's commitment
- Various activities in association with a2i
- Procurement work of SRDI
- Organogram, recruitment rules, different cases etc.

Workplan: 2024-2025

1. Training for capacity building of officers and staff with relation to 4IR.
2. GIS related Training for officers.
3. Training will be Arrange on advanced techniques of Laboratory analysis.
4. Workshop/Training will be Arrange according to Government policy/demand.
5. Fundamental Training on newly appointed officers.
6. Training on Nirdeshika writing and Map preparation.
7. Training on Capacity building of all officers.
8. Training on Capacity Building of all Staff.

2.2.2 Data Processing and Statistical and Information and Communication (DPS & ICT) 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
   - Maps/scan copies requested by various offices of SRDI have been printed and supplied.
   - 25 internet connections have been provided in the GIS Lab.

2. **ICT related**

   Server & LAN management
   - Proper monitoring, maintenance and troubleshooting of the server and internet related devices (server, router, bandwidth controller, switch etc.) of SRDI.
   - Information on 14 customized software applications has been provided to the Ministry of Agriculture.
   - At present there are 150 internet connections in SRDI head office.

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

3. **Others Technical Support**

a. **Updating of Online fertilizer Recommendation Software (OFRS)**
   - Soil Organic matter status of 30 AEZ in 2005 & 2024 under different land type has been provided as demand of Agriculture ministry.

b. **Technical Assistance for BBS**
   - Data has been provided for the preparation of the 'Time Series Environmental Spreadsheet' under the 'ECDS Project' being implemented by the Bangladesh Bureau of Statistics (BBS).

c. **UpazilaNirdeshika Survey**
   - Baliakandi Upazila Nirdeshika updating survey has been done and draft soil map has been prepared.

d. Hardware maintenance and troubleshooting for different computer of SRDI head office.

e. Technical assistance and necessary support provided to prepare different on demand report for MoA, BARC and others.

f. Involved in the innovation activities of SRDI.

g. Technical assistance provided to the students, scientists other visitors for research purpose.

Map Preparation & Printing

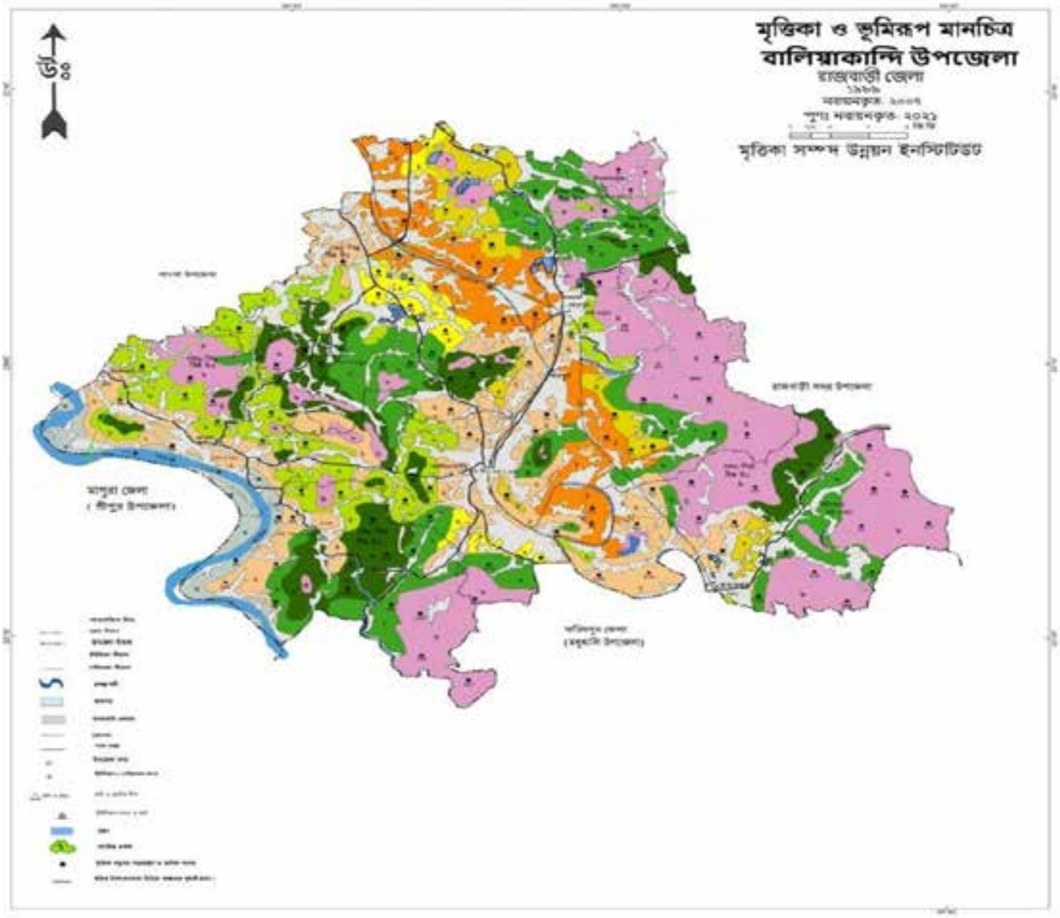


Fig 2.4: Baliakandi Mouza Map

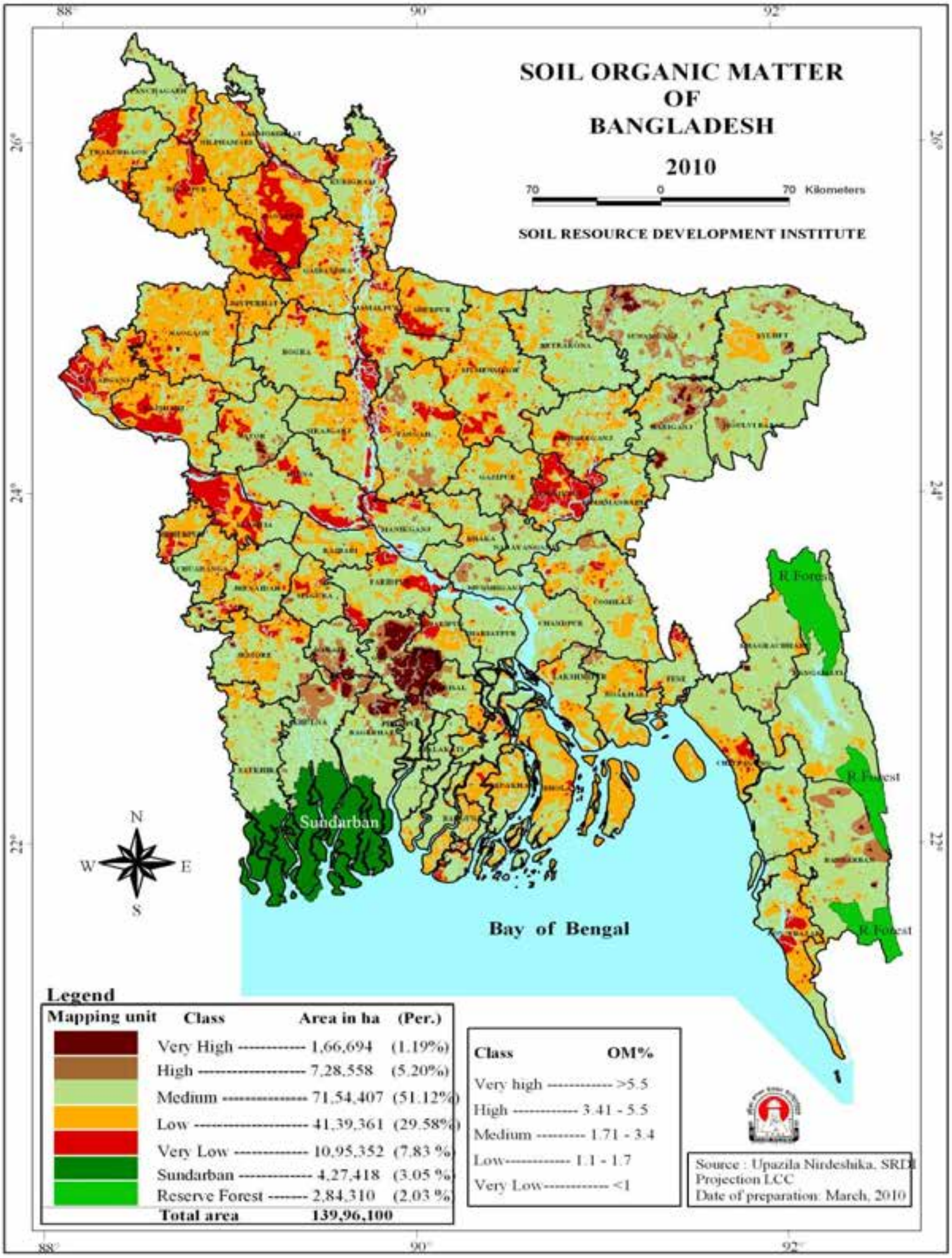


Fig 2.5: Soil Organic Matter Map of Bangladesh

Fig 2.6: Data Processing & Uploading for OFRS

Fig 2.7: Find Out Fertilizer Recommendation Result

সার সুপারিশ কার্ড

জেলা: বগুড়া, **উপজেলা:** গাবতলী, **ইউনিয়ন:** গাবতলী

ভূমি শ্রেণী: মাঝারি উঁচু জমি (মাঝারি উঁচু জমি), **মাটির ধরন:** পলি মাটি

কৃষক: প্রযোজ্য নয়, **গ্রাম**: প্রযোজ্য নয়

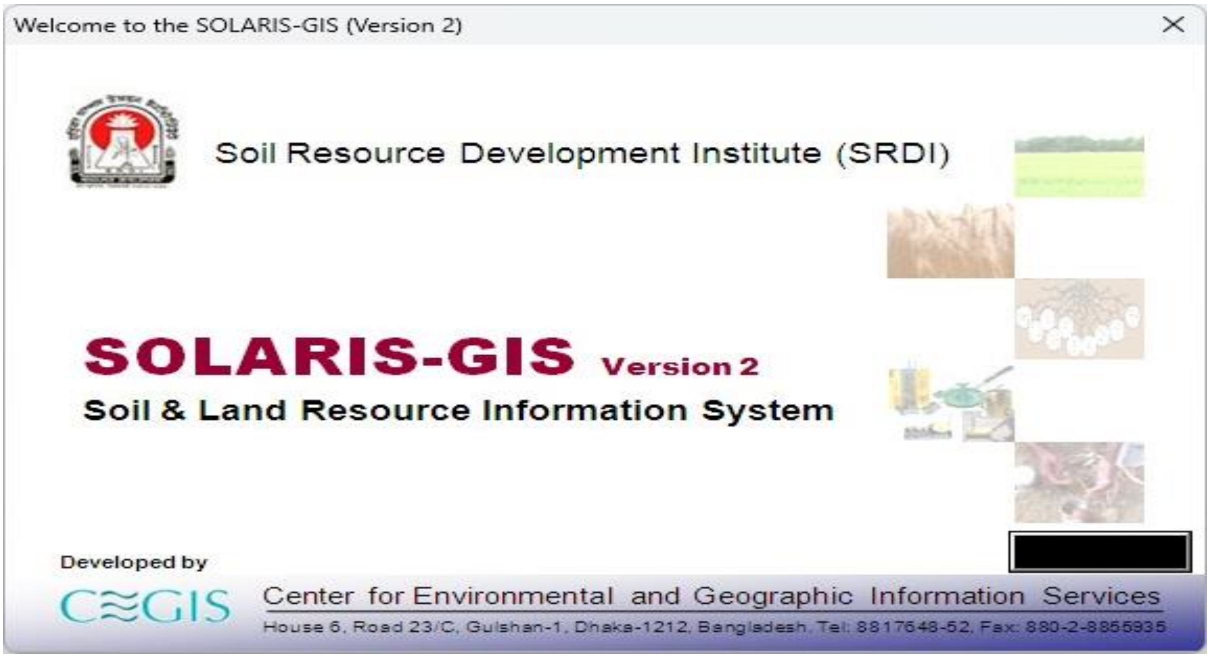
ফসল: আউশ রোপা (বি আর-৬, বি আর-৭, বি আর-২৪, ব্রি ধান-৬৫, ব্রি ধান-৪২, ৪৩)

ক্রমিক	পুষ্টি উপাদান	সার	ফলাফল(৩০ শতাংশ'র জন্য)	সার প্রয়োগ পদ্ধতি
১	নাইট্রোজেন	ইউরিয়া (যদি ডি এ পি ব্যবহার না করা হয়)	২০ কেজি ৪২৭ গ্রাম	১ম কিস্তি- চারা রোপনের ১০-১৫ দিন পর, ২য় কিস্তি- কুশি গজানোর সময়, ৩য় কিস্তি- কাইচ থোড় আসার ৫-৭ দিন পূর্বে ছিটিয়ে দিতে হবে।
		অথবা		
		ইউরিয়া (যদি ডিএপি ব্যবহার করা হয়)	১৯ কেজি ৯৫৩ গ্রাম	১ম কিস্তি- চারা রোপনের ১০-১৫ দিন পর, ২য় কিস্তি- কুশি গজানোর সময়, ৩য় কিস্তি- কাইচ থোড় আসার ৫-৭ দিন পূর্বে ছিটিয়ে দিতে হবে।
২	ফসফরাস	টিএসপি	১ কেজি ২১৫ গ্রাম	জমি তৈরির সময় এক সাথে প্রয়োগ করতে হবে
		অথবা		
		ডিএপি	১ কেজি ২১৫ গ্রাম	জমি তৈরির সময় এক সাথে প্রয়োগ করতে হবে
৩	পটাশিয়াম	এমওপি	১ কেজি ৮২২ গ্রাম	জমি তৈরির সময় এক সাথে প্রয়োগ করতে হবে
৪	গন্ধক	জিপসাম	৫ কেজি ৪০২ গ্রাম	জমি তৈরির সময় এক সাথে প্রয়োগ করতে হবে
৫	দস্তা	জিংক সালফেট (হেপ্টা)	প্রয়োজন নেই	
		অথবা		
		জিংক সালফেট(মনো)	প্রয়োজন নেই	
৬	বোরণ	বরিক এসিড	প্রয়োজন নেই	
		অথবা		
		সলুবর	প্রয়োজন নেই	
৭	গোবর/জৈব পদার্থ	গোবর/কম্পোষ্ট	প্রয়োজন মত	জমি তৈরির সময় এক সাথে প্রয়োগ করতে হবে

উৎসঃ সংশ্লিষ্ট উপজেলা নির্দেশিকা (মৃত্তিকা সম্পদ উন্নয়ন ইনস্টিটিউট)

বিস্তারিত জানার জন্যঃ www.frs-bd.gov.bd অথবা www.srdi.gov.bd ওয়েবসাইটে ক্লিক করুন। কার্ডটি যত্নসহকারে সংরক্ষণ করুন। এটি হারিয়ে গেলে আপনার এলাকার উপ-সহকারি কৃষি কর্মকর্তা বা মৃত্তিকা সম্পদ উন্নয়ন ইনস্টিটিউটের নিকটস্থ জেলা অফিস অথবা গবেষণাগারের সাথে যোগাযোগ করুন।

Fig 2.8: Fertilizer Recommendation Card



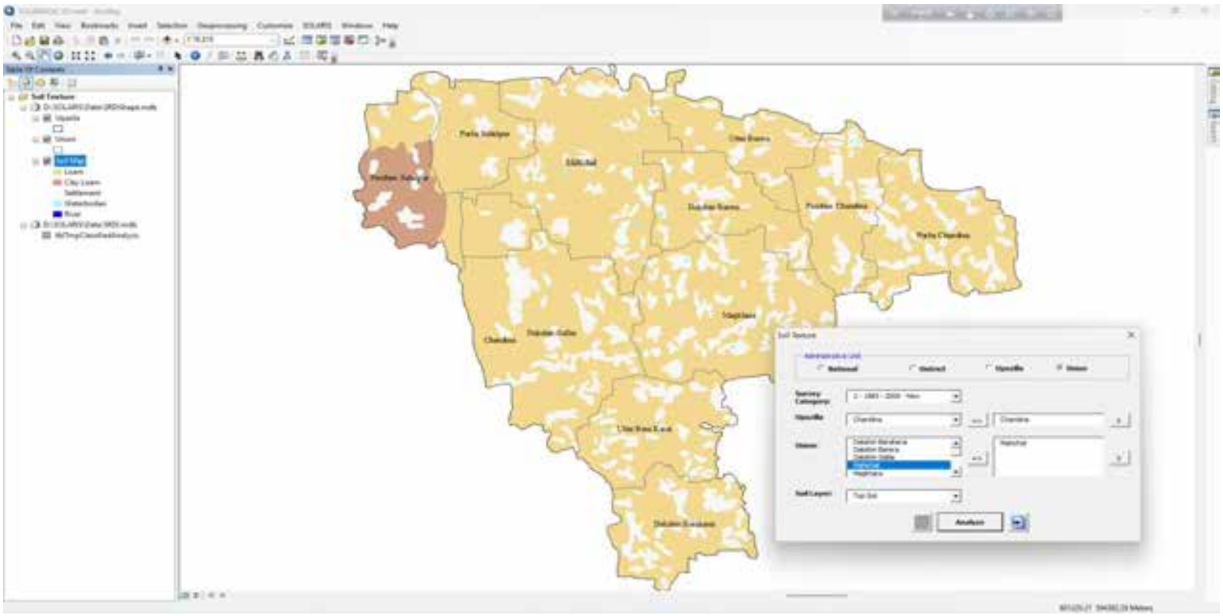


Fig 2.9-10: Updating of SOLARIS Software

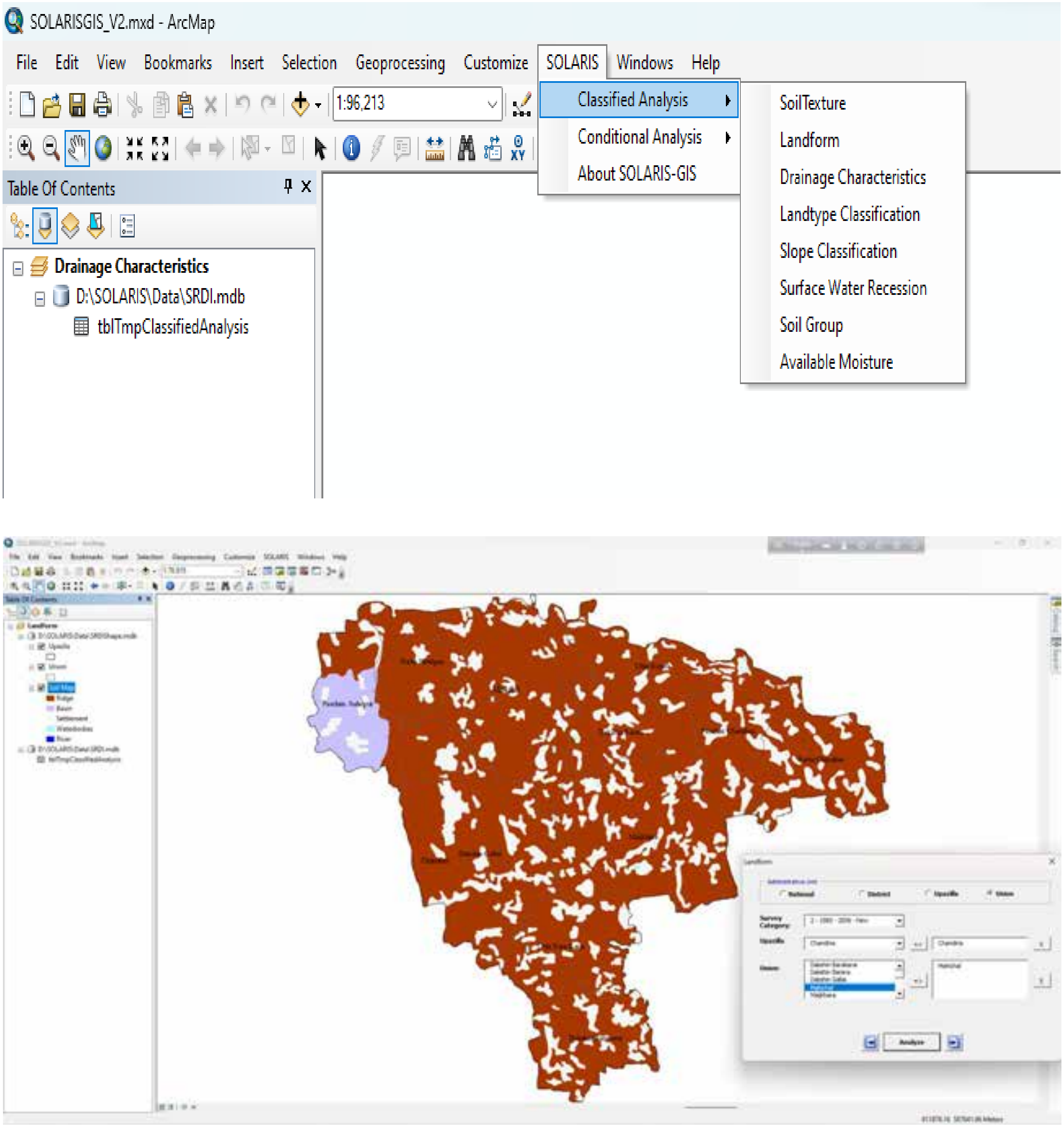


Fig 2.11-12: Updating of SOLARIS Software

2.2.3 Cartography Section

1. **Map Digitizing:**

Name of map	Name of Upazila	Map Scale	No.s
A) Soil and Land type Map	Sayestaganj, Sandwip, Patgram, Gangachara, Lalmai, Matlab(south), Titas, Pirgacha, Pakundia, Guimara, Domar, Gopalpur, Bakerganj, Chakoria, Shahzadpur, Barishal Sadar	1:50000	16
B) Mouza Wise Upazila Map	Sayestaganj, Sandwip, Patgram, Gangachara, Lalmai, Matlab(south), Titas, Pirgacha, Pakundia, Guimara, Domar, Gopalpur, Bakerganj, Chakoria, Shahzadpur, Barishal Sadar		16
C) Union Map	Various union Map		10
D) Union Mauza Map	Sayestaganj, Sandwip, Patgram, Gangachara, Lalmai, Matlab(south), Titas, Pirgacha, Pakundia, Guimara, Domar, Gopalpur, Bakerganj, Chakoria, Shahzadpur, Barishal Sadar		16
E) Physiography Map of Upazila	Various Upzaila Map		10
F) Location Map	Sayestaganj, Sandwip, Patgram, Gangachara, Lalmai, Matlab(south), Titas, Pirgacha, Pakundia, Guimara, Domar, Gopalpur, Bakerganj, Chakoria, Shahzadpur, Barishal Sadar	1:10,00000	16
G) Others Map	Various Bangladesh Map	1:10,00000	3

2. **Map Drafting:**

Name of map	Upazila Name	Map Scale	Nos.
a) Soil and Land type Map	Sayestaganj, Sandwip, Patgram, Gangachara, Lalmai, Matlab(south), Titas, Pirgacha, Pakundia, Guimara, Domar, Gopalpur, Bakerganj, Chakoria, Shahzadpur, Barishal Sadar	1:50,000	16

3. **Map Checking & Correction:**

Name of map	Upazila/ Union	Map Scale	Nos.
Various Map	Various Upazila Map	1:50000	25
	Various Union Map	1:50000	10

4. **Map Printing:**

Name of map	Upazila/ Union	Map Scale	Nos.
Soil and Land form Map	Various Upazila and Union Map	1:50000	35

5. **Area Calculation:**

Name of map	Upazila Name	Map Scale	Nos.
a) Soil and Land type Map	Various Upazila And Union Map	1:50000	26

6. **Provide Cartographic Support to the SRDI activities, beneficiary Organization, Research Institute and Universities.**

Work Plan for 2025-2026

1. Collection of new base material as per demand of SRDI.
2. Ensure Cartographic Support as per demand of various section and divisions of SRDI.
3. Collaborating Work with SOB, LGED, BBS, and SPARRSO will be increase.

2.2.4 Publication and record section

Publication and Record Section of the Training and Communication 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.

Radio Talk

- A good number of officers participated at Radio talk in different agricultural aspects at Bangladesh Betar.
- Publication and Record Section communicated with Bangladesh Betar and proposed names of officers with titles of radio talk to be telecasted in collaboration with AIS.

Achievements (2024-2025):

- **Sale of publications:** Upazila Nirdeshika 03 copies
- **Collections:** Book/Journal/Report 40 copies

a) Prepare Proposal of Nomination for

- Independent Award
- Ekushe Award
- UN Public Service Award
- Begum Rokeya Award etc.

b) Prepare Proposal of Nomination for Betar Kothika

c) Distribution: Poster 126 copies

d) Reader Services: Provided library services for 160 readers.

Work plan: 2025-2026

- Procurements of Books, Journal, Magazines etc.
- Publish Poster, Booklet and Leaflet.
- Publish Annual Report
- Publish Mrittika Katha
- Publish Leaflet, Calendar, Notebook, Diary etc.
- Selling of SRDI publication.
- Collection of Book/ Annual Report /Journal.
- Printing of Upazila Nirdeshika, Union Shohayeka & RSS Report.
- Distribution of Upazila Nirdeshika, Union Shohayika, Poster, Booklet, Leaflet etc.
- Assisting authority as required.

2.3 Upazila Nirdeshika Cell

Four hundred and thirty reports of Upazila Nirdeshikas have been updated till June 2025 with a series of coordinated efforts such as semi-detailed soil survey for updating of relevant maps, collection of land quality and soil characteristics data, soil sample collection for laboratory analysis followed by report writing with the processing of relevant updated data generated during field survey and laboratory analysis. SRDI scientists engaged in district offices usually conduct the soil survey and prepare draft report for respective surveyed Upazila. Editing of the report is done initially by divisional head (Chief Scientific Officer) who supervise survey based soil mapping and finally by the editorial board acting particularly as the approval authority of Upazila Nirdeshika publication. The activities involved in the Upazila Nirdeshika updating system can be expressed as a flow-chart (Figure 1).

The entire activity is coordinated by Upazila Nirdeshika Cell of SRDI Head Office, 50 updated Nirdeshika has been published during the period of 2024-2025 under revenue budget of SRDI (Table 1).

Table 2.1. List of updated Land and Soil Utilization Guide (Upazila Nirdeshika) Published During the financial year 2024-2025

SL. No.	Name of Upazila of Updated Nirdeshika	Name of Respective District	Responsible office for editing and printing Upazila Nirdeshika
1	Itna	Kishoreganj	Divisional Office, SRDI, Dhaka.
2	Tarail	Kishoreganj	
3	Kendua	Netrokona	
4	Sherpur Sadar	Sherpur	
5	Motherganj	Jamalpur	
6	Sreenagar	Munshiganj	
7	Islampur	Jamalpur	
8	Keraniganj	Dhaka	
9	Ajmiriganj	Habiganj	Divisional Office, SRDI, Sylhet.
10	Dharmapasha	Sunamganj	
11	Mymensingh Sadar	Mymensingh	
12	Muktagacha	Mymensingh	
13	Fulgazi	Feni	
14	Nabinagar	Brahmanbaria	
15	Nachol	Chapainawabganj	Divisional Office, SRDI, Rajshahi.
16	Bhangura	Pabna	
17	Manda	Naogaon	
18	Niamotpur	Naogaon	
19	Paba	Rajshahi	
20	Pabna Sadar	Pabna	
21	Fatikchari	Chattogram	
22	Juraichari	Rangamati	
23	Belaichari	Rangamati	
24	Shayestaganj	Hobiganj	
25	Rowmari	Kurigram	Divisional Office, SRDI, Rangpur.
26	Domar	Nilphamari	
27	Dimla	Nilphamari	
28	Chilmari	Kurigram	
29	Gangachara	Rangpur	
30	Sandwip	Chattogram	Divisional Office, SRDI, Chattogram.
31	Barkal	Rangamati	

SL. No.	Name of Upazila of Updated Nirdeshika	Name of Respective District	Responsible office for editing and printing Upazila Nirdeshika
32	Baghaichari	Rangamati	
33	Matiranga	Khagrachari	
34	Matlab South	Chandpur	
35	Dighinala	Khagrachari	
36	Barishal Sadar	Barishal	Divisional Office, SRDI, Barishal.
37	Nesarabad	Pirojpur	
38	Teknaf	Cox's Bazar	
39	Lama	Bandarban	
40	Lalmai	Cumilla	
41	Laxmichhari	Khagrachari	
42	Haimchar	Chandpur	Divisional Office, SRDI, Khulna
43	Gangni	Meherpur	
44	Potuakhali Sadar	Potuakhali	
45	Babuganj	Barishal	
46	Sadarpur	Faridpur	
47	Baliakandi	Rajbari	
48	Ruma	Bandarban	
49	Senbag	Noakhali	
50	Guimara	Khagrachari	

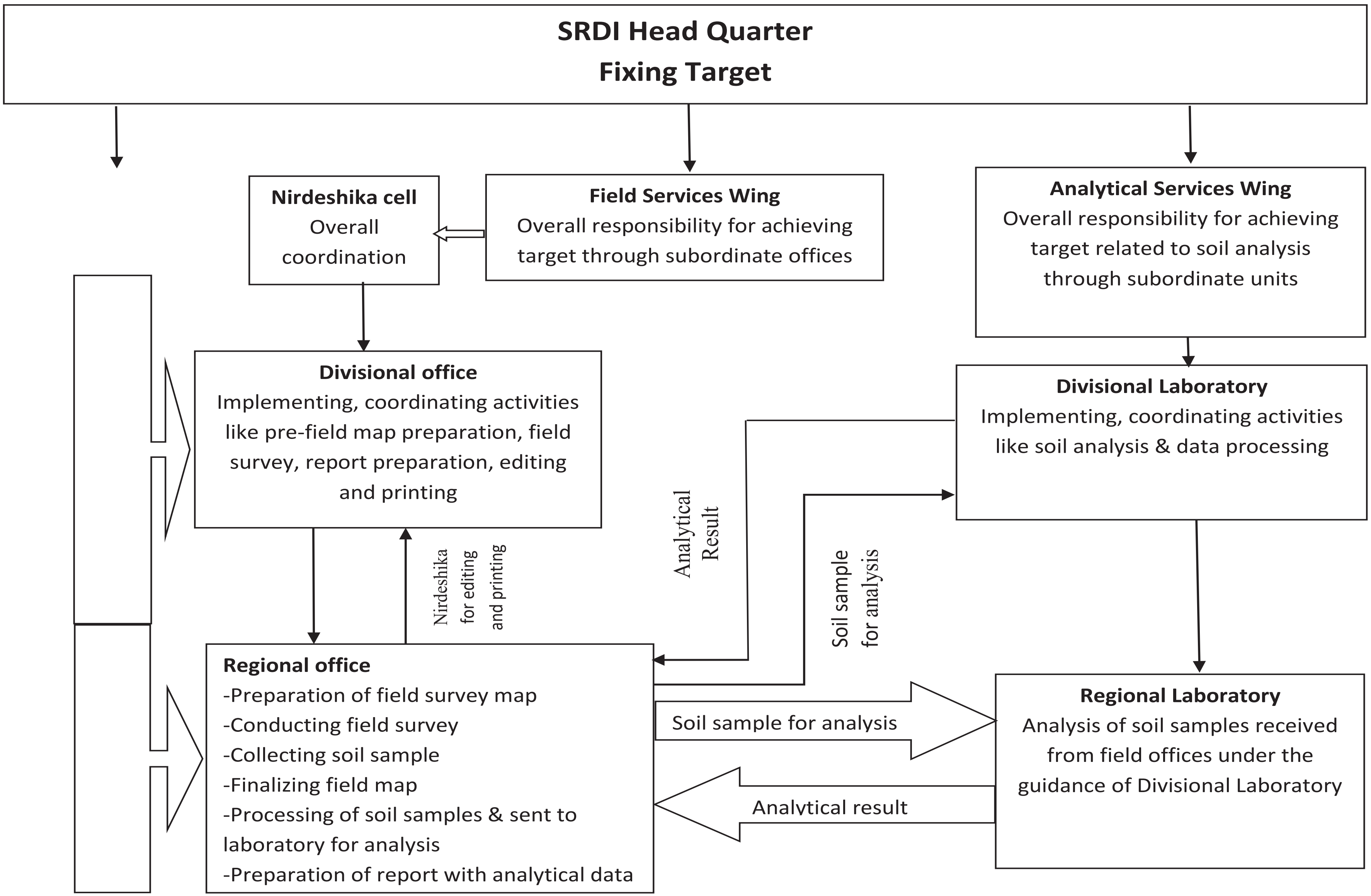


Figure 2.13: Flow chart of Nirdeshika Preparation

Chapter 3: Activities of Field Offices

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

Introduction

Upazila Land and soil Resource Utilization Guide (Upazila Nirdeshika) developed through semi detailed soil survey is one of the basic tools used for local agricultural planning. Commencing from 1986, first round publication of all the 459 Upazila Nirdeshika was completed by June 2002. Following that updating programme of Upazila Nirdeshika has been taken and continued. The guide broadly comprises land and soil characteristics, land use, hydrological and agro climatic, soil fertility and agricultural constraints and potentialities of the concerned Upazila. As our agricultural lands are decreasing due to urbanization, industrialization and construction of new settlements, the need for planning and execution updating the Nirdeshika programme has arisen. As a result, SRDI carrying out a programme to update previous data for developing realistic agricultural planning. Other than resource-based planning tools, the Nirdeshika also guides the user to make fertilizer recommendations for crops. To mitigate upcoming challenges in agriculture, rational use of soil and land resources is of prime importance. Therefore, the programme has been launched with the following objectives.

Objectives

- To update the land, soil and land use database for local level agricultural development planning.
- To update the soil fertility database, which eventually makes the backbone of balanced fertilizer application.
- To accommodate the changes due to infrastructure developments (roads, homestead, embankments etc.), which gives insights into the availability of lands for agriculture.

Methodology

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

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

Ground truthing was done through validating mapping unit, land, soil information following regular traverse and grid as required by semi-detailed survey.

Soils were examined as often as necessary along traverse lines. In general, for each 200 hectares of land, one composite soil sample was collected. The sampling intensity was increased as and when necessary, according to the complexity of the mapping unit.

Composite soil samples are collected from adjacent to or possibly nearer points of previous sampling sites with GPS reading so as to compare time-interval changes of nutrient status due to intensive cultivation.

Mini pits were opened and described as and when necessary. Soil samples were also taken in correlation boxes (if necessary) from identified Mrittika Dal for us as reference for soil correlation. During soil sample collection, information on inundation depth, cropping pattern, constraints for agricultural development etc. were collected through condensation with farmers. Recently, digging atleast one full-scale “Master Pit” of a representative soil and soil profile description and collection of samples for organic carbon assessment, have been sandwitched into the Upazila Nirdeshika Updating Programme, where adequate facilities can be assured.

Collected composite soil samples were analyzed in the laboratory and updated Upazila Nirdeshika was prepared through assembling field information and laboratory data.

Table 3.1: Progress of Upazila Nirdeshika Updating

Name of the Regional office	Field survey		Map finalization		Draft report preparation		Final report preparation	
	Target	Achievement	Target	Achievement	Target	Achievement	Target	Achievement
Divisional Office, Barishal								
Barisal	Jalakathi Sadar	Completed	Barisal Sadar	Completed	Rajapur	In process	Barisal Sadar	Printing
	Barguna Sadar	Completed	-	-	-	-	Teknaf	Completed
Patuakhali	Amtali	Completed	Mirzaganj	In process	Bauphal	In process	Patuakhali sadar	In process
	Bamna	Completed	Dashmina	In process	-	-	-	-
Bhola	-	-	-	-	Tozumuddin	In process	-	-
Divisional Office, Chattogram								
Brahmanbaria	Kachua	Completed	Nabinagar	Completed	Nabinagar	Completed	Nabinagar	Completed
	Bijoynagar	Completed	sandwip	Completed	sandwip	Completed	sandwip	Completed
Chattogram	Chandanaish	Completed						
Cumilla	Burichong	Completed	Itna	Completed	Borkol	on-going	Itna	Editing
	Daudkandi	Completed	Borkol	Completed				
Rangamati	Rangamati Sadar	Completed	Lakshmichari	Completed	Lakshmichari	Sent to Divsional Office Barishal	Panchhari	Completed
			Baghaichhari	Completed	Baghaichari	Sent to Divsional Office Chattogram	Baghaichari	Baghaichari
Divisional Office, Dhaka								
Dhaka	Ghior	Completed	Keraniganj	Completed	Keraniganj	Completed	Keraniganj	Completed
Faridpur	Shaltha	Completed	Goalondo	Completed	Kompanigonj	Completed	Bilaichari	Completed
Jamalpur	Bakshiganj	Completed	Sherpur Sadar	Completed	Nakla	Completed	Sherpur Sadar	Completed
			Joraichari	Completed	-	-	Joraichari	Completed
			-		-	-	Vedarganj	Completed

Madaripur	Dasar	Completed	Nesarabad	Completed	Nesarabad	Completed	Nesarabad	Completed
Munshiganj	Araihazar	Completed	Sreenagar	Completed	Sreenagar	Completed	Sreenagar	Completed
Mymensingh	Tarakanda	Completed	Iswarganj	Completed	Gauripur	Going on	Mymensingh Sadar	Completed
	Charbhadrasan	Completed	Nalitabari	Completed	-	-	Muktagacha	Completed
Netrokona	Polash	Completed	Palash	Completed	Raujan	Completed	Raujan	Completed
	Bishwanath	Completed	Chakaria	Completed	Mirsharai	Completed	Mirsharai	Completed
	Chakaria	Completed	Biswanath	Completed	-	-	-	-
Tangail	Tangail Sadar	Completed	Shakhipur	Completed	Basail	Completed	Mirzapur	Completed
			Melandaha	Completed	Ghatail	Completed	Delduar	Completed
Divisional Office, Khulna								
Jashore	Jhikargacha	Completed	Sadarpur	Completed	Ramgati	Completed	Sadarpur	Completed
		-	Ramgati	Completed	-	-	-	-
Jhenaidah	Jhenaidah Sadar	Completed	Baliakandi	Completed	Baliakandi	Completed	Baliakandi	Completed
	Magura Sadar	Completed	-	-	-	-	-	-
	Bashkhali	Completed	-	-	-	-	-	-
Khulna	Terokhada	Completed	Rupsa	Completed	Fakirhat	Completed	Rupsa	Completed
	Bagerhat Sadar	Completed	Fakirhat	Completed	-	-	-	-
	Mollahat	Completed	Terokhada	Completed	-	-	-	-
	Satkhira Sadar	Completed	Bagerhat Sadar	Completed	-	-	-	-
	-	-	Mollahat	Completed	-	-	-	-
	-	-	Satkhira Sadar	Completed	-	-	-	-
Kushtia	Khoksa	Completed	Gangni	Completed	Pangsha	Completed	Gangni	Completed
Satkhira	-	-	Babugonj	Completed	Bhandaria	Completed	Babugonj	Completed
Divisional Office, Rajshahi								
Bogura	Khetlal,	Completed	Sherpur	Completed	Kahalu	On Going	Gangachora	On Going
Chapainawabganj	Haripur	Completed	Haripur	Completed	Chapainawabganj Sadar	On Going	Nachole, Paba	Completed
Naogaon	Kishorganj	Completed	Kishorganj	Completed	Naogaon sadar, Badalgachi	On Going	Fatikchori	Completed
Pabna	Veramara	Completed	Bera	Completed	Bera	On Going	Pabna Sadar	Completed

Rajshahi	Ghoraghat	Completed	Ghoraghat	Completed	Patnitola	On Going	Manda, Niamotpur	Completed
Sirajganj	Sadar	Completed	Ghatail	Completed	-	-	Islampur Kendua	Completed
Divisional Office, Rajshahi								
Dinajpur	Kaharole	Kaharole	Kaharole	Kaharole	Dinajpur Sadar	On going	Domar	11.02.2025
	Bochaganj	Bochaganj	Bochaganj	Bochaganj	Nawabganj	On going		
Gaibandha	Sadullahpur	Completed	Gangachara	Completed	Gangachara	Completed	Gangachara	Completed
Lalmonirhat	Kurigram Sadar	Completed	Ruma	Completed	Ruma	Completed	Ruma	Completed
	Kaunia	Completed	-	-	-	-	-	-
	Nilphamari Sadar	Completed	-	-	-	-	-	-
Rangpur	Badarganj	Completed	Dimla	Completed	Saidpur	On-going	Dimla	Completed
Thakurgaon	Baliadangi	Completed	Roumari	Completed	Thakurgaon Sadar	Completed	Roumari	Completed
Divisional Office, Sylhet								
Moulvibazar	Habiganj Sadar	Completed	Habiganj Sadar	Completed	Sreemangal	Sreemangal	-	-
	-	-	-	-	Moulvibazar Sadar	Moulvibazar Sadar	-	-
Sunamganj	Modhynagar	Completed	Modhynagar	Completed	-	-	-	-
Sylhet	Kanaighat	Completed	Kanaighat	Completed	Companiganj	Companiganj	-	-
	Bishwanath	Completed	Bishwanath	Completed	zokigonj	zokigonj	-	-

Findings of Selective Upazila under Field Service Wing

3.1.1 Major findings of Amtali Upazila, Barguna

i) Total area-29,697 ha
ii)Total sample colleted-107
iii)Physiography & AEZ code- Ganges Tidal Floodplain (13)
iv)Major land type- Medium Highland
v)Major soil group- Ramgati, Jhalakati, Barishal and Polymati
vi) Major land use- RC-F-TA

Table-3.2: Changes in Land Type of Amtali Upazila, Barguna (for floodplain, piedmont and terrace area)

Land type	Previous (2015)		Present (2025)		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Highland	494	1.7	519	1.7	-	Cultivable land (MHL) converted into homestead area
Medium highland	21,525	72.5	20,924	70.5	-2.0	
Medium lowland	-	-	904	3.1	+3.1	Land type converted due to change in flooding depth
Lowland	-	-	-	-	-	-
Miscellaneous	7,678	25.8	7,350	24.7	-1.1	Riverbank erosion
Total	29,697	100	29,697	100	-	

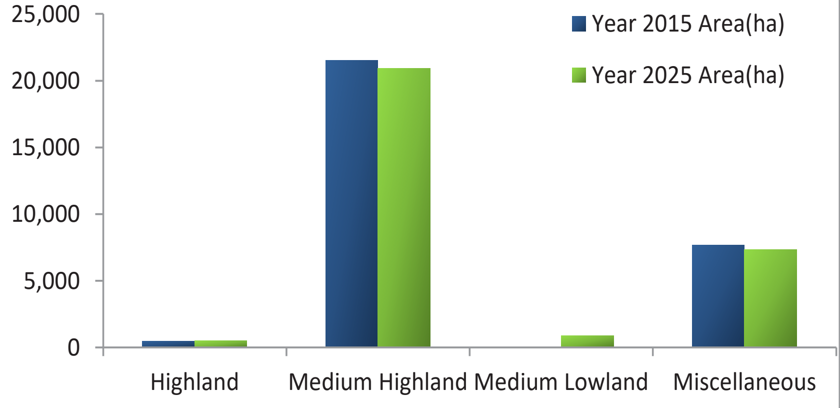


Fig 3.1: Changes in Land Type of Amtali Upazila, Barishal

Table-3.3: Changes in Land Use in different Land type of Amtali Upazila, Barguna

Land use	Previous (2015)		Present (2025)		% increase/ Decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Rc-T.Aus- TA	10,441	35.1	7,997	27.0	-8.1	Aus production has declined due to cost and uneven seasonal rain
RC-F-TA	7,975	26.9	8,529	28.7	+1.8	
F-TA-TA	1,679	5.7	-	-	-5.7	
F-F-TA	1,430	4.8	818	2.8	-2.0	Land use changed
B-F-TA	3,072	10.1	3,716	12.5	+2.4	Increased irrigation facility, Improved land use & higher return
B-TA-TA	247	0.9	768	2.6	+1.7	
RV-KV- and Others	490	1.7	519	1.7	0	-
Miscellaneous	7,678	25.8	7,350	24.7	-1.1	Riverbank erosion
Total	29,697	100	29,697	100	-	-

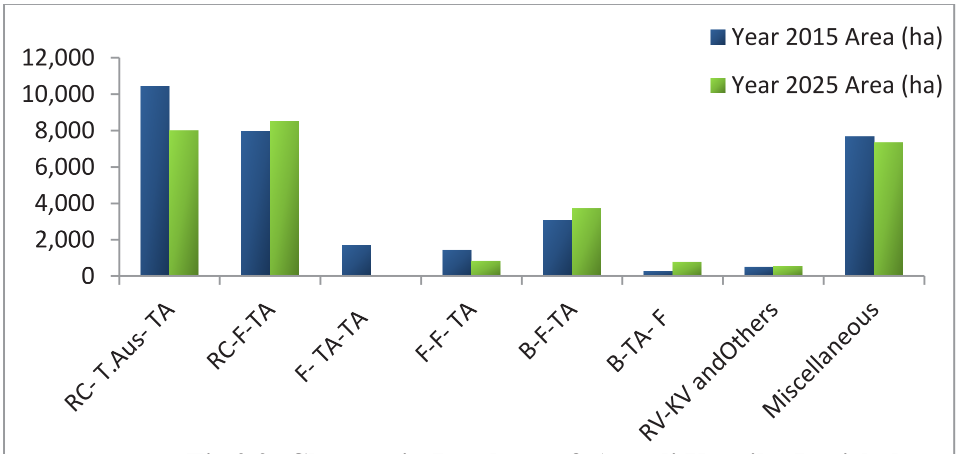


Fig 3.2: Changes in Land use of Amtali Upazila, Barishal

3.1.2 Major findings of Araihazar Upazila, Narayanganj

i) Total area- 18335 ha
ii)Total sample collected - 98
iii) Physiography & AEZ code- 1. Brahmaputra Flood Plain (9)
2. Meghna Estuarine Floodplain (19)
3. Meghna Floodplain (16)

iv) Major land type- MLL
v) Major soil group- Jolkundi, Debiddar, Fuldi
vi) Major land use- Boro-Fallow-Bona Aman

Table-3.4: Changes in Land Type of Araihazar Upazila, Narayanganj (for floodplain, piedmont and terrace area)

Land type	Previous (Year)		Present (Year)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	785	4.3	1185	6.5	+2.2	VLL converted to LL, LL converted to MLL and MLL converted to MHL and HL. this shift in land type is due to establishment of Economic Zone and increase in settlement and infrastructure development
Medium highland	3427	18.7	3996	21.8	+3.1	
Medium lowland	5354	29.2	4819	26.3	-2.9	
Low land	2654	14.5	1998	10.9	-3.6	
Very lowland	277	1.5	-	-	-1.5	
Miscellaneous	5838	31.8	6337	34.5	+2.7	
Total	18335	100	18335	100		

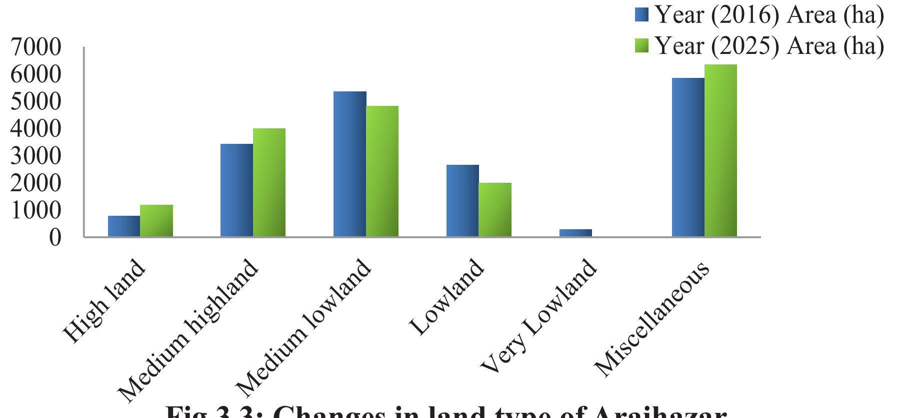


Fig 3.3: Changes in land type of Araihazar, Narayanganj

Table-3.5: Changes in Land Use in different Land type of Araihazar Upazila, Narayanganj

Land Use	Land type	Previous (2014)		Present (2025)		% increase/ decrease	Possible Reasons
		Area (ha)	%	Area (ha)	%		
Boro-Fallow-B. Aman	-	3462	18.9	1784	14.9	-4.0	Increase in Mustard and Aush Rice Cultivation
Boro-Fallow-Fallow	-	2402	13.1	1495	12.5	-0.6	
Mustard+Boro-Fallow-Fallow	-	268	1.5	1124	9.4	+7.9	
Boro-Aush-Fallow	-	-	-	1219	10.2	+10.2	

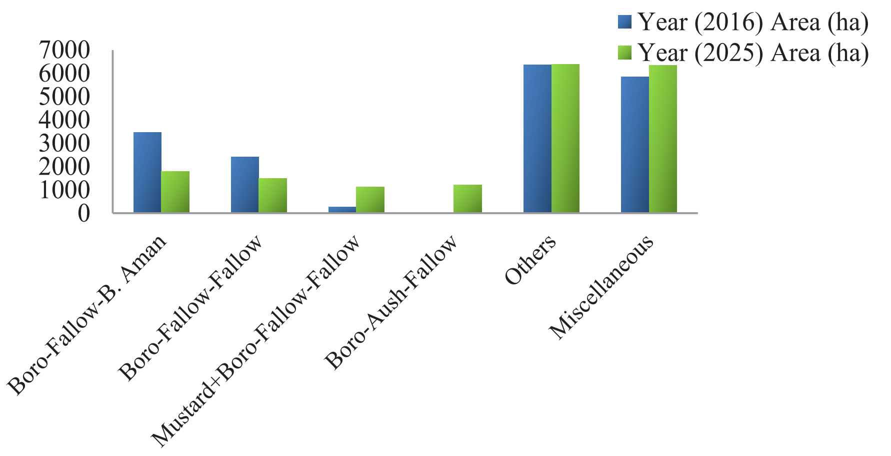


Fig 3.4: Changes in land use of Araihazar, Narayanganj

3.1.3 Major findings of Badarganj Upazila, Rangpur

i) Total area- 30127

ii) Total sample collected- 157

iii) Physiography & AEZ code: 1. North-Eastern Barind Tract (27)
2. Tista Meander Floodplain (3)
3. Active Tista Floodplain (2)

iv) Major land type- HL, MHL, MLL

v) Major soil group- Pirghacha, Polashbari, Gangachora, Kaunia, Nijhuri, Lauta, Belabo, Noadda

vi) Major land use- Boro -Fallow- T. Aman
Potato- Boro- T. Aman

Rabi Crops (Mustard/Potato/Vegetables)-Maize-T. Aman
Robi vegetables- Kharif Vegetables
Mango/Litchi/Banana/Sugarcane/Papaya/Ginger

Table-3.6: Changes in Land Type of Badarganj Upazila of Badarganj Upazila, Rangpur

Land type	Previous (Year 2015)		Present (Year 2024)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	13197	43.8%	11811	39.2	-4.6	Infrastructural Development, Top Soil Removal for Brick field etc.
Medium highland	12978	43.1%	13792	45.8	+2.7	
Medium lowland	214	0.7%	304	1.0	+0.3	
Miscellaneous	3738	12.4%	4220	14	+1.6	
Total	30127	100%	30127	100%	0.0	

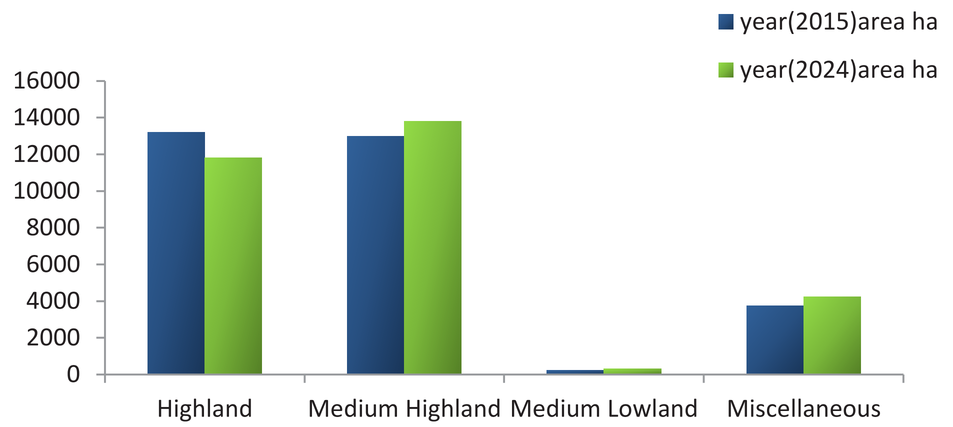


Fig 3.5: Changes in land type of Badarganj, Rangpur

Table-3.7: Changes in Land Use of Badarganj Upazila of Badarganj Upazila, Rangpur

Land Use	Previous (Year 2015)		Present (Year 2024)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Boro –F- T. Aman	12995	43	10394	34.5	-8.5	Invention of High Yielding Variety, Shorter lifetime variety, Modern Agricultural Technology, More Irrigation Facility, Increase of settlement etc.
Potato-Boro-T. Aman	2500	8.3	2711	9.0	0.7	
Robi vegetables- Kharif Vegetables	2353	7.8	2561	8.5	0.7	
Sugarcane/Banana/Zinger/Termric	1936	6.4	2049	6.8	0.4	
Wheat-Jute/Maize/T. Aus/T. Aman Seedbed	1475	5.0	1265	4.2	-0.8	
Orchard (Mango/Litchi/Jujubi)	1316	4.4	1506	5.0	0.6	
Mustard-Boro/Maize-T. Aman	1051	3.5	1597	5.3	1.8	
Robi vegetables- T. Aman Seedbed	1032	3.4	1205	4.0	0.6	
Onion/Garlic-Jute- T. Aman	491	1.6	784	2.6	1.0	
Potato-Jute/Maize- T. Aman	478	1.6	723	2.4	0.8	
Maize –F- T. Aman	272	0.9	482	1.6	0.7	
Boro-F-F	154	0.5	90	0.3	-0.2	
Others Cropping Pattern	336	1.2	542	1.8	0.6	
Miscellaneous (Settlement/Water body/Forest etc,)	3738	12.4	4218	14	1.6	
Total	**30127**	**100**	**30127**	**100**	**0.0**	

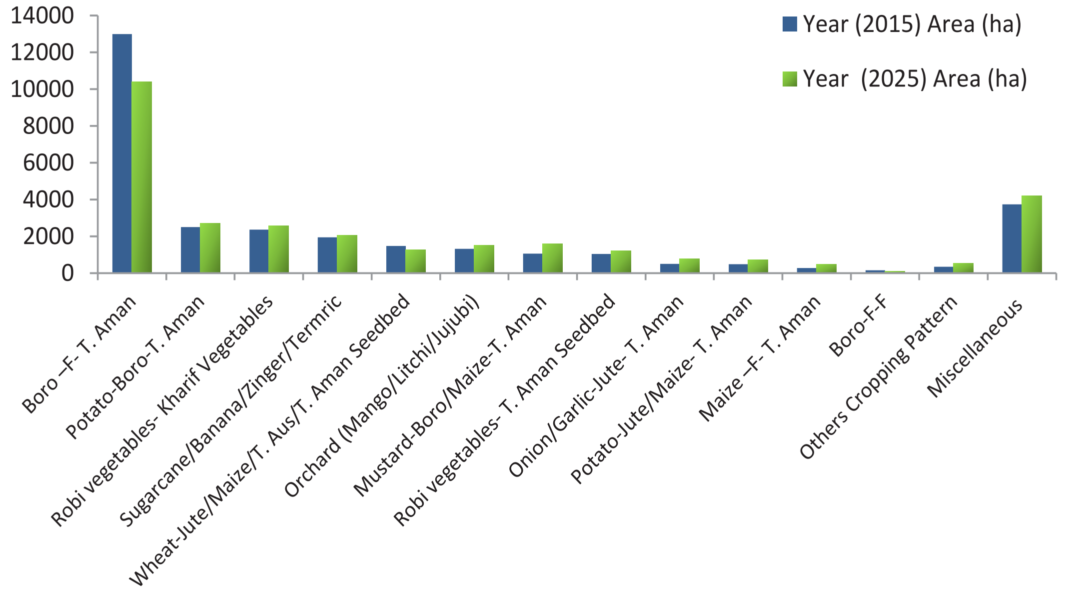


Fig 3.6: Changes in land use of Badarganj, Rangpur

3.1.4 Major findings of Bagerhat Sadar Upazila, Bagerhat

i) Total area- 26,950 ha

ii) Total sample collected-

iii) Physiography & AEZ code- Ganges Floodplain and Ganges Tidal Floodplain, Gopalgonj Khulna Bills & AEZ 11, AEZ 13 and AEZ 14.

iv) Major land type- Highland, Medium Highland, Medium Lowland, Lowland etc.

v) Major soil group- Sara, Gopalpur, Ishwardi, Ghior, Jhalkathi, Barishal, Harta, Satla etc.

Table-3.8: Changes of land type of Bagerhat Sadar Upazila, Bagerhat

Land type	Previous (2014)		Present (Year)		% increase/ Decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Highland	2600	9.6	1895	6.0	-3.6	
Medium highland	13245	49.1	16055	51.2	+2.1	
Medium lowland	2797	10.4	3030	9.6	-0.8	
Lowland	54	0.2	61	0.2	0.0	
Miscellaneous	8254	30.6	10333	33.0	+2.4	
Total	26950	100.0	31374	100.0	0.0	

N.B. Dema union of Rampal has been recently added which area is 4424 ha.

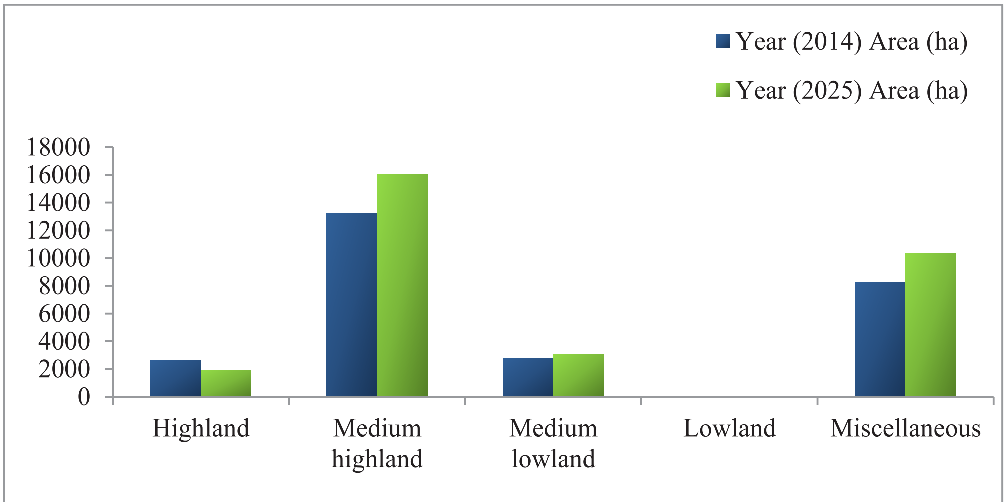


Fig 3.7: Changes in land type of Bagerhat Sadar, Bagerhat

Table-3.9: Changes of land use of Bagerhat Sadar Upazila, Bagerhat

Land Use	Previous (2014)		Present (2025)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Shr-TA	9285	34.5	1800	5.7	-28.8	
Bo-Shr	6194	23.0	12491	39.0	+16.0	
RV-KV	948	3.5	146	0.5	-3.0	
F-TA	288	1.1			-100.0	
RC-Aus/Jute-TA	172	0.6	115	0.4	-0.2	
RC-Bo -TA			154	0.5	+0.5	
Bo-F-TA	117	0.4	4665	18.0	+17.6	
F-Shrimp	98	0.4	-	-	-0.4	
Annual crops			138	0.4	+0.4	
Perennial crops			252	0.8	+0.8	
Shr-Shr			344	1.0	+1.0	
Other	1594	5.9	936	3,0	-2.9	
Miscellaneous	8254	30.6	10333	32.9	+2.3	
Total	26950	100.0	31374	100.00		

N.B. Dema union of Rampal has been recently added which area is 4424 ha.

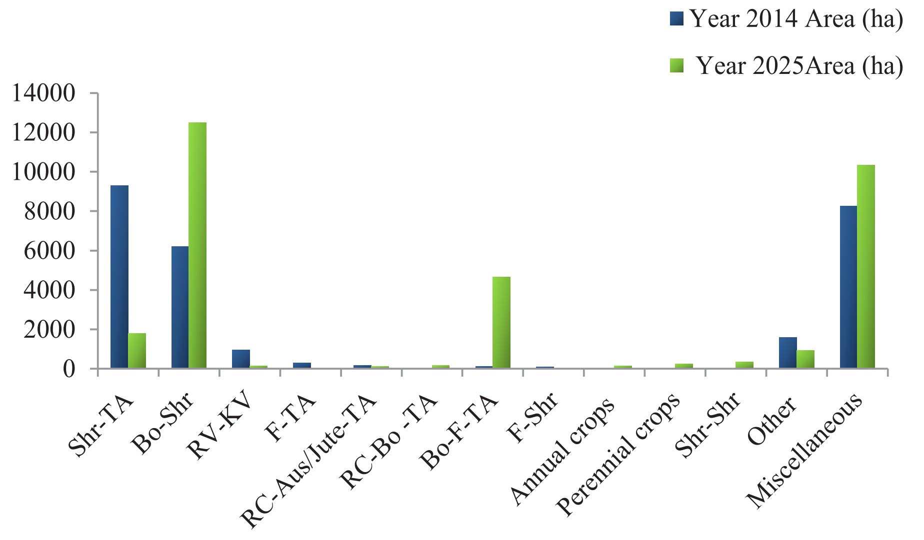


Fig 3.8: Changes in land use of Bagerhat Sadar, Bagerhat

3.1.5 Major findings of Bakshiganj Upazila, Jamalpur

i) Total area- 20,438 ha.

ii) Total sample collected- 112.

iii) Physiography & AEZ code- Northern and Eastern Hills (29), Northern and Eastern Piedmont Plain (22), Old Brahmaputra Flood plain (9), Young Brahamaputra Flood plain (8), Active Brahamaputra Flood plain (7).

iv) Major land type- High Land, Medium High Land, Medium Low Land, Low Land.

v) Major soil group- Kulaura, Borolekha, Ghushgao, Sreemongol, Gajni, Jhenaigati, Pritimpasha, Monu, Nalitabari, Tajpur, Palashtola, Sreebordi, Nakla, Sherpur, Sonatola, Silmondi, Ghatail, Balina, Melandaha, Dhamrai, Brahmaputra Sandy Alluvium & Brahmaputra Silty aliuvium.

Upazila	District	Physiography & AEZ	Major land type	Major soil group	Major Land use	Major constraints	Remarks
Bakshiganj	Jamalpur	Northern & Eastern Hills (29) Northern & Eastern Pidmond Plains (22) Old Brahamaputra Flood plain (9) Young Brahamaputra Flood plain (8) Active Brahamaputra Flood plain (7)	HL – 8,705 ha (42.60%) MHL- 4,690 ha (22.90%) MLL- 4,056 ha (19.90%) LL-630 ha (3.10%) Miscella-neous - 2,357 ha (11.50%)	Kulaura Borolekha Ghushgao Sreemongol Gajni Jhenaigati Pritimpasha Monu Nalitabari Tajpur Palashtola Sreebordi Nakla Sherpur Sonatola Silmondi Ghatail Balina Melandaha Dhamrai Brahmaputra Sandy allu. Brahmaputra Silty allu.	1. Natural Mixed Forest (Shal, Gamar, kadoi, Garjon, Shegun, Mehogani, Bambo, Akashia, Ucalactor etc.) 695 ha (3.4%) . Annual (Pineapple, Banana, Papaya, Zinger, Termaric, Sugarcane, Kasaba) 593 ha (2.9%) . R. Vegetable - K. Vegetable: 633 ha (3.1%) . RC -F- K. Vegetable: 225 ha (1.1%) . RC-Jute/T.Aus -T. Aman: 2,820 ha (13.8%) . R. Vegetable/ RC-Jute-F: 572 ha (2.8%) 7. R. Vegetable-F- T. Aman: 450 ha (2.2%) 8. Boro-Jute - T. Aman: 3,129 ha (15.3%) 9. Mustard -Boro-T. Aman: 163 ha (08%) 10. Boro -F-T. Aman: 7,186 ha (35.2%) 11. Boro- F – F 1,063 ha (5.2%) 12. Others: 552 ha (2.7%) 13. Miscellaneous: 2,357 ha (11.5%)	1. Croping Sequence Intensified to Triple crop with Mustard/Potato-Boro and TA. 2. RC, Aus & B.Aman practices decreased remarkably	

Upazila	District	Physiogra- phy & AEZ	Major land type	Major soil group	Major Land use	Major constraints	Remarks
Bakshiganj	Jamalpur	Northern & Eastern Hills (29) Northern & Eastern Pidmond Plains (22) Old Brahamaputra Flood plain (9) Young Brahamaputra Flood plain (8) Active Brahamaputra Flood plain (7)	HL – 8,705 ha (42.60%) MHL- 4,690 ha (22.90%) MLL- 4,056 ha (19.90%) LL-630 ha (3.10%) Miscella- neous - 2,357 ha (11.50%)	Kulaura Borolekha Ghushgao Sreemongol Gajni Jhenaigati Pritimpasha Monu Nalitabari Tajpur Palashtola Sreebordi Nakla Sherpur Sonatola Silmondi Ghatail Balina Melandaha Dhamrai Brahmaputra Sandy allu. Brahmaputra Silty allu.	1. Natural Mixed Forest (Shal, Gamar, kadoi, Garjon, Shegun, Mehogani, Bambo, Akashia, Ucalactor etc.) 695 ha (3.4%) . Annual (Pineapple, Banana, Papaya, Zinger, Termaric, Sugarcane, Kasaba) 593 ha (2.9%) . R. Vegetable - K. Vegetable: 633 ha (3.1%) . RC -F- K. Vegetable: 225 ha (1.1%) 0. RC-Jute/T.Aus -T. Aman: 2,820 ha (13.8%) 1. R. Vegetable/ RC- Jute-F: 572 ha (2.8%) 7. R. Vegetable-F- T. Aman: 450 ha (2.2%) 8. Boro-Jute - T. Aman: 3,129 ha (15.3%) 11. Mustard -Boro- T. Aman: 163 ha (08%) 12. Boro -F-T. Aman: 7,186 ha (35.2%) 11. Boro- F – F 1,063 ha (5.2%) 12. Others: 552 ha (2.7%) 13. Miscellaneous: 2,357 ha (11.5%)	1. Croping Sequence Intensified to Triple crop with Mustard/Potato-Boro and TA. 2. RC, Aus & B.Aman practices decreased remarkaby	

Table-3.10: Changes in Land Type of Bakshiganj Upazila, Jamalpur (for floodplain, piedmont terrace area)

Land type	Previous (1993)		Present (2024)		% Increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	9,069	44.4	8,705	42.6	-1.8	New Settlement, Infrastructure etc. occupied the high land, Top soil selling.
Medium highland	4,550	22.2	4,690	22.9	+0.7	
Medium lowland	4,270	20.9	4,056	19.9	-1.0	Decrease of inundation depth.
Lowland	636	3.1	630	3.1	-0.0	
Miscellaneous	1,913	9.4	2,357	11.5	+2.1	Increase of Settlement & Infrastructure
Total	20,438	100.00	20,438	100.00		

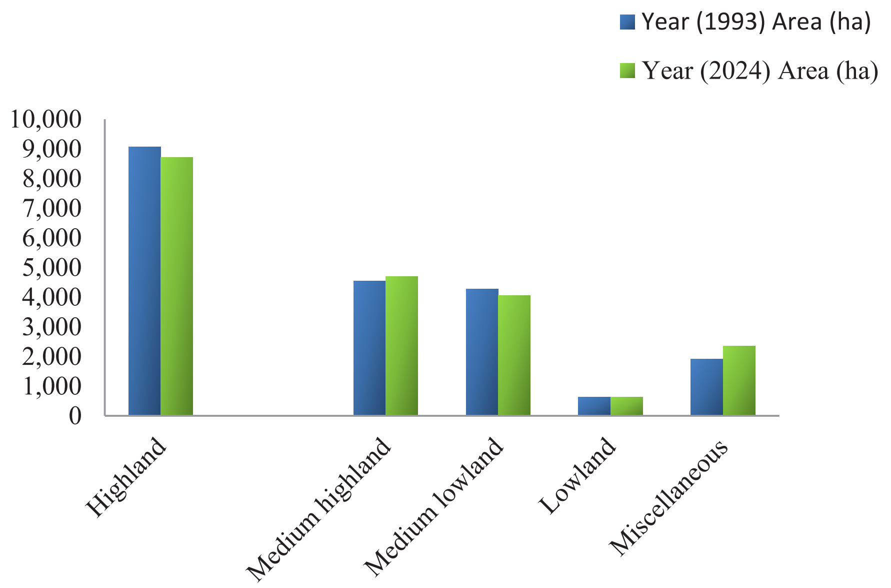


Fig 3.9: Changes in land type of Bakshiganj, Jamalpur

Table-3.11: Changes in Land Use in different Land type of Bakshiganj Upazila, Jamalpur

Land Use	Previous (1993)		Present (2024)		% increase/ decrease	Possible Reasons
	Area (ha)	%	Area (ha)	%		
Natural Mixed Forest (Shal, Gamar, kadoi, Garjon, Shegun, Mehogani, Bambo, Akashia, Ucalactor etc.)	1,053	5.2	695	3.4	-1.8	
Annual (Sugarcane,Pineapple, Banana, Papaya, Zinger, Termaric, Kasaba)	779	3.8	593	2.9	-0.9	
RC-Jute/T.Aus- T. Aman	1477	7.2	2,820	13.8	+6.6	
RC- Jute/T.Aus – F	1946	9.5	572	2.4	-7.1	
RC-Mixed B.Aus& Aman	1,746	8.5	-	-	-100	
RC-F-F	520	2.5	-	-	-100	
R. Vegetable - K. Vegetable	-	-	633	3.1	+100	
RC -F- K. Vegetable	-	-	225	1.1	+100	
R. Vegetable-F- T. Aman	-	-	450	2.2	+100	
F-Jute/T.Aus- T. Aman	7168	35.1	-	-	-100	
F-T.Aus- F	24	0.1	-	-	-100	
F-F- T.Aman	337	1.7	-	-	-100	
Boro-Jute - T. Aman	-	-	3,129	15.3	+100	
Mustard -Boro-T. Aman	-	-	163	0.8	+100	
Boro-F- T.Aman	1286	6.3	7,186	35.2	+28.9	
Boro-F- D. T.Aman	1108	5.4	-	-	-100	
Boro-F-F	445	2.2	1,063	5.2	+3.0	
F-F-F/ Other	636	3.1	552	2.7	-0.4	
Miscellaneous	1913	9.3	2,357	11.5	+2.2	
Total	**20,438**	**100.0**	**20,438**	**100.0**		

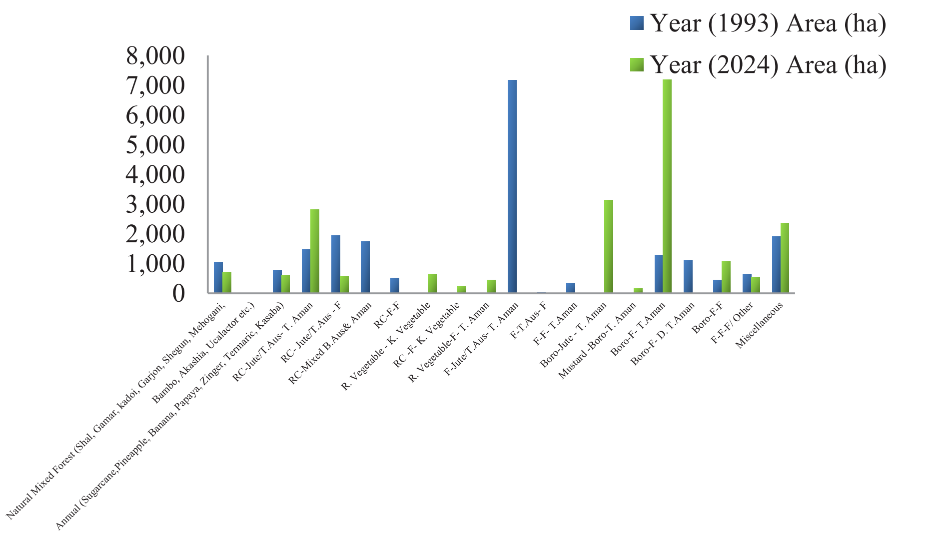


Fig 3.10: Changes in land use of Bakshiganj, Jamalpur

3.1.6 Major findings of Baliadangi Upazila, Thakurgaon

i) Total area-28,425
ii) Total sample collected- 187
iii) Physiography & AEZ code- Old Himalayan Piedmont Plain (1)
iv) Major land type- High Land, Medium High Land & Medium Low Land
v) Major soil group- Ranishangkail, Jamun, Baliadangi, Jagdol, Kaunia & Loshkora
vi) Major land use- Agriculture, settlement & Orchard

Table-3.12: Changes in Land Type of Baliadangi Upazila, Thakurgaon (for floodplain, piedmont and terrace area)

Land type	Previous (Year 2015)		Present (Year 2024)		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Highland	13,794	48.5	12,425	43.7	-4.8	Infrastructural development, top soil removal for Brick kiln etc.
Medium highland	10,301	36.2	10,998	38.7	2.5	
Medium lowland	299	1.1	348	1.2	0.1	
Miscellaneous	4,031	14.2	4,654	16.4	2.2	
Total	28,425	100.0	28,425	100.0	0.0	

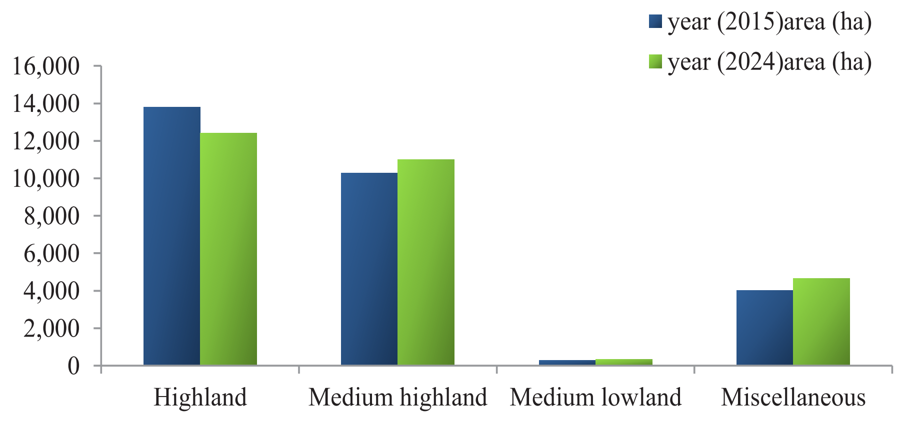


Fig 3.11: Changes in land type of Baliadangi, Thakurgaon

Table-3.13: Changes in Land Use in different Land type of Baliadangi Upazila, Thakurgaon

Land use	Previous (Year 2015)		Present (Year 2024)		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Mango/Litchi/Banana/Sugarcane/Papaya/Ginger/Tea	1,703	6.0	1,825	6.4	0.4	Invention of High-Yielding Varieties, Development of Short-Duration Crops, Advancement in Modern Agricultural Technology, Expansion of Irrigation Facilities, Growth of Human Settlements, etc.
Rabi Vegetables -Kharip Vegetables	851	3.0	895	3.1	0.2	
Rabi Crops (Mustard/Potato/Vegetables)-Maize-T. Aman	386	1.4	3,646	12.8	11.5	
Rabi Crops (Mustard/Potato/Wheat)-Boro-T. Aman	5,055	17.8	4,880	17.2	-0.6	
Potato/Wheat/Maize-F-T. Aman	10,193	35.9	5,105	18.0	-17.9	
Potato/Wheat/Maize-Kharif Vegetables-T. Aman	0	0	320	1.1	1.1	
Onion Seed-F-T.Aman	0	0	150	0.5	0.5	
Boro-Fallow-T. Aman	5,664	19.9	4,375	15.4	-4.5	
Mastard-Boro-T. Aman	150	0.5	2,345	8.2	7.7	
Boro-F-F	149	0.5	80	0.3	-0.2	
Others Cropping Pattern	243	0.9	150	0.5	-0.3	
Others (Settlement/Water body/Forest etc,)	4,031	14.2	4,654	16.4	2.2	
Total	28,425	100.0	28,425	100.0	0.0	

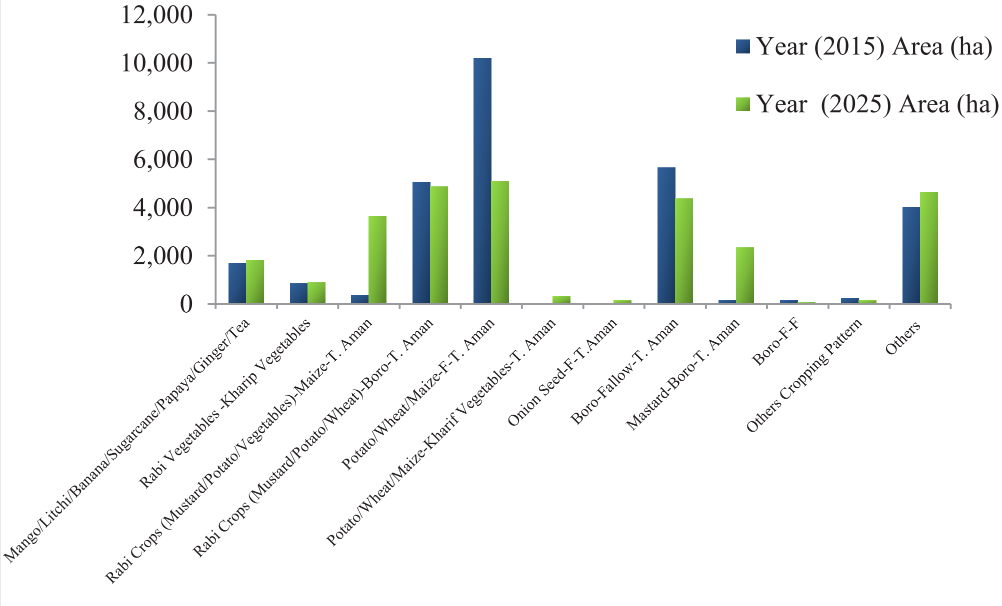


Fig 3.12: Changes in land use of Baliadangi, Thakurgaon

3.1.7 Major findings of Bamna Upazila, Barguna

i) Total area-10,105 ha
ii)Total sample colleted-48
iii)Physiography & AEZ code- Ganges Tidal Floodplain (13)
iv)Major land type- Medium Highland
v)Major soil group- Ramgati, Jhalakati, Barishal and Polymati
vi) Major land use- Rc-T.Aus- TA

Table-3.14: Changes in Land Type of Bamna Upazila, Barguna (for floodplain, piedmont and terrace area)

Land type	Previous (2013)		Present (2025)		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Highland	279	2.8	330	3.3	+0.5	Cultivable land (MHL) converted into homestead garden, orchard
Medium highland	6,969	68.9	6,729	66.5	-2.4	
Medium lowland	16	0.2	48	0.5	+0.3	Cultivable land (MHL) converted into homestead garden, orchard
Miscellaneous	2,841	28.1	2,998	29.7	+1.6	Due to siltation river area converted into new cultivable land and expansion of homestead
Total	10,105	100	10,105	100	-	

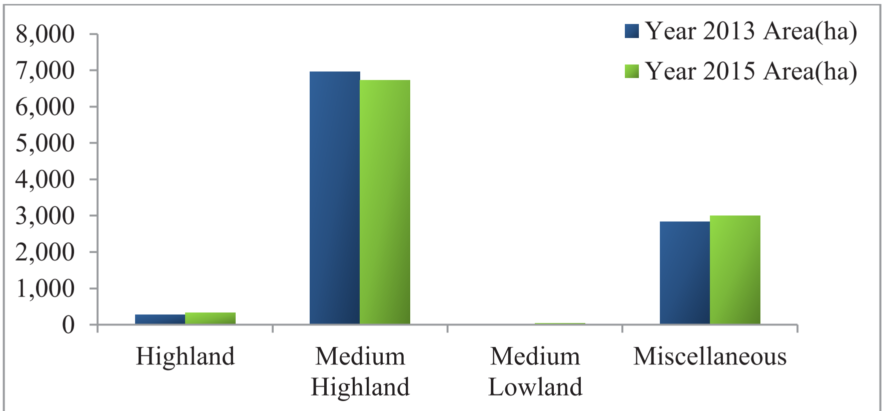


Fig 3.13: Changes in land type of Bamna, Barishal

Table-3.15: Changes in Land Use of Bamna Upazila, Barguna

Land use	Previous (2013)		Present (2025)		% increase /decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Rc-T.Aus- TA	2,741	27.1	2,177	21.5	-5.6	Aus production has declined due to cost and uneven seasonal rain
F-T.Aus-TA	2,126	21.0	2,184	21.6	+0.6	Low input cost & low management than return
RC-F-TA	1,039	10.3	2,154	21.3	+11.0	Improved land use & higher return
F-F-TA	1,079	10.7	262	2.6	-8.1	Land use changed from single crop to double/triple crop
RV-KV- and Others	279	2.8	330	3.3	+0.5	Land use converted from field crop to other
Miscellaneous	2,841	28.1	2,998	29.7	+1.6	Siltation and homestead
Total	10,105	100	34,828	100	-	-

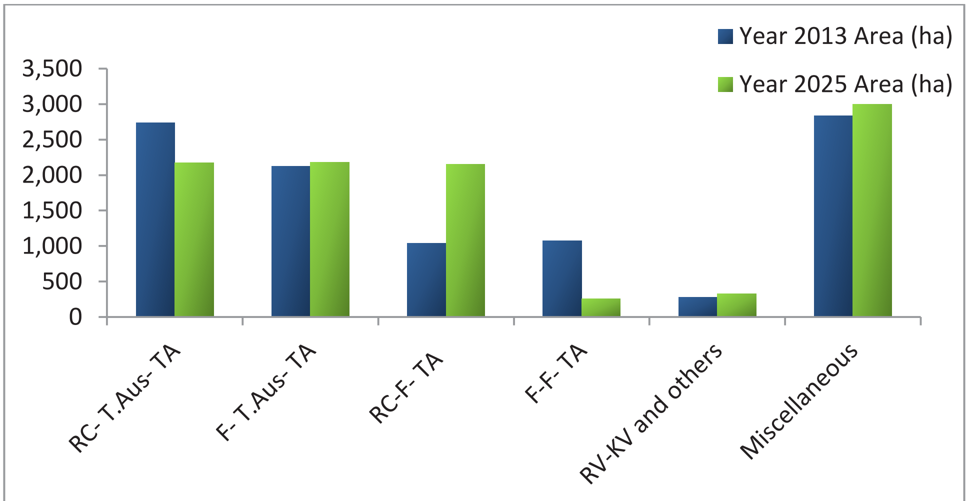


Fig 3.14: Changes in land use of Bamna, Barishal

3.1.8 Major findings of Barguna Sadar Upazila, Barguna

i) Total area- 38,833ha
ii)Total sample colleted-117
iii)Physiography & AEZ code- Ganges Tidal Floodplain (13)
iv)Major land type-Medium highland
v)Major soil group- Ramgati, Jhalakati, Barishal & Polymati
vi) Major land use-
Boro – T. Aus – T. Aman,
Mugbean - T. Aus - T. Aman,
Boro – F -T. Aman,
Rabi Vegetables-Kharif vegetables,
Mug – F – T. Aman,
Water melon – F – T. Aman,
Rabi Crops - T. Aus - T. Aman

Table-3.16: Changes in Land Type of Barguna Sadar Upazila, Barguna (for floodplain, piedmont and terrace area)

Land type	Area				% increase/ decrease	Possible reasons
	Previous (2017)		Present (2025)			
	(ha)	%	(ha)	%		
Medium highland	24,399	62.8	18,865	48.6	-14.2	Increasing homestead, urbanization, development activities, orchard, garden etc.
Vitimati	1,102	2.8	1,292	3.3	0.5	
Homestead	6,245	16.1	11,632	30.0	13.9	
Miscellaneous	7,087	18.2	7,044	18.1	-0.1	
Total	38,833	100.0	38,833	100.0		

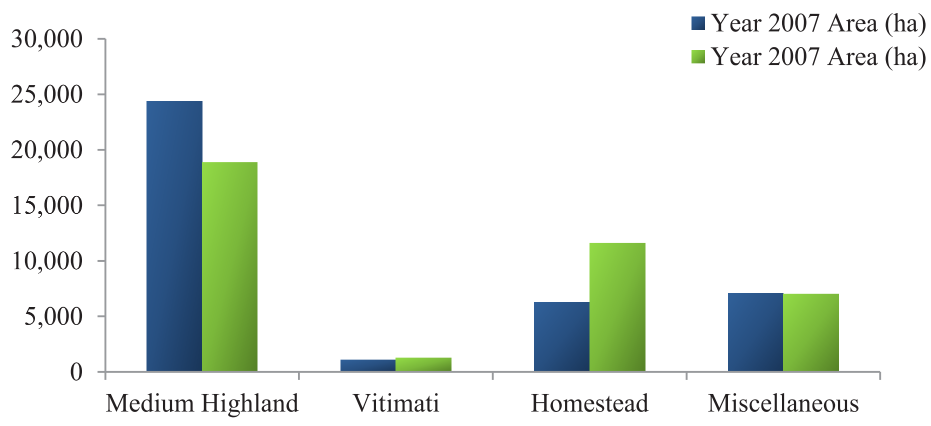


Fig 3.15: Changes in land type of Barguna Sadar, Barguna

Table-3.17: Changes in Land Use of Barguna Sadar Upazila, Barguna

Land Use	**Previous (2017)**		**Present (2025)**		**% increase/ decrease**	**Possible reasons**
	Area (ha)	**%**	**Area (ha)**	**%**		
1.Boro – T. Aus – T. Aman	5,740	14.8	750	1.9	-12.9	Aus production has declined due to cost and uneven seasonal rain
2. Rabi Crops - T. Aus - T. Aman	13783	35.5	2650	6.8	-28.7	
3. Mugbean - T. Aus - T. Aman	2,423	6.2	6816	17.5	+11.3	
4.Boro – F - T. Aman	-	-	2417	6.2	+6.2	
5. Rabi Vegetables-Kharif vegetables	-	-	203	0.5	+0.5	
6.Rabi Crops – F - T. Aman	4116	10.6	2095	5.3	-5.3	
7.F – F - T. Aman	5279	13.6	2025	5.2	-8.4	
8.Mug – F – T. Aman	-	-	10218	26.3	+26.3	Land use changed
9.Water melon – F – T. Aman	-	-	1211	3.1	+3.1	
10.F – T. Aus – T. Aman	489	1.2	359	0.9	-.3	
Miscellaneous	7,087	18.2	7,044	18.1	-0.1	Increasing homstead, urbanization, development activities, orchard, garden etc
Total	38,833	100.0	38,833	100.0		

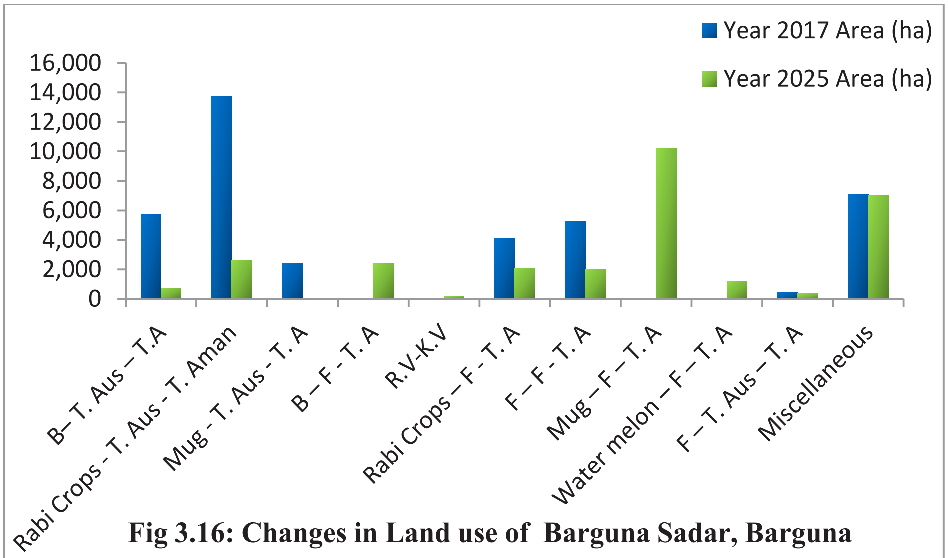


Fig 3.16: Changes in Land use of Barguna Sadar, Barguna

3.1.9 Major findings of Bashkhali Upazila, Chattogram

i) Total area-36,511 ha
ii) Total sample colleted-164
iii) Physiography & AEZ code- Northern and Eastern Hills (29), Northern and EasternPiedmont Plains (22) & Chattogram Coastal Plain (23)
iv)Major land type- HL, MHL
v) Major soil group-Borkol, Subalong, Dhum, Khadimnagar, Salbon, Rangapani, Rangamati, Nolua, Bijipur, Pahartoli, Suvopur, Mirsorai, Raujan, Noapara, Kutubdia.
vi) Major land use- Forest land

Table-3.18: Changes in land type of Bashkhali Upazila, Chattogram

Land type	Previous (2016)		Present (2025)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	13,801	37.8	13176	36.1	(-) 4.5	
Medium Highland	15,003	41.1	14,939	40.9	(-) 0.4	
Miscellaneous	7,707	21.1	8,396	23.0	(+) 8.9	
Total	36,511	100.0	36,511	100.0		

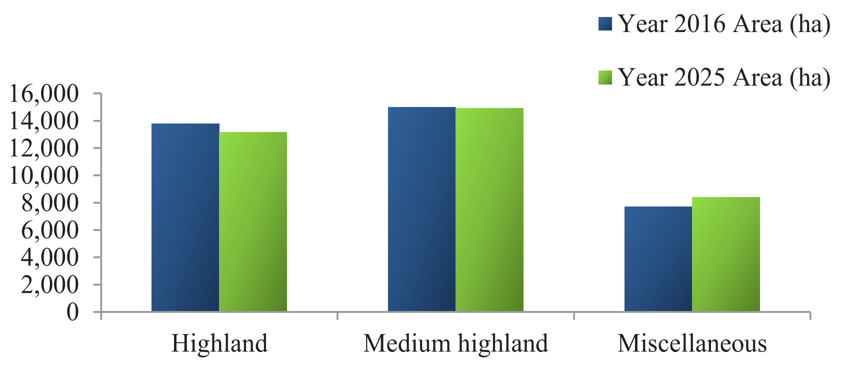


Fig 3.17: Changes in land type of Bashkhali, Chattogram

Table-3.19: Slope Class of Bashkhali Upazila, Chattogram

Slope class/Land type	Previous (Year)		Present (Year)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Nearly level (<5%)	18,240	49.9	17,782	48.7	(-) 2.5	
Mild slope (5-15%)	746	2.1	664	1.8	(-) 11.0	
Medium slope (15-30%)	994	2.7	885	2.4	(-) 10.9	
Steep slope (30-50%)	4,032	11.1	3,915	10.8	(-) 2.9	
Very steep (50-70)	2,747	7.5	2,724	7.4	(-) 0.9	
Excessively steep (>70)	2,045	5.6	2,145	5.9	(+) 4.9	
Miscellaneous	7,707	21.1	8,396	23.0	(+) 8.9	
Total	36,511	100.0	36,511	100.0		

Table-3.20: Changes in land use: of Bashkhali Upazila, Chattogram

Land use	Previous (year)		Present (year)		% increase/ Decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Forest	7,670	21.0	5,462	14.9	- (28.79)	
Garden (Mango, Litchi, Jackfruit, Guava)	3,676	10.0	2,411	6.6	- (34.41)	
Jum	3,008	8.2	1,576	4.3	- (47.6)	
Bushy Plant, grass land	8,030	22.0	2,234	6.1	- (72.17)	
Annual Crop	1165	3.2	1,935	5.3	+ (66.1)	
Boro- F -TA	1132	3.1	2,990	8.2	+(164.1)	
RC- F- TA	1166	3.2	1,207	3.3	+ (3.5)	
RV- KV	1052	2.9	2,960	8.1	+(181.3)	
Boro- F- F	543	1.5	1,123	3.1	+(106.8)	
Boro- Aus- Aman		-	2,851	7.8	-	
RV- F- TA		-	2,371	6.5	-	
Others	1362	3.8	995	2.8	- (26.9)	
Miscellaneous (settlement/reservoir/ river/pond etc.)	7,707	21.1	8,396	23.0	+ (8.9)	
Total	36,511	100.0	36,511	100.0		

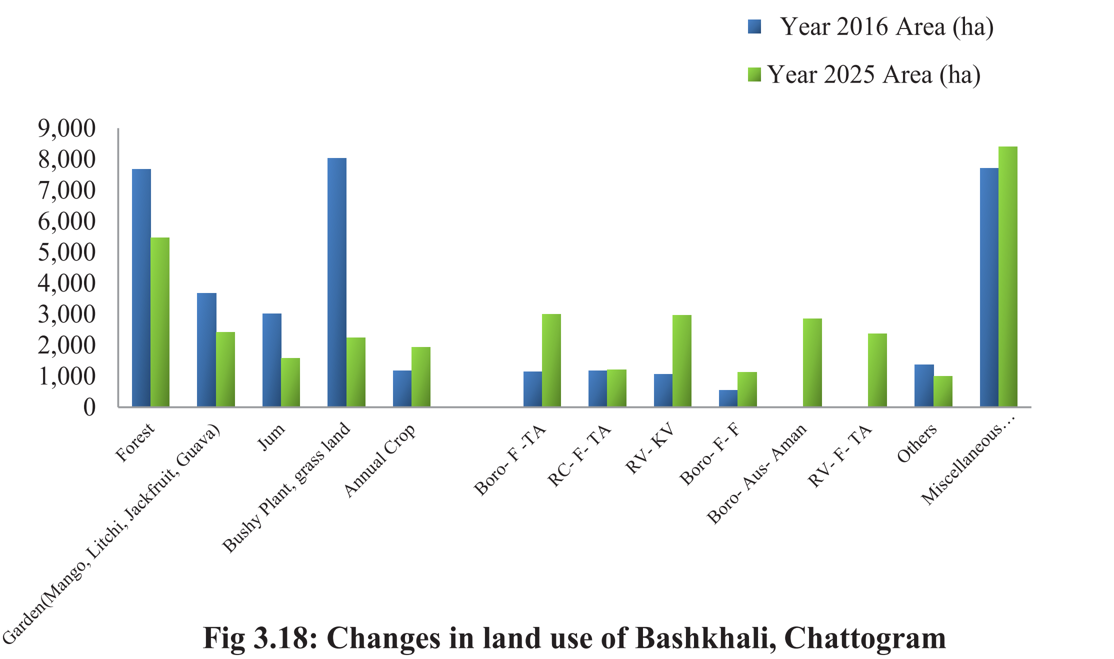


Fig 3.18: Changes in land use of Bashkhali, Chattogram

3.1.10 Major findings of Bishwanath Upazila, Sylhet

i) Total area-21184 ha
ii) Total sample collected-110
iii) Physiography & AEZ code-

- North and Eastern Piedmont Plain. (22)
- Eastern Surma-Kushiyara floodplain (20)

iv) Major land type- HL, MHL, MLL, LL, VLL
v) Major soil group- Ramgor, Bijipur, Pritimpasha, Balagonj, Gowaynghat, Fagu, Techribari.
vi) Major land use-

- Boro-felloew-fallow
- Rabi veg- Fallow- T.aman
- Fallow –Aus- T.aman
- Fallow- fallow – T.aman
- Boro- fallow- T.aman

Table-3.21: Changes in land type of Bishwanath Upazila, Sylhet (for floodplain piedmont and terrace area)

land type	Previous (2014)		Present (2024)		%increase/ decrease		Possible reasons/Remarks
	Area(ha)	%	Area(ha)	%	Area(ha)	%	
Highland	205	1	254	1	+49	0	The upland or hill areas gradually erode and become lower. On the other hand, are filled with sediments from the uplands and gradually become comparative higher. Again soil erosion from hills, seasonal flooding with uneven sediment depression, and ongoing geological subsidence cause many area to naturally transform into low lying lands. Additionally miscellaneous land uses increase due to increase settlement and human activities
Medium highland	8583	40.5	8179	39	-404	-1.5	
Medium lowland	4813	22.7	4490	21	-323	-1.7	
Lowland	2596	12.3	2570	12.1	-26	-0.2	
Very lowland	939	4.4	949	4.5	+10	+0.1	
Miscellaneous	4048	19.1	4742	22.4	+694	+3.3	
Total	21184	100	21184	100	0	0	

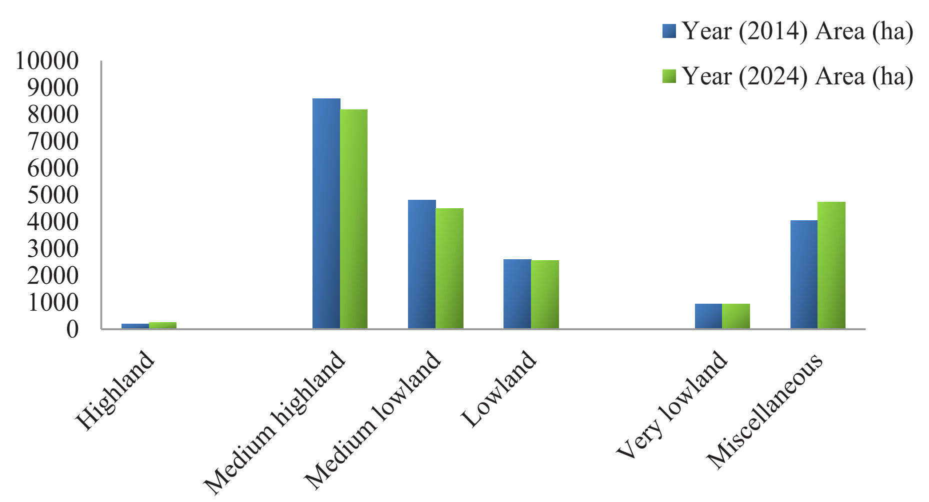


Fig 3.19: Changes in land type of Bishwanath, Sylhet

Table-3.22: Changes in land use of Bishwanath Upazila, Sylhet

Land use	Previous (year)		Present (Year)		%increase/ decrease		Possible reasons/Remarks
	Area(ha)	%	Area(ha)	%	Area(ha)	%	
Fruit orchard (HL)	21	0.01	18	0.08	-3	-0.07	These overall changes in crop arrangement has been observed due to socio economic status of the farmers.
Rabi veg (MHL,MLL)	163	0.8	233.7	1.1	+70.7	+0.3	
Robi veg-fallow-T.aman (MHL,MLL)	1251	5.9	1296	6.1	+45	+0.2	
Fallow-T.aus- T.aman (MHL, MLL)	1006	4.8	1041.1	4.9	+45.1	+0.21	
Boro-fallow-T.aman (MLL,MHL)	974	4.6	998.6	4.7	+24.6	+0.1	
Fallow-fallow-T.aman (MHL)	6468	30.5	6182.8	29.1	-285.2	-1.4	
Fallow-fallow-B.aman (MHL)	1253	5.9	1104.8	5.2	-148.2	-0.7	
Boro-fallow-fallow (LL)	5666	26.7	5779.1	27.2	+113.1	+0.5	
Fallow (VLL)	334	1.6	404	1.9	+70	+0.3	
Miscellaneous	4048	19.1	4125.9	19.7	+77.9	+0.6	
Total	21184	100	21184	100	0	0	

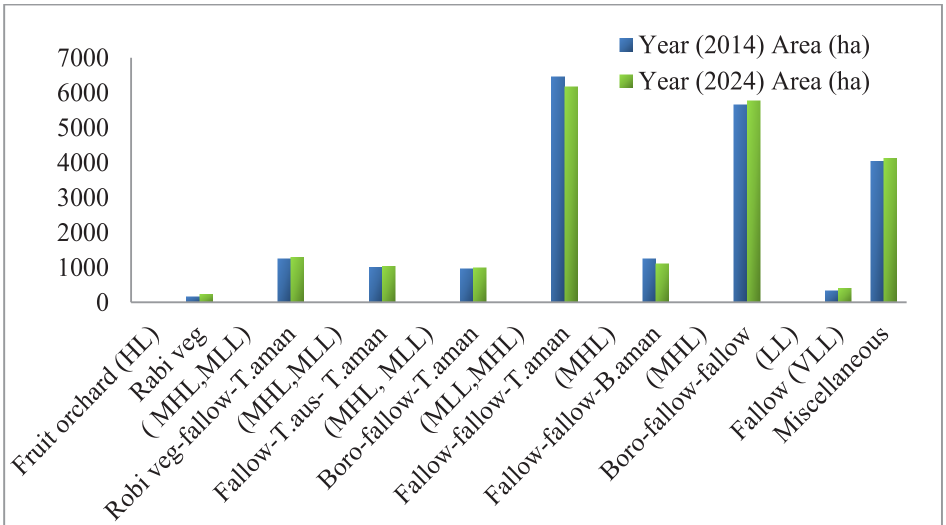


Fig 3.20: Changes in land use of Bishwanath, Sylhet

3.1.11: Major findings of Bijoynagar Upazila, Brahmanbaria

i) Total area	21,570 ha
ii) Total sample collected	129
iii) Physiography & AEZ code	Total physiography : 4 a) Akhaura terrace (30) b) Northern and eastern piedmont plains (22) c) Old Meghna eastuarine floodplain (19) d) Surma-Kushyara floodplain (21)
iv) Major land type	Total land type : 5 Highland, Medium highland (major), Medium lowland, Lowland, Very lowland.
v) Major soil group	Total soil Series : 15 Patton,Shibna,Nidarabad,Pahartoli,Pritimpasha,Suvopur,Monu,Durga pur, Chandina (major), Debidwar, Burichong, Homna, Titas, Nasirnagar, Nabinagar.
vi) Major land use	Total crop rotation : 09 Boro -F-F (major), Rabi Vegetables-F-F, Rabi Vegetables-Boro-T. Aman, Boro-T. Aus-T. Aman, Boro-F-T.Aman etc.

Table-3.23: Changes in land type of Bijoynagar Upazila, Brahmanbaria (for floodplain, piedmont and terrace area)

Slope class/ land type	Previous (2017)		Present (2025)		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Highland	2311	10.71	2157	10	(-) 0. 71	Due to new roads, more homesteads & increases of settlement
Medium highland	2,747	12.74	3,235	15	(+) 2.26	Due to changes of socio-economic condition of people.
Medium lowland	5,827	27.01	5,392	25	(-) 2.01	
Lowland	4,840	22.44	4,314	20	(-) 2.44	Due to more flash flood,siltation and sediments
Very lowland	1,831	8.49	1,079	5	(-) 3.49	
Peat	-	-	1,079	5	(+) 5	Peat minor area
Miscellaneous	4,014	18.61	4,314	20	(+) 1.39	Due to increase of homestead garden, Hill and terrace orchard etc.
Total	21,570	100	21,570	100	0	

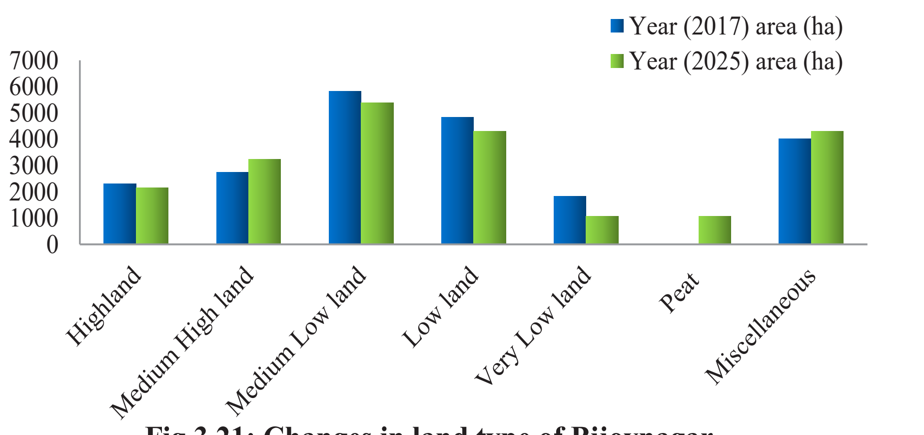


Fig 3.21: Changes in land type of Bijoynagar, Brahmanbaria

Table-3.24: Changes in land use in different Land type of Bijoynagar Upazila, Brahmanbaria

Land use	Previous (2017)		Present (2025)		% increase(+)/ decrease(-)	Possible reasons
	Area (ha)	%	Area (ha)	%		
Forest Trees (Mahogany, Gamar, Bamboo etc)	688	3.2	647	3	(-) 0.2	Due to new roads, more homesteads & increases of settlement
Fruit Trees (Mango, Jackfruit, Litchi)	409	1.9	324	1.5	(-) 0.4	
Annuals (Banana, Ginger, Turmeric)	455	2.1	431	2	(-) 0.1	
Rabi and kharif Vegetables	518	2.4	755	3.5	(+) 1.1	Increases of high value profitable crops like Rabi vegetables
Rabi Vegetables - F - T. Aman	1414	6.6	1510	7	(+) 0.4	
Boro-F-T.Aman	1578	7.3	2157	10	(+) 2.7	HYV
Rabi Vegetables-F-B. Aman	1886	8.7	1726	8	(-) 0.7	Decrease of annual rainfall
Boro-F-B.Aman	2565	11.9	2157	10	(-) 1.9	
Boro -F-F	8043	37.3	7549	35	(-) 2.3	
Miscellaneous	4014	18.6	4314	20	(+) 1.4	Settlement
Total	21,570	100	21,570	100	0	-

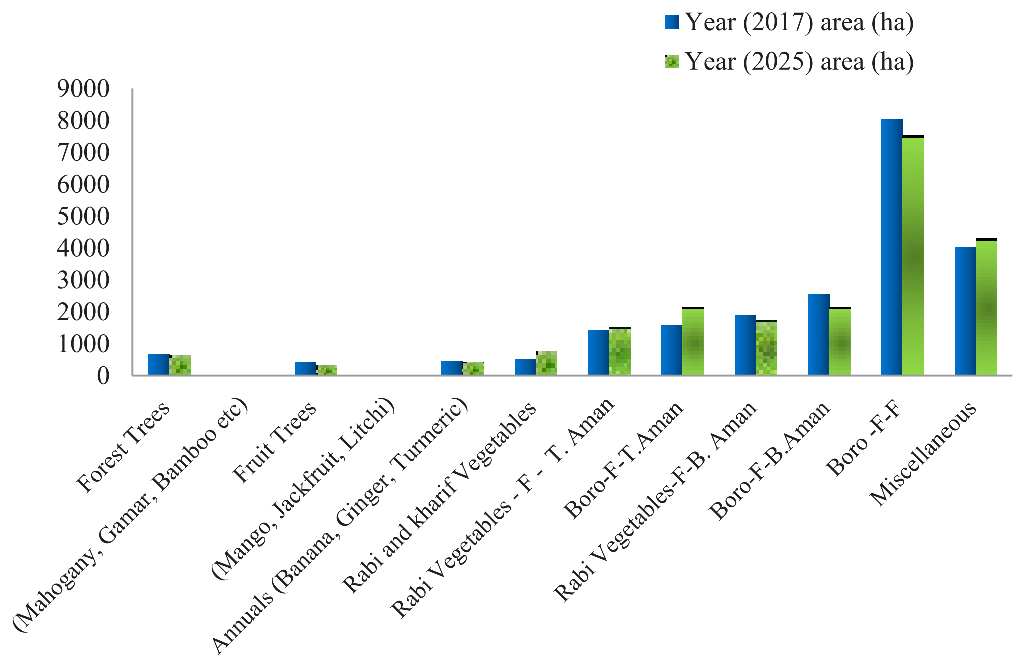


Fig 3.22: Changes in land use of Bijoynagar, Brahmanbaria

3.1.12 Major findings of Burichong Upazila, Cumilla

i) Total area	16,377 ha
ii) Total sample collected	104
iii) Physiography & AEZ code	Total Physiography : 3 a) Northern and eastern hills (29) b) Northern and eastern piedmont plains (22) c) Meghna eastuarine floodplain (19)
iv) Major land type	Total land type : 3 High Land, Medium High land (major), Medium Low land.
v) Major soil group	Total soil Series : 10 Kamuri, Varella, Bijipur, Pahartoli, (major), Pritimpasha, Chakla, Gomoti, Chandina, Debidwar, Burichong.
vi) Major land use	Total crop rotation : 06 Boro-F-T. Aman, Boro-T. Aus-T. Aman (major), Rabi Vegetables - F - T. Aman, Rabi Vegetables - F - Kharif vegetables, Potato-Boro-F-T.Aman, Boro -F-F , Rabi Vegetables - Aus - Kharif Vegetables

Table-3.25: Changes in land type of Burichong Upazila, Cumilla (for floodplain, piedmont and terrace area)

Land type	Previous (2018)		Present (2025)		% increase/ decrease	Possible reasons
	Area (ha) %		Area (ha) %			
Highland	1,178	7.2	1113	6.8	(-) 0.4	Due to new roads, more homesteads & increases of settlement
Medium highland	9,233	56.4	8674	52.9	(-) 3.5	Due to changes of socio-economic condition of people.
Medium lowland	866	5.3	850	5.3	0	-
Miscellaneo us	5,100	31.1	5740	35	(+) 3.9	Due to increase of homestead garden and settlement etc.
Total	16,377	100	16,377	100	0	

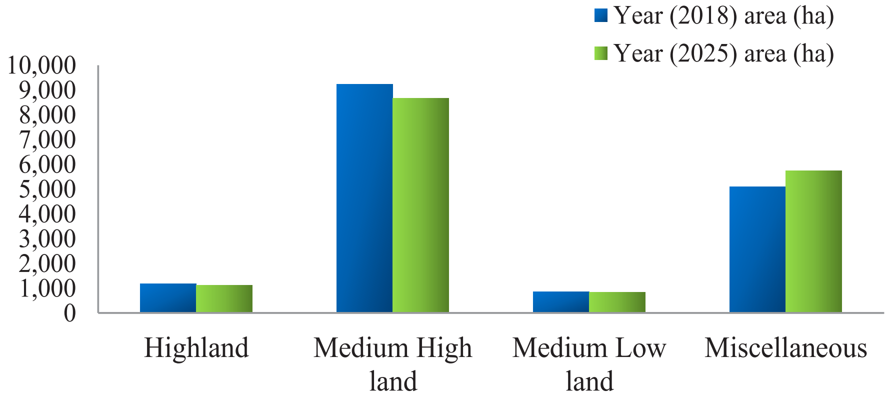


Fig 3.23: Changes in land type of Burichong, Cumilla

Table-3.26: Changes in Land Use of Burichong Upazila, Cumilla

Land type	Previous (2018)		Present (2025)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Jackfruit, Mango, Bambo, Banana	179	1.1	179	1.1	0	Due to new roads, more homesteads & increases of settlement
Boro-F-T.Aman	3,594	22	2948	18	(-) 4.0	
Boro-T.Aus-T.Aman	2,545	15.6	3276	20	(+) 4.6	Increases Of high value profitable crops like Rabi vegetables
Rabi Vegetables - F - T. Aman	1,077	6.6	753	4.6	(-) 2.0	Decrease of annual rainfall
Rabi Vegetables - F - Kharif Vegetables	1,201	7.3	1032	6.3	(-) 1.0	
Potato-Boro-F-T.Aman	1,342	8.2	1638	10	(+) 1.8	HYV
Boro- F- F	593	3.6	457	2.8	(-) 0.8	Decrease of annual rainfall
Rabi Vegetables - Aus - Kharif Vegetables	212	1.2	181	1.2	0	-
Others	534	3.3	173	1	(-)2.3	
Miscellaneous	5,100	31.1	5740	35	(+) 3.9	Settlement
Total	16,377	100	16,377	100	0	

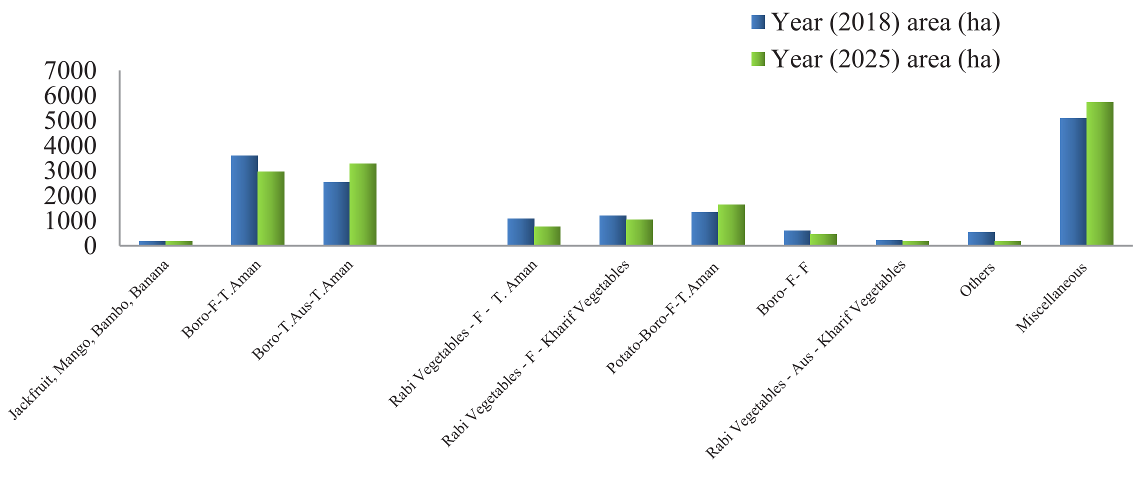


Fig 3.24: Changes in land use of Burichong, Cumilla

3.1.13 Major findings of Chakaria Upazila, Cox's Bazar

i) Total area-60,451 ha
ii) Total sample collected- 163
iii) Physiography & AEZ code-

- Northern and Eastern Hills. (29)
- Northern and Eastern Piedmont Plain (22)

iv) Major land type- HL, MHL, MLL, LL, VLL
v) Major soil group- Borokol, Subalong, Sitakundu, Nolua, Khadimnagar, 99angamati, Matiranga, Pahartali, Misrai, Rangapani, Lama, Ukia, Shuvopur, Mohori, Chakaria, Kutubdia, Chiringa, Harbang.
vi) Major land use-

- Fallow- fallow – T.aman
- Boro- fallow- T.aman
- Natural and Social forest
- Salt Bed, Shrimp culture.

Table-3.27: Changes in land type of Chakaria Upazila, Cox's Bazar (for floodplain piedmont and terrace area)

land type	Previous (1999)		Present (2024)		%increase/ decrease		Possible reasons/ Remarks
	Area(ha)	%	Area(ha)	%	Area(ha)	%	
Highland	17453	28.87	12594	25	-4859	-3.87	Due to separation of Pekua Upazila from Chakaria, the area has decreased by approximately 10,000 hectares. Because of human induced reasons such as soil cutting, deforestation new practices of settlements etc and also natural induced factors. Additionally, the area calculations have been corrected using digital mapping techniques.
Medium highland	33857	56	27708	55	-6149	-1	
Medium lowland	185	0.31	negligible	-	-184.69	-0.31	
Lowland	-	-	-	-	-	-	
Very Lowland	-	-	-	-	-	-	
Miscellaneous	8956	14.82	10076	20	+1120	+5.18	
Total	60451	100	50378	100	0	0	

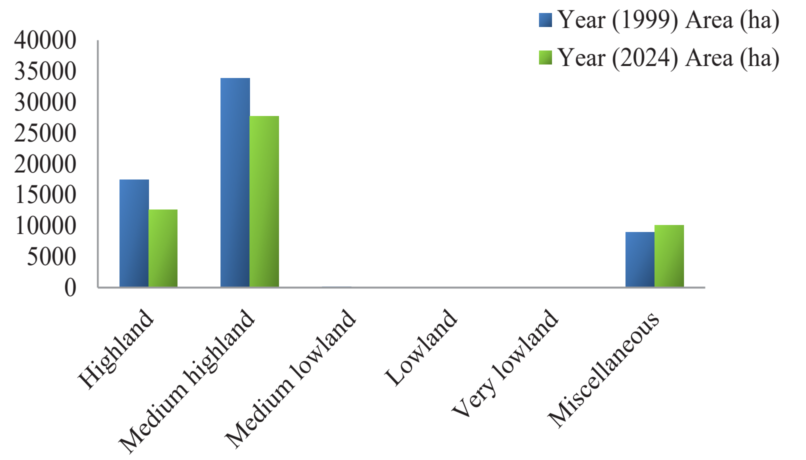


Fig 3.25: Changes in land type of Chakaria, Cox's Bazar

Table-3.28: Changes in land use of Chakaria Upazila, Cox's Bazar

Land use	Previous (1999)		Present (2024)		% increase/ decrease		Possible reasons/ Remarks
	Area(ha)	%	Area(ha)	%	Area(ha)	%	
1.Forest- natural& social (HL)	6045	10.0	4886	9.7	-1159	-0.3	These overall changes in crop arrangement has been observed due to socio economic status of the farmers. For making higher profit, farmers are increasingly turning to shrimp & salt cultivation. Additionally, the practice of Boro cultivation is increasing due to availability of irrigation.
2.Boro-fallow-T.Aman (MHL)	10337	17.1	14761	29.3	+4424	+12.2	
3. Tobacco-Fallow- T. Aman (HL, MHL)	5743	9.5	8060	16.0	+2317	+6.5	
4. Fallow-fallow-T.Aman (HL)	14145	23.4	4937	9.8	-9208	-13.6	
5. Rabicrops- Fallow- T. Aman (HL,MHL)	3023	5.0	2620	5.2	+403	+0.2	
6. Orchard & Perennial Plants (HL,MHL)	8826	14.6	2771	5.5	-6055	-9.1	
7.Salt bed & Shrimp culture (MHL, MLL)	3264	5.4	7305	14.5	+4041	+9.1	
8. Miscellaneous	9068	15.0	5038	10.0	-4030	-5.0	
Total	60,451	100.0	50,378	100.0	0.0	0.0	

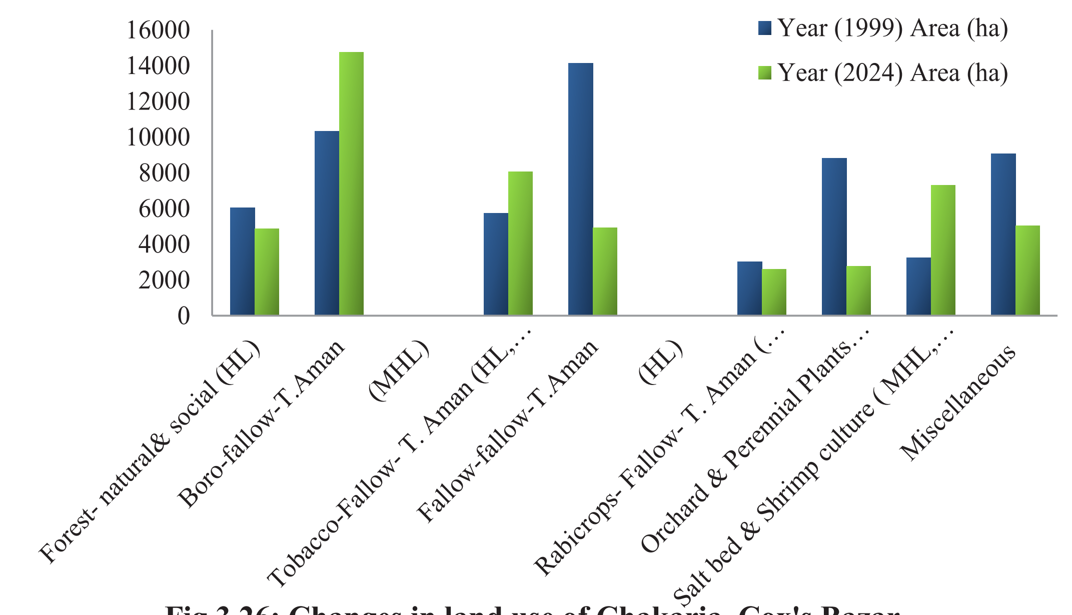


Fig 3.26: Changes in land use of Chakaria, Cox's Bazar

3.1.14 Major findings of Dasar Upazila, Madaripur

i) Total area-7,739 (ha)
ii) Total sample collected- 40
iii) Physiography & AEZ code- Low Ganges River Floodplain (12), Old Meghna Estuarine Floodplain (19), Gopalganj-Khulna Bills (14)
iv) Major land type- Highland, Medium Highland, Medium Lowland, Lowland
v) Major soil group- Sara, Gopalpur, Ishwardi, Ghior, Poisa, Palong, Uzirpur, Harta, Satla.

Table-3.29: Changes in land type of Dasar Upazila, Madaripur (for floodplain, piedmont and terrace area)

Land type	Previous Survey (2018)		Present Survey (2025)		% increase / decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	217	2.8	190	2.5	-0.3	Medium highland area increases due to decrease of inundation depth and improvement of drainage condition. Miscellaneous area increases due to increase of homestead garden, orchard and settlement.
Medium highland	1310	17	1558	20.1	+3.1	
Medium lowland	2323	30	2072	26.8	-3.2	
Lowland	1999	25.8	1854	24.0	-1.8	
Miscellaneous	1890	24.4	2065	26.6	+2.2	
Total	7,739	100	7,739	100		

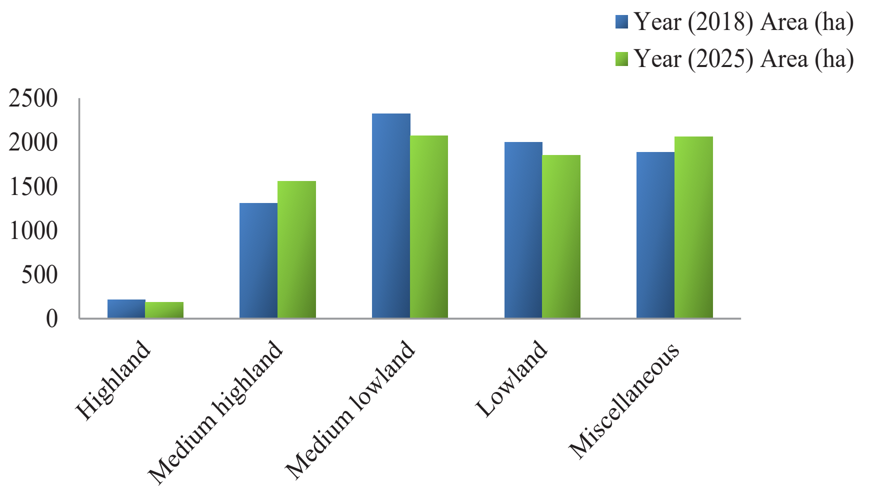


Fig 3.27: Changes in land type of Dasar, Madaripur

Table-3.30: Changes in land use of Dasar Upazila, Madaripur

Land use	**Land type**	**Previous Survey (2018)**		**Present Survey (2025)**		**% increase/ decrease**	**Possible reasons**
		Area (ha)	%	Area (ha)	%		
Boro- Fallow- T. Aman	HL, MHL, MLL	191	2.4	246	3.2	+0.8	Boro area coverage increases because of government incentives
RC– Fallow- T. Aman		342	4.4	410	5.3	+0.9	
Rc/Boro–Jute/B.Aman		1346	17.5	1369	17.7	+0.2	
Boro-B.Aman	MLL, LL	1063	13.7	1436	18.6	+4.9	
Boro- Fallow-Fallow	MLL, LL	2187	28.3	2080	26.9	-1.4	
Others	HL, MHL	720	9.3	133	1.7	-7.6	
Miscellaneous		1890	24.4	2065	26.6	+1.1	
Total		**7,739**	**100.0**	**7,739**	**100.0**		

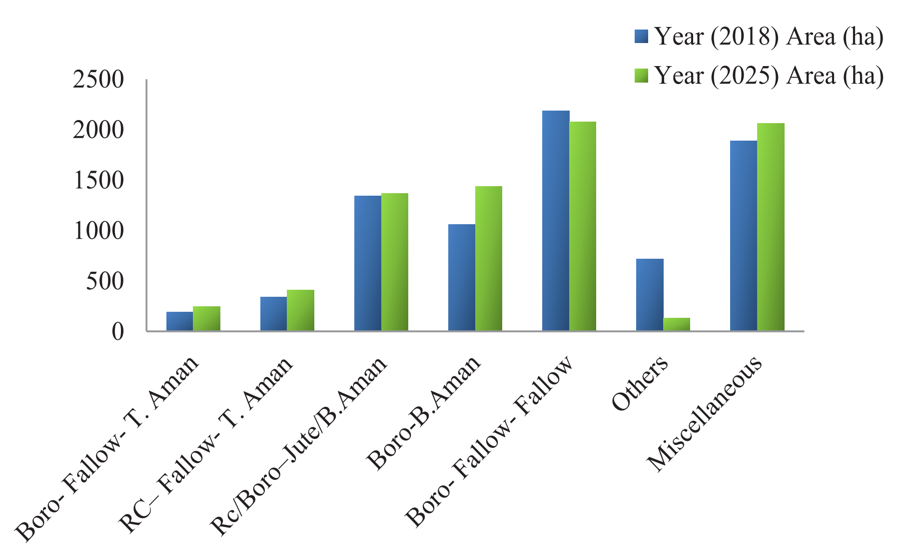


Fig 3.28: Changes in land use in Dasar, Madaripur

3.1.15 Major findings of Daganbhuiyan Upazila, Feni

i) Total area- 16583 ha
ii) Total sample colleted- 85
iii) Physiography - Young Meghna Estuarine Floodplain (18), Old Meghna Estuarine Floodplain (19)
iv)Major land type- MHL
v) Major soil group- Chandina, Chilonia, Homna, Faridgonj.
vi) Major land use- Boro-F-F, RC-F-TA, Boro-F-TA,

Table-3.31: Changes in Land Type of Daganbhuiyan Upazila, Feni

Land type	Previous (2014) Area (ha)	%	Present (2025) Area (ha)	%	% increase/ decrease	Possible reasons
Highland	346	2.1	307	1.9	-11.3	
Medium highland	12035	72.6	9303	56.1	-22.7	
Medium lowland	330	2.0	308	1.9	-6.7	
Miscellaneous	3872	23.3	6665	40.2	+72.1	
Total	16583	100.0	16583	100.0	0.0	

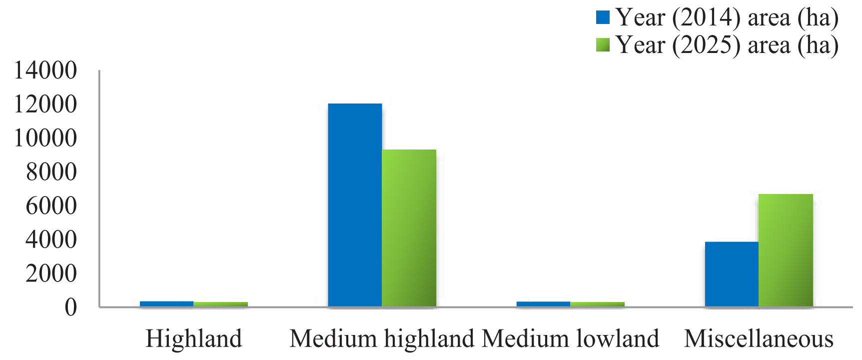


Fig 3.29: Changes in land type of Daganbhuiyan, Feni

Table-3.32: Changes in Land Use of Daganbhuiyan Upazila, Feni

Land Use	Previous Area (2015) (ha)	Previous %	Present Area (2025) (ha)	Present %	% increase/ decrease	Possible reasons
RV & KV	346	2.09	120	0.72	-65.32	
RC-F-TA	2105	12.69	1210	7.3	-42.52	
RC-T.Aush-TA	46	0.28	66	0.4	43.48	
Boro-F-TA	8789	53.0	3217	19.4	-63.4	
F- T.Aush-TA	504	3.04	169	1.02	-66.47	
F-F-TA	525	3.16	160	0.96	-69.52	
Boro-F-F	330	1.99	3798	22.9	1050.91	
Others	66	0.4	1248	7.53	1790.91	
Miscellaneous (settlement/reservoir/river/pond etc.)	3872	23.35	6595	39.77	70.33	
Total	16583	100.0	16583	100.0	0.0	

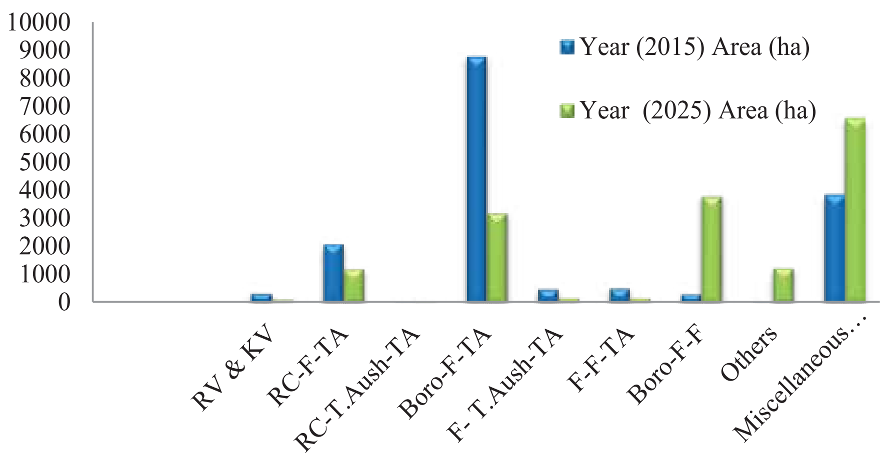


Fig 3.30: Changes in land use of Daganbhuiyan, Feni

3.1.16 Major findings of Ghior Upazila, Manikganj

i) Total area- 14467 ha
ii)Total sample collected- 70
iii)Physiography & AEZ code- Brahmaputra Floodplain (7, 8)
Ganges Floodplain (12)
iv)Major land type- Medium Low Land
v)Major soil group- Dhamrai, Sara, Gopalpur, Melandaha, Ghior
vi) Major land use-Robi Crops (Maize/Mustard)/ Boro-Fallow (38.5%)

Table-3.33: Changes in Land Type of Ghior Upazila, Manikganj (for floodplain, piedmont and terrace area)

Land type	Previous (Year)		Present (Year)		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Highland	120	0.8	140	1.0	+0.2	
Medium highland	668	4.0	875	6.0	+2	
Medium lowland	6592	46.0	7597	53	+7	
Lowland	4426	31.0	3083	21	-10	
Very Low land	26	0.2	0	0	-0.2	
Miscellaneous	2588	18	2772	19	+1	
Total	14420	100	14467	100		

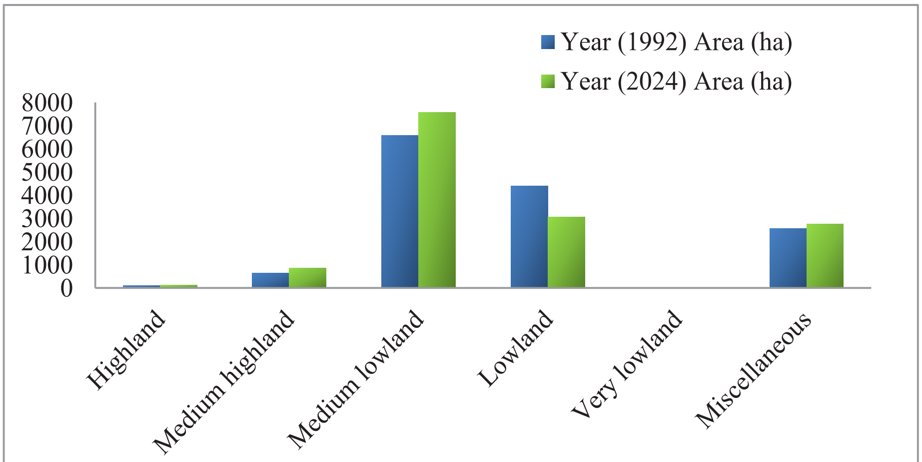


Fig 3.31: Changes in land type of Ghior, Manikganj

Table-3.34: Changes in land use of Ghior Upazila, Manikganj

Land use	Previous (1992)		Present (2024)		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Robi Crops-Mixed B.Aus & Aman	4616	32	-	-		
Boro-Fallow-Fallow	2662	18.5	2748	19	+0.5	
Robi Crops-B. Aus/Jute	2388	16.5	-	-	-16.5	
Robi Crops-B. Aman	2166	15	-	-	-15	
Robi Crops (Maize/Mustard)/Boro-Fallow	-	-	5547	38.5	+38.5	
Robi Crops (Maize/Mustard)/Boro-Transplanted Aman	-	-	2315	16	+16	
Robi Crops (Potato/Mustard/ Maize)/Boro-B.Aman	-	-	1085	7.5	+7.5	
Miscellaneous	2588	18	2772	19	+1	

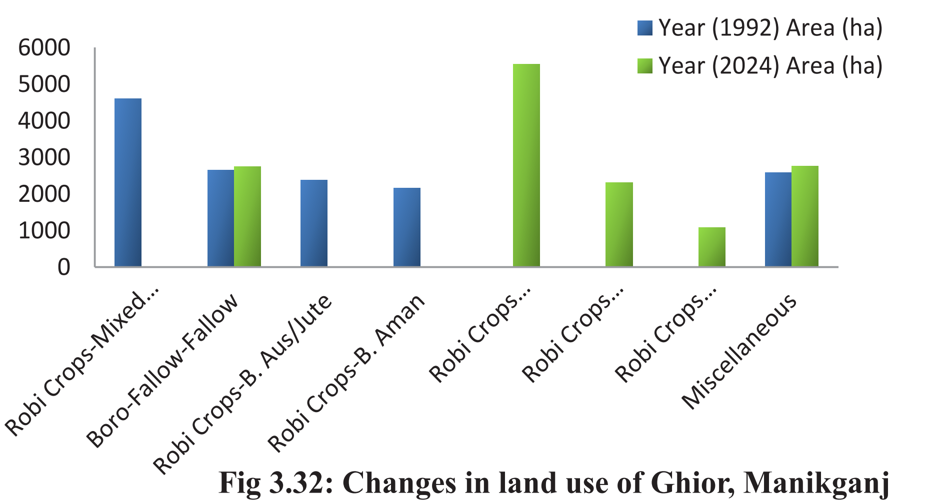


Fig 3.32: Changes in land use of Ghior, Manikganj

3.1.17 Major findings of Ghoraghat Upazila, Dinajpur

i) Total area- 14874
ii)Total sample colleted-111
iii)Physiography & AEZ code- Barind Area (25) & Tista Flood Plain (3)
iv)Major land type- MHL
v)Major soil group-Noadda, Amnura, Akdala, Jamun, Gangacora, Manda, Kaunia, Laskora, Tista Silt.
vi) Major land use- Robi crops -Boro-T.Aman

Table-3.35: Changes in land type of Ghoraghat Upazila, Dinajpur

Land type	Previous (2016)		Present (2024)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	5243	35.25	49828	33.5	-0.25	Increased due to settlement and infrastructure development
Medium highland	7222	48.55	7437	50.0	1.45	
Medium lowland	198	1.33	223.1	1.5	0.17	
Miscellaneous	2211	14.86	2231	15	0.14	
Total	14879	100.00	14789	100		

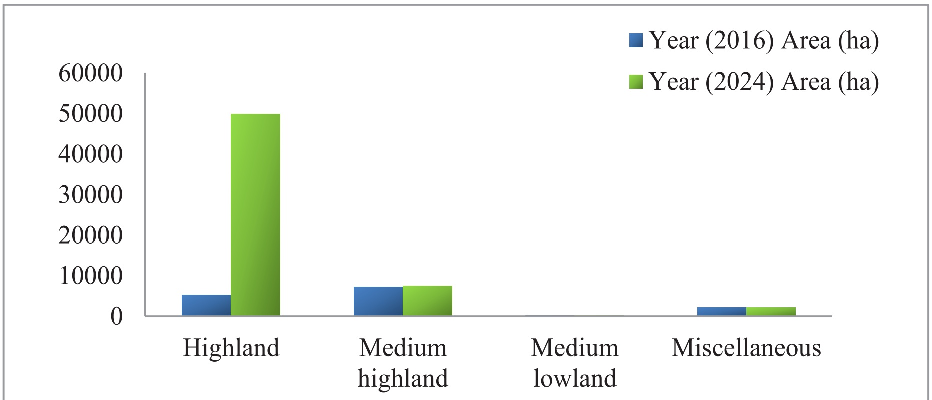


Fig 3.33: Changes in land type of Ghoraghat, Dinajpur

Table-3.36: Changes in land use of Ghoraghat Upazila, Dinajpur

Land use	Previous (year)2016		Present (year)2023		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Fruit orchard Mango/Jackfruit/Lichi/Ber	744	5	1488	10	0.05	
Rabi vegetables- Kharif vegetables	2232	15	2232	15	-	Due to changes in agricultural practices
Maize-Fallow-T.Aman	2976	20	2232	15	-5	
Potato/Mustard-Boro-T.Aman	0		2232	15	15	
Robi Crops-Jute/T.Aus-T. Aman	0		1488	10	10	
Boro-Fallow-T.Aman	3720	25	1488	10	-15	
Boro-Fallow-Fallow	2232	15	744	5	-10	
Other cropping patterns	1488	10	744	5	-5	
Miscellaneous	1488	10	2232	15	5	Rapid urbanization
Total	14,879	100	14,879	100		

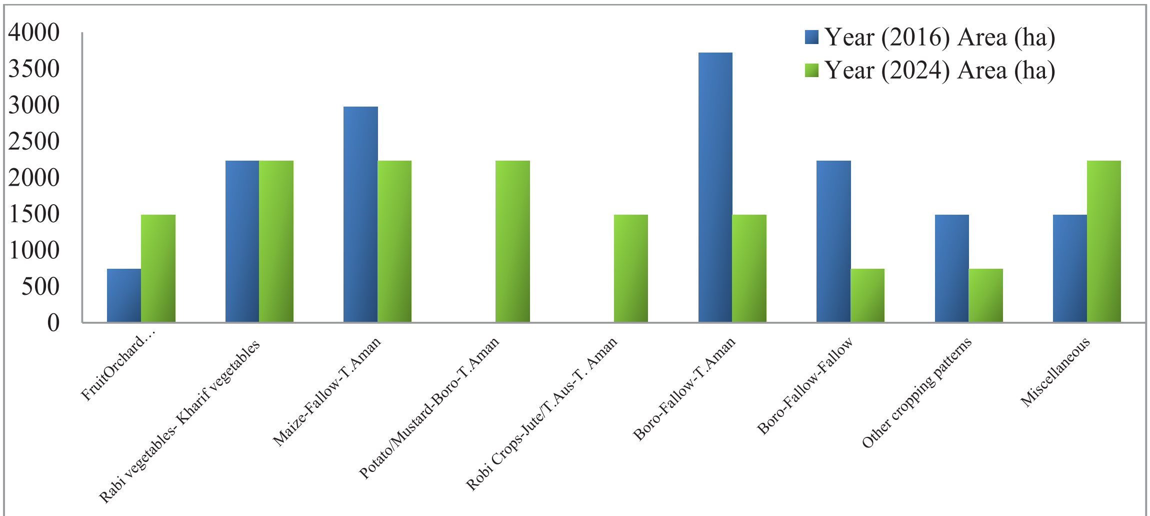


Fig 3.34: Changes in land use of Ghoraghat, Dinajpur

3.1.18 Major findings of Hatibandha Upazila, Lalmonirhat

i) Total area- 28,842 ha
ii)Total sample colleted-125
iii)Physiography & AEZ code- Tista Floodplain, Bhrammaputra Floodplain, AEZ-2, AEZ-3,
iv)Major land type- HL, MHL, MLL
v)Major soil group- Pirgacha, Polashbari, Gangachara, Kaunia, Saghata, Laskara
vi) Major land use- Boro-fallow-T. Aman

Table-3.37: Change in land type of Hatibandha Upazila, Lalmonirhat (for floodplain, piedmont and terrace area): Hatibandha, Lalmonirhat.

Land type	Previous (Year) 1998		Present (Year) 2024		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	7,734	26.9 %	5,130	17.8 %	9.1 % decrease	Due to increase of settlement, industries, change in river, pond, char land & exchange of Enclave (Seat Mahal).
Medium highland	12,052	41.9 %	10,332	35.8 %	6.1 % decrease	
Medium lowland	365	1.3 %	343	1.2 %	0.1 % decrease	
Miscellaneous	8,626	30.0 %	13,037	45.2 %	15.2% increase	
Total	28,777	100 %	28,842	100 %		

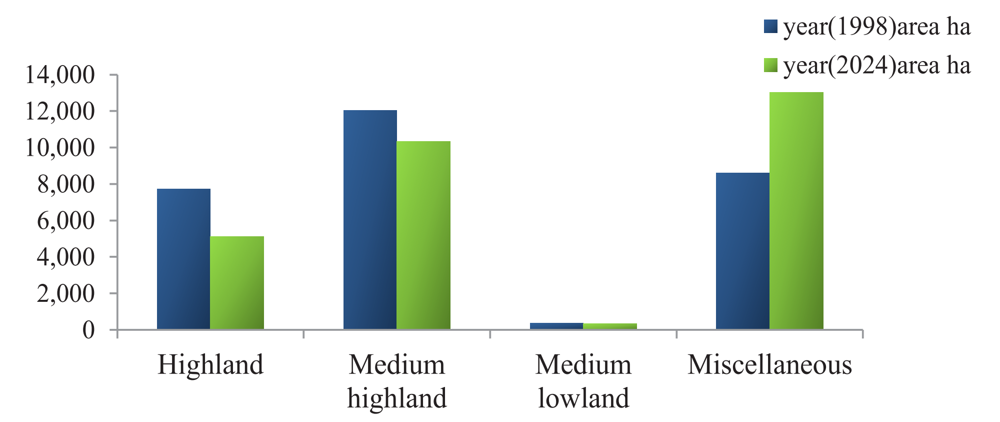


Fig 3.35: Changes in land type of Hatibandha, Lalmonirhat

Table-3.38: Change in land use: (Hatibandha upazila, Lalmonirhat)

Land use	1998 (year)		2024 (year)		% increase/ Decrease	Previous Cropping Pattern in 1998
	Area (ha)	%	Area (ha)	%		
Betel nut/banana/papaya/zinger/ Turmeric/ Perennial crops			213	0.7 %	0.3 % increase	Peanut-Fallow-T. aman =473 Fallow-Jute-T. Aman = 2470 Potato-Peanut-Fallow = 345 Fallow-Peanut-T. Aman = 177 Wheat-Fallow-T. Aman = 2193 Tobacco-Fallow-T. Aman =549
Vegetable- Vegetable- Vegetable			95	0.4 %	new introduce	
Robi Vegetables -Kharif Vegetables	512		215	0.7 %	Decrease	
Potato-Maize-T. Aman			1107	3.8 %	new introduce	
Maize-Aus- T. Aman			1590	5.5 %	new introduce	
Boro-Aus- T. Aman			297	1.0 %	new introduce	
Tobacco-Jute- T. Aman			281	1.0 %	new introduce	
Tobacco-Aus- T. Aman			213	0.7 %	new introduce	
Wheat-Jute- T. Aman	722		111	0.4 %	Decrease	
Mustard-Boro- T. Aman			545	1.9 %	new introduce	
Boro-Fallow- T. Aman	2790		3364	11.7 %	Increase	Wheat -Fallow- Fallow = 1024 Tobacco-Fallow-Fallow =960 Fallow-Fallow-T. Aman =7430 Boro- Fallow-Fallow =389 Fallow-FoxtailMillet-Fallow =112
Maize-Fallow- T. Aman			3516	12.2 %	new introduce	
Maize -Fallow-Fallow			2022	7 %	new introduce	
Pulse-Vegetables-Peanut			75	0.3 %	new introduce	
Vegetables-Peanut- T. Aman			139	0.5 %	new introduce	
Fallow	4087		1303	4.5%	Decrease	
Others			814	2.8 %	-	
Miscellaneous			13037	45.2 %	Increase	
Total			**28842**	**100** %		

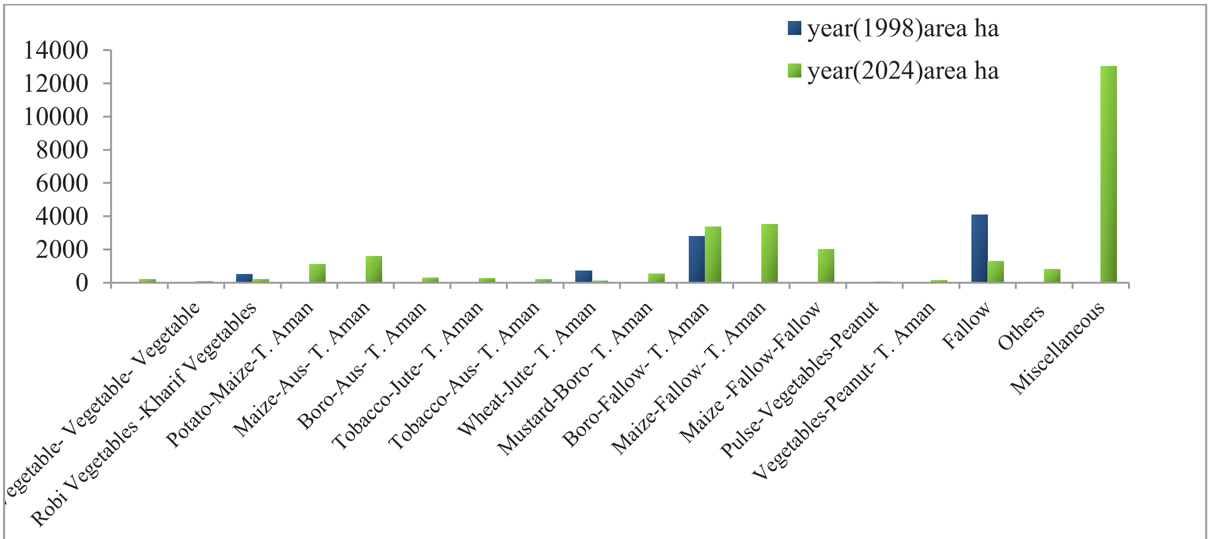


Fig 3.36: Changes in land use of Hatibandha, Lalmonirhat

Major Observations:

- Three vegetables cropping pattern introduced.
- 9,915 ha one crop cropping pattern converted to two crops cropping pattern
- In 2024 Wheat cultivated area reduced to 111 ha from 3,217 ha in 1998.
- Introduce Maize cultivation (cultivated area 6,214 ha; Rabi+kharif)
- Abolished/Vanished FoxtailMillet cultivation.
-

3.1.19 Major findings of Haripur Upazila, Thakurgaon

i) Total area-20,115

ii)Total sample colleted-107

iii)Physiography & AEZ code-Mixed Himalayan piedmont plain (1) and Tista floodplain (3)

iv)Major land type- HL

v)Major soil group-Jamun

vi) Major land use- Maize-Fallow-T. aman

Table-3.39: Changes in land type of Haripur Upazila, Thakurgaon (for floodplain, piedmont and terrace area)

Land type	Previous (2016)		Present (2025)		% increase/ Decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Highland	9,383	46.65	10,040	49.91	+3.26	Increased settlement and infrastructure development
Medium highland	7,518	37.38	7,135	35.47	-1.91	
Medium lowland	526	2.61	225	1.12	-1.49	
Miscellaneous	2,688	13.36	2,715	13.50	+0.14	
Total	20,115	100.00	20,115	100.00		

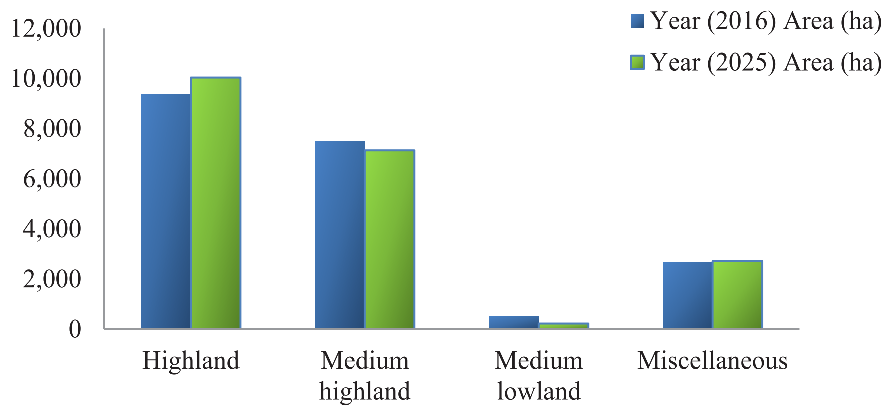


Fig 3.37: Changes in land type of Horipur, Thakurgaon

Table-3.40: Changes in land use of Haripur Upazila, Thakurgaon

Land use	Previous (2016)		Present (2025)		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Mustard/Potato-Boro (New variety)- T. Aman(New variety)	3322	16.5	1,230	6.11	-10.39	Due to introduction of/increase of wheat/maize in cropping pattern
Boro (New variety)-F.-T. Aman(New variety)	5296	26.33	3,145	15.63	-10.7	
Wheat/Maize-F.-T. Aman	5,440	27.04	10,520	52.30	+25.26	
Orchard(Mango/Lichi/Guava)	805	4.0	1,500	7.46	+3.46	
Banana/Papiya/Ginger/Sugarcane	805	4.0	200	1.0	-3.0	
Potato/Mustard-Maize- T. Aman(New variety)	623	3.1	220	1.10	-3.0	
Robi veg-Kharif veg	753	3.7	350	1.73	-1.97	
Robi veg-F.-T. Aman	52	0.3	-	-	-	
Others	106	0.5	50	0.25	-0.25	
Boro-F.-F.	225	1.12	185	0.92	-0.20	
Miscellaneous	2,688	13.4	2,715	13.5	+0.14	
	20,115	100.0	20,115	100.0		

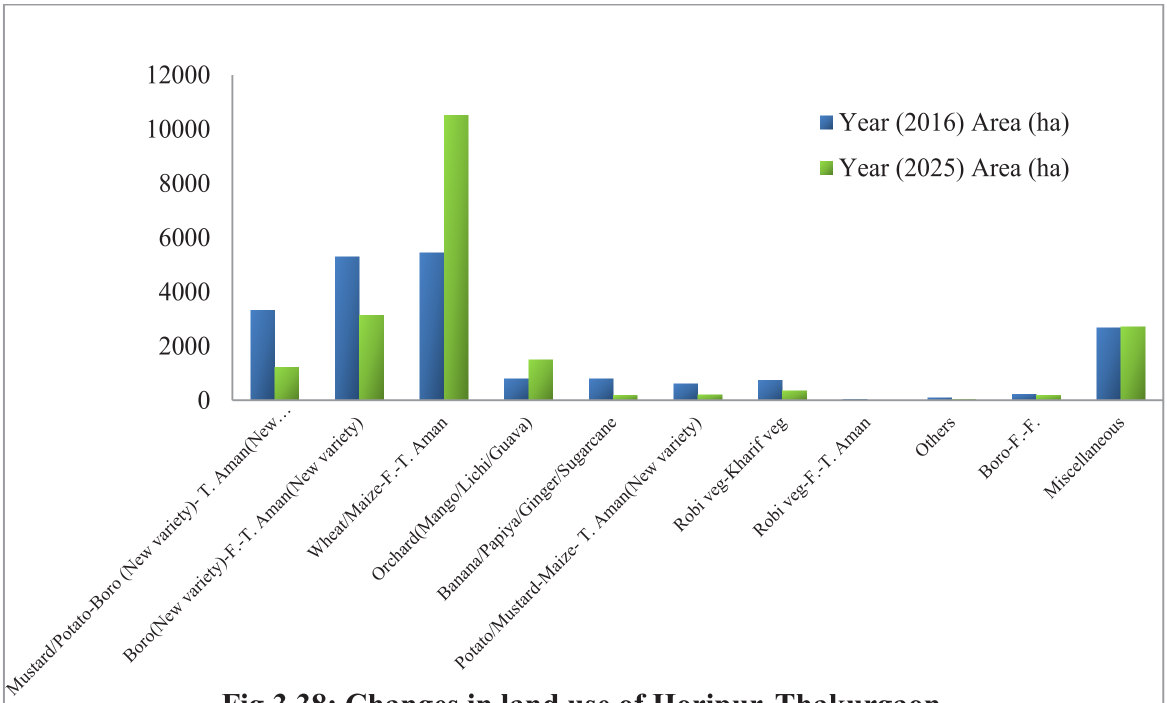


Fig 3.38: Changes in land use of Horipur, Thakurgaon

3.1.20 Major findings of Kachua Upazila, Chadpur

i) Total area	23,582 ha
ii) Total sample collected	121
iii) Physiography & AEZ code	Total Physiography : 1 Old Meghna eastuarine floodplain (19)
iv) Major land type	Total land type : 4 High Land, Medium Highland (major), Medium Low land, Low land.
v) Major soil group	Total soil Series : 3 Chandina (major),Debidwar,Burichong,
vi) Major land use	Total land use : 17 Potato - Mixed Aush & T. Aman (major), Rabi Vegetables-F-F, Rabi Vegetables-Boro-T. Aman, Boro-T. Aus-T. Aman, Boro-F-T.Aman etc. Rabi Vegetables-Boro-T. Aman

Table-3.41: Changes in land type of Kachua Upazila, Chadpur

(for floodplain, piedmont and terrace area)

Slope class/ Land type	Previous (1999)		Present (2025)		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Highland	585	2.48	1179	5	(+) 2.52	Due to increase of homestead garden, orchard etc.
Medium highland	5,014	21.26	4,716	20	(-) 1.26	Due to new roads, more homesteads & increases of settlement
Medium lowland	8,190	34.73	8,254	35	(+) 0.27	Increases of high value profitable crops like Rabi vegetables (potato).
Lowland	4,004	16.98	3,537	15	(-) 1.98	Due to more flash flood, siltation and sediments
Very lowland	0	0	0	0	0	-
Miscellaneous	5,789	24.55	5,896	25	(+) 0.45	Due to new roads, more homesteads & increases of settlement
Total	23,582	100	23,582	100	0	-

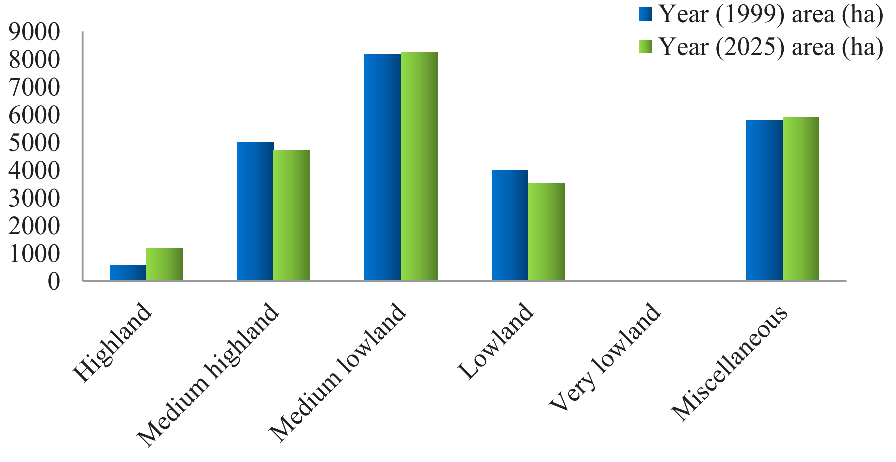


Fig 3.39: Changes in land type of Kachua, chandpur

Table-3.42: Changes in land use of Kachua Upazila, Chadpur

Land use	Previous (1999)		Present (2025)		% increase(+)/ decrease(-)	Possible Reasons
	Area (Ha)	%	Area (Ha)	%		
Orchard (Betel Nut, Coconut etc.)	128	0.54	142	0.6	(+) 0.06	1) Increases of high value profitable crops like Rabi vegetables (potato) 2) Increases of Boro rice cultivation due to high yield. 3) Due to new roads, more homesteads & increases of settlement
Rabi Vegetables - Aush - T. Aman	1714	7.27	2004	8.5	(+) 1.23	
Boro - F - T.Aman	2058	8.73	2240	9.5	(+) 0.77	
F - Aush - T. Aman	208	0.88	146	0.62	(-) 0.26	
Rabi Vegetables - Aush - F	189	0.8	224	0.95	(+) 0.15	
Rabi Vegetables - F - T. Aman	2174	9.21	2134	9.05	(-) 0.16	
Rabi Vegetables - Mixed Aush & T. Aman	240	1.02	111	0.47	(-) 0.55	
Boro -T. Aush - T. Aman	586	2.48	601	2.55	(+) 0.07	
Wheat -T. Aush - T. Aman	407	1.73	137	0.58	(-) 1.15	
Potato -T. Aush - T. Aman	172	0.73	201	0.85	(+) 0.12	
Wheat - Mixed Aush & Aman	3,649	15.47	1,729	7.33	(-) 8.14	
Potato - Mixed Aush & T. Aman	2547	10.8	2948	12.5	(+) 1.7	
F - Mixed Aush & T. Aman	212	0.9	146	0.62	(-) 0.28	
Rabi Crops - Jute - T. Aman	813	3.45	1061	4.5	(+) 1.05	
Potato – Aman	170	0.72	2170	9.2	(+) 8.48	
Boro - Mixed Aush & T. Aman	169	0.72	120	0.51	(-) 0.21	
Boro - F – F	2306	9.78	1233	5.23	(-) 4.55	
Miscellaneous	5840	24.77	6235	26.44	(+) 1.67	
Total	23582	100	23582	100	0	-

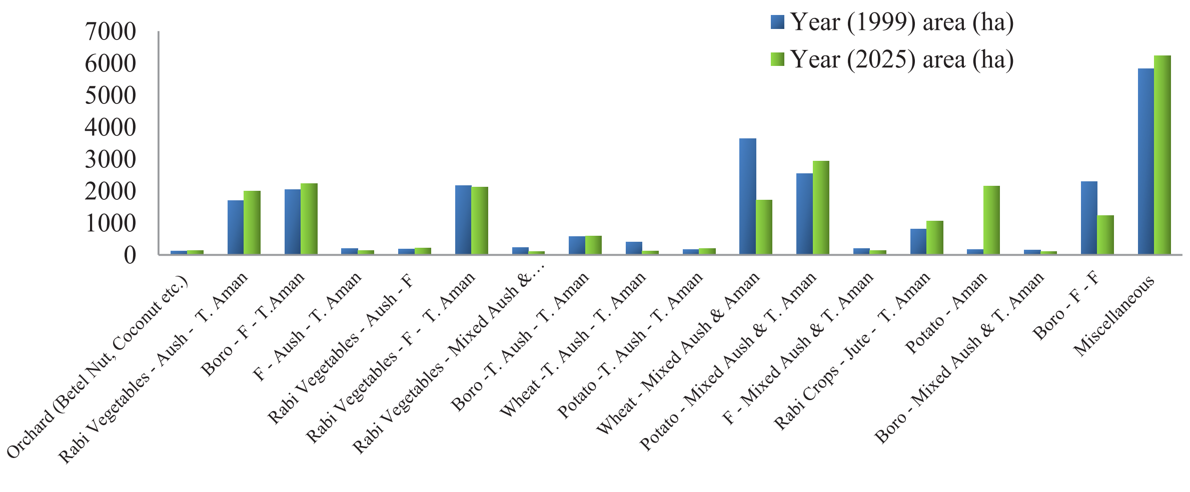


Fig 3.40: Changes in land use of Kachua, chandpur

3.1.21 Major findings of Kaharole Upazila, Dinajpur

i) Total area-20,555 ha.
ii) Total sample collected-82
iii) Physiography & AEZ code- Old Himalayan Piedmont Plain (1), Barind Tract (25 & 27), Tista Floodplain (3)
iv) Major land type- Highland, Medium highland & Medium lowland.
vi) Major soil group-Noadda, Amnura, Ekdala, Ranisankail, Domar, Pirgachha, Jamun, Gangachara, Loshkora, Nandigram, Kaunia.

Table-3.43: Changes in Land Type of Kaharole Upazila, Dinajpur (for floodplain, piedmont and terrace area)

Land type	Previous (Year-2017)		Present (Year-2025)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	8079	39.3	7998	38.9	-1.00	Infrastructural Development, Top Soil Removal for Brick kiln, Riverbank Erosion etc.
Medium highland	9192	44.7	8732	42.5	-2.2	
Medium lowland	72	0.4	72	0.4	0.00	
Lowland	-	-	-	-	-	
Miscellaneous	3212	15.6	3753	18.2	2.6	
Total	20,555	100.0	20.555	100.0		

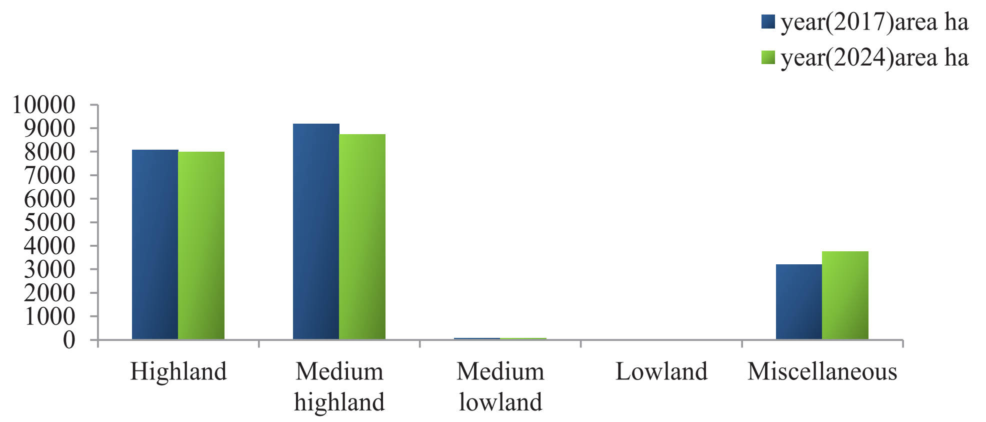


Fig 3.41: Changes in land type of Kaharole, Dinajpur

Table-3.44: Changes in land use of Kaharole Upazila, Dinajpur

Land use	Previous (year-2017)		Present (year-2025)		% increase / decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Mango/Litchi/Banana/Jackfruit/Sugarcane	1538	7.5	1538	7.5	+0.0	Invention of High Yielding Variety, Modern Agricultural Technology, More Irrigation Facility, Increase of Awareness etc.
RabiCrops(Mustard/Potato)-Boro-(M)/Maize-T Aman(M)	2973	14.5	3093	15.0	+0.5	
RabiCrops (Wheat/Maize/Potato/Mustard)-F- T. Aman(M)	2912	14.2	3088	15.0	+0.8	
Boro –F- T. Aman	43	0.2	43	0.2	0.0	
Rabi Vegetables- Kharif Vegetables	211	1.0	211	1.0	0.0	
Rabi Crops (Potato/ Mastard)- Boro /Maize- T. Aman	2585	12.6	2382	11.6	-1.0	
Boro- F- T. Aman	5480	26.7	5318	25.9	-0.8	
RabiCrops(Wheat/Maize/Potato/Mustard) -F-T.Aman(M)	1054	5.2	959	5.1	+0.1	
RabiCrops (Mustard/Maize/Wheat)-Boro-T. Aus-T. Aman	36	0.1	36	0.1	0.0	
Robi Crops- Mustard- Boro- T. Aman	37	0.1	37	0.1	0.0	
Boro-F-F	72	0.4	72	0.4	0.0	
Other Patterns	402	1.9	25	0.1	-1.8	
Others (Settlement/water body/Orchard)	3212	15.6	3753	18.2	+2.6	
Total	20,555	100.0	20,555	100.0		

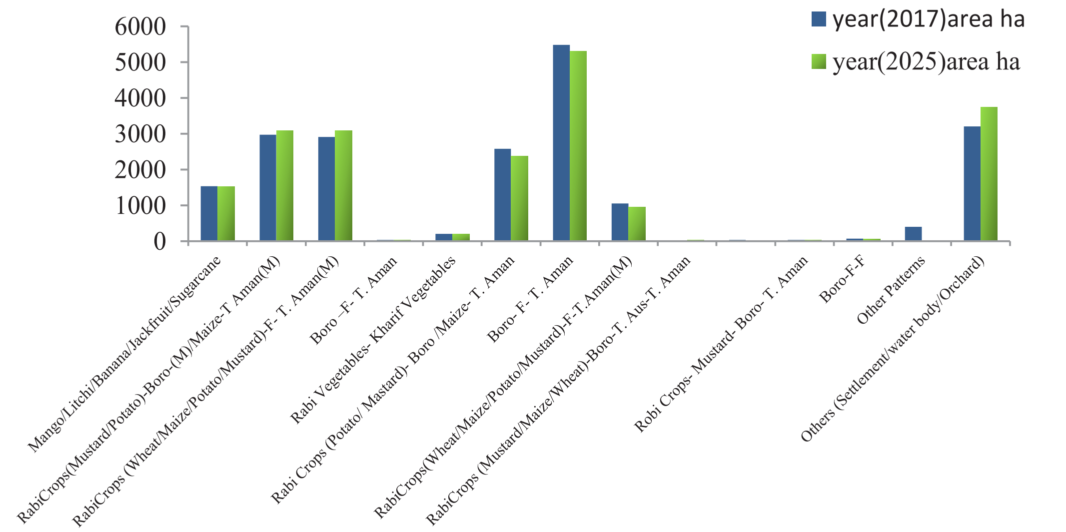


Fig 3.42: Changes in land use of Kaharole, Dinajpur

3.1.22 Major findings of Kanaighat Upazila, Sylhet

i) Total area-40101 ha
ii) Total sample colleted-125
iii) Physiography & AEZ code- Eastern Surma Kushiara Floodplain (Code-20)
NORTHERN AND EASTERN PIEDMONT PLAINS (Code-22)
NORTHERN AND EASTERN HILLS(Code-29)
iv) Major land type - Medium High Land, High Land, Low Land, Medium Low Land
v) Major soil group- Phagu, Gowainghat, Balagonj
vi) Major land use- Boro-Fallow-Fallow, Fallow-T.Aus-T.Aman, Fallow-Fallow- T.Aman, Fallow-Aus-T.Aman

Table-3.45: Changes in land type of Kanaighat Upazila, Sylhet

Land type	Previous (Year) 2001		Present (Year) 2024		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
High land	9511	23.7%	7179	19.9%	-5.8%	Urban expansion
Medium highland	12072	30.1%	11904	29.7%	-0.4%	Urban expansion
Medium Lowland	4224	10.5%	4407	11.0%	+0.50%	Low land has become Medium Lowland
Lowland	5822	14.5%	5366	13.4%	-1.1%	Siltation and erosion of Surma River
Very Lowland	1143	2.9%	1013	2.6%	-0.3%	Siltation and erosion of Surma River
Miscellaneous	7329	18.3%	10214	25.4%	+7.1	Increased area of Settlement
Total	40101	100	40101	100	-	

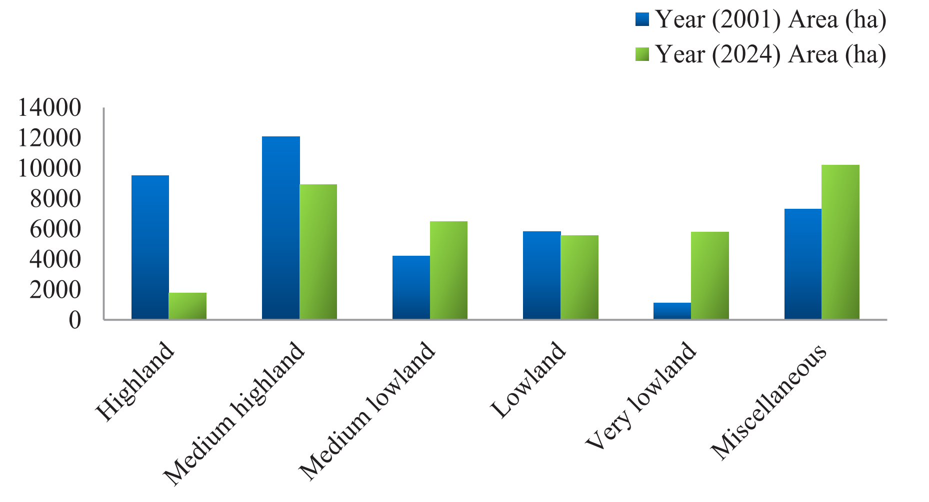


Fig 3.43: Changes in land type of Kanaighat, Sylhet

Table-3.46: Changes in land use of Kanaighat Upazila, Sylhet

Land use	Previous (year) 2001		Present (year) 2024		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Perennial crops	2354	5.9%	2005	5%	-0.9%	-
Fallow-T.Aus-T.Aman	7586	18.8%	-	-	-	Change in Cropping Pattern
Fallow-Fallow-T.Aman	5080	12.7%	12030	30%	17.3%	Change in Cropping Pattern,Change of Farmers Choice
Boro- Fallow-Fallow	6767	16.9%	6015	15%	-1.9%	Decrease in LL and VLL
Others	10985	27.4%	12031	30%	2.6%	-
Miscellaneous	7329	18.3%	8020	20%	1.7%	Urban expansion
Total	40101	100	40101	100		

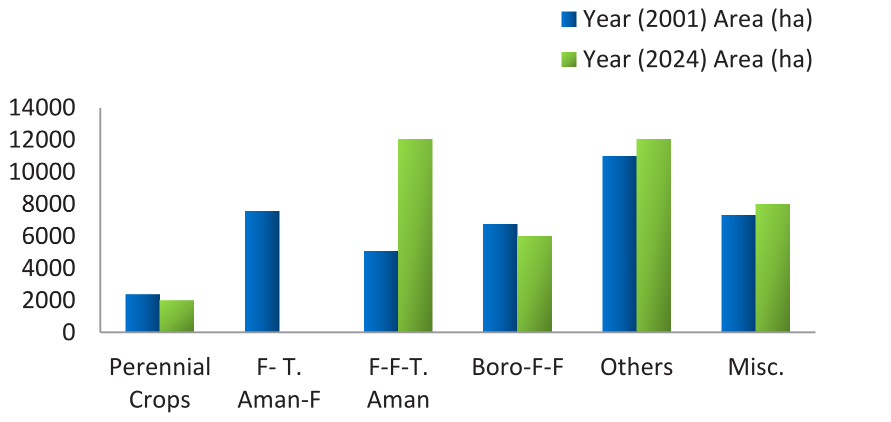


Fig 3.44: Changes in land use of Kanaighat, Sylhet

3.1.23 Major findings of Khoksa Upazila, Kushtia

i) Total area- 10,672 ha
ii)Total sample colleted- 58
iii)Physiography & AEZ code- Active Ganges Floodplain, High Ganges River Floodplain, Low Ganges River Floodplain and AEZ 10, 11 and 12.
iv)Major land type- Highland, Medium Highland, Medium Lowland, Lowland
v)Major soil group- Sara, Gopalpur, Ishurdi, Ghior, Etc.
vi) Major land use- Rabi Crops-Jute-T. Aman; Rabi Crops-Fallow-T. Aman/Fallow; Boro-Fallow-T. Aman; Boro (Local/HYV)-T. Aus-T. Aman.

Table-3.47: Changes in land type of Khoksa Upazila, Kushtia

Land type	Previous (2008)		Present (2024)		% increase/ Decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Highland	2,384	22.34	2165	20.29	-9.18	
Medium highland	2,687	25.17	2507	23.49	-6.70	
Medium lowland	3,097	29.02	2940	27.55	-5.07	
Lowland	416	3.90	310	2.90	-25.48	
Miscellaneous	2,088	19.57	2750	25.77	+31.71	
Total	**10,672**	**100**	**10,672**	**100**		

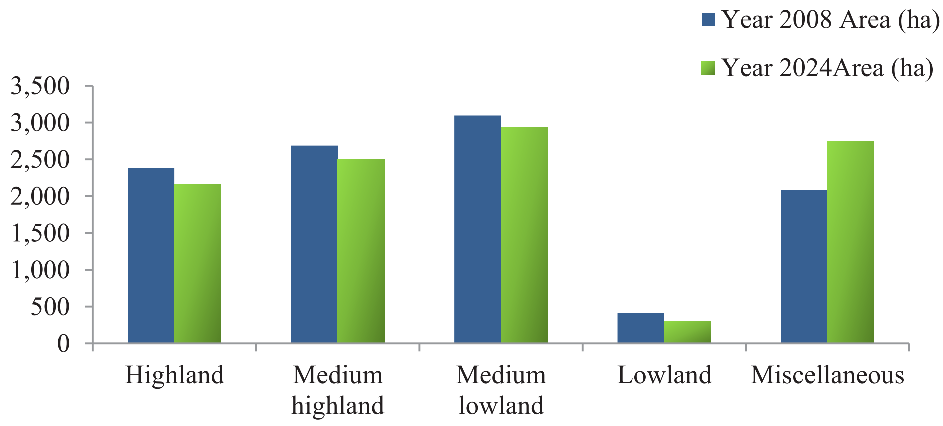


Fig 3.45: Changes in land type of Khoksha, Kushtia

Table-3.48: Changes in land use of Khoksa Upazila, Kushtia

Land use	Previous (2012)		Present (2024)		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Annual	430	4.03	380	3.56	-11.63	
Perennial	-	-	262	2.46	-	
Miscellaneous	2088	19.56	2750	25.77	+31.71	
Rabi vegetables-Kharif vegetables	52	0.49	200	1.87	+284.62	
Rabi crops- Mixed B. (Aus+Aman)	1219	11.42	105	0.98	-91.30	
Rabi crops-Jute-T. Aman	3767	35.30	2830	26.52	-24.87	
Rabi crops-Jute- Mixed B. (Aus+Aman)	83	0.78	-	-	-	
Rabi crops-Fallow-T. Aman/Fallow	783	7.34	1035	9.70	+32.19	
Rabi crops-Kharif vegetables- T. Aman/Fallow	238	2.23	205	1.92	-13.86	
Boro (Local/HYV)-T. Aus-T. Aman	754	7.06	815	7.64	+8.10	
Boro-Fallow-T. Aman	195	1.83	900	8.43	+361.54	
Boro-B. Aus/T. Aman(local/HYV)-Fallow	365	3.42	190	1.78	-47.95	
Boro- Mixed B. (Aus+Aman)	208	1.95	-	-	-	
Boro-Fallow- Fallow	-	-	150	1.41	-	
Rabi crops-Sesame-T. Aman	-	-	250	2.34	-	
Others	490	4.59	600	5.62	+22.45	
Total	**10,672**	**100**	**10,672**	**100**		

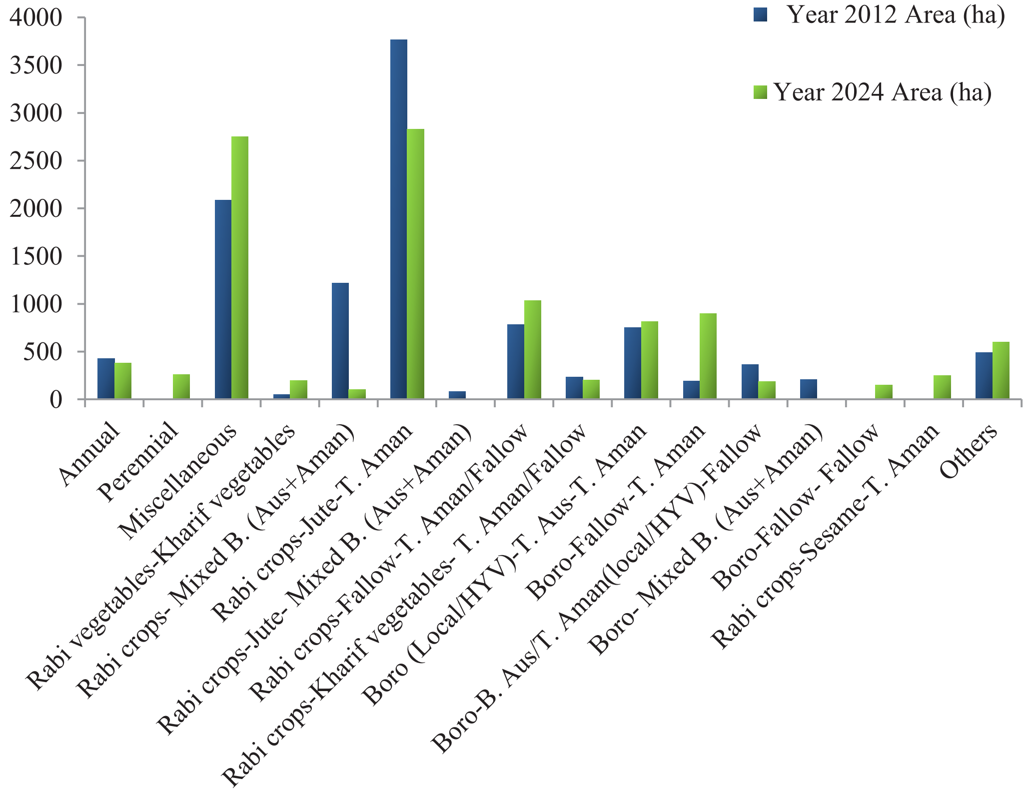


Fig 3.46: Changes in land use of Khoksha, Kushtia

3.1.24 Major findings of Kishoreganj Upazila, Nilphamari

i) Total area- 20,492
ii) Total sample colleted- 159
iii) Physiography & AEZ code- Tista Flood Plain (3)
iv) Major land type- HL, MHL, MLL
v) Major soil group- Domar, Pirgacha, Polash Bari.
vi) Major land use- Tobaco-Fellow-T.Aman, Boro-Fellow-T.Aman

Table-3.49: Changes in Land Type of Kishoreganj Upazila, Nilphamari

Land type	Previous (Year) 2015		Present (Year) 2024		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	6,906	33.7	7,106	34.68	2.90	Siltation/sedimentation, Reduced flooding depth
Medium highland	11,125	54.3	10,925	53.31	-1.85	
Medium lowland	137	0.7	126	0.61	12.85	
Lowland	-	-				
Miscellaneous	2,324	11.3	2,335	11.4	0.88	
Total	20,492	100	20492	100		

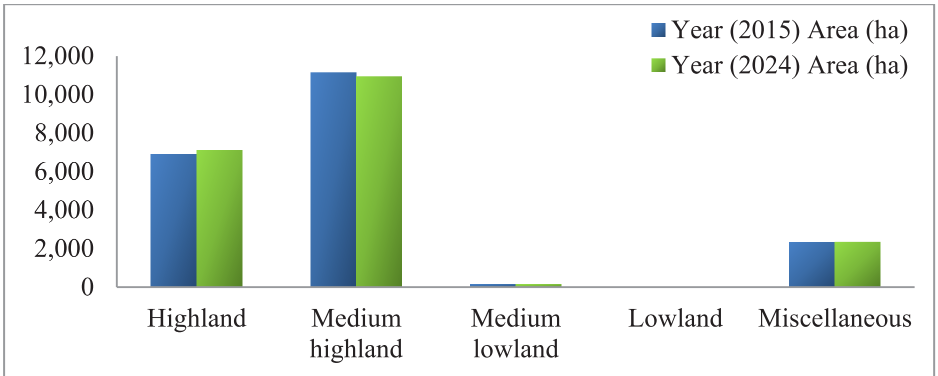


Fig 3.47: Changes in land type of Kishoreganj, Nilphamari

Table-3.50: Changes in land use of Kishoreganj Upazila, Nilphamari

Land use	Previous (2008 Year)		Present (2023 Year)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Annual Crops (Zinger/Turmeric/Sugarcane)	573	2.8	1025	5	2.2	Due to increased crop intensity
Rabi Vegetables-Kharif Vegetables	572	2.8	2049	10	7.2	
Tobaco-Boro-T. aman	1,668	8.1	1025	5	-3.1	
Boro-Fellow-T. Aman	7,711	37.6	3074	15	-22.6	
Potato – Maize-T.Aman	458	2.2	1025	5	2.8	
Mastered-Boro- T. Aman	444	2.2	2049	10	7.8	
Potato(Early)-Maize-Tobaco/T.Aman	5,452	26.6	2049	10	-16.6	
Wheat –Jute-T.Aman	444	2.2	2049	10	7.8	
Potato/Chilies-Jute-T.Aman	336	1.8	2049	10	8.2	
Potato(Early)-Potato-Maize(Fellow)	336	1.6	1025	5	3.4	
Other Croping Pattern	174	0.8	1025	5	4.2	
Miscellaneous(Homestead/Water bodies /Garden etc)	11.3	2049	10	-1.3		
Total	100	20,492	100			

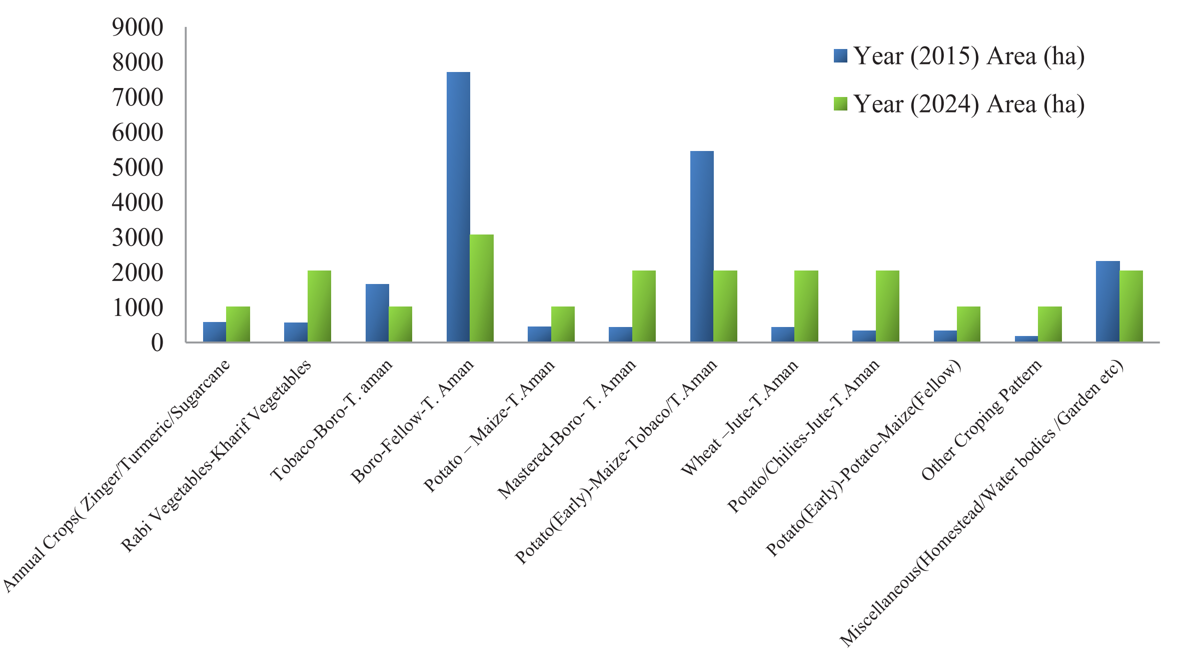


Fig 3.48: Changes in land use of Kishoreganj, Nilphamari

3.1.25 Major findings of Jalakathi Sadar Upazila, Jalakathi

i) Total area- 21,293 ha
ii)Total sample colleted- 100
iii)Physiography & AEZ code- Ganges Floodplain (12) and Ganges Tidal Floodplain (13)
iv)Major land type- Medium Highland
v)Major soil group- Sara, Gopalpur, Ramgati, Jhalakati, Barishal, Betagi, Pirojpur & Polymati
vi) Major land use-
F- T.Aus- TA, B-F-TA, RC(Chilli/Gnut/Potato/Grasspea/til/lentil)-F- TA, Boro- T.Aus- TA, F-F-TA, B-F- F, Surjon.

Table-3.51: Changes in Land Type of Jalakathi Sadar Upazila, Jalakathi (for floodplain, piedmont and terrace area)

Land type	Previous (2007)		Present (2025)		% increase/ Decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	1,061	4.9	776	3.6	-1.3	Cultivable land converted into homestead garden, orchard and settlement
Medium highland	14,031	65.9	13,230	62.2	-3.7	
Medium lowland	461	2.2	365	1.7	-0.5	
Miscellaneous	5,740	27.0	6,922	32.5	+5.5	Gain of area due to homestead garden, orchard and settlement
Total	21,293	100.0	21,293	100.0	-	

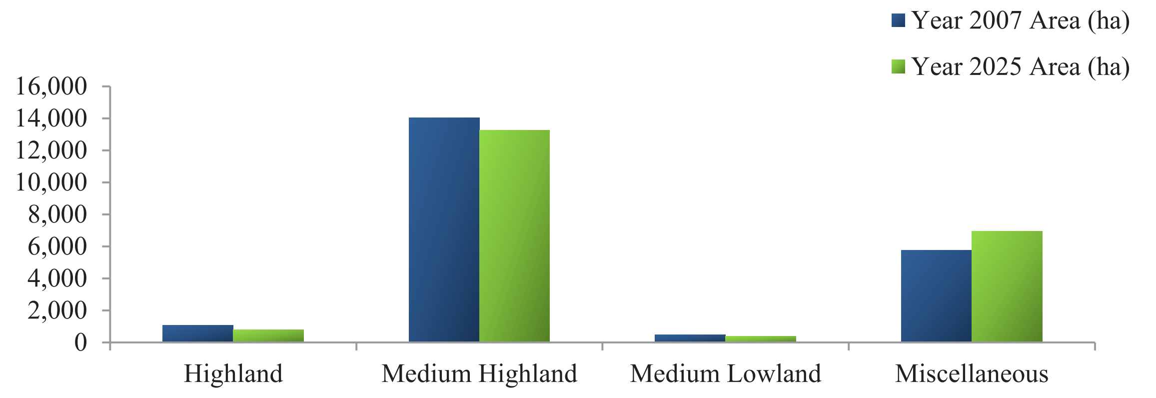


Fig 3.49: Changes in Land Type of Jalakathi Sadar Upazila, Jalakathi

Table-3.52: Changes in Land Use of Jalakathi Sadar Upazila, Jalakathi

Land Use	Land type	Previous (2007)		Present(2025)		% increase/ decrease	Possible Reasons
		Area (ha)	%	Area (ha)	%		
1. F- T.Aus- TA	MHL	4,141	19.4	477	2.2	-17.2	Aus production has declined due to cost and uneven seasonal rain
2. B-F-TA	HL/MHL/ MLL	3,045	14.3	6524	30.6	+16.3	
3.RC(Chilli/Gnut/Potato/Grasspea/til/lentil)-F- TA	HL/MHL	2,423	11.3	3010	14.2	+2.9	
4. Boro- T.Aus- TA	MHL	0	0	753	3.5	+3.5	
5. F-F-TA	MHL/MLL	2,203	10.3	985	4.6	-5.7	
6. B-F- F	MHL/MLL	2,119	10.0	89	0.4	-9.6	
7. Sarjon	MHL	212	1.0	674	3.3	+2.3	Improved land use & higher return
8. Others	HL/MHL	1410	6.7	1859	8.7	+2.0	Land use changed
Miscellaneous	-	5,740	27.0	6,922	32.5	+5.5	Increasing homstead, urbanization, development activities, orchard, garden etc
Total		21,293	100.0	21,293	100.0		

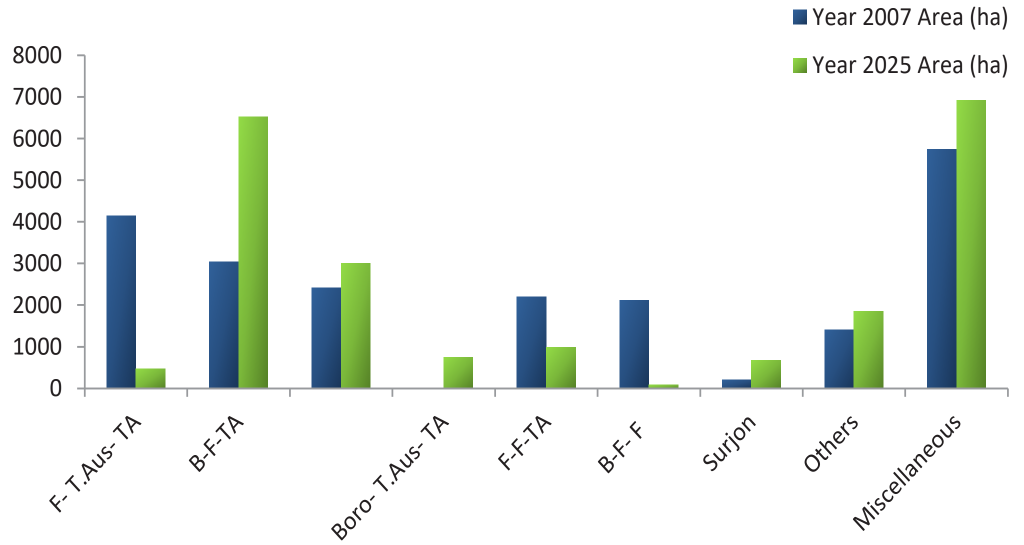


Fig 3.50: Changes in Land use of Jalakathi Sadar Upazila, Jalakathi

3.1.26 Major findings of Jhenaidah Sadar Upazila, Jhenaidah

i) Total area- 46,778 ha
ii) Total sample colleted-219
iii) Physiography -Ganges Floodplain; AEZ code- High Ganges River Floodplain (11)
iv) Major land type- HL, MHL, MLL, LL
v) Major soil group-Sara, Gopalpur, Ishwardi, Ghior.
vi) Major land use- Boro- F –TA

Table-3.53: Changes in land type of Jhenaidah Sadar Upazila, Jhenaidah

Land type	Previous (2014)		Present (2025)		% increase/ Decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	10,818	23.1	9,817	21.0	(-) 9.3	-
Medium highland	17,665	37.8	16,375	35.0	(-) 7.3	-
Medium lowland	5,705	12.2	5,386	11.5	(-) 5.6	-
Lowland	1,642	3.5	1,478	3.2	(-) 10.0	-
Miscellaneous	10,948	23.4	13,722	29.3	(+) 5.9	-
Total	46,778	100.0	46,778	100.0		

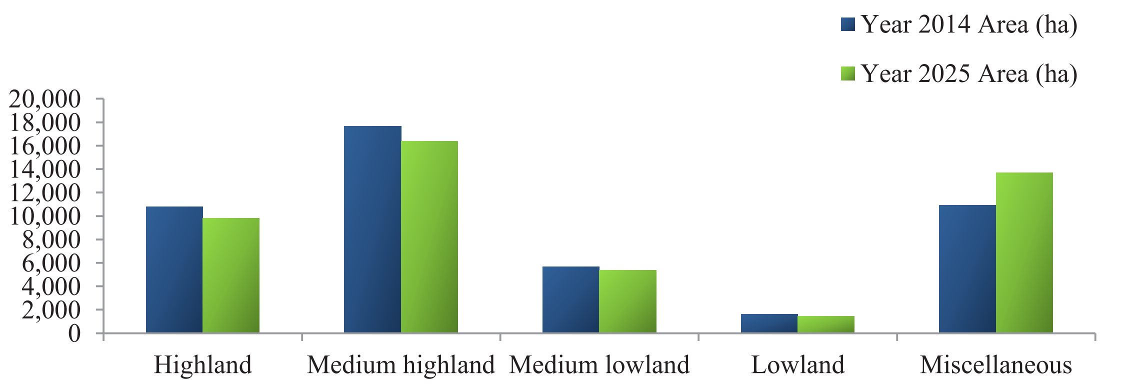


Fig 3.51: Changes in land type of Jhenaidah Sadar, Jhenaidah

Table-3.54: Changes in land use of Jhenaidah Sadar Upazila, Jhenaidah

Land Use	Previous (2015)		Present (2025)		% increase/ Decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Sugarcane/Banana/Betel leaf	1,332	2.9	1,852	3.9	+ (39.1)	
Garden(Mango, Litchi, Jackfruit, Guava)	1,332	2.9	1,620	3.5	+ (21.6)	
RV-KV	5,091	10.8	5,989	12.8	+ (17.7)	
RC-Jute-TA	5,933	12.7	3,234	6.9	- (45.5)	
RC(Mustard)- Boro- TA	3,462	7.4	4,227	9.1	+ (22.1)	
Boro- F -TA	11,836	25.3	10,254	21.9	-(13.4)	
Boro -Fallow-Fallow	5,904	12.6	1,207	2.6	- (79.6)	
Maize- KV- TA		-	2,960	6.3	-	
Rc(Mustard)- Boro- Jute-TA		-	1,123	2.4	-	
Tobacco- Jute- TA		-	1,052	2.2	-	
Onion-Jute- TA		-	884	1.9	-	
Others	940	2.0	995	2.1	+ (5.9)	
Miscellaneous (settlement/reservoir/river/pond etc.)	10,948	23.4	11,381	24.4	+ (3.9)	
Total	**46,778**	**100.0**	**46,778**	**100.0**		

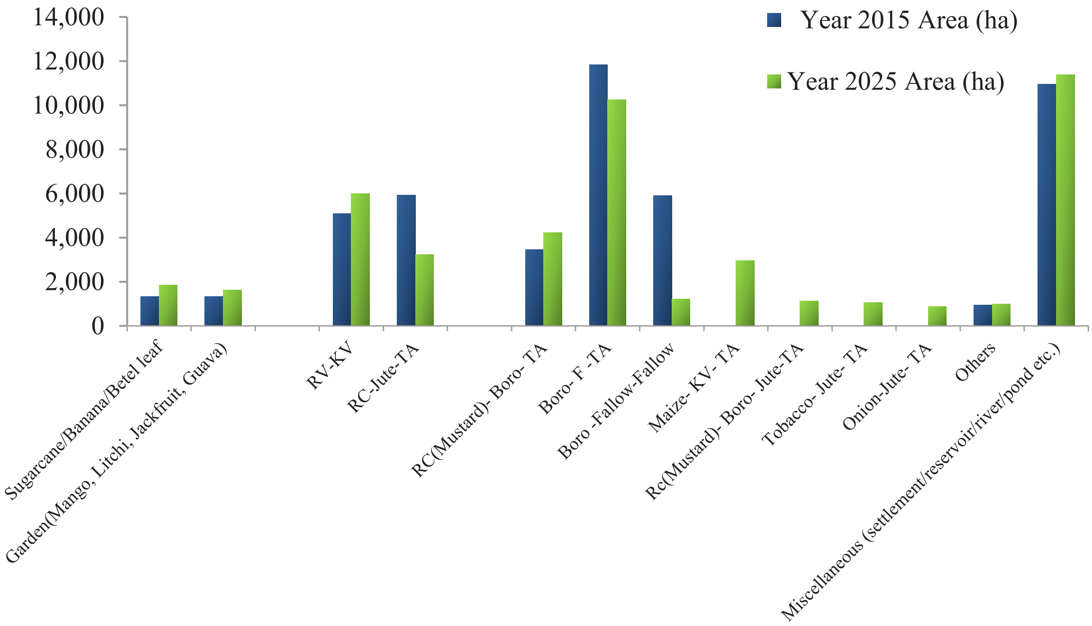


Fig 3.52: Changes in land use of Jhenaidah Sadar, Jhenaidah

3.1.27 Major findings of Jhikargacha Upazila, Jashore

i) Total area- 30,760 ha
ii)Total sample colleted- 110
iii)Physiography & AEZ code- Gangase Flood Plain, AEZ: 11
iv)Major land type- High Land
v)Major soil group- Gopalpur
vi) Major land use- Rabi vegetables (Potatoes, cabbage, cauliflower, eggplant, gourd, beans, radishes) Kharif vegetables (Gourd, bitter gourd, snake gourd, pumpkin).

Table-3.55: Changes in land type of Jhikargacha Upazila, Jashore

Land type	Previous (2015)		Present (2024)		% increase/ decrease	Possible reasons/Remarks
	Area (ha)	%	Area (ha)	%		
Highland	11190	36.38	10440	33.94	-2.44	
Medium highland	8357	27.17	8107	26.36	-0.81	
Medium lowland	2029	6.60	2010	6.53	-0.06	
Lowland	678	2.20	696	2.26	0.06	
Miscellaneous	8506	27.65	9507	30.91	3.25	
Total	**30760**	**100**	**30760**	**100**		

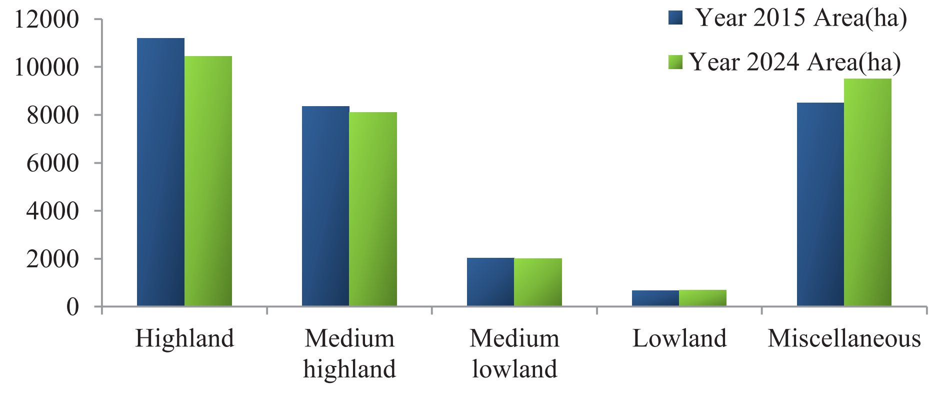


Fig 3.53: Changes in land type of Jhikargacha, Jashore

Table-3.56: Changes in land use of Jhikargacha Upazila, Jashore

Land Use	Previous (2015)		Present (2024)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Annual Crops	617	2.0	1275	6.0	+106	
Perennial Crops	532	1.7	3613	17.0	+579	
Flower cultivation	814	2.7	850	4.0	+4	
RV-KV	5,671	18.5	2338	11.0	-59	
RC-J-TA	3,280	10.7	1488	7.0	-55	
Mustard-Bo-TA	1,398	4.5	1913	9.0	+37	
Bo-F-TA	4,903	15.9	7225	34.0	+47	
BO-F-F	2,621	8.5	638	3.0	-76	
RC-F-TA	-	-	850	4.0	+100	
RV-F-TA	-	-	850	4.0	+100	
Other cropping pattern	2,418	7.9	213	1		
Miscellaneous	8,506	27.6	9507	30.9		
Total	**30,760**	**100**	**30,760**	**100**		

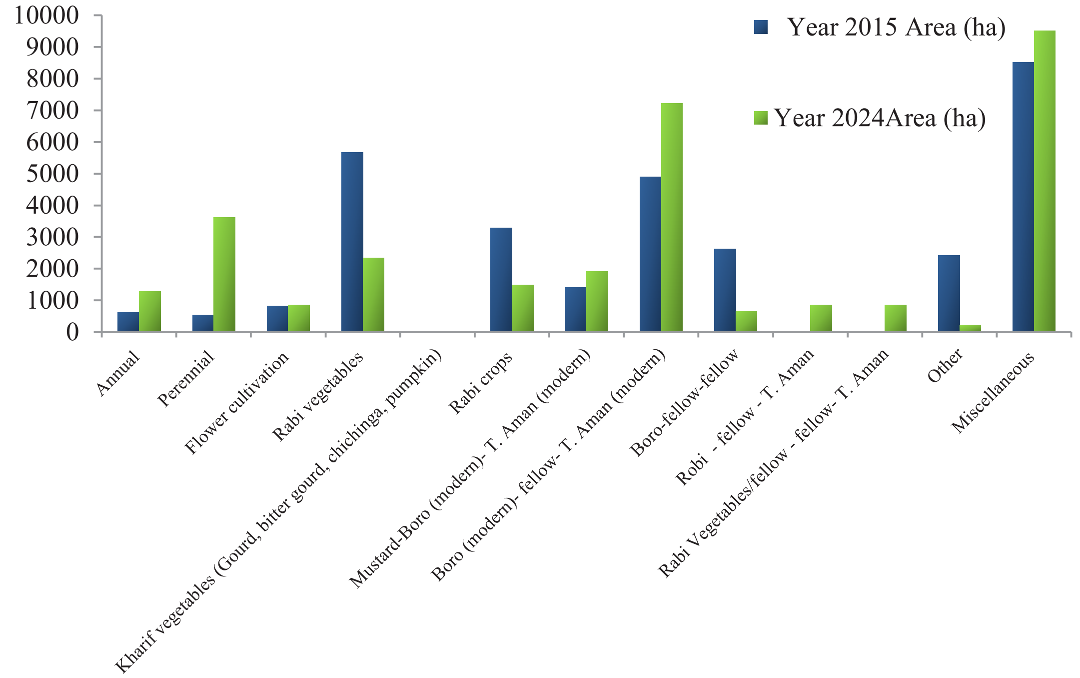


Fig 3.54: Changes in land use of Jhikargacha, Jashore

3.1.28 Major findings of Mollahat Sadar Upazila, Bagerhat

i) Total area- 17,995 ha
ii) Total soil sample collected-
iii) Physiography & AEZ code- Ganges Floodplain and Ganges Tidal Floodplain, Gopalgonj Khulna bills & AEZ 11, AEZ 13 and AEZ 14
iv) Major land type- Highland, Medium Highland, Medium Lowland, Lowland etc.
v) Major soil group- Gopalpur, Ishwardi, Ghior, Borishal, Harta, Satla etc.

Table-3.57: Changes in land type of Mollahat Sadar Upazila, Bagerhat

Land type	Previous (2015)		Present (2025)		% increase/ Decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Highland	1815	10.1	1516	8.4	-1.7	
Medium highland	5210	29.0	5390	30.0	1.0	
Medium lowland	4626	25.7	4476	24.9	-0.8	
Lowland	2456	13.6	2394	13.3	-0.3	
Miscellaneous	3888	21.6	4219	23.4	1.8	
Total	17995	100.0	17995	100.0	0.0	

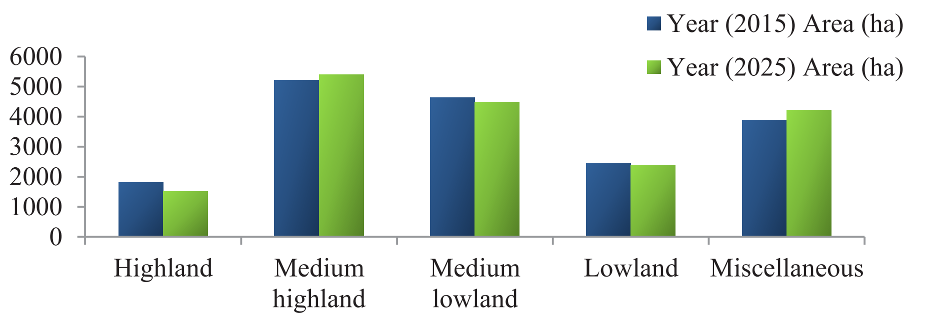


Fig 3.55: Changes in land type of Mollahat, Bagerhat

Table-3.58: Changes in land use of Mollahat Sadar Upazila, Bagerhat

Land Use	Previous (2015)		Present (2025)		% increase/ Decrease	Possible Reasons
	Area (ha)	%	Area (ha)	%		
Annuals crop	1007	5.6	90	0.5	-91.1	
RC-J-TA	2667	14.8	1198	6.7	-55.1	
RV-KV	144	0.8	350	1.9	143.1	
RC-J-F	201	1.1		0.0	-100.0	
Bo-F-TA	202	1.1	1120	6.2	454.5	
Bo-J-TA	258	1.4	368	2.0	42.6	
RC-F-TA	301	1.7	70	0.4	-76.7	
Bo-Aus-F	643	3.6	420	2.3	-34.7	
F-BA	1265	7.0	532	3.0	-57.9	
Bo-J/BA-F	879	4.9	140	0.8	-84.1	
Bo-(Shrimp+Fish	4439	24.7	9348	51.9	110.6	
Bo-BA/TA	1830	10.2		0.0	-100.0	
Bo-F-F	271	1.5	140	0.8	-48.3	
Miscellaneous	3888	21.6	4219	23.4	8.5	
Total	17995	100.0	17995	100.0		

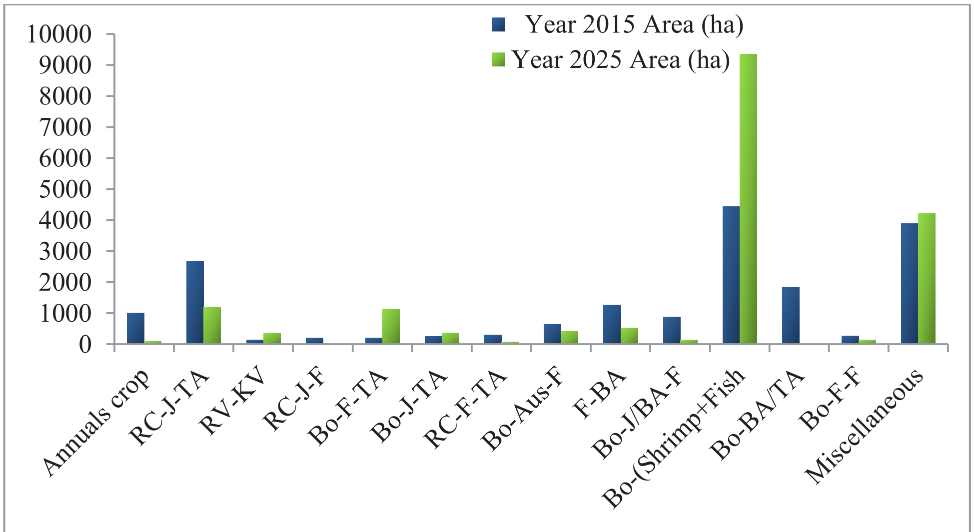


Fig 3.56: Changes in land use of Mollahat, Bagerhat

3.1.29 Major findings of Palash Upazila, Narsingdi

i) Total area- 9013 ha
ii) Total sample collected- 63
iii) Physiography & AEZ code-

- Madhupur Tract (28)
- Brahmaputra Floodplain (09)

iv) Major land type-HL, MHL, MLL, LL
v) Major soil group- Sonatola, Silmondi, Tejgaon, Ghorargoan, Naraibagh, Sayek, Payati.
vi) Major land use-

- Boro- fallow- T.aman
- Boro- fallow- fallow
- Banana orchard
- Orchard

Table-3.59: Changes in Land Type of Palash Upazila, Narsingdi (for floodplain piedmont and terrace area)

land type	Previous (2011)		Present (2024)		%increase/ decrease		Possible reasons/Remarks
	Area(ha)	%	Area(ha)	%	Area	%	
Highland	1401	15.5	1649	18.3	+248	+2.8	Palash is an industrial area. Agricultural lands are filled for industry and settlement.
Medium highland	1664	18.5	1704	18.9	+40	+0.4	
Medium lowland	1217	13.5	829	9.2	-388	-4.3	
Lowland	1198	13.3	523	5.8	-675	-7.5	
Miscellaneous	3533	39.2	4308	47.8	+775	+8.6	
Total	9013	100	9013	100	0	0	

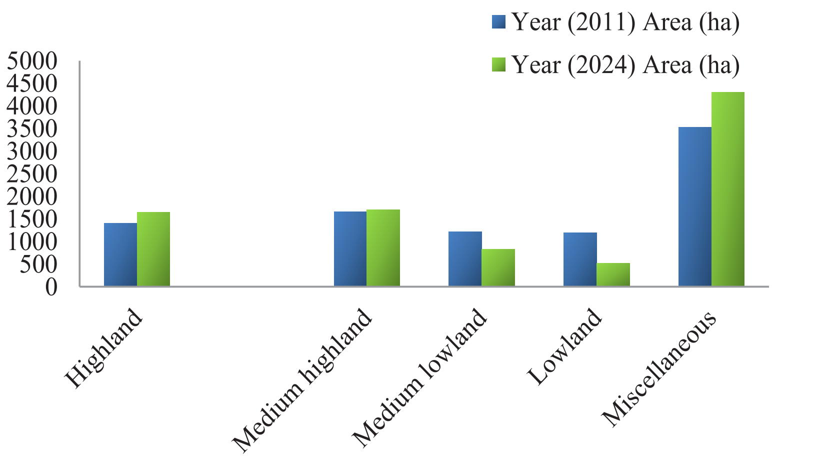


Fig 3.57: Changes in land type of Palash, Narsingdi

Changes in Land Use

Polash, Narsingdi-No major changes

3.1.30 Major findings of Rangamati Sadar, Rangamati

i) Total area-54,665 ha
ii)Total sample colleted- 224
iii)Physiography & AEZ code- Northern and eastern hill (29), Northern and eastern Foothills (27) and Costal land (23)
iv)Major land type- High land (Hill)
v)Major soil group- Sitakunda, Barkal, Dhum, Subalong, Khadimnagar, Nalua, Rangamati, Pahartoli, Mirsarai.
vi) Major land use- Fallow, Forest, Orchard

Table-3.60: Changes in Land Type of Rangamati Sadar, Rangamati (for floodplain, piedmont and terrace area)

Slope class/Land type	Previous (Year)		Present (Year)		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Nearly level (<5%)	395	0.72	395	0.72		
Gentle slope (5-15%)	424	0.78	424	0.78		
Moderate slope (15-30%)	2553	4.67	2553	4.67		
Steep slope (30-50%)	12304	22.51	12304	22.51		
Very steep (50-70)	10872	19.89	10872	19.89		
Extremely steep (>70)	6664	12.18	6664	12.18		
Highland	342	0.63	342	0.63		
Miscellaneous	21111	38.62	21111	38.62		
Total	54665	100	54665	100		

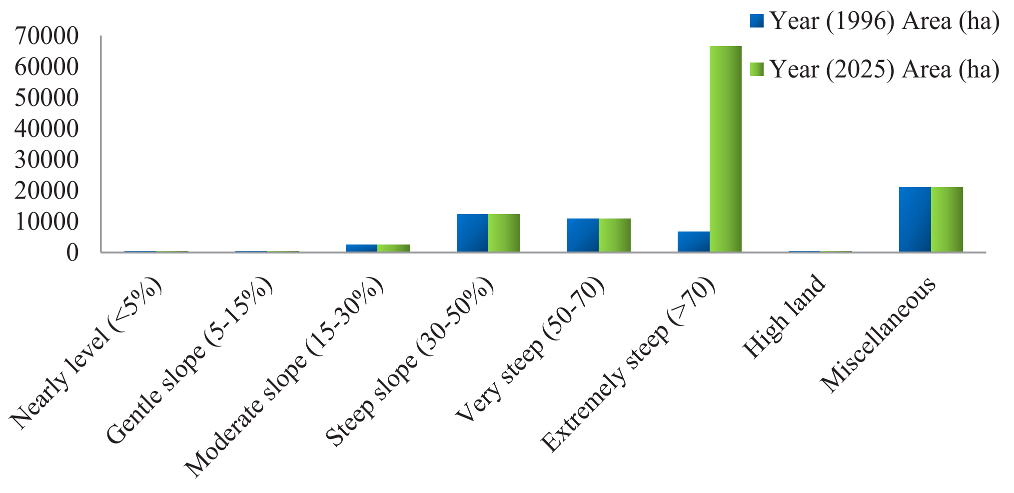


Fig 3.58: Changes in land type of Rangamati Sadar, Rangamati

Table-3.61: Changes in Land Use of Rangamati Sadar, Rangamati

Land use	1998		2024		% increase(+)/ decrease(-)	Possible Reasons
	Area (Ha)	%	Area (Ha)	%		
Forest	11537	21.1	10383	19	-2.1	Deforestation
Fallow	10207	18.7	11360	20.8	+2.1	
Orchard	7373	13.4	8110	14.8	1.4	Jum cultivation converted to orchard
Jum	4081	7.5	3344	6.1	-1.4	
Rc-Fallow-Kharif veg	99	0.2	99	0.2	0	
Boro-Fallow-T. A.	98	0.2	98	0.2	0	
Others	158	0.3	158	0.3	0	
Miscellaneous	21111	38.6	21111	38.6	0	
Total	54665	100	54665	100	0	

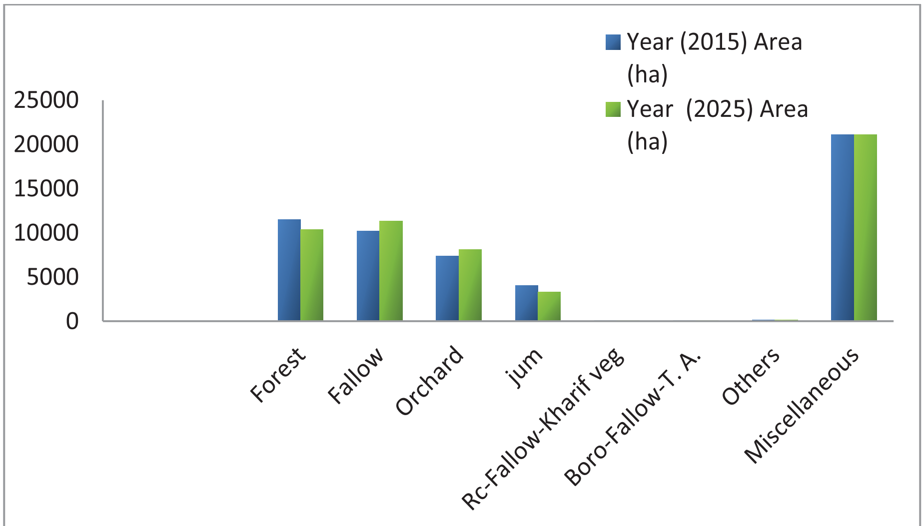


Fig 3.59: Changes in land use of Rangamati Sadar, Rangamati

3.1.31 Major findings of Sadullahpur, Gaibandha

i) Total area-22,800 ha
ii)Total sample colleted- 108
iii)Physiography & AEZ code- Barind Tract (25), Active Tista Flood Plain (2) & Tista Flood Plain (3)
iv)Major land type-High land, Medium High Land, Medium Low Land, Low Land
v) Major soil group- Pirghacha, Gangachora, Polashbari, Kaunia, Jamun
vi) Major land use- Boro-Fallow -T.Aman

Table-3.62: Changes in Land Type of Sadullahpur, Gaibandha (for floodplain, piedmont and terrace area)

Land type	Previous (Year)2015		Present (Year)2024		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	5271	23.1	4000	17.5	-5.6	Due to rapid urbanization and conversion of agricultural land into non-agricultural land
Medium highland	12534	55.0	11000	48.4	-6.6	
Medium lowland	1848	8.1	2700	11.8	+3.7	
Lowland	107	0.5	100	0.4	-0.1	
Miscellaneous	3040	13.3	5000	21.9	+8.6	
Total	22800	100	22800	100		

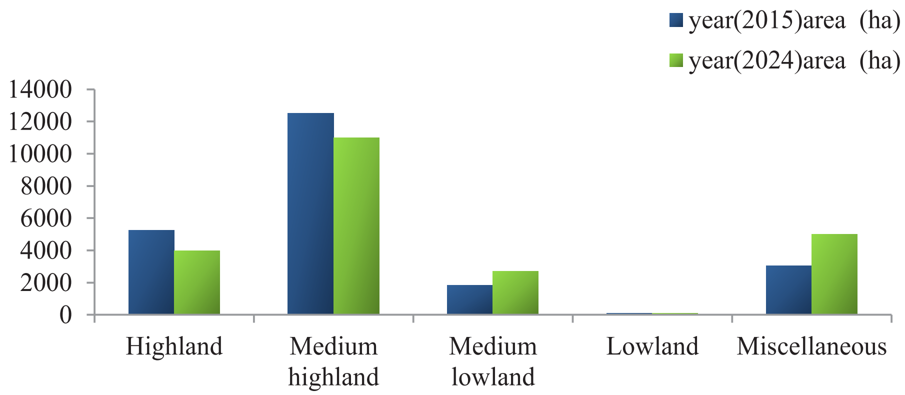


Fig 3.60: Changes in land type of Sadullahpur, Gaibandha

Table-3.63: Changes in Land Use of Sadullahpur, Gaibandha

Land Use	Previous (year)		Present (year)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
1.Cucurmin	514	2.3	1596	7	+4.7	Introduction of new variety, changes in cultivation pattern
2. Rabi crops -Aus -T.Aman	1924	8.4	1140	5	-3.4	
3. Rabi crops - Fallow -T.Aman	2687	11.8	1140	5	-6.8	
4. Boro-Fallow - T.Aman	8738	38.3	6840	30	-8.3	
5. Rabi crops - Boro -T.Aman	3205	14.1	3420	15	-1.1	
6. Boro -Fallow – Fallow	1718	7.5	1381	6.1	-1.4	
7.other cropping pattern	974	4.3	2280	10	+5.7	
Miscellaneous	3040	13.3	5000	21.9	+8.6	
Total	22800	100	22800	100		

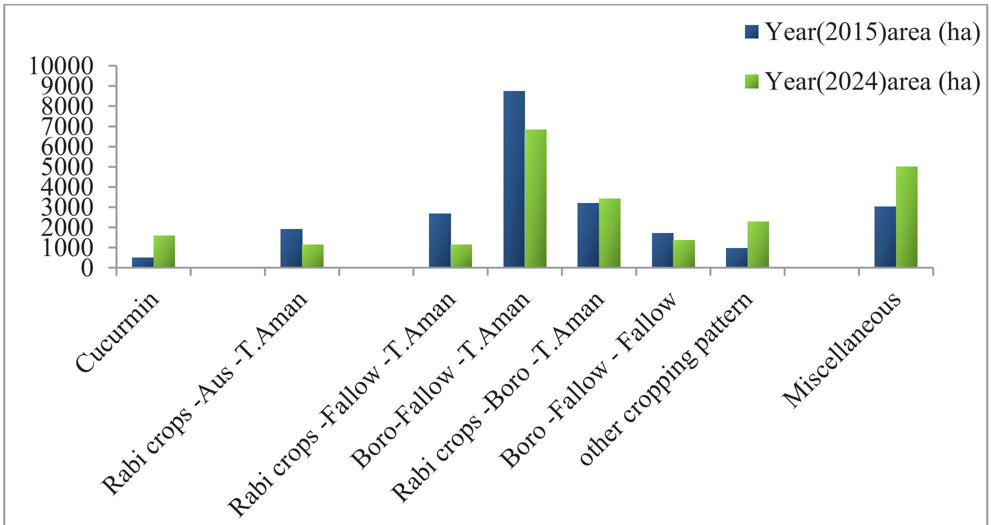


Fig 3.61: Changes in land use of Sadullahpur, Gaibandha

3.1.32 Major findings of Satkhira Sadar, Satkhira

i) Total area- 36,609 ha

ii) Total soil sample collected-

iii) Physiography & AEZ code- Ganges Floodplain and Ganges Tidal Floodplain, Gopalgonj Khulna Bills & AEZ 11, AEZ 13 and AEZ 14.

iv) Major land type- Highland, Medium Highland, Medium Lowland, Lowland etc.

v) Major soil group- Sara, Gopalpur, Ishwardi, Ghior, Bajoa, Jhalokati, Doulotpur, Borishal, etc.

Table-3.64: Changes in land type of Satkhira Sadar, Satkhira

Land type	Previous (2013)		Present (2025)		% increase/ Decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Highland	7693	21.0	7439	18.6	-2.4	
Medium highland	16932	46.3	18470	46.1	-0.1	
Medium lowland	4215	11.5	3988	10.0	-1.6	
Lowland	179	0.5	252	0.6	0.1	
Miscellaneous	7590	20.7	9902	24.7	4.0	
Total	36609	100.0	40051	100.0	0.0	

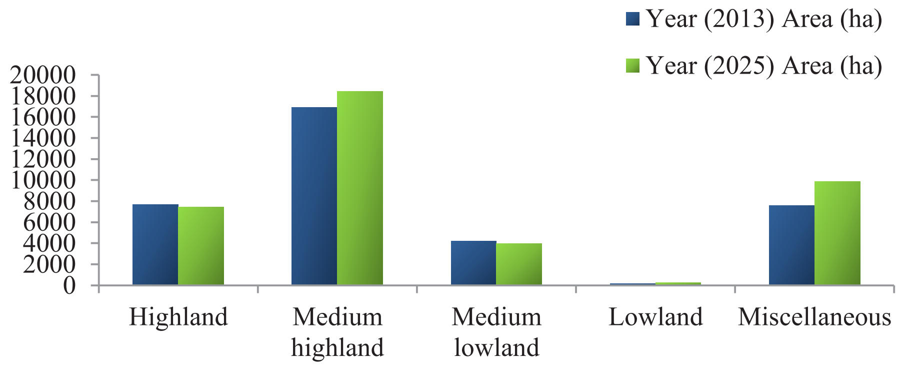


Fig 3.62: Changes in land type of Satkhira sadar, Satkhira

Table-3.65: Changes in land use of Satkhira Sadar, Satkhira

Land use	Previous (2013)		Present (2025)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Mixed Fruit Orchard			854	2.1	2.1	
RV-KV			756	1.9	1.9	
RC-KC			658	1.6	1.6	
Bo-F-TA	10737	29.3	6927	17.3	-12.0	
Bo-Jute-TA	4787	13.1	5381	13.4	0.3	
RC-Jute-TA	2851	7.8	2034	5.1	-2.7	
Fish-TA	523	1.4	761	1.9	0.5	
Bo-Fish	5275	14.4	7247	18.1	3.7	
Bo-F-F	822	2.2	1124	2.8	0.6	
Fish-Fish	1918	5.2	3023	7.5	2.3	
Other Cropping Pattern	2106	5.8	1384	3.5	-2.3	
Miscellaneous	7590	20.7	9902	24.7	4.0	
Total	36609	100	40051	100.0	0.0	

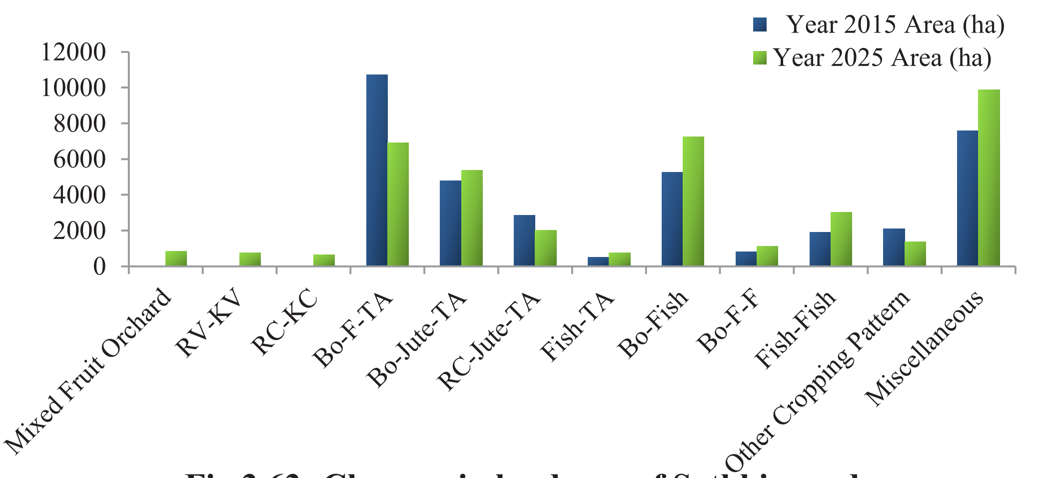


Fig 3.63: Changes in land use of Satkhira sadar, Satkhira

3.1.33 Major findings of Shaltha, Faridpur

i) Total area-18658 ha
ii)Total sample colleted-104
iii)Physiography& AEZ code- Low Ganges Floodplain (12)
iv)Major land type-Highland, Medium Highland, Medium Lowland, Lowland
v)Major soil group- Sara, Gopalpur, Ishwardi, Ghior & Ramdia

Table-3.66: Changes in Land Type of Shaltha, Faridpur (for floodplain, piedmont and terrace area)

Land type	Previous (2017)		Present (2025)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	2170	11.6	1942	10.4	+1.2	
Medium highland	5221	28.0	4115	22.1	+5.9	
Medium lowland	7486	40.1	7108	38.0	+2.1	
Lowland	1152	6.2	1040	5.6	+0.6	
Miscellaneous	2629	14.1	4453	23.9	-9.8	
Total	**18658**	**100**	**18658**	**100**	0	

Table-3.67: Changes in land use of Shaltha, Faridpur

Land use	Land type	Previous (2017)		Present (2025)		% increase/ decrease	Possible reasons
		Area (ha)	%	Area (ha)	%		
1.Rabi crop-jute-T.Aman	-	3295	17.6	9175	49.2	+31.6	
2. Rabi crop-Jute-Fallow	- -	4554	24.4	1700	9.1	-15.3	
3. Rabi crop –Jute Mixed-B. Aus & Aman	- -	1858	10.0	750	4.0	-6	
4. Rabi crop –B. Aush- Fallow	-	438	2.3	-	-	-	
5.Boro-Fallow-Fallow	-	3129	16.8	1200	6.4	-10.4	
6. Boro- B. Aman	-	1512	8.1	-	-	-	
7. Onion-Til-T.Aman	-	-	-	658	3.5		
8. Mustard-jute-vegetable	-	-	-	200	1.1		
9. Other(crop)	-	1243	6.7	880	4.7	-2	
10. Miscellaneous	-	2629	14.1	4095	22.0	+7.9	
Total		**18658**	**100**	**18658**	**100.0**		

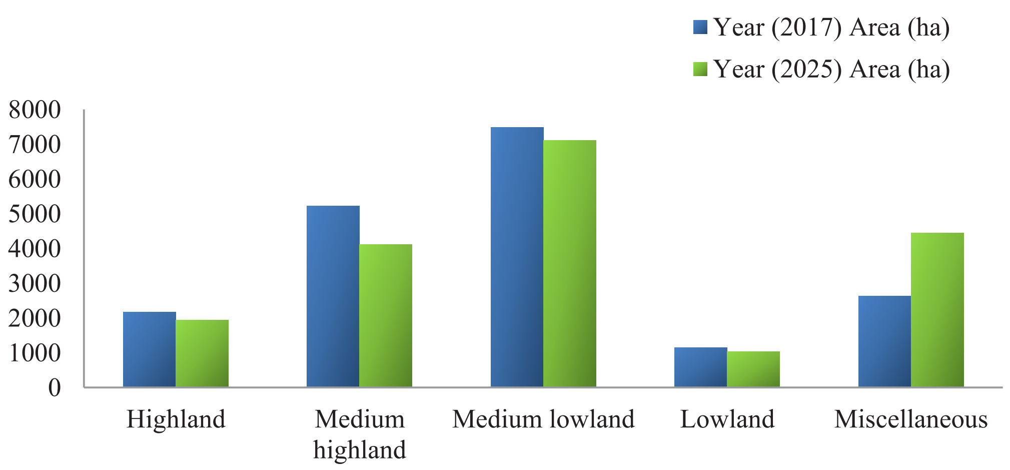


Fig 3.64: Changes in land type of Saltha, Faridpur

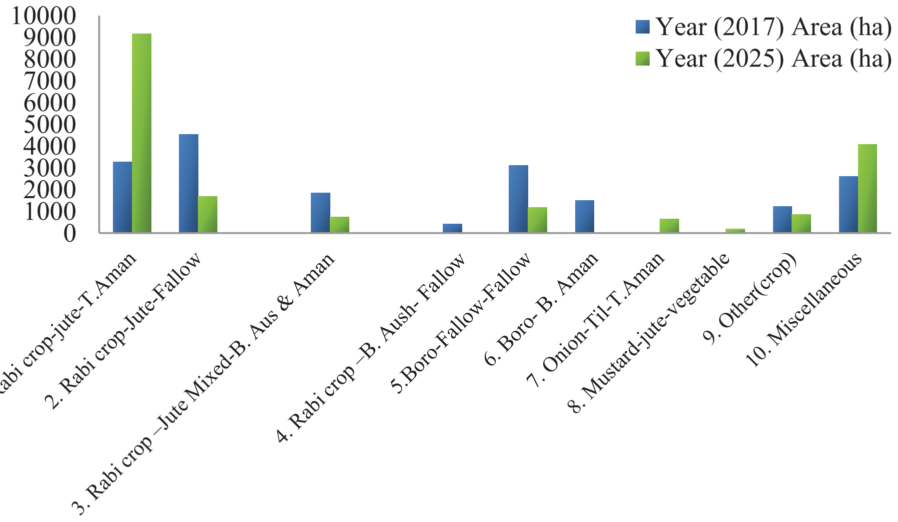


Fig 3.65: Changes in land use of Saltha, Faridpur

3.1.33 Major findings of Sirajganj Sadar, Sirajganj

i) Total area- 30855
ii)Total sample colleted- 130
iii)Physiography & AEZ code-Tista Flood Plain, Active Brahmaputra - Jamuna Flood Plain
iv)Major land type- HL MHL, MLL, LL
v)Major soil group- Manda, Jamun, Amgaon, Maldaha, Jamuna silty alluvium, Jamuna sandy alluvium
vi) Major land use- RV-TAus-Taman

Table-3.68: Changes in Land Type of Sirajganj Sadar, Sirajganj (for floodplain, piedmont and terrace area)

Land type	Previous (2016)		Present (2024)		% increase/ Decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
High land	6639	21.5	5831	18.9	-2.6	Intensive cultivation, River erosion, Uplifting or removal of top soil
Medium highland	9714	31.5	10120	32.7	1.3	
Medium lowland	4811	15.6	4227	13.7	1.9	
Lowland	1457	4.7	679	2.2	-2.2	
Miscellaneous	8234	26.7	9998	32.5	5.8	
Total	30855	100	30855	100		

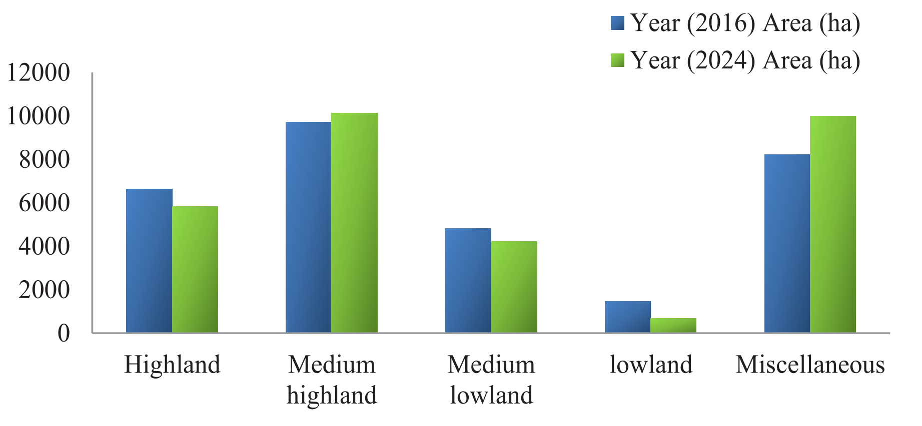


Fig 3.66: Changes in land type of Sirajganj Sadar, Sirajganj

Table-3.69: Changes in land use of Sirajganj Sadar, Sirajganj

Land use	Previous (year)		Present (year)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Orchard	842	3	617	2	-1	-
B-F-TA	3962	13	1234	4	-9	
B-BAus-TA	926	3	-		-3	
B-Jute-TA	421	2	926	3	1	
B-F-F	421	2	1542	5	3	
RV-KF	1680	5	926	2	-3	
RV-F-F	1234	4	1851	5	1	
RV-F- TA	3085	10	1851	6	-4	
Mustard-B-TA	4011	13	7713	23	10	
Mustard-B-F	1234	4	617	2	-2	
RV-TAus-Taman	3394	11	1234	3	-8	
Maize	-		1851	6	6	
Sugarcane	-		421	2	2	
Others pattern	926	3	926	3		
Miscellaneous	8234	27	9998	32		
Total	30855		30855	30855		

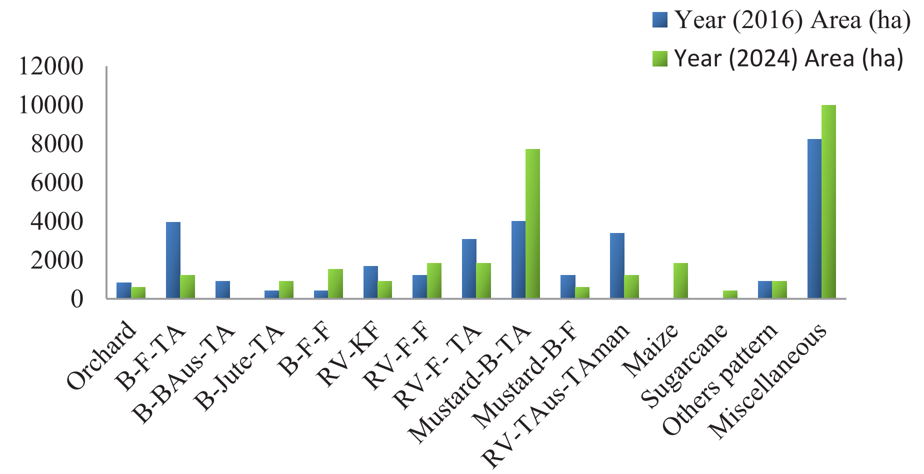


Fig 3.67: Changes in land use of Sirajganj Sadar, Sirajganj

3.1.34 Major findings of Tangail Sadar, Tangail

i) Total area- 30,286 ha
ii)Total sample collected- 171
iii)Physiography & AEZ code- Brahmaputra Flood Plain and AEZ 7, 8, 9
iv)Major land type- High land, Medium High Land, Medium Low Land and Low Land
v)Major soil group- Sonatala, Silmondi, Ghatail, Melandah, Dhamrai, Savar Bazar, Brahmaputra silt and sandy alluvium soil

Table-3.70: Changes in Land Type of Tangail Sadar, Tangail (for floodplain, piedmont and terrace area)

Land type	Previous (2010)		Present (2024)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	1194	3.9	606	2.0	- 1.9	For settlement and other infrastructures
Medium highland	10560	34.9	11248	37.2	+ 2.3	Decreasing flooding depth
Medium lowland	8992	29.7	8309	27.4	- 2.3	Transformation to medium highland
Lowland	2277	7.5	2272	7.5	0	
Very lowland	-	-	-	-	-	
Miscellaneous	7263	24.0	7851	25.9		
Total	30286	100.0	30286	100.0		

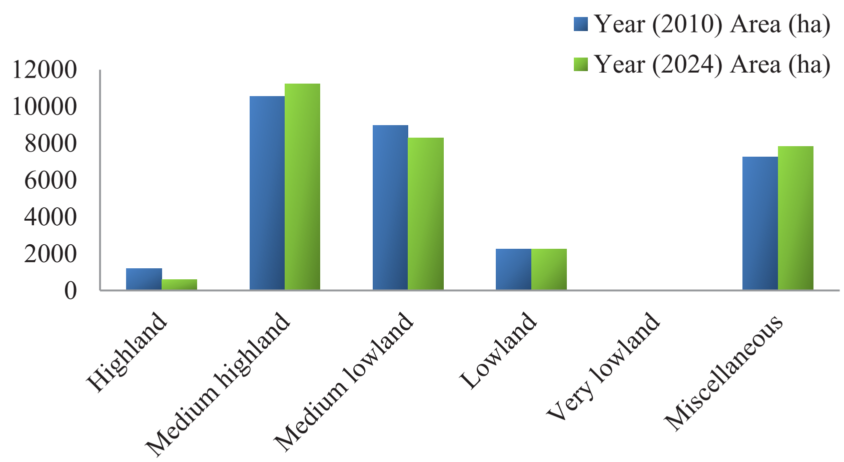


Fig 3.68: Changes in land type of Tangail Sadar, Tangail

Table-3.71: Changes in land use of Tangail Sadar, Tangail

Land use	2010		2024		% increase/ decrease	Possible reason
	Area (ha)	%	Area (ha)	%		
Banana	349	1.2	400	1.3	+ 0.1	Cash crop
Rabi vegetables- Kharif vegetables	122	0.4	200	0.7	+ 0.3	Cash crop
Rabi crops -Fallow-T. Aman	227	0.7	200	0.7	0	Converted to triple crops area
Mustard - Boro- T. Aman (MV)	4845	16.0	7145	23.5	+ 7.5	
Boro- Fallow-T. Aman	2467	8.2	2167	7.2	- 1	
Mustard-Boro- T. Aman (Local)	706	2.3	703	2.3	0	
Tobacco - Jute/Sesame- T. Aman	615	2.0	0	0	- 2	Negative impact
Mustard-Boro- Fallow	3743	12.4	3958	13.1	+ 0.7	Mustard area
Black gram, Kheshari, Ground nut – Fallow - Fallow	616	2.0	1215	4.0	+ 2	
Black gram, Kheshari, Lentil – Jute/Sesame – B. Aman	615	2.0	816	2.7	+ 0.7	
Black gram – Boro – Fallow	615	2.0	545	1.8	- 0.2	
Wheat – Fallow - Fallow	615	2.0	0	0	- 2	
Boro-Fallow-Fallow	4,054	13.4	1578	5.2	- 8.2	Mustard area
Ground nut – Fallow - Fallow	1231	4.1	0	0	- 4.1	Intensive crops
Wheat – - Jute/Sesame - T. Aman	172	0.6	567	1.9	+ 1.3	Intensive crops
Others	2040	6.7	2941	9.7	+ 3	Cash crops
Miscellaneous (Homestead/Water bodies etc.)	7263	24.0	7851	25.9	+ 1.9	
Total:	30286	100	30286	100		

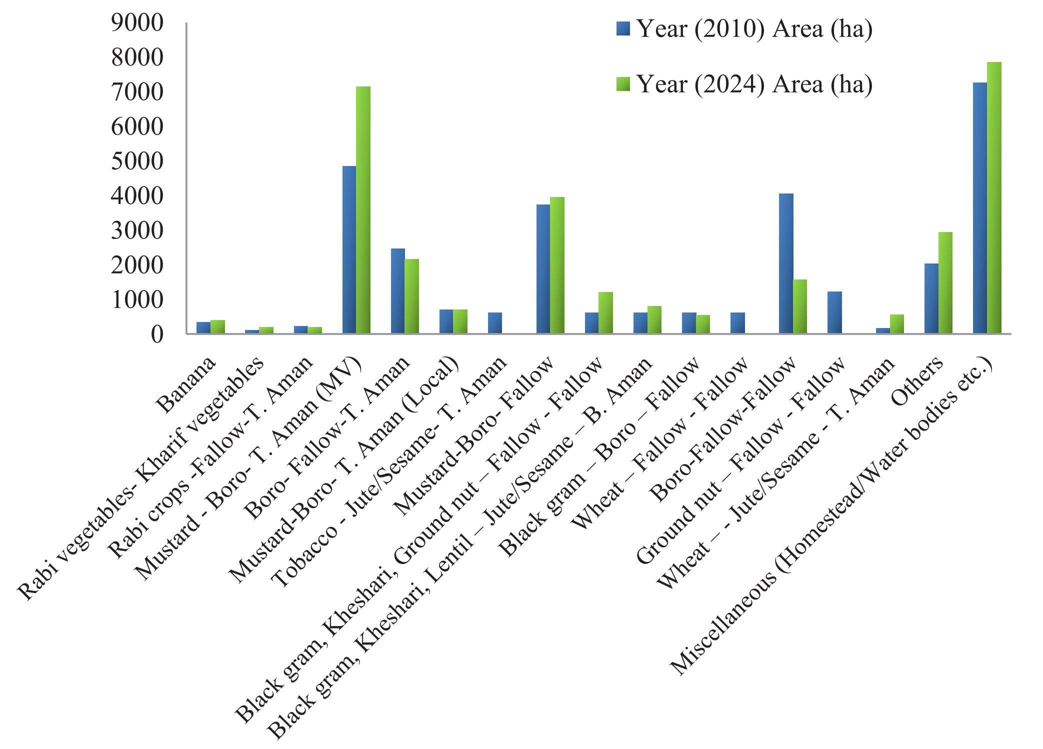


Fig 3.69: Changes in land use of Tangail Sadar, Tangail

3.1.35 Major findings of Tarakanda, Mymensingh

i)Total area-28,784
ii)Total sample colleted-130
iii)Physiography & AEZ code- Brahmaputra Floodplain (9)
iv)Major land type-Highland, Medium Highland, Medium Lowland, Lowland
v)Major soil group-Phulpur, Nakla, Sherpur, Tarakanda, Sonatola, Silmondi, Lokdeo, Ghatail
vi) Major land use-
1. R.veg-K.veg
2. Rabi crop (mustard, potato, wheat etc) -F-T. Aman
3.Boro-Jute/Aus-T.Aman
4.Boro-F-T. Aman
5. Boro-F-F

Table-3.72: Changes in land type of Tarakanda, Mymensingh (for floodplain, piedmont and terrace area)

Land type	Previous (2016)		Present (2024)		% increase/ decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
Highland	4,715	16.4	4,573	15.9	-0.50	1. Increasing Trend Was found at sector of urbanization, settlement and highways overtime. 2. MLL converted to MHL due to less inundation and continuous sediment accumulation from higher topographic location to lower topography in catena.
Medium highland	12,756	44.3	12,909	44.8	+0.50	
Medium lowland	4,878	16.9	4,678	16.3	-0.60	
Lowland	1,121	3.9	948	3.3	-0.60	
Miscellaneous	5,314	18.5	5,676	19.7	+1.2	
Total	28,784	100	28,784	100		

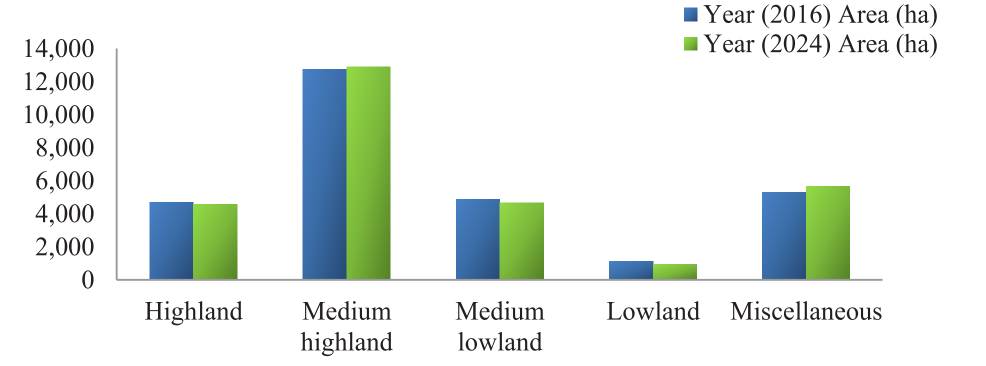


Fig 3.70: Changes in land type of Tarakanda, Mymensingh

Table-3.73: Changes in land use of Tarakanda, Mymensingh

Land use	Previous (2016)		Present (2024)		% increase/ Decrease	Possible reasons/ Remarks
	Area (ha)	%	Area (ha)	%		
1. R. veg-K. veg	786	2.7	806	2.8	+0.1	1. Vegetable area has been increased. 2. Boro cultivation increased for increased irrigation facilities. 2. Increase of commercial fisheries.
2. Rabi crop (mustard, potato, wheat etc)-F-T. Aman	52	0.2	92	0.3	+0.1	
3.Boro-Jute/Aus- F-T. Aman	682	2.4	690	2.4	0	
4.Boro-F-T. Aman	15,746	54.7	15,166	52.7	-2.0	
5. Boro-F-F	5,999	20.8	6,124	21.3	+0.5	
6.Others	205	0.7	230	0.8	+0.1	
7.Miscellaneous	5,314	18.5	5,676	19.7	+1.2	
Total	28,784	100	28,784	100		

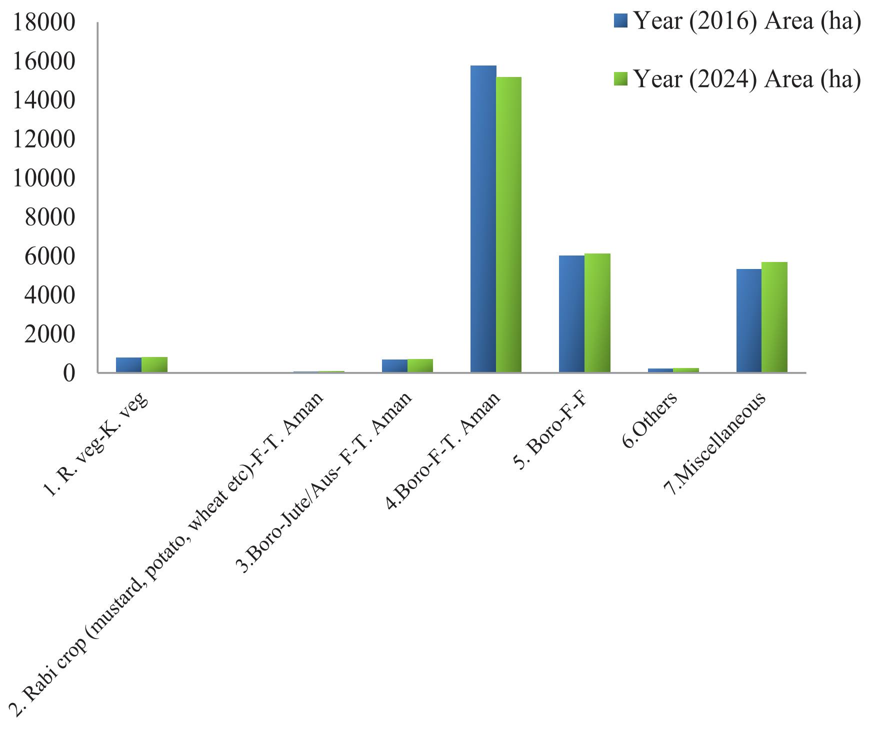


Fig 3.71: Changes in land use of Tarakanda, Mymensingh

3.1.36 Major findings of Terokhada upazila, Khulna

i) Total area- 18,769 ha.

ii) Total soil sample collected-

iii) Physiography & AEZ code- Ganges Floodplain and Ganges Tidal Floodplain, Gopalganj Khulna Bills & AEZ 11, AEZ 13 and AEZ 14

iv) Major land type- Highland, Medium Highland, Medium Lowland, Lowland etc.

w) Major soil group- Sara, Gopalpur, Ishwardi, Ghior, Narail, Doulotpur, Borishal, Harta, Satla etc.

Table-3.74: Changes in land type of Terokhada upazila, Khulna

Land type	Previous (2010)		Present (2025)		% increase/ decrease	Possible reasons
	Area (ha)	%	Area (ha)	%		
Highland	189	1.0	180	0.95	-4.8	
Medium highland	4554	24.3	4386	23.4	-3.7	
Medium lowland	7657	40.8	7558	40.3	-13.0	
Low land	3681	19.6	3385	18	-8.1	
Miscellaneous	2688	14.3	3260	17.4	+21.3	
Total	**18,769**	**100.0**	**18,769**	**100.0**		

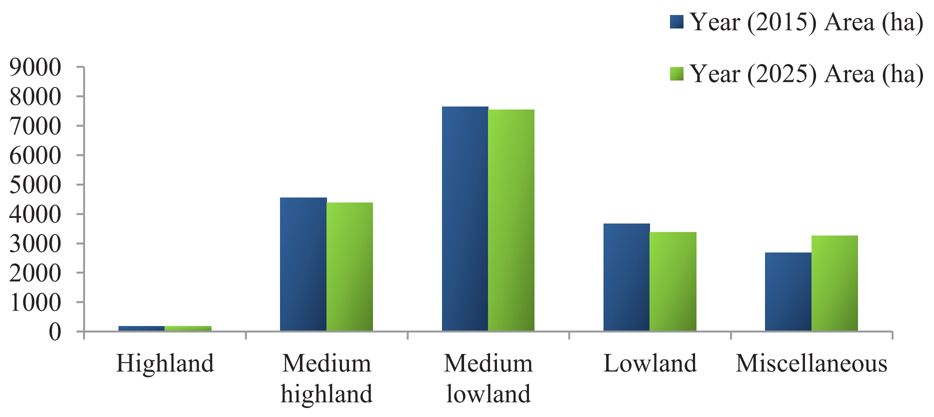


Fig 3.72: Changes in land type of Terokhada, Khulna

Table-3.75: Changes in land use of Terokhada upazila, Khulna

Land use	Land type	Previous (2010)		Present (2025)		% increase/ decrease	Possible Reasons
		Area (ha)	%	Area (ha)	%		
Annual crops		-	-	44	0.2	+100	
RV-KV		-	-	44	0.2	+100	
Boro-BA/B.Aus		7421	39.5	4553	24.4	-38.6	
F-B.Aus/ Mixed aus & aman		3183	16.9	-	-	-100	
B-(Shrimp+fish)		2193	11.7	5324	28.3	+142.8	
B- F-TA		1126	6.0	3233	17.2	+187.1	
RC-Jute/sesame/Aus-TA		1102	5.9	859	4.6	-22.1	
Boro-Mixed aus & aman		551	3.0	-	-	-100	
B-F-F		-	-	962	5.1	+100	
B- Jute-F		-	-	264	1.4	+100	
Other		505	2.7	226	1.2	-55.3	
Miscellaneous		2688	14.3	3260	17.4	+21.3	
Total		18769	100.0	18769	100.0		

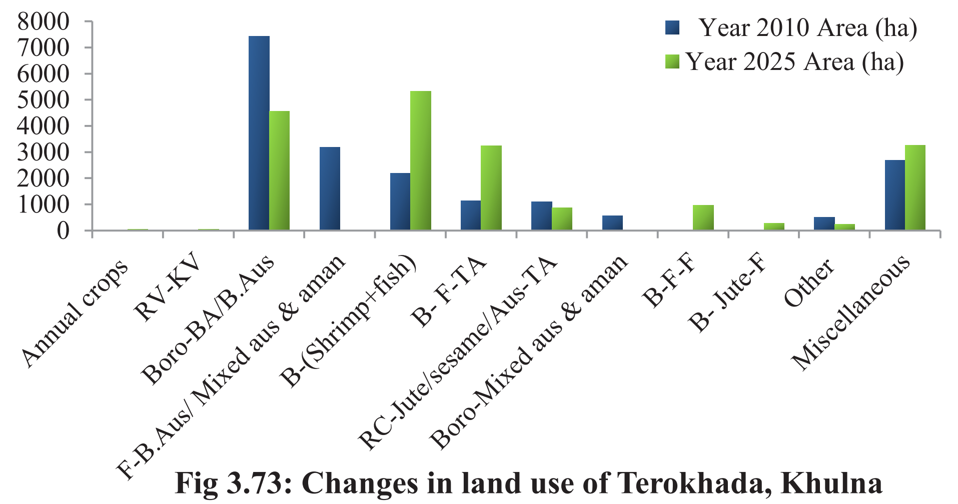


Fig 3.73: Changes in land use of Terokhada, Khulna

3.2 Union Land, Soil and Fertilizer Recommendation Guide (Union Sahayika) Preparation

Union based Land, Soil and Fertilizer Recommendation Guide (Union Sahayika) is being used as a tool for agricultural development activities/planning at grassroots level. It provides soil and land associated information more precisely at Union level. The guide facilitates the farmers to acquire land and soil related information for their area. In addition, it acts as a tool for location-based fertilizer recommendation for any crops. It 2024-2025, the total number for Union Sahayika prepared by field offices was 162.

Table 3.76: Union Sahayika prepared by respective Divisional & Regional Office (2024-25)

Name of divisional/ regional office	District	Upazila	No. of Union Sahayika prepared
Divisional Office, Barishal	Pirojpur	Mathbaria	4
Regional Office, Bhola	Pirojpur	Mathbaria	4
Regional Office, Patuakhali	Bhola	Borhanuddin	6
Divisional Office, Chattogram.	Chattogram	Karnafuli	5
	Feni	Chhagalnaiya	6
	Brahmanbaria	Bijoynagar	4
Regional Office, Cumilla	Cumilla	Debidwar	4
Regional Office, Chandpur	Chandpur	Shahrasti	4
Regional Office, Rangamati	Khagrachhari	Panchhari	5
Regional Office, Gopalganj	Gopalganj	Moksudpur	4
Regional Office, Munshiganj	Narayanganj	Rupganj	3
		Araihazar	2
Regional Office, Tangail	Tangail	Gopalpur	5
Regional Office, Kishoreganj	Kishoreganj	Tarail	5
Regional Office, Narshingdi	Narshingdi	Shibpur	4
Regional Office, Faridpur	Faridpur	Bhanga	5
Regional Office, Madaripur	Shariatpur	Naria	4
Regional Office, Mymensing	Mymensingh	Nandail	4
Regional Office, Jamalpur	Jamalpur	Jamalpur Sadar	4
Regional Office, Netrokona	Netrokona	Madan	4
Divisional Office, Khulna	Jashore	Chowgacha	4
Regional Office, Satkhira	Jashore	Chowgacha	4
Regional Office, Jashore	Jashore	Keshabpur	4
Regional Office, Kushtia	Kushtia	Kushtia Sadar	4
Regional Office, Jhenaidah	Magura	Mohammadpur	4
Divisional Office, Rajshahi	Rajshahi	Tanore	4

Name of divisional/ regional office	District	Upazila	No. of Union Sahayika prepared
Regional Office, Chapainawabganj	Chapai-nawabganj	Bholahat, Shibgonj	4
Regional Office, Pabna	Pabna	Sujanagor	4
Regional Office, Bogura	Bogura	Sahjahanpur Nandigram	4
Regional Office, Sirajganj	Sirajganj	Sirajganj sadar	4
Regional Office, Naogaon	Nagaona	Sapahar	4
Divisional Office, Rangpur	Rangpur	Mithapukur	4
Regional Office, Dinajpur	Dinajpur	Parbatipur	4
Regional Office, Lalmonirhat	Kurigram	Bhurungamari	4
Regional Office, Gaibandha	Gaibandha	Gobindagonj	4
Regional Office, Thakurgaon	Thakurgoan	Ranishankail	4
Divisional Office, Sylhet	Sylhet	Osmaninagar	2
		Sylhet Sadar	2
Regional Office, Moulvibazar	Moulvibazar	Chunarughat	4
Regional Office, Sunamgonj	Sunamganj	Jagannatpur	4
Total			162

Union Sahayika is an effective tool for local level agricultural planning and for location specific fertilizer recommendation. Field officers (SAAOs) of Department of Agricultural Extension (DAE) could be more equipped by this guide in respect of providing advisory services to farmers as a part of their professional demand.

3.3 Monitoring & Evaluation of Farmer's Service through Mobile Soil Testing Laboratories (MSTL)

(a) Introduction: Soil Test Based (STB) fertilizer use is considered one of the best practices to minimize the yield gap. The farmers of the country are not yet fully aware of the benefit of the STB fertilizer application for crop production. For this reason, SRDI operates farmer's service through MSTL to provide soil testing service at grass root level with a view to motivating farmers regarding balanced use of fertilizers. Actually, it is a programmed for developing awareness among farmers about soil test-based fertilizer use so that farmers become more interested in getting services from static laboratories. SRDI propelled this programmed through two MSTL since 1996. At present, SRDI runs 10 MSTL for serving the farmers with soil testing facilities in Rabi and Kharif season every year.

(b) Objectives

- To enhance awareness among the farmers on the benefit of balanced fertilizer application according to STB and crop requirements.
- To assess the effect of soil test-based fertilizer application on crop production.

In 2024-2025, soil analytical service through MSTL provided to 80 Upazila if the country and provided 5,823 farmers with Fertilizer Recommendation Cards.

Table 3.77: Name of the Upazila and number of soil samples analyzed through MSTL under farmer's service programme during Rabi 2024 season

Sl No.	Name of Divisional/ Regional Office	District	Upazila	No. of Soil Samples Analyzed
01	Divisional Office, Barishal	Pirojpur	Nesarabad	50
02		Barishal	Gouranadi	50
03	Regional Office, Patuakhali	Patuakhali	Dumki	50
04		Barguna	Barguna Sadar	50
05	SRDI, Brahmanbaria	Brahmanbaria	Sadar	53
06	SRDI, Rangamai	Bandarban	Bandarban Sadar	50
07	Divisional Office Office, Chattogram	Chattogram	fatikchhari	50
08			Hathazari	50
09			Patiya	50
10	Regional Office, Chandpur	Chandpur	Matlab South	50
11	Regional Office, Cumilla	Cumilla	Titas	50
12			Nangolkot	50
13	Regional Office, Noakhali	Feni	Sonagazi	50
14		Lakshmipur	Ramgati	50
15	Regional Office, Rangamati	Bandarban	Bandarban Sadar	50
16	Regional Office, Faridpur	Faridpur	Boalmari	50
17	Regional Office, Gopalganj	Gopalganj	Muksudpur	50
18	Regional Office, Jamalpur	Jamalpur	Sarishabari	58
19			Bakshigonj	50
20		Sherpur	Jhenaigati	51
21			Sreebordi	50
22	Regional Office, Kishoreganj	Kishoreganj	Hossainpur	50
23	Regional Office, Madaripur	Madaripur	Madaripur Sadar	50
24		Shariatpur	Vedorganj	50
25	Regional Office, Mymensing	Mymensingh	Phulpur	50

Sl No.	Name of Divisional/ Regional Office	District	Upazila	No. of Soil Samples Analyzed
26	Regional Office, Netrokona	Netrokona	Durgapur	50
27	Regional Office, Narshingdi	Narsingdi	Sreepur	57
28	Regional Office, Tangail	Tangail	Delduar	73
30			Kalihati	64
31	Regional Office, Jashore	Narail	Narail Sadar	50
32		Jashore	Chowgacha	50
33	Regional Office, Jhenaidah	Jhenaidah	Harinakundu	50
34		Bagerhat	Fakirhhat	50
35		Khulna	Rupsa	50
36	Regional Office, Kushtia	Meherpur	Mujibnagar	50
37		Kushtia	Daulatpur	50
38	Regional Office, Satkhira	Satkhira	Debhata	50
39	Regional Office, Bogura	Bogura	Sahjahanpur	50
40	Regional Office, Chapainawabganj	Chapainawabganj	Sadar, Chapai	50
41	Regional Office, Naogaon	Naogaon	Naogaon sadar	59
42	Regional Office, Pabna	Pabna	vangura	52
43	Divisional Office, Rajshahi	Rajshahi	Charghat	54
44		Natore	Singra	50
45	Regional Office, Sirajganj	Sirajganj	Sahjadpur	50
46	Regional Office, Dinajpur	Dinajpur	Dinajpur Sadar	57
47	Regional Office, Gaibandha	Gaibandha	Gaibandha Sadar	50
48	Regional Office, Lalmonirhat	Lalmonirhat	Lalmonirhat Sadar	50
49	Divisional Office, Rangpur	Rangpur	Gangachora	50
50	Regional Office, Thakurgaon	Thakurgaon	Pirganj	50
51	Regional Office, Moulvibazar	Moulvibazar	Barlekha	50
52			Madhabpur	50
53	Divisional Office, Sylhet	Sylhet	Kanaighat	50
54	Regional Office, Sunamganj	Sunamganj	Derai	50
Total				2,728

Table 3.78: Name of the Upazila and number of soil samples analyzed through MSTL under farmer's service programme during kharip 2025 season

Sl No.	Name of Divisional/ Regional Office	District	Upazila	No. of Soil Samples Analyzed
01	Divisional Office, Barishal	Barishal	Wazirpur	50
02		Jhalakathi	Nalchity	50
03		Pirojpur	Nesarabad	50
04	Regional Office, Patuakhali	Barguna	Amtali	50
05		Patuakhali	Kolapara	50
06	Regional Office, Bhola	Bhola	Lalmohan	50
07	Regional Office, Brahmanbaria	Brahmanbaria	Kasba	50
08	Divisional Office, Chattogram	Chattogram	Mirsharai	50
09		khagrachari	Khagrachari Sadar	50
10	Regional Office, Chandpur	Chandpur	Hymchar	50
11	Regional Office, Cumilla	Cumilla	Burichong	50
12	Regional Office, Noakhali	Feni	Fulgazi	50
13		Noakhali	Hatia	50
14	Regional Office, Rangamati	Bandarban	Rowangchhari	50
15		Khagrachhari	Khagrachhari sadar	50
16		Rangamati	Rangamati Sadar	50
17	Divisional Office, Dhaka	Dhaka	Keraniganj	54
18		Manikganj	Harirampur	53
19	Regional Office, Faridpur	Faridpur	Sadarpur	50
20		Rajbari	Kalukhali	50
21	Regional Office, Jamalpur	Jamalpur	Madargonj	53
22		Sherpur	Sherpur Sadar	52
23	Regional Office, Kishoreganj	Kishoreganj	Katiadi	50
24	Regional Office, Madaripur	Madaripur	Rajoir	50
25		Shariatpur	Goshairhat	50
26	Regional Office, Mymensing	Mymensingh	Nandail	50
27	Regional Office, Netrokona	Netrokona	Mohangonj	46
28	Regional Office, Narsingdi	Narsingdi	Palash	62
29	Regional Office, Tangail	Tangail	Mirzapur	93
30	Regional Office, Jashore	Jashore	Sharsha	50
31		Narail	Kalia	50
32	Regional Office, Jhenaidah	Jhenaidah	Jhenaidah Sadar	50
33		Magura	Magura Sadar	50

Sl No.	Name of Divisional/ Regional Office	District	Upazila	No. of Soil Samples Analyzed
34	Divisional Office, Khulna	Khulna	Dumuria	54
35		Bagerhat	Mollahat	50
36	Regional Office, Kushtia	Kushtia	Mirpur	50
37		Meherpur	Gangni	50
38	Regional Office, Satkhira	Satkhira	Kaliganj	53
39	Regional Office, Bogura	Bogura	Adamdighi	50
40		Joypurhat	Khetlal	86
41	Regional Office, Chapainawabganj	Chapainawabganj	Shibganj	50
42	Regional Office, Naogaon	Naogaon	Dhamurhat	62
43	Regional Office, Pabna	Pabna	Sathia	66
44	Divisional Office, Rajshahi	Rajshahi	Godagari	50
45		Natore	Natore Sadar	50
46	Regional Office, Sirajganj	Sirajganj	Belkuci	56
47	Regional Office, Dinajpur	Dinajpur	Chirirbandar	60
48	Regional Office, Gaibandha	Gaibandha	Saghata	50
49	Regional Office, Lalmonirhat	Lalmonirhat	Kaliganj	50
50		Kurigram	Rajarhat	50
51	Divisional Office, Rangpur	Rangpur	Taraganj	55
52		Nilphamari	Saidpur	50
53	Regional Office, Thakurgaon	Thakurgaon	Thakurgaon Sadar	70
54		Panchagarh	Debiganj	70
55	Regional Office, Moulvibazar	Moulvibazar	Moulvibazar Sadar	50
56			Lakhai	50
57	Divisional Office, Sylhet	Sylhet	Companiganj	50
58	Regional Office, Sunamganj	Sunamganj	Sunamgonj Sadar	50
Total				3,095

3.4 Soil and Water Salinity Monitoring

Introduction

The total area of Bangladesh is 147, 570 km². 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 km². The remaining part of the coastal area is used in agriculture. The cultivable areas in coastal districts are affected by 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, Pirojpur, Jhalokati, Barishal, Patuakhali, Chattogram 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 Chattogram district. They cover about 9,37,000 ha or about 33% of the coastal area. Saline soil contains an excess of neutral soluble salts that affects the normal physiological process of plants. Dominant salts are sulphate, chloride of calcium, potassium and sodium. Presence of bicarbonate and carbonate is not significant in the soils of Bangladesh. Saline affected soils of Bangladesh are saline soil rather than being sodic or saline sodic soil. These soils contain soluble salts in such quantities that they interfere with the growth of most crop plants. Ec value having more than 2 dS/m, ESP less than 15 and SAR less than 13. The pH of the saline soil is less than 8.5. It is estimated that Bangladesh has about 2.8 million ha (Chanratchakool, 2007) of land affected by salinity and poor-quality water. 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 Chattogram districts of the coastal and offshore lands.

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 (SRDI, 2012). Crop production in salt affected areas in the coastal regions differs considerably from non-saline areas. Crop 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.

Recently salinity area of coastal land has been reassessed to be 1.156 million hectare (Saline Soils of Bangladesh, 2025: In Press).

Objectives

- To determine the soil and water salinity round the year and to delineate area under different degrees of salinity.
- To determine the duration of the year when surface water is suitable for irrigation.
- To record present land use and crop response to soil salinity.
- To provide a necessary data base for developing appropriate technology and disseminate efficiently.

Methodology

Field data was being collected from strategically representative sites over the coastal area. Soil samples at variable depths (0-10cm, 10-30 cm 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) were collected twice in every month. Salinity of soils and water was determined by EC meter.

Findings

Khulna Division

26 soil salinity sites, 23 surface water salinity sites and 9 shallow tube well water salinity sites were selected in Khulna division (greater Khulna and Jashore district and Satkhira district). In greater Khulna, monitoring sites are located in Batiaghata, Dumuria, Fultala, Koyra, Dakop of Khulna district, Mongla, Morrelganj, Sharankhola of Bagerhat district and Shyamnagar of Satkhira district. In greater Jashore the monitoring sites are located in Jashore Sadar and Keshabpur of Jashore district and Kalia, Lohagara and Narail Sadar of Narail district. In Satkhira monitoring sites are located in Satkhira Sadar, kolaroa, Ashashuni, Tala of satkhira district. Surface water (river, canals) samples were collected twice in month during dry season and once in a month during rainy season. Salinity of water was determined by EC meter.

Table 3.79. Site specification of the soil sample collection sites of Khulna Division

Sl no.	Name of site	Location	Soil series	Land type	Land Use	Physiography
Khulna						
1	Krishnanagar,	Krishnanagar, Batiaghata, Khulna	Bajoa	MHL	F-TA	GTF
2	Krishnanagar	Krishnanagar, Batiaghata, Khulna	Dumuria	MHL	F-TA	GTF
3	Ghutudia	Ghutudia, Dumuria, Khulna	Bajoa	MHL	F-TA	GTF
4	Ghutudia	Ghutudia, Dumuria, Khulna	Dumuria	MHL	F-TA	GTF
5	Kismat	Kismat, Fultala, Batiaghata	Bajoa	MHL	F-TA	GTF

Sl no.	Name of site	Location	Soil series	Land type	Land Use	Physiography
6	Kismat	Kismat, Fultala, Batiaghata	Dumuria	MHL	F-TA	GTF
7	Fultala,	Fultala, Batiaghata, Khulna	Bajoa	MHL	F-TA	GTF
8	Fultala,	Fultala, Batiaghata, Khulna	Dumuria	MHL	F-TA	GTF
9	Digraj	Digraj ,Biddarbaon, Mongla	Barisal	MHL	F-TA	GTF
10	Shibbari	Shibbari, Paikgacha	Barisal	MHL	F-TA	GTF
Jashore						
11	Narail Ferry ghat	Narail Sadar, Narail	Gopalpur	HL	RV-KV	GRF
12	Baraipara	Kalia, Narail	Gopalpur	MHL	RV-KV	GRF
13	Kalna ghat	Lohagara, Narail	Sara	HL	RC-F-TA	GRF
14	Sagardari	Kesabpur, Jahore	Amjhupi	MHL	B-F-TA	GRF
15	Noapar	Jashore Sadar, jashore	Gopalpur	HL	Banana Orchard	GRF
16	Tularampur	Narail Sadar, Narail	Sara	HL	Banana Orchard	GRF
17	Gobra Bazar	Narail Sadar, Narail	Gopalpur	MHL	RC-F-TA	GRF
18	Baradia	Kalia, Narail	Gopalpur	HL	RC-J-F	GRF
19	Sheikhati	Narail Sadar, Narail	Gopalpur	HL	RV-KV	GRF
Satkhira						
20	kumira	kumira, Tala.	Ishwardi	MHL	B-F-TA	GRF
21	Binerpota	Binerpota, Satkhira	Ishwardi	MHL	B-F-TA	GRF
22	Shreepatipur	Shreepatipur, Kolaroa.	Ishwardi	MHL	B-F-TA	GRF
23	Capra	Capra, Budhhata, Ashashuni.	Barisal	MHL	B-Fish	GTF
24	Shokhipur	Shokhipur, Debhata	Ishwardi	MHL	B-F-TA	GRF
25	Varashimla	Varashimla, Kaliganj	Barisal	MHL	B-F-TA	GTF
26	Shrifalkathi	Ishwaripur, Shyamnagar	Barishal	MHL	B-F-TA	GTF

Graphical presentation of some selected soil monitoring site of Khulna division:

Table 3.80. Serial no 1: Site no. 14A, Soil series: Bajoa, MHL, Location: Krishnanagar, Batiaghata.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	2.5	5.2	9.6	15	10.2	6.7	5.3	2.1	1.4	1.7	2.1	4.18
2022	4.6	5.07	9.2	11.2	8.2	6.5	6	3.9	3.4	3	3.7	4
2023	4.6	5.2	6	8	11.2	8.2	5.3	3.8	3.6	3.4	3.7	4
2024	4.3	4.5	4.6	6.4	7.8	6.2	5.4	0.24	1.4	1.8	1.4	3.8

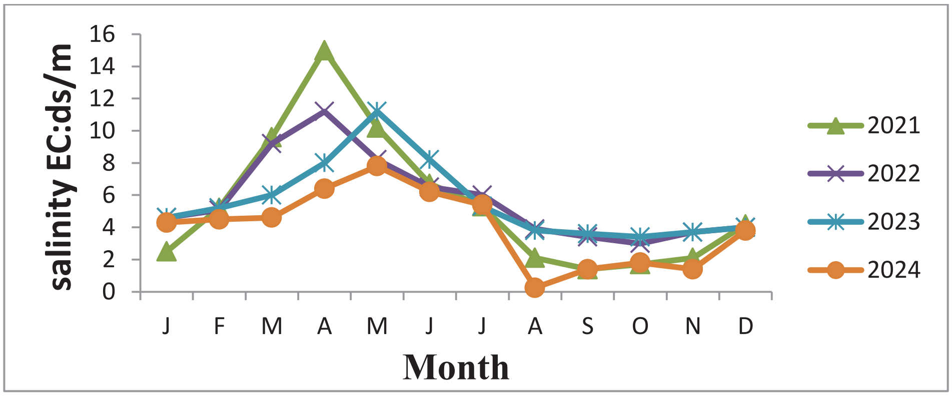


Fig 3.74: Changes in soil salinity in Bajoa soil series (MHL), Krishnanagar, Batiaghata.

Table 3.81. Serial no 2: Site no. 14B, Soil series: Dumuria, MHL, Location: Krishnanagar, Batiaghata.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	2.3	5.0	10.1	15.6	11	1.6	1.2	1.1	1.2	1.83	2.0	3.91
2022	4.2	6.21	9.0	11.5	8.0	7.0	6.6	3.7	3.3	2.9	3.8	4.1
2023	4.5	5.0	6.4	8.2	11.0	8.3	5.0	3.7	2.5	3.3	3.8	3.9
2024	4.5	4.8	4.9	7.3	8.1	6.2	5.5	0.38	1.50	1.9	1.4	3.8

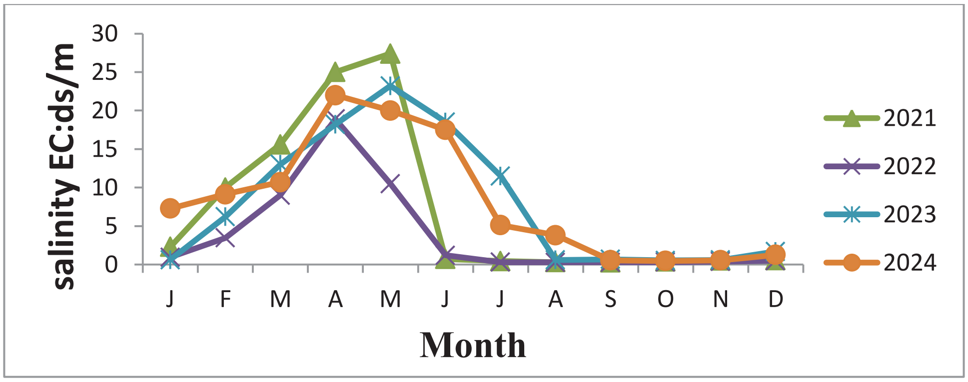


Fig 3.75: Changes in soil salinity in Dumuria soil series (MHL), Krishnanagar, Batiaghata.

Table 3.82. Serial no 10: Site no. 19, Soil series: Barisal, MHL, Location: Shibbari, Paikgacha.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	3.5	7.5	13.2	17.3	16	4.6	1.9	1.6	1.8	4	5	5.32
2022	6.2	7.5	13.1	16	9.5	8.2	5.7	1.8	1.3	1.8	3.7	3.9
2023	4.1	7	8	11.2	15	9.5	7.2	5.2	4.1	3.9	4.2	5
2024	7.2	7.6	19	25.5	22.9	5.4	14.1	7.3	1.3	1.7	1.7	5.9

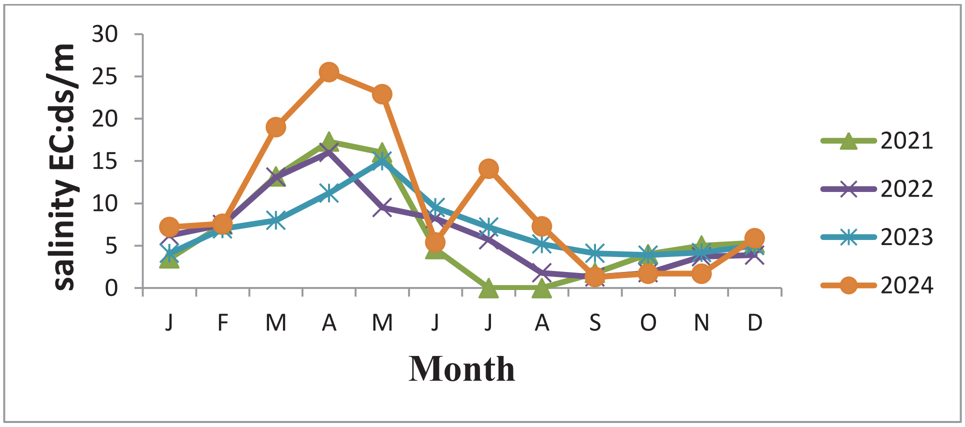


Fig 3.76: Changes in soil salinity in Barisal soil series (MHL), Shibbari, Paikgacha.

Table 3.83. Serial no 11: Site no.-3, Soil series: Gopalpur, HL, Location: Narail Ferry ghat, Narail.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.77	1.03	1.17	1.17	1.4	1.03	0.97	0.5	0.24	0.38	0.38	0.51
2022	0.91	0.64	0.91	1.03	1.03	0.91	1.04	0.64	0.51	0.64	0.9	0.78
2023	1.03	0.63	0.38	0.51	1.3	0.64	0.38	0.38	2.23	0.38	0.51	0.38
2024	0.91	0.91	0.64	0.38	0.51	0.38	0.38	0.64	0.24	0.24	0.38	0.77

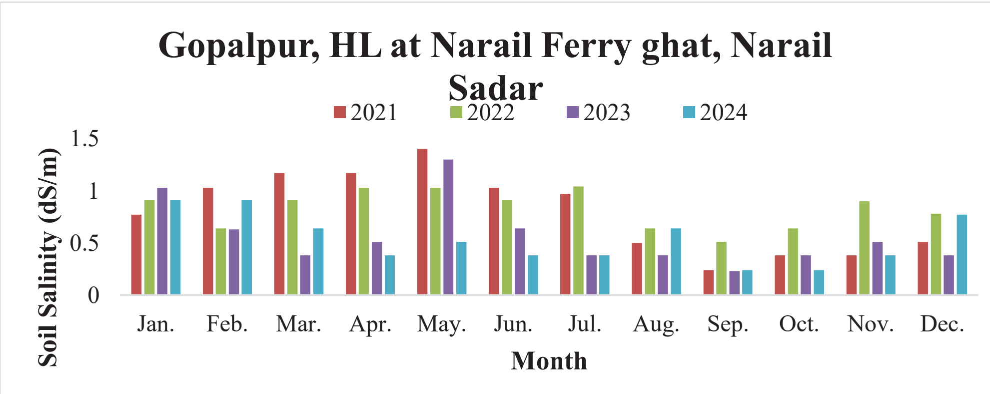


Fig 3.77: Changes in soil salinity in Gopalpur soil series (HL), Narail Ferry ghat, Narail.

Table 3.84. Serial no 13: Site no.-5, Soil series: Sara, HL, Location: Kalna ghat, Lohagara, Narail.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	1.03	0.39	1.17	1.17	1.54	1.17	0.97	0.38	0.24	0.97	0.64	0.77
2022	0.77	0.91	0.91	1.17	1.03	0.77	1.04	0.51	0.38	0.51	0.77	0.77
2023	0.77	0.9	0.64	0.64	1.17	0.38	0.38	0.38	0.38	0.38	0.51	0.38
2024	0.51	0.51	0.38	2.23	2.1	2.1	0.38	0.38	0.38	0.51	0.51	0.38

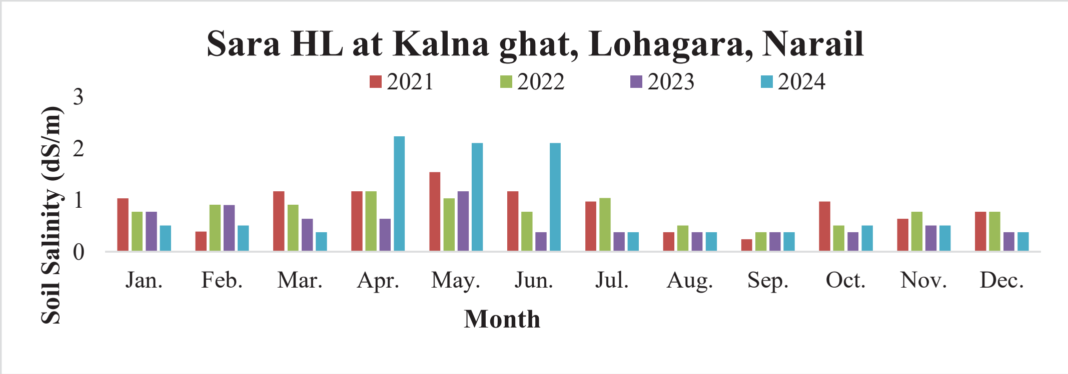


Fig 3.78: Changes in soil salinity in Sara soil series (HL), Kalna ghat, Lohagara, Narail.

Table 3.85. Serial no 14: Site no.-7, Soil series: Amjhupi, MHL, Location: Kalna ghat, Lohagara, Narail.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	1.03	1.03	1.3	1.4	1.97	0.97	0.38	0.24	0.24	0.24	0.91	0.91
2022	1.17	0.97	0.77	1.5	1.4	1.04	0.93	0.91	0.91	0.77	0.91	0.97
2023	0.91	0.91	1.04	0.64	0.91	0.51	0.38	0.38	0.51	0.77	0.77	1.57
2024	1.3	1.04	1.04	1.04	4.69	0.38	0.91	0.51	0.51	0.38	0.77	1.57

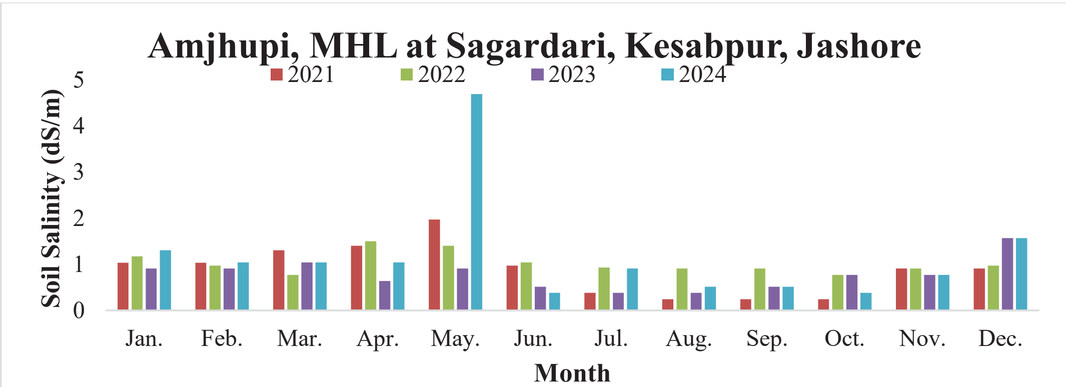


Fig 3.79: Changes in soil salinity in Amjhupi soil series (MHL), Sagardari, Kesabpur, Jashore.

Table 3.86. Serial no 17: Site no.-12, Soil series: Gopalpur, MHL, Location: Gobra Bazar, Narail.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.98	1.17	1.57	1.4	1.97	1.3	0.9	0.38	0.11	0.51	0.38	0.63
2022	0.91	1.04	1.04	1.4	1.03	1.03	1.04	0.91	0.77	0.51	0.77	0.9
2023	0.77	1.02	4.69	1.04	5.86	0.77	1.97	0.24	4.44	0.51	0.51	1.7
2024	4.69	5.58	7.73	1.83	4.31	5.32	3.93	0.64	1.56	3.93	5.2	0.77

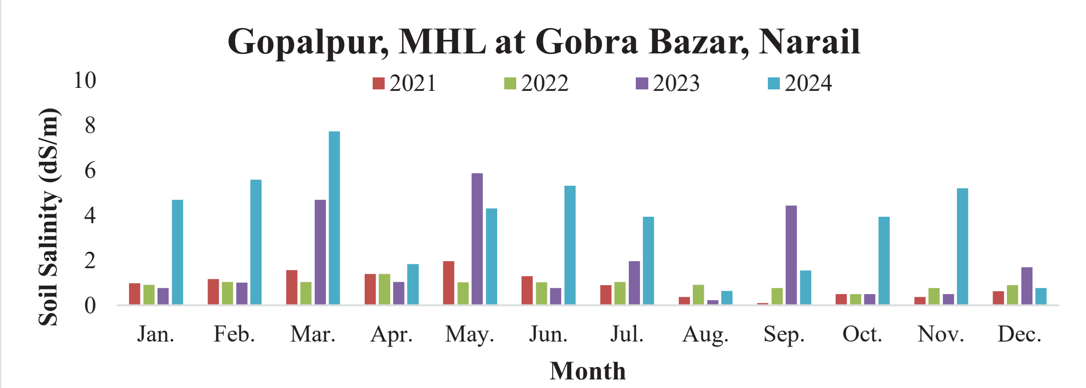


Fig 3.80: Changes in soil salinity in Gopalpur soil series (MHL), Gobra Bazar, Narail.

Table 3.87. Serial no 20: Site no.-1, Soil series: Ishurdi, MHL, Location: Kumira, Tala.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	1.83	1.97	1.70	1.83	2.23	2.63	2.10	1.92	1.87	1.83	1.80	1.84
2023	3.80	3.89	2.63	1.70	1.30	1.18	0.91	0.77	0.75	0.71	0.91	1.04
2024	0.99	1.17	1.30	1.97	2.23	2.10	1.97	1.70	1.57	1.44	1.57	1.17

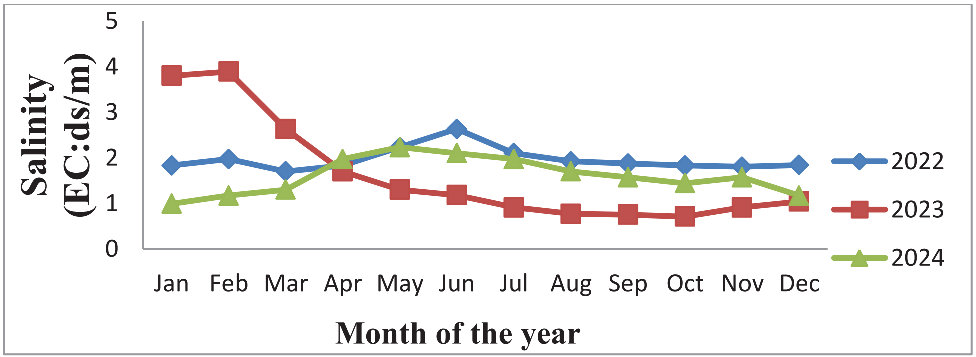


Fig 3.81: Changes in soil salinity in Ishurdi soil series (MHL), Kumira, Tala.

Table 3.88. Serial no 23: Site no.-4, Soil series: Barisal, MHL, Location: Capra, Budhhata, Ashashuni.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	5.1	5.8	5.2	5.7	6.1	8.5	5.5	4.8	4.63	4.56	4.50	4.55
2023	6.72	6.83	6.08	7.86	6.84	6.76	6.34	5.32	5.01	4.96	5.73	5.83
2024	5.11	6.59	6.84	7.10	7.98	7.35	6.13	5.12	5.07	4.94	5.07	6.08

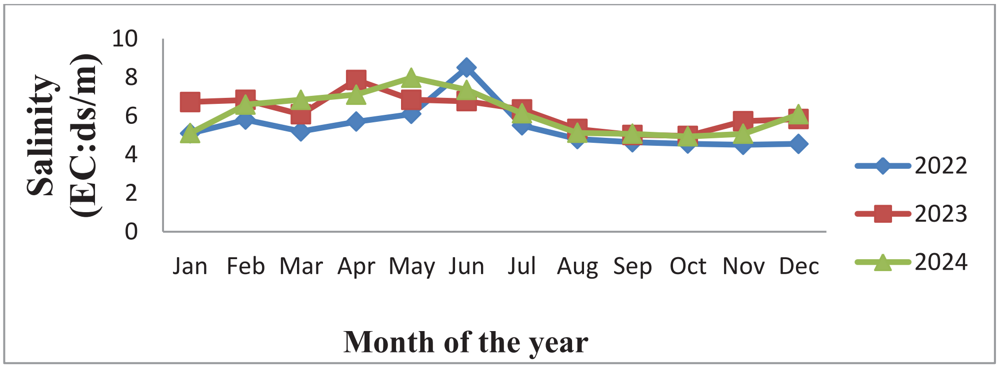


Fig 3.82: Changes in soil salinity in Barisal soil series (MHL), Capra, Budhhata, Ashashuni.

Table 3.89: Site specification of the water collection sites of Khulna Division

Sl. No	Name of river	Location
Khulna		
1	Madhumati River	Mollahat, Bagerhat
2	Rupsa River	Rupsa Ferryghat, Khulna.
3	Shailmari River	Koiya Bazar, Batiaghata, Khulna.
4	Vadra River	Khornia.Dumuria, Khulna
5	Shibsha River	Paikgacha HQ, Khulna.
6	Kazibachha River	Batiaghata, Khulna
7	Pasur River	Mongla port, Mongla, Bagerhat.
8	Daratana River	Bagerhat ferry ghat, Bagerhat.
9	Ghoshiakhali River	Rampal, Bagerhat
Jashore		
10	Chittra River	Narail Ferry ghat.Narail Sadar
11	Kapotaxma River	Sagardari, Kesabpur, Jashore.
12	Bhairab River	Noapara, Jashore.
13	Afra River	Tularampur, Narail Sadar
14	Chittra River	Gobra, Narail sadar, Narail (New site).
15	Naboganga River	Baraypara, Kalia.
16	Modhumoti River	Bardia, Lohagara.
17	Modhumoti River	Kalna ghat, Lohagara
18	Afra River	Shaikhati, Narail.
Satkhira		
19	Kapotaksha River	Patkelghata, Tala, Satkhira.
20	Betna River	Benerpota, Satkhira sadar, Satkhira.
21	Betna River	kolaroa bazar, kolaroa, Satkhira
22	Morichap River	Ashashuni, Satkhira.
23	Kakshiali River	Kaliganj HQ, Satkhira.

Graphical presentation of some selected water monitoring site of Khulna division:

Table 3.90. Serial no 1: Site no. 13. Madhumati river, Mollahat, Bagerhat.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.6	0.7	0.9	7.2	5.1	0.3	0.4	0.5	0.4	0.43	0.45	0.40
2022	0.57	0.52	1.0	3.9	0.70	0.60	0.52	0.33	0.34	0.37	0.46	0.60
2023	0.69	0.74	0.91	2.3	2.70	2.70	.39	0.29	0.30	0.37	0.35	0.40
2024	0.37	0.53	0.86	0.99	3.25	3.61	2.01	0.24	0.24	0.24	0.30	0.31

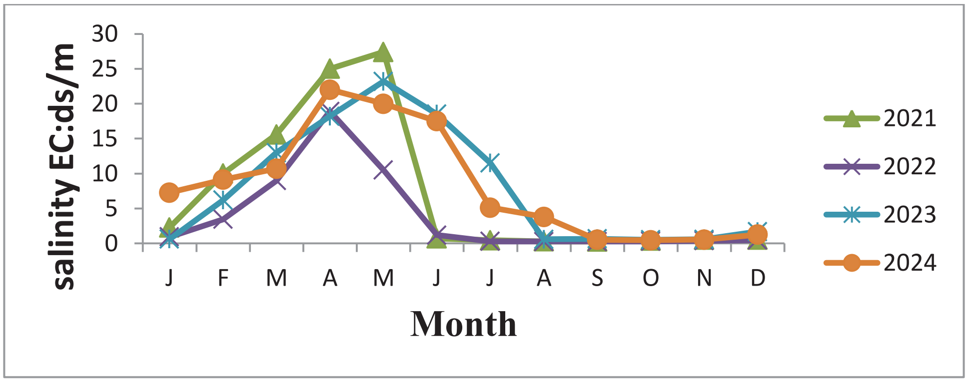


Fig 3.83: Changes in water salinity in Madhumati River, Mollahat, Bagerhat.

Table 3.91. Serial no 2: Site no. 15. Rupsa river, Rupsa Ferryghat, Khulna.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	1.70	5.00	11.8	25.9	30.2	0.29	0.4	0.4	0.3	0.34	0.35	0.56
2022	0.74	1.0	10.0	14.6	10.5	0.72	0.22	0.26	0.24	0.32	0.35	0.45
2023	0.72	4.0 0	11.5	16.7	32.0	29.4	0.29	0.55	0.32	0.34	0.32	0.63
2024	0.70	3.03	9.40	23.7	25.4	24.7	3.14	0.26	0.25	0.30	0.35	0.45

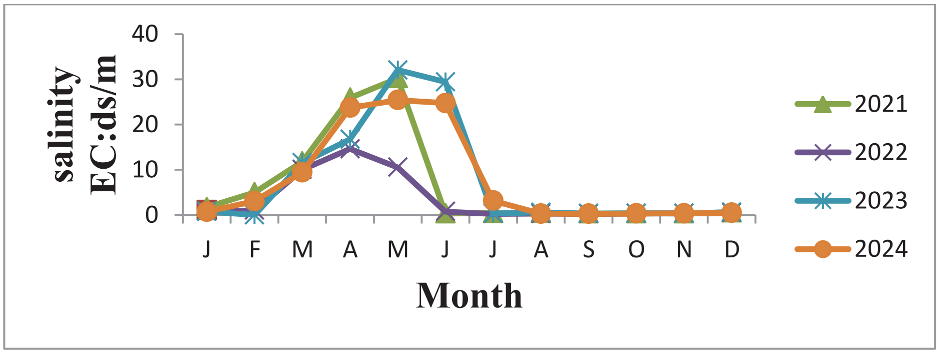


Fig 3.84: Changes in water salinity in Rupsa River, Rupsa Ferryghat, Khulna.

Table 3.92. Serial no 3: Site no. 16. Shailmari river, Koiya Bazar, Batiaghata, Khulna.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	2.30	10.0	17.0	28.0	33.0	0.84	0.4	0.5	0.4	0.4	0.60	0.49
2022	0.93	2.8	10.2	16.0	13.5	1.5	0.31	0.28	0.29	0.35	0.41	0.59
2023	4.0	8.15	18.6	26.2	34.2	31.0	0.30	0.66	0.34	0.47	0.46	0.61
2024	2.62	6.34	15.3	26.2	29.0	25.0	3.06	3.38	0.32	0.31	0.39	0.46

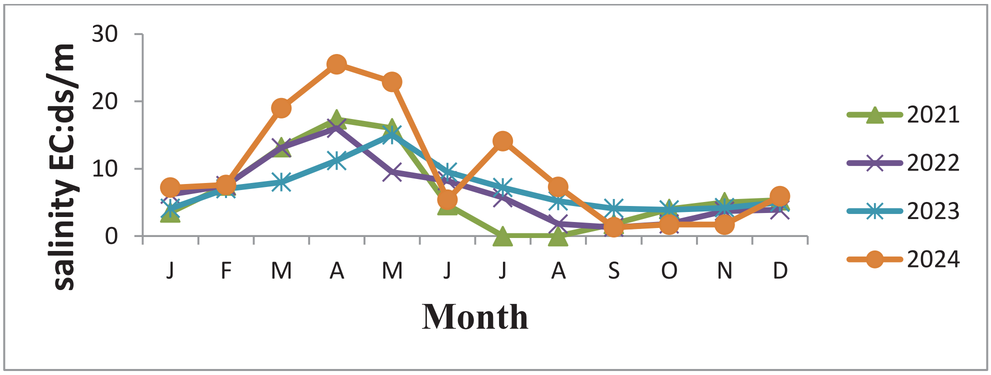


Fig 3.85: Changes in water salinity in Shailmari river, Koiya Bazar, Batiaghata, Khulna.

Table 3.93. Serial no 4: Site no. 17. Vadrariver, Khornia, Dumuria, Khulna

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	1.50	2.20	3.9	19.5	24.7	13.5	1.6	1.9	0.7	0.71	0.75	1.6
2022	1.73	2.5	15.3	22.0	19.0	15.6	6.37	3.0	1.86	3.29	3.80	4.0
2023	12.0	17.2	21	26.5	31.2	29.2	9.2	4.38	2.80	2.70	3.0	1.9
2024	2.24	2.93	3.2	5.7	18.8	18.9	7.55	2.35	1.56	0.74	0.95	1.45

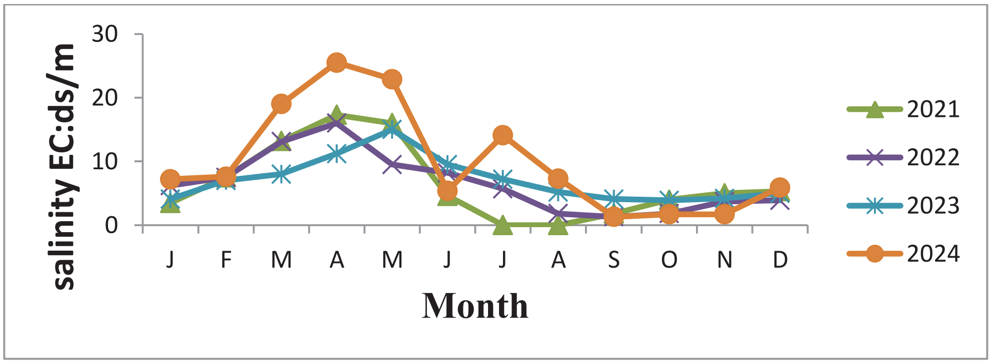


Fig 3.86: Changes in water salinity in Vadra River, Khornia.Dumuria, Khulna.

Table 3.94. Serial no 5: Site no. 25. Shibsha river, Paikgacha HQ, Khulna.

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	1.2	7.7	18.6	28.8	33.6	20.0	2.9	2.1	0.9	0.91	1.2	1.65
2022	2.1	2.8	17.2	25.0	32.7	29.7	17.2	11.5	9.2	3.76	4.20	5.1
2023	14.9	20.1	26.0	32.5	36.2	34.0	17.0	6.52	5.1	3.9	4.40	4.3
2024	6.07	13.37	19.3	35.9	32.0	32.2	8.52	2.46	0.90	0.97	1.42	2.18

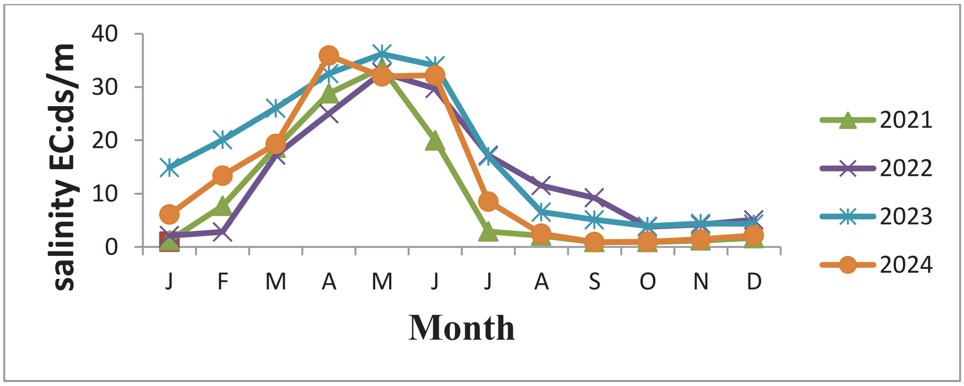


Fig 3.87: Changes in water salinity in Shibsha river, Paikgacha HQ, Khulna.

Table 3.95. Serial no 6: Site no. 26. Kazibachha river, Batiaghata, Khulna

Year	Monthwise EC Value (ds/m)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	2.4	11.4	17.2	29.2	33.2	0.85	0.4	0.6	0.4	0.42	0.57	0.5
2022	0.94	2.85	13.5	18.5	15	1.6	0.33	0.3	0.31	0.37	0.48	0.63
2023	4.15	12.8	21	27.5	35.2	32	0.32	0.61	0.37	0.5	0.47	0.57
2024	2.9	8.13	16.2	26.2	31	26.1	3.47	4.1	0.33	0.42	0.48	0.48

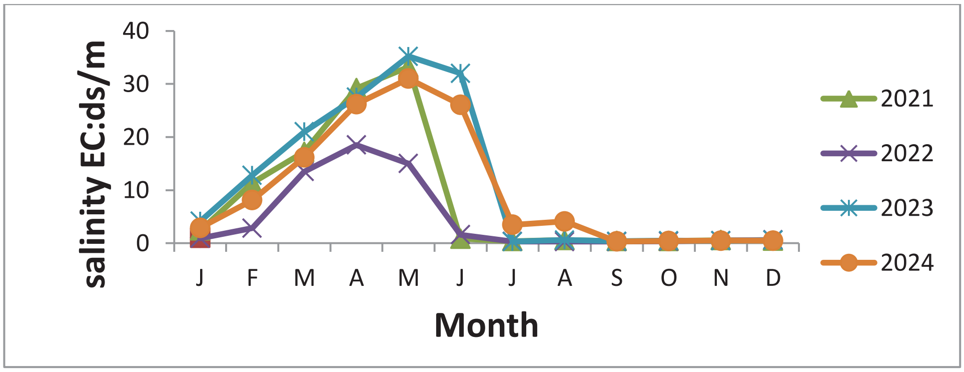


Fig 3.88: Changes in water salinity in Kazibachha river, Batiaghata, Khulna.

Table 3.96. Serial no 7: Site no. 27. Pasur river, Mongla port, Mongla, Bagerhat.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	2.6	13	28.2	29.5	33.7	1	0.4	0.5	0.5	0.5	0.65	0.55
2022	1.2	5.7	15.2	20.2	16	1.8	0.35	0.33	0.35	0.4	0.5	0.7
2023	5	13.2	23	27.1	37	32.8	0.4	0.62	0.4	0.57	0.6	1.6
2024	7.45	10.9	24.1	33.3	30	24	14.6	5.52	0.67	0.45	0.62	1.27

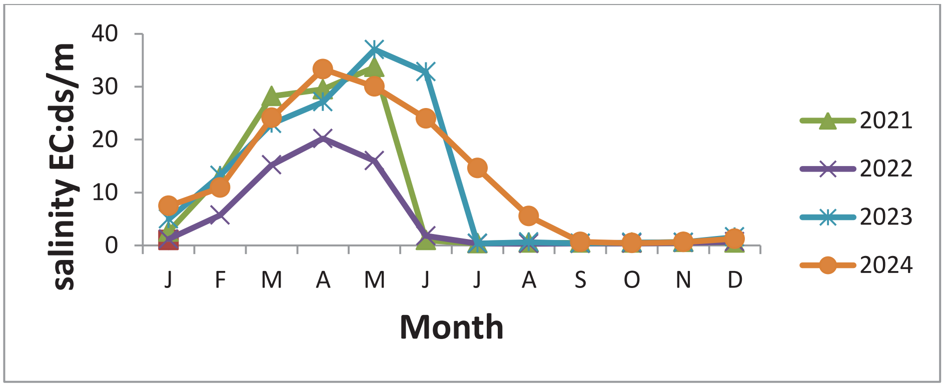


Fig 3.89: Changes in water salinity in Pasur river, Mongla port, Mongla, Bagerhat.

Table 3.97. Serial no 8: Site no. 28. Daratana river, Bagerhatferryghat, Bagerhat.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	1.14	2.3	5.77	19.6	24.7	1.95	1.2	1.3	1.4	1.45	1.8	2
2022	2.6	2.7	12.7	12.7	12.7	2.1	5.9	3.5	2.2	2.16	2.24	2.7
2023	3.2	5	11.5	15.7	28.9	24.6	9.7	4.32	3.1	3	2.95	3.44
2024	4.8	8.58	12.5	22.8	18.4	13.1	5.38	2.62	1.56	1.32	1.52	1.09

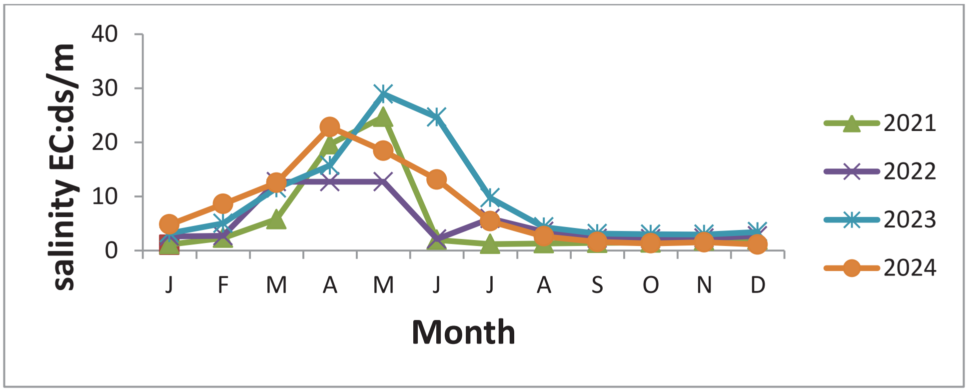


Fig 3.90: Changes in water salinity in Daratana river, Bagerhat ferryghat, Bagerhat.

Table 3.98. Serial no 9: Site no: 29 Ghoshiakhali river, Rampal

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	2.3	10.0	15.6	25.0	27.4	0.71	0.45	0.29	0.27	0.40	0.52	0.56
2022	0.95	3.45	9.0	18.9	10.5	1.2	0.29	0.27	0.27	0.30	0.39	0.49
2023	0.62	6.20	13.0	18.2	23.2	18.5	11.5	0.60	0.67	0.52	0.59	1.7
2024	7.27	9.13	10.7	22.0	20.0	17.5	5.12	3.80	0.54	0.46	0.55	1.25

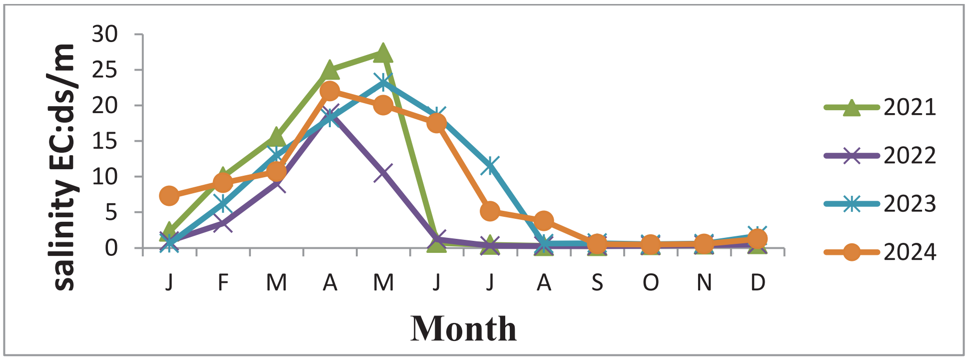


Fig 3.91: Changes in water salinity in Ghoshiakhali river, Rampal

Table 3.99. Serial no 10: Chittra River, Narail Ferry ghat, Narail Sadar

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.8	0.4	0.6	0.8	0.8	0.5	0.7	0.3	0.3	0.5	0.5	0.5
2022	0.4	0.5	0.5	0.8	0.7	0.6	0.8	0.6	0.4	0.3	0.4	0.4
2023	0.5	0.5	0.6	0.9	3.0	1.0	0.9	0.6	0.4	1.3	0.4	2.0
2024	2.0	0.6	0.8	1.6	4.3	9.7	8.2	0.8	0.4	0.3	0.3	0.5

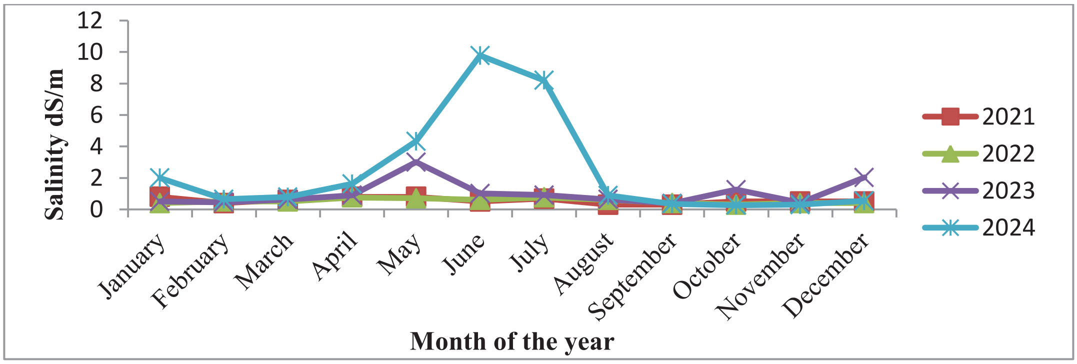


Fig 3.92: Changes in water salinity in Chittra River, Narail Ferry ghat, Narail Sadar

Table 3.100. Serial no 11: Kapotaksha river, Sagardari, Kesabpur, Jashore.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.8	1.0	2.5	6.4	13	3	5.4	0.4	0.4	0.4	0.6	0.7
2022	0.7	0.8	0.9	9.0	8.5	3.8	9.5	2.0	0.8	0.6	1.5	1.2
2023	1.8	0.8	7.5	10.2	15.7	7.5	11.4	4.9	0.5	0.7	1.5	1.8
2024	1.1	1.3	1.9	6.9	12.5	16.1	16.1	0.6	0.4	0.3	0.5	0.7

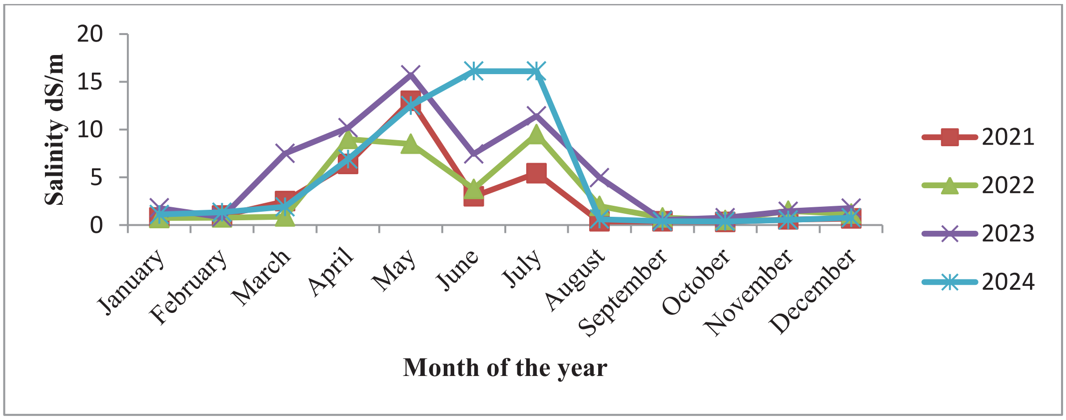


Fig 3.93: Changes in water salinity in Kapotaksha river, Sagardari, Kesabpur, Jashore.

Table 3.101. Serial no 12: Bhairab river, Noapara, Jashore

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.8	1.2	2.8	4.6	12.5	2.8	5.1	0.7	0.5	0.3	0.6	0.6
2022	0.6	0.7	0.8	6.0	5.8	4.0	9.0	1.8	0.7	0.6	0.8	0.8
2023	1.0	0.7	1.2	6.0	11.8	12.3	16.7	4.3	0.4	0.6	0.6	1.0
2024	1.3	1.5	1.3	6.6	13.0	14.9	7.8	3.2	0.3	0.2	0.3	0.6

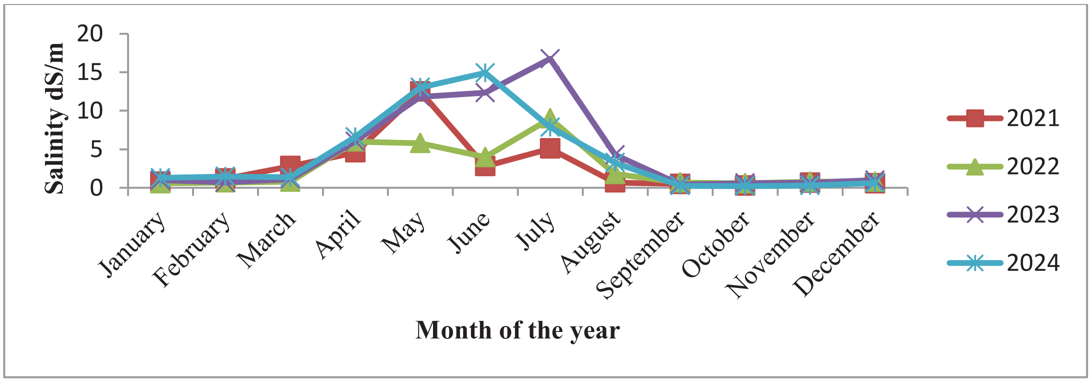


Fig 3.94: Changes in water salinity in Bhairab river, Noapara, Jashore.

Table 3.102. Serial no 13: Afra river, Tularampur, Narail Sadar.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.8	1.4	1.9	2.8	4.8	1.8	3.4	0.5	0.4	0.4	0.6	0.5
2022	0.6	0.7	0.9	2.0	3.0	2.0	4.5	1.1	0.6	0.5	0.5	0.6
2023	0.75	0.74	1.0	3.6	8.8	6.4	5.6	0.9	0.5	0.3	0.6	0.5
2024	1.0	1.2	1.8	2.5	9.9	12.7	3.9	0.8	0.3	0.3	0.3	0.7

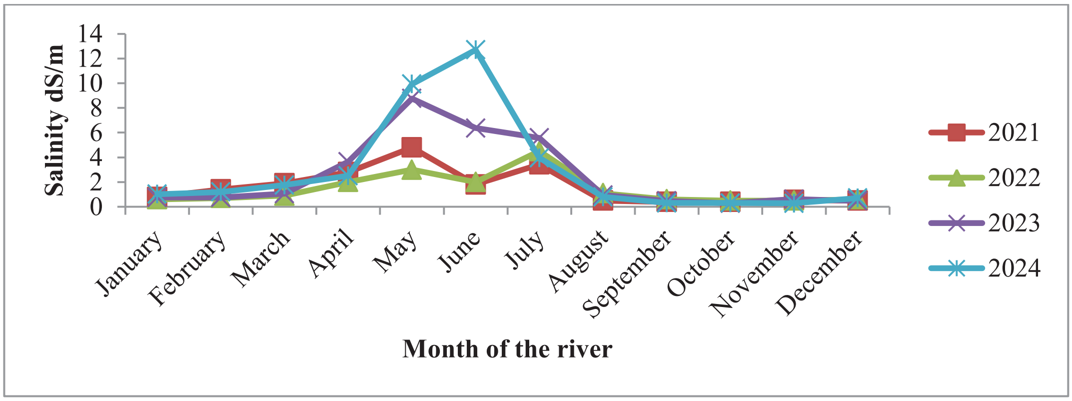


Fig 3.95: Changes in water salinity in Afra river, Tularampur, Narail Sadar.

Table 3.103. Serial no 15: Nabaganga River, Baraypara, Kalia.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.8	1.4	3.1	6.0	12.0	2.0	5.6	0.4	0.4	0.6	0.6	0.7
2022	0.7	0.6	0.8	9.1	8.0	4.5	8.9	1.5	0.7	0.5	1.0	1.3
2023	1.4	0.6	1.7	4.8	9.6	4.4	0.5	0.3	0.2	0.2	0.2	0.3
2024	0.3	1.0	1.1	4.4	4.4	8.9	0.2	0.2	0.2	0.3	0.3	0.3

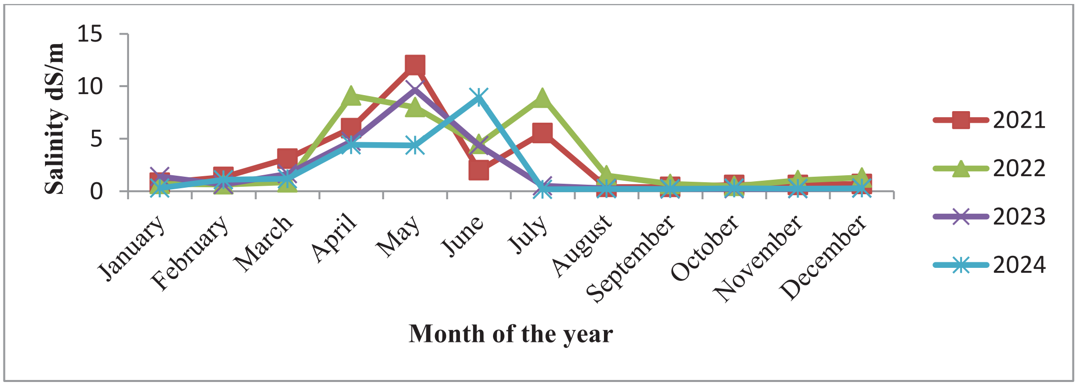


Fig 3.96: Changes in water salinity in Nabaganga River, Baraypara, Kalia.

Table 3.104. Serial no 16: Madhumati River, Bardia, Lohagara.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.7	0.3	0.5	0.8	1.8	0.4	0.7	0.3	0.3	0.4	0.4	0.3
2022	0.4	0.4	0.5	0.7	0.7	0.7	0.7	0.6	0.8	0.3	0.3	0.5
2023	0.5	0.4	0.4	0.4	0.7	0.5	0.4	0.2	0.2	0.2	0.3	0.3
2024	0.3	0.3	0.3	0.4	1.0	0.4	0.2	0.2	0.2	0.3	0.3	0.3

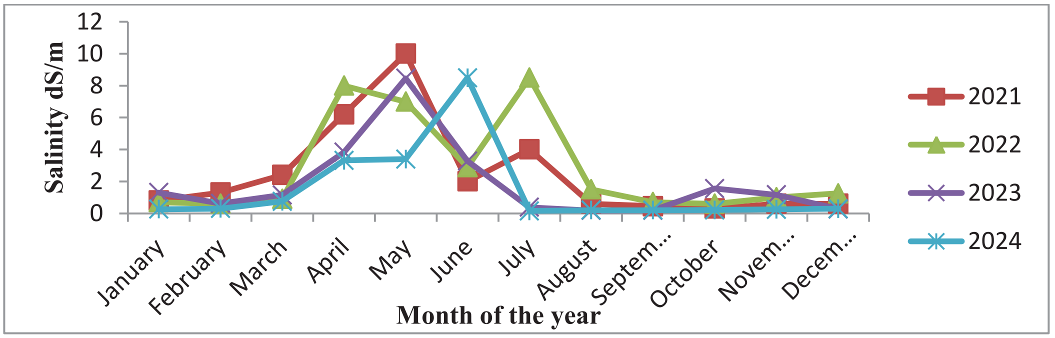


Fig 3.97: Changes in water salinity in Madhumati River, Bardia, Lohagara.

Table 3.105. Serial no 19: Kapotaksha river, Patkelghata, Tala, Satkhira.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.55	0.7	1.8	16	25.6	11.2	0.9	0.5	0.3	0.5	0.6	0.3
2022	0.6	0.8	1.1	14.3	18.1	21	17.1	11.2	1.5	3.8	2.7	3.1
2023	3.3	8.1	13.7	22.1	27.7	29.4	8.2	1.3	0.9	1.3	4.1	4.3
2024	2.2	2.1	6.6	19.3	21.4	24.1	8.28	1.55	1.82	1.5	1.05	2.6

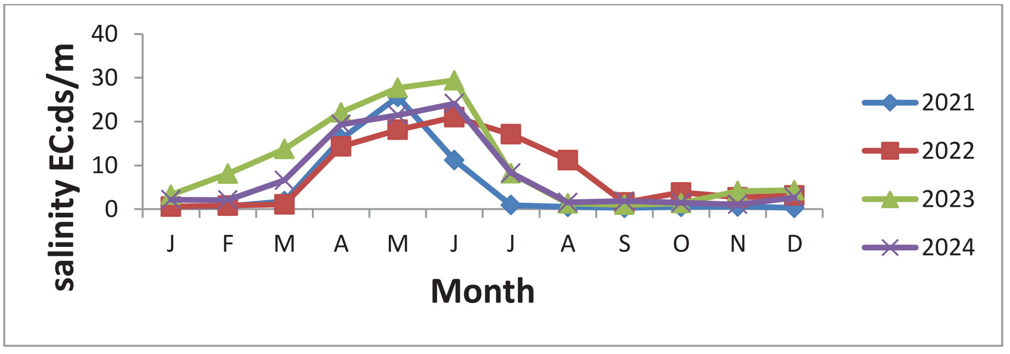
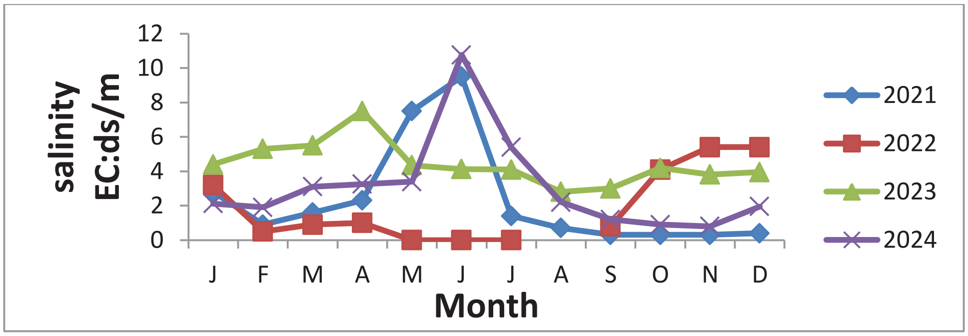


Fig 3.98: Changes in water salinity in Kapotaksha river, Patkelghata, Tala, Satkhira.

Table 3.106. Serial no 20: Betna river, Benerpota, Satkhira Sadar, Satkhira.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	2.8	0.9	1.6	2.3	7.5	9.5	1.4	0.7	0.3	0.3	0.3	0.4
2022	3.2	0.5	0.9	1.0	*	*	*	*	0.8	4.1	5.4	5.4
2023	4.4	5.3	5.5	7.5	4.3	4.13	4.10	2.8	3.0	4.2	3.8	3.9
2024	2.1	1.9	3.1	3.2	3.3	10.7	5.4	2.2	1.2	0.9	0.8	1.9



*Due to ongoing river excavation work data collection was not possible

Fig 3.99: Changes in water salinity in Betna river, Benerpota, Satkhira Sadar, Satkhira.

Table 3.107. Serial no 22: Morichap river, Ashashuni, Satkhira

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	4	12.1	18.2	30.4	23.5	10.2	7.7	5.2	3.1	1.8	3.2	2.6
2022	3.3	5.1	16.5	22.5	29	31.1	18.2	13.8	8.1	8.3	10.4	11.5
2023	13.9	17.3	21.9	28.7	29.6	31.7	13.5	6.1	6	5.35	7.2	9.8
2024	5.66	8	17.8	29.5	32.1	29.5	15.7	5.85	12.6	9.08	5.8	6.9

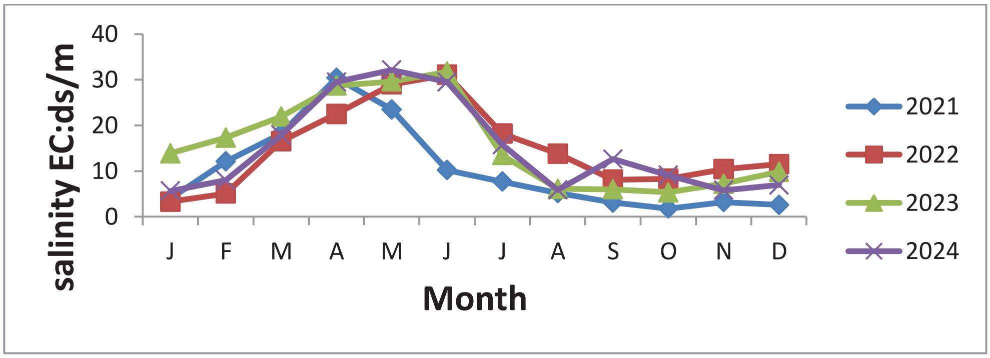


Fig 3.100: Changes in water salinity in Morichap river, Ashashuni, Satkhira

Table 3.108. Serial no 23: Kakshiali river, Kaligonj HQ, Satkhira.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	3.4	8.6	14.2	25.5	34.1	16.2	8.5	6	2.8	1.2	1.7	1.8
2022	2.8	5.8	11.3	19.8	25.2	26.7	24.6	18.6	7.6	7.7	7.8	10.5
2023	12.2	15.6	20.5	27.9	28.4	30.6	20.2	9.57	7.2	6.3	6.8	8.13
2024	9.5	10.8	16.1	27.8	31.1	27.5	17.1	5.14	14.8	10.6	5.96	10.1

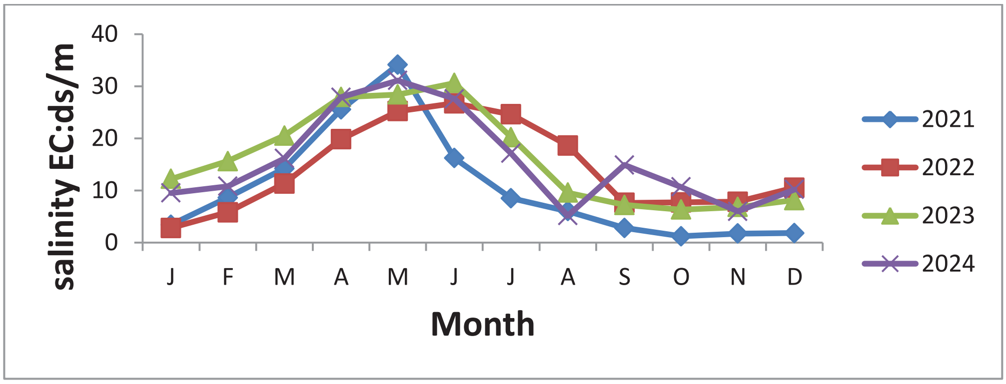


Fig 3.101: Changes in water salinity in Kakshiali river, Kaliganj HQ, Satkhira.

Table 3.109. Site specification of the STW (Shallow Tube well) water collection sites of Khulna Division

Sl No	Location
1.	**Site No-1: STW at Narail Ferry ghat, Narail Sadar**
2.	**Site No-2: STW at Sagardari, Kesabpur, Jashore**
3.	**Site No-3: STW at Noapara, Jashore**
4.	**Site No-4: STW at Tularampur, Narail Sadar**
5.	**Site No-5: STW at Gobra, Narail Sadar, Narail (New site)**
6.	**Site No-6: STW at Baraypara, Kalia**
7.	**Site No-7: STW at Bardia, Lohagara**
8.	**Site No-8: STW at Kalna ghat, Lohagara**
9.	**Site No-9: STW at Shaikhati, Narail**

Graphical presentation of some selected shallow tube well water salinity monitoring site of Khulna division:

Table 3.110. Serial no 1: STW at Narail Ferry ghat, Narail Sadar.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	1.0	1.2	1.2	1.2	1.5	0.9	-	0.8	0.9	0.7	0.8	0.8
2022	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.9
2023	0.9	0.8	1.3	1.3	1.3	1.3	2.5	1.3	0.8	0.3	1.2	0.4
2024	0.4	1.9	2.0	0.8	0.7	2.0	2.2	2.2	2.1	1.8	2.1	1.9

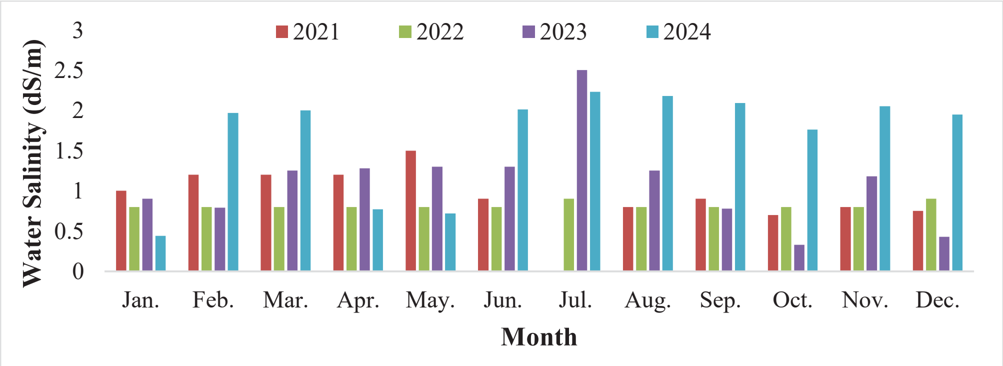


Fig 3.102: Changes in water salinity in STW at Narail Ferry ghat, Narail Sadar.

Table 3.111. Serial no 2: STW at Sagardari, Kesabpur, Jashore.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.8	1.3	0.9	0.9	1.0	0.9	-	0.8	0.8	0.7	0.8	0.8
2022	0.9	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.8	0.8	0.8
2023	0.9	0.8	0.8	0.8	0.8	0.8	1.2	0.8	0.5	0.8	0.8	0.8
2024	0.7	0.8	0.8	0.8	1.3	0.8	0.8	0.8	0.8	0.8	0.7	0.7

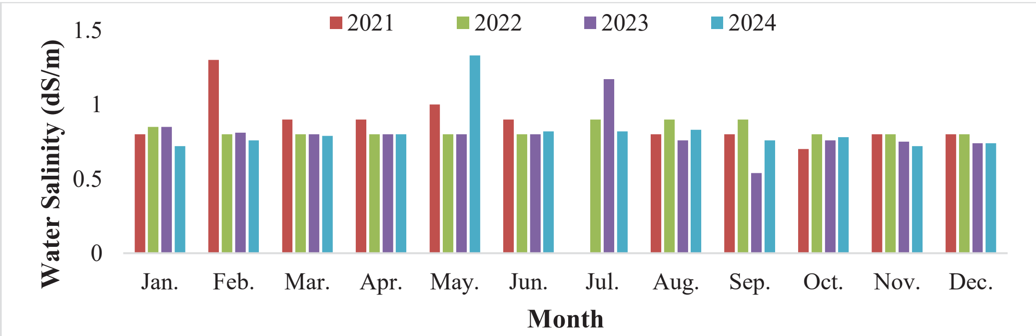


Fig 3.103: Changes in water salinity in STW at Sagardari, Kesabpur, Jashore.

Table 3.112. Serial no 3: STW at Noapara, Jashore.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.8	0.9	0.8	0.8	0.9	0.9	-	0.8	1.0	0.8	0.8	0.8
2022	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.9
2023	0.8	0.8	1.1	1.1	1.1	1.1	1.7	1.2	1.2	1.2	1.2	1.1
2024	1.1	1.2	1.2	1.2	1.2	1.2	1.3	1.1	1.1	1.1	1.1	1.1

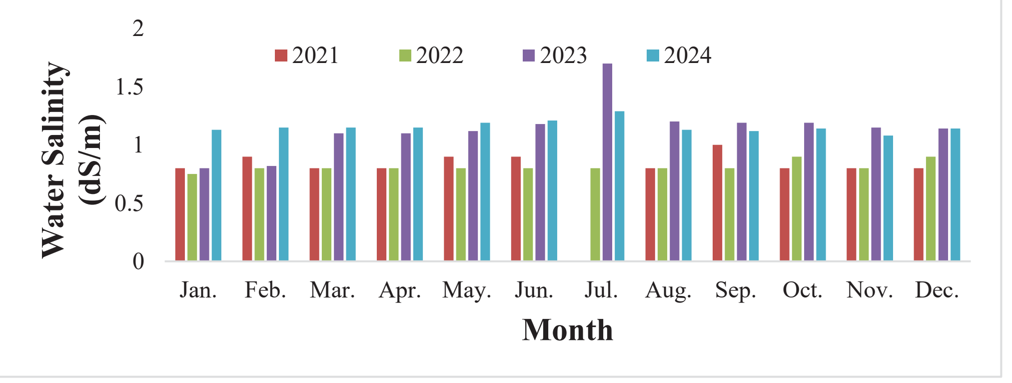


Fig 3.104: Changes in water salinity in STW at Noapara, Jashore.

Table 3.113. Serial no 5: STW at Gobra, Narail sadar, Narail.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	1.5	0.8	1.2	1.2	1.2	0.9	-	0.7	0.9	0.8	0.8	0.7
2022	0.8	0.9	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.9	0.8
2023	0.8	0.8	1.0	1.0	1.0	1.0	1.3	0.9	1.5	1.1	1.0	1.5
2024	1.1	1.0	1.5	1.1	1.2	1.1	1.6	1.6	1.5	1.3	1.5	1.5

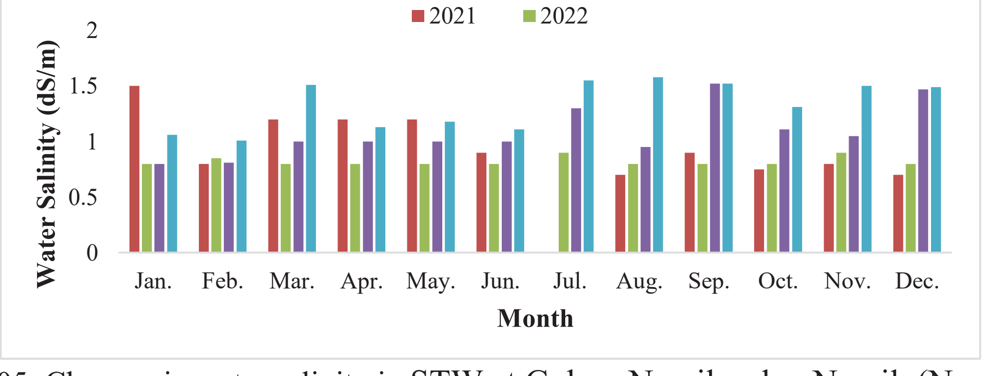


Fig 3.105: Changes in water salinity in STW at Gobra, Narail sadar, Narail. (New site).

Table 3.114. Serial no 6: STW at Baraypara, Kalia.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.9	1.1	0.9	0.9	1.0	0.8	-	0.8	0.8	0.9	0.8	0.8
2022	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
2023	0.9	0.8	0.6	0.9	0.9	0.9	1.4	0.9	0.7	0.6	0.9	0.9
2024	0.7	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.6	0.9	0.4

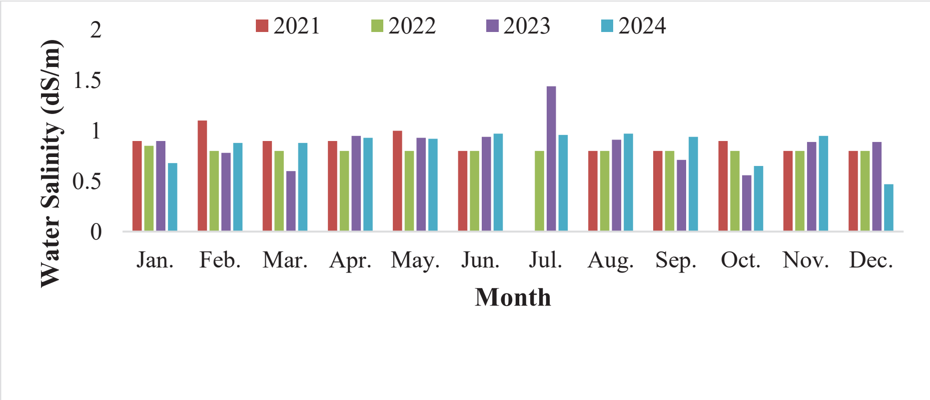


Fig 3.106: Changes in water salinity in STW at Baraypara, Kalia.

Table 3.115. Serial no 7: STW at Bardia, Lohagara

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	1.4	1.1	1.0	1.0	1.0	0.8	-	0.7	0.8	0.8	0.8	0.8
2022	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8
2023	0.9	0.8	0.9	0.8	1.8	1.6	2.2	1.5	0.9	0.2	0.3	1.5
2024	1.5	0.7	1.5	1.5	1.6	1.6	1.5	1.6	1.5	1.3	1.5	1.5

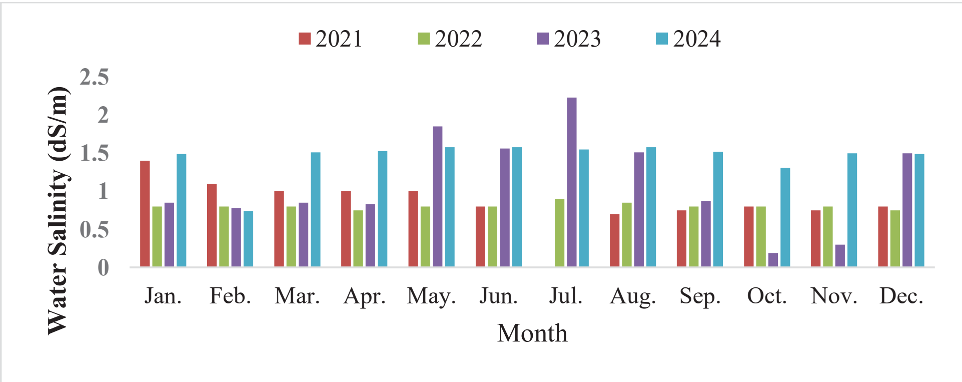


Fig 3.107: Changes in water salinity in STW at Bardia, Lohagara

Table 3.116. Serial no 9: STW at Shaikhati, Narail

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	1.0	0.9	1.0	1.0	1.2	0.9	-	0.6	0.7	0.9	0.7	0.8
2022	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.8	0.9	0.9	0.8	0.8
2023	0.8	0.8	0.6	0.6	0.6	0.6	1.2	0.8	0.9	1.0	0.8	0.7
2024	0.6	0.7	1.3	1.4	0.8	0.8	0.9	0.8	0.7	0.8	0.7	0.6

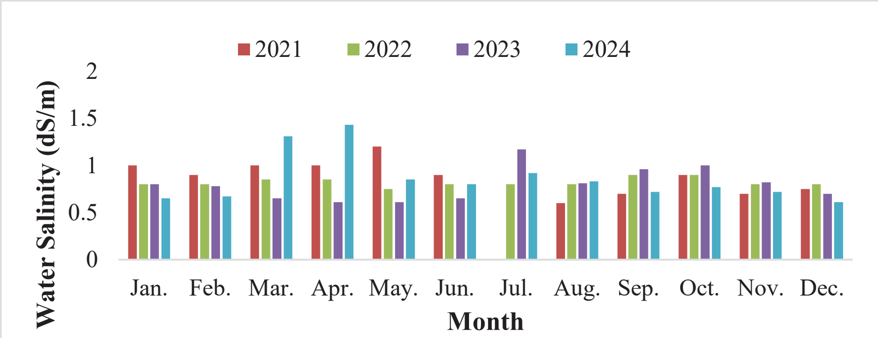


Fig 3.108: Changes in water salinity in STW at Shaikhati, Narail

Barishal Division

27 surface water salinity sites, 11 soil salinity sites and 8 ground water salinity sites were selected in greater Barisal and Patuakhali District. In Barisal monitoring sites are located in Nazirpur, Mathbaria, Pirojpur Sadar and Indurkani of Pirojpur District and Charfashion, Manpura, Bhola Sadar, Tazumuddin, Borhanuddin and Lalmohan of Bhola District. In Patuakhali the monitoring sites are located in Amtali, Taltali, Barguna Sadar, Patharghata, Bamna and Betagi of Barguna District and Kalapara, Galachipa, Patuakhali Sadar, Bauphal, Dashmina and Mirzaganj of Patuakhali District. Surface water (river) samples were collected twice in a month during the dry season and once in a month during the rainy season. Salinity of water was determined by EC meter.

Table 3.117. Site specification of the soil collection sites of Barishal Division

SI No.	Name of site	Location	Soil series	Land type	Land Use	Physiography
	Parer hat-1	Indurkani, Pirojpur	Jhalakathi	MHL	Boro-F-T.Aman	Ganges Tidal Floodplain
	Char raghunathpur	Nazirpur, Pirojpur	Sara	MHL	Rc-F-T.Aman	Low Ganges River Floodplain
	kolaron	Indurkani Pirojpur	Jhalakathi	MHL	Rc-F-T.Aman	Ganges Tidal Floodplain
	Parer hat-2	Indurkani, Pirojpur	Jhalakathi	MHL	Rc-F-T.Aman	Ganges Tidal Floodplain
	Parer hat-3	Indurkani, Pirojpur	Jhalakathi	MHL	Rc-F-T.Aman	Ganges Tidal Floodplain
	Taltali Upazila sadar	District: Barguna	Ramgati	MHL	Rc-F-T.Aman	Ganges Tidal Floodplain
	Kalapara Upazila Sadar	District: Patuakhali	Ramgati	MHL	Rc-F-T.Aman	Ganges Tidal Floodplain
	Kolakopa	Daulatkhan	Bhola	MLL	Boro-F-T.Aman	Young Meghna Estuarine floodplain
	Hakimuddin	Borhanuddin	Bhola	MLL	Boro-F-T.Aman	Young Meghna Estuarine floodplain
	Chanpur	Tazumuddin	Bhola	MLL	Mustard-F-T.Aman	Young Meghna Estuarine floodplain
	Ayeshabag, Betua	Charfassion	Nilkamal	LL	Mustard-F-T.Aman	Young Meghna Estuarine floodplain

Table 3.118. Site specification of the river water collection sites of Barishal Division

SI No	Name of River	Location
Divisional Office, Barishal		
1.	Pirojpur Bridge	Baleshwar River, Pirojpur
2.	Raghunathpur	Nazirpur, Baleshwar River
3.	Bekutia Ferryghat	Kocha River
4.	Charkhali Ferryghat	Kocha River
5.	Indurkani	Panguchi River
6.	Upazila Bridge	Nazirpur, Panguchi River
7.	Bara Machua Steamerghat	Mathbaria, Pirozpur, River- Baleswar
Regional Office, Patuakhali		
8.	Panpatti Launchghat,	Galachipa, River- Tetulia
9.	Taltali Upazila Sadar,	Taltali, Barguna River- Payra
10.	Amtali Ferryghat,	Amtali, Barguna River- Payra
11.	Payrakunja Ferryghat,	Patuakhali Sadar River- Payra
12.	Patharghata launchghat,	Patharghata, Barguna River- Bishkhali
13.	Baraitala Ferryghat,	Barguna Sadar, River- Bishkhali
14.	Bamna Launchghat, Bamna	Barguna, River- Bishkhali
15.	Betagi Launchghat, Betagi,	Barguna, River- Bishkhali
16.	Charduani Bazar, Patharghata,	Barguna, River- Baleswar
17.	Kalapara Ferryghat, Kalapara,	Patuakhali, River- Andharmanik
18.	Galachipa Ferryghat, Galachipa	Patuakhali, River- Galachipa
Regional Office, Bhola		
19.	Meghna River	Ilisha Launchghat, Bhola Sadar
20.	Meghna River, Daulatkhan Launchghat	Daulatkhan, Bhola
21.	Hakimuddin Launchghat	Burhanuddin, Bhola
22.	Meghna River, Tazumuddin Lauchghat	Tazumuddin, Bhola
23.	Meghna River, Mongolsikder Launchghat	Lalmohon, Bhola
24.	Meghna River, Betua Launchghat	Charfassion, Bhola
25.	Tetulia River, Gongapur Launchghat	Burhanuddin, Bhola
26.	Tetulia River, Bhola Kheyaghat	Bhola Sadar
27.	Tetulia River,	Veduria launch ghat Bhola Sadar

Graphical presentation of some selected river water salinity monitoring site of Barishal division:

Table 3.119. Serial no 8: Panpatti Launchghat, Galachipa, River- Tetulia,

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.21	0.35	0.48	4.48	2.15	1.72	0.44	0.39	0.34	0.33	0.31	0.29
2022	0.25	0.75	0.90	0.97	0.64	0.51	0.49	0.42	0.32	0.29	0.33	0.28
2023	0.33	0.45	1.57	0.77	0.82	0.62	0.46	0.45	0.35	0.28	0.35	0.78
2024	0.41	0.43	1.25	0.77	0.46	0.39	0.43	0.41	0.30	0.31	0.39	0.24

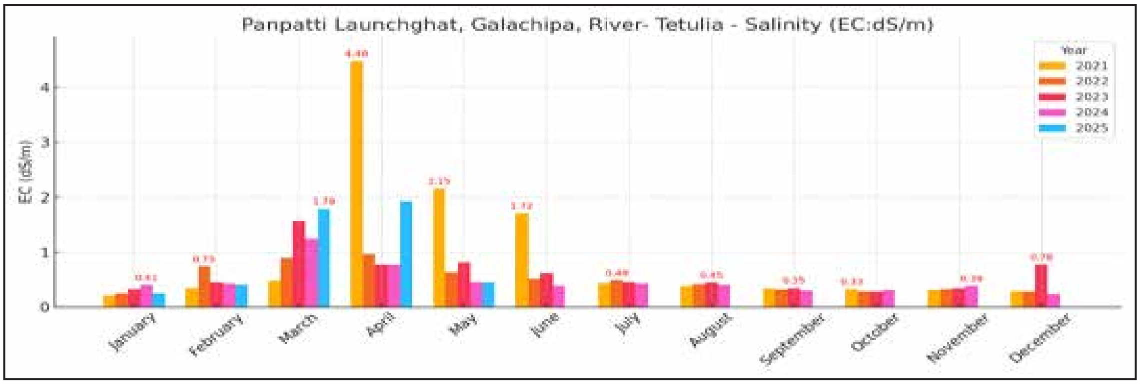


Fig 3.109: Changes in water salinity in Panpatti Launchghat, Galachipa, River- Tetulia.

Table 3.120. Serial no 9: Taltali Upazila Sadar, Taltali, Barguna River- Payra.

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.47	1.85	3.0	12.2	6.61	1.22	0.86	0.66	0.61	0.42	0.36	0.42
2022	0.55	1.14	3.22	2.23	1.65	1.31	0.76	0.52	0.56	0.39	0.33	0.50
2023	0.43	0.58	1.37	1.35	1.42	1.11	0.83	0.63	0.65	0.48	0.30	0.28
2024	0.52	0.53	0.88	1.71	0.9	0.31	0.68	0.71	0.77	0.43	0.39	0.33

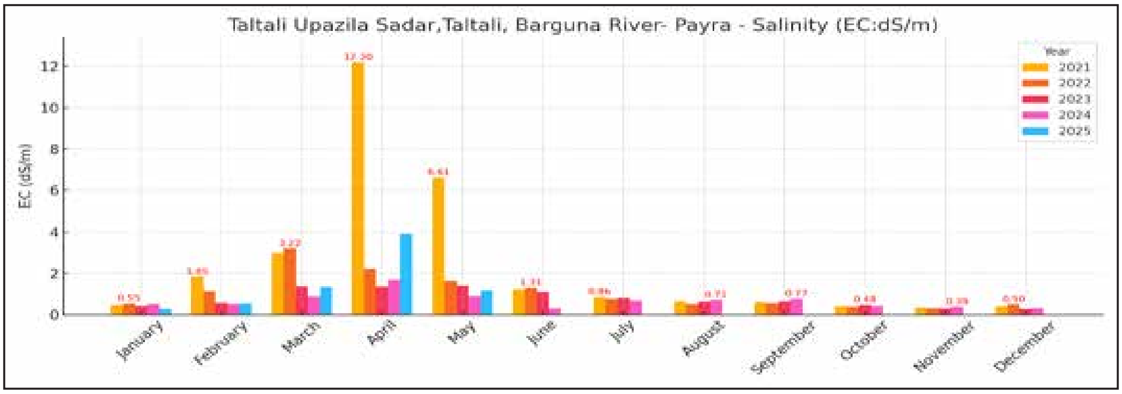


Fig 3.110: Changes in water salinity in Taltali Upazila Sadar, Taltali, Barguna River- Payra.

Table 3.121. Serial no 12: Patharghata launchghat, Patharghata, Barguna River- Bishkhali

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.49	0.94	1.35	3.96	3.16	0.67	0.61	0.57	0.56	0.42	0.43	0.59
2022	0.36	0.69	1.18	1.18	0.81	0.38	0.52	0.49	0.47	0.38	0.35	0.35
2023	0.58	0.71	1.65	0.91	1.22	0.71	0.65	0.55	0.59	0.45	0.39	0.55
2024	0.85	0.88	0.53	1.24	0.62	0.32	0.41	0.49	0.41	0.47	0.42	0.61

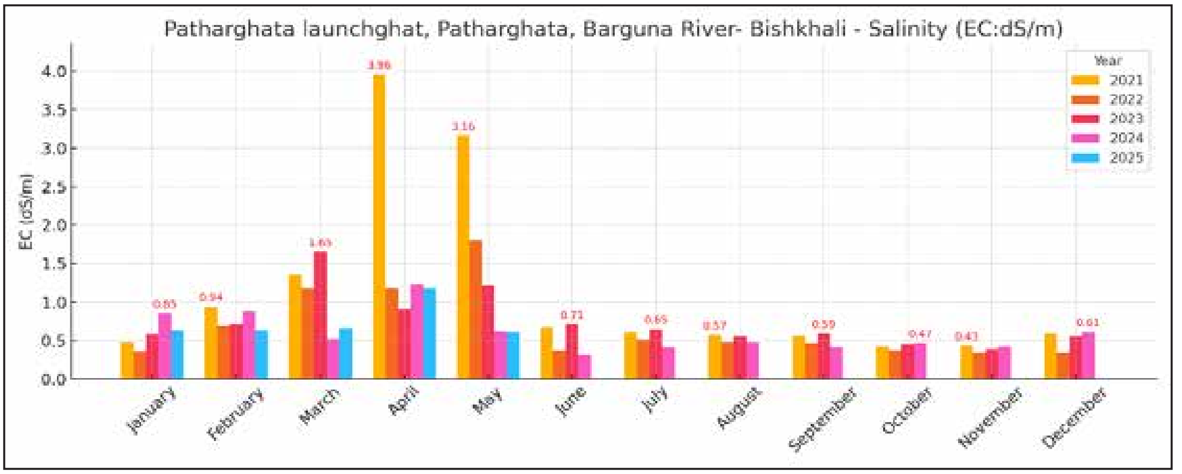


Fig 3.111: Changes in water salinity in Patharghata launchghat, Patharghata, Barguna River-Bishkhali.

Table 3.122. Serial no 16: Charduani Bazar, Patharghata, Barguna, River- Baleswar

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	2.62	4.03	4.18	4.56	5.05	3.87	3.56	3.31	2.95	2.77	2.26	1.30
2022	3.38	3.51	4.21	4.62	4.4	3.54	3.11	3.21	2.92	2.85	1.97	1.51
2023	3.05	4.51	6.04	9.94	8.51	4.50	3.33	3.07	3.01	2.79	2.25	2.16
2024	2.89	3.22	7.72	8.13	3.14	2.33	2.47	2.65	2.88	3.14	2.71	2.20

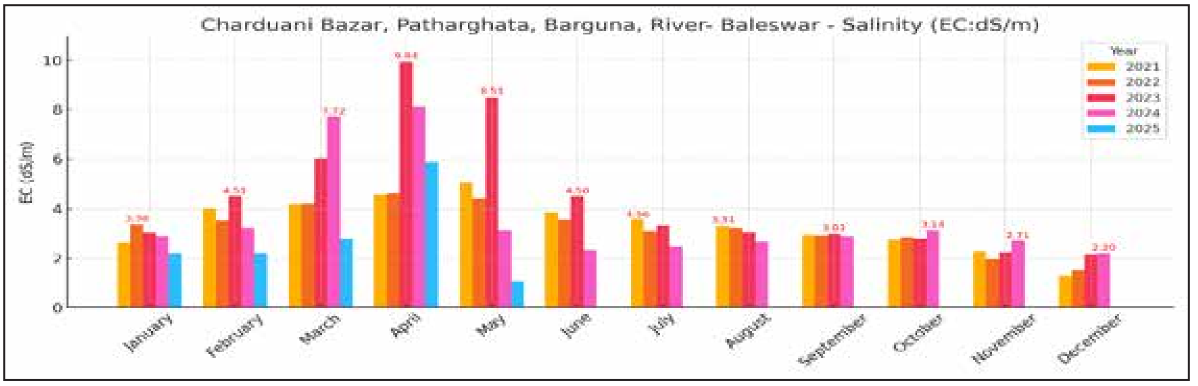


Fig 3.112: Changes in water salinity in Charduani Bazar, Patharghata, Barguna, River- Baleswar

Table 3.123. Serial no 17: Kalapara Ferryghat, Kalapara, Patuakhali, River- Andharmanik

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	7.28	13.65	22.2	27.8	25.20	10.32	8.85	7.21	6.35	4.12	4.51	4.86
2022	5.13	7.36	12.29	18.09	15.30	12.14	11.21	8.63	5.65	3.91	4.11	4.10
2023	7.33	9.12	15.67	13.82	12.44	11.26	13.45	10.04	6.33	4.01	3.90	4.11
2024	4.81	8.81	9.10	19.73	11.56	18.06	16.09	9.88	7.10	4.78	4.52	7.65

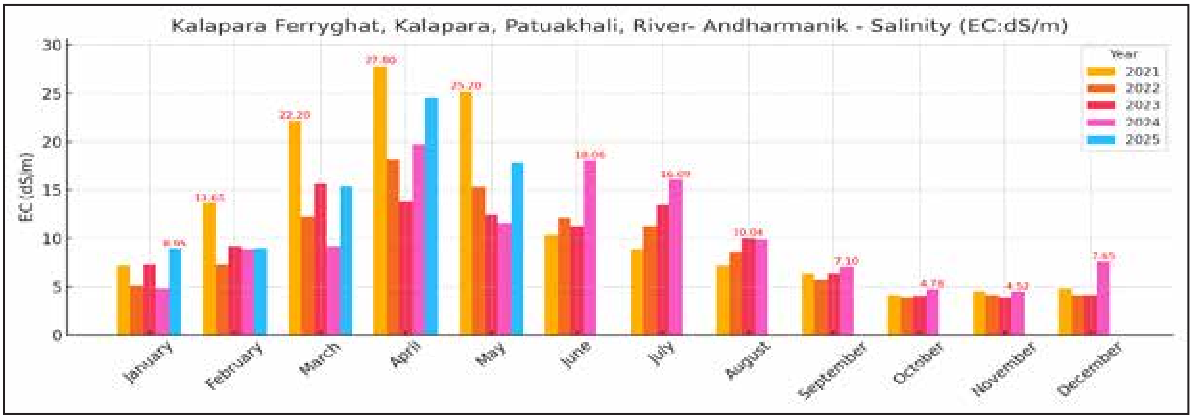


Fig 3.113: Changes in water salinity in Kalapara Ferryghat, Kalapara, Patuakhali, River-Andharmanik

Table 3.124: Site specification of the Ground Water (DTW) collection sites of Barishal Division

Sl No	Location
1.	Choumahal Bustand, Najirpur
2.	Kalapara Upazila Sadar, Kalapara, Patuakhali
3.	Taltali Upazila Sadar, Taltali, Barguna
4.	Amtali Upazila Sadar, Amtali, Barguna
5.	Kolakopa, Daulatkhan
6.	Hakimuddin, Burhanuddin
7.	Mangal Sikder Launchghat, Lalmohon
8.	Ayeshabag, Betua, Charfassion

Graphical presentation of some selected ground water salinity monitoring site of Barishal division:

Table 3.125. Serial no 2: Kalapara Upazila Sadar, Kalapara, Patuakhali

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	1.72	1.80	1.79	1.52	1.59	1.66	1.02	1.01	0.97	1.01	1.05	1.10
2022	1.85	1.81	1.77	1.61	1.45	1.53	1.01	1.01	0.99	1.03	1.00	1.01
2023	1.48	1.69	1.68	1.85	1.76	1.43	1.15	1.22	0.88	0.97	1.08	0.93
2024	1.49	1.50	1.50	1.78	1.72	1.47	1.41	1.33	1.21	1.15	1.35	1.19

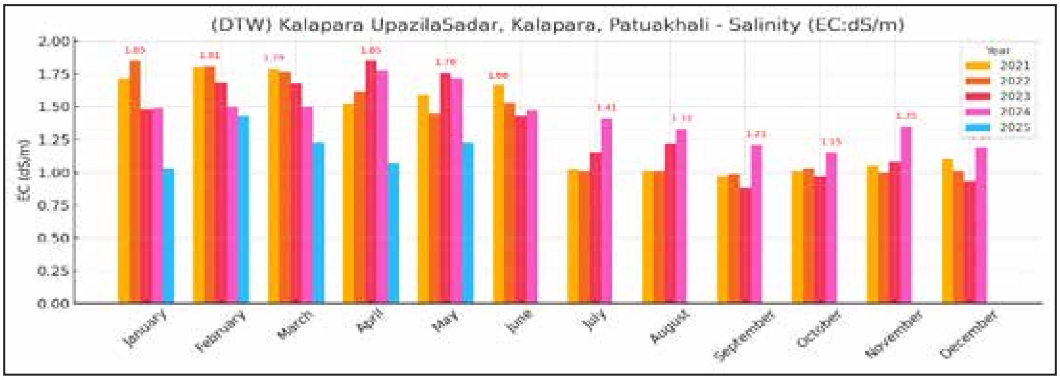


Fig 3.114: Changes in ground water salinity in Kalapara Upazila Sadar, Kalapara, Patuakhali

Table 3.126. Serial no 4: Amtali Upazila Sadar, Amtali, Barguna

	Monthwise EC Value											
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	0.94	0.98	1.21	1.19	1.03	1.09	1.00	0.98	1.01	0.99	1.20	1.22
2022	0.97	0.99	1.11	1.19	1.22	0.98	0.93	0.87	0.86	0.98	1.00	1.11
2023	1.10	1.10	1.15	1.16	1.18	0.98	0.87	0.83	0.89	0.75	0.91	0.96
2024	0.93	0.91	0.90	1.05	1.01	0.88	0.75	0.95	1.01	0.97	0.85	0.79

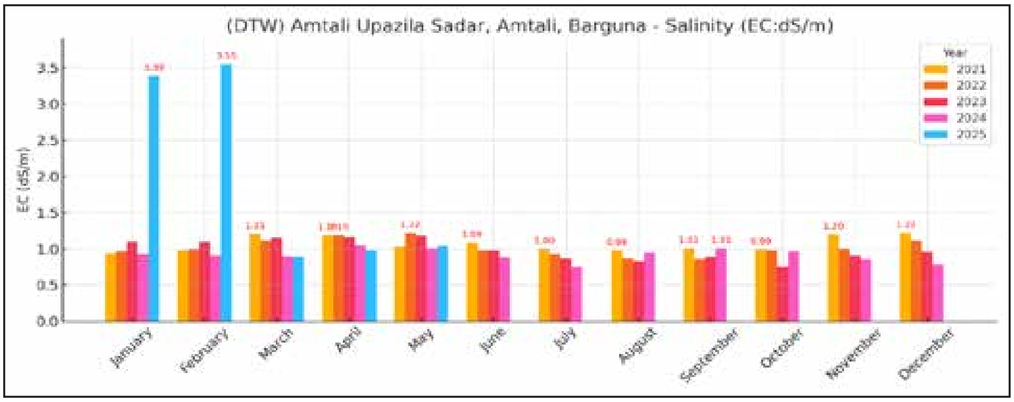


Fig 3.115: Changes in ground water salinity in Amtali Upazila Sadar, Amtali, Barguna

Dhaka division

Gopalganj district started to observe soil and water salinity in the year 2023. 7 surface water salinity sites, 7 soil salinity sites and 7 hand tube well water salinity sites were selected in Gopalganj district. The monitoring sites are located in Different areas of Gopalganj District. Surface water (river, STW) samples were collected twice in month during dry season and once in a month during rainy season. Salinity of water was determined by EC meter.

Table 3.127: Site specification of the soil collection sites of Dhaka Division

SI No.	Name of site	Location	Soil series	Land type	Land Use	Physiography
1.	Dumuria ghat,	Dumuria ghat, Tungipara	Ghior	MHL	Boro(hybrid)-F-F	Ganges Flood Plain
2.	Patghati Bridge	Patghati Bridge, Tungipara	Barishal	MLL	Boro(hybrid)-F-F	Ganges Tidal Floodplain
3.	Khalek Bazar (Nilfa)	Khalek Bazar (Nilfa) Tungipara	Gopalpur	MHL	RC(Mustard)-Jute(0’9897)-TA(Modern)	Ganges Flood Plain
4.	Haridaspur Bridge Sadar	Haridaspur Bridge Sadar Gopalganj	Ghior	MLL	Boro(hybrid)-Jute(deshi)-F	Ganges Flood Plain
5.	Vatiapara	Vatiapara, Khashiani	Ishurdi	MHL	Boro(hybrid)-F-TA(Modern)	Ganges Flood Plain
6.	North Vennabari	NorthVennabari, Satpar, Sadar Gopalganj	Gopalpur	MHL	RC(Mustard)-Jute(0’9897)-TA(Modern)	Ganges Flood Plain
7.	South Gangarampur	South Gangarampur, Mukshudpur	Ishurdi	MHL	Sugarcane	Ganges Flood Plain

Graphical presentation of some selected soil salinity monitoring site of Dhaka division:

Table 3.128. Site no.1, Soil series: Ghior, MHL, Location: Dumuria ghat, Tungipara

Year	Monthwise EC Value											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	-	-	-	2.63	1.44	0.72	0.97	0.91	0.77	0.91	1.04	2.10
2023	2.10	2.50	2.50	2.50	1.97	2.10	0.77	0.38	0.38	0.51	0.64	1.17
2024	1.04	1.17	1.17	1.17	0.64	0.38	0.77	0.51	0.38	0.24	0.77	0.77

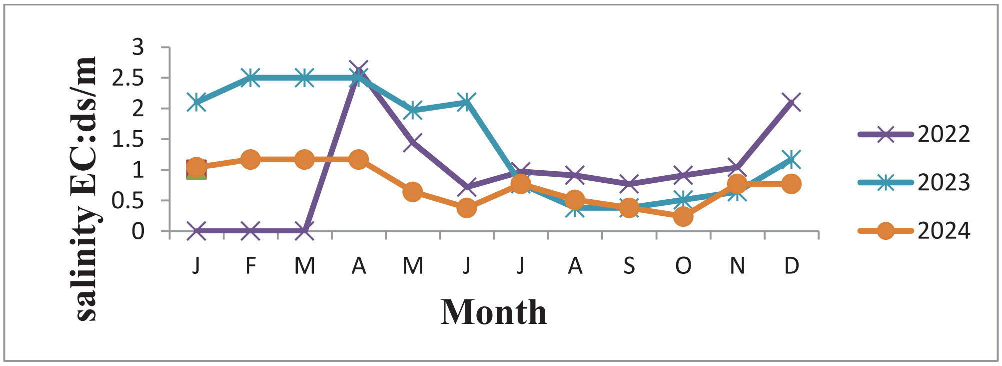


Fig 3.116: Changes in soil salinity in Ghior Soil series (MHL), Dumuria ghat, Tungipara.

Table 3.129. Site no.2, Soil series: Barisal, MLL, Location: Patghati Bridge, Tungipara

Year	Monthwise EC Value											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	-	-	-	2.10	2.52	0.61	1.70	0.61	2.25	1.97	1.44	3.93
2023	2.23	1.97	3.80	2.36	3.80	2.10	0.91	0.24	0.38	0.64	0.91	0.77
2024	0.77	0.91	1.04	1.30	0.51	0.51	0.38	0.64	1.30	1.17	1.44	3.80

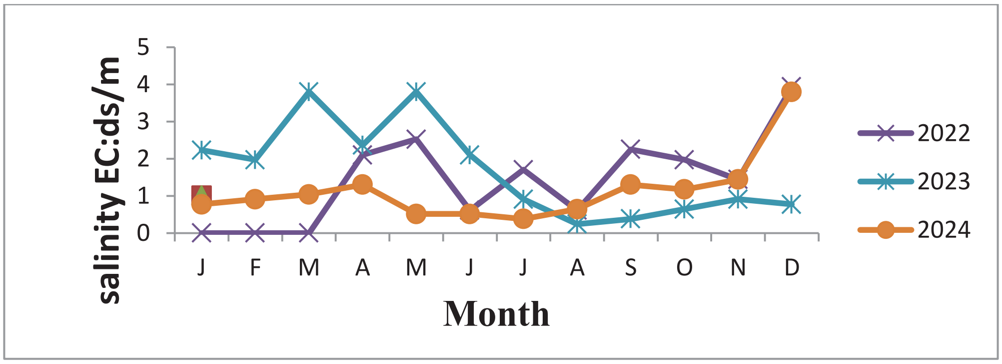


Fig 3.117: Changes in soil salinity in Barisal Soil series (MLL), Patghati Bridge, Tungipara.

Table 3.130. Site no.3, Soil series: Gopalpur, MHL, Location: Khalek Bazar (Nilfa) Tungipara

Year	Monthwise EC Value											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	-	-	-	2.10	0.91	1.30	0.64	0.91	1.57	0.77	0.24	0.38
2023	1.30	1.44	1.57	2.23	0.77	2.23	0.51	0.77	1.04	0.91	0.51	0.51
2024	1.17	1.57	1.44	1.97	0.24	1.44	0.64	0.64	0.51	0.64	0.91	0.64

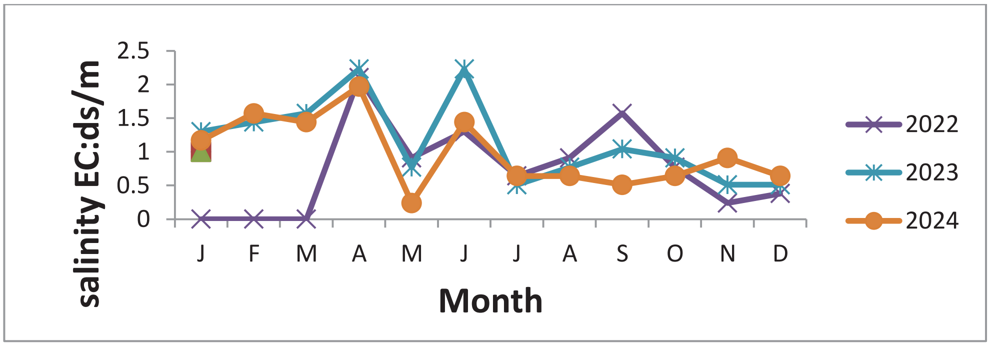


Fig 3.118: Changes in soil salinity in Gopalpur Soil series (MHL), Khalek Bazar (Nilfa) Tungipara.

Table 3.131. Site no.4, Soil series: Ghior, MLL, Location: Haridaspur Bridge Sadar Gopalganj

Year	Monthwise EC Value											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	-	-	-	2.10	0.91	0.51	0.64	0.77	0.77	0.91	1.04	0.91
2023	0.51	0.64	0.77	2.36	0.77	0.38	0.77	0.91	0.91	0.51	1.17	0.51
2024	0.38	0.51	0.91	1.57	0.91	0.91	0.51	0.51	0.38	0.91	0.77	0.38

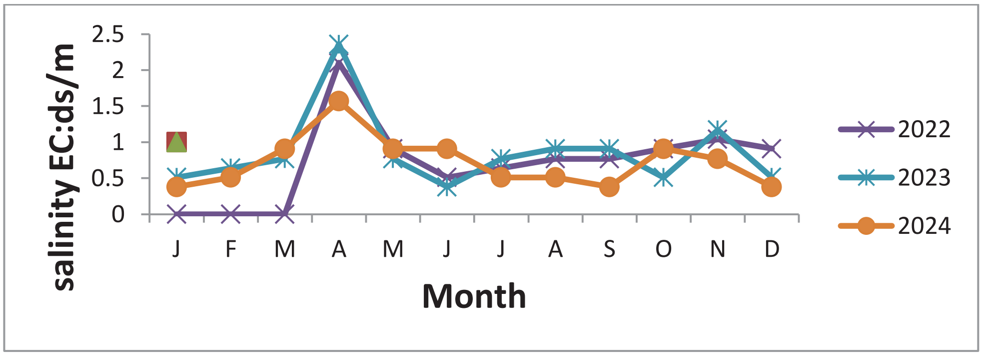


Fig 3.119: Changes in soil salinity in Ghior Soil series (MLL), Haridaspur Bridge Sadar Gopalganj

Table 3.132. Site no.5, Soil series: Ishurdi, MHL, Location: Vatiapara, Khashiani

Year	Monthwise EC Value											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	-	-	-	1.57	0.64	0.77	0.64	0.38	0.24	0.38	0.51	0.38
2023	0.38	0.51	1.04	1.17	0.91	0.64	0.51	0.64	0.38	0.77	0.64	0.38
2024	0.38	0.38	0.64	1.57	0.38	0.38	0.38	0.38	0.24	0.24	0.38	0.51

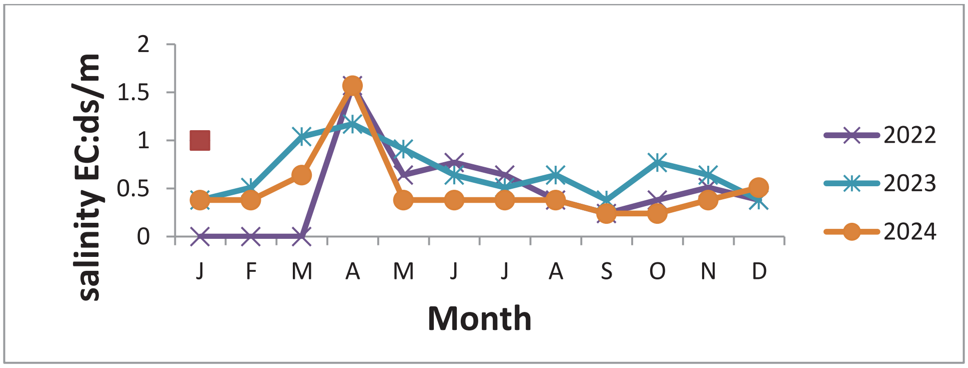


Fig 3.120: Changes in soil salinity in Ishurdi Soil series (MHL), Vatiapara, Khashiani

Table 3.133: Site specification of the river water collection sites of Dhaka Division

SI No	Name of River	Location
1.	Ghagor River	Dumuria ghat, Tungipara
2.	Modhumoti River	Patghati Bridge, Tungipara
3.	Modhumoti River	Khalek Bazar (Nilfa) Tungipara
4.	Madaripur bill root channe,1	Haridaspur Bridge Sadar Gopalganj
5.	Modhumoti River	Vatiapara, Khashiani
6.	Madaripur bill root channe	North Vennabari,Satpar, Sadar Gopalganj
7.	Madaripur bill root channe	South Gangarampur, Mukshudpur

Graphical presentation of some selected river water salinity monitoring site of Dhaka division:

Table 3.134. Site no.1 Ghagor river, Location: Dumuria ghat, Tungipara

Year	Monthwise EC Value											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	-	-	0.50	0.46	0.36	0.28	0.25	0.33	0.31	0.33	0.37	0.47
2023	0.54	0.48	0.59	1.70	0.34	2.03	0.32	0.40	0.44	0.26	0.40	0.44
2024	0.39	0.34	0.53	1.71	1.19	1.13	0.25	0.42	0.33	0.31	0.36	0.45

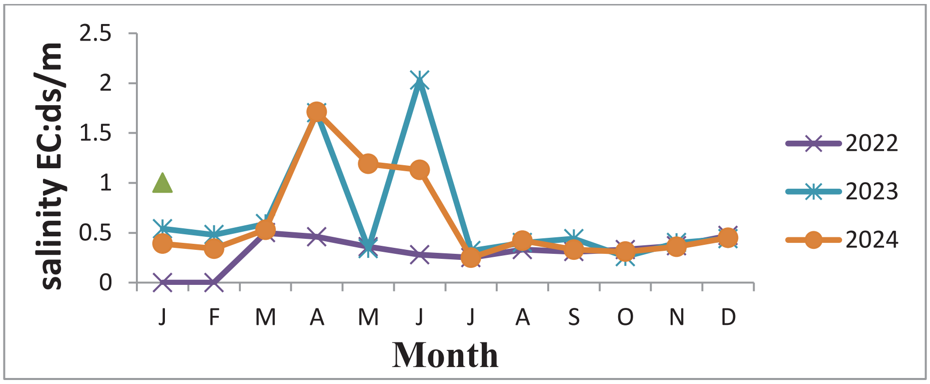


Fig 3.121: Changes in water salinity in Ghagor river, Location: Dumuria ghat, Tungipara

Table 3.135. Site no.2 Modhumoti river, Location: Patghati Bridge, Tungipara

Year	Monthwise EC Value											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	-	-	0.51	0.49	0.38	0.33	0.23	0.30	0.32	0.34	0.36	0.43
2023	0.58	0.46	0.59	1.97	3.69	2.48	0.28	0.21	0.29	0.34	0.31	0.41
2024	0.37	0.47	0.55	1.96	0.90	0.56	0.24	0.40	0.25	0.28	0.32	0.49

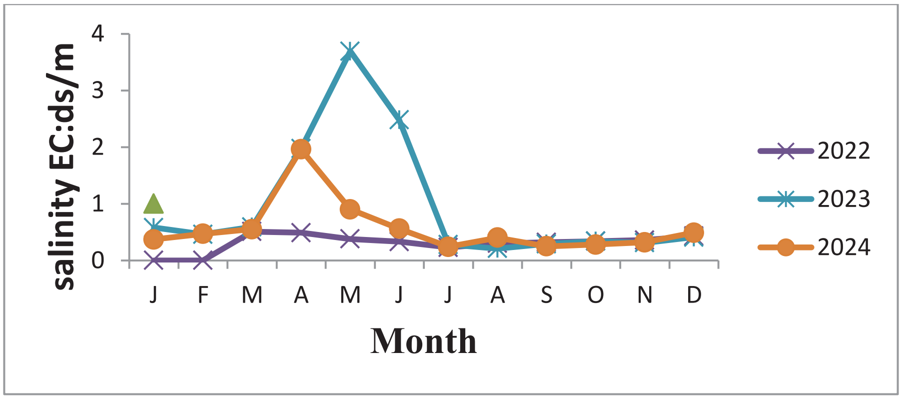


Fig 3.122: Changes in water salinity in Modhumoti river, Location: Patghati Bridge, Tungipara

Table 3.136. Site no.4 Madaripur bill root channe, l Location: Haridaspur Bridge Sadar Gopalganj

Year	Monthwise EC Value											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	-	-	0.48	0.31	0.24	0.30	0.25	0.29	0.32	0.31	0.34	0.44
2023	0.41	0.49	0.46	0.37	0.45	0.26	0.24	0.23	0.23	0.23	0.29	0.42
2024	0.34	0.38	0.46	0.48	0.20	0.44	0.23	0.28	0.24	0.38	0.33	0.53

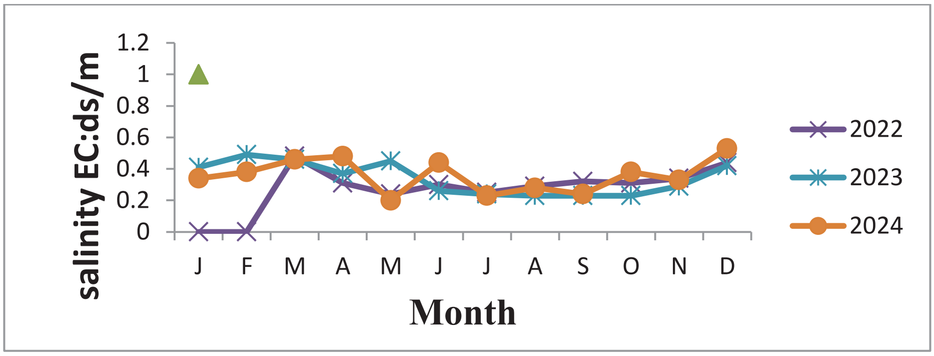


Fig 3.123: Changes in water salinity in Madaripur bill root channe, l Location: Haridaspur Bridge Sadar Gopalganj

Table 3.137: Site specification of the Hand tubewell water collection sites of Dhaka Division

Sl No	Location
1.	Dumuria ghat, Tungipara
2.	Patghati Bridge, Tungipara
3.	Khalek Bazar (Nilfa) Tungipara
4.	Haridaspur Bridge Sadar Gopalganj
5.	Vatiapara, Khashiani
6.	North Vennabari,Satpar, Sadar Gopalganj
7.	South Gangarampur, Mukshudpur

Graphical presentation of some selected hand tube well water salinity monitoring site of Dhaka division:

Table 3.138. Site no.1 Hand tubewell, Location: Dumuria ghat, Tungipara

Year	Monthwise EC Value											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	-	-	-	4.82	5.56	5.84	6.00	5.90	5.45	5.37	5.31	5.86
2023	5.77	5.95	6.12	5.25	5.84	5.88	6.19	4.50	4.36	4.42	4.24	4.07
2024	3.80	3.97	4.08	4.14	4.04	4.12	3.98	4.12	3.90	3.95	3.88	4.14

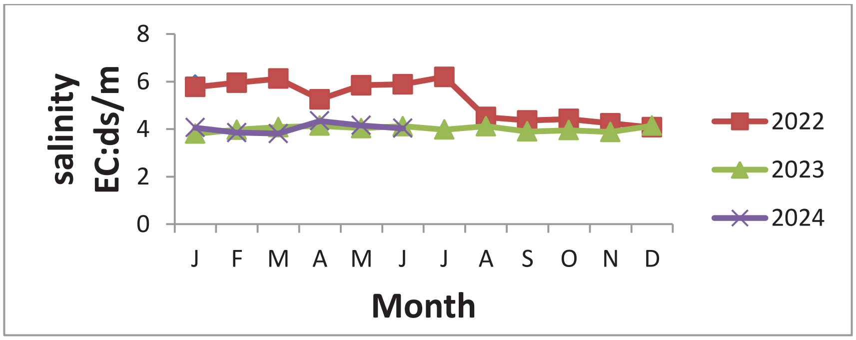


Fig 3.124: Changes in water salinity in Hand tubewell, Location: Dumuria ghat, Tungipara

Table 3.139. Site no.4 Hand tubewell, Location: Haridaspur Bridge Sadar Gopalganj

Year	Monthwise EC Value											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	-	-	-	0.70	0.91	0.94	0.97	0.94	0.92	0.85	0.73	0.75
2023	0.74	0.73	0.73	0.80	0.76	0.78	0.76	0.57	0.58	0.57	0.60	0.62
2024	0.69	0.60	0.67	0.69	0.98	0.59	0.67	0.66	0.58	0.58	0.73	0.60

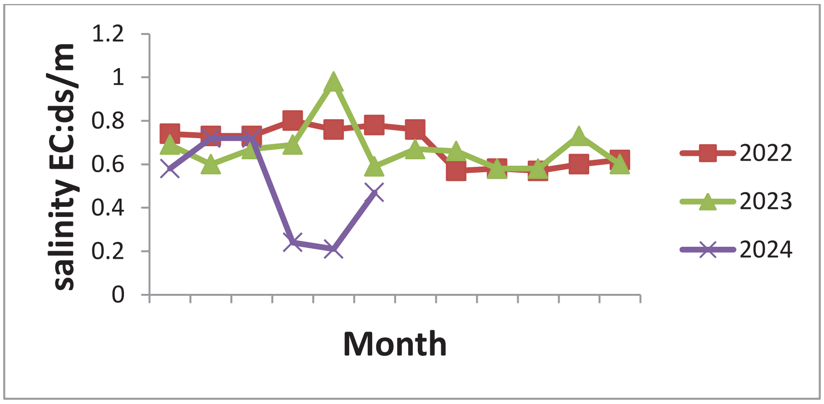


Fig 3.125: Changes in water salinity in Hand tubewell, Location: Haridaspur Bridge Sadar Gopalganj

Table 3.140. Site no.5 Hand tubewell, Location: Vatiapara, Khashiani

Year	Monthwise EC Value											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	-	-	-	0.92	1.12	1.18	1.20	1.17	1.16	1.18	1.14	1.17
2023	1.27	1.16	1.19	1.21	1.18	1.25	1.22	0.90	0.88	0.91	0.80	0.85
2024	0.78	0.85	0.95	0.86	0.84	0.85	0.85	0.77	0.94	0.90	0.62	0.88

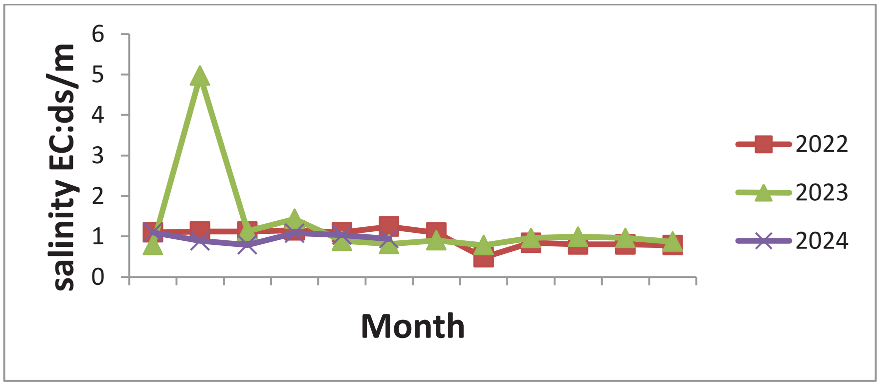


Fig 3.126: Changes in water salinity in Hand tubewell, Location: Vatiapara, Khashiani

3.5 Technology Transfer through Adaptive Trials

Introduction

Technology Transfer through Adaptive Trial programmed has been initiated to popularize Upazila Nirdeshika based fertilizer recommendation system among the farmers as well as to demonstrate the benefits of balanced fertilizers to conserve soil health with sustainable crop production. Using balanced fertilizers not only averts misuse of valuable fertilizers but also declines environmental pollution. Use of balanced fertilizers ensures the sustainability of increased trend of crop yields to popularize balanced fertilizer application among farmers with a view to reducing crop production cost and environmental pollution, adaptive trials are established on the basis of Upazila Nirdeshika.

Objectives

- To exhibit the benefit of using balanced fertilizer in crops according to Upazila Nirdeshika so test results.
- To promote the use of Upazila Nirdeshika among farmers.
- To stimulate the farmers to conserve soil health through rational use of chemical fertilizers.

Materials and Methods

Two different plots of farmer's are selected for setting up an 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 farmers 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 suggestions. 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 than that of control plot. Farmer's knowledge gap, resource constraint and lack of communication with resource persons are responsible for the yield.

Table 3.141: Comparative crop yield between FRC based fertilizer and farmer's practice in (FY 2024-2025)

Sl. No.	Name of Upazila	District	Crop & Variety	Average yield (t/ha)		
				Farmer's field	Demon-stration plot	Yield increase %
Rabi-2020						
01	Babuganj	Barishal	BRRI dhan 74	13.9	18.1	+30
02	Babuganj	Barishal	BRRI dhan 74	14.1	17.6	+24
03	Wazirpur	Barishal	BRRI dhan 74	16.2	18.7	+15
04	Wazirpur	Barishal	BRRI dhan 74	12.5	15.3	+22
05.	Nalchity	Barishal	BRRI dhan 74	15.6	18.4	+18
06	Nalchity	Barishal	BRRI dhan 74	12.8	16.5	+28
07.	Barishal Sadar	Barishal	BRRI dhan 74	11.9	14.8	+24
08	Barishal Sadar	Barishal	BRRI dhan 74	12.7	16.1	+26
09	Daulatkhan	Bhola	BARI Soyabean 5	1.3	1.8	+38
10	Daulatkhan	Bhola	BARI Soyabean 5	1.5	1.7	+13
11.	Amtali	Barguna	BRRI dhan 74	6.8	8.1	+19
12	Patuakhali Sadar	Patuakhali	BARI Mung 6	.86	1.26	+46
13	Mirsharai	Chattogram	BARI Sharisha-14	2.50	2.81	+12.40
14	Mirsharai	Chattogram	BRRI Dhan-28	4.85	5.35	+21.26
15	Rangamati sadar	Rangamati	Boro 2025 (BRRI DHAN-25)	5.8	7.99	+37.7
16	Adarsha sadar	Cumilla	BRRI dhan-89	6.0	7.25	+20.83
17	Sadar south	Cumilla	BRRI dhan-92	7.30	8.67	+18.77
18	Feni Sador	Feni	BARI Sharisha-14	2.21	2.68	+10.30
19	Shahorasti	Chandpur	BRRI dhan 96	6.26	7.83	+25.07
20	Kachua	Chandpur	BRRI dhan 92	6.8	8.04	+18.23
21	Ashuganj	Brahmanbaria	BARI Wheat-33	4.42	4.98	+12.66
22	Ashuganj	Brahmanbaria	BRRI Dhan-88	*7.55*	*8.35*	+10.59
23	Saturia	Manikganj	BRRI Dhan-92	6.89	9.93	+44.12
24	Saturia	Manikganj	BRRI Dhan-89	6.16	7.48	+21.43
25	Sirajdikhan	Munshiganj	T.Aman (BRAC 10 Hybrid)	3.75	3.87	+3.2
26	Munshiganj Sadar	Munshiganj	Potato (Daimond	23.05	24.54	+6.5
27	Delduar	Tangail	Boro rice, BRRI dhan 92	7.2	8.4	+17
28	Kalihati	Tangail	Boro rice, BRRI dhan 92	7.3	8.3	+14
29	Muksudpur	Gopalganj	Rice (Babylon-2)	7.80	8.70	+11.54
30	Kashiani	Gopalganj	Rice (Hira-2)	6.40	7.28	+13.75
31	Kishoreganj Sadar	Kishoreganj	BRRI Dhan-17	7.97	8.93	12.0
32	Karimganj	Kishoreganj	BRRI Dhan-92	8.18	9.15	+11.8
33	Nagarkanda	Faridpur	Biri dhan-87	5.5	6.5	+18

Sl. No.	Name of Upazila	District	Crop & Variety	Average yield (t/ha)		
				Farmer's field	Demon-stration plot	Yield increase %
34.	Kalukhali	Rajbari	Biri dhan-75	4.8	5.5	+15
35	Rajbari Sadar	Rajbari	Bari Mashur- 38	1.8	2.1	+17
36	Madaripur Sadar	Madaripur	BARI Sarisha-14 BRRI Dhan-89	1.2 7.1	1.5 8.3	+25 +17
38	Trishal	Mymensingh	BRRI dhan-88	5.69	6.88	+20
39	Mymensingh Sadar (Katlasen)	Mymensingh	BRRI dhan-100	6.12	7.64	+25
40	Sarishabari	Jamalpur	BRRI Dhan-89	8.70	10.22	+18
41	Nakla	Sherpur	Hybrid (Tejgold)	8.06	9.77	+21
42	Hironpur	Netrokona	BRRI Dhan 92	6.9	7.8	+13.04
43	Laxmiganj	Netrokona	Brinjal (Hybrid)	32	41.7	+30.31
44	Dumuria	Khulna	BRRI dhan100	6.2	7.1	+14.52
45	Fultola	Khulna	BRRI dhan100	6.5	7.0	+7.69
46	Debhata	Satkhira	BRRI dhan100	5.6	6.1	+8.90
47	Tala	Satkhira	BRRI dhan100	5.8	6.2	+6.87
48	Jashore Bagharpara	Jashore	BRRI Sarisha14	1.582	1.976	24.9
49	Narail Sadar	Narail	BRRI Gom33	3.146	4.040	28.4
50	Bheramara	Kushtia	Hybrid Maize	10.4	11.1	+6.7
51	Khoksa	Kushtia	BRRI dhan89	8.2	8.6	+4.9
52	Shailkupa	Jhenaidah	BRRI dhan100	6.3	6.5	+6.6
53	Magura Sadar	Magura	BRRI dhan100	6.3	6.8	+7.9
54	Tanore	Rajshahi	Potato	29.39	31.1	+5.8
55	Godagari	Rajshahi	Rice (BRRI dhan-28)	6.0	6.6	+10
56	Shahjahanpur	Bogura	Rice (BRRI dhan-88)	6.17	7.41	+20.29
57	Aria	Bogura	Wheat, BARI Gom-30	3.95	4.56	+15.44
58	Atrai	Naogaon	BRRI dhan-87	5.17	5.30	+2.5
59	Naogaon sadar	Naogaon	BARI Gom-33	4.19	4.75	+13.4
60	Chapainawabganj sadar	chapainawabganj	Wheat, BARI Gom-30	4.28	5.21	+21.73
61	Gomostapur	chapainawabganj	Wheat, BARI Gom-30	4.5	4.78	+6.22
62	Sirajganj sadar	Sirajganj	BRRI dhan-100	5.4	6.1	+12.9
63	Sirajganj sadar	Sirajganj	BRRI dhan-89	6.6	7.4	+12.12
64	Atghoriya	Pabna	BRRI dhan-98	2.1	2.3	+10.01
65	Vangura	Pabna	BRRI dhan-105	3.0	3.4	+13.33
66	Biral	Dinajpur	BARI Sorisha 14	1.31	1.69	29.01
67	Bochaganj	Dinajpur	BARI Sorisha 14	1.21	1.36	21.43

Sl. No.	Name of Upazila	District	Crop & Variety	Average yield (t/ha)		
				Farmer's field	Demon-stration plot	Yield increase %
68	Shaghata	Gaibandha	Mustard, (BARI Sorisha14)	1.7	2.1	+23.5
69	Gobindagonj	Gaibandha	Mustard, (BARI Sorisha14)	1.9	2.2	+15.8
70	Lalmonirhat Sadar	Lalmonirhat	BARI Sarisa-14	0.16	1.48	+22
71	Lalmonirhat Sadar	Lalmonirhat	BARI Gom-30	4.44	5.68	+21
72	Pirganj	Thakurgaon	Wheat (BARI Gom -32)	4.68	5.32	+14
73	Thakurgaon Sadar	Thakurgaon	Mustard (BARI sarisha-14)	4.35	4.60	+6
74	Habiganj Sadar	Moulvibazar	BRRI dhan 39	5.16	6.58	17.29
75	Habiganj Sadar	Moulvibazar	BRRI dhan 39	6.3	7.21	14.44
76	Bishwanath	Sylhet	BRRI dhan 100	4.16	5.7	37.02
77	Dakshin Surma	Sylhet	Ispahani-9	7.02	7.8	+11.11
78	Osmaninagar	Sylhet	BRRI dhan-92	7.02	8.11	+15.53
79	Doara Bazar	Sunamgonj	BRRI dhan-92	5.74	6.76	+17.77
80	Jamalganj	Sunamgonj	BRRI dhan-92	5.94	7.17	20.7

Conclusion

Farmers obtained higher yield by using balanced doses of fertilizer on the basis of Upazila Nirdeshika. It is a low/no cost technology which contributes farmers higher yield through sustainable soil management. The results revealed that farmers got 2.5%-46% higher yield in different crops and varieties in in comparison to farmers' practices in different locations. The average yield increase was 17.7%.

3.6 Distribution of Fertilizer Recommendation Cards

Introduction

Increasing crop production through sustainable soil management is now a global concern. It is also relevant to our Sustainable Development Goals SDGs. It is a harsh reality that our government has to ensure food security with limited land resources. So, food security is indissolubly linked with soil health management. We must feed our swelling population, but it should not be for the cost of nutrient mining. Keeping it in view SRDI launched the programme in order to popularize and disseminate the practice of balanced fertilizer use among farmers throughout the country. In 2024-2025, total number of fertilizer recommendation cards distributed was 17,289 of which 6,869 numbers were on the basis of Upazila Nirdeshika, 8,197 on the basis of OFRS and the rest 2,223 were soil test basis.

Table 3.142: Fertilizer Recommendation Cards Distribution:

Name of Office	District	Upazila	Type of service			Total no. of card distributed
			No. of Nirdeshika based recommendation	No. of Online based recommendation	Soit Test based recommendation	
Divisional Office, Barishal	Jhalakathi	Jhalakathi Sadar	100	50		150
Regional Office, Bhola	Bhola	Doulatkhan	100	100		200
Regional Office, Patuakhali	Patuakhali	Bauphal	207			207
		Patuakhali Sadar		100		100
	Barguna	Bamna	50			50
	Barguna	Barguna Sadar		100		100
	Patuakhali	Dumki		100		100
Regional Office, Brahmanbaria	Brahmanbaria	Sadar	100	100	-	200
		Kasba	100	50	-	150
		Ashugonj	70	60	20	150
Regional Office, Chandpur	Chandpur	Kachua	-	250	-	250
		Shahorasti	100	-	-	100
Regional Office, Cumilla	Cumilla	Cumilla Sadar South	100	-	-	100
		Lalmai	100	-	-	100
		Chouddogram	100	-	-	100
		Burichong	-	300	-	300
Regional Office,	Rangamati	Rangamati	25	85	-	110

Name of Office	District	Upazila	Type of service			Total no. of card distributed
			No. of Nirdeshika based recommendation	No. of Online based recommendation	Soit Test based recommendation	
Rangamati		Sadar				
		Kaukhali	40	53	-	93
	Bandarban	Sadar	30	41	-	71
		Rowangchhari		45	-	45
Regional Office, Faridpur	Faridpur	Goalanda, Faridpur Sadar, Boalmari, Nagarkanda	200	300	-	500
Regional Office, Gopalganj	Gopalganj	Gopalganj Sadar	50	-	-	250
		Muksudpur	-	100	-	
		Kashiani	50	50	-	
Regional Office, Jamalpur	Jamalpur	Jamalpur Sadar Islampur Melandaha Sorishabari Madargonj Dewangonj Bakshigonj	290	426	20	736
	Sherpur	Sherpur Sadar Nakla Jhinaigati Nalitabari Sreebordi				
Regional Office, Kishoreganj	Kishoreganj	-	200	200	2	402
Regional Office, Madaripur	Madaripur	Madaripur Sadar	50	200	350	900
		Shibchar	50	-	-	
		Rajoir	50	-	-	
	Shariatpur	Vedorganj	50	50	100	
Regional Office, Regional Office, Munshiganj	Munshiganj	Munshiganj Sadar	450	30	1	605
		Tongibari	-	-	50	
		Shreenagar	-	-	40	
	Narayanganj	Rupganj	-	-	34	
Regional Office, Mymensingh	Mymensingh	Nandail, Fulphur, Katlasen, Bhaluka, Sutiyakhali, Trishal	250	340		590
Regional Office, Narsingdi	Narsingdi		600	-	-	600
Regional Office, Netrokona	Netrokona	Sadar	25	185	-	210
Regional Office, Tangail	Tangail	Tangail Sadar, Madhupur, Delduar,	400	400	230	1030

<table>
<tr><th rowspan="2">Name of Office</th><th rowspan="2">District</th><th rowspan="2">Upazila</th><th colspan="3">Type of service</th><th rowspan="2">Total no. of card distributed</th></tr>
<tr><th>No. of Nirdeshika based recommendation</th><th>No. of Online based recommendation</th><th>Soit Test based recommendation</th></tr>
<tr><td></td><td></td><td>Kalihati, Dhanbari</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Regional Office, Jashore</td><td rowspan="2">Narail</td><td>Lohagara</td><td>100</td><td>-</td><td>-</td><td rowspan="2">400</td></tr>
<tr><td>Narail Sadar</td><td>-</td><td>300</td><td>-</td></tr>
<tr><td>Regional Office, Jhenaidah</td><td>Jhenaidah</td><td>Jhenaidah Sadar</td><td>100</td><td>300</td><td></td><td>400</td></tr>
<tr><td rowspan="7">Regional Office, Kushtia</td><td rowspan="3">Kushtia</td><td>Kumarkhali</td><td>17</td><td>-</td><td>-</td><td rowspan="3">188</td></tr>
<tr><td>Khoksa</td><td>3</td><td>51</td><td>-</td></tr>
<tr><td>Bheramara</td><td>-</td><td>117</td><td>-</td></tr>
<tr><td rowspan="2">Chuadanga</td><td>Damurhuda</td><td>32</td><td>-</td><td>-</td><td rowspan="2">119</td></tr>
<tr><td>Alamdanga</td><td>48</td><td>39</td><td>-</td></tr>
<tr><td rowspan="2">Meherpur</td><td>Meherpur Sadar</td><td>-</td><td>27</td><td>-</td><td rowspan="2">93</td></tr>
<tr><td>Gangni</td><td>-</td><td>66</td><td>-</td></tr>
<tr><td rowspan="5">Divisional Office, Khulna</td><td rowspan="2">Bagerhat</td><td>Rampal</td><td>-</td><td>180</td><td>-</td><td>180</td></tr>
<tr><td>Fokirhat</td><td>-</td><td>180</td><td>-</td><td>180</td></tr>
<tr><td>Khulna</td><td>Terokhada</td><td>-</td><td>180</td><td>-</td><td>180</td></tr>
<tr><td rowspan="2">Satkhira</td><td>Satkhira sadar</td><td>55</td><td></td><td></td><td>55</td></tr>
<tr><td>kolaroa</td><td>45</td><td></td><td></td><td>45</td></tr>
<tr><td>Regional Office, Bogura</td><td>Bogura & Joypurhat</td><td></td><td>200</td><td>200</td><td>80</td><td>480</td></tr>
<tr><td>Regional Office, Chapainawabganj</td><td>Chapainawabganj</td><td></td><td>15</td><td>150</td><td>142</td><td>307</td></tr>
<tr><td>Regional Office, Naogaon</td><td>Naogaon</td><td></td><td>30</td><td>160</td><td>120</td><td>310</td></tr>
<tr><td>Regional Office, Pabna</td><td>Pabna</td><td></td><td>300</td><td>180</td><td>30</td><td>510</td></tr>
<tr><td>Divisional Office, Rajshahi</td><td>Rajshahi</td><td></td><td>200</td><td>160</td><td>50</td><td>410</td></tr>
<tr><td>Regional Office, Sirajganj</td><td>Sirajganj</td><td></td><td>100</td><td>150</td><td>50</td><td>300</td></tr>
<tr><td rowspan="4">Regional Office, Dinajpur</td><td rowspan="4">Dinajpur</td><td>Dinajpur Sadar</td><td rowspan="4">240</td><td rowspan="4">160</td><td rowspan="4">-</td><td rowspan="4">400</td></tr>
<tr><td>Biral</td></tr>
<tr><td>Bochaganj</td></tr>
<tr><td>Kaharole</td></tr>
<tr><td>Regional Office, Gaibandha</td><td>Gaibandha</td><td>All</td><td>267</td><td>342</td><td>-</td><td>609</td></tr>
<tr><td>Regional Office, Lalmonirhat</td><td>Lalmonirhat</td><td>Aditmari Sadar</td><td>250</td><td>240</td><td>474</td><td>964</td></tr>
<tr><td>Divisional Office, Rangpur</td><td>Rangpur</td><td>Gangachora, Badarganj, Taraganj, Rangpur Sadar</td><td>230</td><td>250</td><td>165</td><td>645</td></tr>
<tr><td rowspan="4">Regional Office, Thakurgaon</td><td rowspan="4">Thakurgaon</td><td>Thakurgaon Sadar</td><td rowspan="4">250</td><td rowspan="4">240</td><td rowspan="4">265</td><td rowspan="4">755</td></tr>
<tr><td>Baliadangi</td></tr>
<tr><td>Ranishangkail</td></tr>
<tr><td>Pirganj</td></tr>
<tr><td>Regional Office,</td><td>Moulvibazar</td><td>Barlekha</td><td></td><td>300</td><td>-</td><td>300</td></tr>
</table>

Name of Office	District	Upazila	Type of service			Total no. of card distributed
			No. of Nirdeshika based recommendation	No. of Online based recommendation	Soit Test based recommendation	
Moulvibazar		Hobigonj Sadar	100		-	100
		Lakhai	50		-	50
Regional Office, Sunamgonj	Sunamganj	Derai		200	-	200
		Shantiganj		60	-	60
		Sunamganj Sadar	150		-	150
Divisional Office, Sylhet	Sylhet	Kanaighat	-	200	-	200
		Dakshin Surma		50	-	50
		Dakshin Surma	150	-	-	150
Total			6869	8197	2223	Grand Total= 17289

3.7. Table 3.143: Advisory Services to Beneficiaries

Name of office	District	Upazila	Agency	Service provider
Divisional Office, Barishal	Barishal	Barishal Sadar	Dept. of Soil Sc. BM College	Soil profile description and soil texture and soil series identification.
Regional Office, Patuakhali	Patuakhali	All Upazilla	DAE NGO (CIMMYT, Cordaid and solidaridad and coast)	Provided information on soil and water salinity of Bhola District.
	Patuakhali			Provided Sadar Upazilla Land and soil related information.
	Patuakhali	All Upazilla	jagonews, Patuakhali Correspondent	Provided soil nutrient status, and salinity related information.
	Patuakhali	Patuakhali sadar	Farmers	Identify Soil fertility related problems give suggestion for nutrient management.
	Patuakhali	Kolapara	Farmers	Identify Soil Salinity related problems give suggestion for salinity management.
	Patuakhali	Kolapara	BARI, OFRD	Provided soil nutrient status, and salinity related information.
Regional Office, Bhola	Bhola	All Upazilla	DAE	Provided information on soil and water salinity of Bhola District.
Regional Office, Cumilla	Cumilla	Cumilla Sadar South	Cumilla University	Land use and soil data
	Cumilla	Chouddogram	DAE	Upazila Land and Soil Utilization Guide
	Cumilla	Lalmai	DAE	Upazila Land and Soil Utilization Guide
	Cumilla	Sadar South	DAE	Upazila Land and Soil Utilization Guide
Reginal Office, Rangamati	Rangamati	Rangamati Sadar	Researchers	Land use data

Name of office	District	Upazila	Agency	Service provider
Regional Office, Brahmanbaria	Brahmanbaria	Ashugonj	Arishida Krishi Club	Soil testing Services provided for 30 Farmers of this club
Regional Office, Munshiganj	Munshiganj	Munshiganj Sadar, Sirajdikhan, Shreenagar	Farmer	Necessary Advice for Cultivation and Soil Management
	Narayanganj	Rupganj, Araihazar		
Regional Office, Tangail	Tangail	Tangai sadar Ghatail, Basail Dhanbari, Gopalpur, Madhupur	DAE, BADC Farmers, Students, Teacher, Scientists	Poster, leflet, booklet, festoon, Upazila Nirdeshika, Union Shahaika, FRC distribution, Soil fertility data, Soil management
Regional Office, Mymenshing	Mymensingh	Mymensingh Sadar	MS & PhD student of BAU	Sample collection
Regional Office, Jamalpur	Jamalpur	Jamalpur Sadar	PhD Student, BAU, Mymensingh	Soil Series, Soil structure and Other Soil Characters of Different AEZ
	Jamalpur	Jamalpur Sadar, Melandaha, Dewangonj, Islampur	`Mrittika Krishi Club'	Fertilizer Recommendation Card/ Festoon Distribution, Soil Sample Collection Technique, Adulterated Fertilizer Identification etc.
	Sherpur	Nakla, Nalitabari, Sherpur Sadar	`Mrittika Krishi Club'	
Divisional Office,Khulna	Khulna Bagerhat Satkhira	Rampal Koyra Dacope Bagerhat Sadar Shyamnagar Ashashuni	Cordaid Bangladesh	Consultative Workshop with the Relevant Stakeholders of Climate Resillient Agriculture in Costal Area
		19 Upazila of Khulna, Bagerhat and	DU, KU, BU, KIU, BRAC University,	Provided Salinity data

Name of office	District	Upazila	Agency	Service provider
		Satkhira		
Regional Office, Jashore	Jashore	Jashore sadar	CIMIT Bangladesh	Assisted technical issues for their evaluation team for project piloting program
		Jashore sadar	Solidaridad	Delivered technical assistance led farmers about using USG for upland crop cultivation
		Jashore sadar and Chaugasha	BADC seed farm, Dottonagor	Delivered technical assistance of the NGOs led farmers about soil sample collection for soil testing.
	Jhenaidah	Moheshpur	RRF and JCF	Prepared a visited report about constrains and situations of using balanced fertilizer which sent to MoA through proper channel.
Divisional Office, Rajshahi	Rajshahi, Natore	All Upazila	University graduates Of RU, JUST, BMDA, Wheat and Maize Research Organization etc	Soil sampling, series Identification, Other Information Shared.
Regional Office, Chapainawabganj	Chapainawab ganj	Volahat, Shibganj, Chapainawabga nj Sadar, Nachole, Gomostapur	Rajshahi University, Krishi Somprosaron Odhidoptor, BARI, BINA, BMDA, Wheat and Maize Research Organization etc	SRDI on Soil sampling, series Identification, Other Information Shared.
Regional Office,Bogura	Bogura, Joypurhat	All Upazila	University graduates Of RU	Soil sampling, series Identification, Other Information Shared.
Regional Office, Naogaon	Naogaon	All Upazila of Naogaon.	University graduates Of RU	Soil sampling, series Identification,

Name of office	District	Upazila	Agency	Service provider
				Other Information Shared.
Regional Office, Sirajganj	Sirajganj	All Upazila	DAE, Cotton Development Board	Information shared about land type and char land of different upazila
Regional Office, Pabna	Pabna	Pabna Sadar	BADC Farm	Fertilizer Recommendation
Divisional Office, Rangpur	Rangpur	Rangpur Sadar	DAE, Entrepreneur, Students	Soil sample collection, fertilizer recommendation card and information provided
Regional Office, Dinajpur	Dinajpur	Dinajpur Sadar	Hajee Mohammad Danesh Science and Technology University (HSTU)	Soil Profile Presentation in Field Trip
			Department of Agriculture Extension, HSTU	Technical Assistance
			Department of Soil Science, HSTU	Technical Assistance
Regional Office, Lalmonirhat	Lalmonirhat		SCA	Technical Support Provided
			DAE	Technical Support Provided
			Bangladesh Air Force	Technical Support Provided
	Lalmonirhat	Aditmari	I Farmer Pvt. Ltd.	Technical Support Provided
	Lalmonirhat	Sadar	GUK (Gram Unnayan Kendra)	Technical Support Provided
Regional Office, Gaibandha	Gaibandha	All	DAE, Farmers & Students	Soil sample collection, fertilizer recommendation card and information provided
Regional Office, Thakurgaon	Thakurgaon	Thakurgaon Sadar	DAE	Related to Soil Health

3.8. Table 3.144: Training Imparted

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Type	Number
Divisional Office, Barishal	Method of Soil Sample Collection, Use of Balance fertilizers and Fertilizer Management	1 day	SRDI	Farmers	250
Regional Office, Bhola		1 day	SRDI	Farmers	100
Regional Office, Patuakhali		1 day	SRDI	Farmers	200
Divisional Office, Chattogram	MSTL Training : Rabi/2024 'Soil Sample Collection Procedure & Use of Balance Fertilizer and Identification of Adulterated Fertilizer.'	1 day	Upazila Krishi Office, fatikchhari	Farmer	50
	MSTL Training : Rabi/2024 'Soil Sample Collection Procedure & Use of Balance Fertilizer and Identification of Adulterated Fertilizer.'	1 day	Upazila Krishi Office, Hathazari	Farmer	50
	MSTL Training : Rabi/2024 'Soil Sample Collection Procedure & Use of Balance Fertilizer and Identification of Adulterated Fertilizer.'	1 day	Upazila Krishi Office, Patiya	Farmer	50
	MSTL Training : Rabi/2024	1 day	Upazila Krishi Office,	Farmer	50

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Type	Number
	'Soil Sample Collection Procedure & Use of Balance Fertilizer and Identification of Adulterated Fertilizer.'		Mirsharai		
	MSTL Training : Rabi/2024 'Soil Sample Collection Procedure & Use of Balance Fertilizer and Identification of Adulterated Fertilizer.'	1 day	Upazila Krishi Office, Khagrachari Sadar	Farmer	50
Regional Office, Rangamati	Soil sample collection technique, identification of adulterate fertilizers, Soil & Fertilizer management	1 day	SRDI, Rangamati	Farmer	150
Regional Office, Cumilla	MSTL Training : Rabi/2024 'Soil Sample Collection Procedure & Use of Balance Fertilizer and Identification of Adulterated Fertilizer.'	1 day	Upazila Krishi Office, Titas, Cumilla	Farmer	50
	MSTL Training : Rabi/2024 'Soil Sample Collection Procedure & Use of Balance Fertilizer and Identification of	1 day	Upazila Krishi Office, Nangolkot, Cumilla	Farmer	50

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Type	Number
	Adulterated Fertilizer.’				
	MSTL Training : Kharif/2025 Soil Sample Collection Procedure & Use of Balance Fertilizer and Identification of Adulterated Fertilizer etc.	1 day	Upazila Krishi Office, Burichong, Cumilla	Farmer	50
Regional Office, Noakhali	Soil sample collection	1 day*5	SRDI	Farmer	250
Regional Office, Chandpur	MSTL Training : Rabi/2024 ‘Soil Sample Collection Procedure & Use of Balance Fertilizer and Identification of Adulterated Fertilizer.’	1 day	Upazila Krishi Office, Matlab South, Chandpur	Farmer	50
	MSTL Training : Kharif/2025 Soil Sample Collection Procedure & Use of Balance Fertilizer and Identification of Adulterated Fertilizer etc.	1 day	Upazila Krishi Office, Hymchar, Chandpur	Farmer	50
Regional Office, Brahmanbaria	MSTL Training : Rabi/2024 Soil Sample Collection & Procedure, Use of Balance Fertilizer and	1 day	Upazila Krishi Office, Sadar, Brahmanbaria	Farmer	50

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Type	Number
	Identification of Adulterated Fertilizer etc.				
	MSTL Training : Kharif/2025 Soil Sample Collection & Procedure, Use of Balance Fertilizer and Identification of Adulterated Fertilizer etc.	1 day	Upazila Krishi Office, kasba, Brahmanbaria	Farmer	50
Divisional Office, Dhaka	Method of soil sample collection and use of balanced fertilizer	1 day	SRDI, Dhaka Divisional Office	Farmer	100
Regional Office, Munshiganj	Training on Soil Sample Collection and Balanced Fertilizer Application	1 day	SRDI, RO, Munshiganj	Farmer	100
Regional Office, Tangail	Method of soil sample collection and use of balanced fertilizer	1 day	SRDI, BADC, DAE, SCA	Farmer	500
	Soil and Fertilizer Management	1 day	DAE	SAAO	100
	Soil and Fertilizer Management	1 day	DAE	Cadre officers	60
Regional Office, Faridpur	Soil Sample Collection and Balanced Fertilizer Application	1 day	SRDI	Farmers	150
Regional Office, Madaripur	Soil Sample collection and Balanced dose fertilizer use	1 day	SRDI	Farmer	200
Regional Office, Kishoreganj	Method of Soil Sample collection	1 day	SRDI, Kishoreganj	Farmer	100
Regional Office,	Method of soil sample collection and use of	1 day	SRDI, Narshingdi	Farmer	100

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Type	Number
Narsingdi	balanced fertilizer				
Regional Office, Gopalganj	Soil sample collection technique, identification of adulterate fertilizers, Soil & Fertilizer management	1 day	SRDI, Gopalganj	Farmers	100
Regional Office, Mymensingh	Training on Method of Soil Sample Collection	1 day	SRDI, RO, Mymensingh	Farmer	50
	Training on Method of Soil Sample Collection	1 day	SRDI, RO, Mymensingh	Farmer	50
	Training on Organic Fertilizer, Balanced Fertilizer and Online Fertilizer Recommendation	1 day	BINA, Mymensingh	SAAO	60
	Training on Balanced Fertilizer Application and Soil Sample Collection	1 day	AIS, Mymensingh	Farmer	50
Regional Office, Jamalpur	Soil sample collection technique.	1 day	SRDI, RO, Jamalpur	Farmar	300
Regional Office, Netrokona	MSTL Durgapur	1 day	SRDI, RO, Netrokona	farmers	60
	MSTL Mohongonj	1 day	SRDI, RO, Netrokona	farmers	60
	Day-long workshop on Technical Acitivites of SRDI	1 day	SRDI, RO, Netrokona	Students of BAU	35
Divisional Office, Khulna	Problematic soil management	02 days	Funded by: GKBSP project Implemented by: SRDI,DO, Khulna	Officers	30

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Type	Number
	Soil sample collection technique, identification of adulterate fertilizers, methods & time of fertilizer application, deficiency symptoms of nutrient element and use of balanced fertilizer. Salinity management	1 day	SRDI, DO, Khulna		1480
Regional Office, Jashore	Training of farmers on soil sample collection technique, identification of adulterate fertilizers, methods & time of fertilizer application, deficiency symptoms of nutrient element and use of balanced fertilizer	1 day	SRDI, RO, Jashore	Farmer	250
Regional Office, Jhenaidah	Training on soil sampling, use of balanced fertilizers and methods of detection of adulterated fertilizers	1 days	SRDI, RO, Jhenaidah	Farmers	150
Divisional Office, Rajshahi	Training on balanced fertilizer utilization,soil sample collection and identification of adulterated fertilizer	1 day	SRDI,Rajshahi	Farmer/SAAO	315
Regional Office, Bogura	Training on balanced fertilizer utilization,soil sample collection and	1 day	SRDI,Bogura	Farmers SAAO	125

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Type	Number
	identification of adulterated fertilizer				
Regional Office, Naogaon.	Soil Sample Collection procedure	02 days	SRDI, Naogaon.	Farmer/SAAO	145
Regional Office, chapainawabganj	MSTL	1 day	SRDI	Farmers	100
	SAAO Training	02 days	SRDI	SAAO, Farmers	40
	Farmer	1 day			75
Regional Office, Pabna.	Training on balanced fertilizer utilization,soil sample collection and identification of adulterated fertilizer	1 day	SRDI,Pabna	Farmers, SAAO	100
Regional Office, Sirajganj	Soil sample collection procedure	1 day	Regional office, Sirajganj	Farmer	100
Divisional Office, Rangpur	MSTL Farmers Training at Gangachora Upazila During Rabi season.	1 day	SRDI, Divisional Office, Rangpur	Farmers	50
	MSTL Farmers Training at Saidpur upazila During Kharif season.	1 day	SRDI, Divisional Office, Rangpur	Farmers	50
	MSTL Farmers Training at Taraganj upazila During Kharif season.	1 day	SRDI, Divisional Office, Rangpur	Farmers	50
	Acid Soil Management Training at Divisional Office Rangpur	1 day	SRDI, Divisional Office, Rangpur	Farmers	25
Regional Office, Dinajpur	Method of Soil Sample Collection, Use of Balance Fertilizer & Fertilizer	1 day	SRDI, Regional Office, Dinajpur	Farmers	100

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Type	Number
	Management				
Regional Office, Lalmonirhat	MSTL Farmers Training at Lalmonirhat Sadar Upazila During Rabi season.	1 day	SRDI, Lalmonirhat	Farmers	50
	MSTL Farmers Training at Kaliganj upazila During Kharif season.	1 day	SRDI, Lalmonirhat	Farmers	50
	MSTL Farmers Training at Rajarhat upazila During Kharif season.	1 day	SRDI, Lalmonirhat	Farmers	50
	Acid Soil Management Training at Aditmari upazila	1 day	SRDI, Lalmonirhat	Farmers	25
Regional Office, Gaibandha	Training on balanced fertilizer utilization, soil sample collection and Identification of Adulterated fertilizers	1 day	SRDI, RO, Gaibandha	Farmers, Agricultural entrepreneur	100
	Acidic soil Management	1 day	SRDI, RO, Gaibandha	Farmers, Agricultural entrepreneur	25
Regional Office, Thakurgaon	Method of Soil Sample Collection, Use of Balanced Fertilizer & Fertilizer Management	1 day	SRDI, Regional Office, Thakurgaon	Farmers	180
Divisional Office, Sylhet	Acidic Soil Management Related	1 day	SRDI, Regional Office, Dinajpur	Farmers	25+25=50
	Soil Sample Collection	1 day	SRDI, Sylhet	Farmer Companiganj	25+25=50

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Type	Number
Regional Office, Moulvibazar	Soil Sample Collection	1 day	SRDI, Moulvibazar	Farmer Barlekha	25+25=50
	Soil Sample Collection	1 day	SRDI,Moulvi bazar	Farmer Madhabpur	25+25=50
	Soil Sample Collection	1 day	SRDI,Moulvi bazar	Farmer Moulvibazar Sadar	25+25=50
	Soil Sample Collection	1 day	SRDI, Moulvibazar	Farmer Lakhai	25+25=50
Regional Office, Sunamganj	Soil Sample Collection	1 day	SRDI, Sunamgonj	Farmer Derai	25+25=50
	Soil Sample Collection	1 day	SRDI, Sunamganj	Farmer Sunamganj Sadar	25+25=50

3.9 Table 3.145: Training received

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Designation	Number
Divisional Office, Barishal	Data management training	3 days	SRDI	SO	1
	Map preparation and report writing based on semi–detailed soil survey	3 days	SRDI	SO	1
	GIS Base	3 days	CCBS project, SRDI	SO	1
Regional Office, Patuakhali	77 th Foundation Course	6 months	BPATC, Savar	SO	1
	Data management	3 day	SRDI	SO	1
	GIS Base	3 day	SRDI	SO	1
Regional Office, Bhola	Induction Training	12 days	NATA	SO	1
	Departmental Training	2 months	SRDI	SO	1
	GIS Base & Data Management	6 days	CCBS project SRDI	SO	1
Regional Office, Cumilla	Foundation training	180 days	BPATC	SO	1
	Training on Upazila Land & Soil Utilization Guide	11 days	SRDI	SO	1
	GIS base Training	3 days	SRDI	SO	1
	Training on Data Management	3 days	SRDI	SO	1
	Training on Project Financial Management	5 days	SRDI	SO	1
Regional Office, Noakhali	Departmental Training	60 days	SRDI	Officer	1
	GIS Training	3 Day	SRDI	Officer	1
	Applied nutrition	5 Day	BIRTAN	Officer	1
Regional Office, Chandpur	Induction training	12 days	NATA	SO	1
	Departmental Training	60 days	SRDI	SO	1
	GIS base Training	3 days	SRDI	SO	1
	Training on Data Management	3 days	SRDI	SO	1
SRDI Regional Office, Brahmanbaria	Fumdamentals of ICT	5 days	NATA	SSO	1
	Seminar	1 days	SRDI	SO & SSO	2
	Induction training	12 days	NATA	SO	1
	Departmental Training	60 days	SRDI	SO	1
	English Language Skills Development	12 days	NATA	SO	1
Divisional Office, Dhaka	বাজেট পরিপত্র-১ এর আলোকে আইবাস++ সিস্টেমে বাজেট প্রাক্কলন ও প্রক্ষেপণ প্রণয়ন	1 Day	Finance Division, Ministry of	PSO, Office Assistant	1 1

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Designation	Number
	প্রক্রিয়া (অর্থবছর ২০২৫-২০২৬)		Finance	Cum Computer Typist	
	ডিডিও অন্যান্য বিলের মাধ্যমে প্রাপকের ব্যাংক হিসাবে ইএফটি এর মাধ্যমে পেমেন্ট কার্যক্রম বিষয়ে অনলাইন প্রশিক্ষণ	1 Day	CAFO Office, Ministry of Agriculture	PSO, Cashier, Upper Division Assistant Cum Accountant	1 1 1
Regional Office , Munshiganj	Foundation Training Course	6 Months	Bangladesh Public Administration Training Center	SO	1
	Semi Detail Survey based Soil Map and Report Writing Training Trainig	11 Days	Soil Resource Development Institute	SO	1
	GIS Base Training	3 Days	Soil Resource Development Institute	SO	1
	Data Management Training	3 Days	Soil Resource Development Institute	SO	1
	Food Based Nutrition	5 Days	Bangladesh Institute of Research and Training on Applied Nutrition	SO	1
	International Training on Overview of Public Administration, Governance Principles and Ethics	10 Days	Ministry of Public Administration and AIT	SO	1
	Applied Nutrition Follow Up Training	2 Days	BIRTAN	SO	1
Regional Office , Tangail	Departmental Training	60 days	SRDI	SO	1
	GIS, Data processing	7 days	SRDI	SO	1
Regional Office ,	GIS Based Training	3 days	SRDI	SO	1
	Data Management	3 days	SRDI	SO	1

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Designation	Number
Faridpur	Training				
	Training on GAP & IPM	1 days	SDC	SO	1
Regional Office , Kishoreganj	D document Training	5 Day	SRDI, DHAKA	16 Grade	25
Regional Office , Gopalganj	Training on 'GIS base'	3 days	SRDI, Head office, CCBS Project	SO	1
	Training on 'Good Governance'	5 days	NATA	SO	1
	Integrated Water Resource Management in Agriculture	5 days	NATA	SO	1
	Departmental Training of SO	60 days	SRDI	SO	1
Regional Office , Mymensingh	Training on preparation of semi detailed survey-based map and reports	10 days	SRDI	SO	1
	Training on GIS Base	3 days	SRDI	SSO SO	1 2
	Training on digital Data Management	3 days	SRDI	SSO SO	1 2
	About budget implementation module in iBAS++ System	1 day	Ministry of Finance	SSO	1
	Skill development of employees	5 days	SRDI	13 and 17 Grade Employee	1 1
	Departmental training	60 days	SRDI	SO	2
	In House Training (No cost)	1 day	SRDI, RO Mymensingh	11-20 Grade Employees	15
	Training on preparation of semi detailed survey-based map and reports	10 days	SRDI	SO	1
Regional Office , Jamalpur	Basic Microbiological Study	3 Days	SRDI, Dhaka	PSO	1
	Administrative & Financial Management	14 Days	BIM, Dhaka	PSO	1
	GIS Base	3 Days	SRDI, Dhaka	PSO	1
Regional Office , Netrokona	Foundation Training	6 months	BPATC	SO	2
	Map preparation and report writing based on	10 ways	SRDI, Dhaka	SO	2

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Designation	Number
	semi-detailed soil survey				
	Foundation Training	6 months	BPATC	SO	2
Divisional Office, Khulna	Departmental training	11 Days	SRDI, Dhaka	SO	1
	Good Agricultural practices for fruits and vegetables in Bangladesh	6 Days	SRDI, Dhaka	SO	1
	Departmental training	2 Months	SRDI, Dhaka	SO	1
	Training on soil and land draft map preparation and digitization for Soil Survey	5 days	SRDI, Dhaka	SO	1
	Training on GIS Base.	3 days	SRDI, Dhaka	PSO, SSO, SO	3
	Soilless cultivation and vertical farming	5 days	NATA, Gazipur	SO	1
	Induction training for 43rd BCS cadre officers	15 days	NATA, Gazipur	SO	1
	76th Foundation Training Course	180 days	MOPA	SO	1
Regional Office, Jashore	Conduct and Discipline Course for Grade 13-16 Employees	20 to 24 April 2025	RPATC, Khulna	Casher	1
	Development of Improved verity to fid adverse climatic condition	10 April 2025	RARS, Jashore	PSO	1
Regional Office, Kushtia	76th Foundation Training Course	180 days	MOPA	Officer	1
	Training to Enhance Technical Skills	5 days	SRDI, Khulna	Officer	1
	Map Preparation and Report Writing Based on Semi-detailed Soil Survey	11 days	SRDI, Dhaka	Officer	1
	GIS base Training	3 days	SRDI, Dhaka	Officer	1
	Data Management Training	3 days	SRDI, Dhaka	Officer	1
	Training Programme on Fertilizer Recommendation	5 days	BARC	Officer	1

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Designation	Number
	Guide-2024				
	Training Programme on Remote Sensing (RS) & Geographic Information System (GIS)	5 days	BARC	Officer	1
	Fundamental Training Course	12 days	RPATC, Khulna	Staff	1
Regional Office, Jhenaidah	Training Course on Geographic Information System(basic)	3 days	SRDI, Dhaka	Senior Scientific Officer	1
	Training Course on Data Management	3 days	SRDI, Dhaka	Senior Scientific Officer	1
	Foundation Training Course	180 days	BPATC	Scientific Officer	1
	Fundamentals of GIS and Remote Sensing	5 days	NATA	Scientific Officer	1
	Map & Report Preparation on the basis of Semi-detailed Soil Survey	10 days	SRDI, Dhaka	Scientific Officer	1
	Data analysis in agricultural research and approaches including R-software	5 days	BARC	Scientific Officer	1
	Basic Microbiological Analysis	5 days	SRDI, Dhaka	Scientific Officer	1
Divisional Office, Rangpur	Map & Report Preparation on the Basis of Semi-Detailed Soil survey	11 Days	Head Office, SRDI	Scientific Officer	1
	GIS Base Training	3 Days		Scientific Officer	1
	Data Management	3 Days		Scientific Officer	1
	Foundation Training	6 Months	BPATC	Scientific Officer	1
Regional Office, Dinajpur	Human Resources Management	5 Days	NATA	Scientific Officer	1
	Departmental Training	60 Days	SRDI	Scientific Officer	1
	GIS base	3 Days	SRDI	Scientific Officer	1

Name of Office	Title of the programme	Duration	Host organization	Participant	
				Designation	Number
	Data Management	3 Days	SRDI	Scientific Officer	1
Regional Office, Lalmonirhat	Remote Sensing & GIS	3 Days	SRDI	SO	1
	Good Governance	5 Days	NATA	SO	1
	Departmental Training	60 days	SRDI	SO	1
	Hybrid Rice Cultivation	14 days	China Government	SSO	1
SRDI, Regional Office, Thakurgaon	Map & Report Preparation on the Basis of Semi-Detailed Soil survey	11 Days	Head Office, SRDI	Scientific Officer	01
	GIS Base Training	11 Days		Scientific Officer	01
	Data Management	11 Days		Scientific Officer	01
	Public Financial Management	11 Days	NATA, Gazipur	Scientific Officer	01

Chapter 4: Activities of the Analytical Services Wing

4.1Achievement of Divisional and Regional Laboratories

Analytical Works

Abstract

For sustainable crop production, reliable fertilizer recommendations depend on tools such as soil testing, plant analysis, and fertilizer quality assessment. Soil tests indicate the level of nutrients available to crops; plant analysis shows the nutrients absorbed and removed from the soil, and evaluating fertilizer quality helps determine the precise fertilizer requirements. Therefore, 24 static laboratories and 10 mobile soil testing laboratories (MSTL) under the Analytical Services Wing (ASW) of Soil Resource Development Institute (SRDI) provide analytical work of soil, plant, water, and fertilizer to prepare fertilizer recommendation card, standardize fertilizer and fertilizer related materials, qualify irrigation water, and to quantify removal of the nutrients from the soil. In 2024-2025, a total of 28,912 samples and 2,22,437 parameters were analyzed in 23 static laboratories and 10 mobile soil testing laboratories, of which 19,495 soil samples with 2,20,274 parameters, 275 plant samples with 482 parameters, 473 water samples with 1,181 parameters, and 8,669 fertilizer samples. The sources of soil, plant, and water samples were mainly farmers, upazila land and soil resource use Nirdeshika update program of SRDI, NARS (National Agricultural Research System) institutes, universities, and different government organizations (GOs) and non-government organizations (NGOs). For fertilizer analysis, samples were primarily collected from the Department of Agricultural Extension (DAE), ports, and various government and non-government organizations. The analytical activities generated a revenue of Tk. 40,99,683.00. In addition to analyzing soil, plant, water, and fertilizer samples, the ASW laboratories also conducted field-level training on soil sample collection and the identification of adulterated fertilizers.

Introduction

Soil forms the foundation of our food security. Without fertile and healthy soil, farmers could not supply us with food, feed, fiber, or fuel. It is the primary reservoir of the essential nutrients needed for crop growth. These nutrients move from the soil into the plants we consume. Naturally, soil contains important elements such as N, P, K, S, Ca, Mg, B, Zn, Cu, Fe, Mn, Mo, and Cl, all of which support plant development. When any of these nutrients are lacking or insufficient, plants experience deficiencies and their growth is hindered. If nutrient levels become too low, plants cannot function properly or produce enough food to sustain the global population. After crops are harvested, the nutrients removed from the soil must be replenished. For this reason, farmers add nutrients back into the soil through various sources such as organic matter, chemical fertilizers, and certain nutrient-fixing plants. This replenishment helps maintain soil fertility and enables the continued production of healthy, nutritious crops.

Agricultural practices disrupt soil's natural nutrient cycles. Continuous cultivation and the removal of crops for food or feed can deplete essential plant nutrients. To maintain soil fertility and achieve adequate yields, farmers must apply soil amendments. Early civilizations learned to enrich their fields using materials such as animal manure, ash, charcoal, and lime. Modern agriculture uses a variety of amendments, including inorganic fertilizers and organic sources such as compost and manure, which can sometimes lead to excesses of key macronutrients. Because fertilizer use is not always efficient, surplus nutrients- particularly nitrogen and phosphorus- may run off or leach into water bodies, contaminating both surface and groundwater (Moss, 2008; Sharpley et al., 2002).

To prevent such problems, farmers typically send soil samples to a laboratory for baseline analysis before applying fertilizers. Soil testing helps determine which nutrients are needed and in what quantities- using too little results in reduced crop yields.

Therefore, although fertilizers play a vital role in crop production, farmers must apply them in the correct amounts and at the appropriate time to prevent environmental harm. This is why using soil test-based, high-quality fertilizers is essential- not only for profitable crop yields, but also for maintaining soil fertility, enhancing productivity, and improving overall soil health.

Objectives

1. To determine the physical, physicochemical, and chemical properties of soils.
2. To prepare soil test-based fertilizer recommendations for crops and cropping patterns.
3. To test and standardize the organic manure, chemical fertilizer, and fertilizer-related materials.
4. To identify the water quality in irrigation as well as other sources of water.
5. To analyze plant samples for measuring the nutrient content within the plant tissue.
6. To provide advisory services related to soil, fertilizers, and crops.

Materials and Methods

The Analytical Services Wing (ASW) of the Soil Resources Development Institute (SRDI) operates 24 static laboratories along with 10 Mobile Soil Testing Laboratories (MSTLs). Among the static laboratories, 07 are divisional (Dhaka, Rajshahi, Rangpur, Chattogram, Khulna, Sylhet, and Barishal), 16 are regional (Mymensingh, Jamalpur, Tangail, Faridpur, Kishoreganj, Gopalganj, Pabna, Bogura, Dinajpur, Cumilla, Noakhali, Rangamati, Jashore, Kustia, Jhenaidah, and Patuakhali), and 01 is the Central laboratory. All static laboratories conduct physical, chemical, and physicochemical analyses of soil and fertilizer samples collected by SRDI survey teams or submitted by various stakeholders, including farmers, the DAE, NARS institutions, universities, entrepreneurs, and other government and non-governmental organizations. These laboratories also analyze water and plant samples. Additionally, the 10 Mobile Soil Testing Laboratories (MSTLs) conduct two seasonal programs—during the Rabi and Kharif seasons—to provide farmers at the Upazila level with soil test–based fertilizer recommendation cards.

The central laboratory under ASW performs somewhat different functions compared to the other static labs. It undertakes research activities, quality control programs, and analytical work as directed by higher authorities. A dedicated Soil Microbiology and Biochemistry section has been established exclusively in the central laboratory in Dhaka. Therefore, the central laboratory's operations are discussed separately.

Soil, plant, water, and fertilizer samples received by the various laboratories were processed and analyzed using the procedures outlined in Analytical Methods: Soil, Water, Plant Material, and Fertilizer (SRDI, 2016), the Manual for Fertilizer Analysis (BARC, 2003), and the Fertilizer Recommendation Guide (BARC, 2024). The analytical results for soil samples were evaluated for pH, salinity, and nutrient status based on the Fertilizer Recommendation Guide–2024 (FRG, 2024). Fertilizer recommendation cards were also prepared in accordance with the FRG 2024 guidelines. Advisory services were provided both in person and over the phone.

Result and Discussion

Soil sample

A total of 28,912 samples with 2,22,437 parameters (Moisture, Texture, pH, EC, OC, N, P, S, K, Ca, Mg, B, Zn, Fe, Cu, Mn, Cd, Cr, Pb, Ni, and others as per required) were analyzed in the division and regional laboratories of ASW (Table 4.1).

Table 4.1: Analyzed soil samples in divisional and regional laboratories of ASW.

Name of Division	Name of Laboratory	No. of Sample	No. of ingredient
Dhaka	Divisional Lab. Dhaka	7,013	47,190
	Regional Lab. Faridpur		
	Regional Lab. Jamalpur		
	Regional Lab. Mymensingh		
	Regional Lab. Kishoreganj		
	Regional Lab. Tangail		
	Regional Lab. Gopalganj		
Rajshahi	Divisional Lab Rajshahi	5,724	46,530
	Regional Lab. Bogura		
	Regional Lab. Pabna		
Khulna	Divisional Lab. Khulna	3,861	31,511
	Regional Lab. Jhenaidha		
	Regional Lab. Kushtia		
	Regional Lab. Jashore		
Chattogram	Divisional Lab. Chattogram	4,272	34,810
	Regional Lab. Cumilla		
	Regional Lab. Noakhali		
	Regional Lab. Ragamati		
Sylhet	Divisional Lab. Sylhet	997	6,168
Barishal	Divisional Lab. Barishal	1,426	8,893
	Regional Lab. Potuakhali		
Rangpur	Divisional Lab. Rangpur	5,619	47,335
	Regional Lab. Dinajpur		
Total		**28,912**	**2,22,437**

Among the analyzed soil samples 46.92 % was received from farmer 37.17% was obtained from SRDI program (Upazila Land and Soil Resource Utilization Guide), 2.25% was received from research institute, 8.83% was received from universities and 4.53% was received from different GOs (1.38%) and NGOs (3.15%) to backup research/ educational activities (Figure 4.1). The highest number of soil samples (7,013 samples) was analyzed by the Dhaka division, but the total parameters (47,335 parameters) were analyzed in the laboratories of the Rangpur division, whereas the lowest number of samples (997 samples with 6,168 parameters) was analyzed in the laboratories of the Sylhet division. However, variations in the parameters of the analyzed samples among laboratories depend directly on manpower and instrumental facilities.

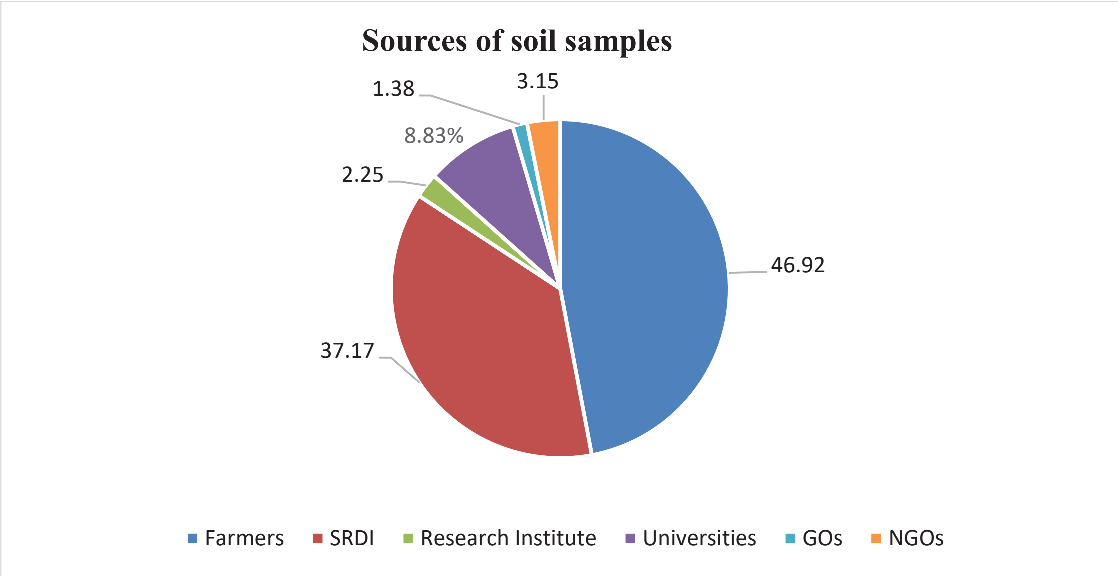


Fig 4.1: Sources of soil Samples

Fertility status of the analyzed farmer's samples

Soil Reaction (pH) status

Soil pH status ranged from very strongly acidic to very strongly alkaline. Among the analyzed soil samples, 6.89 of % soil pH were very strongly acidic, 32.11 of % soil pH were strongly acidic, and 24.11 of % soil pH were slightly acidic. Consequently, 15.92%, 20.16%, 0.75% and 0.02% of the soil pH were neutral, slightly alkaline, strongly alkaline, and very strongly alkaline, respectively (Table 4.2). In the Dhaka and Rajshahi divisions, 21.32% to 56.46 of % soils' pH ranged from very strongly acidic to strongly acidic. In Khulna and Barishal Divisions, 0 to 11.78% of the soils had pH values ranging from very strongly acidic to strongly acidic. In the Chattogram, Sylhet, and Rangpur Divisions, 31.07 to 77.32% of the soils had pH ranging from very strongly acidic to strongly acidic.

Table 4.2 Soil pH status of analyzed farmer's samples

Division	Sample No.	Very strongly acidic	Strongly acidic	Slightly acid	Neutral	Slightly alkaline	Strongly alkaline	Very strongly alkaline
		<4.5	4.6-5.5	5.6-6.5	6.6-7.3	7.4-8.4	8.5-9.0	>9.0
Dhaka	2627	255	1228	395	234	484	30	0
	%	9.71	46.75	15.04	8.91	18.42	1.14	0
Rajshahi	3887	58	771	1340	803	903	12	0
	%	1.49	19.83	34.47	20.65	23.23	0.30	0
Khulna	2537	0	0	41	895	1571	30	0
	%	0	0	1.61	35.27	61.92	1.18	0
Chattog ram	2242	78	619	1154	190	140	57	4
	%	3.47	27.60	51.47	8.47	6.24	2.54	
Barishal	577	0	68	110	213	186	0	0
	%	0	11.78	19.06	36.91	32.23	0	0
Sylhet	269	53	155	47	11	3	0	0
	%	19.70	57.62	17.47	4.09	1.12	0	0
Rangpur	5080	741	2688	1065	396	185	0	0
	%	14.58	52.91	20.96	7.79	3.64	0	0
Total	**17219**	**1185**	**5529**	**4152**	**2742**	**3472**	**129**	**4**
	%	**6.89**	**32.11**	**24.11**	**15.92**	**20.16**	**0.75**	**0.02**

Soil EC (dS/m) status

Electrical conductivity (EC) of the received soil samples ranged from non-saline to very strongly saline. 63.76% of the received soil samples from Khulna, Barishal, and Chattogram Divisions were non-saline; 12.47% were very slightly saline, whereas 13.66%, 4.12%, 1.54%, and 0.80% were slightly saline, moderately saline, strongly saline, and very strongly saline, respectively (Table 4.3).

Table 4.3 Soil EC (dS/m) status of analyzed farmer's samples

Division	Sample	NS	VSS	SS	MS	StS	VStS
		0.0-2.0	2.1-4.0	4.1-8.0	8.1-12.0	12.1-16.0	>16.0
Dhaka	129	56	35	25	13	0	0
	%	43.41	27.13	19.37	10.07	0	0
Khulna	1363	759	185	220	61	27	19
	%	55.68	13.57	16.14	4.47	1.98	1.39
Chattogram	530	502	17	6	3	4	0
	%	94.71	3.20	1.13	0.56	0.75	0
Barishal	577	340	87	104	30	9	2
	%	58.92	15.07	18.02	5.19	1.55	0.34
Total	**2599**	**1657**	**324**	**355**	**107**	**40**	**21**
	%	**63.76**	**12.47**	**13.66**	**4.12**	**1.54**	**0.80**

Soil OM status

The soil organic matter (OM) status of farmers' samples across different divisions of Bangladesh showed the ranged from very low to very high. Most soils fall within the Very Low (VL), Low (L), or Medium (M) OM categories. Dhaka division shows nearly 60% of samples in the VL and L ranges, Rajshahi has the highest proportion of Low OM soils (60.78%). Khulna and Chattogram divisions have comparatively better soil health, with around 46-49% of samples in the Medium OM category. Barishal shows the worst condition, with nearly half of the soils classified as Very Low in OM. Rangpur displays a mixed pattern, with a large portion (42%) in the Low category but also some soils in High and Very High ranges. This suggests a nationwide need for improved soil management and incorporation of organic materials to restore fertility.

Table 4.4 Soil OM status of analyzed farmer's samples

Division	Total sample No.	VL	L	M	H	VH
		≤ 1.0	1.0-1.7	1.8-3.4	3.5-5.5	>5.5
Dhaka	2260	649	698	611	86	63
	%	28.72	30.88	27.04	3.80	2.79
Rajshahi	3886	248	2362	1276	0	0
	%	6.38	60.78	32.83	0	0
Khulana	2542	346	914	1173	99	10
	%	13.61	35.96	46.14	3.89	0.39
Chattogram	2176	319	715	1063	35	31
	%	14.65	32.85	48.65	1.60	1.42
Barishal	232	108	81	38	0	0
	%	46.55	34.91	16.37	0	0
Sylhet	0	0	0	0	0	0
	%	0	0	0	0	0
Rangpur	5080	821	2135	1579	167	101
	%	16.16	42.02	31.08	3.28	1.98
Total	**16176**	**2491**	**6905**	**5740**	**387**	**205**
	%	15.40	42.69	35.48	2.39	1.27

Soil Total N status

The table (Table 4.5) shows the total nitrogen (N) status of soil samples collected from farmers. Most samples fall in the Very Low (VL) and Low (L) categories, indicating widespread nitrogen deficiency. Divisions like Barishal, Khulna, Chattogram, and Rangpur show extremely high percentages of nitrogen-deficient soils, often above 95%. Rajshahi has the highest proportion of Very Low nitrogen soils (68.81%), Among the analyzed soil samples, 34.81% of the soils had very low TN, 38.83% had low TN, and 6.04% had medium TN. Consequently, 0.46%, 0.09%, and 0.01% soil TN were considered optimal, high, and very high, respectively (Table 2.4). In All Divisions, 60.29-99.23% of soils had TN ranging from very low to low. Overall, 94.59% of the total samples are nitrogen-deficient, which highlights a serious need for nitrogen enrichment through fertilizers or organic inputs.

Table 4.5 Total N status of analyzed farmer's samples

Division	Total sample No.	VL	L	M	Deficient	O	H	VH
		≤ 0.09	0.091-0.18	0.181-0.27	≤ 0.27	0.271-0.36	0.361-0.45	>0.45
Dhaka	2531	672	854	195	1721	35	15	3
	%	26.55	33.74	7.70	67.99	1.38	0.59	0.11
Rajshahi	3886	2674	1182	30	3886	0	0	0
	%	68.81	30.42	0.77	1	0	0	0
Khulna	2542	1179	863	496	2538	3	1	0
	%	46.38	33.94	19.51	99.84	0.11	0.03	0
Chattogram	2810	1286	1375	134	2795	10	5	0
	%	45.76	48.93	4.76	99.47	0.35	0.17	0
Barishal	232	192	37	2	231	0	0	0
	%	82.75	15.94	0.86	99.57	0	0	0
Sylhet	0	0	0	0	0	0	0	0
	%	0	0	0	0	0	0	0
Rangpur	4455	1815	2079	500	4394	57	0	0
	%	40.74	46.66	11.22	98.63	1.27	0	0
Total	**16456**	**7818**	**6390**	**1357**	**15565**	**105**	**21**	**3**
	%	**34.81**	**38.83**	**6.04**	**94.59**	**0.46**	**0.09**	**0.01**

Soil Available P (ppm) status

Table 4.6 shows the phosphorus (P) fertility status of soils across different divisions using both Bray & Kurtz and Olsen extraction methods. The available P status of received soils ranged from very low to very high. The available P status of 10.11% of the soils was very low, 11.13% were low, while 12.22%, 9.92%, 9.86%, and 43.92% were medium, optimum, high, and very high, respectively. In the Dhaka and Rajshahi divisions 8.06 to 31.16 % soils available P ranged from very low to low. In Khulna and Barishal Divisions, available P in soils ranged from very low to low (31.62% to 54.84%). In Chattogram, Sylhet, and Rangpur Division, 4.68 to 63.57% of the available P ranged from very low to low.

Table 4.6 Available P (ppm) status of analyzed farmer's samples

Division	Total sample No.	VL	L	M	Deficient	O	H	VH
		Bray & Kurtz Method						
		≤ 5.25	**5.251-10.5**	**10.51-15.75**	**≤ 15.75**	**15.76-21.0**	**21.1-26.25**	**>26.25**
		Olsen Method						
		≤ 7.5	**7.51-15.0**	**15.1-22.5**	**≤ 22.5**	**22.51-30.0**	**30.1-37.5**	**>37.5**
Dhaka	2596	417	392	260	1069	100	207	1182
	%	16.06	15.10	10.02	41.18	3.85	7.97	45.53
Rajshahi	3792	105	202	456	763	606	425	2000
	%	2.76	5.32	12.02	20.12	15.98	11.20	52.74
Khulna	2419	272	493	516	1281	405	188	545
	%	11.24	20.38	21.33	52.96	16.74	7.77	22.52
Chattogram	3208	676	566	636	1878	165	82	820
	%	21.07	17.64	19.82	58.54	5.14	2.55	25.56
Barishal	299	94	70	52	216	29	22	32
	%	31.43	23.41	17.39	72.24	9.69	7.35	10.70
Sylhet	269	143	28	34	205	36	18	10
	%	53.16	10.41	12.64	76.21	13.38	6.69	3.72
Rangpur	4754	45	178	165	388	379	767	3025
	%	0.94	3.74	3.47	8.16	7.97	16.13	63.63
Total	**17337**	**1752**	**1929**	**2119**	**5800**	**1720**	**1709**	**7614**
	%	10.11	11.13	12.22	33.45	9.92	9.86	43.92

Soil Exchangeable K status

Table 4.7 indicates that potassium (K) deficiency is widespread, as over 50-70% of samples in many divisions fall in the deficient category. Exchangeable K status of 14.51% soils was very low, 30.35 % soils were low, while 21.81%, 8.97%, and 10.55% soils were medium, optimum, high, and very high, respectively. In the Dhaka and Rajshahi divisions, 29.9% to 48.83% of the soils had exchangeable K ranging from very low to low. While in Khulna and Barishal Division, 16.04 to 22.99 % of the soils had exchangeable K ranging from very low to low. In Chattogram, Sylhet, and Rangpur Division, 51.67% to 63.57% soils' exchangeable K ranged from very low to low.

Table 4.7 Exchangeable K status of analyzed farmer's samples

Division	Total sample No.	VL	L	M	Deficient	O	H	VH
		≤ 0.09	0.091-0.18	0.181-0.27	≤ 0.27	0.271-0.36	0.361-0.45	>0.45
Dhaka	2595	216	560	748	1524	568	292	283
	%	8.32	21.58	28.82	58.73	21.89	11.25	10.91
Rajshahi	2937	395	1039	505	1939	453	315	566
	%	13.45	35.38	17.19	66.02	15.42	10.73	19.27
Khulna	2419	147	409	563	1119	669	300	321
	%	6.08	16.91	23.27	46.26	27.66	12.40	13.27
Chattogram	2894	771	1069	341	2181	221	126	231
	%	26.64	36.93	11.78	35.07	7.63	4.35	7.98
Barishal	299	4	44	106	154	93	38	11
	%	1.33	14.71	35.45	32.44	31.10	27.75	3.67
Sylhet	269	53	86	58	197	26	32	14
	%	19.70	31.97	21.56	73.23	9.70	11.90	5.20
Rangpur	4427	713	1601	1133	3447	416	318	245
	%	16.10	36.16	25.59	78.33	9.39	7.18	5.53
Total	**15840**	**2299**	**4808**	**3454**	**10561**	**2446**	**1421**	**1671**
	%	**14.51**	**30.35**	**21.81**	**66.67**	**15.44**	**8.97**	**10.55**

Soil Available S status

Table 4.8 reveals that sulfur deficiency is common across all divisions, with 45-72% of samples categorized as deficient. Rajshahi, Barishal, and Chattogram have the highest S deficiency percentages. Very high sulfur levels are only seen in limited locations, such as Khulna and Rangpur. The available S status of 18.22% soils was very low, 25.08% soils were low, whereas 19.58%, 12.31%, 6.43% and 15.33% soils were medium, optimum, high, and very high in available S content, respectively. In the Dhaka and Rajshahi divisions 41.24% to 55.02 % soils Available soil S ranged from very low to low. While in Khulna and Barishal Division, 30.45 to 51.83 % of the Available soil S ranged from very low to low. In Chattogram, Sylhet and Rangpur Division 35.68% to 53.46% soils Available soil S ranged from very low to low.

Table 4.8 Available S status of analyzed farmer's samples

Division	Total sample No.	VL	L	M	Deficient	O	H	VH
		≤ 7.5	7.51-15.0	15.1-22.5	≤ 22.5	22.51-30.0	30.1-37.5	>37.5
Dhaka	3071	550	717	561	1828	217	232	327
	%	17.90	23.34	18.26	59.52	8.82	7.55	10.64
Rajshahi	3792	590	1497	667	2754	535	111	375
	%	15.55	39.47	17.58	72.62	14.10	2.92	9.88
Khulna	2419	422	315	363	1100	388	244	687
	%	17.44	13.01	15.00	45.47	16.04	10.09	28.40
Chattogram	2439	652	652	417	1721	270	112	321
	%	26.73	26.73	17.09	70.56	11.07	4.59	13.16
Barishal	299	75	80	55	210	48	4	30
	%	25.08	26.75	18.39	70.23	16.05	1.33	10.03
Sylhet	269	64	43	79	186	30	25	28
	%	23.79	15.99	29.37	69.14	11.15	9.29	10.41
Rangpur	4427	692	888	1131	2719	569	347	795
	%	15.63	20.05	25.54	61.41	12.85	7.83	17.95
Total	**16716**	**3045**	**4192**	**3273**	**10518**	**2057**	**1075**	**2563**
	%	**18.22**	**25.08**	**19.58**	**62.92**	**12.31**	**6.43**	**15.33**

Soil Available Zn status

Table 4.9 indicates zinc deficiency is a major soil fertility issue, as more than 50% of samples in several divisions fall under the deficient category. The available Zn status of 8.69 % soils was very low, 25.08% soils were low, whereas 19.61%, 12.28%, 8.51% and 21.90% soils were medium, optimum, high, and very high in available Zn content, respectively. In the Dhaka and Rajshahi divisions, available Zn in soils ranged from very low to low (12.77% to 38.68%). While in Khulna Division, 11.74% to 28.44 % soils had Available Zn ranging from very low to low. In Chattogram and Rangpur Division, 36.14% to 36.35% soils Available Zn ranged from very low to low.

Table 4.9 Availability Zn status of analyzed farmer's samples

Division	Total sample No.	VL	L	M	Deficient	O	H	VH
		≤ 0.45	0.451-0.9	0.91-1.35	≤ 1.35	1.351-1.80	1.81-2.25	>2.25
Dhaka	2270	97	193	232	522	312	212	851
	%	4.27	8.5	10.22	22.99	13.74	9.33	37.48
Rajshahi	3412	77	1245	883	2205	276	243	503
	%	2.2	36.48	25.87	64.62	8.08	7.12	14.74
Khulna	2419	284	688	728	1700	226	238	255
	%	11.74	28.44	30.09	70.27	9.34	9.83	10.54
Chattogram	1704	135	479	340	954	322	119	309
	%	7.92	28.22	19.95	55.98	18.89	6.98	18.13
Rangpur	4427	645	965	608	2218	611	399	1199
	%	14.56	21.79	13.73	50.10	13.80	9.01	27.08
Total	**14232**	**1238**	**3570**	**2791**	**7599**	**1747**	**1211**	**3117**
	%	**8.69**	**25.08**	**19.61**	**53.39**	**12.28**	**8.51**	**21.90**

Soil Available B status

The range of available B status of the analyzed soils varied from very low to very high. A significant proportion of samples (over 33-76%) in many divisions are categorized as deficient. The available B status of 10.47 % soils was very low, 28.03% soils were low, whereas 16.76%, 9.84%, 8.23% and 15.53% soils were medium, optimum, high, and very high in available B content, respectively (Table 4.10). In the Dhaka and Rajshahi divisions, 25.47% to 65.09% of the available B soil ranged from very low to low. While in Khulna Division, 4.88% to 8.64% of the soils Available B ranged from very low to low. In Chattogram and Rangpur division, 24.13% to 49.16% of the Available B soils ranged from very low to low.

Table 4.10 Available B status of analyzed farmer's samples

Division	Total sample No.	VL	L	M	Deficient	O	H	VH
		≤ 0.15	**0.151-0.3**	**0.31-0.45**	**≤0.45**	**0.451-0.6**	**0.61-0.75**	**>0.75**
Dhaka	2897	202	538	482	1222	291	165	306
	%	6.9	18.57	16.63	42.18	10.04	5.6	10.56
Rajshahi	3412	400	1821	749	2970	138	114	190
	%	11.72	53.37	21.95	87.04	4.04	3.34	5.56
Khulna	2419	118	209	230	557	291	211	1044
	%	4.88	8.64	9.51	23.02	12.03	8.72	43.16
Chattogram	1611	38	351	460	849	224	279	201
	%	2.35	21.78	28.55	52.70	13.90	17.31	12.47
Rangpur	3047	644	834	523	2001	373	334	338
	%	21.79	27.37	17.16	65.67	12.24	10.96	11.09
Total	**13386**	**1402**	**3753**	**2244**	**7599**	**1317**	**1103**	**2079**
	%	**10.47**	**28.03**	**16.76**	**56.76**	**9.84**	**8.23**	**15.53**

Plant and Water Sample

Nutrient content in plant tissue is a vital indicator of soil fertility, soil productivity, and crop yield, as well as nutrient deficiencies. Moreover, quality water is an important input for agricultural production as well as human health. Divisional and regional laboratories under ASW analyzed a total of 275 plant samples and 473 water samples using parameters 982 and 1181, respectively. The highest number of plant samples (145) and water samples (229) were analyzed by the divisional laboratory, Dhaka and Chattogram, respectively (Table 4.11). The highest number of analyzed parameters for plant and water samples was 364 and 456, respectively, from Barishal and Dhaka.

Table 4.11: Plant and water samples analyzed by divisional and regional laboratories of ASW

Name of Division	Name of Laboratory	Plant		Water	
		Sample	Parameters	Sample	Parameters
Dhaka	Divisional Lab. Dhaka	145	293	99	456
	Regional Lab. Faridpur				
	Regional Lab. Jamalpur				
	Regional Lab. Mymensingh				
	Regional Lab. Kishoreganj				
	Regional Lab. Tangail				
	Regional Lab. Gopalganj				
Rajshahi	Divisional Lab Rajshahi	0	0	0	0
	Regional Lab. Bogura				
	Regional Lab. Pabna				
Khulna	Divisional Lab. Khulna	0	0	19	79
	Regional Lab. Jhenaidha				
	Regional Lab. Kushtia				
	Regional Lab. Jashore				
Chattogram	Divisional Lab. Chattogram	23	87	229	495
	Regional Lab. Cumilla				
	Regional Lab. Noakhali				
	Regional Lab. Rangamati				
Sylhet	Divisional Lab. Sylhet	0	0	0	0
Barishal	Divisional Lab. Barishal	28	364	100	101
	Regional Lab. Potuakhali				
Rangpur	Divisional Lab. Rangpur	102	238	26	50
	Regional Lab. Dinajpur				
Total		**298**	**982**	**473**	**1181**

Fertilizer Recommendation Card

Soil-test-based balanced fertilizer application ensures optimum yield with minimum inputs, maintaining soil health and the environment. Divisional and regional laboratories under ASW had prepared 18,817 fertilizer recommendation cards based on soil test results (18,299), online fertilizer recommendation system (200), and Upazila land and soil utilization guide (225), which were distributed to respective farmers (Table 4.12).

Table 4.12 Fertilizer recommendation card prepared and distribution by divisional and regional laboratories of ASW

Name of Division	Name of Laboratory	No. of card			
		STB	OFRS	ULSUG	Total
Dhaka	Divisional Lab. Dhaka Reginal Lab. Faridpur Reginal Lab. Jamalpur Reginal Lab. Mymensingh Regional Lab. Kishoreganj Regional Lab. Tangail Regional Lab. Gopalganj	3759	0	25	3784
Rajshahi	Divisional Lab Rajshahi Reginal Lab. Bogura Regional Lab. Pabna	3621	0	0	3621
Khulna	Divisional Lab. Khulna Reginal Lab. Jhenaidha Reginal Lab. Kushtia Regional Lab. Jashore	2230	0	0	2230
Chattogram	Divisional Lab. Chattogram Reginal Lab. Cumilla Reginal Lab. Noakhali Regional Lab. Rangamati	2836	0	0	2836
Sylhet	Divisional Lab. Sylhet	269	0	0	269
Barishal	Divisional Lab.Barishal Reginal Lab. Potuakhali	577	100	100	777
Rangpur	Divisional Lab. Rangpur Reginal Lab. Dinajpur	5107	100	100	5307
Total		**18399**	**200**	**225**	**18824**

Revenue earning

Divisional and regional laboratories under ASW earned Tk. 40,99,683.00 as revenue by analyzing soil, water, plant and fertilizer samples (Table 4.13). The highest amount (Tk. 26,62,420.00) was earned from fertilizer analysis. Divisional laboratory, Dhaka with regional laboratories under the division was the most top position in revenue earning (Tk. 17,85,495.00)

Table 4.13 Revenue earning by divisional and regional laboratories of ASW

Name of Division	Name of Laboratory	Earning (Tk.)				
		Soil	Water	Plant	Fertilizer	Total
Dhaka	Divisional Lab. Dhaka	6,57,615	22,650	15,330	14,60,895	2156490
	Reginal Lab. Faridpur					
	Reginal Lab. Jamalpur					
	Reginal Lab. Mymensingh					
	Regional Lab. Kishorganj					
	Regional Lab. Tangail					
	Regional Lab. Gopalganj					
Rajshahi	Divisional Lab Rajshahi	3,17,537	-	-	4,95,522	8,13,059
	Reginal Lab. Bogura					
	Regional Lab. Pabna					
Khulna	Divisional Lab. Khulna	4,66,965	18,883	1,200	6,60,860	11,47,908
	Reginal Lab. Jhenaidha					
	Reginal Lab. Kushtia					
	Regional Lab. Jashore					
Chattogram	Divisional Lab. Chattogram	3,74,150	4,090	8700	9,80,075	13,67,015
	Reginal Lab. Cumilla					
	Reginal Lab. Noakhali					
	Regional Lab. Rangamati					
Sylhet	Divisional Lab. Sylhet					3,41,015
Barishal	Divisional Lab. Borisal	1,07,855	225	-	2,38,850	3,46,930
	Reginal Lab. Potuakhali					
Rangpur	Divisional Lab. Rangpur	4,26,940	2135	26120	7,82,635	12,37,830
	Reginal Lab. Dinajpur					
Total		**2351062**	**47983**	**51350**	**4618837**	**7410247**

Fertilizer and fertilizer related materials

1n 2024-2025 fiscal year, 5,057 fertilizer samples were analyzed in different laboratories of ASW (Table 6), in which 2,958 (58.50%) fertilizer samples were standard and 2,099 (41.50%) samples were adulterated (Table 4.14).

Table 4.14 Quantity of analyzed fertilizer in divisional and regional laboratories of ASW

Name of the fertilizers	Dhaka	Rajshahi	Khulna & Jashore	Chattogram & Cumilla	Barishal	Sylhet	Rangpur	Grand total
Urea	18	3	21	106	21	15	8	192
(NH4)2SO4	22	0	18	25	0	0	2	67
TSP	13	18	33	222	40	28	16	370
DAP	22	9	39	229	46	36	15	396
MoP	18	9	27	234	39	28	4	359
K2SO4	52	10	0	130	4	0	7	203
Gypsum	148	23	53	363	48	33	43	711
NPKS	10	15	1	61	3	8	5	103
MgSO4	271	198	44	617	44	36	164	1374
ZnSO4 (Mono.)	218	506	265	733	90	45	266	2123
ZnSO4 (Hepta.)	22	26	3	68	5	14	35	173
Chelated Zn	90	54	2	250	5	21	36	458
Solubor boron	176	187	73	307	20	36	119	918
Boric acid	100	135	32	289	27	24	125	732
Fertibor B15%	35	16	6	58	0	0	34	149
Organic fertilizer	95	33	24	89	0	4	68	313
Dolomite	1	11	0	12	0	0	0	24
Rock phosphate	0	0	0	4	0	0	0	0
Micronutrient	0	0	0	0	0	0	6	6
Bonemeal	0	0	0	0	0	0	0	0
Total	**1311**	**1253**	**641**	**3797**	**392**	**328**	**947**	**8669**

Macronutrient fertilizers i.e. Urea, $(NH_4)_2SO_4$, $MgSO_4$ and Rock phosphate were around 100% standard. Besides, other macronutrient fertilizers like TSP, DAP, MoP, K_2SO_4 and Gypsum were 23.03%, 10.61% 17.42%, 8.43% and 20.11% adulterated, respectively (Table 7). In contrast, micronutrient i.e., 93.36% zinc sulfate monohydrate, 40.00% zinc sulfate heptahydrate, 26.75% chelated zinc, 25.45% solubor boron, 49.26% boric acid and 37.50% Boron 15% were adulterated. The highest percent of sub- standard was observed for zinc sulfate monohydrate. The amount of adulterated organic fertilizers was 34.62% (Table 4.15).

Table 4.15 Quality of analyzed fertilizer in divisional and regional laboratories of ASW

Name of the fertilizers	Total	Standard	Sub- standard
	No.	%	
Urea	96	100	0
$(NH4)_2SO4$	32	100	0
TSP	178	76.97	23.03
DAP	132	89.39	10.61
MoP	155	82.58	17.42
K_2SO4	83	91.57	8.43
Gypsum	348	79.89	20.11
NPKS	47	68.09	31.91
MgSO4	797	99.75	0.25
ZnSO4 (Mono.)	1400	6.64	93.36
ZnSO4 (Hepta.)	110	60	40.00
Chelated Zn	228	73.25	26.75
Solubor boron	613	74.55	25.45
Boric acid	475	50.74	49.26
Fertibor B15%	96	62.5	37.50
Organic fertilizer	234	65.38	34.62
Dolomite	23	78.26	21.74
Rock phosphate	4	100	0
Micronutrient	6	83.3	16.7
Bonemeal	0	0	0
Total	**5057**	**58.50**	**41.50**

Service of mobile soil testing laboratory (MSTL)

A total of 6,069 soil samples were tested through 10 MSTLs, namely Jamuna, Madhumoti, Brahmaputra, Tista, Karatoya, Rupsa, Karnophuly, Titas, Shurma, and Kirtonkhola in Robi and Kharif seasons (Table 4.16). The tested soil samples were collected from farmers' fields of different Upazilas with the cooperation of the Department of Agricultural Extension (DAE). After the analysis, soil test-based fertilizer recommendation cards were prepared and distributed to the respective farmers.

Table 4.16 Analyzed soil samples by MSTLs

MSTL	Working area		Upazila	Sample
	Division	District		
Jamuna	Dhaka	Munsiganj, Dhaka, Narayonganj, Netrokona, Mymensingh, Kishorganj, Gazipur, Narshindi, Manikganj.	13	664
Brahmaputra	Dhaka	Tangail, Jamalpur, Sherpur, Netrokona, Mymensingh,	11	605
Madhumoti	Dhaka	Faridpur, Rajbari, Sariyatpur, Madaripur, Gopalganj, Magura, and Norail.	11	545
Tista	Rajshahi	Naogaon, Chapainawabgonj, Rajshahi, Natore, Pabna, Bogura, Sirajganj, Joypurhat, Rangpur	12	768
Karatoa	Rajshahi	Bogura	14	787
	Rangpur	Lalmonirhat, Nilphamari, Gaibandha, Panchagor, Rangpur, Kurigram, Dinajpur,		
Rupsa	Khulna	Kushtia, Chuadanga, Narail, Satkhira, Bagerhat, Jhenaidah, Jashor	15	805
Shurma	Sylhet	Sylhet, Sunamgonj, Moulavibazar, Habigonj	8	404
Kirtonkhola	Barishal	Bhola, Barguna, Patuakhali, Jhalokati, Pirojpur, Barishal, Magura	9	479
Kornafuli	Chattogram, Hill Tracts	Chattugram, Khagrachori, Cox's Bazar, Bandarban, Rangghamati	11	404
Titas	Chattogram	Cumilla, Noakhali, Feni, Chandpur, Brahmanbaria, Laxmipur	11	608
Total			**115**	**6,069**

Conclusion

The natural soil fertility of Bangladesh is reducing day by day rapidly which hampering crop productivity. The farmers of Bangladesh have realized the importance and benefits of soil test-based fertilizer recommendation for crop cultivation though soil test-based fertilizer recommendation facility at farmer's level is still inadequate and scanty. Furthermore, input costs are also getting higher step by step. In this situation, increase of recommended quality fertilizer uses through soil and fertilizer testing by the farmers with the support of SRDI and DAE could contribute in resource use efficiency and more economic return from cultivated crops. Nevertheless, managing the soil health and sustainable crop production soil test-based standard fertilizer application has to be ensured through soil and fertilizer testin

References

BARC (Bangladesh Agricultural Research Council). 2003. Manual for Fertilizer Analysis. Ministry of Agriculture. Soils Publication # 44. Farmgate, Dhaka.

BARC (Bangladesh Agricultural Research Council). 2018. Fertilizer Recommendation Guide- 2018. Soil Publication # 45. Farmgate, Dhaka.

Moss, B. 2008. Water pollution by agriculture. Philosophical Transactions of the Royal Society B-Biological Sciences, 363: 659-666.

Sharpley, A. N., Haygarth, P. M. and Jarvis, S. C. 2002.3 Introduction: Agriculture as a potential source of water pollution. Agriculture, hydrology, and water quality, 4-5.

SRDI (Soil Resource Development Institute). 2016. Analysis Methods: Soil, Water, Plant Materials, and Fertilizer. Offline Digital Fertilizer Recommendation Program.

Changes of Soil Fertility in Jamalganj Upazila under Sunamganj District

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Abstract

A comparative study was conducted to assess soil characteristics and fertility status in Jamalganj Upazila, Sunamganj District. The primary objective was to evaluate changes in soil fertility over time by examining various parameters, including soil pH, organic matter (OM), total N, available P, S, B, Zn, Cu, Fe, Mn, exchangeable K, Ca, and Mg. Over the years from 2001 to 2023, notable trends emerged in soil properties. During the 2001s, the soil in the area exhibited a range of characteristics. The pH has turned very strongly acidic to slightly acidic from very strongly acidic to neutral. Over the observed period, the organic matter (OM) content in the recent soil was higher than in the previous soil in most soil series, except the Monu and Terchibari soil series. The total nitrogen (N) content is the same as the OM content. Available phosphorus (P) levels also increased. The availability of zinc (Zn), iron (Fe), manganese (Mn), and available copper (Cu) increased substantially. Additionally, sulfur (S) content was very high in both cases. Exchangeable potassium (K), calcium (Ca), and Magnesium exhibited a decrease. On the other hand, exchangeable magnesium (Mg). In the case of soil-available boron (B), it did not follow a specific pattern. In summary, the findings of the study strongly suggest that soil fertility has declined in the study area. These changes in soil properties and nutrient status have implications for agriculture and land management practices in the region.

Key words: Soil group, Soil reaction (pH), Organic matter (OM), Plant nutrients, Soil fertility.

Introduction

Bangladesh, a country known for its fertile deltaic plains and agricultural heritage, is heavily dependent on the agriculture sector, employing a significant portion of its population and contributing to its economy. However, with the increasing population, food demand in Bangladesh is constantly rising, and thus the practice of intensive agriculture using agrochemicals has dominated cropping systems for several decades. Unfortunately, in the pursuit of increased food production, sustainability, and environmental concerns, the issue of land degradation has often been overlooked. As a result, soil fertility has significantly declined, particularly in areas where land-use intensification is more pronounced and inefficient. Bangladesh's soils are subjected to/experience high temperatures, abundant rainfall, and the pressure of cultivating two or more crops in a year, sometimes without balanced fertilization practices. This has led to widespread soil nutrient depletion. The intensification of agricultural land use, coupled with the adoption of modern crop varieties, has contributed to the deterioration of soil fertility and the emergence of new nutrient deficiencies. As a result, soil fertility is deteriorating progressively (Islam, 2008; SRDI, 2010a, b). To address this challenge, it is imperative to assess the trend of soil fertility decline to ensure optimal nutrient management and the development of sustainable cropping systems in Bangladesh. Soil fertility levels vary across regions, necessitating variable fertilizer applications for different crop types. Insufficient fertilizer application can reduce crop yields, while excessive use can result in economic losses and pose environmental risk.

A comprehensive understanding of soil fertility provides valuable insights into the current nutrient status, distribution patterns, and trends (Dafonte *et al.,* 2010). This knowledge is crucial for decision-making processes aimed at enhancing crop productivity. To assess the extent of soil fertility degradation, it is essential to compare and analyze the initial and current soil fertility status. Therefore, this study examines changes in soil pH, organic matter (OM), total nitrogen (TN), phosphorus (P), sulfur (S), potassium (K), calcium (Ca), magnesium (Mg), boron (B), zinc (Zn), copper (Cu), iron (Fe), and manganese (Mn) over a period spanning from 2001 to 2023. This analysis aims to provide insights into the evolving nutrient dynamics in the soil over time. In summary, the availability of productive soil and land resources is crucial to meet the ever-increasing demand. Addressing these challenges, Bangladesh requires a holistic approach that considers sustainable soil management practices, environmental protection, and the prevention of soil fertility degradation. Understanding the dynamics of soil nutrient availability is crucial for making informed agricultural decisions and ensuring long-term food security.

Materials and Methods

Study location: The study site, Jamalganj Upazila, in Sunamganj district, Bangladesh, covers an area of 131.69 km^2 in the eastern part of the country.

Soil sampling and analysis: Soil sampling was done under the national soil survey program of the Soil Resource Development Institute, Bangladesh. Samples were collected based on soil series, land type, and land use. Composite samples were collected from the upper 0-15 cm of depth. In 2023, 68 soil samples were collected. Soil pH was measured as described by Jackson (1962). Organic matter (OM) was determined by the wet oxidation method (Page *et al.*, 1982). Available P was extracted by the Bray and Kurtz (1945) methodology. The P in the extract was then determined by developing blue color absorbance with ammonium molybdate-ascorbic acid solution and measuring the color using a Spectrophotometer at 890 nm wavelength. The S content in the extract was determined turbidimetrically, and the turbidity was measured by a spectrophotometer at 535 nm wavelength (Alvarez *et al.,* 2001). Exchangeable K content was determined by extraction with 1M ammonium acetate, pH 7.0 solution followed by determination of extractable K by flame photometer (Thomas, 1982). Exchangeable Ca and Mg content were determined by extraction with 1M ammonium acetate, pH 7.0 solution followed by measurement by atomic absorption spectrophotometer (Thomas, 1982). Available Zn, Cu, Fe and Mn were extracted by 0.05M DTPA solution (pH 7.3) maintaining 1:2 soil-extractant ratio. The extracted level was measured by flame AAS (Lindsay and Norvell, 1978). Available B was extracted by hot water-0.02M $CaCl_2$ solution (1:2). The extractable B was determined by spectrophotometer following azomethine-H method (Keren, 1996).

Result and discussion:

Soil Reaction (pH): The previous soil pH range was 4.2-6.4 and recent was 4.0-6.5 in different soil series at Jamalganj Upazila. The present pH shows a decreasing trend compared to previous data. These were due to the harvest of high-yielding crops and the nitrification of ammonium and acidic parent material.These findings were supported by Hailin, 2017. Over the course of two decades, from 2001 to 2023, efforts to intensify crop production have led to a notable rise in the application of chemical fertilizers. Unfortunately, this surge in fertilizer use, marked by imbalances and excessive quantities, particularly stemming from improper utilization of ammonia-based acid- forming fertilizers, appears to be the primary factor contributing to the increasing levels of soil acidity in the study area.

Table: 4.17 Change in soil analytical data of pH, OM, N and P

Soil Group	Land type	Elements/Parameters							
		pH		OM (%)		N (%)		P (ppm)	
		Previous	Recent	Previous	Recent	Previous	Recent	Previous	Recent
Pritimpasha	MLL	6.4	5.3	2.4	4.1	0.14	0.20	1.0	1.2
Nalitabari	MLL	4.8	4.3	3.44	3.9	0.26	0.19	2.0	2.5
Monu	LL	4.8	4.1	3.44	2.9	0.26	0.13	1.0	3.5
Balagonj	MHL	4.6-5.4	4.0-5.4	2.2	2.8	0.14	0.15	2.0	2.7
Balagonj	MLL	4.5-4.9	4.6	2.14	3.5	0.12	0.18	2.0	3.4
Goainghat	MHL	4.6-5.0	4.0-5.2	1.9	2.7	0.11	0.14	2.0	3.8
Goainghat	MLL	4.3-5.8	4.6-6.1	2.41	2.8	0.13	0.14	3.0	3.8
Surma'sSilty Soil	MLL	5.5-6.4	4.4-5.3	2.49	2.8	0.15	0.15	2.0	3.2
Surma'sSilty Soil	LL	5.0	4.8	1.72	1.8	0.12	0.10	2.0	4.0
Fagu	LL	4.4-6.5	4.2	6.5	2.5	0.13	0.13	3.0	3.7
Fagu	VLL	4.2-5.2	4.2-5.4	2.88	2.94	0.12	0.15	1.0	3.1
Terchibari	LL	4.6-4.8	4.3-5.0	2.96	2.69	0.13	0.14	1.0	4.5
Terchibari	VLL	4.5-5.0	4.3-6.5	3.26	3.14	0.13	0.15	1.0	4.7
Dhirai	VLL	4.5-4.6	4.3-6.1	3.45	3.32	0.14	0.16	1.0	3.1

Organic Matter (%) and Total N (%): More or less the same trend was observed in the case of nitrogen and organic matter. The organic matter in the soil increased in recent soil compared to previous soil in most of the soil series. In the case of the Monu and Terchibari soil series, the recent soil OM decreased slightly but their status was the same. Organic matter decreased markedly in the Fagu soil series with low land in recent years. Increasing use of organic amendment, leaving crop residues in the field after harvest or incorporating them into the soil and cover cropping might be the cause of increased amount of organic matter in that region.

Phosphorus: The previously available P was found in very low status at different soil series. In recent years, the available P has increased slightly, but their status is the same as in previous data. An increase in soil-available phosphorus might be achieved through the adoption of practices such as liming acidic soils, applying organic amendments to acidic soils, tillage practices, and regulating the timing and method of P fertilizer application.

Potassium (K): Out of nine soil series, the recent K level decreased compared to the previous K level, except for the Balaganj soil series (Table 4.18). The status of exchangeable K did not follow any specific pattern for each soil group and land type. Overall, it increased in 2023 compared to 2001, except in Balaganj, where it decreased slightly.

Calcium (Ca) and Magnesium (Mg): Exchangeable Ca decreased recently compared to the previous Ca, except in the Nalitabari and Goainghat soil series. Among the soil series, only Goainghat with MHL occupies a different status. The recent exchangeable Mg has increased in Nalitabari, Monu, and Goainghat, particularly in the MHL and Dhirai soil series, compared to the previous Mg. A decreasing trend of Mg was observed in the remaining soil series.

Table 4.18 Change in soil analytical data of K, S, Ca, Mg, and B

Soil Group	Land type	Elements									
		K (meq/100g soil)		Ca (meq/100g soil)		Mg (meq/100g soil)		S (ppm)		B (ppm)	
		Previous	Recent	Previous	Recent	Previous	Recent	Previous	Recent	Previous	Recent
Pritimpasha	MLL	0.20	0.10	9.90	6.26	2.90	1.69	72	39	0.54	0.56
Nalitabari	MLL	0.14	0.10	3.40	4.49	1.10	1.28	88	68	0.39	0.32
Monu	LL	0.19	0.15	5.60	3.81	1.00	1.14	59	79	1.00	0.44
Balagonj	MHL	0.18	0.19	5.90	5.00	2.10	1.34	129	65	0.42	0.39
Balagonj	MLL	0.17	0.20	4.30	3.76	1.30	1.17	58	60	0.33	0.22
Goainghat	MHL	0.17	0.17	3.10	5.14	1.10	1.48	50	62	0.40	0.37
Goainghat	MLL	0.20	0.19	4.80	4.95	1.60	1.45	96	66	0.37	0.31
Surma'sSilty Soil	MLL	0.24	0.21	9.10	5.21	2.90	1.40	158	105	0.19	0.29
Surma'sSilty Soil	LL	0.22	0.17	6.50	3.62	2.10	1.33	152	47	0.71	0.33
Fagu	LL	0.21	0.18	6.90	5.08	1.90	1.49	75	66	0.68	0.26
Fagu	VLL	0.23	0.22	8.00	5.47	1.90	1.60	82	44	0.36	0.32
Terchibari	LL	0.27	0.17	9.10	6.50	1.80	1.52	80	104	0.33	0.46
Terchibari	VLL	0.21	0.19	7.10	5.46	1.60	1.54	66	82	0.34	0.33
Dhirai	VLL	0.20	0.20	7.00	5.93	1.50	1.53	60	109	1.04	0.43

Sulfur (S) and Boron (B): Available S was found between 50-150 ppm (Very High) in 2001, while it was observed between 39-109 ppm (Very High) by the year 2023 in different soil series with land types (Table 4.18). The status of available S was found to be very high in both cases (previous and present). Available B was found between 0.19-1.04 ppm (Low to Very High) in 2001, while it was observed between 0.22-0.56 ppm (Low to High) by 2023 across different soil groups and land types. In some cases, available B values decreased due to crop uptake and sediment deposition.

Table 4.19 Change in soil analytical data of Zn, Cu, Fe, and Mn

Soil Group	Land type	Elements							
		Zn (ppm)		Cu (ppm)		Fe (ppm)		Mn (ppm)	
		Previous	Recent	Previous	Recent	Previous	Recent	Previous	Recent
Pritimpasha	MLL	0.70	0.78	2.80	3.39	84	88	9.2	43
Nalitabari	MLL	2.10	3.81	3.70	5.79	240	338	116	138
Monu	LL	1.60	2.52	4.10	3.09	280	103	114	76
Balagonj	MHL	1.00	2.59	3.00	4.03	118	158	141	117
Balagonj	MLL	1.00	3.09	2.30	5.17	164	252	137	117
Goainghat	MHL	0.90	2.46	3.10	4.23	147	222	56	135
Goainghat	MLL	1.40	2.34	3.70	4.70	193	187	108	124
Surma'sSilty Soil	MLL	0.60	2.51	2.80	4.51	74	240	111	149
Surma'sSilty Soil	LL	0.50	2.37	3.20	4.83	340	143	62	59
Fagu	LL	1.60	1.93	4.20	4.54	294	187	151	105
Fagu	VLL	1.80	2.77	4.30	5.09	341	286	142	132
Terchibari	LL	1.90	2.09	4.40	4.64	347	369	143	172
Terchibari	VLL	1.70	2.41	4.70	4.76	321	317	158	164
Dhirai	VLL	1.80	2.81	4.20	4.85	334	362	109	164

Available Zn, Cu, Fe, and Mn:

Over time, from 2001 to 2023, the available Zn reserve in the soil had increased across the soil series (Table 4.19). In 2001, available Zn was found between 0.70-2.10 ppm (Optimum to Very high), whereas in 2023 it was observed between 0.78-3.81 ppm (Optimum-Very high) across different soil groups and land types.

Similarly, the soil available Cu reserve had increased from 2001 to 2023 (Table 4.19). Mean available Cu was observed between 2.30 and 4.70 ppm (Very high) in 2001, whereas by 2023 it was between 3.39 and 5.79 ppm (Very high) across different soil groups and land types. The available Fe content increased during the period 2001 to 2023 (Table 4.19). Mean available Fe ranged from 74 to 347 ppm (Very high) in 2001, though by 2023 it ranged from 88 to 369 ppm (Very high) across different soil groups and land types. In 2001, available Mn was found to range from 9.2 to 158 ppm (Very high), and by 2023, it was observed to range from 43 to 172 ppm (Very high) across different soil groups and land types (Table 4.19).

The findings of this study were consistent with the results reported by various authors. Siddique *et al.* (2014) found that soil pH ranged from 5.4 to 6.0 in 1991, but by 2012 it ranged from 4.4 to 5.4 in the northeastern piedmont soil. A comparison between the soil pH maps of BARC for the years 2005 and 2012 revealed that there was an expansion of

0.15 million hectares of very strongly acidic soil (pH < 4.5) and 0.44 million hectares of strongly acidic soil (pH 4.5-5.5) over time. The increasing rate of SOC indicates an increase in organic matter in the soils of Bangladesh over time. According to SRDI, the medium organic matter content comprises 55.57% of arable land in 2010, increasing to 59.19% in 2020 (Soil fertility trends in Bangladesh 2010 to 2020, 2020). This may be due to the rice-rice cropping system, increased cropping intensity, and farmers' awareness of the incorporation of organic manures into their land. Additionally, soil available P, K, S, and B content has arisen in that study area, which is a good indication considering our soil health. An increase in soil-available phosphorus might be achieved through the adoption of practices such as liming acidic soils, applying organic amendments in both alkaline and acidic soils, tillage practices, and regulating the timing and method of P fertilizer application. The exchangeable K content in the study area may have decreased due to the use of HYV rice monocrops and the neglect of Potash fertilizer. Zahid *et al. (2020) reported that soil productivity may decrease* to 10-25% if soil sulphur is in the range of 18.1-23.5 ppm. In the study area, the Sulphur content was 36.89 to 151.40 ppm, which indicates that the soil of the study area is undergoing a change for the management of crop production. Besides, the Ca and Mg content of the study area was decreased. However, soil magnesium content in loamy to clayey soils, both of upland crops and wetland rice crops across the country, declined alarmingly over the years. Hasan *et.al.,* 2015, reported that there is a considerable leaching of base materials such as Ca, Mg, and K from top soils and subsequent accumulation in subsoils.

Nonetheless, a significant proportion of Bangladeshi farmers opt to apply nitrogen (N) fertilizers due to the immediate and noticeable effects on soil and crop production (Biswas *et al.,* 2008). This preference for N fertilizers contributes to nutrient imbalances that can adversely affect soil characteristics and overall crop production. The decline in soil fertility in regions with intensive cropping practices, as highlighted by Jahiruddin and Satter (2010), suggests that the replenishment of essential nutrients is not occurring, or it exceeds the soil's capacity to provide the necessary nutrients for the cultivation of high-yield crop varieties. During prolonged flooding, as soil Eh reduction continues, pH decreases while zinc availability increases leading to high tissue zinc concentrations (Pavanasasivam, and Axley,1980) and reduced ferric and manganic forms that are soluble (Ponnamperuma, 1972). Increased solubility of Zn, Fe and Mn may result increased movement of these micronutrients to lower horizons from surface horizons, thereby depleting the surface horizons.

Conclusion

The findings of this study highlight significant changes in soil characteristics and agricultural practices in Bangladesh. The study noted a decline in soil pH levels over the years, with an expansion of very strongly acidic and strongly acidic soils in some areas. This shift may have implications for crop production and soil health. The research indicates a positive trend in SOC, suggesting an increase in organic matter in Bangladeshi soils. Soil available phosphorus, sulfur, and zinc content showed an increase, which is beneficial for soil health and agriculture. This rise may be due to various practices, including liming acidic soils, organic amendments, and regulated phosphorus fertilizer application. The study identified a depletion of potash (K) content in selected areas between 2001 and 2023, potentially leading to a decline in crop productivity. This depletion may be linked to intensive agricultural practices and a lack of potash supplementation. This indicates the need to reverse or restore the soil's natural fertility status from its current critical nutrient status to increase crop productivity through efficient farming. Soil test-based balanced fertilization by quality organic, inorganic, and bio fertilizers, judicious and efficient use of acid-forming fertilizers like urea and di-ammonium phosphate (DAP), crop diversification, inclusion of green manuring crops, and incorporation of crop residue might be some effective tools for soil fertility restoration.

References

Alvarez, V.H., Dias, L.E., Ribeiro Jr., E.S., Souza, R.B. and Fonseca, C.A. 2001. Métodos de análises de enxofre em solos e plantas. Viçosa: Editora UFV. P.131.

Biswas, J.C., Maniruzzaman, M., Sattar, M.A., and Neogi, M.G. 2008. Improvement of rice yield through fertilizer and cultural management in the farmers' fields. Bangladesh Rice J., 13:9-14.

Bray, R.H. and Kurtz, L.T. 1945. Determination of total, organic, and available forms of phosphorus in soils. Soil Science, 59: 39-45.

Dafonte, J.D., Ulloa, G.M., Jorge, P., Glécio, S., Vázquez, M. and Vidal, E. Mapping of soil micronutrients in a European Atlantic agricultural landscape using ordinary kriging and indicator approach. Bragantia, 69:175-186.

FRG (Fertilizer Recommendation Guide). Bangladesh Agricultural Research Council, Farmgate Dhaka, 1215. In Press; 2018.

Hartemink, A.E. 2003. Soil fertility decline in the tropics: with case studies on Plantations. CABI Publishing, UK.

Hasan, M. Nazmul. and M. Lutfar Rahman, 2015. A Comparative Assessment of Soil Fertility in Birganj Upazila of Dinajpur District and Hatibandha Upazila of Lalmonorhat District of Bangladesh. “FAO suppoeted research work.” pp-73.

Hailin Z 2017: Cause and effects of soil acidity. Director, Soil, Water and Forage, Analytical laboratory.

Islam, M.S. 2008. Soil fertility history, present status and future scenario in Bangladesh, Bangladesh Journal of Agriculture and Environment, 4: 129-151.

Jackson, M.L. 1962. Soil Chemical Analysis. Prentice Hall Inc., Engle wood, Clift, N.J.p 143. Jahiruddin, M., Satter, M.A., 2010. Agricultural Research Priority: Vision 2030 and beyond.

Bangladesh Agricultural Research Council, Farmgate, Dhaka, Bangladesh.

Keren, R. 1996. Boron. In: Methods of Soil Analysis, Part 3 - Chemical Methods. Sparks, D.L., Page, A.L., Helmke, P.A., Loeppert, R.H., Soltanpour, P.N., Tabatabai, M.A., Johnston, C.T., Sumner, M.E. (Eds.). American Society of Agronomy Inc., Madison, Wisconsin, USA. pp. 603-626.

Lindsay, W.L., Norvell, W.A. 1978. Development of a DTPA Test for zinc, iron, manganese and copper. Soil Science Society of America Journal, 42(3): 421-428.

Page, A.L., Miller, R. H. and Keeny, D. R. 1982. Methods of Soil Analysis. Part-I and Part-II.

2ndEd. Ani. Soc. Agron. Inc. Madi., Wis., USA.

Pavanasasivam, V. and Axley, J.H. 1980. Influence of flooding on the availability of soil zinc. Commun. Soil Sci. Plant Anal., 11: 163-174.

Ponnamperuma, F.N. 1972. The chemistry of submerged soil. Adv. Agron., 24: 29-96.

Siddique, M.N.E.A., Halim, M.A., Kamaruzzaman, M., Karim, D. and Sultana, J. 2014. Comparative insights for the investigation of soil fertility degradation in a piedmont area that covers the Anjamkhor Union of Baliadangi Upazila, Thakurgoan, Bangladesh. IOSR Journal of Environmental Science, Toxicology and Food Technology, 8(4): 82-87.

SRDI (Soil Resources Development Institute), 2020. Soil fertility trends in Bangladesh 2010 to 2020, SRDI. Ministry of Agriculture, Dhaka, Bangladesh.

SRDI (Soil Resource Development Institute), 2010a. GIS map, Zinc Status of Bangladesh Soils. Farmgate, Dhaka, Bangladesh. SRDI (Soil Resource Development Institute), 2010b. GIS map, Boron Status of Bangladesh Soils. Farmgate, Dhaka, Bangladesh.

SRDI (Soil Resources Development Institute), 2010b. Saline Soils of Bangladesh, SRDI. Ministry of Agriculture, Dhaka, Bangladesh.

Thomas, G.W. 1982. Exchangeable cations. In A.L. Page *et al.* (eds.), Methods of Soil Analysis, Part 2, 2nd ed. Agron. Monogr. 9. ASA and SSSA, Madison, WI. pp. 159-165.

Zahid, A.M., Hossain, Kohinoor, N.A., Hossain, M.A. and Shoaib, J.U. 2020. Land Degradation in Bangladesh: Baseline Study of Land Degradation Processes 1985-2000. FAO-supported Research Report, SRDI, Dhaka.

Changes in Soil Fertility from 2007 to 2024 in Rupsa Upazila under Khulna District

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Abstract

A comparative study was conducted to assess variations in soil characteristics and fertility status in Rupsa Upazila, Khulna District. The changes in soil Fertility over time were examined, including the parameters like soil pH, salinity (EC), organic matter (OM), total N, available P, S, B, Zn, Cu, Fe, Mn, exchangeable K, Ca, and Mg. Over the time (2007 to 2024), notable changes were observed in soil properties. The pH has turned neutral to slightly alkaline from strongly acidic to slightly alkaline. Over the observed period, the organic matter OM content in the soil decreased in most of the soil series except the Gopalpur and Ishwardi soil groups. The total N content is the same as the OM content. Available P levels also qualified for an increase. In most soil series, the availability of zinc Zn, Fe, B and Ca showed slightly increases. Additionally, S content showed both cases very high. Exchangeable K, available S, Mg, Mn, Cu and EC exhibited a decrease. In summary, the findings of the study strongly suggest that soil fertility has declined in the study area. These changes in soil properties and nutrient status have implications for agriculture and land management practices in the region.

Keywords: Soil characteristics, Fertility status, Soil series.

Introduction

Bangladesh is known for its fertile deltaic plains and agricultural heritage. A significant portion of its population and economy is heavily dependent on the agriculture sector. The demand for food in Bangladesh is constantly increasing with the increasing population; thus, the practice of intensive agriculture using agrochemicals has been dominating the cropping systems for several decades. Unfortunately, in the pursuit of increased food production, sustainability, environmental concerns, and the issue of land degradation have often been overlooked. As a result, soil fertility has significantly declined, particularly in areas where land-use intensification is more pronounced and inefficient. Bangladesh's soils are subjected to experience high temperatures, abundant rainfall, and the pressure of cultivating two or more crops in a year, sometimes without balanced fertilization practices. This has led to the widespread depletion of nutrients from the soil. The intensification of agricultural land use, coupled with the adoption of modern crop varieties, has contributed to the deterioration of soil fertility and the emergence of new nutrient deficiencies. As a result, soil fertility is deteriorating progressively (Islam, 2008; SRDI, 2010a, b).

A comprehensive understanding of soil fertility provides valuable insights into the current nutrient status, distribution patterns, and trends (Dafonte *et al.,* 2010). This knowledge is crucial for decision-making processes aimed at enhancing crop productivity. To assess the extent of soil fertility degradation, it is essential to compare and analyze the initial and current soil fertility status. Therefore, this study examines changes in soil pH, EC, OM, TN, P, S, K, Ca, Mg, B, Zn, Cu, Fe, and Mn over a period spanning from 2007 to 2024.

Materials and Methods

The studied site, Rupsa Upazila, under the Khulna district of Bangladesh, covers an area of 120.25 km^2 in the western part of the country. Soil sampling was done under the national soil survey program of the Soil Resource Development Institute (SRDI), Bangladesh. Samples were collected based on soil series, land type, and land use. Composite samples were collected from the upper 0-15 cm of depth. Collected soil samples were prepared for laboratory analysis. Soil pH was measured as described by Jackson (1962). Organic matter (OM) was determined by the wet oxidation method (Page *et al.*, 1982). Available P was extracted by the Olsen methodology. The P in the extract was then determined by developing blue color absorbance with ammonium molybdate-ascorbic acid solution and measuring the color by

Spectrophotometer at 890 nm wavelength. The S content in the extract was determined turbidimetrically, and the turbidity was measured by a spectrophotometer at 535 nm wavelength (Alvarez *et al.,* 2001). Exchangeable K content was determined by extraction with 1M ammonium acetate, pH 7.0 solution followed by determination of extractable K by flame photometer (Thomas, 1982). Exchangeable Ca and Mg content were determined by extraction with 1M ammonium acetate, pH 7.0 solution followed by measurement by atomic absorption spectrophotometer (Thomas, 1982). Available Zn, Cu, Fe, and Mn were extracted by 0.05M DTPA solution (pH 7.3), maintaining a 1:2 soil-extractant ratio. The extracted level was measured by flame AAS (Lindsay and Norvell, 1978). Available B was extracted with a hot water-0.02 M CaCl2 solution (1:2). The extractable B was determined by spectrophotometry using the azomethine-H method (Keren, 1996).

Result and Discussion

Soil Reaction (pH): The previous (2007) soil pH range was 5.1-8.3 (Strongly acidic - Slightly alkaline), and the recent (2024) range was 6.7-8.2 (Neutral - Slightly alkaline) in different soil series at Rupsa Upazila (Table 4.20). The present pH shows an increasing trend compared to previous data. This was due to the use of calcium carbonate ($CaCO_3$) in fish cultivation. Over about two decades (2007 to 2024), efforts to intensify fish cultivation in this area have led to a notable increase in the use of $CaCO_3$. Unfortunately, this surge in the use of $CaCO_3$ may be the primary factor contributing to the increasing levels of soil pH in the study area.

Salinity (EC): The status of soil salinity (EC) was found to have decreased sharply in 2024 in comparison to 2007. In 2007, soil salinity ranged from 0.9 to 27.9 dS/m (Non-saline to Very strongly saline), while by 2024 it ranged from 0.8 to 8.5 dS/m (Non-saline to Moderately saline) across different soil series and land types (Table 4.20). In 2007, the EC status was very high due to severe storm surge from the super cyclone "Sidor". A decreasing trend in soil salinity over the years might be due to the application of non-saline irrigation water and to the absence of severe storm surges during this period.

Organic matter (OM) and total N (%): The changing trend of soil OM and total N was observed, with a more or less the same trend as soil salinity EC). In the Gopalpur and Ishwardi soil groups, recent soil OM increased slightly (Medium-very high to Low-High), but their status remained the same in MHL (Table 4.20). Organic matter (OM) status decreased markedly in the Harta (5.74 to 3.54), Satla (7.38 to 3.21), and Ghior (6.87 to 3.51) soil series in MLL in recent years. Imbalanced fertilization and intensification of crop production might be the causes of decline the amount of OM in that region.

Table-4.20. Soil group and land type wise data on soil pH, salinity (EC), organic matter (OM) and total N.

Soil Group	Land Type	Parameter							
		pH		EC (dS/m)		OM (%)		Total N (%)	
		2007	2024	2007	2024	2007	2024	2007	2024
Gopalpur	HL	5.6-8.0	7.3-8.1	1.3-7.8	1.1-4.3	2.11	2.35	0.112	0.126
Ishwardi	HL	6.8	8.0	4.8	1.1	3.19	3.09	0.147	0.158
Ishwardi	MHL	6.7-7.7	7.8-8.2	1.2-8.9	0.9-4.7	2.52	2.64	0.136	0.144
Ghior	MHL	6.3-6.9	7.4-7.9	2.4-9.3	1.5-5.2	4.00	2.87	0.172	0.162
Ghior	MLL	5.7-6.4	7.5-7.7	13-16.2	1.7-8.5	6.87	3.51	0.267	0.176
Ramgoti	HL	7.9	8.1	2.4	1.6	2.96	1.77	0.157	0.104
Bajoa	MHL	7.2-8.3	7.5-8.1	1.3-13.9	1.7-8.1	3.11	2.44	0.146	0.135
Barishal	MHL	6.3-8.0	7.2-8.2	0.9-27.9	0.8-7.7	3.26	2.93	0.168	0.154
Harta	MLL	5.1-7.0	7.2-7.5	7-19.3	1.2-2.5	5.74	3.54	0.239	0.175
Satla	MLL	5.4-6.7	6.7-7.5	11.3-26.2	2.5-8.0	7.38	3.21	0.335	0.162

***** HL = Highland, MHL = Medium highland.

Available Phosphorus (P): The change in available P content was increased (from Low-Optimum to Medium-Very high) during the time span of 2007 to 2024. In 2007, it was found to be 5.02-12.63 ppm, whereas by 2024 it was observed to be 8.66-28 ppm across different soil groups and land types (Table 4.21). An increase in soil available P might be the adoption of practices such as excessive application of P fertilizer and liming in fish cultivation.

Table 4.21 Soil group and land type-wise data on soil available phosphorus (P), sulfur (S), and boron (B).

Soil Group	Land Type	Parameter					
		P (ppm)		S (ppm)		B (ppm)	
		Previous	Recent	Previous	Recent	Previous	Recent
Gopalpur	HL	11.21	17.27	51.6	35.0	0.94	1.17
Ishwardi	HL	10.79	19.15	63.2	34.0	1.24	1.67
Ishwardi	MHL	11.22	28.07	33.3	48.0	1.09	1.52
Ghior	MHL	6.33	20.69	223.0	98.0	1.22	1.60
Ghior	MLL	5.02	21.15	548.3	58.8	3.43	1.21
Ramgoti	HL	5.76	8.66	42.0	172.2	1.21	1.32
Bajoa	MHL	9.54	13.83	113.0	89.4	1.02	1.06
Barishal	MHL	9.95	11.56	327.7	79.4	1.00	1.50
Harta	MLL	12.63	15.12	463.3	187.9	2.21	1.81
Satla	MLL	9.16	10.36	613.8	266.2	5.23	1.40

* HL = Highland, MHL = Medium highland.

Available Sulfur (S) and Boron (B): Available S status was found between 33.3-548.3 ppm (Optimum to Very high) in 2007, while it was observed between 34.0-266.2 ppm (Optimum to Very high). by the year 2024 in different soil groups with land types (Table 4.21). The content of available S was found to decrease sharply in 2024 compared with 2007 (548.3 to 266.2 ppm). In the Ramgoti and Ishwardi soil group of MHL, soil S increased acutely in recent samples compared to previous samples (42.00-172.2 ppm vs. 33.3048.00 ppm, respectively). Available B was found between 0.94-5.23 ppm (Very high) in 2007, while it was observed between 1.17-1.81 ppm (Very high) by the year 2024 in different soil groups with land types. The status of B did not follow any specific pattern in a specific soil group and land type.

Exchangeable Potassium (K), Calcium (Ca), and Magnesium (Mg): In the year 2007, exchangeable K was found between 0.26-0.89 cmole$^+$/kg (Optimum to Very high), while it was observed between 0.22-0.53 cmole$^+$/kg (Medium to Very high) by the year 2024 in different soil groups with land types (Table 4.22). Out of 8 soil series, the K level decreased in recent compared to the previous K level, except for the Ishwardi and Bajoa soil series (0.24-0.33 and 0.35-0.41 cmole+/kg, respectively). The status of exchangeable Ca was increased in 2024 in comparison to 2007 (from 17.61-34.95 to 26.06-39.21 cmole$^+$/kg), except for the Ramgoti soil group (32.75 to 30.93 cmole$^+$/kg). The increased exchangeable Ca status might be due to excessive lime application in fish cultivation. The exchangeable Mg status has decreased slightly in recent years in most soil groups compared to previous (5.56-10.00 to 3.82-8.44 cmole$^+$/kg). Among the soil groups, Mg status in Ishwardi soil series of HL and Bajoa soil series of HL showed slightly increased in 2024 compared to 2007 (8.25-8.44 and 5.81-5.98 cmole$^+$/kg, respectively). The status of exchangeable K and Mg did not follow any specific pattern for a specific soil group with a land type.

Table 4.22 Soil group- and land-type-wise data on soil exchangeable K, Ca, and Mg.

Soil Group	Land Type	Parameter					
		K (meq/100g soil)		Ca (meq/100g soil)		Mg (meq/100g soil)	
		2007	2024	2007	2024	2007	2024
Gopalpur	HL	0.26	0.24	19.25	26.06	5.56	4.99
Ishwardi	HL	0.39	0.41	18.50	39.21	8.25	8.44
Ishwardi	MHL	0.24	0.33	17.61	25.90	6.81	5.76
Ghior	MHL	0.56	0.46	28.25	28.33	8.62	5.66
Ghior	MLL	0.89	0.48	31.25	31.67	10.00	6.54
Ramgoti	HL	0.27	0.22	32.75	30.93	5.75	3.82
Bajoa	MHL	0.35	0.41	25.69	30.62	5.81	5.98
Barishal	MHL	0.57	0.39	23.96	26.69	7.27	6.00
Harta	MLL	0.65	0.35	29.45	34.42	9.20	5.85
Satla	MLL	0.85	0.53	34.95	47.80	10.45	7.11

***** HL = Highland, MHL = Medium highland.

Available Zn, Cu, Fe, and Mn: Over the time from 2007 to 2024, soil available Zn reserve had increased all over the soil groups, except the Ghior soil of MLL (Table 4.22). In 2007, available Zn was found between 0.13-1.86 ppm (Very low- Optimum), whereas it was observed between 0.25-2.51 ppm (Very low- Very high) in 2024 in different soil groups with land types. Contrastingly, the available soil Cu reserve decreased from 2007 to 2024 (Table 4.22). Mean available Cu was found between 3.16-8.85 ppm in 2007, whereas it was observed between 1.79-6.22 ppm by the year 2024 in different soil groups with land types. The change in available Fe and Mn content did not show any specific pattern in the specific soil group and land type (Table 4.22). In some soil groups, available Fe and Mn had increased in recent years compared to previous years, whereas the status of Fe and Mn in some soil series was found to have decreased sharply in 2024.

Table 4.23 Change in soil analytical data of Zn, Cu, Fe, and Mn.

Soil Group	Land Type	Parameter							
		Zn (ppm)		Cu (ppm)		Fe (ppm)		Mn (ppm)	
		Previous	Recent	Previous	Recent	Previous	Recent	Previous	Recent
Gopalpur	HL	0.22	0.69	3.96	3.1	50.6	31.8	7.8	10.2
Ishwardi	HL	0.13	0.25	8.85	2.68	49.1	30.3	7.6	5.2
Ishwardi	MHL	0.23	1.15	3.69	2.99	34.6	36.0	8.2	10.9
Ghior	MHL	0.44	1.27	7.08	4.88	53.2	56.9	23.4	16.5
Ghior	MLL	1.86	1.83	5.25	6.22	42.2	82.2	20.8	29.0
Ramgoti	HL	0.25	2.51	4.77	1.79	17.2	20.0	17.5	6.5
Bajoa	MHL	0.15	0.84	4.81	4.17	23.8	22.9	9.1	11.3
Barishal	MHL	0.69	1.12	5.31	4.84	38.5	42.8	15.9	16.8
Harta	MLL	0.72	2.24	6.61	6.01	71.3	115.1	25.2	15.8
Satla	MLL	1.23	2.41	3.16	5.22	184.0	101.6	21.4	31.4

* HL = Highland, MHL = Medium highland.

Conclusion

The findings of this study highlighted significant modifications in soil characteristics and agricultural practices in the investigated soil. The study noted an increase in soil pH levels over the years. A negative trend in SOC and total N suggested a decrease in OM. Soil available P and Zn content showed an increasing trend, which is beneficial for soil health. The study identified depletion of K and S in the selected soils between 2007 and 2024. This indicates the need to reverse or restore the soil's natural fertility status from its current critical nutrient status to increase crop productivity through efficient farming. Soil test-based balanced fertilization using quality organic, inorganic, and bio-fertilizers, crop diversification, inclusion of green manuring crops, and incorporation of crop residue might be effective tools for soil fertility restoration.

References

Alvarez, V. H., Dias, L. E., Ribeiro, Jr., E. S., Souza, R. B. and Fonseca, C. A. 2001. Métodos de análises de enxofre em solos e plantas. Viçosa: Editora UFV. p. 131.

Dafonte, J. D., Ulloa, G. M., Jorge, P., Glécio, S., Vázquez, M. and Vidal, E. 2010. Mapping of soil micronutrients in a European Atlantic agricultural landscape using ordinary kriging and indicator approach. Bragantia, 69:175-186.

Islam, M. S. 2008. Soil fertility history, present status and future scenario in Bangladesh.Bangladesh Journal of Agriculture and Environment, 4: 129-151.

Jackson, M. L. 1962. Soil Chemical Analysis. Prentice Hall Inc., Engle wood, Clift, N. J .p. 143.

Keren, R. 1996. Boron. In: Methods of Soil Analysis, Part 3 - Chemical Methods. Sparks, D.L., Page, A.

L., Helmke, P. A., Loeppert, R. H., Soltanpour, P. N., Tabatabai, M. A., Johnston,C. T., Sumner, M.

E. (Eds.). American Society of Agronomy Inc., Madison, Wisconsin, USA. pp. 603-626.

Lindsay, W. L., Norvell, W. A. 1978. Development of a DTPA Test for zinc, iron, manganese and copper. Soil Science Society America Journal, 42(3): 421-428.

Page, A. L., Miller, R. H. and Keeny, D. R. 1982. Methods of Soil Analysis. Part-I and Part-II. 2nd Ed. Ani. Soc. Agron. Inc. Madi., Wis., USA.

SRDI (Soil Resource Development Institute). 2010a. GIS map, Zinc Status of Bangladesh Soils. Farmgate, Dhaka, Bangladesh. SRDI (Soil Resource Development Institute), 2010b. GIS map, Boron Status of Bangladesh Soils. Farmgate, Dhaka, Bangladesh.

SRDI (Soil Resources Development Institute). 2010b. Saline Soils of Bangladesh, SRDI. Ministry of Agriculture, Dhaka, Bangladesh.

Thomas, G. W. 1982. Exchangeable cations. In A. L. Page *et al.* (eds.), Methods of Soil Analysis, Part 2, 2nd ed. Agron. Monogr. 9. ASA and SSSA, Madison, WI. pp. 159-165.

Assessment of Soil Fertility Trends in Adarsha Sadar Upazila, Cumilla: A Comparative Study between 2015 and 2024

Abstract

Soil fertility is a key aspect of the productivity of land. Continuous agricultural practices by farmers can alter the fertility of the land. Monitoring soil fertility indicating parameters over time intervals can help us follow the fertility condition of a land and take necessary steps to keep soil health reasonable. In 2015 and 2024, the Soil Resource Development Institute conducted two semi-detailed soil surveys in Adarsha Sadar Upazila of Cumilla district to publish the Upazila Land and Soil Utilization Guide (updated) of this upazila. In this study, we have compared some soil chemical properties of these two semi-detailed soil surveys. Those parameters are soil pH, Organic matter content, exchangeable Potassium, available Phosphorus, available Sulfur, available Zinc and available Boron. The result shows an increase in extremely acidic lands to a greater extent and a slight increase in soil organic matter content. Use of liming materials can raise the pH of the soil. Quantitative analysis of plant nutrients shows an increase in Potassium, Phosphorus and Boron but a decrease in Sulfur and Zinc. It may be due to biased fertilizer applications. Farmers should be aware of soil test-based balanced fertilization to maintain good soil conditions.

Key words: soil fertility, soil pH, organic matter, plant nutrients, deficiency.

Introduction

Soil fertility is the integrated result of the supply of plant nutrients in a soil. If favorable climatic conditions are available, the productivity of a land depends on its soil's fertility. Intensive crop production for a long period can cause soil fertility deterioration. On the other hand, farmers use chemical and organic fertilizers to maximize crop production. It can also affect the fertility of the soil. So, it is important to monitor soil fertility status over time to keep track of nutrient availability trends.

Adarsha Sadar is an Upazila of the Cumilla district of Bangladesh. The main city of Cumilla is within this Upazila. The Gomoti River flows almost in the middle of this Upazila. The physiography of this area is diversified with hills, piedmont plains and floodplains. Agriculture in this area is dominated by rice cultivation.

Soil Resource Development Institute (SRDI) is a unique government organization in Bangladesh that works with the soils of this country. Upazila Land and Soil Utilization Guide, a soil inventory of a specific Upazila, is continuously published and updated by this organization. Last updated Upazila Land and Soil Utilization Guide of Adarsha Sadar Upazila was published in 2015. The data on soil chemical properties of this edition of Upazila Land and Soil Utilization Guide is the base material of this study.

In 2024, a new semi-detailed soil survey was conducted using the previous map of 2015 to publish a new edition of the updated Upazila Land and Soil Utilization Guide of Adarsha Sadar Upazila. During this survey, a series of soil fertility-indicating parameters was determined. Here, we consider only a few parameters showing a remarkable change in this period. Those parameters are- soil pH, Organic matter content, exchangeable Potassium, available Phosphorus, available Sulfur, available Zinc and available Boron.

Soil pH is the indicator of the acidity or alkalinity of a soil solution. It affects all reactions that occur in the soil solution. Availability of all plant nutrients depends on it. So, the soil pH trend indicates a soil solution's capacity to make essential plant nutrients available [1].
Organic matter is a key indicator of soil fertility because it increases the exchange capacity of the soil solution. It is a storehouse of essential plant nutrients and can regulate the supply of available nutrients through mineralization and immobilization [2].
The quantity of available nutrients in soil reflects the ability of soil to comply with the requirements of a plant's different life cycle stages. If soil is deficient in one or more essential nutrients, the plant growing on that soil will show deficiency symptoms. Thus, the productivity of that soil will not be up to the mark.
The objective of this study is to monitor trends of different nutrients over time, whether positive or negative, to calculate the changes numerically, to understand the nature of the changes, to predict the reasons behind those changes, and to suggest soil management.

Materials and Methods

Study site description

The study area is Adarsha Sadar (Geographic location: 23°24' to 23°32' North latitude and 91°03' to 91°16' East longitude), an Upazila of Cumilla district. This Upazila is within three Agro-Ecological Zones. They are AEZ-19, Old Meghna Estuarine Floodplain (16.7% area), AEZ-22, Northern and Eastern Piedmont Plain (51.9% area) and AEZ-29, Northern and Eastern Hills (2.3% area).
The area of this Upazila covers 125 square kilometers. In this area, the total cultivable land is 89 square kilometers. Seven types of cropping pattern identified in this area. Rice is the dominant crop. In addition to rice, vegetables are also cultivated in this area. Horticulture crops are found in the hilly areas.
Most of this area's land is medium-high and almost flat. A few low hills are found in AEZ-29, which covers only 2.3 percent of the total area. This area's soil texture is dominated by loam, clay loam, and clay [3].

Climate and Hydrology

The area has a tropical climate. Among six seasons, three seasons are strongly observed in this area. The climate is hot and humid in the rainy season (May to October). About 88% of annual rainfall occurs in this season. The climate is cool and dry in the winter (November to February). The air becomes hot in the summer (March to April).
Average annual rainfall in this area is about 2131mm. Mean annual temperature is about 25.5 °C. The lowest temperature observed in December to January is 20°C on average, and the highest is from April to May, which is 41.7°C on average [3].
The Gomoti River flows almost in the middle of this Upazila. Dams on both sides of this river protect this area from seasonal flooding. The drainage capacity of the soils of this area is poor. So, the rainwater remains for a longer period in this area. Although cultivation of this area depends on rain, irrigation is needed in the dry season.

Time frame

In 2015, the Soil Resource Development Institute conducted a semi-detailed soil survey at Adarsha Sadar Upazila of Cumilla district. Seventy-five soil samples were collected and analyzed during that survey to determine chemical properties. These data served as a baseline for the present study to quantify the change in soil chemical properties over time.

Subsequently, a new semi-detailed soil survey was conducted using the previous map in the year 2024. This time, 78 soil samples were collected from the same or adjacent sampling points of 2015 and analyzed to determine chemical properties. In this study, we have compared soil chemical properties of these two semi-detailed soil surveys for the time frame from 2015 to 2024.

Soil sample analysis

The samples were air-dried and sieved through a 2 mm sieve. Identifiable crop residues, root material, and stones were removed during sieving—the sieved soil was stored in separate plastic containers [4].

A series of soil fertility-indicating parameters was determined from those soil samples. However, only a few parameters, which have shown remarkable change in this period, were considered for this comparative study. An important parameter, total nitrogen, has remained very low, similar to the data from the 2015 edition, due to the volatile properties of the nitrogenous compounds found in soil. So, we ignored such parameters. Here we consider soil pH, Organic matter content, exchangeable Potassium, available Phosphorus, available Sulfur, available Zinc and available Boron.

Soil sample pH values were measured in a 1:2.5 mixture of air-dried soil in distilled water using a glass electrode pH meter [5]. Other parameters were determined through the following methods-

Table 4.24: List of methods used for the analysis of plant nutrients in soil

Analysis	**Method**
Soil organic matter content determination	Walkley-Black method [6]
Available Potassium determination	Ammonium acetate extraction method [7]
Available Phosphorus determination	Brey and Kutz method [8]
Available sulfur determination	Turbidimetric method [9]
Available Zinc determination	DTPA extraction method [10]
Available Boron determination	Calcium chloride extraction method [11]

Data analysis:

The data from soil sample analysis of both semi-detail soil surveys were analyzed based on average value, areas of the Upazila covered by various plant nutrient status categories, and areas of the Upazila covered by nutrient deficiency. Areas of the different plant nutrient categories were expressed as a percentage.

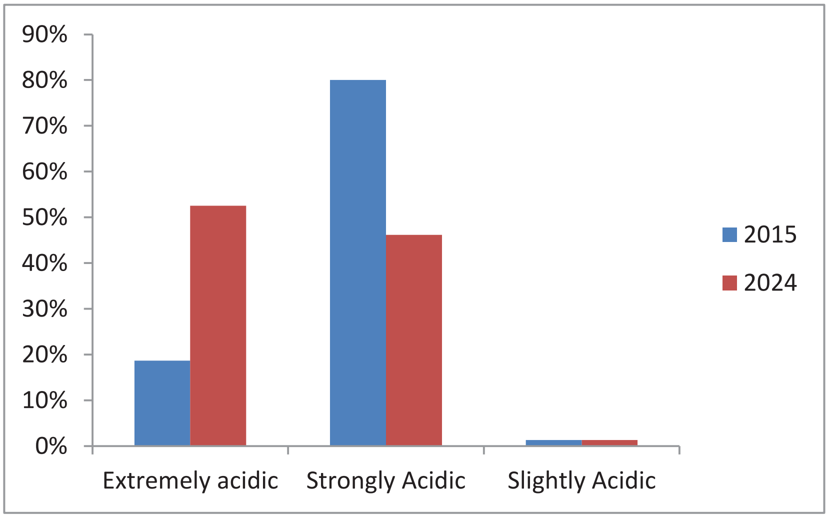
Results and Discussion

Data from soil sample analysis of the semi-details soil survey for 2024 shows a remarkable change from 2015. The average values of different soil chemical properties of both years, with their difference, are as follows-

Table 4.25: Comparative analysis of soil chemical properties

Year	pH	OM	K	P	S	B	Zn
		%	meq/100g soil	micro g/ g soil			
2015	4.84	1.70	0.12	10.33	23.09	0.41	1.09
2024	4.59	1.94	0.22	18.49	17.44	0.51	1.00
Difference	-0.26	0.24	0.10	8.15	-5.65	0.09	-0.09
Change in Percentage	-5%	14%	87%	79%	-24%	23%	-8%

The average pH value of the soils of this Upazila was below 5 in 2015. Moreover, in 2024, it decreased to 4.59 from 4.84. A more detailed analysis of the soil pH value of this Upazila, separating the values category-wise, is shown in Figure 4.2.

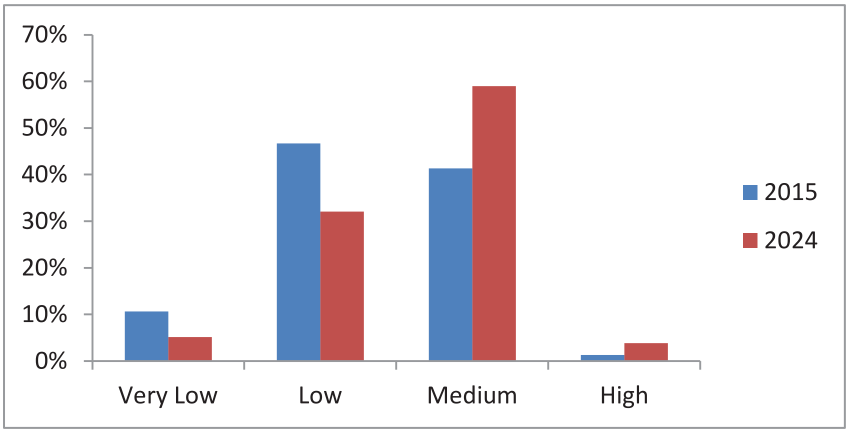


Category	pH
Extremely acidic	Below or equal to 4.5
Strongly acidic	4.6 to 5.5
Slightly acidic	5.6 to 5.5

Fig 4.2: Category-wise pH comparison between 2015 and 2024

The figure shows that the soil, which was previously strongly acidic, has been converting to extremely acidic since 2015. Already, 34 percent of those have converted to extremely acidic. In 2024, 53 percent of the land in this Upazila is extremely acidic. This Upazila is at the centre of Cumilla city, where urbanization and industrialization are flourishing. It may play a vital role in this acidification of the soil. Farmers' excessive use of urea and TSP fertilizers can also contribute to this acidification.

However, in 2024, the organic matter content of this area had increased to 1.94 from 1.70 in 2015. A more detailed analysis of the soil organic matter content of this Upazila, separating the values category-wise, is shown in Figure 4.3.



Category	pH
Very Low	Below 1
Low	1 to 1.7
Medium	1.8 to 3.4
High	3.5 to 5.0

Fig 4.3: Category-wise organic matter content comparison between 2015 and 2024

The figure shows that the lands with low organic matter content are converting to the medium category. The data reflect that 21 percent of the land area of this Upazila has increased organic matter content. It may be due to farmers' higher cropping intensity in this area.
The quantity of available nutrients has shown a remarkable difference in this period. Specifically, the availability of Potassium and phosphorus has increased in huge numbers. However, the quantity of available Sulfur has decreased. Among the micronutrients, the amount of available Boron has increased, while the amount of available Zinc has decreased slightly.
This scenario can be observed through category-wise difference to find how much area has converted from a low nutrient zone to a high nutrient zone and vice versa. The status of various nutrients can be categorized as shown in Table 4.26.

Table 4.26: Separating different nutrient values in categories

Category	K	P	S	B	Zn
	meq / 100g soil	**micro g/ g soil**			
Very Low	up to 0.09	up to 5.25	up to 7.5	up to 0.15	up to 0.45
Low	0.091 to 0.18	5.251 to 10.50	7.51 to 15.0	0.151 to 0.30	0.451 to 0.90
Medium	0.181 to 0.27	10.51 to 15.75	15.1 to 22.5	0.31 to 0.45	0.91 to 1.35
Optimum	0.271 to 0.36	15.76 to 21.0	22.51 to 30.0	0.451 to 0.60	1.351 to 1.80
High	0.361 to 0.45	21.1 to 26.25	30.1 to 37.5	0.61 to 0.75	1.81 to 2.25
Very High	> 0.45	> 26.25	> 37.5	> 0.75	> 2.25

The land area of this Upazila is divided based on the area covered by soil of a specific category of nutrient and expressed in percentage.

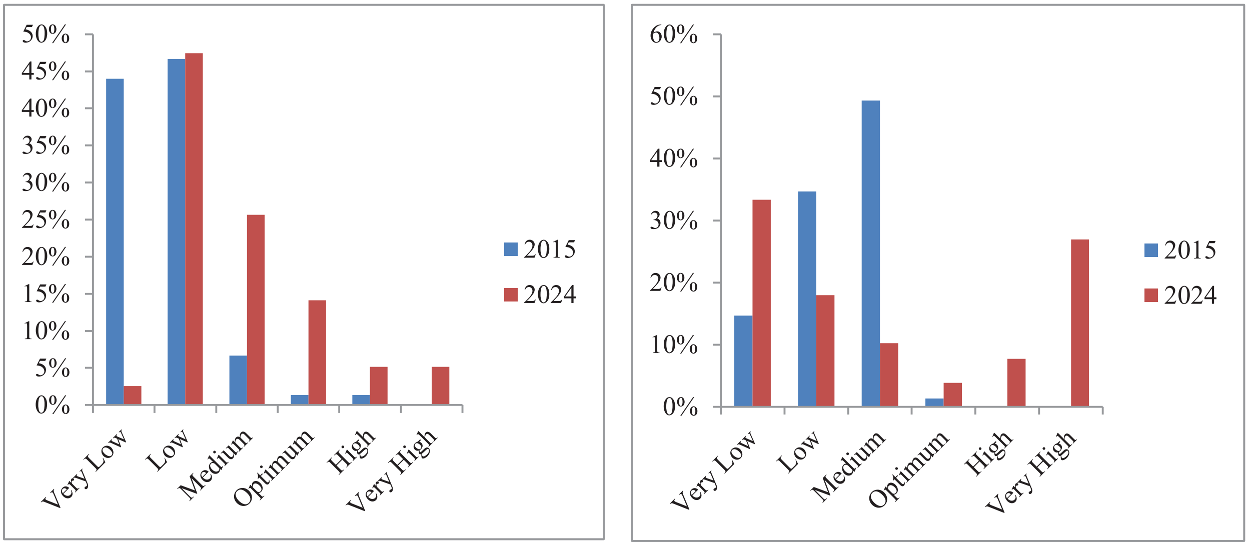


Fig 4.4: Category-wise Potassium and Phosphorus comparison between 2015 and 2024

Figure 4.4 shows that the land area with low available Potassium has drastically decreased from 44 percent to 3 percent, converted to medium and some portions of high and very high. Moreover, the land area with low and medium available phosphorus has decreased, while that with very low and very high available phosphorus has increased. The increase in Potassium and phosphorus may be due to regular fertilizer application.

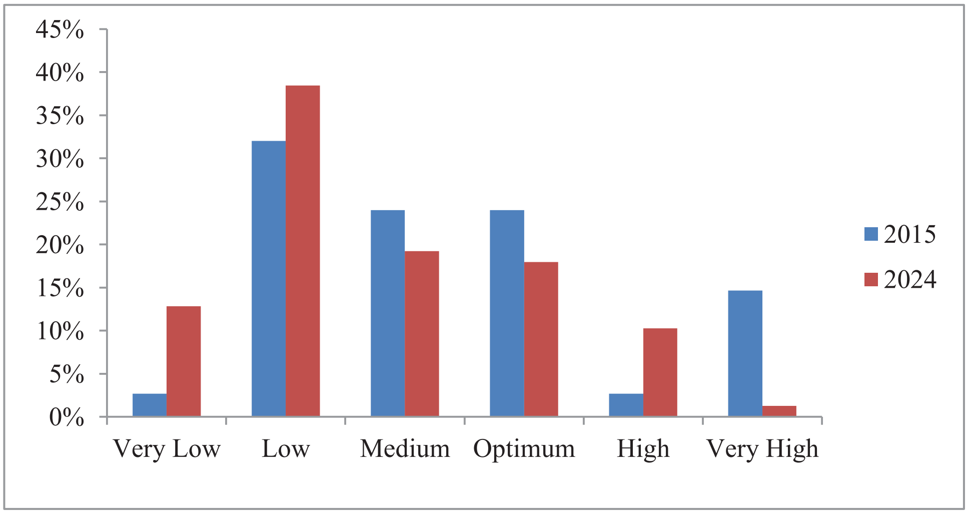


Fig 4.5: Category-wise Sulfur comparison between 2015 and 2024

Figure 4.5 shows that the land area with medium and optimum available Sulfur is converting into low and very low. Moreover, the area of land with very high available Sulfur is converting into high. Overall decrease in available Sulfur is evident.

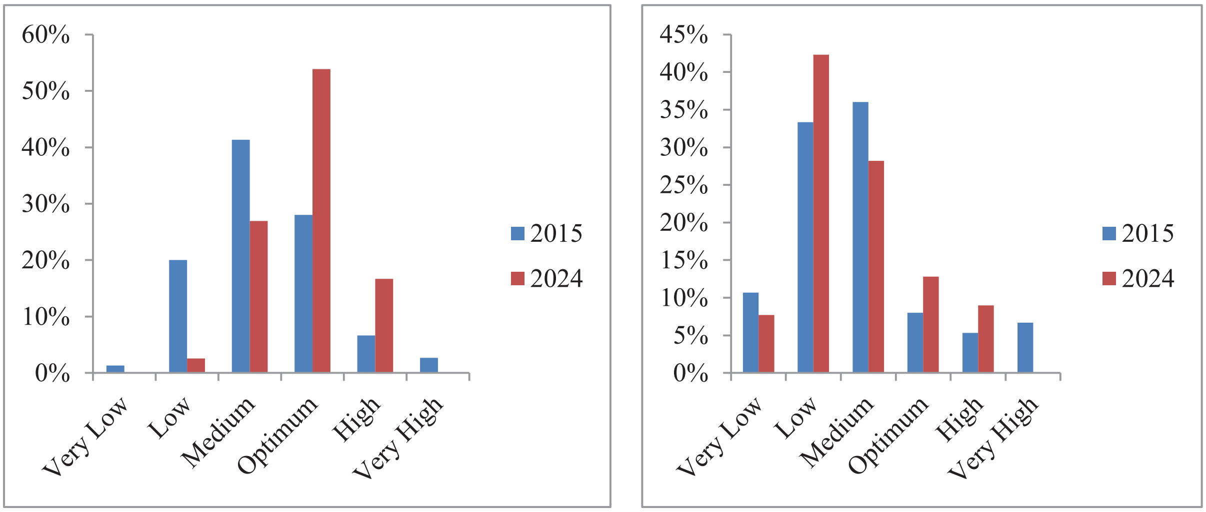


Fig 4.6: Category-wise Boron and Zinc comparison between 2015 and 2024

Figure 4.6 shows no land area with very low and very high available Boron in 2024. Even areas with low and medium are converting to optimum and high. There is no area of land with very high available Zinc as of 2015; all areas are converted to optimum and high. The land area with very low and medium available Zinc has decreased, and the area with low available Zinc has increased. So, the trend of Boron is positive for plant growth, but it is slightly decreasing for Zinc.

Most of the lands of Adarsha Sadar Upazila were deficient in nutrients in 2015, but the regular fertilizer application by the farmers of the area has changed the scenario- the comparisons of the area of land cover by nutrient deficiency are shown in Figure 4.7.

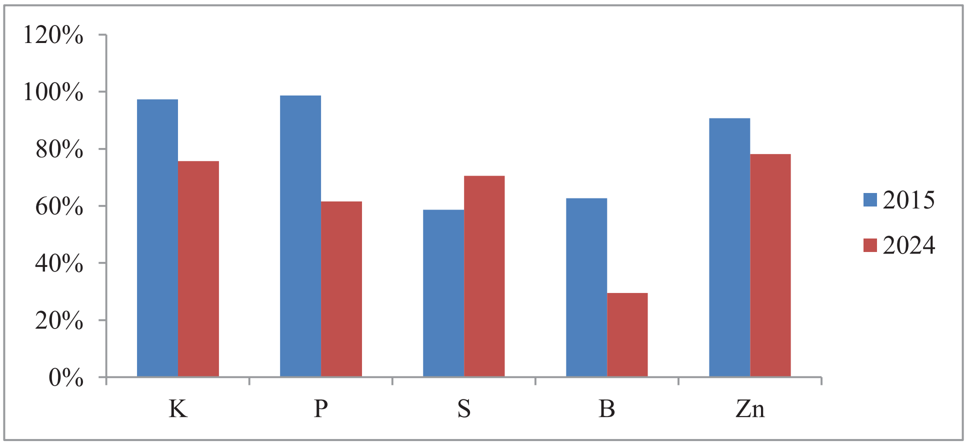


Fig 4.7: Nutrient deficiency comparison between 2015 and 2024

Almost all the lands of this Upazila were deficient in Potassium (97% of total area), Phosphorus (99% of total area), and Zinc (91% of total area) in 2015. In 2024, deficiency decreases to 76 percent of the total area for available Potassium, 62 percent of the total area for Phosphorus, and 78 percent of the total area for Zinc. Boron's deficiency has decreased to 29 percent from 63 percent of the total area. However, the deficiency of Sulfur has increased to 71 percent from 63 percent of the total area.

Conclusion

This comparative study of Adarsha Sadar Upazila of Cumilla district shows a complex scenario. In 2015, most of the chemical properties were below the range. Soil pH and organic matter content were low, and the soil of most of the land was deficient in nutrients. In 2024, soil pH became more acidic than in 2015, but the organic matter content of the soil has increased slightly. The condition of soil pH is a matter of great concern for the soil of this Upazila. The application of liming material can increase soil pH. Research on the lime requirement of this Upazila's soil can help determine the quantity of liming material to be applied to the soil. An increase in organic matter content is a positive sign, but using organic fertilizers must continue to improve soil quality. The regular application of chemical fertilizers shows positive trends for most nutrients. However, special concern has to be given to the application of sulfur and zinc fertilizers, as those nutrient trends are going in a negative direction. The concept of soil test-based balanced fertilization needs to be developed among farmers to combat environmental hazards and soil acidification due to the excess use of chemical fertilizers. Balanced fertilizer application of all required nutrients and liming materials can make the soil productive and sustainable.

Acknowledgement

The author would like to acknowledge the officials and staff of the Soil Resource Development Institute (SRDI) who contributed to these semi-detailed soil surveys, collected soil samples, analyzed soil chemical properties in the laboratory, and published the Upazila Land and Soil Utilization Guide for Adarsha Sadar Upazila, Cumilla district.

References

1. Thomas, Grant W. (1996). "Soil pH and soil acidity". In Sparks, Donald L.; Page, A. L.; Helmke, Philip August; Loeppert, Richard H.; Soltanpour, Parviz N.; Tabatabai, M. Ali; Johnston, Cliff T.; Sumner, Malcolm E. (eds.). Methods of soil analysis. SSSA Book Series. Madison, Wisconsin: Soil Science Society of America; 475-90.
2. Hashimi, R., Matsuura, E., & Komatsuzaki, M. (2020). Effects of Cultivating Rice and Wheat with and without Organic Fertilizer Application on Greenhouse Gas Emissions and Soil Quality in Khost, Afghanistan. Sustainability; 12(16), 6508.
3. Upazila land and soil utilization guide (updated), Adarsha Sadar Upazila (2015), Soil Resource Development Institute, Ministry of Agriculture, Bangladesh.

4. Gelderman, R.H., and A.P. Mollarino. 1998. Soil sample preparation. In J.R. Brown (ed.), Recommended Chemical Soil Test Procedures for the North Central Region (Revised). Missouri Agr. Exp. Sta. SB1001. Columbia, MO; 5-6.
5. McLean EO. Soil pH and lime requirement. In Methods of soil analysis, part 2, chemical and microbiological properties (E.d.) AL page, RH Miller, Keeny DR. Am. Soc. of Agron. 1982; 199-224
6. Nelson DW, Sommers LE. Total carbon, organic carbon, and organic matter. In: Methods of soil analysis, part 2. Chemical and Microbiological Properties (E.d.); A.L. Page, Miller RH, Keeny DR. Am. Soc. Of Agron. 1982; 537-579.
7. D. Warncke and J. R. Brown. 1998. Potassium and Other Basic Cations. In J.R. Brown (ed.), Recommended Chemical Soil Test Procedures for the North Central Region (Revised). Missouri Agr. Exp. Sta. SB1001. Columbia, MO; 31-33.
8. Bray R. H., and L. T. Kurtz. 1945. Determination of total, organic, and available forms of phosphorus in soil. Soil Soc. 59:39-45.
9. S. M. Combs, J. L. Denning and K. D. Frank. 1998. Sulfate-Sulfur. In J.R. Brown (ed.), Recommended Chemical Soil Test Procedures for the North Central Region (Revised). Missouri Agr. Exp. Sta. SB1001. Columbia, MO; 35-40.
10. D. A. Whitney. 1998. Micronutrients: Zinc, Iron, Manganese, and Copper. In J.R. Brown (ed.), Recommended Chemical Soil Test Procedures for the North Central Region (Revised). Missouri Agr. Exp. Sta. SB1001. Columbia, MO; 41-44.
11. M. E. Watson. 1998. Boron. In J.R. Brown (ed.), Recommended Chemical Soil Test Procedures for the North Central Region (Revised). Missouri Agr. Exp. Sta. SB1001. Columbia, MO; 45-48.

4.2 Achievement of Central Laboratory

Central Laboratory

The Central Laboratory is under the Soil Resource Development Institute's headquarters. The Laboratory usually conducted chemical and physical analyses of soil samples received from various stakeholders, including Government organizations, NARS institutions, Autonomous organizations, Public and Private Universities, research fellows, Private entrepreneurs, farmers, and NGOs. After revisiting the organogram, the Central Laboratory conducted research activities in collaboration with national and international organizations, including FAO and IFDC. In addition to that, it has played a vital role in maintaining the quality of inorganic and organic fertilizers, especially in the laboratory, which performed the quality of fertilizers for registration of new fertilizer companies, as well as new fertilizers which was provided by the Department of Agricultural Extension (DAE) and the Bangladesh Agricultural Research Council (BARC). The Central Laboratory has performed the activities of the Accreditation process, and it has fulfilled almost all of the nonconformity issues. It has participated in Proficiency Test (PT) with European PT providers. Hopefully, the PT round will be completed successfully, and all nonconformities that need to be resolved to obtain accreditation will be resolved.

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.

Functions of the Central Laboratory

- Research activities on different soil and environmental-related issues.
- To maintain the quality of analytical work of other Laboratories of SRDI.
- To maintain the quality of imported fertilizers, new fertilizer registration, and renewal of fertilizer registration.
- To analyze water and plant samples received from different organizations.
- To analyze fertilizer samples to assist the agricultural system in controlling adulteration of fertilizers.
- To Characterization of microbes according to AEZ and Soil series-based profile study.
- To Isolation of Beneficial microbes with population count.
- Genome sequencing of beneficial microbes.

Program of Central Laboratory:

- Quality control of the chemical analysis of different Laboratories for updating Upazila Nirdeshika
- Research Program
- Publications
- Training
- Quality control of fertilizers

Annual progress report of Soil Chemistry Section, 2024-2025

Table- 4.27: Analyzed soil samples in a static laboratory

Sources of the soil sample	No. of sample	No. of parameter
Farmers:		
Direct		
DAE	100	900
SRDI		
SRDI:		
Upazila land and soil resource utilization guide		
Others	191	1852
Research institute:		
BARI		
BRRI		
University (Teacher/Student):	239	1437
GOs:	57	768
NGOs:	150	1018
Private Entrepreneurs:	175	291
Quality control:	12	12
Total	**924**	**6278**

Table 4.28: Soil pH status of analyzed farmer's samples

Total sample	Very strongly acidic	Strongly acidic	Slightly acid	Neutral	Slightly alkaline	Strongly alkaline	Very strongly alkaline
	<4.5	4.6-5.5	5.6-6.5	6.6-7.3	7.4-8.4	8.5-9.0	>9.0
24	4	10	6	2	2	0	0
%	16.67	41.67	25	8.33	8.33	0	0

Table 4.29: Soil OM status of analyzed farmer's samples

Total sample	**VL**	**L**	**M**	**H**	**VH**
	≤ 1.0	**1.0-1.7**	**1.8-3.4**	**3.5-5.5**	**>5.5**
22	2	18	2	0	0
%	9.09	81.82	9.09	0	0

Table 4.30: Total N status of analyzed farmer's samples

Total sample	VL	L	M	Deficient	O	H	VH
	≤ 0.09	0.091-0.18	0.181-0.27	≤ 0.27	0.271-0.36	0.361-0.45	>0.45
24	16	7	1	0	0	0	0
%	66.67	29.17	4.17	0	0	0	0

Table 4.31: Available P (ppm) status of analyzed farmer's samples

Total sample	VL	L	M	Deficient	O	H	VH
	Bray & Kurtz Method						
	≤ 5.25	5.251-10.5	10.51-15.75	≤ 15.75	15.76-21.0	21.1-26.25	>26.25
20	7	3	0	0	0	0	10
%	35	15	0	0	0	0	50
	Olsen Method						
	≤ 7.5	7.51-15.0	15.1-22.5	≤ 22.5	22.51-30.0	30.1-37.5	>37.5
4	0	1	0	0	3	0	0
%	0	25	0	0	75	0	0

Table 4.32: Exchangeable K status of analyzed farmer's samples

Total sample	VL	L	M	Deficient	O	H	VH
	≤ 0.09	0.091-0.18	0.181-0.27	≤ 0.27	0.271-0.36	0.361-0.45	>0.45
24	1	12	5	18	1	4	1
%	4.2	50	20.8	75	4.2	16.7	4.2

Table 4.33: Available S status of analyzed farmer's samples

Total sample	VL	L	M	Deficient	O	H	VH
	≤ 7.5	7.51-15.0	15.1-22.5	≤ 22.5	22.51-30.0	30.1-37.5	>37.5
22	10	7	4	21	1	0	0
%	45	31.81	18.18	95.45	4.55	0	0

Table 4.34: Available Zn status of analyzed farmer's samples

Total sample	VL	L	M	Deficient	O	H	VH
	≤ 0.45	0.451-0.9	0.91-1.35	≤ 1.35	1.351-1.80	1.81-2.25	>2.25
24	1	2	4	7	3	4	10
%	4.17	8.33	16.67	29.17	12.5	16.67	41.67

Table 4.35: Available B status of analyzed farmer's samples

Total sample	VL	L	M	Deficient	O	H	VH
	≤ 0.15	0.151-0.3	0.31-0.45	≤0.45	0.451-0.6	0.61-0.75	>0.75
24	8	10	4	22	1		1
%	33.33	41.67	16.67	21.67	4.17		4.17

Table 4.36: Analyzed plant samples

Source of sample	No. of sample	No. of ingredient
Students	33	237
Researchers	159	819
Private organizations	21	81
Total	**213**	**1137**

Table 4.37: Analyzed water samples

Source of sample	No. of sample	No. of ingredient
Researchers	11	44
Total	**11**	**44**

Table 4.38: Source and quantity of analyzed fertilizer samples

Name of fertilizers	Source	Quantity		
		Total	Standard	Sub-standard
Urea	DAE (Registration)			
	DAE (UAO)			
	Port			
	Private			
TSP	DAE (Registration)	6	2	1
	DAE (UAO)			
Total		6	2	1

Table 4.39: Quality of analyzed fertilizer sample

Name of fertilizer	Quality		
	Total	Standard%	Sub-standard%
Urea	98	100	0
TSP	6	33.33	66.67
DAP	8	75	25
MOP	6	83.33	16.67
Gypsum	71	100	0
$MgSO_4$	3	100	0
$ZnSO_4$ (monohyate)	108	31.48	68.52
$ZnSO_4$ (heptahydrate)	23	60.87	39.13
Chelated zinc	68	61.76	38.24
Solubor boron	52	100	0
Boric acid	56	5.36	94.64
Fertibor	6	100	0
Organic fertilizer	127	73.23	26.77
K_2SO_4	15	100	0
MAP	2	100	0
$(NH4)_2SO_4$	50	100	0
NPKS	18	66.67	33.33
Dolomite	5	100	0
Grand Total	**722**	**72.29**	**27.71**

Table 4.40 Revenue earning

Source	(Tk.)
Soil	405,257/-
Water	270,00/-
Plant	105,261/-
Fertilizer	16,12,552/-
Total	21,50,070/-

Annual progress report of Soil Physics and Minerology, 2024-2025

Table 4.41: Analyzed Physical Properties of Soil Samples

Source of sample	No. of sample	No. of ingredient
SRDI	270	547
Students	27	27
Researcher	40	40
Private organizations	67	169
Farmer	1	1
Total	**405**	**784**

Annual progress report of Soil Microbiology and Biochemistry Section, 2024-2025

Present status and works performed in 2024-2025 to start initial lab work and strengthening of the section:

- ➢ The Specialized Modern Microbiology Laboratory has been established in the new Mrittika Bhaban, with technical assistance from the CCBS project (SRDI).
- ➢ Lab equipment has been provided by the PARTNER project (SRDI and DAE) for initial research work, and the installation is ongoing.
- ➢ Communication built up and visited various organizations (BRRI, BSMRAU, BARI, BCSIR, BRICM, DU) to enrich officers' knowledge and skills in lab work.
- ➢ Participation of Officers for skill development in various training and workshop programmers of SRDI, PARTNER, and other organizations.

Initiation of advanced research in the Future with expert suggestions

- ❑ Characterization of microbes according to AEZ and Soil series-based profile study.
- ❑ Isolation of Beneficial microbes (with population count)
- ▪ Free living or symbiotic (aerobic and anaerobic) nitrogen-fixing bacteria. Phosphate solubilizing bacteria, K solubilizing bacteria, Zn solubilizing bacteria etc.
- ❑ Genome sequencing of beneficial microbes.
- ❑ Microbial study in relation to soil pollution and for healthy soil management.

To Strengthen Lab for consideration of higher authority:

- Skilled human resource development with continuous training.
- Scientific Officer and staff posts should be fulfilled for the smooth running of the section.

Chapter 5: Achievement of Projects & Programmes

1. Name of the project: Construction and Capacity Building of SRDI (CCBS)

Duration: January, 2020 to December, 2025 (1^{st} Revised)

Objective: Increasing institutional capacity through infrastructure development of the Soil Resource Development Institute.

Specific Objectives:

a. Modernization of two research centers located in khulna and Bandarban.
b. Construction of a 6(six) storied building with 8 storied foundation (including 2 basements) at the head office of SRDI, Dhaka and one 6(six) storied building with 6 storied foundation each in Rajshahi, Khulna and Cumilla Districts.
c. Creation of ICT Backbones and GIS modernization in various offices of SRDI.
d. Training on technology and knowledge transfer to enhance the skills of officials.

Progress of the Activities in 2024-2025:

Head office and other stations:

- **Head Office Dhaka:** The 6(six) storied building is completed and it was inaugurated by Honorable Agriculture Advisor on 09/02/2025. Plastering, tiling, electrical renovation, lift installation, wall painting, sanitary and other works of the old building are still in progress.
- **Rajshahi:** All roof castings have been completed**.** Construction of boundary wall and gate, Plastering, sanitary, tiling, lift installation, wall painting, electrical and other finishing works of the building are still in progress.
- **Khulna:** All roof castings have been completed**.** Construction of boundary wall and gate, Plastering, sanitary, tiling, lift installation, wall painting, electrical and other finishing works of the building are still in progress.
- **Cumilla:** All roof castings have been completed**.** Construction of boundary wall and gate, Plastering, sanitary, tiling, lift installation, wall painting, electrical and other finishing works of the building are still in progress.

Research centres:

- **SMRC, Batiaghata, Khulna:** Electrical work, boundary wall and internal road work has been completed.
- **SCWMC, Bandarban**: Electrical work, boundary wall, main gate, guard room and internal road work has been completed.

GIS modernization and creation of ICT Backbones:

A modern GIS and ICT lab has been established in Head office, Dhaka. 2 ArcGIS Software with licence, 1 Remote sensing Data Analysis Software and 1 SOLARIS (upgradation) Software has been implemented in the DPS and ICT section. A customized accounts software has been implemented in the accounts section of SRDI for smooth account operations.

Training:

All the Domestic training of the officials has been completed and two overseas training is yet to arrange due to different Government restrictions.

2. Name of the Programme: "Acidic soil management and sustainable crop production & improvement of soil fertility by practicing climate smart agricultre in the Rajshahi & Rangpur Division including Madhupur Tract"

Duration: July 2022- June 2025

Objectives:

Main objective: Use of Climate Smart Agriculture technology to increase soil fertility and sustainable crop production in acidic soils of Madhupur Tract including Rajshahi and Rangpur divisions.

Detailed Objectives:

a) To encourage farmers to use Climate Smart Agriculture technology (lime and lime-like substances, biochar, organic fertilizers and SRDI developed technology) to increase soil fertility and sustainable crop production in acidic soils of Madhupur Tract including Rajshahi and Rangpur divisions.

b) To encourage farmers to increase the production of crops with low water demand (such as wheat, lentils, mung bean, chickpea, sesame, linseed, cotton, pineapple, etc.) in acidic and drought-affected areas of Madhupur Tract including Rajshahi and Rangpur divisions.

c) To determine the number soil microorganisms of major soil series in acidic soils of Rajshahi and Rangpur divisions including Madhupur Tract to preserve soil health and maintain environmental balance (subject to availability of laboratory facilities).

d) To distribute 2,700 fertilizer recommendation cards based on Upazila Nirdeshika/Union Sahayaka/Online fertilizer recommendation/Soil test among the farmers of the research area for the use of organic fertilizers and balanced chemical fertilizers to preserve soil health and maintain environmental balance by managing acidic soils.

e) To encourage farmers to produce nutritious food for the residents of acidic areas of Rajshahi and Rangpur divisions including Madhupur Tract by increasing crop production by managing acidic soils.

f) Providing training about 970 Sub Assistant Agricultural Officers/Extension Workers/Progressive Farmers on Upazila Nirdeshika/Union Sahayaka to use of dolomite technology/soil testing and field identification of adulterated fertilizers for Sustainable Crop Production and Soil Fertilizer Management in the Madhupur Tract including Rajshahi and Rangpur Divisions.

Target & Achievement

Types of Activities	Target	Achievements
a) Research/adaptive trials on different pH levels and different crops will be set up on farmers' lands using Smart Agriculture Lime technology for the management of acidic soils in the Madhupur Tract including Rajshahi and Rangpur divisions.	Number of Research/adaptive trials- 164	164
b) Progressive farmers including Sub Assistant Agricultural Officers/Extension Workers will be provided training on the use of fertilizer recommendations/dolomite technology through Upazila Nirdeshika/Union Sahayika/Online Fertilizer Recommendatin /Soil testing, through which skilled human resources will be created.	Training imparted (Number of batch)-11 (20 participants*11)	11 (220)
c) Farmers will be trained on the use of dolomite technology in acidic soils of Madhupur Tract including Rajshahi and Rangpur divisions, balanced fertilizer application based on soil tests, and field identification of adulterated fertilizers, thereby increasing crop density and encouraging farmers.	Training imparted (Number of batch)-30 (25 participants*30)	30 (750)
d) Distribution of posters, leaflets, fact sheets and festoons on technology to encourage farmers to cultivate crops using dolomite technology in the Madhupur Tract including Rajshahi and Rangpur divisions regarding acidic soil management.	Number of distributed posters, leaflet, fact sheet and festoon-5000	5000
e) Workshops/seminar	Number of Workshops/seminars-2	2
f) Purchase of computers and research equipment	Number of purchased equipment-35	35

Chapter 6: Activities of Research Centers

6.1 Soil Conservation and Watershed Management Center (SCWMC)

SoilResource Development Institute

Bandarban

EXPT. No. 1

TITLE: ANALYZING THE PERFORMANCE OF *PIPER CHABA (*CHUI JHAL) AS AN AGROFORESTRY PRACTICE IN THE CONTEXT OF CHATTOGRAM HILL TRACTS

Abstract

Piper chaba (Chui Jhal) is an economically valuable spice crop with medicinal properties and growing market demand in Bangladesh. This study examined its growth performance under different agroforestry systems in the Chattogram Hill Tracts. A field trial was conducted at the Soil Conservation and Watershed Management Centre, Bandarban, using a completely randomized design with 15 replications and four treatments: Mango, Jackfruit, Gamari as supporting plants, and a control without support. Growth parameters were recorded at six and 18 months, followed by statistical analysis (ANOVA, DMRT, LSD). After 18 months, vines supported by Mango showed the greatest growth with mean plant height of 974.93 cm, 482.07 leaves/plant, and stem diameter of 11.36 mm, significantly outperforming Jackfruit (795.6 cm, 365.27 leaves, 8.44 mm), Gamari (570.47 cm, 303.93 leaves, 7.72 mm), and the control (266.2 cm, 244.87 leaves, 8.57 mm) ($p < 0.001$). Early growth differences were minor, but long-term monitoring revealed pronounced treatment effects. Findings confirm that Mango is the most suitable companion species for *Piper chaba*, enhancing growth and yield performance. These results highlight the potential of *Piper chaba*–based agroforestry to improve farmer income, conserve soil, and promote sustainable land use in the hill regions of Bangladesh.

Introduction

Chui Jhal (*Piper chaba* H.) is a pungent vegetable belonging to the Piperaceae family, commonly utilized in the southern region of Bangladesh, West Bengal, and Tripura in India. It is also recognized as Java long pepper or Choi Jhal, and it thrives in warmer regions of Asia, including Sri Lanka, Malaysia, Indonesia, and Singapore (1) (2) Chui Jhal is widely utilized as a spice in popular dishes, including meat, fish, and mutton curry, owing to its pungent and flavorful taste. This creeper type flowering vine from the Piperaceae family spreads on the ground and may also grow around large trees, making it a year-round additive spice for various culinary delights. In Bangladesh, Chui Jhal is considered a relatively costly spice, with its roots being more expensive than the stems due to their more potent aroma. (25)

Chui Jhal plant possesses numerous medicinal properties and can be beneficial in treating various ailments such as bronchitis, asthma, colic pain, piles, colic, gastralgia and dyspepsia. (3) (4)

Each part of the Chui Jhal plant, including the leaves, stems and fruits, contains active medicinal compound (16)

The aerial parts of this plant have shown various beneficial properties, including antibacterial, anti-diarrheal, carminative, anti-hypertensive, diuretic, stimulant, analgesic, expectorant, and smooth muscle relaxant effects. (5) (6) (7) (8)

The primary phytochemical constituents of *Piper chaba* Hunter are isoflavanons and alkaloids, which contribute to its main pharmacological activities such as antioxidant, antimicrobial, anti-inflammatory, cytotoxic, and hypolipidemic effect (9)

Piper chaba contains a significant alkaloid that exhibits antimycobacterial activity (10) along with various pharmacological effects like antihyperlipidemic (11), antiandrogenic (12), immunoregulatory (13), and antidepressant (14) properties. Additionally, the fruits of *Piper chaba* are used for their gastro-protective, anti-flatulent, appetizing, expectorant, anti-fungal, and anti-tussive properties. They are also known for their cholesterol-lowering effects (15).

The ethanolic fruit juice of *Piper chaba* has demonstrated erythropoietic effects (18) as well as central nervous system depressant and anxiolytic effects. (19). The stem of *Piper chaba* is utilized to alleviate post-delivery pain in mothers and is also beneficial for treating rheumatic pains and diarrhea. (20)

Natural resource degradation in modern agriculture, especially soil and water, threatens sustainability due to reduced productivity, profits, ecological imbalances, and environmental security. Agroforestry offers a viable solution for maintaining sustainable agriculture. (17)

Agroforestry's potential is often studied through its biophysiological aspects, cost-benefit analysis, and impact on poverty reduction. Research in CHT revealed that agroforestry interventions boosted farmers' income by creating jobs, selling farm products, and improving ecological conditions through reduced soil erosion, increased tree coverage, and enhanced soil fertility. (24)

Another study in the Chinai union of Rajarhat Upazila, Kurigram district, Bangladesh, surveyed 105 *Piper chaba* farmers to evaluate the effects of an agroforestry system on their livelihoods. By providing a consistent supply of food, fruit, timber, fodder, and fuelwood, this agroforestry approach significantly enhanced the sustainability of their livelihoods. It is believed that this practice strengthens farmers' livelihood assets, with the most improvement seen in natural capital and the least improvement in social capitals. (26)

Agroforestry systems are widely acknowledged as an integrated approach to sustainable land use, offering benefits not only in climate change mitigation and adaptation but also in various other aspects. (27)

Combining agroforestry with Climate-Smart Agriculture (CSA) holds the potential to address multiple concerns, including soil health, resource allocation, carbon sequestration, biodiversity, water management, and food security, leading to significant progress in these areas. (28)
Spice crop-based agroforestry systems, like the Choi Jhal (*Piper chaba*)-based system, are commonly integrated into home gardens. These agroforestry practices serve as valuable sources of fuelwood and charcoal. Moreover, agroforestry practitioners reduce their expenses, dependency, and time spent gathering fuelwood. For vulnerable food producers, agroforestry can enhance farm income and crop resilience (29)

By adopting this approach, one can enhance resilience to climate change while simultaneously improving access to food, livelihood opportunities, health, and environmental sTable (30)

Farmers in the Kurigram district have observed that *Piper chaba* is a highly lucrative and cost-effective crop, primarily because of its high market value and low production cost (31)

Rasul and Thapa evaluated the financial and economic benefits of agroforestry in the Chattogram Hill Tracts, showed that economic returns from agroforestry were better than from shifting cultivation (jhum) (32)

Adoption of sustainable agricultural technologies is very significant due to the global climate crisis. Due to soil erosion and wrong agricultural practices in the hills, on the one hand the living standards of the people living in the hills are decreasing and on the other hand we are losing the precious soil of the hills. Sustainable agriculture in the hills is possible through the practice of agroforestry. Chui Jhal is recognized as an economically viable spice in southwestern and northern regions of Bangladesh. Chui Jhal-based agroforestry has great potential in the hills.

Objectives:

1. To assess the growth and productivity of *Piper chaba* in agroforestry systems in Chattogram Hill Tracts
2. To analyze the economic viability and profiTableity of incorporating *Piper chaba* in agroforestry practices

Materials and Methods

The study is being conducted at the research field of the Soil Conservation and Watershed Management Centre in Bandarban to evaluate the performance and economic viability of Chaba germplasm (*Piper chaba*) in the agroforestry system of Chattogram Hill Tracts. The experimental site represents the agroecological zone (AEZ)-29, which is recognized as the Northern and Eastern Hill region. Germplasm of Chui Jhal was collected from Khulna. Saplings were collected and transplanted near different tree species such as *Gmelina arborea, Mangifera indica, and Artocarpus heterophyllus* to provide support for the creeping growth habit of Chui Jhal. Chui Jhal is being cultivated as a vine crop on these supporting trees. Fertilizers and manures are being applied according to the recommendations in the fertilizer guide. Light irrigation is being provided just after transplantation to ensure optimum soil moisture for normal growth and development. The crop is being managed using the recommended package of intercultural practices.

To ensure the proper growth of all supporting trees, necessary management activities such as pruning, watering, cleaning, weeding, and fertilizing are being performed in a timely manner. The growth and yield performance of the supporting trees are being recorded. The Chui Jhal saplings have been then planted beside the supporting plants in pits filled with manures and fertilizers. Pits were prepared one week before plantation. Waterlogging Condition will be avoided for all of them.

Completely randomized design with thirty replications is being used for all crops in association with the supporting trees. Four treatments will be employed, including Mango as supporting plants (Treatment 1), Gamari as supporting plants (Treatment 2), Jackfruit as supporting plants (Treatment 3), and no supporting plants (Treatment 4).

Data collection is being carried out for the growth parameters and yield parameters of Chui Jhal both inside and outside the agroforestry system. Observations on different morphological and yield attributing characters such plant height, number of leaves per plant, leaf length, leaf breadth, branch number, will be recorded for Chui Jhal. The average total yield value of a supporting tree will be estimated. Statistical analysis will be performed on all recorded data using the CRD design to determine the statistical significance of the experimental results. The means for all recorded data of the studied multistoried agroforestry system were calculated and analyzed statistically by using R Programming software package to find out the statistical significance of the experimental results for all growth and yield parameters were performed. The mean differences were evaluated by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) at 1% level of significance and also by Least Significance Difference (LSD) test.

Result & Discussion

Table 6.1: Data of first six months

Treatment	Plant Height(cm)	Leaves/Plant	Stem Diameter(mm)
No Bearing Plant	111.66 a	55.40 a	6.74 a
Gamari	134.20 a	27.13 b	4.58 b
Jack fruit	99.93 a	17.40 c	4.86 b
Mango	97.60 a	27.80 b	6.75 a
Mean	110.85	31.93	5.739
CV	48.26637	39.42	25.24288
F value	1.4683	25.2925	9.8204
P	0.2369	1.656e-09 ***	4.955e-05 ***
Level of significance		***	***
Significance codes: ***’ 0.001, **’ 0.01, *’ 0.05. Means in column followed by the different letters are significantly different by DMRT at P< 0.001			

Table 6.2: ChuiJhal Growth Parameters after 18 Months (with DMRT Group Letters)

Treatment	Plant Height (cm)	Leaves/Plant	Stem Diameter (mm)
Mango	974.93 ± 162.51 a	482.07 ± 61.95 a	11.36 ± 1.48 a
Jack fruit	795.6 ± 105.79 b	365.27 ± 25.45 b	8.44 ± 1.42 c
Gamari	570.47 ± 75.14 c	303.93 ± 47.11 c	7.72 ± 1.49 d
Without bearing plant	266.2 ± 70.94 d	244.87 ± 41.28 d	8.57 ± 1.67 b
Mean	651.8	349.03	9.02
CV (%)	44.13	28.42	22.58
F value	116.1523	73.3629	16.7893
P value	5.099e-24	2.16e-19	6.701e-08
Significance levels	***	***	***
Significance codes: ***’ 0.001, **’ 0.01, *’ 0.05. Means in column followed by the different letters are significantly different by DMRT at P< 0.001			

The 18-month evaluation of *Piper chaba* growth under different companion plant treatments revealed statistically significant variation across all measured parameters, indicating the substantial influence of support species on vine development within an agroforestry system.

Plant Height

Significant differences (ANOVA, $F = 116.15$; $p < 0.001$) were observed in vine height across the four treatments. The tallest vines were consistently associated with one particular companion species, which significantly outperformed all other treatments as confirmed by post hoc analysis (DMRT, group 'a'). This suggests that the structural and microclimatic advantages provided by this species—possibly related to optimal light penetration, humidity moderation, or physical support—substantially promote vertical growth in *P. chaba*. The shortest vines were recorded in the control treatment (without a bearing plant), highlighting the critical role of a suitable host in supporting upward growth.

Leaf Production

Leaf number per plant also varied significantly among treatments ($F = 73.36$; $p < 0.001$), following a similar trend to plant height. The highest leaf counts were observed in association with the same species that promoted the greatest height, suggesting a synergistic effect of the host on both vertical and foliar development. Treatments with moderate or no support showed reduced leaf production, likely due to suboptimal growing conditions and reduced light exposure, which can limit photosynthetic capacity and vegetative expansion.

Stem Diameter

Differences in stem diameter were also statistically significant ($F = 16.79$; $p < 0.001$), though the ranking of treatments varied slightly from those observed in height and leaf number. The companion species that led in height and leaf production also resulted in the thickest stems, which may reflect enhanced structural support and nutrient allocation. Interestingly, one non-dominant treatment exhibited relatively moderate stem development despite lower values for other growth parameters, suggesting that certain tree-vine interactions may selectively influence specific aspects of morphology.

Biological Variability

The coefficient of variation (CV) for plant height (44.13%), leaf number (28.42%), and stem diameter (22.58%) indicated moderate to high variability among individual plants within treatments. This is characteristic of field-based agroforestry trials, where interactions between biotic and abiotic factors contribute to heterogeneous plant responses.

Temporal Dynamics and Long-Term Insights

Comparison with the initial six-month data reveals an important temporal trend: early observations showed minimal or no statistically significant differences across treatments, while the extended 18-month monitoring period captured pronounced and consistent growth differentials. This progression underscores the necessity of long-term assessment in agroforestry research. Short-term studies may fail to detect the cumulative effects of interspecific interactions and environmental feedbacks, which are essential for accurate evaluation of companion plant suiTableity.

Implications for Agroforestry Practice

The findings clearly demonstrate that companion species selection plays a pivotal role in the growth and productivity of *Piper chaba* vines. Trees that provide a supportive physical structure, favorable microclimatic conditions, and possibly complementary root zone interactions offer the greatest potential for enhancing vine performance. Conversely, the absence of a bearing plant or selection of suboptimal hosts can significantly limit growth. These insights are critical for the design and management of integrated agroforestry systems aiming to optimize both crop yield and ecological sustainability.

Conclusion

The 18-month study of *Piper chaba* cultivated under different companion plant treatments clearly demonstrates that the choice of support species significantly affects vine growth and development. Among the evaluated treatments, the use of Mango as a companion plant consistently promoted superior performance across all key parameters—plant height, leaf production, and stem diameter—indicating its strong potential as an optimal host in agroforestry systems. Jackfruit showed moderate compatibility, while Gamari and the control (no bearing plant) provided limited benefits.

These results emphasize the importance of species-specific interactions in designing effective agroforestry models. The significant divergence in growth performance over time also highlights the necessity of long-term evaluations to capture the full impact of companion planting on perennial vine crops like *P. chaba*. Integrating well-suited support species not only enhances crop productivity but also contributes to the ecological and structural integrity of mixed cropping systems.

Future research should explore the underlying physiological and ecological mechanisms driving these interactions, as well as assess the economic and environmental outcomes of different tree–vine combinations under varied agroclimatic conditions.

References

1. Bhandari SPS, Babu UV, Garg (Late)H. S. A lignan from Piper chaba stems. Phytochemistry. 1998 Apr 1;47(7):1435–6.

2. Basu B.D KKR. Indian Medicinal Plants. 3rd ed. International Book Distributors; 1987. 2130–2131 p.

3. N CR, Chopra IC. Indigenous Drugs of India. Academic Publishers; 1994. 868 p.

4. M.K.S. Krishnan. The useful plants of India. CSIR, New Delhi, India,: Publication and Information Directorate; 1986.

5. Ghani A. Medicinal Plants of Bangladesh. 2nd ed. Dhaka: Medicinal Plants of Bangladesh; 2003. 267–268 p.

6. Yusuf M., Chowdhury J.U., Begum D.J. Medicinal Plants of Bangladesh. Bangladesh Council of Scientific and Industrial Research; 1994. 192 p.

7. Rahman MdA, Amin A, Shekher H. Alkamide and Lignan from the Stem Bark of Piper chaba (Piperaceae). Dhaka University Journal of Pharmaceutical Sciences. 2007 Jun 14;3.

8. Sarfaraz S., Najam R., Hassan F. Evaluation of Erythropoietic effects of ethanolic extract of fruit of Piper chaba in albino rabbits. International Journal of Pharmaceutical Research and Bioscience. 2014;3:759–62.

9. Haque E, Roy AC, Rani M. Review on Phytochemical and Pharmacologi-cal Investigation of Piper chaba Hunter. 2018;9(3).

10. Jin J, Zhang J, Guo N, Feng H, Li L, Liang J, et al. The plant alkaloid piperine as a potential inhibitor of ethidium bromide efflux in Mycobacterium smegmatis. J Med Microbiol. 2011 Feb;60(Pt 2):223–9.

11. Jin Z, Borjihan G, Zhao R, Sun Z, Hammond GB, Uryu T. Antihyperlipidemic compounds from the fruit of Piper longum L. Phytother Res. 2009 Aug;23(8):1194–6.

12. Hirata N, Tokunaga M, Naruto S, Iinuma M, Matsuda H. Testosterone 5alpha-reductase inhibitory active constituents of Piper nigrum leaf. Biol Pharm Bull. 2007 Dec;30(12):2402–5.

13. Pradeep CR, Kuttan G. Piperine is a potent inhibitor of nuclear factor-kappaB (NF-kappaB), c-Fos, CREB, ATF-2 and proinflammatory cytokine gene expression in B16F-10 melanoma cells. Int Immunopharmacol. 2004 Dec 20;4(14):1795–803.

14. Lee SA, Hwang JS, Han XH, Lee C, Lee MH, Choe SG, et al. Methylpiperate derivatives from Piper longum and their inhibition of monoamine oxidase. Arch Pharm Res. 2008 Jun;31(6):679–83.

15. Chojnowska I, Kucharczyk K, Myszkowski L, Radzikowski A, Szymańska K. Blood serum proteins in experimental chronic liver injury in rabbit. Patol Pol. 1979;30(1):71–88.

16. Islam S, Roy AC, Haque M, Hossain S, Abu M. PHYTOCHEMICAL STUDIES ON PIPER CHABA HUNTER. International Journal of Pharmaceutical Sciences and Research. 6.

17. Sireeratawong S, Itharat A, Lerdvuthisopon N, Piyabhan P, Khonsung P, Boonraeng S, et al. Anti-Inflammatory, Analgesic, and Antipyretic Activities of the Ethanol Extract of Piper interruptum Opiz. and Piper chaba Linn. ISRN Pharmacol. 2012 Mar 18;2012:480265.

18. Lumb PJ, Slavin BM. Determination of serum cholesterol concentration in the presence of ascorbate. J Clin Pathol. 1993 Mar;46(3):283–4.

19. M. Yusuf, J.U. Chowdhury, M.A. Wahab, J. Begum. Medicinal plants of Bangladesh, BCSIR, Dhaka, Bangladesh. 1994;193.

20. Daware MB, Mujumdar AM, Ghaskadbi S. Reproductive toxicity of piperine in Swiss albino mice. Planta Med. 2000 Apr;66(3):231–6.

21. Piyachaturawat P, Glinsukon T, Toskulkao C. Acute and subacute toxicity of piperine in mice, rats and hamsters. Toxicol Lett. 1983 May;16(3–4):351–9.

22. Dogra RKS, Khanna S, Shanker R. Immunotoxicological effects of piperine in mice. Toxicology. 2004 Mar 15;196(3):229–36.

23. Kumar A, Hasanain M, Singh R, Verma G, Meena D, Mishra R, et al. Role of Agroforestry Measures for Soil and Water Conservation. 2020 Mar 1;

24. Nath TK, Inoue M, Myant H. Small-scale agroforestry for upland community development: a case study from Chattogram Hill Tracts, Bangladesh. Journal of Forest Research. 2005 Dec 1;10(6):443–52.

25. Islam MdR, Mehedi MdNH, Ara R, Obaidullah AJM, Moniruzzaman Md, Aktar N. Evaluation of Different Chaba (Piper chaba) Germplasm for Growth and Yield Performances. APRJ. 2021 Feb 24;23–9.

26. Hemel SAK, Hasan MK, Wadud MdA, Akter R, Roshni NA, Islam MdT, et al. Improvement of Farmers' Livelihood through Choi Jhal (Piper chaba)-Based Agroforestry System: Instance from the Northern Region of Bangladesh. Sustainability. 2022 Dec 1;14(23):16078.

27. Cubbage F, Balmelli G, Bussoni A, Noellemeyer E, Pachas AN, Fassola H, et al. Comparing silvopastoral systems and prospects in eight regions of the world. Agroforest Syst. 2012 Nov 1;86(3):303–14.

28. Newaj R, Chavan S, Prasad R. Climate-smart agriculture with special reference to agroforestry. Indian Journal of Agroforestry. 2015 Jun 1;17:96–108.

29. Waldron A, Garrity D, Malhi Y, Girardin C, Miller D, Seddon N. Agroforestry Can Enhance Food Security While Meeting Other Sustainable Development Goals. Tropical Conservation Science. 2017 Aug 1;10:194008291772066.

30. Duffy C, Toth GG, Hagan RPO, McKeown PC, Rahman SA, Widyaningsih Y, et al. Agroforestry contributions to smallholder farmer food security in Indonesia. Agroforest Syst. 2021 Aug 1;95(6):1109–24.

31. Piper chaba vines lucrative for Kurigram farmers | The Daily Star [Internet]. [cited 2023 Aug 6]. Available from: https://www.thedailystar.net/country/piper-chaba-vines-lucrative-kurigram-farmers-1443340

32. Rasul G, Thapa GB. Financial and economic suiTableity of agroforestry as an alternative to shifting cultivation: The case of the Chattogram Hill Tracts, Bangladesh. Agricultural Systems. 2006 Nov 1;91(1):29–50.

EXPT. No. 2

TITLE: PERFORMANCE ASSESSMENT OF KHASIA BETEL LEAF AS AN AGROFORESTRY PRACTICE IN CHATTOGRAM HILL TRACTS.

Abstract

The cultivation of Khasia betel leaf (*Piper betle L.*) represents a unique tree-based agroforestry practice that supports both livelihoods and ecological sustainability in the hilly regions of Bangladesh. This study was conducted at the Soil Conservation and Watershed Management Centre, Bandarban, within Agroecological Zone-29, to evaluate the growth performance and productivity of Khasia betel leaf under different supporting tree species. Using a completely randomized design with fifteen replications, four treatments were tested: mango (*Mangifera indica*), litchi (*Litchi chinensis*), jackfruit (*Artocarpus heterophyllus*), and control (without supporting trees). Growth and yield parameters including plant height, stem diameter, and number of leaves per plant were recorded over an 18-month period. Results revealed highly significant treatment effects, with mango trees emerging as the most compatible and productive host, supporting superior vine growth (plant height 945.33 cm, stem diameter 12.6 mm, and 1071 leaves/plant). Litchi provided moderate benefits, particularly for leaf production, while jackfruit and control treatments performed comparatively lower. These findings underline the importance of host tree selection in optimizing vine performance, with mango offering the most favorable canopy structure and microclimatic conditions. The results confirm that Khasia betel leaf cultivation in agroforestry systems is not only agronomically viable but also economically promising for sustainable hill farming in the Chattogram Hill Tracts. Long-term monitoring and economic analysis are recommended to further refine management practices and enhance farmer profiTableity while conserving hill ecosystems.

Introduction

Piper betle L. is a widely familiar perennial creeping plant that belongs to the Piperaceae family. It has its origins in central and eastern Peninsular Malaysia but can also be found in East Africa and various tropical Asian countries (1)

It serves as a profitable cash crop primarily grown in countries such as India, Bangladesh, Sri Lanka, Thailand, Taiwan, Malaysia, and a handful of other nations in Southeast Asia (2) (3)

The term "green gold of India" is attributed to the betel vine due to its role as a livelihood source for nearly 20 million individuals. These people rely on the plant for their earnings, which come from various stages like cultivating, transporting, managing, processing, and arranging betel leaves (4) (5)

The betel vine, often asexually propagated, features multiple cultivars with male and female plants. Worldwide, there are about a hundred betel plant varieties, with 40 exclusives to India. Of these, 30 are identified in West Bengal and Bangladesh. (6)

P. betel is recognized by diverse names across the globe in various countries, yet 'Paan' is predominantly employed in India, Pakistan, Nepal, and Bangladesh. (7)

Betel quid consumption is a widespread tradition in multiple nations, valued for its natural revitalizing properties that help combat oral malodor. The International Agency for Research on Cancer conducted a survey, approximating a global user count ranging between 200 to 600 million individuals. (8) (9)

In Bangladesh, approximately 30% of adults partake in betel quid chewing, while on a global scale, this practice is observed at around 10-20% (10) (11)

In addition to its socio-cultural and ceremonial significance, betel quid possesses antacid, carminative, and calming properties. These attributes aid in digestion, eliminate oral malodor, enhance taste and appetite, and fortify dental health. (12)

P. betle finds roles in traditional medicine systems including Ayurveda, Chinese medicine, and West Indies/Latin American remedies. Ayurveda employs it in formulations like Lokantha Rasa, Puspadhava Rasa, and others to treat diverse conditions. Betle leaf juice is a common Ayurvedic enhancer in herbal combinations. (13)

In the realm of tradition, the plant is employed to heal various maladies like colds, bronchial asthma, cough, stomach pain, and rheumatism. It also serves as a remedy for conditions like boils, halitosis, constipation, conjunctivitis, gum inflammation, abscesses, and cuts, whether contagious or non-contagious in nature. (14)

The intense, sharp scent emitted by betel leaves originates from the presence of abundant terpenes and phenols within its essential oil. (15,16)

Various phytochemicals found in betel plants include chavicol, chavibetol, hydroxychavicol, eugenol, estragole, methyl eugenol, hydroxycatechol, α-pinene, caryophyllene, β-pinene, 1,8-cineol, and similar compounds. (17)

Numerous research studies have demonstrated the effectiveness of the bioactive components within essential oils as antioxidants for deterring cancer, inflammation, neurodegenerative ailments, and as agents with qualities like antimutagenic, antifertility, antilipidemic, antiglycemic, and cardioprotective properties. (18) (19)

The essential oil derived from betel leaves also possesses the ability to counter bacterial, protozoan, and fungal infections, as well as repel insect assaults. (20)

Well-prepared betel quid remains a valued mouth freshener and mild energizer, commonly served during social, cultural, and religious occasions. This tradition of offering betel quid to guests signifies respect and cultural heritage, particularly in countries like Bangladesh, Burma, China, India, Indonesia, Malaysia, Nepal, Pakistan, Philippines, South Africa, Sri Lanka, and Thailand. These societies have a long history of chewing betel leaves with various natural ingredients, emphasizing its unique cultural significance (21)

Research validates the protection of tree diversity facilitated by betel leaf cultivation practiced by the Khasia community in the Sylhet district. (22)

Betel cultivation is extensive in various regions of Bangladesh including Sylhet, Moulvibazar, Jashore, Khulna, Kustia, Bagerhat, Satkhira, Narail, Bhola, Barisal, Faridpur, Rajshahi, Rangpur, Gaibanda, Pabna, Cox's Bazar, and the broader Chattogram district. (23)

In Bangladesh, betel vines are divided into plain land betel-leaf (boroj pan) and tree-betel-leaf (gach pan) based on cultivation practices. The Khasia people in the greater Sylhet district cultivate tree betel leaf, known as Khasia pan. Additionally, nearby Bengali residents also cultivate Khasia betel leaf around their homes. (24)

Over 80% of the Khasia population relies on livelihoods tied to the cultivation of tree-based betel-leaf. (25)

Cultivation of betel-leaf on trees stands as a significant agroforestry practice in Bangladesh, and it is ecologically and economically sustainable (26). In forested regions, this practice involves using forest trees as support for climbing betel vines, creating a cash-oriented production system. Although labor-intensive and localized, it holds significance for the Khasia community's agroforestry and biodiversity conservation efforts. (27)

A study in North-eastern Bangladesh's forests revealed sustainable betel leaf production within agroforestry. Positive attributes like disease control, soil fertility, profiTableity, and cultural acceptance thrive under traditional management. Betel leaf sales sustain livelihoods, aided by villagers conserving forest resources through collaborative efforts. (28)

The experience of economic development and forest conservation of Khasia community through cultivation of khasia betel leaf in the hilly areas of the north-eastern part of the country shows that it is possible to improve the quality of life of the tribals of Chattogram Hill Tracts and preserve the hilly soil and forest by cultivating khasia betel leaf.

Objectives:

1. To assess the growth and productivity of Khasia Betel Leaf plants in an agroforesty system

2. To evaluate the economic viability of Khasia Betel Leaf cultivation in Chattogram Hill Tract

Materials and methods:

The experiment is being held at the research area of Soil Conservation and Watershed Management Centre in Bandarban. The geographical location of this area is N 22^{0} $10^{/}$ $30^{//}$ and E $92^{0}11^{/}14^{//}$. The present study focuses on an experimental site representing agroecological zone (AEZ)-29, acknowledged as the Northern and Eastern Hill region. The germplasm of Khasia betel leaf (Piper betle) was collected from Moulvibajar and transplanted adjacent to diverse tree species such as *Litchi chinensis, Mangifera indica, and Artocarpus heterophyllus,* aimed at providing structural support for the creeping growth habit of Khasia betel leaf. The Khasia betel leaf is being cultivated as a vine crop utilizing these supporting trees. Fertilizers and manures are being applied as per the recommendations outlined in the fertilizer guide. After transplantation, light irrigation was administered to maintain optimal soil moisture for ensuring normal growth and development. The recommended package of intercultural practices is being implemented for managing the crop. The avoidance of waterlogging is crucial, as excessive moisture accumulation can have adverse impacts on the growth and overall health of the betel vines. To mitigate this potential issue, proper drainage measures are being implemented. The planting pits were designed and prepared in a manner that facilitates efficient water drainage, thereby minimizing the risk of waterlogging. The betel vine plantation was done in June. Prior to planting, meticulous weed and grass clearance was carried out in the base of the supporting trees. Subsequently, planting pits were carefully prepared, adhering to specific dimensions. These pits measure approximately 6 to 7 inches in depth, 1 foot in length, and 6 inches in width. During the planting process, the seedling was positioned in the pit in such a way that two nodes were buried beneath the soil surface, while one node remains exposed above the ground.

To fill the pit, loose mud was carefully added without any compacting. Two pits were created around a supporting tree. At least three years old cuttings were taken from healthy vines. After planting, the seedlings are being kept Weed-free to prevent shoot suppression. Debranching (2-3 weeks after planting) was done in supporting plants.

Completely randomized design with fifteen replications is being used for all crops in association with the supporting trees. The experiments involved four distinct treatments: Treatment 1 using mango as supporting plants, Treatment 2 utilizing litchi as supporting plants, Treatment 3 involving jackfruit as supporting plants, and Treatment 4 without any supporting plants. Appropriate and timely application of manures and fertilizers will be confirmed after testing the soil nutrients contents.

The amount of growth such as leaf size, length of plants, diameter of plant as well as compatibility with host plant will be measured over a period.

Harvesting, sampling, and data collection are being conducted to assess the growth parameters and yield parameters of the betel leaf in the agroforestry system. For betel leaf, the edible portion of individual plants will be recorded both inside and outside the agroforestry system.

Observations on different morphological and yield-related characteristics such as germination percentage, days to germination, plant height, number of leaves per plant, leaf length, stem diameter are being documented for betel leaf.

The average total yield value of a supporting tree will be estimated for various crop combinations in the multistoried agroforestry system.

Statistical analysis will be performed on all recorded data using the Completely randomized design to determine the statistical significance of the experimental results. The means for all recorded data of the studied multistoried agroforestry system were calculated and analyzed statistically by using R Programming software package to find out the statistical significance of the experimental results for all growth and yield parameters were performed. The mean differences were evaluated by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) at 1% level of significance and also by Least Significance Difference (LSD) test.

Results & Discussion

Table 6.3: After six months

Treatment	Plant Height(cm)	Leaves/Plant	Stem Diameter(mm)
No Bearing Plant	247.40 a	54.00 a	5.72 a
Jack fruit	98.13 c	15.66 b	4.09 b
Litchi	185.06 b	28.13 b	4.42 b
Mango	132.60 bc	22.33 b	4.36 b
Mean	165.8	30.03333	4.6505
CV	46.04028	57.44945	17.85272
F value	10.9067	14.16	11.611
Pr	1.996e-05 ***	1.603e-06 ***	1.129e-05 ***
Level of significance	***	***	***
Significance codes: '***' 0.001, '**' 0.01, '*' 0.05. Means in column followed by the different letter are significantly different by DMRT at P< 0.001			

Table 6.4: Khasia betel leaf (Pan) Growth Summary after 18 Months (with DMRT Group Letters)

Treatment	Stem Diameter (mm)	Leaves/Plant	Plant Height (cm)
Mango	12.6 a	1071 a	945.33 a
Without bearing plant	11.36 b	554.6 c	911.46 ab
Jack fruit	9.90 c	681.2 b	882.53 b
Litchi	8.4 d	723 b	830.53 c
Mean	10.58 d	757.45	892.4667
SD	1.79	220.9544	48.61513
CV%	16.95452	29.17083	5.447277
value	122.6	135.3	12.78
Pr	5.01E-07	3.41E-07	0.00203
Significance	***	***	**
Significance codes: ***' 0.001, **' 0.01, *' 0.05. **Means in column followed by the different letters are significantly different by DMRT at P< 0.001**			

The 18-month evaluation of Khasia betel leaf growth parameters under different agroforestry systems showed statistically significant differences among treatments (Table 6.4). The presence and type of supporting tree species had a pronounced effect on stem diameter, plant height, and number of leaves per plant.

Mango emerged as the most effective supporting plant, significantly enhancing all measured growth parameters — stem diameter (12.6 mm), number of leaves per plant (1071), and plant height (945.33 cm) — far surpassing other treatments. This result contrasts with the earlier 6-month findings, where mango was less prominent. Over time, mango's canopy structure and possibly its compatibility in terms of microclimate, shade regulation, and root interactions may have created a more favorable environment for vine growth.

Litchi also showed considerable promise, particularly in leaf development (723 leaves/plant), consistent with the previous observation. However, it lagged behind mango in height and stem diameter, possibly due to its smaller crown and lighter shade provision, which may benefit leaf growth but limit vertical extension and vine thickness.

Jackfruit and the non-bearing plant (control) systems produced moderate results. While jackfruit outperformed litchi in stem diameter (9.90 mm vs 8.4 mm), it lagged behind in leaf number. The non-bearing system still supported decent plant height (911.46 cm), indicating that in the absence of competition, vines invest in vertical growth, though leaf and stem development were compromised due to lack of physical support and possibly higher sun exposure stress.

Statistical tests confirmed high significance for all parameters: stem diameter ($p = 5.01E-07$), leaves per plant ($p = 3.41E-07$), and plant height ($p = 0.00203$), indicating strong treatment effects. The coefficient of variation was lowest in plant height (CV = 5.45%), suggesting more uniformity across replicates, while leaves per plant showed higher variability (CV = 29.17%).

These extended observations affirm the critical influence of host plant selection in Khasia betel cultivation. The superiority of mango trees over time highlights the importance of matching vine and support tree physiology for optimized productivity in hill agroforestry systems.

Conclusion:

The 18-month study underlines the agronomic and ecological viability of cultivating Khasia betel leaf in agroforestry systems in the Chattogram Hill Tracts. While early-stage growth favored non-bearing plants due to minimal competition, longer-term results clearly demonstrate that mango trees serve as the most compatible and productive support species for Khasia betel cultivation. They facilitate superior vine development in terms of height, stem diameter, and foliage density.

Litchi also holds potential, particularly for enhancing foliage, which is the commercially valuable part of the crop. However, its performance remains secondary to mango. The findings provide critical insights into long-term vine-tree interactions and suggest that appropriate tree species selection can substantially improve betel leaf productivity and economic returns.

Future research extending beyond 18 months is encouraged to assess long-term yield sTableity, pest dynamics, and soil health under different tree supports. Additionally, economic analysis of input-output ratios across treatments will help further guide the best practices in hill agroforestry design involving Khasia betel leaf cultivation**.**

References:

1. Madhumita M, Guha P, Nag A. Extraction of betel leaves (Piper betle L.) essential oil and its bio-actives identification: Process optimization, GC-MS analysis and anti-microbial activity. Industrial Crops and Products. 2019 Oct 5;138:111578.

2. Bajpai V, Sharma D, Kumar B, Madhusudanan KP. Profiling of Piper betle Linn. cultivars by direct analysis in real time mass spectrometric technique. Biomed Chromatogr. 2010;24(12):1283-1286.

3. Sudjaroen Y. Evaluation of ethnobotanical vegetables and herbs in Samut Songkram province. Procedia Engineering. 2012 Jan 1;32:160–5.

4. Das S, Parida R, Sriram Sandeep I, Nayak S, Mohanty S. Biotechnological intervention in betelvine (Piper betle L.): A review on recent advances and future prospects. Asian Pacific Journal of Tropical Medicine. 2016 Oct 1;9(10):938–46.

5. Jane NS, Deshmukh MAP, Joshi MMS. Review Of Study Of Different Diseases On Betelvine Plant and Control Measure. 2014;3(3).

6. Khan, A. A., Bhatnagar, S. P., Sinha, B. N., & Lal, U. R. (2013). Pharmacognostic specifications of eight cultivars of Piper betle from eastern region of India. *Pharmacognosy Journal*, *5*(4), 176-183. https://doi.org/10.1016/j.phcgj.2013.07.002

7. Guha P, Nandi S. Essential oil of betel leaf (Piper betle L.): a novel addition to the world food sector. In Malik, S ed. Essential oil research. Springer; 2019:149-196

8.Jeng JH, Chang MC, Hahn LJ. Role of areca nut in betel quid-associated chemical carcinogenesis: current awareness and future perspectives. Oral Oncology. 2001 Sep 1;37(6):477–92.

9. Yoonus J, Resmi. R, Beena B. Greener nanoscience: Piper betel leaf extract mediated synthesis of CaO nanoparticles and evaluation of its antibacterial and anticancer activity. Materials Today: Proceedings. 2021 Jan 1;41:535–40.

10. Gupta PC, Warnakulasuriya S. Global epidemiology of areca nut usage. Addiction Biology. 2002;7(1):77–83.

11. Meerjady S Flora, Mascie-Taylor CG, Rahmanc M. Betel quid chewing and its risk factors in Bangladeshi adults. WHO South-East Asia Journal of Public Health. 2012 Apr;1(2):169–81.

12. Islam Q, Matin M. ProfiTableity level of betel leaf (Piper betel L.) cultivation in some selected sites of Bangladesh. Bangladesh J Agric Res. 2017 Jun 7;42(2):343–51.

13. Taukoorah U, Lall N, Mahomoodally F. Piper betle L. (betel quid) shows bacteriostatic, additive, and synergistic antimicrobial action when combined with conventional antibiotics. South Afr J Botany. 2016;105:133-140.

14. Gundala SR, Yang C, Mukkavilli R, Paranjpe R, Brahmbhatt M, Pannu V, et al. Hydroxychavicol, a betel leaf component, inhibits prostate cancer through ROS-driven DNA damage and apoptosis. Toxicology and Applied Pharmacology. 2014 Oct 1;280(1):86–96.

15. Bhagath B, Guha P. Development of novel Sooji Halwa with unique properties of essential oil of betel leaf. Int J Agric Food Sci Technol. 2014;5:87-93

16. Bhoite VS, Kamble DK, Patil YN. Effect of different levels of Piper betel leaves on physico-chemical attributes of ice-cream. Int J Chem Stud. 2019;7(5):168-171.

17. Arambewela LSR, Kumarathunge KGA, Dias K. Studies on Piper betel of Sri Lanka. J Natl Sci Foundation Sri Lanka. 2013;33(2):133-139.

18. Arawwawala L, Arambewela LSR, Ratnasooriya WD. Gastroprotective effect of Piper betle Linn. leaves grown in Sri Lanka. J Ayurveda Integr Med. 2014;5(1):38.

19. Chakraborty D, Shah B. Antimicrobial, antioxidative and antihemolytic activity of Piper betel leaf extracts. Int J Pharm Pharm Sci. 2011;3(3):192-199

20. Biswas P, Anand U, Saha SC, Kant N, Mishra T, Masih H, et al. Betelvine (Piper betle L.): A comprehensive insight into its ethnopharmacology, phytochemistry, and pharmacological, biomedical and therapeutic attributes. J Cell Mol Med. 2022 Jun;26(11):3083–119.

21. Princy PS. AGRONOMY AND AGRO-ECONOMICS OF BETEL LEAF PRODUCTION.

22. Mohiuddin M. AM. Conservation of Tree Diversity through betel-leaf (Piper betle) based Agroforestry in Sylhet. Bangladesh Journal of Forest Science. 1995;24(2):49−53.

23. Fila P, Haider MR, Mohiuddin M, Zashimuddin M & Alam MK, Khasia betel-leaf cultivation technique (in Bangla), (Bangladesh Forest Research Institute, Chattogram), 2006, 12.

24. Haider MR, Khair A, Rahman MM, Alam MK. Indigenous management practices of betel-leaf (Piper betle L.) cultivation by the Khasia community in Bangladesh. 2013;12(2).

25. Costa T, Dutta A. The Khasia of Bangladesh; A Socioeconomic survey of Khasia people. Society for Environment and Human Development SEHD), Dhaka, Bangladesh. 2007;59.

26. Alam MK, Ahmed FU, Mohiuddin M. Agroforestry practices in forest land. Agroforestry-farming systems linkages in Bangladesh Dhaka, Bangladesh: BARC-Winrock International Agroforestry and participatory Forestry Research and Training Support Program. 1993;87–122.

27. Bhattee SS, Agroforestry in Auranachai Prodesh, In: Agroforestry in India. Forest Research Institute and Colleges, Dehradun, edited by Mathur RS & Gogate MG, 1994, 22-26.

28. Nath TK, Inoue M. Sustainability Attributes of a Small-Scale Betel Leaf Agroforestry System: A Case Study in North-eastern Hill Forests of Bangladesh. Small-scale Forestry. 2009 Sep;8(3):289–304.

EXPT. No. 3
STUDYING PERFORMANCE OF WATER MELON IN RAINY SEASON AT HILL SLOPES USING SOIL CONSERVATION TECHNIQUE.

Abstract

A study on performance of Watermelon in rainy season at hill slope using Soil Conservation Technique has been taken by Soil Conservation and Watershed Management Centre, Bandarban. Its main objective is to find out the sustainability and challenges of cultivation of watermelon on sloping lands during rainy season. Three types of sloping land like gentle, moderate and steep sloping has been selected for this study. There were three plots on three sloping lands having an equal area. Soil conservation technique like pineapple hedge and Vetiver hedge were introduced following contour. Bamboo made colored pegs were inserted into the soil to estimate the soil erosion hazard. Local bamboos made platforms (Macha) were used for cultivation of watermelon during rainy season. Height yields and lowest soil loss were gained from the managed plot by pineapple hedge and gentle slope. Lowest yields and Height soil loss were gained from the control plot and steep slope. Hedge always plays a vital role on plant growth, crops productivity, no of fruit & weight as well as minimizing of soil erosion. soil conservation technique is must for any agricultural practice on the slopping land. Fungal, bacterial and virus diseases are more during rainy season which affects badly on growing watermelon and its yields and quality. Attract of white flies hampers the production of watermelon during rainy season. Watermelon cultivation is not possible on the hilly areas during the dry season due to lack of water. So it is possible to successfully grown during the rainy season without irrigation.

Introduction

Watermelon (*Citrullus lanatus*) belongs to the family Cucurbitaceae. It is one of the most widely cultivated crops in the world with global production reaching about 89.9 million ton per year. Its centre of origin has been traced to both Kalahari and Sahara desert in Africa and these areas have been regarded as point of diversification to other parts of the world. The crop has wide distribution as a garden crop while as a commercial vegetable production; its cultivation is confined to drier Savanna region of the Nigeria. It is horticultural crop that provide high return and has relatively low water requirement compared to other crops. It is traditional food plant in Africa with potential to improve nutrition, boost food security, foster rural development and support sustainable land cares. Smallholder farmer in different semi-arid zones of the world grow watermelon mostly under rainfed conditions and to lesser suplimental furrow irrigation. Now a day the demand of watermelon is increasingly growing up day by day. *Citrullus lanatus* is an important Cucurbitaceous Vegetable/Fruit in our neighboring country India. It is an excellent desert fruit and its juice contains 92% water along with proteins, minerals and carbohydrates. Now it is going to be extended day by day. In India, Watermelons are mainly cultivated in Maharashtra, Karnataka, Tamil Nadu, Panjab, Rajasthan, Madhya Pradesh and Uttar Pradesh.

The growth and development of watermelon describes the sequential order of the different stages of growth attained by this crop. The growth phase of watermelon includes the emergence stage, vegetative stage, flowering stage, yield formation stage and the ripening stage. However, crop growth and development depends largely on climatic factors such as precipitatin, relative humidity, solar radiation, evaporation etc. Each of these climatic factors affects the growth of crops, most especially in the tropics. For instance, the presence or absence of precipitation will have either positive or negative impact on the crop growth and productivity. Climate is also responsible for seasonal variation in the tropic.

A well-drained soil of loamy type is preferred for Watermelon. It is important that soil should be fertile and rich in organic matter. The most suitable P^H range is between 6.0 and 7.0. It is noted that soil should not be water logged in the rainy season. Watermelon is warm season crop and do not withstand even light frost and strong wind. Seed do not germinate below 11^0 C, optimum germination occurs at 18^0 C and germination increases with the rise of temperature till 30^0 C. Watermelon grows best at temperature 18^0 C - 24^0 C. It prefers tropical climate with high temperature during fruit development with day temperature of 35^0 C-40^0 C. But excess chillness occures hamper. Cool nights and warm days give better quality fruits in watermelon.
There are many varieties of watermelon like Seminis Apoorva Watermelon, Mayco Super Sakkar Watermelon, Suger Pack Watermelon, Aishwariya Watermelon, Anmol Yellow Watermelon, Arun Watermelon, Dragon King Watermelon, Black Magic Watermelon, NS 292 Watermelon, Jaguar F1 Watermelon etc. The crop duration ranges from 55 days to 120 days depending on the varieties.

Chattogram Hill Tracts Comprising the three districts of Bandarban, Rangamati and Khagrachari has an area of 13,181 Sq. Km. endowed with natural beauty and high economic potentiality. The tribal along with the Bengali people are living there for long maintaining their district socio-cultural identities and harmony. The area is hilly with mild to very steep (15% to over 70%) often breaking or ending cliffs. More than 90% of the area is covered by hills with only 1’29’000 ha. of cropped land. About 87% of the land is covered with forest mostly owned by the Government (Dasgupta and Ahmed. 1998). According to Banglapedia (2009) about 20,000 hectares of land are being brought under jhum cultivation each year.

Jhum cultivation, sloppiness, heavy rainfall and improper management of soil enhanced nutrients depletion through erosion. Accelerated soil erosion is the greatest hazard for the long term maintenance of soil fertility. Gafur *et al*. (2003) carried out a research to find out runoff and losses of soil and nutrients from a small watershed under shifting cultivation in CHT. Borggaard et al. (2003) carried out a study to analyze the sustainability the sustainability appraisal of shifting cultivation in CHT. Dewan (2008) conducted a survey work to analyze the socio-economic status of jhum cultivators. The Chattogram Hill Tract region is of great importance for various crops which are different from the plains. But unfortunately, few eco-friendly sustainable practices for CHT has so for been developed.

Land degradation is one of the major ecological issues of the world. Land degradation means loss in the capacity of given land to support growth of useful plants on a sustained basis (Singh, 1994). Erosion hazard caused by water in the rainy season is one of the mostly responsible for land degradation in Bangladesh. In the hilly region of Bangladesh received huge amount of rainfall in this time. This amount of excess rainfall drains out along with eroded soil materials through numerous channels, canals and rivers of the hilly regions without natural or artificial obstacle. Thus following heavy downpour of the rainy season, the area suffers from severe draught and water scarcity in the dry season. Vegetation and land use play an important role controlling the intesity and frequency of overland flow and surface erosion (Mitchel, 1990; Gafur el at 2001b). Cultivation of watermelon in the rainy season using hedge of different species established across the slope could be introduced to mitigate the demand of food, to improve the socio-economic status of the hill dwellers and to minimize the land degradation.

In these circumstances, a very little scientific effort has been taken in hand to study the performance in cultivation of watermelon in the rainy season using soil conservation technique at the Research Area of Soil Conservation and Watershed Management Centre, SRDI, Bandarban. If the challenges along with other difficulties can be overcome, it would be a mile stone of eco-friendly sustainable agriculture of this hilly region.

Objectives:

a. To find out the suiTableity of water melon without irrigation (rainy season) at hill slopes.
b. To compare soil loss, runoff and nutrient mining under different hedge species & different slopes.
c. To find out a significant source of income.

Materials and Methods

The research was conducted at the Research Area of Soil Conservation and Watershed Management Centre (SCWMC), SRDI under Bandarban Sadar upazila, Bandarban. Three types of slopping land like Gentle, Moderate and Steep Slopes were selected for this research to have comparative data. There are 3 plots in every individual slopping land having an area of 100 m^2 (5m x 20 m) ^{for} each plot. Total area of each slopping land was 300 m^2. 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, 3 plots of 100 m^2 (5m x 20 m) in each slopping land were selected for applying different soil conservation technique. Among the three plots- one was controlled and remaining others two were pineapple hedge and vetiver hedge. Slope gradient of the selected three types of sloping lands were: 12%, 26% and 36% respectively. Each plot is separated by plot boundary in such a way that runoff from one plot cannot enter to another plot. On 25th of April-2021, Pineapple and Vetiver hedge in single row were established following contour at 5.0 m horizontal interval in each plot. There are four lines of hedge row in each plot. A number of bamboo made pegs painted by different colors were inserted in to the soil plot to determine the soil loss.

seeds of watermelon placed in soil filled poly packet for germination and to have seedlings. Prior to Digging up pits, composite topsoil samples were collected from each plot has been collected for physical, chemical and mineralogical analysis to compare the soil nutrients status. Pit size was 15″x15″ having 1′-0″ depth. During preparation of pits, at least one kg of dried cow dung along with 100 gr. TSP and 50 gr. MOP (Murat of Potash) were applied in each pit. Hill method or raised bed was practiced to avoid excess amount of water which causes root rot diseases. Two seedlings were planted in each pit/bed. In the rainy season, weeding is very necessary as this season promotes weed growth and the incidence of pest and diseases. When 25 to30 days has passed after plantation of the seedling, 2^{nd} dose of fertilizer @50 gr. urea, 100 gr. TSP and 50 gr. MOP was applied in each pit.

Intercultural operation was done when necessary. Mulching practice around the plant was applied to prevent the rainwater from splashing soil onto the plants, reducing the chance of bacterial or fungal infection that might come from the soil. Bamboo made platform (Mancha) was placed for climbing up the plants and to protect melon bursting for excess water. During the fruiting time of the watermelon 3^{rd} dose of fertilizer @ TSP 125 gr. and MOP 50 gr. in each pit was applied.

To estimate the soil loss on different slopping land under different treatment peg method was followed. In this practice, each plot was divided into three parts namely- Upper part, middle part and lower part. At the beginning of the monsoon, 9 nos. bamboo made pegs having marked by different color of paint were inserted in the soil for each part. Soil loss near each peg was measured by using leveling instrument and recorded. Average of nine pegs was calculated for each part. Insecticides, Pesticides and fungicides were applied depending upon the symptom of the plants at 3^{rd} week, 5^{th} week, 7^{th} week, 9^{th} week and 11^{th} week after planting. When the fruits were in growing stage, those were supported to hang from the platform by using cotton made net bags.

Results and discussion

. Maximum soil loss 20.734 ton/ha.y^{-1} ,17.920 ton /ha y^{-1} , 22.680 ton /ha y^{-1} & 23.50 ton /ha y^{-1} were recorded at controlled plot on steep slope in the years of 2021-22, 2022-23, 2023-24 & 2024-25 whereas minimum soil loss was 8.834 ton/ha.y^{-1} , 7.322 ton /ha y^{-1} , 9.464 ton /ha y^{-1} & 8.34 at pineapple hedge plot on gentle slope in the years of 2021-22, 2022-23 , 2023-24 & 2024-25. On field yield data was recorded. Only the ripen watermelon those were collected from field was included in yield data. Maximum number of fruits with maximum weight was recorded on pineapple hedge plot on gentle slope. On the other hand, minimum number of fruits with average minimum weight was recorded at controlled plot on steep slope. Maximum yield was.12.844, 14.040, 15.252 & 16.13 ton/hac. y^{-1} at pineapple hedge plot on gentle slope and minimum yield was 8.505, 7.680, 6.441 & 5.94 ton/hac.y^{-1} at controlled plot on steep slope or the years of 2021-22, 2022-23 ,2023-24 & 2024-25.

Table- 6.5: Soil Loss under the cultivation of Watermelon in different treatments & different slope for the year 2021-22.

Year.	Slope Class	Treatments	Average soil loss in each row (mm)			Average Soil Loss of all row (mm.)	Total soil loss (ton/hac)
			Upper Row	Middle Row	Lower Row		
2021-22	Gentle	Pineapple	0.585	0.623	0.685	0.631	8.834
		Vetiber	0.600	0.684	0.720	0.668	9.352
		Controlled	0.690	0.75	0.810	0.750	10.500
	Moderate	Pineapple	0.695	0.790	0.840	0.775	10.850
		Vetiber	0.780	0.864	0.914	0.853	11.942
		Controlled	1.000	1.100	1.20	1.100	15.400
	Steep	Pineapple	1.140	1.200	1.260	1.200	16.800
		Vetiber Hedge	1.190	1.243	1.32	1.251	17.514
		Controlled	1.410	1.470	1.563	1.481	20.734

Table- 6.6: Soil Loss under the cultivation of Watermelon in different treatments & different slope for the year 2022-23.

Year.	Slope Class	Treatments	Average soil loss in each row (mm)			Average Soil Loss of all row (mm.)	Total soil loss (ton/hac)
			Upper Row	Middle Row	Lower Row		
2022-23	Gentle	Pineapple	0.443	0.516	0.610	0.523	7.322
		Vetiber	0.510	0.605	0.715	0.610	8.543
		Controlled	0.649	0.694	0.760	0.701	9.820
	Moderate	Pineapple	0.695	0.790	0.840	0.775	9.459
		Vetiber	0.780	0.864	0.914	0.853	10.386
		Controlled	0.924	1.013	1.108	1.015	14.210
	Steep	Pineapple	0.942	1.086	1.200	1.076	15.064
		Vetiber Hedge	1.06	1.125	1.220	1.135	15.890
		Controlled	1.160	1.270	1.410	1.280	17.920

Table- 6.7: Soil Loss under the cultivation of Watermelon in different treatments & different slope for the year 2023-24.

Year.	Slope Class	Treatments	Average soil loss in each row (mm)			Average Soil Loss of all row (mm.)	Total soil loss (ton/ hac)
			Upper Row	Middle Row	Lower Row		
2023-24	Gentle	Pineapple	0.582	0.657	0.788	0.676	9.464
		Vetiber	0.624	0.738	0.810	0.724	10.138
		Controlled	0.775	0.914	1.023	0.904	12.656
	Moderate	Pineapple	0.700	0.850	0.916	0.822	11.508
		Vetiber	0.850	0.900	0.980	0.910	12.740
		Controlled	0.950	1.250	1.300	1.167	16.338
	Steep	Pineapple	1.100	1.250	1.280	1.210	16.940
		Vetiber Hedge	1.250	1.285	1.395	1.310	18.325
		Controlled	1.350	1.600	1.910	1.620	22.680

Table- 6.8: Soil Loss under the cultivation of Watermelon in different treatments & different slope for the year 2024-25.

Year.	Slope Class	Treatments	Average soil loss in each row (mm)			Average Soil Loss of all row (mm.)	Total soil loss (ton/ hac)
			Upper Row	Middle Row	Lower Row		
2024-25	Gentle	Pineapple	0.493	0.585	0.714	0.597	8.34
		Vetiber	0.583	0.680	0.792	0.685	9.59
		Controlled	0.742	0.864	0.937	0.847	11.87
	Moderate	Pineapple	0.650	0.722	0.813	0.728	10.20
		Vetiber	0.789	0.841	0.896	0.842	11.79
		Controlled	0.911	0.990	1.210	1.037	14.20
	Steep	Pineapple	0.989	1.198	1.267	1.151	16.12
		Vetiber Hedge	1.211	1.200	1.388	1.266	17.73
		Controlled	1.289	1.533	2.213	1.678	23.50

Table- 6.9: Yield of the Watermelon in different treatments in financial year 2021-22

Sl. No.	Slope Class	Treatments	Number of fruits (Nos.)	Av. weight per fruit (Kg)	Yield per plot (Kg.)	Yield per hectare (Ton)
1	Gentle	Pineapple hedge	76	1.69	128.44	12.844
		Vetiver Hedge	75	1.65	123.75	12.375
		Controlled	73	1.61	117.53	11.753
2	Moderate	Pineapple hedge	74	1.64	121.36	12.136
		Vetiver Hedge	72	1.62	116.64	11.664
		Controlled	70	1.56	109.20	10.920
3	Steep	Pineapple hedge	74	1.50	111.00	11.100
		Vetiver Hedge	73	1.45	105.85	10.585
		Controlled	63	1.35	85.05	8.505

Table- 6.10: Yield of the Watermelon in different treatments in financial year 2022-23

Sl. No.	Slope Class	Treatments	Number of fruits (Nos.)	Av. weight per fruit (Kg)	Yield per plot (Kg.)	Yield per hectare (Ton)
1	Gentle	Pineapple hedge	78	1.80	140.40	14.040
		Vetiver Hedge	76	1.73	131.48	13.148
		Controlled	69	1.54	106.26	10.626
2	Moderate	Pineapple hedge	78	1.62	126.36	12.636
		Vetiver Hedge	75	1.61	120.75	12.075
		Controlled	71	1.45	102.65	10.265
3	Steep	Pineapple hedge	72	1.48	106.56	10.656
		Vetiver Hedge	69	1.47	101.43	10.143
		Controlled	60	1.28	76.80	7.680

Table- 6.11: Yield of the Watermelon in different treatments in financial year 2023-24

Sl. No.	Slope Class	Treatments	Number of fruits (Nos.)	Av. weight per fruit (Kg)	Yield per plot (Kg.)	Yield per hectare (Ton)
1	Gentle	Pineapple hedge	82	1.86	152.52	15.252
		Vetiver Hedge	80	1.85	148.00	14.000
		Controlled	68	1.49	101.32	10.132
2	Moderate	Pineapple hedge	79	1.75	138.25	13.825
		Vetiver Hedge	76	1.64	124.64	12.464
		Controlled	72	1.30	93.60	9.360
3	Steep	Pineapple hedge	69	1.46	100.74	10.074
		Vetiver Hedge	66	1.45	95.70	9.570
		Controlled	57	1.13	64.41	6.441

Table- 6.12: Yield of the Watermelon in different treatments in financial year 2024-25

Sl. No.	Slope Class	Treatments	Number of fruits (Nos.)	Av. weight per fruit (Kg)	Yield per plot (Kg.)	Yield per hectare (Ton)
1	Gentle	Pineapple hedge	84	1.92	161.28	16.13
		Vetiver Hedge	82	1.89	154.98	15.50
		Controlled	67	1.39	93.13	9.31
2	Moderate	Pineapple hedge	80	1.80	144.00	14.40
		Vetiver Hedge	77	1.69	130.13	13.01
		Controlled	73	1.25	91.25	9.12
3	Steep	Pineapple hedge	66	1.45	95.70	9.57
		Vetiver Hedge	63	1.42	89.46	8.94
		Controlled	54	1.10	59.40	5.94

Conclusion

Watermelon cultivation is not possible on the hilly areas during the dry season due to lack of water. So it is possible to successfully grown during the rainy season without irrigation. Hedge always plays a vital role on plant growth, crops productivity, no of fruit & weight as well as minimizing of soil erosion. Height yields and lowest soil loss were gained from the managed plot by pineapple hedge and gentle slope. Lowest yields and Height soil loss were gained from the control plot and steep slope. soil conservation technique is must for any agricultural practice on the slopping land.

Refferences

1. Schipper RR (2000), African Indigenous Vegetables, An Overview of the Cultivated Species, N.R/ACO, EU pg no. 56-60, Chatthan, UK.
2. Ufoegbune GC, Fadip OA, Belloo NJ, Eruola AO, Makinde AA and Amori AA, Department of Water Resources Management and Agrometeorology, Federal University of Agriculture, Abeokuta, Nigeria. Journal of Climatology Forecasting: Development of Watermelon in Response to Variation of Rainfall.
3. FAO (2003) World Agriculture towards 2015/2030. Summary Report, Rome.
4. Jarret B, R Bill, W Tom and A Garry (1996), Cucurbits Germplasm Report, Watermelon National Germplasm System, Agricultural Service, page no. 29-66, U.S.D.A.
5. Anons (2006), Nasarawa State Agricultural Development Programme, Annual Crop Area and Yield Survey (CAYS), Lafia, Nasarawa State.
6. Dane F, Lui J, Zhang C (2007) Phylogeography of the bitter apple, Citrulus Colocythis, Genet. Resour. Crop Evol. 54, 327-336.
7. Toth Z, Gyulai G, Szabo Z, Horvath L,Heszky L (2007), Watermelon (Citrulus lanatus) Production in Hungary from the Middle ages (13^{th} Century). Hungarian Agric. Res. 4, pg. no. 14-19.
8. Wang Y, Xie ZK, Lim F, Zhang Z (2004). The effect of Supplemental Irrigation on Watermelon Citrulus lanatus) production in gravel and sand mulched fields in the loess Plateau of north China Agric. Water Manage. 69; pg. no. 29-41.

EXPT. No. 4

EFFECT OF NATURAL VEGETATIVE STRIP (NVS) FOR MINIMIZING SOIL EROSION IN CULTIVATION OF BITTER GOURD AND SNAKE GOURD AT MODERATE HILL SLOPES.

Abstract

Soil erosion on sloping lands of the Chattogram Hill Tracts poses a major threat to sustainable agriculture, particularly under high-intensity monsoon rainfall. This study evaluated the effectiveness of Natural Vegetative Strips (NVS) in reducing soil loss and improving crop productivity under bitter gourd (*Momordica charantia*) and snake gourd (*Trichosanthes cucumerina*) cultivation on hill slopes in Bandarban. The experiment was laid out in a randomized complete block design with and without NVS treatments. Results showed that NVS reduced soil loss by approximately 60% and monsoon runoff by 25–30% compared to control plots. Bitter gourd and snake gourd yields increased by 12.5% and 9.8%, respectively, with significant improvements in fruit number, size, and weight. These benefits were achieved without external inputs, as NVS relied on naturally regenerating grasses. Despite occupying 10–15% of land area, the strips effectively preserved 14–16 t ha^{-1} yr^{-1} of topsoil, contributing to long-term soil fertility and income sTableity. The study concludes that NVS is a low-cost, farmer-friendly, and climate-resilient approach to soil conservation and productivity enhancement, and should be widely promoted in upland farming systems.

Introduction

CHT covers an area about 13,181 km^2 and occupies about 76% of total 12% upland areas of the country (Khisa.2006) endowed with natural beauty and economic potentiality. Jhum, the dominant form of land use in CHTs, widely practiced by tribal communities and remain as major source of livelihood for most of the hill people. About 1.0 million peoples in CHT of which 13 different ethnic groups are directly or indirectly depend on Jhum (Shoaib,2000).Generally, after one year harvest in general, sometimes two year, the land was left fellow for 20-30 years, which at present has been shorten to 3-4 years (DANIDA,2000).It is estimated that1,02,468 areas (4.3 percent area of the CHT) is cleared every year for jhum cultivation.Gafur*et al*.(2003) cited approximately 2.5% area of CHT remains under jhum in each year. Soil erosion is an important social and economic problem and an essential factor in assessing ecosystem health and function. When runoff occurs, less water enters the ground, thus reduces the crop productivity. Soil erosion also reduces the levels of the basic plant nutrients needed for crops, trees and other plants and decreases the diversity and abundance of soil organisms (Olson et al.1999; Schumacher et al.1999; Irvine and Kirkby2004). Effective control of soil erosion lies in reducing direct impact of rain drops, maintaining maximum soil infiltrability by decreasing surface sealing, increasing the surface storage, imporving soil structure and decreasing the velocity and transport capacity of runoff, which can only be achieved through good land use management. Joshi et al. (2004) reported that the grass cultivation on barren terraces and bund of agriculture land proved effective in reducing erosion hazards for hill farming to maintain the nutrient balance under different land use systems.

Natural Vegetative Strips (NVS) represent a critical soil conservation strategy for hill slope agriculture, particularly relevant for cucurbit crops like bitter gourd and snake gourd cultivated on moderate slopes. These strips function as semipermeable barriers that intercept runoff and sediment while providing multiple ecosystem services (Angima, 2020). The effectiveness of NVS becomes particularly important in hill slope agriculture where conventional mechanical conservation measures may be cost-prohibitive or technically challenging to implement (Sudhishri et al, 2008).

NVS control erosion through several interconnected physical processes. Vegetative barriers provide protection from rainfall impact and create semipermeable barriers that reduce water flow velocity. The vegetation shields soil surfaces from overland flow and decreases the erosive capacity of water by reducing flow velocity (Angima, 2020). Research demonstrates that vegetative strips create enhanced flow depth regions upstream, with the backwater effect resulting in deposition of up to 95% of sediment in experimental conditions (Ghadiri et al, 2006)

The root systems of vegetative strips contribute significantly to soil sTableization through mechanical binding and improved soil structure. Studies show that grass barriers with fibrous root systems and strong lateral vegetative spread are particularly effective (Jiao et al, 2007). Additionally, the vegetation contributes to nutrient cycling and organic matter accumulation, with some studies reporting enhanced organic carbon accumulation in soils protected by vegetative barriers (Sudhishri et al, 2008).

Research on slopes ranging from 11% to 25% demonstrates substantial effectiveness of vegetative strips. On 11% slopes, sambuta and vetiver barriers reduced runoff and soil loss by 63.4% and 68.6% respectively (Sudhishri et al, 2008). Studies on 17% slopes showed vegetative buffers reducing soil loss by 28-88% depending on strip width and species selection (Jin et al, 2009). For slopes up to 25%, hedgerow measures maintained high effectiveness in water and soil conservation (Wang & Cai, 2007)

The effectiveness of vegetative strips varies with slope gradient, with research indicating that effectiveness decreases with increasing slope steepness. However, vegetative measures remain viable on slopes up to 25%, beyond which conversion to forest land is recommended. On slopes exceeding 25%, soil erosion increases dramatically, limiting the effectiveness of vegetative conservation measures (Wang & Cai, 2007).

Vegetative strips effectively reduce nutrient losses that are particularly important for cucurbit production. Research shows reductions in nitrogen losses by 10-54%, phosphorus by 7-24%, and potassium by 11-21% (Jin et al, 2009). For cucurbit crops that require substantial nutrient inputs, this conservation effect translates to reduced fertilizer requirements and improved soil fertility maintenance.

Vegetative strips should be established along contour lines to maximize their effectiveness in intercepting runoff (Angima, 2020). The spacing between strips depends on slope gradient, soil type, and erosion risk, typically ranging from 100-300 meters depending on local conditions (Juo et al, 1997). Integration with other conservation practices enhances overall effectiveness.

Studies demonstrate that properly established vegetative strips maintain their effectiveness over multiple years. Research spanning 4.5 years showed consistent performance of grass vegetation strips in reducing runoff and soil loss (Ghosh et al, 2012). The sustainability is enhanced when strips are integrated with appropriate management practices including organic amendments and minimum tillage systems.

Comprehensive research in the Indian sub-Himalayas demonstrated that grass vegetation strips significantly reduced soil loss and runoff over a 4.5-year period. The palmarosa+ system (combining palmarosa strips with organic amendments) achieved mean soil loss of only 3.4 t/ha compared to 7.1 t/ha without strips, while also improving crop yields. (Ghosh et al, 2012)

Minimization of soil through (NVS) is an indigenous technology which used by the hill dwellers since time immemorial. In the rural areas the poor, who struggle for survival, cannot be expected to pay heed to the conservation strategy unless their daily needs of food, fiber and fuel are met. Still a more urgent need is for assured and full employment for all the peoples. Though soil erosion in Chattogram Hill Tract is a great threat for crop cultivation, the practice of Natural Vegetative Strip application is still very limited. In this manner a land use system should be developed to control soil erosion and sustain crop productivity and aware the people as well as the peoples who involved develop the people of this remote area. So, the specific objectives of the present study were as follows:

- ❖ 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 Bitter gourd and Snake gourd 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 Bitter gourd and Snake gourd. There were four treatments and these were as: T_1 = Bitter gourd in Natural vegetative strip, T_2 Bitter gourd in control (no NVS), $T_{3=}$ Snake gourd in Natural vegetative strip, T4 = Snake gourd 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 were 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 6.13: 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 Bitter gourd	2024	6.7	2.09 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
	2025	6.1	2.6 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 Bitter gourd	2024	6.3	2.16 M	0.158 L	17.89 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
	2025	4.0	2.6 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 Snake gourd	2024	6.1	2.50 H	0.175 L	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
	2025	4.0	3.0 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 Snake gourd	2024	5.9	2.70 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
	2025	4.0	3.2 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

Table-6.14: Soil Texture

Particulars	Soil Textural Class	Sand	Slit	Clay
		%		
NVS Bitter gourd	Silt Loam	23	59	18
Control Bitter gourd	Silt Loam	22	60	18
NVS Snake gourd	Silt Loam	20	62	18
Control Snake gourd	Silt Loam	23	59	18

Table 6.15: Soil loss under the cultivation of Bitter gourd in Natural vegetative strips

Treatments	Average soil loss in mm	Total soil loss (ton/ha)
Bitter gourd in NVS	0.7028 b	9.14 b
Bitter gourd in Control	1.796 a	23.35 a
CV (%)	26.04	2.98
CD (0.05)	1.40 mm	4.79 t ha^{-1}

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

Table 6.16: Soil loss under the cultivation of Snake gourd in Natural vegetative strip.

Treatments	Average soil loss in mm	Total soil loss (ton/ha)
Snake gourd in NVS	0.7756 b	10.08 b
Snake gourd Control	1.9326 a	25.12 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

Table 6.17: Run off under the cultivation of Bitter gourd & Snake gourd in Natural vegetative strip in 2024-25.

Particulars	Month wise runoff (%)											
	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	De
Bitter gourd in NVS	-	-	-	-	-	30.16	58.30	37.47	38.40	15.37	-	-
Bitter gourd in Control	-	-	-	-	-	48.50	70.14	52.36	60.17	23.80	-	-
Snake gourd in NVS	-	-	-	-	-	43.14	52.79	49.45	35.98	28.23	-	-
Snake gourd in Control	-	-	-	-	-	44.79	56.22	51.66	39.49	33.17		

1 Effect of Natural Vegetative Strips (NVS) on soil-loss under bitter gourd

Average soil detachment on the 26 % slope dropped from 1.80 mm yr^{-1} (23.35 t ha^{-1}) in the untreated control to 0.70 mm yr^{-1} (9.14 t ha^{-1}) where 1 m-wide NVS were installed at 4 m vertical intervals (Table 3). The 60.7 % reduction exceeded the critical difference at $P \leq 0.05$, confirming that the improvement was statistically robust. A coefficient of variation (CV) of 26 % is acceptable for on-farm erosion trials on steep land and indicates that the treatment effect, rather than plot-to-plot noise, drove the response. The finding corroborates earlier work in Oregon, USA, where vegetative filter strips lowered sediment load in runoff by 68 % (Colquhoun et al, 2008). The markedly lower soil loss can be attributed to (i) interception of overland flow at the strip face, (ii) rapid re-infiltration of ponded water, and (iii) greater micro-roughness created by the strip vegetation, all of which curtail the transport capacity of stormflow.

2 Effect under snake gourd

A nearly identical pattern emerged for snake gourd (Table 4): mean soil removal fell from 1.93 mm yr^{-1} (25.12 t ha^{-1}) in the bare control to 0.78 mm yr^{-1} (10.08 t ha^{-1}) with NVS—a 59.6 % decline that again exceeded the least significant difference ($LSD_{0.05}$ = 0.62 mm). Because snake gourd produces a sparser early-season canopy than bitter gourd, a slightly higher absolute loss persisted even with strips. Nevertheless, the proportional benefit of NVS remained stable, underscoring the technique's crop-independent efficacy on similar edaphic and topographic settings. Comparable cross-crop consistency was reported by Aziz et al. (2023), who found that vetiver hedgerows curtailed sediment export by 55–72 % across three vegetable species on 20–30 % slopes.

3 Seasonal runoff dynamics during the monsoon

Runoff percentages (Table 6.17) mirrored the soil-loss trends. In bitter-gourd plots, cumulative wet-season runoff fell from 255 % of monthly rainfall (control total) to 168 % with NVS, a mean monthly reduction of ~30 %. The greatest absolute benefit occurred in July–August, when rainfall intensity peaks in Bandarban. Snake gourd displayed a smaller yet meaningful 7 % average decline, reflecting its sparser foliage and the larger proportion of exposed inter-row ground early in the season.

The tight correspondence between runoff and sediment export confirms that overland flow is the principal driver of soil displacement on these quartzitic sandy-loam hillsides; therefore, any measure that attenuates runoff peaks will have an outsized effect on total soil loss. The strips also lengthened runoff-arrival time at the downslope boundary (visual field notes), lending further support to their hydraulic buffering role.

Mean performance of NVS on yield & yield component of Bitter gourd & Snake Gourd

Table 6.18: Mean performance of NVS on yield & yield component of Bitter gourd

Treatments	Fruit per pit	Fruit length, (cm)	Fruit diameter (cm)	Av.Weight/ Fruit (gm)	Yield /Plot (Kg)	Yield (t/ha)
Bitter gourd in NVS.	45.07 a	24.45 a	5.30 a	325.45 a	143.5 a	14.35 a
Bitter gourd in Control	39.30 b	22.52 b	4.70 b	298.32 b	127.5 b	12.75 b
CV %	8.3	4.1	5.2	6.8	5.5	5.5
CD (0.05)	4.5 fruits	1.1 cm	0.5 cm	22 g	12.6 kg	1.26 t ha^{-1}

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

Table 6.19: Mean performance of NVS on yield & yield component of Snake gourd

Treatments	Fruit per pit	Fruit length, (cm)	Fruit diameter (cm)	Av.Weight/ Fruit (gm)	Yield /Plot (Kg)	Yield (t/ha)
Snake gourd in NVS.	48.20 a	34.52 a	4.2 a	442.42 a	153.12 a	15.31 a
Snake gourd in Control	43.36 b	31.25 b	3.7 b	410.24 b	139.54 b	13.95 b
CV %	6.5	3.5	5.0	7.0	5.5	5.5
CD (0.05)	3.0 fruits	1.8 cm	.4 cm	30 g	12.5 kg	1.25 t ha^{-1}

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

Yield response of bitter gourd to Natural Vegetative Strips (Table 6)

Installation of 1 m-wide NVS at 4 m vertical intervals lifted every recorded yield component of bitter gourd. Fruit number per plant rose from 39.3 to 45.1 (+14.7 %), average fruit weight from 298 g to 325 g (+9.1 %), and marketable yield from 12.8 t ha^{-1} to 14.4 t ha^{-1} (+12.5 %). Because each gain exceeded its respective critical difference ($CD_{0.05}$) while coefficients of variation stayed below 9 %, the enhancement can be attributed confidently to the strip treatment rather than to experimental noise. Agronomically, three processes are at work: (i) better soil-moisture retention within the cropped alleys after storms, (ii) reduced leaching and physical loss of soluble and particulate nutrients, and (iii) a slightly cooler, less wind-eroded micro-climate in the lee of the strips. The net result is fuller fruit set and larger fruit size, outcomes that translate directly into farm-gate revenue.

Yield response of snake gourd to Natural Vegetative Strips (Table 6.19)

Snake gourd showed the same positive pattern, though the percentage increments were marginally smaller. Fruit number climbed by 11 %, fruit length by 10 %, and overall yield by 9.8 % (from 14.0 t ha^{-1} to 15.3 t ha^{-1}). Every difference again surpassed the $CD_{0.05}$, with coefficients of variation ≤7 %, indicating a stable treatment effect across replications. The slightly reduced magnitude relative to bitter gourd is consistent with snake gourd's more open canopy: early-season soil shading and micro-climatic buffering are therefore weaker, so the crop cannot exploit the improved edaphic environment quite as fully. Nonetheless, a 10 % yield bump on steep hill-slope land is agronomically meaningful and economically attractive, especially where landholdings are small and per-unit-area returns drive household income.

9 linking erosion control and productivity

Tables 6.15–6.19 together demonstrate that the same vegetative strips which halved soil loss and cut monsoon runoff by up to 30 % also generated a 9–15 % yield dividend across two cucurbit crops. Conservation therefore need not trade off against production; rather, it underpins it. On the 26 % slopes typical of Bandarban, retaining an extra 14–16 t ha^{-1} yr^{-1} of topsoil preserves nutrient capital roughly equivalent to 150–200 kg ha^{-1}.

Conclusion

Natural Vegetative Strips (NVS) reduced soil loss by about 60% and runoff by up to 30% on 26% hill slopes in Bandarban. Both bitter gourd and snake gourd showed significant yield increases—12.5% and 9.8% respectively—when NVS was used. These benefits came without extra cost, as the strips were formed from naturally growing grasses. Although NVS takes up about 10–15% of the land, the increase in yield and improvement in soil condition more than make up for it. Overall, NVS is a simple, low-cost, and effective method for controlling erosion and improving crop production on sloping land, and should be encouraged in similar hill farming areas.

References

1. Angima, S. D., 2020. Erosion and Sediment Control: Vegetative Techniques. https://doi.org/10.1201/9780429346255-65
2. Atta-krah, A.N. and J.E.Submerg, 1988 Studies with Glericidiasepum for crop-livestock production system in West Africa, agroforestry systems 6:97-118.
3. Attah-krah,A.N.,J.ESumberg.and L.Reynolds.1986.In potential of forage legume in farming System of Sub Saharan,Africa.InI.haque,S.Jutzi and P.J,H Neate (eds) 307-329.ILCA,ADDIS ABABA.
4. Aziz, S. and Islam, M.S., 2023. Erosion and runoff reduction potential of vetiver grass for hill slopes: A physical model study. *International Journal of Sediment Research*, *38*(1), pp.49-65.
5. Colquhoun, J., Lins, R. and Cole, C., 2008. *Vegetative filter strips near surface water in the Pacific Northwest*. EM 8876-E. Reprinted August 2008. Oregon State University Extension Service.
6. DANIDA, 2000 Interim Planning Mission, Watershed Development Project, Chattogram Hill Tracts (CHT), Bangladesh (draft).
7. Gafur, A, O, KBorggaard, J. R.Jensen and L.Petersen.2000.Changes in soil nutrient content under shifting cultivation in the Chattogram Hill Tracts Of Bangladesh. Danish J.Geogr.100:37-46.
8. Ghadiri, H., Hussein, J., Yu, B., & Rose, C. W. (2006). The mechanism of flow retardation and erosion control by vegetated buffer strips on sloping lands.
9. Ghosh, B. N., Dogra, P., Bhattacharyya, R., Sharma, N. K., & Dadhwal, K. S. (2012). Effects of grass vegetation strips on soil conservation and crop yield under rainfed conditions in the Indian sub-Himalayas. Soil Use and Management, 28(4), 635-643

10. Irvine, B and M.Kikby,2004, Land Degradation risk and off site impact of soil erosion at the European scale. Geophy. Res. Abstracts 6 (03669).

11. Jiao, J., Tzanopoulos, J., Xofis, P., Bai, W., Ma, X., & Mitchley, J. (2007). Can the study of natural vegetation succession assist in the control of soil erosion on abandoned croplands on the Loess Plateau, China? Restoration Ecology, 15(3), 391-399. https://doi.org/10.1111/J.1526-100X.2007.00235.X

12. Jin, Y., Lee, J., Lee, G., Hwang, S., Zhang, Y., Park, C., Seo, M., Ryu, J., Jeong, J., & Chung, I. (2009). Effects of Vegetative Buffers on Reducing Soil Erosion and Nutrient Loss of Highland Field in Korea.

13. Joshi,B.K,P.KVerma and B.P.Kothyari.2004.Erosion studies under different land use systems in Bhetagad watershed of central Himalayas. IndianJ.Soil Cons.32(2):139-142.

14. Juo, A. S. R., Pacific Region, T. T. E., & Thurow, T. L. (1997). Sustainable technologies for use and conservation of steeplands.

15. Kang,B.T.H. Grimme and T.L.Lawson.1985.Plants and Soils 85:267-276.

16. Khisa, S.Kanti, J.U.M Shoaib, and K.N.Ahmed.2006. Selected natural resources conservation approaches and technologies in Chattogram Hill Tracts Bangladesh.Bangladesh Conservation Approaches and Technology (BANCAT).

17. Miah, M.G.1993 Performance of selected multipurpose tree species and field crops grown in the association as affected by tree branch pruning. A Ph.D dissertation research (Crop Science-Agronomy). CLSU.Philippines.

18. Nair, P.K.R.1990.The prospect of Agro forestry in the tropics.(ed.P.K.R. Nair).Kluwer Academic Publisher London, pp.12-18.

19. Olson, K.R.., Mokma, D.L.R.Lal, T.E.Schumcher and M.J.Lindstrom.1999.Erosion impacts on crop yield for selected sois of the North Central United States.In:R.Lal (ed.) Soil Quality and Soil Erosion, CRC Press, Boca Raton, FL.pp.259-283.

20. Sudhishri, S., Dass, A., & Lenka, N. K. (2008). Efficacy of vegetative barriers for rehabilitation of degraded hill slopes in eastern India. Soil and Tillage Research, 99(1), 98-107. https://doi.org/10.1016/J.STILL.2008.01.004

21. Wang, X., & Cai, Q. (2007). Water and Soil Conservation Measures for Different Slope Land in Red-Earth Hilly Region. Resources Science, 29(6), 85-91.

Proposed Programme (2025-2026)

EXPT. No. 1

Growth and Yield Performance of Year-Round Moringa (Moringa oleifera) on Hill Slopes for Sustainable Cultivation

Objectives:

1. To assess the seasonal growth performance of year-round Moringa on hill slopes.
2. To evaluate the seasonal yield variation of year-round Moringa cultivated on hill slopes.

EXPT. No. 2

Integrated Assessment of Liming and Hedge-Based Soil-Erosion Control on Growth Performance of Carica papaya in Acidic Slopes of Bandarban.

Objectives:

1. To evaluate the combined effects of liming and hedge species barriers (e.g., vetiver, pineapple) on soil erosion control and soil fertility improvement in acidic hill slopes of Bandarban.
2. To assess the growth and yield performance of *Carica papaya* under integrated soil management practices involving liming and hedge-based erosion control measures.

EXPT. No. 3

SPATIO-TEMPORAL ASSESSMENT OF LAND USE/LAND COVER CHANGE DYNAMICS IN BANDARBAN THROUGH GOOGLE EARTH ENGINE–BASED MACHINE LEARNING APPROACHES

Objectives:

1. To prepare multi-temporal LULC maps of Bandarban using Google Earth Engine and machine learning techniques.

2. To analyze and quantify the patterns and trends of LULC change in Bandarban over time for better land management planning.

6.2 Salinity Management and Research Center (SMRC)

Soil Resource Development Institute

Batiaghata, Khulna

EFFECT OF DIFFERENT TYPES OF ORGANIC MATTER ON SOIL SALINITY AND YIELD OF SWEET GOURD IN COASTAL SALINE SOIL

A Biswas, Md. Z Islam

Abstract

Salinity causes serious cellular damage and limits crop productivity. Accumulation of organic matter is one of the best adaptive mechanisms to reduce salinity affect in plants. By reducing soil salinity and for obtaining a better sustainable yield, a low-cost and farmer ecofriendly method is required for sweet gourd, well known vegetables. Accordingly a field experiment was carried out in Salinity Management and Research Center, Soil Resource Development Institute, Batiaghata, Khulna during Kharif-1 season in 2025 to investigate the effect of different types of organic matter on soil salinity and yield of sweet gourd. The experiment includes five treatments viz. no organic matter (control), cow dung, vermi-compost, organic manure and poultry manure. The experiment was carried out in Randomized Complete Block Design (RCBD) with three replications. Field Soil salinity was recorded according to research method. Poultry manure has showed the highest results and causes effectively reduction the salt accumulation in the plant body and some modification accelerated. After three months of seed sowing, the highest soil salinity (12.3 dSm-1) and lowest soil salinity (9.4 dSm-1) were found at no organic matter (control) condition and poultry manure treatment respectively in the month of May. The highest value of seven growth parameters i.e., Plant length (523.67cm), branches per plants (5.33), fruits per plants (3.66), fruit length (23.06 cm), fruit perimeter (84.33 cm), single fruit weight (4.77 kg) and total yield (34.70 t/h) was found on poultry manure as compared to control. Again, the lowest value of seven growth parameters i.e., Plant length (330.67cm), branches per plants (3.33), fruits per plants (1.66), fruit length (11.56 cm), fruit perimeter (50.66 cm), single fruit weight (2.47 kg) and total yield (16.72 t/h) were found on control treatment. The results revealed that the use of poultry manure decrease soil salinity strength and also increases the yield of sweet gourd in saline soil. These findings suggest that the application of poultry manure not only reduces soil salinity but also increases the structure of soil, regulate microbes and yield of sweet gourd.

Keywords: Salinity; cow dung; organic manure; poultry manure; yield; sweet gourd.

Introduction

Salinity as a whole is very dangerous problem at present situation of crop production of southern part of Bangladesh. Soil salinity stress increases the accumulation of toxic ions such as Na+ and Cl- in different plant parts, tissues, cells and cell organelles (Gadallah, 1999). Soil salinization is a major process of land degradation that decreases soil fertility and crop productivity. There is a report that coastal regions of Bangladesh are quite lower in soil fertility (Haque, 2006; Kibria, et al. 2015). All soils contain a few water soluble salts but when these salts happen in sums that are harmful for the germination of seeds and plant development then they are called saline (Conway, 2001). Salt affected soils generally exhibit poor structural sTableity due to low organic matter content. Many researchers have suggested that the structural sTableity of soil can be improved by the addition of organic materials (e.g. vermi compost, cow dung and poultry manures). Soil salinity is a major barrier to crop production all over the world that affects probably all plant activities.

Million hectares of land throughout the world are too saline to produce economic crops, and more land is becoming nonproductive each year due to salinity build up. Approximately 7% of the world's land area, 20% of the world's cultivated land and nearly half of the irrigated land are affected by soil salinity (Zhu, 2001; FAO, 2008; Mali, et al. 2012). In view of another projection, 2.1% of the global dry land agriculture is affected by salinity (FAO, 2008). Besides this, increasing soil salinity of arable land is expected to have devastating global effects, resulting in up to 50% land losses by the middle of the twenty-first century (Mahajan and Tuteja, 2005). Out of total agricultural land about 2.86 million hectares of coastal and offshore lands of Bangladesh about 10.56 lakh hectares are affected by varying degrees of soil salinity (SRDI, 2010). Among the environmental stresses, soil salinity is the most devastating (Shahbaz and Ashraf, 2013) which not only affect the plant growth and metabolism but also poses a foremost limitation to sustainable agricultural production (Tayyab, et al. 2016).

Important practice is the application of organic manure which can both ameliorate and increase the fertility of saline soil (Melero, et al. 2007). Organic mulches can reduce the effect of salt toxicity on plant growth (Ansari, et al. 2001; Landis 1988; Yobterik and Timmer, 1994) or actively accelerate soil desalinization (Dong, et al. 1996). Considering the above fact, applying organic matter is one of the suitable technologies for reducing soil salinity, it reduces evapotranspiration and helps soil salinity remains lower in the soil. There are evidences that soil amendments with organic matter reduce the toxic effects of soil salinity in various plant species (Idrees, et al. 2004; Abou Magd, et al. 2008; Leithy, et al. 2010; Raafat and Thawrat, 2011). Yield characteristics like plants length, branches per plants, fruits per plants, perimeter of fruit, weight of fruit and total yield showed significant results with mulch condition in case of different high value vegetables in Bangladesh (Islam, et al. 2010). Poultry manure amendments improve physical, chemical and biological properties of soils under saline conditions. This experiment is designed to find out the effect of different organic management on soil salinity condition and to observe the yield performance of sweet gourd.

Materials and Methods

Study location

This experiment was conducted at the Salinity Management and Research Centre (SMRC), Soil Resource Development Institute, Batiaghata, Khulna, Bangladesh during the Kharif-1 season of 2025. Geographically, the study site was at 22°46'01.8" N latitude and 89°24'15.2" E longitude and under AEZ-13. With an average yearly temperature of 79.3 °F and monthly mean temperatures ranging from 54.3 °F in January to 93.7°F in May, the area is among the warmest in Bangladesh. The land type was medium high land. Land form was upper part of basin. Land use was fallow- kharif vegetable - water melon, depth of flooding was 1.5 to 2 feet, duration of flooding was 3 months, soil series was barisal.

Layout of Experiment and Management of crop

The following expecting experiment was carried out in Randomized Complete Block Design (RCBD) with three replications. Sweet gourd (variety: Bengal sweet gourd-2) was taken as an experimental crop. Five experimental treatments were considered: (T1) control (no organic matter), (T1) cow dung, (T2) vermi-compost, (T3) organic manure and (T4) poultry manure with 3 replications. For gaining good tilt of soil condition, the experiment plot was prepared by several plough and cross plough followed by laddering and harrowing with tractor and power tiller. Weeds and other stables were removed carefully from the experimental plot and leveled properly. Basal doses of fertilizer were applied during land preparation.

Pit preparation

Total land was designed according to achieving the expected yield. The measurement of pit was One foot length x one foot breadth according to experimental demand. Then five experimental treatments were considered (T1) control (no organic matter), (T1) cow dung, (T2) vermi-compost, (T3) organic manure and (T4) poultry manure. Then pit soil and treatments materials were mixed with soil very properly, leveling and marked for data collection. After processing the pit area, sweet gourd seeds were sown in the pit with experimental need. Proper care and management were taken when pit was prepared. Necessary care and other intercultural operations were done when necessary. Data were recorded in accordance with the requirements. Soil salinity was measured by using an EC Meter at 15 days intervals. All the intercultural operations like watering, gap filling, staking, weeding and plant protection measures were executed carefully.

Measurement of Growth and Yield attributes

Four growth and yield parameters such as plants length (cm), branches per plants, fruits per plants, fruit length (cm), fruit perimeter (cm), single fruit weight (kg) and total yield (ton/hectare) were taken into consideration to analyze the effect of organic matter on yield of sweet gourd. Total yield (t/ha) was calculated by measuring the total fruit weight of the plot.

Initial Chemical properties of soil of pot

pH	OM (%)	K meq/100 gm soil	Total N (%)	P	S	Zn	B
				µg/g			
7.5	2.74	0.34	0.16	10.61	14.82	2.89	0.51

Statistical Analysis

The collected data were tabulated and statistically analyzed using Statistix10 software. The treatment means were separated statistically at a 5 % level of significance using Duncan's Multiple Range Test (DMRT).

Results and Discussion

Effects of Different organic treatments on Soil Salinity reduction

Salinity controlling in root zone area in saline soil fields is highly considered beneficial to seed emergence and stand establishment (Dong et al. 2010). In modern studies has shown that organic matter is a promising technique for salinity control in present agriculture. An upward trend of soil salinity at all treatments was observed from February to May (Table 6.20). In the month of February, the lowest soil salinity was found at poultry manure (4.2 dSm-1) while the highest soil salinity was observed at control (5.3dSm-1) where no organic treatment was used. Since soil salinity increases gradually from the month of February to May, the lowest soil salinity was found in the month of February (4.2dSm-1) as compared to the highest in the month of May (12.3dSm-1). In the month of May, the lowest soil salinity was found at poultry manure (9.4dSm-1 in comparison with the highest soil salinity found in control condition (12.3dSm-1) (Table 6.20). This data revealed that soil salinity can be reduced by using different organic matter in which poultry manure has a great significant effect on reducing soil salinity. Some authors emphasized and reported that all the organic matter effectively reduced salt accumulation in the root zone (Taia et al. 2016).

Table 6.20: Month wise soil salinity of the experimental plot

Treatment	Month wise Soil salinity (EC: dS/m)			
	Feb	Mar	April	May
T_0 (Control)	5.3	10.3	11.8	12.3
T_1 (Cow dung)	5.2	9.4	10.6	10.7
T_2 (Vermi-compost)	4.5	8.1	9.3	9.6
T_3 (organic manure)	5.1	8.8	9.5	10.1
T_4 (Poultry manure)	4.2	7.7	9.1	9.4

Effects of different organic matter on Yield Attributes of sweet gourd

Plant length of sweet gourd (cm)

This experiment showed that the plant length varies to a great extent that was statistically analyzed as shown in Table 6.21. After treating with organic amendment, the plant length at control treatment (no organic matter was applied) was 330.67cm. The plant length at cow dung application was 365cm. The plant length at vermi-compost application was 497.33cm. The plant length at organic manure application was 453 cm. The highest plant length at poultry manure application was 523.67 cm. The vermi-compost and poultry manure application are similar on plant length. It is also found that plant length (cm) of sweet gourd were significantly superior at poultry manure treatments to other amendments while plants without treatments (control condition) resulted in poor growth and yield of sweet gourd.

Branches per plants (numbers)

This experiment indicated that the Branches per plant vary to a great extent that was statistically analyzed as shown in Table 6.21. Branches per plants showed a significant variation in relation to different doses of organic matter application. After treating with organic amendment, the branch per plants at control treatment (no organic matter was applied) was 3.33 and it was the lowest branch number. The branch per plants at cow dung application was 3.33. The branch per plants at vermi-compost application was 4.66. The branch per plants at organic manure application was 3.66. The highest branch per plants at poultry manure application was 5.33. It is also found that branch per plants of sweet gourd were significantly superior at poultry manure treatments to other amendments plot or other fertilizer treatments while plants with control condition resulted in poor growth and yield of sweet gourd.

Fruits per plants (numbers)

This experimental data vary to a great extent that the fruits per plant that was statistically analyzed as shown in Table 6.21. Fruits per plant showed a significant variation in relation to different doses of organic matter application. After treating with organic amendment, the fruit per plants at control treatment (no organic amendment was applied) was 1.66 and it was the lowest fruit per plants. The fruit per plants at cow dung application was 2.00. The fruit per plants at vermi-compost application was 3.33. The fruit per plants at organic manure application was 2.66. The highest fruit per plants at poultry manure application was 3.66. It is also found that fruits per plant of sweet gourd were significantly superior at poultry manure treatments to other amendments plot or other fertilizer treatments while plants with control condition resulted in poor growth and yield of sweet gourd cultivation.

Fruit length of sweet gourd (cm)

This experiment shows that the fruit length and other fruit length related parameters varies a lot that were statistically analyzed as shown in Table 6.21. They showed a significant variation in relation to different organic matter. The fruit length at control condition was 11.56 cm. At the cow dung treatment the fruit length was 17.93 cm. In vermi-compost treatment, the fruit length was 22.26 cm. At organic treatments the fruit length was 19.83 cm. The highest fruit length was 23.06 cm and it was found at poultry manure treatments while the lowest fruits length 11.56 cm was found where no organic treatment was applied (Table 6.21).

Table 6.21: Yield contributing biological parameters of sweet gourd

Treatment	Plant length (cm)	Branch per plants	Fruits per plants	Fruit Length (cm)	Fruit Perimeter (cm)	Single fruit weight (kg)	Yield (t/ha)
T_0 (Control)	330.67d	3.33c	1.66d	11.56d	50.66d	2.47c	16.72d
T_1 (cow dung)	365.00c	3.33c	2.00cd	17.93c	59.93c	3.14b	20.21c
T_2 (Vermi-compost)	497.33a	4.66ab	3.33ab	22.26a	81.90a	4.47a	33.49a
T_3 (Organic manure)	453.00b	3.66bc	2.66bc	19.83b	66.76b	3.25b	27.92b
T_4 (Poultry manure)	523.67a	5.33a	3.66a	23.06a	84.33a	4.77a	34.70a
CV (%)	3.99	15.55	19.36	5.21	2.11	5.64	2.43
LSD	32.59	1.19	0.97	1.85	2.73	0.38	1.21

Fruit Perimeter of sweet gourd (cm)

Fruit perimeter manipulated in accordance with the organic matter treatment at the plot. So that continuing experiment showed that, fruit perimeter and other components of creating fruit diameter quality enhance related parameters varies to a wide that were statistically analyzed as shown in Table 6.21. Those attributes showed a significant variation in relation to different organic amendment. The fruit perimeter at control condition was 50.56 cm. At the cow dung treatment the fruit perimeter was 59.93 cm. In vermi-compost treatment, the fruit perimeter was 81.90 cm. At organic manure treatment, the fruit perimeter was 66.76 cm. The highest fruit perimeter was 84.33 cm found at poultry manure while the lowest fruit perimeter (50.66 cm) was found at control condition. The highest fruit perimeter (84.33 cm) was observed at poultry manure in comparison with control treatment where the lowest fruit perimeter (50.56 cm) was found (Table 6.21). It had been observed that fruit perimeter (cm) and other fruit perimeter contributing characteristics to plant of sweet gourd were significantly superior to poultry manure.

Single fruit weight of sweet gourd (kg)

Different growth stages and developmental indicators of sweet gourd varied at the different plot. It was happened due to application of different organic matter to plants. The single fruit weight of different plants of various plot of sweet gourd grown under different organic matter treatments are presented in Table 6.21. Statistical analysis was carried out on yield and yield attributes which revealed that these were significantly varied due to different organic matter. The single fruit weight at control condition was 2.47 kg. At the cow dung treatment, single fruit weight was 3.14 kg. At vermi-compost treatment, the single fruit weight was 4.47 kg. At organic treatment, the single fruit weight was 3.25 kg. The highest single fruit weight (4.77 kg) was found at poultry manure while the lowest single fruit weight (2.47 kg) was found where at control condition. This experiment indicated that plants under different organic matter treatment produce larger fruit and higher fruit weight per plant because of the better plant growth that is due to a favorable hydrothermal regime of soil. Organic matter changes the micro environment of soil and the plant and thus it enhances plant growth and vigor as well as production and yield. This result may be due to the improvement of soil physical properties as well as increasing soil water holding capacity which gave rise to good aeration and drainage that encourage better root growth and nutrient absorption.

Total yield of sweet gourd (t/ha)

Properly completion of sweet gourd growth stages and developmental process varied at the different plot. It was occurred due to application of different organic matter to plants. The total yield of different plants of various plot of sweet gourd grown under different organic matter treatments are presented in Table 6.21. Statistical analysis was carried out on yield and yield attributes which revealed that these were significantly varied due to different organic matter. The total yield of sweet gourd at control condition was 16.72 t/ha. At cow dung treatment, total yield was 20.21 t/ha. In vermi-compost treatment, the total fruit yield was 33.49 t/ha. In organic manure treatment, the total fruit yield was 27.92 t/ha. The highest total fruit yield (34.70 t/ha) was found at poultry manure while the lowest total fruit weight (16.72 t/ha) was found at control condition (Table 6.21). The doing experiment showed that plants under different organic matter promotes larger fruit and have higher fruit yield per plant because of the better plant growth that is due to a favorable nutrient channel through the soil and a completely symbiosis environment. This result may be due to lowering soil salinity and the improvement of soil physical properties as well as increasing soil water holding capacity which gave rise to good aeration and drainage that encourage better root growth and nutrient absorption.

Conclusion

Sustainable soil management practices and the maintenance of soil salinity are central issues to agricultural sustainability. It may be concluded from that experiment's findings that using organic matter prompt to a noticeable decrease in the accumulation of soil salinity. This experiments point out that, soil salinity reduce by the following order of treatment: Poultry manure > Vermi-compost > Organic manure> Cow dung > Control. Different growth and yield attributes were significantly impacted due to different organic matter treatments. This results showed that, poultry manure treatments gave the highest yield (34.70 t/ha) whereas the lowest yield (16.72 t/ha) was recorded in control condition. Among five of organic treatment, poultry manure can be used at the farmer's level to reduce soil salinity strength and increase the yield of sweet gourd. However, further research is still needed to work out a cost effective technology to reduce soil salinity and increase the yield of sweet gourds.

References

Abou El-Magd MM, Zaki MF, Abou Hussein SD, 2008. Effect of organic manure and different levels of saline irrigation water on growth, green yield and chemical content of sweet fennel. Australian Journal of Basic Applied Science, 2: 90-98

Ansari R, Marcar NE, Khanzada AN, Shirazi MU, Crawford DF, 2001. Mulch application improves survival but not growth of Acacia ampliceps Maslin, Acacia nilotica (L.) Del, and Conocarpus lancifolius L. on a saline site in southern Pakistan. Intern. For. Rev. 3: 158-163.

Conway T., 2001. Plant Materials Technical Note 26, 26: 1-7

Dong BB, Zhu HT, Zhong ZK, Ye GF, 1996. Study on ecological effect of the forest land under-crop sowing and mulching of coastland soil by newly planted. Acta Agriculturae, Zhejiangensis, 8: 154-157.

FAO, 2008: Land and Plant Nutrition Management Service.

Gadallah, MS, Mandour MS, 1999. Increasing drought resistance of wheat plants during grain filling by using chemical desiccants. Journal Science of Mansoura University, 25(2): 833-844.

Haque S A, 2006. Salinity Problems and Crop production in coastal regions of Bangladesh. Journal of Botany 38:1359-1365

Idrees S, Qureshi MS, Ashraf MY, Hussain M, Naveed NH, 2004. Influence of sulphate of potash (Sop) and farmyard manure (Fym) on sugarcane (Saccharum officinarum L.) grown under salt stress. Journal Life of Social Science, 2: 65–69.

Islam F, Quamruzzaman A, Mallick SR, 2021. Effect of different mulch paper on growth and yield of different high value vegetables in Bangladesh Agricultural Sciences, 12:237-246.

Khan S, Pal M, Kumar V.,2015. Influence of different mulches on growth and yield of sponge gourd (Luffa cylindrica L.). Plant Archives, 15(1):393-395.

Kibria MG, Islam ABMS, Basak KD, Hossain M, Hoque MA, 2015. Assessment of soil fertility and farmer's live style in south-western Bangladesh. Journal of Soil and Nature, 8(3): 1-6.

Leithy S, Gaballah MS, Gomaa AM, 2010. Associative impact of bio- and organic fertilizers on geranium plants grown under saline conditions. Electronic Journal of Environmental, Agricultural and Food Chemistry, 9(3): 617-626.

Mahajan S, Tuteja N., 2005. Cold, salinity and drought stresses. An Overview Architecture of Biochemistry and Biophysics, 444:139-158.

Mali BS, Thengal SS, Pate PN., 2012. Physico-chemical characteristics of salt affected soil from Barhanpur. Indian Annals of Biological Research, 3: 4091-4093

Melero, S., Madejo´n, E., Ruiz, J.C., Herencia, J.F., 2007. Chemical and biochemical properties of a clay soil under dryland agriculture system as affected by organic fertilization. European Journal of Agronomy, 26: 327-334.

Raafat NZ, Tharwat EER, 2011. Improving wheat grain yield and its quality under salinity conditions at a newly reclaimed soil using different organic sources as soil or foliar applications. Journal of Applied Sciences Research, 7: 42-55.

Shahbaz, M. and Ashraf. M., 2013. Improving salinity tolerance in cereals. Crit. Rev. Plant Sci, 32:237 -249.

SRDI, 2010. Saline soils of Bangladesh. SRMAF Project, Ministry of Agriculture, Dhaka, Bangladesh. pp. 1–60

Taia A. Abd El-Mageed, Wael M. Semida, Mohamed H. Abd El-Wahed, 2016. Effect of mulching on plant water status, soil salinity and yield of squash under summer-fall deficit irrigation in salt affected soil. Agricultural Water Management, 173(C):1-12.

Tayyab, M., Qasim, M., Ahmad, N. and Ahmad, R., 2016. Salt stress responses of pigeon pea on growth, yield and some biochemical attributes. Pak. J. Bot., 48(4):1353-1360

Zhu JK, 2001. Plant salt tolerance. Trends in Plant Science, 6: 66-71.

AVOIDING SOIL SALINITY THROUGH DIFFERENT SOWING METHOD OF SWEET GOURD IN COASTAL SALINE SOIL

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Abstract

A major obstacle to agricultural output is coastal saline soils especially for crops that are sensitive to salt such as sweet gourd (*Cucurbita pepo*). In order to lessen the negative impacts of soil salinity on sweet gourd development and yield, this study examined how well various seeding techniques worked. In comparison to the traditional sowing method in saline circumstances, the results showed that modified sowing techniques especially ridge and pit sowing greatly improved plant establishment and increased growth and production. Better drainage less salt buildup in the root zone and increased water and nutrient availability were probably made possible by these techniques. A field experiment was conducted at Salinity Management and Research Center, Soil Resource Development Institute, Batiaghata, Khulna during 2025 in kharif-1 season to study the impact of saline water in the saline soil on the economics of sweet gourd (*Cucurbita pepo*) yield and soil salinity after the end of the crop. There were three treatments having early pit method, tray seedling transplanting method and conventional method. The design of the experiment was Randomized Complete Block Design (RCBD) with three replications. Every plot received recommended rate of nitrogen, phosphorus, potash and other fertilizers. The promising text crop was sweet gourd. Field Soil salinity was recorded at 15 days intervals. The treatments were early pit method, tray seedling transplanting and seed sowing directly conventional method. After three months of seed sowing into early pit method, tray seedling transplanting and conventional method the highest soil salinity (14.3 dSm^{-1}) and the lowest soil salinity (2.7 dSm^{-1}) were found at conventional method plot and early pit method plot respectively in the month of May. Early pit method treatment obviously has increased the growth and yield attributes of sweet gourd. The highest value of seven growth parameters viz., Plant length (534.33cm), branch per plants (5.66), fruits per plants (3.66), fruit length (21.53cm), fruit perimeter (84.40 cm), single fruit weight (4.80 kg) and total yield (34.46 t/h) were found on early pit method as compared to other method. Again, the lowest value of i.e., Plant length (328cm), branch per plants (2.33), fruits per plants (1.66), fruit length (14.40 cm), fruit perimeter (69.26 cm), single fruit weight (2.50 kg) and total yield (24.79 t/h) were found on conventional method respectively. The changing of crop production time and method has a positive effect on fruit yield. Application of different time of cultivation and method increase soil moisture content and reduce electrical conductivity therefore it is recommended for sustainable yield of sweet gourd in saline soil and reduces soil salinity related land degradation and have a great potential under saline prone areas.

Keywords: salinity; pit method; tray; conventional; potential

Introduction

Soil salinity rises in crop production and economic outputs may begin to fall. Many crops are now struggling with the effects of salt environment in soil and water. Most abiotic stressors impacts as a result of intensive field usage of different fertilizers and the fast expansion of protected farming land (A. Bouzidi *et al.* 2021; L. Wu *et al.* 2019). However, scar attempts have been made to combat and ameliorate the possible adverse salt stress influence in sweet gourd. The present study was conducted to investigate the impact of different hydro, halo and osmo-priming agents on the seed germination indices seedling performance and physio-biochemical attributes of sweet gourd subjected to high salt stress by computing the correlation coefficient and principal components.

Evaporation, evapotranspiration, hydrolysis, and leakage are the causes of salt accumulation when mineralized ground water near the ground surface continually evaporates and causes minerals to precipitate and by evapotranspiration where infiltrating recharge water is continually taken up by plants and salt is concentrated in the unsaturated root zone. It is very difficult to control of salinity existing in soil and water. It affects crops depending on degree of salinity at the critical stages of growth, which reduces yield and in severe cases total yield is lost. If planting date or seedling transplantation may change in early or time may convert in different sowing time, it will cause the crop production in early without any damage of yield.

It will prohibit salt storing and upward in top soil by breaking down the capillary action that increases starts from last of February. Ground water depth and salinity are affected by the sea and river water level and river water salinity. Since groundwater is the lower boundary condition of surface soil salinity, and also groundwater is closed related to river water, it is the important link between soil and river water. As the river water level and salinity changes, groundwater environment and soil salinity would be affected. Salinity level increases starts from February to May and decrease starts from the starting of rainy season in every year. It has a great effect on crop yield in dry season due to increased salinity level.

If fresh water supply may increase in dry season, it reduces the salinity effect in crop production in Khulna. Rainfall also reduces the surfaces soil salinity. Soil salinity adversely influences seed germination, agricultural productivity, and soil and water quality, particularly in semiarid and arid regions, bringing about loss of arable areas and land degradation (Balkanlou *et al*. 2020; Bennett *et al*. 2019; Buthelezi Dube *et al.* 2020). Soil salinization is the main reason for land degradation and crop yield reduction (Ivushkin *et al.* 2019; Makinde & Oyelade, 2019). In dry irrigated regions, the combination of elevated evapotranspiration (ET), little precipitation and soil factors hamper infiltration.

Agricultural land use in these areas is very poor, which is much lower than a country's average cropping intensity that cause hydrological situation that restrict the normal crop production throughout the year. The factors which contribute significantly to the development of saline soil are tidal flooding during wet season (June to October), direct inundation by saline water, and upward or lateral movement of saline ground water during dry season (February to May). The severity of salinity problem in Bangladesh increases with the desiccation of the soil. In general, soil salinity is believed to be mainly responsible for low land use as well as low cropping intensity in the area (Rahman & Ahsan, 2001).

Salt accumulation in the root zone or soil surface results in loss of soil fertility and alters the soil properties and therefore harmfully impacts soil's environmental functions (Fu et al., 2020). For instance, it restricts water intake and soil water capacity limit to plant uptake, which prompts surface runoff and erosion (Gorji *et al*. 2020). The occurrence of parent materials and physical or chemical weathering of minerals and seawater intrusion is the leading natural cause of soil salinization (Ramos *et al.* 2020). Saltwater intrusion is a natural process where seawater mix with coastal groundwater aquifers due to the density difference between saline and fresh waters, creating a barrier that evolves landward (Barlow and Reichard, 2010). Since, soil "joe" condition comes late in coastal area, thus farmer starts cultivation in late and that is why that crop faced high salinity. But if we start cultivation early, then we can avoid salinity. Thus, the study was carried out to find out the yield of sweet gourd by avoiding the soil salinity.

Limitation in crop productions in south and south western area due to salinity problem in soil and water is a very serious problem. In the coastal saline belt with short winter season timely sowing/planting of Rabi (winter season) crops is essential but this is restricted by late harvest of aman rice. Rainy water storing in land causes late water recession from the cropping land. This water inundation condition makes the 'Joe' stage occurring in mid February to mid March. And when Joe comes in cropping soil, at the same time salinity starts to increase in soil and water. If seeds are sown in February to March, plant face high soil salinity at their growth to fruiting stage (in April/May). In order to avoid high soil salinity this experiment was carried out to find out suitable seed sowing method.

Materials and Methods

Study location

This experiment was conducted at the Salinity Management and Research Centre (SMRC), Soil Resource Development Institute, Batiaghata, Khulna, Bangladesh during the Kharif-1 season of 2025. Geographically, the study site was at 22°46'01.8" N latitude and 89°24'15.2" E longitude and under AEZ-13. With an average yearly temperature of 79.3 °F and monthly mean temperatures ranging from 52.4 °F in January to 99.8°F in May, the area is among the warmest in Bangladesh (AEZ-13). The land type was medium high land. Land form was upper part of basin. Land use was fallow- kharif vegetable - water melon, depth of flooding was 1.5 to 2 feet, duration of flooding was 3 months, soil series was barisal.

Experimental design

The following expecting experiment was carried out in Randomized Complete Block Design (RCBD) with three replications. Sweet gourd (variety: Bengal sweet gourd-2) was taken as an experimental crop. Three experimental treatments were considered: (a) early pit method, (b) Tray seedling transplanting method and (c) Conventional pit preparation method with five replications.

Preparation of early pit

Water recession condition of south west part of Bangladesh is late. Thus "joe" condition comes at first week of March. Before that soil keep moist. In early pit method, pit was prepared in 21-01-2025 in moist soil condition without plough the land. Then pit was kept fallow in sunshine. The "joe" condition of pit came in 05-02-2025. Then sweet gourd seed was sown in 10-02-2025.

Tray seedling preparation

The second method was transplanting of tray seedling. Seedlings were grown early in tray. Seed was sown in tray in 25-02-2025. 15 days old seedlings were transplanted in main field in 13-03-2025.

Conventional pit preparation

In conventional method land was plough and made pit. Then pit soil and other fertilizer treatments were mixed with soil very properly. After processing the pit area, seeds were sown in the pit in 13-03-2025. Soil salinity was measured by using an EC Meter at 15 days intervals. All the intercultural operations like watering, gap filling, staking, weeding and plant protection measures were executed very carefully.

Measurement of Growth and Yield attributes

Experiment was carried out for four growth and yield parameters such as fruit length (cm), fruit diameter (cm), single fruit weight (kg) and total yield (t/ha) were taken into consideration to analyze the effect of different pit method on yield of sweet gourd. Total yield (t/ha) was calculated by measuring the total fruit weight of the plot.

Initial Chemical properties of soil of pot

pH	OM (%)	K meq/100 gm soil	Total N (%)	P	S	Zn	B
				μg/g			
7.4	2.69	0.35	0.20	10.35	14.37	2.74	0.49

Statistical Analysis

The collected data were tabulated and statistically analyzed using Statistix10 software. The treatment means were separated statistically at a 5 % level of significance using Duncan's Multiple Range Test (DMRT).

Results and Discussion

Soil salinity condition of different types of pit

When seed was sown (10-02-2025) in pit that made early method then soil salinity was 2.7 dSm^{-1}. At the time of tray seedling sowing and normal seed sowing (13-03-2025), then soil salinity was 4.2 dSm^{-1} (Table 6.22). Soil salinity of early pit method at harvesting time (28-04-2025) was 8.3 dSm^{-1} whereas other two pit method crops were in growing condition. In 13-05-2025 tray seedling transplanted crops were harvested and that time salinity was increasing (11.7 $dS^{-1}m$) at that time. Crops grown in conventional method harvested in 28-05-2025, had faced long period high salinity. At harvesting time of conventional method, the salinity was 14.3 dSm^{-1}.

Table 6.22: EC (dSm^{-1}) at different sowing/transplanting date in the field

Treatment	EC (dSm^{-1})					
	10-02-2025	13-03-2025	13-04-2025	28-04-2025	13-05-2025	28-05-2025
T_1 (Early pit method)	2.7	4.2	6.3	8.3	-	-
T_2 (Tray seedling transplanting method)	-	4.2	6.3	8.3	11.7	-
T_3 (Conventional method)	-	4.2	6.3	8.53	11.7	14.3

EC: Electrical Conductivity

EC determined by 1: 1 extraction Method

Effects of different sowing method on Yield Attributes of sweet gourd

Plant length of sweet gourd (cm)

This experiment showed that the plant length varies to a great extent that was statistically analyzed as shown in Table 6.23. Plant length showed a significant variation in relation to different doses of gypsum application. After treating with gypsum, the highest plant length at T_1 (Early pit method) was 534.33 cm, the plant length at T_2 (Tray seedling transplanting method) was 453.33 cm while the lowest plant length (328cm) was found in T_3 (Conventional method) treatments. It is also found that plant length (cm) of sweet gourd were significantly superior at T_1 (Early pit method) treatments to other amendments plot or other fertilizer treatments while plants without treatments (conventional method) resulted in poor growth and yield sweet gourd.

Branches per plants

This experiment indicated that the Branches per plant vary to a great extent that was statistically analyzed as shown in Table 6.23. Branches per plants showed a significant variation in relation to different doses of gypsum application. After treating with different date manipulation in crop management, the branches per plants at T_1 (Early pit method) was 5.66, the branches per plant at T_2 (Tray seedling transplanting method) was 4.33 while the lowest branches per plants (2.33) was found in T_3 (Conventional method) treatments. It is also found that branches per plants of sweet gourd was significantly superior at T_1 (Early pit method) treatments to other amendments plot or other fertilizer treatments while plants without treatments resulted in poor growth and yield sweet gourd.

Table 6.23: Yield and Yield attributes of sweet gourd at different sowing method

Treatment	Plant length (cm)	Branch per plants	Fruits per plants	Fruit length (cm)	Fruit Perimeter (cm)	Single fruit weight (kg)	Total yield (t/ha)
T_1 (Early pit method)	534.33a	5.66a	3.66a	21.53a	84.40a	4.80a	34.46a
T_2 (Tray seedling method)	453.33b	4.33b	2.33ab	17.73b	78.73b	3.55b	29.02b
T_3 (Conventional method)	328.00c	2.33c	1.66b	14.40c	69.26c	2.50c	24.79c
CV%	2.94	8.11	6.09	3.53	3.06	8.58	2.70
LSD	29.18	0.75	1.51	1.42	5.37	0.70	1.80

Fruits per plants

This experimental data vary to a great extent that the fruits per plant that was statistically analyzed as shown in Table 6.23. Fruits per plant showed a significant variation in relation to different doses of gypsum application. After treating, the highest fruit per plant at T_1 (Early pit method) application was 3.66 but the fruit per plant (2.33) was found at T_2 (Tray seedling method) application. While the lowest (1.66) fruit per plant was found at T_3 (Conventional method) treatments. It is also found that fruits per plant of sweet gourd were significantly superior at T_1 (Early pit method) treatments to other amendments plot or other fertilizer treatments while plants with conventional treatments resulted in poor growth and yield sweet gourd.

Fruit length of sweet gourd (cm)

The research showed that, the fruit length varies to a great extent that was statistically analyzed as shown in Table 6.23. Fruit length showed a significant variation in relation to different pit method treatment. After production with different pit method, the fruit length at early pit method (seed sown in 10-02-2025) was 21.53 cm, the fruit length at tray seedling method (transplanted in 13-03-2025) was 17.73 cm and the fruit length at conventional method (seed sown in 13-03-2025) was 14.40 cm. The highest fruit length (21.53 cm) was found at early pit method while the lowest fruit length (14.40 cm) was found where conventional method was followed. It was also found that fruit length (cm), numbers of fruit per plant of sweet gourd were significantly superior in early pit method to other treatments plot. Other planting treatments resulted in poor growth and yield of sweet gourd.

Fruit Perimeter of sweet gourd (cm)

Salts affect plant growth due to increasing soil osmotic pressure and to interference with plant nutrition. A high salt concentration in soil solution reduces the ability of plants to acquire water, which is referred to as the osmotic or water deficit effect of salinity. The highest fruit perimeter (84.40 cm) was found at early pit method. In case of tray seedling method, the fruit perimeter was 78.73 cm and in case of conventional method, the lowest fruit perimeter was 69.26 cm. The highest fruit perimeter (84.40 cm) was observed at early pit method in comparison with the conventional planting method where the lowest fruit perimeter (69.26 cm) was found (Table 6.23).

It is a great sign that shows different pit method cultivation positively affect the soil salinity and manipulates the soil structure, texture, biochemical reaction and soil fertility. It is also found that the plants length, branches per plants, fruits per plants, fruit perimeter and other growth of sweet gourd were significantly superior in early pit method to other method of another plot. Salinity lowers the total photosynthetic capacity of the plant through decreased leaf growth and inhibited photosynthesis limiting its ability to grow.

Single fruit weight of sweet gourd (kg)

Sweet gourd yield parameters and single fruit weight grown under different methods are presented in Table 6.23. Statistical analysis was carried out on yield and yield attributes which revealed that these are significantly varied due to different planting method. The highest single fruit weight 4.80 kg was observed in early pit method in comparison with the conventional method where the lowest single fruit weight 2.50 kg was found (Table 6.23). That experiment indicated that plants under different planting method produce larger fruit and have higher single fruit weight per plant because of the better plant growth that is due to a favorable agro climate environment of soil and a completely moderate environment. Different planting method changes the micro environment of the plant and thus it enhances plant growth and vigor as well as production.

Total yield of sweet gourd (t/ha)

Soil salinity works against the growth of plants and developmental structure that varies of sweet gourd due to different planting method at different plot. The total yield and yield attributes grown under different pit method are presented in Table 6.23. Statistical analysis was carried out on yield and yield attributes which revealed that these are significantly varied due to different pit method. The total yield of fruit (34.46 t/ha) was found in early pit method. In case of tray seedling method, the total yield of fruit was 29.02 t/ha but in case of conventional method, the total yield of fruit was 24.79 t/ha. The highest total fruit yield (34.46 t/ha) was observed in early pit method in comparison with the conventional method where the lowest total fruit yield (24.79 t/ha) was found (Table 6.23).

Conclusion

Soil salinity is becoming a major constraint to vegetable crop production. This experiments point out that, soil salinity remain by the following order of planting method: Early pit method > Tray seedling method > Conventional method. Different growth and yield attributes were significantly impacted due to different pit method. This results showed that, Early pit method gave the highest total yield (34.46 t/ha) whereas the lowest total yield (24.79 t/ha) of sweet gourd was recorded in conventional method. It may be conclude that early pit method may be helpful for avoiding soil salinity.

Reference

L. Bouzidi, A. Krouma, M. Chaieb, 2021. Chemical seed priming alleviates salinity stress and improves Sulla carnosa germination in the saline depression of Tunisia, Plant Direct 5: 357.

Balkanlou, K. R., Muller, B., Cord, A. F., *et al.* 2020. Spatiotemporal dynamics of ecosystem services provision in a degraded eco-system: A systematic assessment in the Lake Urmia basin Iran. Science of the Total Environment, 716.

Barlow, P. M., and E. G. Reichard, 2010. Saltwater intrusion in coastal regions of North America, Hydrogeol. J., 18: 247–260.

Ben Asher, J., A. D., Matthias, and A. W. Warrick, 1983. Assessment of evaporation from bare soil by infrared thermometry, Soil Sci. Soc. Am. J., 47(2): 185 – 191.

Bennett, J. M., Marchuk, A., Marchuk, S., & Raine, S., 2019. Towards predicting the soil specific threshold electrolyte concentration of soil as a reduction in saturated hydraulic conductivity: the role of clay net negative charge. Geoderma, 337: 122–131.

Buthelezi, Dube, N. N., Hughes, J. C., Muchaonyerwa, P., Caister, K. F., & Modi, A. T., 2020. Soill fertility assessment and manage-ment from the perspective of farmers in four villages of eastern South Africa. Soil Use and Management, 36: 250–260.

Fu, Z., Wang, P., Sun, J., Lu, Z., Yang, H., Liu, J., Xia, J., & Li, T., 2020. Composition, seasonal variation, and salinization char-acteristics of soil salinity in the Chenier Island of the Yellow River Delta. Global Ecology and Conservation, 24:13-18.

Gorji, T., Yildirim, A., Hamzehpour, N., Tanik, A., & Sertel, E., 2020. Soil salinity analysis of Urmia Lake Basin using Landsat--8 OLI and Sentinel--2A based spectral indices and electrical conduc-tivity measurements. Ecological Indicators, 112:106-173.

Ivushkin, K., Bartholomeus, H., Bregt, A. K., Pulatov, A., Franceschini, M. H. D., Kramer, H., van Loo, E. N., Jaramillo Roman, V., & Finkers, R., 2019. UAV based soil salinity as-sessment of cropland. Geoderma, 338: 502–512.

L. Wu, W. Huo, D. Yao, M. Li, 2019. Effects of solid matrix priming (SMP) and salt stress on broccoli and cauliflower seed germination and early seedling growth, Sci. Hortic. 255:161–168.

Makinde, E. O., & Oyelade, E. O., 2019. Land cover mapping using Sentinel--1 SAR and Landsat 8 imageries of Lagos State for 2017. Environmental Science and Pollution Research, 27(1): 66–74.

Rahman, M.M. and M. Ahsan., 2001. Salinity constraints and agricultural productivity in coastal saline area of Bangladesh, Soil Resources in Bangladesh: Assessment and Utilization.

Ramos, T. B., Darouich, H., Simunek, J., Goncalves, M. C., & Martins, J. C., 2019. Soil salinisation in very high--density olive orchards grown in southern Portugal: Current risks and possible trends. Agricultural Water Management, 217:265–281.

IDENTIFICATION OF YIELD REDUCTION PERCENTAGE OF CAULIFLOWER DUE TO DIFFERENT SOIL SALINITY STRENGTH

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Abstract

The significant horticultural crop cauliflower (*Brassica oleracea* var. *botrytis* L.) is mostly vulnerable to the excessive salt concentration in the soil which contributes to its scaled down growth and productivity among other indices. The current study examines the efficacy of osmoregulation and biochemical activities on the physiological attributes and tolerance to salinity in cauliflower under controlled conditions. The results showed that the soil salinity has significant deleterious impacts on cauliflower seedling growth and photosynthetic attributes and provoked the production of biological yield. In Bangladesh, south and southwest part, salt concentration in soil is a major agricultural concerning issue. The production of cauliflower (*Brassica oleracea* var. *botrytis* L.) and other crops is severely hampered by this salt intensity. The experiment was carried out at the Salinity Management and Research Center (SMRC) in under Soil Resource Development Institute, Batiaghata, Khulna to examine the impact of managing the salinity of the soil on cauliflower growth and production. A completely randomized design (CRD) was used for the study and three replications of the salt concentration (2,4,6,8,10 and 12 dSm^{-1}) were used. The experiment's findings demonstrated that all of the variables under investigation were strongly impacted by the various combinations of soil salinity. In T_1 (2 ± 0.2 dSm^{-1}) treatment shows the best result for all parameters; the plant height (33.56cm), number of leaves per plant (36.66), leaf length (39.43cm), Spreading diameter (46.10cm), Curd diameter (17.96cm), Curd yield (733.67gm) and total biological yield per plant (994.33gm) were all examined in relation to others treatment of yield performance per plant.

Introduction

One of the most widely grown cole crops (Botrytis Group) in the world is cauliflower (*Brassica oleracea* var. *botrytis* L.) which is a member of the Brassicaceae family also known as the Cruciferae. Excess salt in soil during cultivation results in major physiological and functional problems restricting vegetables vegetative and reproductive growth causing fertilization problems that lower selling values and ultimately killing of plants (Dolarslan and Gul, 2012). Soil According to Machado and Serralheiro (2017), yield is impacted by salinity tolerance levels ranging from 1.0 to 2.5 dS/m EC. The soil salinity uptake level of irrigation water yield of cauliflower begins to decrease between 1.9 and 2.7 dS/m EC indicating that it is a moderately salt sensitive vegetable (Snapp *et al*. 1991; Kotuby *et al.* 1997). 10°C to 15°C is an ideal temperature for cauliflower growth.

Reduced osmotic potential changes in plant metabolism, suppression of enzyme activities, ionic imbalance, dilutions of solute accumulation, particular ion effects or a combination of these variables are some of the ways that salinity stress impacts crop development and output (Munns *et al*. 2006). Plant growth and development are negatively impacted at both the molecular and physiological levels (Bressan *et al*. 2013). According to Oliveira *et al*. (2014) and Giuffrida *et al.* (2016), Cauliflower (*Brassica* *oleracea* var. *botrytis* L.) is categorized as moderately tolerant to salinity. The effects of salinity on plant biometrics show that salinity tolerance varies among species and is influenced by environmental factors.

In dry and semi-arid regions of the world with low quality irrigation water, soil salinity is a major issue (Tanji, 1990; Maas and Grattan, 1999). Due to inadequate management techniques and nutrient deficiencies in the saline soil, cauliflower yields are low. About 268.48 thousand MT of cauliflower were produced nationwide from 19.42 thousand hectares (BBS, 2016). Roughly 20% (45 million ha) of irrigated land which produces one third of the world's food is thought to be damaged by salt (Shrivastava, P.; Kumar, R., 2015).

An estimated about 10 million hectares of agricultural land is losing annually due to salt accumulation worldwide (Pimentel D. *et al.* 2004). According to estimates, salinity will impact 50% of the world's agricultural land by 2050 (Bartels, D.; Sunkar, R., 2005). It is nearly impossible to grow more than one crop in a saline area due to the high levels of salt in the soil and water. Due to issues with soil and water salinity, farmers are unable to provide their fields with fresh, salt free irrigation when crops are in need. Using irrigation water, soil additives and appropriate cultural techniques can help regulate the physical, chemical and biological characteristics of soil in saline situations (Grattan and Oster, 2003).

By lowering CO_2 availability due to diffusion limitation and a decrease in the amounts of photosynthetic pigments, salinity prevents photosynthesis (Flexas J. *et al*. 2007). Cauliflower salt buildup limits photosynthesis mainly by lowering chlorophyll concentration which can alter light absorbance (Thompson *et al*. 2007), and stomatal and mesophyll conductance to CO_2 (Di Martino, C.; Delfine, S.; Alvino, A.; Loret, 1999). Plant development and curd formation would be significantly impacted by proper saline water and soil management particularly in saline soil used for winter crop cultivation. To acquire the desired outcomes from irrigated crops in salty soil conditions, saline water should be used cautiously and ideally (Alsaadawi and Mohamed, 2000).

In that area of medium high terrain, short duration vegetables can be introduced. With the intensification and diversification of technology on the medium high land during the winter, there is a great deal of potential for vegetable cultivation in saline areas. Plant growth is adversely affected by the salt content of the soil and the lack of fresh water (Asik *et al*. 2009). For that area, Cauliflower would be a promising crop. Cauliflower and other winter crops may be grown in a south salty area with ease if the saline water receded and the soil and water had the lowest possible salt concentration. Plant development responses from particular salt tolerance qualities are typically stressed by soil salinity (Dalton *et al*. 2000).

Saline soil and water management significantly increased curd yield/plant, gross yield/plant, and yield characteristics, according to research. It is commonly known that using saline water can devastating impact on the physical, chemical and biological characteristics of soil. However farmers in salty regions are not accustomed to growing cauliflower with appropriate soil salinity control. Testing cauliflower's ability to withstand salt at varying soil salinity levels was the aim of this study. In order to assess the effects of saline soil on Cauliflower growth, development and yield the current study was implemented.

Materials and methods

To determine how different saline soil strengths affected the emergence, growth and yield of cauliflower plants, an experiment was conducted at the Salinity Management and Research Center which is part of the Soil Resource Development Institute in Batiaghata, Khulna. The experiment was conducted using plastic pots. Firstly, the plastic pots were cleaned and then they were rinsed with distilled water. The pots were then let dry in the air. The plastic pots were prepared for the experiment once they had dried. The pot was filled with saline soil that had been finely prepared.

Before planting the cauliflower seedling, the soil was saturated with the appropriate amount of salt treatment to establish a saline environment. The following treatments were part of the trial: 2±0.2 dSm^{-1}EC for T_1, 4±0.2 dSm^{-1} for T_2, 6±0.2 dSm^{-1} for T_3, 8±0.2 dSm^{-1} for T_4, 10±0.2 dSm^{-1} for T_5 and 12±0.2 dSm^{-1} for T_6. Three replications and a completely randomized design (CRD) were employed in the single factor experiment. Three equal replication blocks, each with six plots which were created for the experiment. Consequently, there were eighteen unit plots in total. The treatment combinations used in the trial were assigned at random to 18 plots, each of which had three replications. The growth of the plants and proper maintenance of the pot's salinity were noted.

Until produce harvesting, periodic weeding, fertilizer application, irrigation, pot inspection and extra attention to plant growth were carried out. Abiotic effects, pest controlling chemicals and water application were noted every three days. Sixty days after the cauliflower reached full maturity then the data were gathered. When necessary then intercultural operations were conducted. Plant height (cm), number of leaves/plant, leaf length (cm), spreading diameter (cm), curd diameter (cm), curd yield/plant (gm) and gross yield/plant (gm) were all measured of cauliflower as yield related indicators.

Preparation of saline soil

Salt affected soil was gathered from several locations within the saline affected area in order to produce the predicted soil salinity of 2 to 12 dSm^{-1}. Different soil salinity concentrations

(2, 4, 6, 8, 10 and 12 dSm^{-1}) were applied to the transplanted seedlings in plastic pots. By measuring the salt level via a lab test, the salinity level was kept constant.

Initial Chemical properties of soil of pot

pH	OM (%)	K meq/100 gm soil	Total N (%)	P	S	Zn	B
				µg/g			
7.2	1.91	0.24	0.09	17.23	57.51	1.12	1.17

Statistical analysis

The data obtained for different characters were statistically analyzed. The mean values of all the characters were evaluated and analysis of variance was performed by the 'F' test by using statistics software, version 10.

Results and discussions

Significant differences in plant height and leaf count were brought about by the influence of varying salinity levels in the soil, and these differences were statistically significant at different salinity levels. The pot soil's initial salinity was 1.54dSm^{-1}. The assessing indicator changed after applying varying soil salinity strengths to various pots.

Plant height (cm)

The T_1 (2±0.2 dSm^{-1}) treatment had the tallest cauliflower plants. At T_1 (2±0.2 dSm^{-1}) treatments, the tallest plant height measured at 33.56 cm in 60 DAT. The plant height under T_2 (4±0.2 dSm^{-1}) treatment was 31.36cm in 60 DAT. The height of the plants in the T_3 (6±0.2 dSm^{-1}) treatment was 29.16 cm. The height of the plants at the T_4 (8±0.2 dSm^{-1}) treatment was 26.86 cm. In T_6 (12±0.2 dSm^{-1}) had the smallest plants height measuring 15.20 cm. The availability of survival environment in soil salinity strength condition when applied only to pots in high saline solutions for plant growth and that is the primary reason of plants death.

Table 6.24: Different plants parameter of Cauliflower in different growth stages at different Soil salinity strength

Treatment	PH at 60 DAT	NL at 60 DAT	LL
T_1 (2±0.2 dSm^{-1}EC)	33.56a	36.66a	39.43a
T_2 (4±0.2 dSm^{-1}EC)	31.36b	32.66b	36.00b
T_3 (6±0.2 dSm^{-1}EC)	29.16c	24.66c	29.70c
T_4 (8±0.2 dSm^{-1}EC)	26.86d	19.00d	25.36d
T_5 (10±0.2 dSm^{-1}EC)	20.30e	17.00d	16.46e
T_6 (12±0.2 dSm^{-1}EC)	15.20f	12.66e	14.56e
LSD	1.91	3.02	2.94
CV (%)	4.13	7.15	6.15

*EC determined by 1: 1 extraction Method

PH- plant height (cm), NL- leaves numbers, LL- leaves length (cm)

Number of leaves per plant

Table 6.24 displays the number of leaves per plant for each cauliflower plant at varying soil salinity levels. This variation was statistically significant at each salinity level due to the influence of varying soil salinity strengths. There were the most leaves per plant (36.66) in the plants treated with T_1 (2±0.2 dSm^{-1}) treatments. About 32.66 leaves per plant in the plants treated with T_2 (4±0.2 dSm^{-1}) and 24.66 leaves per plant in the plants treated with T_3 (6±0.2 dSm^{-1}). However, T_4 (8±0.2 dSm^{-1}) treatment resulted in 19.00 leaves per plant. The lowest leaves per plant 14.56 was produced by the T_6 (12±0.2 dSm^{-1}) treatment. The availability of survival environment in soil salinity strength condition when applied only to pots in high saline solutions for plant growth and that is the primary reason of plants death.

Leaf length (cm)

At the 2, 4, 6, 8, 10 and 12 (±0.2 dSm^{-1}) of soil salinity strength, the cauliflower plants shown notable differences in leaves length (Table 1). Different saline water strengths were used and this resulted in a significant variance in leaf length. The T_1 (2±0.2 dSm^{-1}) treatment produced the longest leaves (39.43 cm). However, the smallest leaf length (14.56 cm) was gained under treated with T_6 (12±0.2 dSm^{-1}) treatments. The availability of survival environment in soil salinity strength condition when applied only to pots in high saline solutions for plant growth and that is the primary reason of plants death. The increased salt concentration that affected cell elongation and cell division due to varying soil salinity preparation most likely affected the cauliflower's leaf growth.

Yield contributing characters of cauliflower

Spreading diameter (cm)

Saline soil treatment of T_1 (2±0.2 dSm^{-1}) had the highest spreading diameter of cauliflower (46.10 cm) in 60 DAT. At T_2 (4±0.2 dSm^{-1}) treatments plant had a spreading diameter of 37.70 cm (Table 02). At T_6 (12±0.2 dSm^{-1}) treatments, the lowest spreading diameter measured was 15.36 cm. The availability of survival environment in soil salinity strength condition when applied only to pots in high saline solutions for plant growth and that is the primary reason of plants death. Significant differences in spreading diameter were seen in the interaction effects of saline soil and cauliflower.

Curd diameter (cm)

Curd size responds favorably to appropriate irrigation and salt management. The highest curd diameter 17.96 cm was recorded at T_1 treatment (2±0.2 dSm^{-1}) (Table 02) while the lowest curd diameter 5.36 cm was recorded with T_5 treatment (10±0.2 dSm^{-1}) with suggested saline soil management. It is a general notice that high soil salinity at 12 dSm^{-1} cauliflower had not given any curd formation.

Table 6.25: Showing of different plant parameter at different growth stages for different Soil salinity strength

Treatment	SD at 60 DAT	CD	CY	GY
T_1 (2±0.2 dSm^{-1})	46.10a	17.96a	733.67a	994.33a
T_2 (4±0.2 dSm^{-1})	37.70b	15.20b	673.33b	892.33b
T_3 (6±0.2 dSm^{-1})	31.03c	12.70c	424.00c	726.67c
T_4 (8±0.2 dSm^{-1})	27.96d	8.46d	356.00d	534.33d
T_5 (10±0.2 dSm^{-1})	19.06e	5.36e	234.67e	293.33e
T_6 (12±0.2 dSm^{-1})	15.36f	0.00f	0.00f	254.33e
LSD	2.06	1.57	27.64	48.61
CV (%)	3.92	8.91	3.85	4.44

*EC determined by 1: 1 extraction Method

SD- spreading diameter (cm), CD- curd diameter (cm), CY- curd yield (gm), GY- Gross yield (gm)

Curd yield (gm)

The salinity of the soil has a significant impact on cauliflower curd output. The formation of curd decreases significantly as the soil and water become saline. The largest curd yield 733.67gm was observed at T_1 treatment (2±0.2 dSm^{-1}) (table 6.25) while the lowest curd yield 234.67gm was reported at T_5 treatment (10±0.2 dSm^{-1}). It is a general notice that high soil salinity at 12 dSm^{-1} cauliflower had not given curd anymore. When various saline soils are combined, the higher strength of the saline soil causes the curd yield to decrease.

Biological/Gross yield per plant (gm)

Cauliflower plants hardly ever thrive on saline soil. Different soil salinity strengths had a substantial impact on the gross yield per plant (Table 6.25). The plants treated with T_1 (2±0.2 dSm^{-1}) had the highest gross yield per plant (994.33gm) whereas the plants treated with T_6 (12±0.2 dSm^{-1}) had the lowest gross yield per plant (254.33gm). It is evident that cauliflower facing plants at higher EC had a total gross output reduction depending on salinity because of the high soil salinity which is significantly different from the yield of other plants and caused of plants death.

Curd Yield Reduction (%)

Cauliflower curd yield reductions was measured in percentage and compared to other treatments where soil salinity was increased equally by 2dSm-1. It was confirmed that about 8.22% of Cauliflower curd yield had reduced at T2 (4±0.2 dSm-1) treatments. In other hand, about 42.20% of Cauliflower curd yield had reduced at T3 (6±0.2 dSm-1) treatments. In the cases of T4 (8±0.2 dSm-1) treatments, the reduction of curd yield had about to 51.47%. In another cases of T5 (10±0.2 dSm-1) treatments, the reduction of curd yield had about to 68.03%. In T6 (12±0.2 dSm-1) treatments, the 100% curd yield had damaged.

Conclusion

According to the study's findings, cauliflower plants thrive in soil salinity strength conditions of T_1 (2±0.2 dSm^{-1}). The experiment's goal was to ascertain how cauliflower growth and production were affected by varying soil salinity strength levels. The finding indicates that the growth and yields of cauliflower is significantly impacted by the application of varying degrees of soil salinity. Cauliflower development and production which is gained from T_1 (2±0.2 dSm^{-1}) treatments had given the maximum gross yield (994.33gm) per plants. It may needs more studies to provide precise findings and suggestions for the soil salinity effect for the growth and yield of cauliflower in different saline regions of Bangladesh.

References

Ali, M.A., M.S.H. Molla, M.R. Alam, M.A. Momin and M.A. Mannan, 2009. Effect of combinations of chemical fertilizers and poultry manure on the productivity of crops in the cauliflower-stem amaranth jute pattern. Bangladesh J. Agril. Res. 34(1): 113-121.

Alsaadawi, I.S. and I.D. Mohamed, 2000. Response of different varieties of barley to salt water irrigation during different stages of growth. Iraq Journal of Agriculture, 5(2), 39-46.

Ara, N., M.O. Kaisar, K.M. Khalequzzman, H. Kohinoor and K.U. Ahamed, 2009. Effect of different dates of planting and lines on the growth, yield and yield contributing characteristics of cauliflower. J. Soil Nat. 3(1): 16-19.

Asık BB, Turan MA, Celik H, Katkat AV., 2009. Effects of Humic Substances on Plant Growth and Mineral Nutrients Uptake of Wheat (Triticum durum cv. Salihli) Under Conditions of Salinity. Asian Journal of Crop Science, 1(2): 87-95.

Bartels, D.; Sunkar, R. Drought and salt tolerance in plants, 2005. Crit. Rev. Plant Sci., 24, 23-58.

BBS, 2016. Statistical Year book of Bangladesh 2016, Bangladesh Bureau of Statistics, Ministry of Planning, Bangladesh, Government of the Republic of Bangladesh. Dhaka, Bangladesh.

Bressan R.A., Park H.C., Orsini F, Oh D.H., Dassanayake M, Inan G, Yun DJ, Bohnert HJ, and Maggio A., 2013. Biotechnology for mechanisms that counteract salt stress in extremophile species: a genome-based view. *Plant Biotechnol Rep* **7**: 27-37.

Dalton F.N., Maggio A., Piccinni G., 2000. Simulation of shoot chloride accumulation, separation of physical and biochemical processes governing plant salt tolerance. Plant Soil 219:1-11.

Di Martino, C.; Delfine, S.; Alvino, A.; Loret, F., 1999. Photorespiration rate in spinach leaves under moderate NaCl stress. Photosynthetica, 36, 233-242.

Din, M., M. Qasim, and N.E. Jan., 2007. Response of different sowing dates on the growth and yield of cauliflower. Sarhad J. Agric. 23(2): 289-291.

Dolarslan M, Gul E 2012. Soil Plant Interaction in Regard to Salinity. Turkish Journal of Scientific Reviews, 5(2): 56-59

Farahzety, A.M. and H.S. Aishah, 2013. Effects of organic fertilizers on performance

Flexas, J.; Diaz-Espejo, A.; Galmés, J.; Kaldenhoff, R.; Medrano, H; Ribas-Carbo, M. Rapid variations of mesophyll conductance in response to changes in CO2 concentration around leaves. Plant Cell Environ. 2007, 30, 1284–1298.

Giuffrida, F.; Cassaniti, C.; Malvuccio, A.; Leonardi, C. Effects of salt stress imposed during two growth phases on cauliflower production and quality. Journal of the Science of Food and Agriculture, v.97, p.1552-1560, 2016.

Grattan, S.R., Oster, J.D., 2003. Use and reuse of saline sodic water for irrigation of crops. In: Goyal, S.S., Sharma, S.K., Rains, D.W. (Eds.), Crop Production in Saline Environments: Global and Integrative Perspectives. Haworth Press, New York, pp. 131–162

J. Trop. Agric. Fd. Sc. 41(1): 15-25.

Maas, E.V., Grattan, S.R., 1999. Crop yields as affected by salinity. In: Skaggs, R.W., van Schilfgaarde, J. (Eds.), Agron. Monogr. No. 38. Am. Soc. Agron, Madison, WI, pp. 55– 108

Machado RMA, Serral heiro RP, 2017. Soil Salinity: Effect on Vegetable Crop Growth Management Practices to Prevent and Mitigate Soil Salinization. Horticulturae, 3(30): 1-13.

Munns R, James RA, and Lauchli A, 2006. Approaches to increasing the salt tolerance of wheat and other cereals. *J Exp Bot* **5**: 1025-1043.

of cauliflower grown under protected structure.

Oliveira, F. A.; Martins, D. C.; Oliveira, M. K. T.; Souza Neta, M. L.; Ribeiro, M. S. S.; Silva, R. T., 2014.

Pardo J.M., 2010. Biotechnology of water and salinity stress tolerance. Curr. Opin. in Biotec. 21:185-196.

Pimentel, D.; Berger, B.; Filiberto, D.; Newton, M.; Wolfe, B; Karabinakis, E.; Clark, S.; Poon, E.; Abbett, E.; Nandaopal, S. Water Resources: Agricultural and Environmental Issues. BioScience 2004, 54, 909–918.

Shrivastava, P.; Kumar, R. Soil salinity: A serious environmental issue and plant growth promoting bacteria as one of the tools for its alleviation. Saudi J. Biol. Sci. 2015, 22, 123–131.

Snapp SS, Shennan C, Bruggen AV., 1991. Effects of Salinity on Severity of Infection by Phytophthoraparasitica DATt., Ion Concentrations and Growth of Tomato, Lycopersicon esculentum Mill. New Phytol., 119: 275-284.

Tanji,K.K.,1990.Natureandextentofagriculturalsalinity. In: Tanji, K.K. (Ed.), Agricultural Salinity Assessment and Management. American Society of Civil Engineers, New York, Manual and Report Engineering Practice 71, 71–92.

Thompson A.J., Andrews J., Mulholland B.J., McKee J.M., Hilton H W., Horridge J.S., Farquhar G.D., Smeeton R.C., Smillie I.R., Black C.R., Taylor I.B., 2007. Overproduction of abscisic acid in tomato increases transpiration efficiency and root hydraulic conductivity and influences leaf expansion. Plant Physiol. 143:1905-1917.

Zhu J.K., 2000. Genetic analysis of plant salt tolerance using Arabidopsis. Plant Physiol. 124:941-948.

EFFECT OF GROUND WATER TABLE & SALT CONCENTRATION ON TOP SOIL SALINITY

A Biswas, Md. Z Islam

Abstract

The process of soil and water salinization that occurs in different geological, hydro-geo-morphological, agricultural, and climatic environment is very complex reaction by various mechanisms. Specifically, the objective is to characterize and find out the groundwater conditions contributing to existing salinity problems. The salinization of land and water is brought about by physical and chemical processes that increase salt concentrations in soil ground water. The process responsible for the development of salinity in soil and water is intimately related to the transport of dissolved salt ion mass in groundwater flow systems. According to the experiment, when ground water level starts to down and the same time salinity in soil and water starts increase. In February, the ground water level was 5 feet 6 inch, the salinity in ground water was 2.4 dSm^{-1}, at single layer mulching, the salinity in soil was 2.5 $dSm^{-1}$and the highest soil salinity was 3.6 dSm^{-1}in open soil and the lowest salinity was in double layer mulching soil (2.0 dSm^{-1}). In June, the ground water level was in down at 10 feet 4 inch, salinity at water was 8.4 dSm^{-1}, in single layer mulching, the salinity was 13.1 $dSm^{-1}$and the lowest salinity was in double mulching covered top soil (9.9 dSm^{-1}), the salinity level was very high in open top soil (19.3 dSm^{-1}). This experiment shows that soil water level starts to decrease from February month to June (early dry season to early rainy season). It is very much significant that salinity increase relation has simultaneously co-relation with the decreasing of ground water level in soil.

Introduction

Crop production in saline area is highly limited because of salinity in ground water. During kharif-1 season, salinity starts to increase from the January and it ranges to November. Saline water from the river water and seawater moves vertically and horizontally to other cropping area. This saline particle and mineral coexist with other yield beneficial up taking nutrient and those create a bilateral saline solution. This saline solution directly moves to ground water and turns the soil micro water into saline. Salinity increases very rapidly when evaporation of water from the top soil get started by sun rays. It influences the vertical upward of saline water at the root zone of plant. The main obstacle to intensification of crop production in the coastal areas is seasonally high content of salts at the root zone of the soil. The salts enter inland through rivers and channels, especially during the early part of the dry (winter) season, when the downstream flow of fresh water becomes very low. During this period, the salinity of the river water increases. The salts enter into the soil by flooding with saline river water or by seepage from the rivers, and the salts become concentrated in the surface water layers through evaporation and evapotranspiration. The saline water may also cause an increase in salinity of the ground water and make it unsuitable for irrigation. The increase in water salinity in ground water of these areas has created a limitation for cultivation. Utilization of low quality ground water for crop irrigation because of prolonged dry spells in conjunction with heavy salt minerals is the principal source bringing about soil salinization. Scarcity of quality irrigation water during dry season limits cultivation of Rabi (winter) crops and kharif-1 (March-July) season. Variability of rainfall, uncertain dates of onset and recession of seasonal floods and risk of drought restrict cultivation. Uncertain rainfall delays sowing/transplanting and flood damages of crops. The texture of most of the saline soils varies silt clay to clay. Land preparation becomes very difficult as the soil dries out. Deep and wide cracks develop and surface soil becomes very hard. These also necessitate deep and rapid tillage operations. Presence of saline ground water table throughout the year within top soil depth is another factor affecting crop production in the saline belt. Sea level rise and reduction of fresh ground water reservoirs due to changes in rainfall patterns are the two major climate change induced hydrological variables that can severely affect saltwater intrusion in coastal water bank. Tidal flooding occurs during wet season (June to October), direct inundation by saline water and upward on lateral movement of saline ground water during the dry season (February to May). In addition, cyclone and tidal surge is accelerating this problem. In the coastal areas of Bangladesh, salinization is one of the most serious types of land degradation as well as a major obstacle to the optimal utilization of ground water resources. The salinization is the process where the concentration of dissolved salts in water and soil is increased due to natural or human induced processes. Fresh water is lost through evapotranspiration and hydrolysis. Arid and semiarid climates are associated with water logging and ground water access. In all represented cases, ground water is the main geological agent for transmitting, accumulating, and discharging salt. The salinization in land and water is brought by physical and chemical processes that increase concentrations of salt in soil and water. The processes that responsible for the development of saline land and water is very complex and intimately related to the transport of dissolved salt mass in groundwater flow systems. The redistribution of soluble salts accumulated in a soil micro pore is evident mainly in topographically lower areas by terminal salt water in river, dry area and sea water. Evaporation, evapo-transpiration, hydrolysis, and leakage leads salt accumulation in water. When mineralized groundwater near the ground surface continually evaporates and causes minerals to precipitate, it increases the salt concentration in root zone. This process involve the mineralization of the groundwater, the physical transport of dissolved salts, the discharge of saline base flow into streams and river and the precipitation of salts within the soil cropping zone. Most of the salt in the groundwater system comes from micro pore, which includes parent materials structures, salt dissolved in the water recharging system and salt contributed from mineral dissolution within the groundwater flow system. The most important process that adds salt to groundwater is mineral dissolution reactions in the subsoil and to a lesser extent along the entire bilateral movement of saline water flow system. The land geography is low lying land, down ward movement of fresh water and inland along the sea coastal part of Bangladesh. According to salinity survey findings and salinity monitoring information about 1.02 million ha (about 70%) of the cultivated lands are affected by varying degrees of soil salinity. Million hectares of lands is affected by very slight, slight, moderate, strong and very strong salinity respectively. Cropping intensity may be increased from very slight to slightly in saline areas by adopting proper soil and water management practices with introduction of salt tolerant varieties of different crops. To mitigate the salt water for fill up the demand of fresh water for irrigation, especial emphasis may be given to adopt ground water reservoir technology.

Materials and Methods

This experiment was conducted at the Salinity Management and Research Centre (SMRC), Soil Resource Development Institute, Batiaghata, Khulna, Bangladesh during the Kharif-1 season of 2025. Ground water depletion is a serious problem for irrigation in crop production. A deep 45 feet pipe was installed directly into the soil vertically in the field at 15-02-2023. It was used for checking the ground water level measurement. Three beds were made for salinity level correction. One bed was open soil condition where no mulch was used, another one was made by single layer mulching bed where mulch was spread under the top soil and third one was double layer mulching bed where two layers of mulch was used. In double layer mulching bed, two layers of mulch was spread out, one was under the soil and another one was upper the top soil. From 15-02-2025, those three beds were made for measurement of soil salinity in every 15 days later.

Results and Discussions

Every 15 days later, the ground water layer depletion was measured through the deep pipe. This collected water and soil salinity were measured and salinity level was recorded (table 6.26). In 15-02-2024, the ground water depth was 5 feet 6 inch, ground water salinity was 2.4 dSm-1, at open soil layer, the highest soil salinity was 3.6 dSm-1, at single mulching layer the salinity was 2.5 dSm-1and at double mulching layer, the lowest soil salinity was 2.0 dSm-1.

Table 6.26: Different Salinity level at different dates of water and soil salinity

Parameter	15-02-2025	01-03-2025	16-03-2025	01-04-2025	16-04-2025	01-05-2025	16-05-25	01-06-25
Water depth	5′6′′	6′0′′	6′6′′	7′1"	7′4"	8′1"	9"4"	10′4"
Ground Water salinity (dSm^{-1})	2.4	3.0	3.7	5.6	6.4	8.5	8.7	8.4
Soil salinity dSm^{-1} (open)	3.6	5.1	6.2	8.7	11.2	12.0	14.6	19.3
Soil salinity dSm^{-1} (SLM)	2.5	4.1	5.3	6.3	7.9	9.2	11.0	13.1
Soil salinity dSm^{-1} (DLM)	2.0	3.6	4.7	5.8	7.1	7.2	8.4	9.9

SLM- Single Layer Mulching
DLM - Double Layer Mulching

In 01-03-2025, the ground water depth was 6 inch, water salinity was increased to 3.0 dSm-1, at open soil layer soil, the highest soil salinity was 5.1 dSm-1, at single mulching layer, the soil salinity was 4.1 dSm-1 but at double mulching layer, it was the lowest soil salinity was 3.6 dSm-1. After 15 days later in 16-03-2025, the ground water depth was down to 6 feet 6 inch, water salinity was raised to 3.7 dSm-1, at open soil layer soil, the highest soil salinity was 6.2 dSm-1, at single mulching layer, the soil salinity was 5.3 dSm-1 and at double mulching layer, the lowest soil salinity down to 4.7 dSm-1. Again 15 days later, in 01-04-2025, the ground water depth was measured at 7 feet 1 inch, water salinity was 5.6 dSm-1, at open soil layer soil, the highest soil salinity ranged at 8.7 dSm-1, at single mulching layer, the soil salinity was 6.3 dSm-1 and at double mulching layer, the lowest soil salinity was gained 5.8 dSm-1. In 16-04-2025, the ground water depth was recorded at 7 feet 4 inch, water salinity was 6.4 dSm-1, at open soil layer soil, the highest soil salinity was 11.2 dSm-1, at single mulching layer, the soil salinity was 7.9 dSm-1 but at double mulching layer, the lowest soil salinity was found 7.1 dSm-1. About 15 days later, in 01-05-2025, the ground water depth was measured at 8 feet 1 inch, water salinity was 8.5 dSm-1, at open soil layer soil, the highest soil salinity was 12.0 dSm-1, at single mulching layer, the soil salinity was 9.2 dSm-1 but at double mulching layer, the lowest soil salinity was 7.2 dSm-1 . In 16-05-2025, the ground water depth was decreased to 9 feet 4 inch, water salinity was 8.7 dSm-1, at open soil layer soil, the highest soil salinity was calculated at 14.6 dSm-1, at single mulching layer, the soil salinity was 11.0 dSm-1and at double layer mulching, the lowest soil salinity was gone down at 8.4 dSm-1. At the date of 01-06-2025, the ground water depth was reached at 10 feet 4 inch, water salinity was touched at 8.4 dSm-1, at open soil layer soil, the highest soil salinity was 19.3 dSm-1, at single mulching layer, the soil salinity was 13.1 dSm-1 and at double mulching layer, the lowest soil salinity was recorded at 10.1 dSm-1. In seepage areas dry spell and water logging induces clay eluviation near the surface and salinization at water depth in present day that reducing environments. When the water table rises to the surface, seepage areas are flushed by fresh water and salinization takes place. The resulting disequilibrium develops severe salinity environment land and degradation problems as a result of rising saline groundwater tables particularly when they act together in down surface positions of the land.

Conclusion

Groundwater plays a major role in the mobilization, accumulation, and discharge of salts into the root zone plant. Salinity increases during these periods of low recharge where only deep water resources are present and the groundwater flows are insufficient. Saline groundwater flows along the vertical and horizontal streams and is accumulated in the soil system acts as a salt depository. This ground water store directly influence the upper soil surface layer salinity range and water uptake by plants. However, ground water is the critical geological agent in the development of the salinization.

Chapter 7: Research Activities done by Head Quarter & Field Offices

Effects of dolomite and vermicompost on soil properties and yield contributing characters of potato in acid soil of Barind tract

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Abstract

The study investigates the effects of dolomite and vermicompost on soil properties and yield-contributing characters of potato (BARI Alu-7 called Diamant) that cultivated in acid soil of Barind Tract. The experiment was conducted from November, 2024 to March, 2025 in the selected Gleysols (popularly known as 'Amnura' soil series) of the Level Barind Tract designated as AEZ - 25 located at N-24°32'28.0" latitude and E- 88°33'30" longitude in loam soil of Tanore upazila under Rajshahi district. The experiment involved seven treatments which included a control, different doses of dolomite (0.5, 1.0, 1.5, 2.0 and 2.5 t ha-1) and 2.5 t ha^{-1} biochar along with 1.0 t ha^{-1} vermicompost. Post-harvest soil analyses revealed significant changes in pH, organic matter (OM), and essential nutrient availability, including phosphorus (P), calcium (Ca), and magnesium (Mg). The results indicated that dolomite amendment effectively increased soil pH by 0.1-1.2 units, which correlated positively with enhanced nutrient availability and potato yield. Key yield components such as diameter of tuber, tuber weight (fresh weight), percentage of dry matter and total yield per hectare were significantly affected by dolomite and vermicompost application. The treatment T_4 (1.5 t ha^{-1} dolomite) produced potato yield of 33.83 t ha-1 which was statistically higher to those in T_1, T_2, T_3, T_5 & T_6 treatments. The treatment T_7 (2.5 t ha^{-1} biochar) produced potato yield of 33.18 t ha-1 which was second highest among all treatments. Apart from this, the total cost of potato cultivation decreased by 33% due to application of dolomite and vermicompost. The findings underscore the importance of utilizing dolomite and vermicompost as valuable soil amendments to enhance soil fertility and promote sustainable soil management as well as sustainable potato production in acid soils of Barind Tract.

Key words: Barind Tract, Acid soil, Dolomite, Vermicompost, Sustainable Soil Management, Soil health, Potato, Yield.

1. Introduction:

Soils in the study area of Bangladesh are becoming acidic (strongly acidic) day by day. Most of the soils of Bangladesh are low to medium acid in reaction, due to the predominance of high rainfall areas and leaching (SRDI, 2020). Soil pH indicates the soil environment as well as soil quality which regulates the availability of plant nutrients, crop yield and also crop quality. Maintaining soil pH above 6.0 optimizes nutrient use, particularly phosphorus (Rahman *et al.,* 2005). Dolomitic Lime [$CaMg(CO_3)_2$] application increased soil pH, P, Ca and Mg availability, which contributed to enhance plant growth and yield contributing parameter (Islam *et al.,*2025) . Dolomite application significantly increases soil pH, which is crucial for improving nutrient availability and microbial activity (Shaaban *et al.,* 2015) (Shaaban *et al.,* 2018). Dolomite enhances the availability of essential nutrients like phosphorus, calcium, and magnesium, which are vital for plant growth (He & Stoffella, 2007); (Higgins *et al.,* 2012).

By raising soil pH, it restores nutrient availability, decreases iron (Fe), aluminum (Al) and manganese (Mn) toxicity; and improves microbial activity, resulting in better root development and crop yields. The addition of lime reduces toxic elements which can hinder nutrient uptake and nutrient absorption (Han *et al.,* 2019). The method of application also matters; incorporating lime into the soil generally yields better results than surface application (Enesi *et al.,* 2023). Optimal liming rates maximizes yield and quality of crops, while excessive liming could lead to nutrient imbalances and reduced yields (Shevchuk et al., 2024)

Dolomite [$CaMg(CO_3)_2$] is recognized as an amendment for soil acidity and vermicompost is a material commonly recommended for the improvement of soil properties. The combined application of dolomite and vermicompost have positive impact on the improvement of soil health including of soil moisture status. Although dolomite increases soil pH, but organic matter acts as a buffering agent controlling the detrimental effects of soil pH on crop production. Therefore, a study was undertaken in acid soil of Tanore upazila under Rajshahi district, to demonstrate the changes of soil properties due to dolomite along with vermicompost in potato field and to evaluate the effects of dolomite and vermicompost on yield and yield contributing traits of potato. Vermicompost significantly enhance the soil phyco-chemical properties in acid soil (Zewide et al., 2021). Use of vermicompost can increases potato production and enhances tuber quality as well as economic benefits to farmers and contributing to sustainable agricultural practices in Bangladesh (Haque et al., 2025). A significant interaction with dolomite and vermicompost identified in increasing plant growth and nutrient uptake (Nufus et al., 2021).

Biochar is black carbon produced from biomass sources [i.e., wood chips, plant residues, manure or other agricultural waste products] in an oxygen-limited environment. Biochar enhances soil physical, chemical, and biological properties, increasing nutrient availability and improving water retention (Baquy et al., 2022); (Ayaz et al., 2021).

2. Material and Method

2.1 Site description and soil information

The experiment was conducted at farmer's field of Tanore upazila under Rajshahi district from November 2024 to March 2025. It belongs to the Agro Ecological Zone- 25 (Level Barind Tract). The top soil texture was loam, initial soil having pH 5.3, organic matter 1.32%, total N 0.091%, available P 25.5 µg g-1, K 0.20 meq 100 g soil-1, available Ca 2.7 meq 100 g soil-1, Mg 0.38 meq 100 g soil-1, S 8.3 µg g-1, B 0.06 µg g-1, Zn 0.73 µg g-1 , Fe 176.89 µg g-1 and Mn 31.09 µg g-1. The test crop was potato (*Solanum tuberosum L.*) cv. BARI Potato-7 for the study.

2.2 Treatments, experimental design and fertilization

There were seven different treatments (doses) of dolomite application along with 1.0 t ha^{-1} Vermicompost (OM) incorporated in soil in each treatment plot in potato experiments field as follows: T_1 (Control); T_2 (0.5 t ha-1 dolomite); T_3 (1.0 t ha-1 dolomite); T_4 (1.5 t ha-1 dolomite); T_5 (2.0 t ha^{-1} dolomite), T_6 (2.5 t ha^{-1} dolomite) and T_7 (2.5 t ha^{-1} biochar). The dolomite material had 20% Ca and 10% Mg. The dolomite material was applied to the soil on 24 November 2024 and mixed well with soil by repeated ploughing by power tiller and country plough. Vermicompost and biochar were applied after three days of dolomite application. Potato seed was sowed on 1st December 2024.

The experiment was laid out in a Randomized Complete Block Design with three replications. There were altogether 21 (7×3) unit plots (5m ×4 m). Inter-block and inter-plot spacing were 1m and 0.7m respectively. Fertilization was as N @ 1140 g decimal-1 from urea, P @ 300 g decimel-1 from TSP, K @ 600 g decimel-1 from MoP, S @ 350 g decimal-1 from gypsum, Zn @ 55 g decimal-1 from zinc sulphate (heptahydrate) and B @ 30 g decimal-1 from boric acid. Irrigations and other cultural practices were provided on time. The crop was harvested on March 8, 2025. Ten plants from each plot were sampled randomly recording for yield parameters. Then a plot wise weight of tuber was recorded.

2.3 Soil sampling and analysis

Before setting up the experiment, initial soil samples were collected randomly from 9 different spots of the field from a depth of 0-15cm using an auger. After harvest of potato, the soil samples again were collected using an auger from each plot at a depth of 0-15 cm. In both cases, the soil samples were left to dry naturally in a shaded area and then pulverized with a mortar and ground to attain a particle size capable of passing through a 2 mm sieve. The initial soil samples were analyzed in SRDI laboratory as per standard methods. Soil samples were analysed for pH by glass-electrode pH meter maintaining 1:2.5 soil-water ratio (Jackson, 1962), organic matter by wet oxidation method (Walkley and Black, 1934), the total N content was determined by micro-kjeldahl method (Kjeldahl, J. (1883), the available P was determined by developing blue color absorbance with ammonium molybdate-ascorbic acid solution and measuring the color by Spectrophotometer at 890 nm wavelength (Bray and Kurtz's, 1945), the S content in the extract was determined turbidimetrically and the turbid was measured by spectrophotometer at 535 nm wavelengths (R. L. Fox, R. A. Olson, H. F. Rhoades, 1964), exchangeable K content was determined by ammonium acetate extraction method using a flame photometer (Schollenberger, C.J. and Simon, R.H., 1945) and exchangeable Ca and Mg content were determined by extraction with 1M ammonium acetate by atomic absorption spectrophotometer (Schollenberger, C.J. and Simon, R.H., 1945), available B was extracted by hot water-0.02M CaCl2 solution (1:2), the extractable B was determined by spectrophotometer following azomethine-H method (Keren, 1996), available Zn, and Mn were extracted by 0.05M DTPA solution (pH 7.3) maintaining 1:2 soil-extractant ratio, the extracted level was measured by atomic absorption spectrophotometer (Lindsay and Norvell, 1978).

2.4 Statistical analysis

The data were analyzed statistically by F-test to examine whether the treatment effects were significant or not. The mean comparisons of the treatments were evaluated by LSD (Least Significant Difference) test if the treatments were significant. The analysis of variance (ANOVA) for different parameters was done by computer using "Statistix-10" software program.

3. Results and Discussion

3.1 Combined effects of Dolomite and Vermicompost on changes of soil properties and effect of biochar on post-harvest acid soils:

The changes in pH, P, Ca and Mg content in soil markedly varied after the harvest of potato. The pH values, P, Ca and Mg availability of the post-harvest soils in different treatments of potato increased steadily with increasing rates of dolomite application (Table 7.1 & Fig.7.1 and Fig.7.2). The pH of the initial soil was 5.3 which increased to 5.4, 6.1, 6.3, 6.5, 6.4, 6.4 and 6.2 in T_1, T_2, T_3, T_4, T_5, T_6, T_7 respectively. The increased in soil pH was due to available Ca and Mg in soils. The initial value of available phosphorus in the soil was 25.4 µg g^{-1} soil and the post-harvest soils had the values 30.73, 33.3, 35.93, 50.47, 48.2, 50.16, and 47.66 µg g^{-1} under the treatment T_1, T_2, T_3, T_4 T_5, T_6, T_7 respectively. Dolomite application increased the soil pH which helped the release of fixed P from the oxides and hydroxides of Fe and Al thus increased the P availability in soils. The available Ca of the initial soil was 2.7 meq 100 g $soil^{-1}$ which increased to 3.0, 3.1, 3.7, 4.6, 5.1, 6.2 and 4.4 meq 100 g $soil^{-1}$ in T_1, T_2, T_3, T_4 T_5, T_6, T_7 respectively. The dolomite material used as dolomite [Ca $Mg(CO_3)_2$], which on dissolution released a large amount of Ca & Mg and thus the available of Ca increased in post-harvest soils. The available Mg of the initial soil was 0.38 meq 100g $soil^{-1}$ which decreased to 1.0, 1.3, 1.6, 1.5, 1.3, 1.7 and 0.80 increased meq 100 g $soil^{-1}$ in T_1, T_2, T_3, T_4, T_5, T_6, T_7 respectively.

Liming generally has little direct effect on potassium (K) availability, but there are some indirect influences. In acid soils, liming can temporarily increase Zn availability by reducing Al^{3+} and Mn toxicity in short term but in the long run liming generally decreases the availability of Zn in soil. The available K of the initial soil was 0.2 meq 100 g $soil^{-1}$ which increased to 0.6, 0.72, 0.67, 0.98, 0.98, 0.8 and 1.1 meq 100 g $soil^{-1}$ in T_1, T_2, T_3, T_4, T_5, T_6, T_7 respectively. The initial value of sulphur in the soil was 8.3 µg g^{-1} soil and the value after post-harvest was 20.6, 21.8, 21.4, 17.7, 17.1, 28.3 and 25.1 µg g^{-1} under the treatment T_1, T_2, T_3, T_4, T_5, T_6, T_7 respectively. The initial status of zinc was 0.73µg g^{-1} soil and the post-harvest soils had the values 5.0, 8.8, 9.2, 15.7, 6.4, 5.42 and 6.3 µg g^{-1} in T_1, T_2, T_3, T_4, T_5, T_6, T_7 respectively (Table 7.1 & Fig.7.3).

Liming decreases the Fe and Mn availability in the soil. The initial value of iron in the soil was 176.89 µg g^{-1} soil and the post-harvest soils had the values 150.4, 125.9, 110.0, 109.8, 112.3, 116.1 and 126.7 µg g^{-1} under the treatment T_1, T_2, T_3, T_4, T_5, T_6, T_7 respectively. The initial status of manganese was 31.09 µg g^{-1} soil and the post-harvest soils had the values 11.3, 7.1, 10.8, 6.4, 10.9, 5.6 and 14.6 µg g^{-1} in T_1, T_2, T_3, T_4, T_5, T_6, T_7 respectively (Table 7.1 & Fig. 7.4) Fig no:213

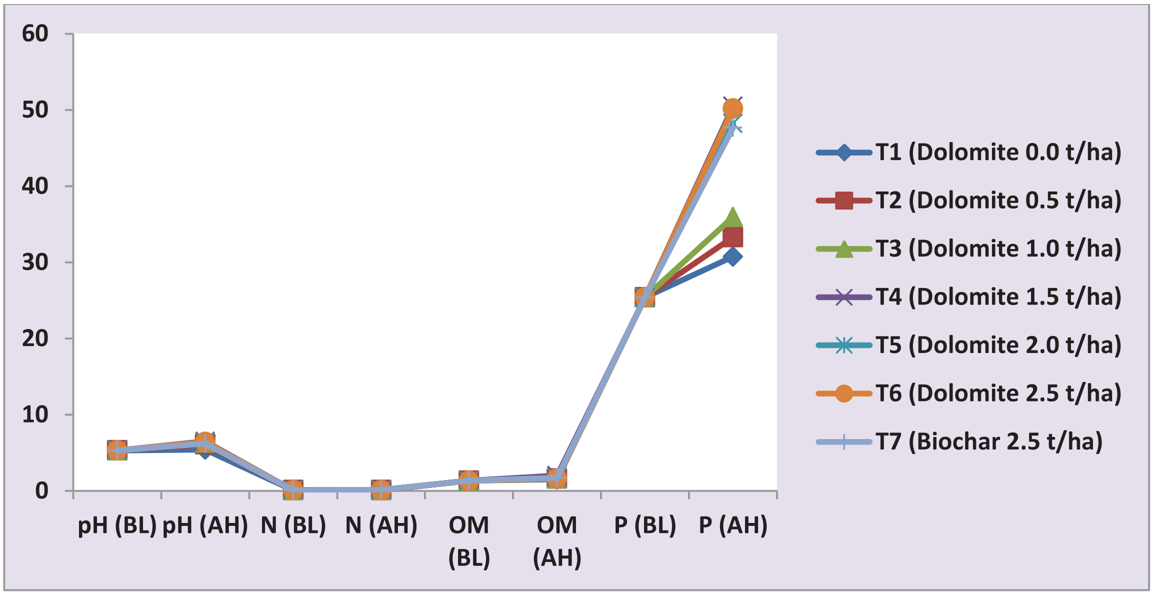

Fig. 7.1 Effects of Dolomite and Vermicompost (VC) on soil pH, N, OM and P of post-harvest soils of Potato field

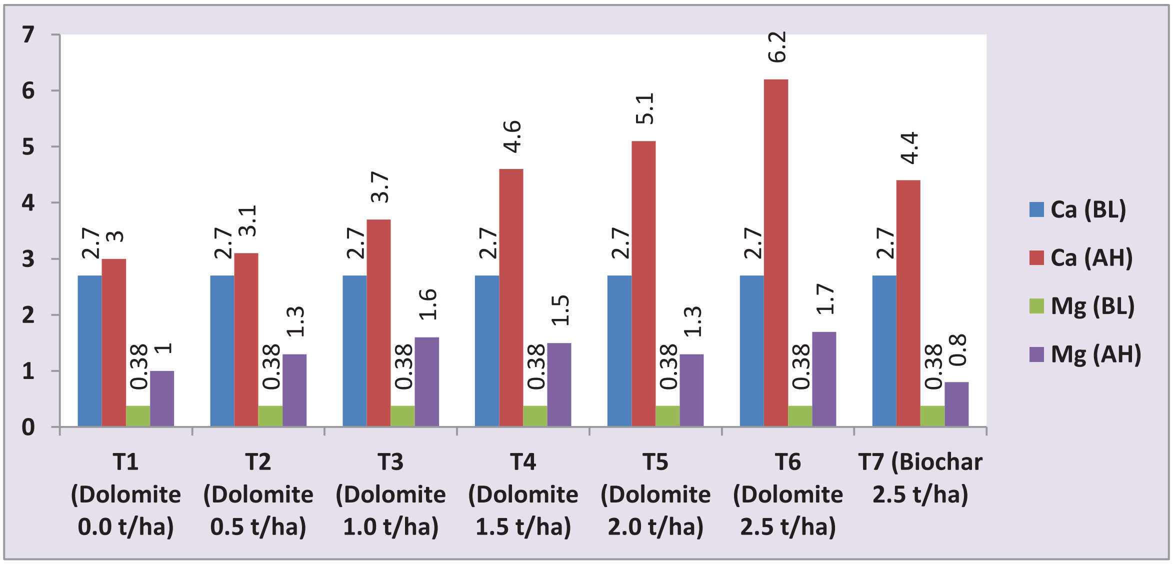

Fig. 7.2 Effects of Dolomite and Vermicompost (VC) on soil Ca and Mg of post-harvest soils of Potato field

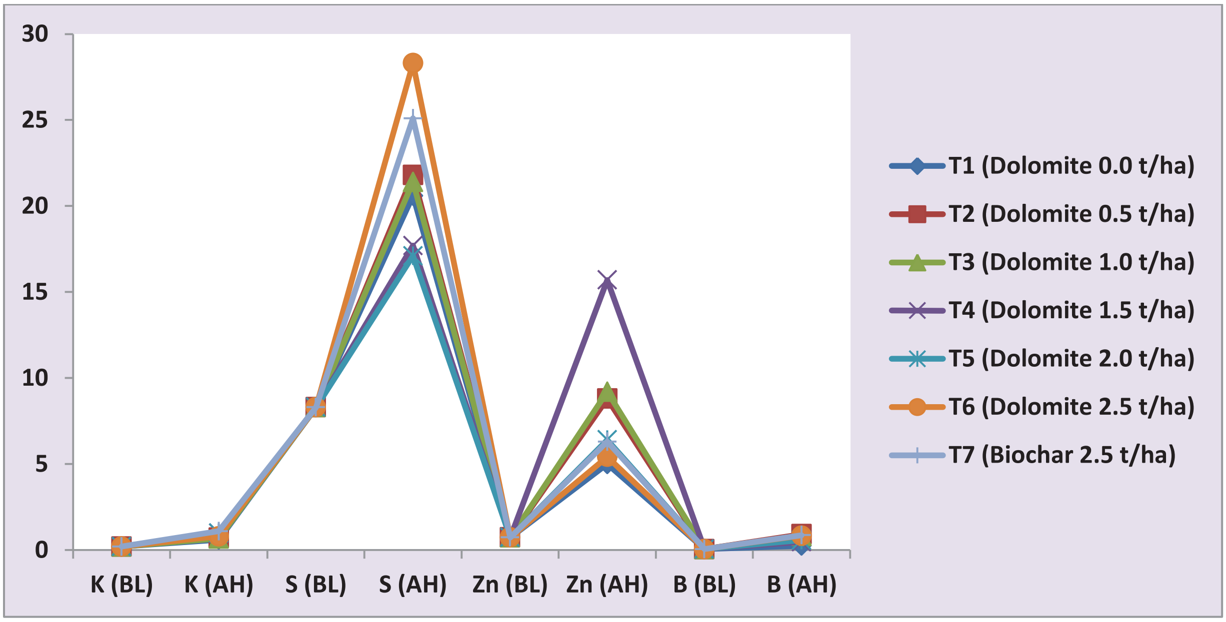

Fig. 7.3 Effects of Dolomite and Vermicompost (VC) on soil K, S, Zn and B of post-harvest soils of Potato field

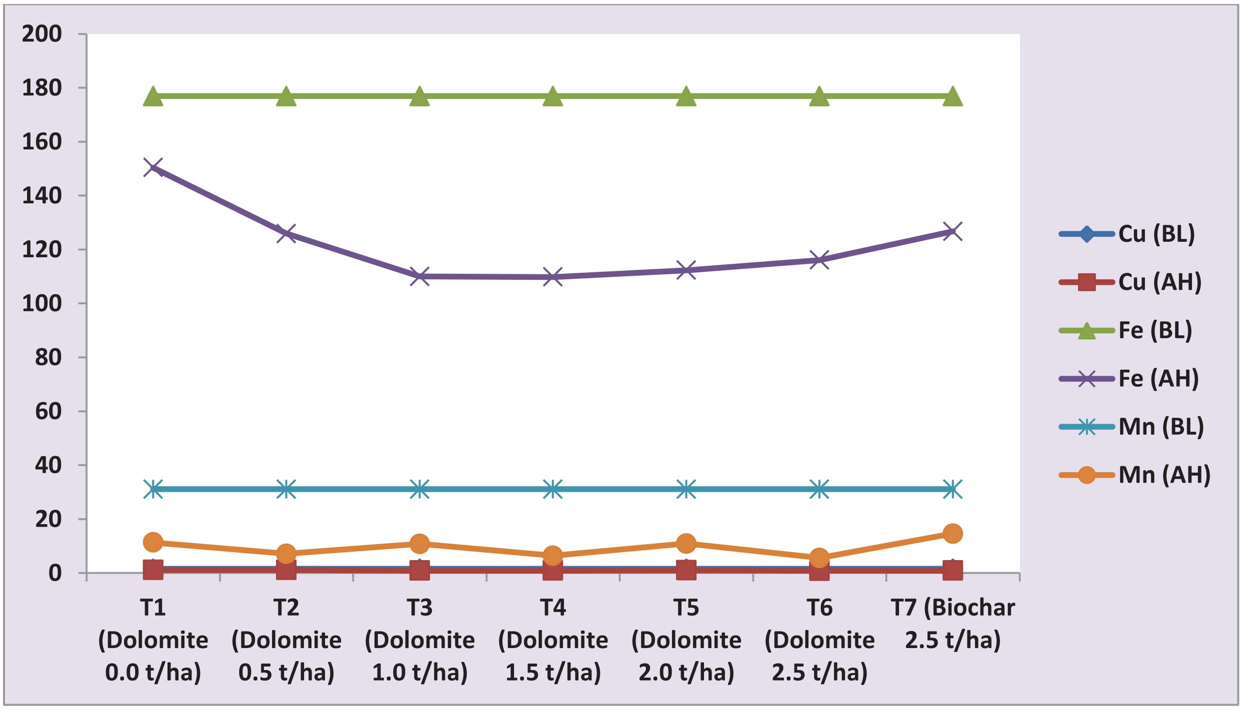

Fig. 7.4 Effects of Dolomite and Vermicompost (OM) on soil Cu, Fe and Mn of post-harvest soils of Potato field

Table 7.1: Combined effects of Dolomite and Vermicompost (OM) on soil properties of post-harvest soils of Potato field

Treatments	pH	OM (%)	TN (%)	K (meq $100g^{-1}$soil)	Ca (meq $100g^{-1}$soil)	Mg (meq $100g^{-1}$soil)	P (µg g^{-1}soil)	S (µg g^{-1}soil)	Zn (µg g^{-1}soil)	B (µg g $soil^{-1}$)	Fe (µg g $soil^{-1}$)	Mn (µg g $soil^{-1}$)	Cu (µg g $soil^{-1}$)
Initial soil Values (Farmer's field)	5.3^{b}	1.32^{c}	0.091^{a}	0.20^{d}	2.7^{b}	0.38^{d}	25.4^{b}	8.3^{b}	0.73^{e}	0.06^{e}	176.89^{a}	31.09^{a}	1.57^{a}
Analytical Values after post-harvest soil of potato field													
T_1: Control + VC	5.4^{b}	1.5^{b}	0.07^{a}	0.60^{c}	3.0^{b}	1.0^{bc}	30.73^{ab}	20.6^{ab}	5.0^{d}	0.25^{de}	150.4^{ab}	11.3^{bc}	1.1^{bc}
T_2: 0.5 t ha^{-1} + VC	6.1^{a}	1.6^{b}	0.092^{a}	0.72^{bc}	3.1^{b}	1.3^{ab}	33.30^{ab}	21.8^{ab}	8.8^{bc}	0.92^{a}	125.9^{bc}	7.1^{bc}	1.1^{b}
T_3: 1.0 t ha^{-1} + VC	6.3^{a}	1.6^{b}	0.092^{a}	0.67^{bc}	3.7^{ab}	1.6^{a}	35.93^{ab}	21.4^{ab}	9.2^{b}	0.82^{ab}	110.0^{c}	10.8^{bc}	0.9^{bc}
T_4: 1.5 t ha^{-1} + VC	6.5^{a}	2.0^{a}	0.100^{a}	0.98^{ab}	4.6^{ab}	1.5^{a}	50.47^{a}	17.7^{ab}	15.7^{a}	0.46^{cd}	109.8^{c}	6.4^{bc}	0.9^{bc}
T_5: 2.0 t ha^{-1} + VC	6.4^{a}	1.7^{b}	0.100^{a}	0.98^{ab}	5.1^{ab}	1.3^{ab}	48.20^{ab}	17.1^{ab}	6.4^{bcd}	0.58^{bc}	112.3^{bc}	10.9^{bc}	1.0^{bc}
T_6: 2.5 t ha^{-1} + VC	6.4^{a}	1.6^{b}	0.095^{a}	0.80^{abc}	6.2^{a}	1.7^{a}	50.16^{ab}	28.3^{a}	5.42^{cd}	0.84^{ab}	116.1^{bc}	5.6^{c}	0.8^{c}
T_7: 2.5 t ha^{-1} + Biochar	6.2^{a}	1.7^{b}	0.095^{a}	1.1^{a}	4.4^{ab}	0.8^{cd}	47.66^{ab}	25.1^{a}	6.3^{bcd}	0.86^{ab}	126.7^{bc}	14.6^{b}	0.9^{bc}
F-test	*	*	NS	*	*	*	*	*	*	*	*	*	*
$LSD_{0.05}$	0.50	0.18	0.09	0.32	2.63	0.45	24.17	13.85	3.67	0.28	38.15	8.75	0.24
CV (%)	4.70	6.35	60.07	24.58	36.60	21.69	34.31	39.46	29.17	27.34	16.96	40.88	13.35

VC= Vermicompost, equally incorporated in soil in every treatment plot
*= Significant at 0.05% level of probability
The Figures having common letter in a column are not significantly different by F-test at 5%level.
LSD= Least Significant Difference, CV= Co-efficient of Variation

3.2 Growth and yield components:

The application of different doses of dolomite with vermicompost significantly increased the plant height, diameter of tuber, tuber weight (fresh weight), percentage of dry matter and total yield per hectare (Table 7.2 & Fig. 7.5). Biochar also plays a significant role on the yield contributing character of potato. **Plant height** of potato progressively increased with increase in dolomite doses. The plant height ranged from 64.80 cm to 83.50 cm in treatments that higher than the farmer's field practice. The tallest plant recorded in T_4 and all the treatments of T_1, T_2, T_3, T_5, T_6, T_7 differed statistically from each other in plant height. The **tuber diameter** by different treatments varied from 112.04 cm to 145.77 cm. The highest tuber diameter was obtained in the treatment T_4. **Fresh tuber weight** of potato ranged from 144.31 gm to 180.83 gm, the highest fresh tuber weight was found in T_4. The other treatments values are statistically different. **Dry tuber weight** of potato ranged from 28.51 gm to 33.83 gm, the highest dry tuber weight was observed in T_4 treatment. **Percentage of Dry matter** varied from 18.78 to 19.76 and the lowest percentage of dry matter was recorded 18.78 in treatment T_4 and T_2. **Tuber yield** of potato (var. BARI Alu-7) was significantly responded due to application of different doses of dolomite along with vermicompost (Table 7.2). The highest yield was found in T_4 (33.83 t ha^{-1}), the second highest yield was observed in the treatment plot of biochar T_7 (33.18 t ha^{-1}), while the lowest in T_1 (29.85 t ha^{-1}) treatment. All the treatments of T_1, T_2, T_3, T_5, T_6, T_7 differed statistically from each other in yields of potato. The plant height, diameter of tuber, fresh tuber weight, dry tuber weight and total yield per hectare of farmer's field were observed 61.93 cm, 101.60 cm, 100.08 gm., 24.76 gm., 24.74 percent, 26.72 t ha^{-1} respectively that was lowest than all the treatments applied. Fertilizer was applied as per Fertilizer Recommendation Guide (FRG, 2018) as N @ 1140 g $decimal^{-1}$ or 38 kg $bigha^{-1}$ from urea, P @ 300 g $decimel^{-1}$ or 10 kg $bigha^{-1}$ from TSP, K @ 600 g $decimel^{-1}$ or 20 kg $bigha^{-1}$ from MoP, S @ 350 g $decimal^{-1}$ or 11 kg $bigha^{-1}$ from gypsum, Zn @ 55 g $decimal^{-1}$ or 2 kg $bigha^{-1}$ from zinc sulphate (heptahydrate) and B @ 30 g $decimal^{-1}$ or 1 kg $bigha^{-1}$ from boric acid with vermicompost @ 4 kg $decimel^{-1}$ in the treatment T_1, T_2, T_3, T_4, T_5, and T_6. Biochar was applied @ 10 kg $decimal^{-1}$ with the recommended fertilizer dose in the treatment T_7. Farmers of Tanore upazila do not follow the soil test based fertilizer dose. They use excessive fertilizer in their field for potato production. Generally, they use N @ 50 kg $bigha^{-1}$ from urea, P @ 50 kg $bigha^{-1}$ from TSP, N & P @ 70 kg $bigha^{-1}$ from DAP, K @ 120 kg $bigha^{-1}$ from MoP, S @ 8 kg $bigha^{-1}$ from gypsum, Zn @ 2 kg $bigha^{-1}$ from zinc sulphate (heptahydrate) and B @ 1 kg $bigha^{-1}$ from boric acid. Sometimes they use cowdung @ 7 maund $bigha^{-1}$. Fertilizer cost analysis showed that the total cost of fertilizer in potato cultivation decrease 33% by application of dolomite and vermicompost with recommended fertilizer dose (Table-7.3).

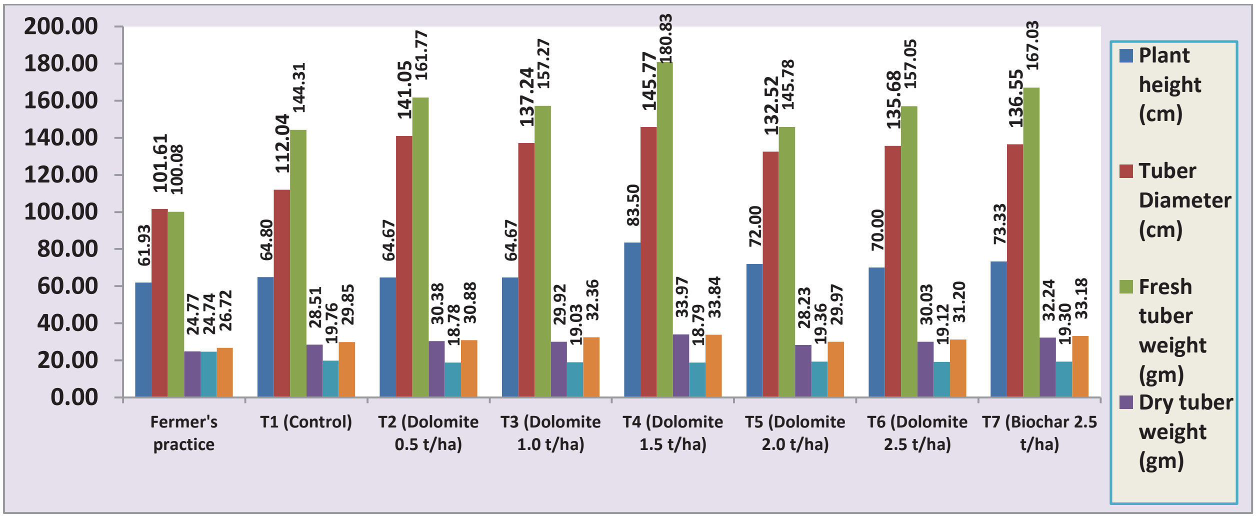

Fig. 7.5 Interaction effects of Dolomite and Vermicompost (OM) on growth and yield components of potato

Table 7.2: Combined effects of Dolomite and Vermicompost (OM) on growth and yield components of Potato

Treatments	Plant Height (cm)	Tuber Diameter (cm)	Fresh tuber weight (gm)	Dry tuber weight (gm)	% Dry matter	Yield (t ha^{-1})
Farmer's Field	61.93^{b}	101.60^{b}	100.08^{d}	24.77^{b}	24.74^{a}	26.72^{b}
T_1: Control + VC	64.80^{b}	112.03^{b}	144.30^{c}	28.51^{ab}	19.76^{b}	29.85^{ab}
T_2: 0.5 t ha^{-1} + VC	64.67^{b}	141.04^{a}	161.76^{abc}	30.38^{ab}	18.78^{b}	30.88^{ab}
T_3 : 1.0 t ha^{-1}+ VC	64.67^{b}	137.23^{a}	157.27^{a}	29.92^{ab}	19.03^{b}	32.36^{a}
T_4: 1.5 t ha^{-1} + VC	83.50^{a}	145.77^{a}	180.83^{a}	33.97^{a}	18.78^{b}	33.84^{a}
T_5 : 2.0 t ha^{-1} + VC	72.00^{ab}	132.52^{a}	145.78^{bc}	28.22^{ab}	19.36^{b}	29.97^{ab}
T_6 : 2.5 t ha^{-1} + VC	70.00^{ab}	135.68^{a}	157.04^{bc}	30.02^{ab}	19.12^{b}	31.20^{ab}
T_7 : 2.5 t ha^{-1} + Biochar	73.33^{ab}	136.54^{a}	167.02^{ab}	32.24^{ab}	19.30^{b}	33.18^{a}
F-test	*	*	*	NS	*	*
$LSD_{0.05}$	14.11	15.59	21.95	8.16	4.19	4.80
CV	11.61	6.83	8.26	15.54	12.05	8.85

VC= Vermicompost, equally incorporated in soil in every treatment plot
*= Significant at 0.05% level of probability
The Figures having common letter in a column are not significantly different by F-test at 5% level.
LSD= Least Significant Difference, CV= Co-efficient of Variation

Table 7.3: Fertilizer Cost Analysis

Amount and cost of fertilizers applied Farmer's rate/ Bigha (33 Decimal)			**Amount and cost of fertilizers applied based on soil test (including lime & vermicompost application)/ Bigha (33 Decimal)**		
Fertilizer's Name	**Quantity & Unit Price**	**Total Taka**	**Fertilizer's Name**	**Quantity & Unit price**	**Total Taka**
Urea	50 kg × 27	1350	Urea	38 kg × 27	891
DAP	70 kg× 21	1470	DAP	-	-
TSP	50 kg × 27	1350	TSP	10 kg × 27	270
MOP	120 kg × 21	2520	MOP	20 kg × 21	420
Gypsum	8 kg × 10	80	Gypsum	11 kg × 10	50
Zinc Sulphate (Hepta)	2 kg × 150	300	Zinc Sulphate (Hepta)	2 kg × 150	300
Boric Acid	1 kg × 150	150	Boric acid	1 kg × 150	150
Cowdung	7 maund × 200	1400	Vermicompost	132 kg × 12	1584
			Dolomite	198 kg x10	1980
	Total=	**8,620/=**		**Total=**	**5,780/=**

Conclusions:

It may be concluded that combined application of dolomite and vermicompost in Level Barind Tract (AEZ-25) in the Amnura soil series increased soil pH along with soil health which in terms of increased yield components and yield of potato. It is supplementary that the amount of dolomite 1.5 t ha^{-1} along with 1.0 t ha^{-1} vermicompost may be optimum for potato cultivation in the loam soil in AEZ-25.

Conflicts of Interest:

The authors declare no conflicts of interest regarding publication of this paper.

Reference:

- Haque, M. A., Roy, T. S., Biswas, M. I., Mannan, M. A., Tasnim, M., Jui, S. M., ... & Easmin, S. (2025). The Response of Selected Potato Varieties to Different Levels of Vermicompost in Bangaladesh. *Asian Plant Research Journal*, *13*(2), 46-60.
- M.N. Islam, A.F.M. Manzurul Hoque, M.Y. Ali, M.M. Hasan and S. Afrin (2025). Changes of Acidic Soil Properties and Yield of Wheat as influenced by Application of Dolomite and Vermicompost. Bangladesh J. Soil Sci. 2024, 40 (2): 141-148.
- Shevchuk, M., Golub, S., & Rovna, H. (2024). The effect of different lime rates on the yield and quality of winter wheat under mineral fertilization on a sod-podzolic soil. *Меліорація і Водне Господарство*, *1*, 98–102. https://doi.org/10.31073/mivg202401-380.
- Enesi, R. O., Dyck, M., Chang, S., Thilakarathna, M. S., Fan, X., Strelkov, S., & Gorim, L. Y. (2023). Liming remediates soil acidity and improves crop yield and profiTableity-a meta-analysis. Frontiers in Agronomy, 5, 1194896.
- Baquy, M. A.-A., Mamun, M. A. A., Mia, S., Alam, M. G. M., Khan, M. H., & Rahman, S. M. (2022). Biochar research advancement in Bangladesh: challenges and opportunities of biochar in improving soil health. *Sains Tanah: Journal of Soil Science and Agroclimatology*, *19*(2), 145. https://doi.org/10.20961/stjssa.v19i2.59758
- Ayaz, M., Feizienė, D., Tilvikienė, V., Akhtar, K., Stulpinaitė, U., & Iqbal, R. (2021). Biochar Role in the Sustainability of Agriculture and Environment. *Sustainability*, *13*(3), 1330. https://doi.org/10.3390/SU13031330
- Zewide, I., Singh, S., & Wogi, L. (2021). Soil physico-chemical properties as affected by integrated use of blended fertilizer, cattle manure, vermicompost and mineral nitrogen and phosphorus in potato (Solanum tubersoum) in acidic soil of south-western Ethiopia. *Indian Journal of Agronomy*, *66*(4), 474-482.
- Nufus, N. H., Sabrina, T., & Hasanah, Y. (2021, July). The role of dolomite and vermicompost in nutrient uptake and production of sweet potato (Ipomoea batatas L) on acid soil. In *IOP Conference Series: Earth and Environmental Science* (Vol. 824, No. 1, p. 012041). IOP Publishing.
- Soil Fertility Atlas Bangladesh. (2020). Soil Resource Development Institute, Farmgate, Dhaka 1215, Bangladesh.
- Han, T., Cai, A., Liu, K., Huang, J., Wang, B., Li, D., Qaswar, M., Feng, G., & Zhang, H. (2019). The links between potassium availability and soil exchangeable calcium, magnesium, and aluminum are mediated by lime in acidic soil. Journal of Soils and Sediments, 19(3), 1382–1392. https://doi.org/10.1007/S11368-018-2145-6.
- FRG. (2018). Fertilizer recommendation guide, 2018. Bangladesh Agricultural Research Council, Farmgate, Dhaka 1215, Bangladesh. p.274
- Shaaban, M., Wu, Y., Peng, Q., Wu, L., Van Zwieten, L., Khalid, M. S., Younas, A., Lin, S., Zhao, J., Bashir, S., Zafar-ul-Hye, M., Abid, M., & Hu, R. (2018). The interactive effects of dolomite application and straw incorporation on soil N2O emissions. *European Journal of Soil Science*, *69*(3), 502–511. https://doi.org/10.1111/EJSS.12541
- Shaaban, M., Peng, Q., Hu, R., Wu, Y., Lin, S., & Zhao, J. (2015). Dolomite application to acidic soils: a promising option for mitigating N2O emissions. *Environmental Science and Pollution Research*, *22*(24), 19961–19970. https://doi.org/10.1007/S11356-015-5238-4

- Lime Technology for the Acid Soil Regions of Bangladesh, Food for Progress Program in Bangladesh, 2014.
- Dolomite enhances the availability of essential nutrients like phosphorus, calcium, and magnesium, which are vital for plant growth(He & Stoffella, 2007)(Higgins et al., 2012).
- Brady, N.C., Weil, R.C., 2012. In: The Nature and Properties of Soils. 14th Edn (Revised). Published by Dorling Kin Dersley (India) Pvt. Ltd., licensees of Pearson Education in Asia, India, pp 513-517.
- Rahman, M. A., Chikushi, J., Duxbury, J. M., MEISNER, C. A., LAUEN, J. G., & YASUNAGA, E. (2005). Chemical control of soil environment by lime and nutrients to improve the productivity of acidic alluvial soils under rice-wheat cropping system in Bangladesh. *Environmental Control in Biology*, *43*(4), 259-266.
- Khandakhar, S. M. A. T., Rahman, M. M., Uddin, M. J., Khan, S. A. K. U., & Quddus, K. G. (2004). Effect of lime and potassium on potato yield in acid soil.
- Keren, R. 1996. Boron. In: Methods of Soil Analysis, Part 3 - Chemical Methods. Sparks.
- Lindsay, W.L. and Norvell, W.A. 1978. Development of a DTPA Test for zinc, iron, manganese and copper. Soil Sci. Soc. Am. J. 42(3): 421-428.
- Jackson, M.L. 1962. Soil Chemical Analysis. Prentice Hall Inc., Engle wood, Clift, N.J. p 143.
- Schollenberger, C.J. and Simon, R.H. 1945. Determination of exchange capacity and exchangeable bases in soil-ammonium acetate method. Soil Sci. 59: 13-24.
- Walkley, A. and I. A. Black. 1934. An examination of degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Sci. 37: 29-37.
- Bray, R.H. and Kurtz, L.T. 1945. Determination of total, organic, and available forms of phosphorus in soils. Soil Science, 59: 39-45.
- Kjeldahl, J. 1883. A New Method for the Determination of Nitrogen in Organic Matter. Zeitschrift für Analyt. Chemie. 22: 366-382.

Research activities of during experiment

Effect of Different Doses of Lime and Biochar Application on Soil Properties, Crop Attributes and Yield of Wheat Grown in Madhupur Tract Soil

Experiment 1: Determination of dolomite rate to minimize soil acidity in the terrace soil

Cropping pattern: Wheat (BARI GOM 30) – Fallow – T. Aman (BRRI Dhan 103)

Land type: High land; Belabo soil series; Chala (2023-24)

Treatments: T_1- 0 kg lime/decimal

T_2- 4 kg lime/decimal

T_3- 6 kg lime /decimal

T_4- 8 kg lime/decimal

T_5- 10 kg lime/decimal

T_6- 12 kg lime /decimal

T_7- 14 kg lime /decimal

Table 7.4: Initial soil properties of the experimental soil

pH	OM	TN	P	K	S	Zn	B	Ca	Mg	Cu	Fe	Mn
4.5	1.92	0.11	215.25	0.34	26.42	3.43	0.86	2.89	1.58	1.03	198.10	42.71

Table 7.5: Fertilizer dose of the experimental soil

Soil Fertility	OM (%)	N	P	K	S	Zn
	Medium	Low	Very high	High	Optimum/ Medium	Very high
Fertlizer (g/dec.)	Cowdung	Urea	TSP	MOP	Gypsum	Zinc sulphate
Wheat	10	890	80	121	75	0
T. Aman	-	670	60	105	175	0

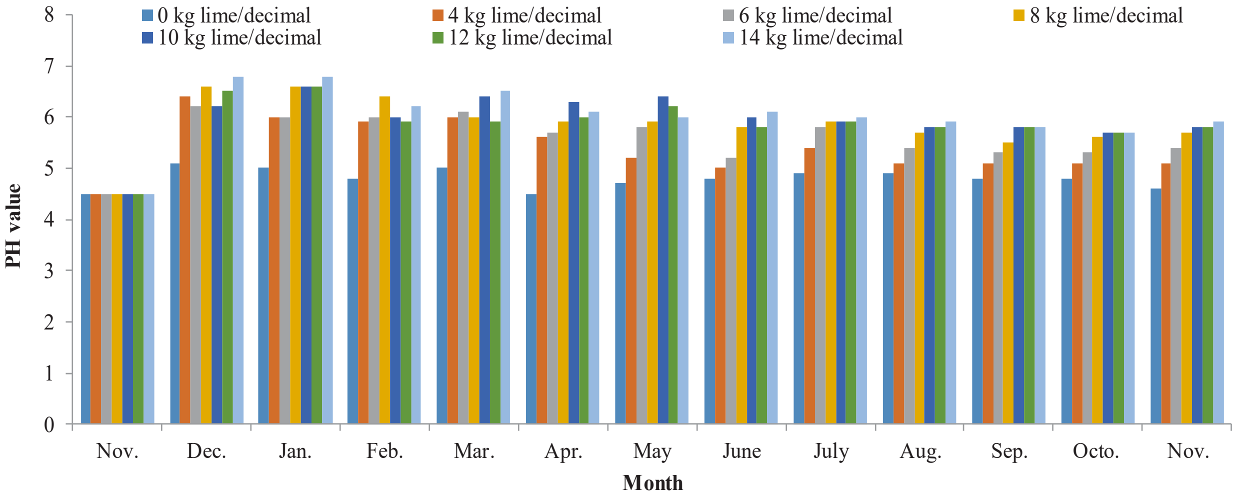

Fig 7.6 Month wise changes in soil pH after dolomite application (2023-2024)

Table 7.6: Month wise changes in soil organic matter (SOM) after dolomite application (2023-2024)

Lime rate (kg/decimal)	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Octo.	Nov.
0	1.92	2.16	2.09	2.15	2.16	2.17	2.14	2.09	2.05	2.09	2.12	2.04	2.04
4	1.92	2.15	2.15	2.12	2.16	2.10	2.17	2.14	2.13	2.09	2.06	1.99	2.01
6	1.92	2.13	1.83	2.04	2.16	2.12	2.06	2.06	2.17	2.11	2.07	2.07	1.99
8	1.92	2.09	2.15	2.08	2.13	2.15	2.16	2.08	2.09	2.02	2.06	2.00	1.99
10	1.92	2.08	2.19	2.14	2.15	2.13	2.10	2.13	2.05	2.07	2.07	2.02	1.99
12	1.92	2.16	2.16	2.10	2.08	2.16	2.16	2.11	2.10	2.13	2.03	2.03	1.99
14	1.92	2.15	2.14	2.17	2.20	2.14	2.10	2.11	2.07	2.05	2.05	2.00	2.00

Table 7.7: Effect of different dose of dolomite on the extractable nutrients content in soil after T. Aman (2nd crop) harvest (2024-25)

Lime rate (kg/decimal)	N	P	K	S	Zn	B	Ca	Mg	Cu	Fe	Mn
0	0.10 cd	114	0.17 a	10.17 a	2.78 a	0.85 bc	2.55 c	1.20 d	1.04 a	200 a	43.39 a
4	0.11 bc	110	0.14 b	9.12 ab	1.84 ab	0.87 ab	3.92 bc	1.93 c	0.48 cd	165 ab	12.65 b
6	0.09 de	106	0.16 ab	5.72 d	1.99 ab	0.90 ab	4.17 b	1.90 c	0.50 bc	140 ab	12.40 b
8	0.08 e	98	0.11 c	6.89 cd	1.94 ab	0.87 ab	4.00 bc	2.00 bc	0.53 bc	157 ab	11.63 b
10	0.09 de	81	0.14 b	9.09 ab	1.36 b	0.79 c	5.24 ab	2.07 ab	0.40 d	105 b	12.59 b
12	0.13 a	100	0.14 b	7.54 bc	1.60 b	0.83 bc	5.87 a	2.19 a	0.61 b	157 ab	16.74 b
14	0.12 ab	106	0.14 b	7.05 bc	1.65 b	1.04 a	5.09 ab	2.15 ab	0.59 bc	129 b	14.48 b
± SE	0.01	18	0.10	1.01	0.44	0.09	0.68	0.08	0.06	28.12	2.6
LSD	0.02	39	0.23	2.20	0.95	0.19	1.48	0.18	0.12	61.27	5.66

Table 7.8: Effect of different dose of dolomite on the yield and yield contributing characters of Transplanted Aman rice in 2024

Treatment (kg/decimal lime)	Plant height (cm)	Spike length (cm)	Tiller /hill	Effective tiller/hill	Grain/ panicle	Effective Grain/ panicle	1000 grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)
	140.07 b	25.90 b	12.17 d	10.07 d	136.33 c	122.90 c	20.47 ab	4.13 d	5.97 d
	143.87 ab	27.13 a	12.40 cd	10.83 c	142.00 b	129.57 b	20.53 ab	4.47 c	7.03 c
	142.73 ab	27.10 a	12.50 bc	10.97 bc	144.00 ab	130.80 b	20.87 ab	5.07 ab	7.90 ab
	146.33 a	27.53 a	12.67 bc	10.93 bc	146.00 ab	133.83 ab	20.17 b	5.17 a	8.07 ab
	147.27 a	27.77 a	13.17 a	11.83 a	149.33 a	136.57 a	21.37 a	5.2 a	8.13 a
	145.33 a	27.73 a	12.93 ab	11.33 b	148.67 a	136.03 a	20.60 ab	5.00 ab	7.63 b
	145.13 a	27.37 a	12.70 ab	11.03 bc	146.00 ab	132.77 ab	20.40 ab	4.87 b	7.60 b
± SE	2.18	0.41	0.22	0.22	2.51	2.35	0.51	0.09	0.22
LSD	4.76	0.90	0.48	0.49	5.47	5.12	1.10	0.21	0.48

Experiment 2: Effect of different doses of dolomite rate on soil acidity, soil properties and crop production in the terrace soil

Cropping pattern: Wheat (BARI GOM 30) – Fallow – T. Aman (BRRI Dhan 103)

Medium high land; Kalma soil series; Baid (2023-24 and 2024-25)

Treatments: T_1- 0 kg lime/decimal

T_2- 2 kg lime/decimal

T_3- 4 kg lime /decimal

T_4- 6 kg lime/decimal

T_5- 8 kg lime/decimal

T_6- 10 kg lime /decimal

Table 7.9: Initial soil properties of the experimental soil

Exp.	pH	OM (%)	TN (%)	K	Ca	Mg	P	S	Zn	B	Cu	Fe	Mn
				meq/100g soil			ppm						
2	5.2	1.18	0.06	0.06	2.74	0.96	21.36	4.91	0.47	0.42	0.62	82.41	6.63

Table 7.10: Fertilizer dose of the experimental soil

Soil Fertility	OM (%)	N	P	K	S	B	Zn
	Medium	Very low	High	Very low	Very low	Medium	Very high
Fertlizer (g/dec.)	Cowdung	Urea	TSP	MOP	Gypsum	Boric acid	Zinc sulphate
Wheat	10	1240	80	860	455	8	39
T. Aman	-	935	60	715	380	-	25

Results:

Results are under processing

Experiment 3: Effect of different doses of dolomite rate and biochar on soil acidity, soil properties and crop production in the terrace soil

Cropping pattern: Wheat (BARI GOM 30) – Fallow – T. Aman (BRRI Dhan 103)

Medium high land; Kalma soil series; Baid

Treatments: T_1- 0 kg lime/decimal
T_2- 2 kg lime/decimal
T_3- 4 kg lime /decimal
T_4- 6 kg lime/decimal
T_5- 8 kg lime/decimal
T_6- 10 kg lime /decimal
T_7- 10 kg Biochar /decimal

Table 7.11: Initial Chemical properties of experimental soil

Exp	pH	OM (%)	TN (%)	K	Ca	Mg	P	S	Zn	B	Cu	Fe	Mn
				meq/100g soil			ppm						
3	5.2	1.18	0.06	0.06	2.74	0.96	21.36	4.91	0.47	0.42	0.62	82.41	16.63

Table 7.12: Fertilizer dose of the experimental soil

Soil Fertility	OM (%)	N	P	K	S	B	Zn
	Medium	Very low	High	Very low	Very low	Medium	Very high
Fertlizer (g/dec.)	Cowdung	Urea	TSP	MOP	Gypsum	Boric acid	Zinc sulphate
Wheat	10	1240	80	860	455	8	39
T. Aman	-	935	60	715	380	-	25

Results:

Results are under processing

SUPPORT ON THE ENVIRONMENTAL AND ECONOMIC IMPACTS OF DIFFERENT SUSTAINABLE SOIL MANAGEMENT PRACTICES IN BANGLADESH (FAO Project)

Experiment 4: Effect of biochar and dolomite application on the soil acidity, properties and crop yield in the terrace soil

Medium high land; Chandra soil series; Baid
Treatments: T_1- Traditional doses of fertilizer (FP)
T_2- Balanced doses of Fertilizer (STB)
T_3- STB + Biochar (10 kg/decimal)
T_4- STB + Biochar (10 kg/decimal) + Lime (8 kg/decimal)
T_5- FP + Biochar (10 kg/decimal) + Lime (8 kg/decimal)

Design: RCBD; Replication: 3; Plot size: 5mX8m=40m^2

Table 7.13: Initial Chemical properties of experimental soil

Exp	pH	OM (%)	TN (%)	K	Ca	Mg	P	S	Zn	B	Cu	Fe	Mn
				meq/100g soil			ppm						
4	5.3	2.15	0.12	0.20	3.80	1.04	26.35	8.87	3.65	0.56	2.31	290.68	22.36

Table 7.14: Fertilizer dose of the experimental soil (Boro Dhan – BRRI Dhan 92)

Soil Fertility	N	P	K	S		B	Zn	Soil ammendment
	Low	High	Medium	Very low		High	Very high	
Fertlizer (g/dec.)	Urea	TSP	MOP	Gypsum	Boric acid	Zinc sulphate	Thiovit	
RFD	1330	80	470	555	0	0	0	0
Farmer's practice	1150	1212	1061	303	0	45	30	45

Table 7.15: Effect of Dolomite and Biochar on the yield and yield contributing characters of Boro rice

Treatment	GrainYield (t/ha)	Straw Yield (t/ha)	1000 grain weight (g)	Plant height (cm)	Panicle length (cm)	Tiller number
FP	7.37 c	10.32 c	23.67 b	105.93 c	23.00 b	20.60 b
STB	7.95 ab	11.13 ab	24.50 ab	106.23 bc	22.9 b	20.73 ab
STB+B	8.03 ab	11.25 ab	25.33 ab	107.57 a	23.80 a	21.03 ab
STB+B+L	8.19 a	11.46 a	25.67 a	107.97 a	23.70 a	21.30 ab
FP+B+L	7.74 b	10.84 b	26 .00 a	107.50 ab	23.83 a	21.53 a
± SE	0.15	0.21	0.75	0.57	0.19	0.4
LSD	0.35	0.49	1.73	1.32	0.45	0.92

Conclusions:

Lime dose should be maintained considering pH value, organic matter content, soil texture and crop choice. 10-12 kg lime per decimal require for experiment 1 (pH - 4.5, OM – 1.92% and texture – silt clay) and 8 kg lime per decimal require for experiment 2 and 3 (pH- 5.2, OM-1.18% and texture –silt clay). Combined application of lime and biochar together with soil test-based fertilizer recommendation gave higher rice yield than other treatments. Final conclusion will be given after completion of the research.

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