

Research Program 2024-2025

Program Leader

Dr. Syed Md. Abdullah Shiblee

Chief Scientific Officer & Head



Agricultural Statistics and ICT Division

Bangladesh Agricultural Research Institute

Gazipur-1701

November 2024

Research Program 2024-2025

Compiled & Edited by

Kowshik Kumar Saha, Ag. Engineer
Dr. Mohammad Mukhlesur Rahman, SSO
Nur Mohammad, SSO
Mohammad Rasel, SO
Jamila Khatun Prioty, SO



Agricultural Statistics and ICT Division
Bangladesh Agricultural Research Institute
Gazipur-1701, Bangladesh

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ই-গভর্নেন্স ও উদ্ভাবন কর্মপরিকল্পনা ২০২৪-২৫
কৃষি পরিসংখ্যান এবং তথ্য ও যোগাযোগ প্রযুক্তি (এএসআইসিটি) বিভাগ
বাংলাদেশ কৃষি গবেষণা ইনস্টিটিউট, গাজীপুর-১৭০১

ক্রম	কার্যক্রম	কর্মসম্পাদন সূচক	একক	কর্মসম্পাদন সূচকের মান	লক্ষ্যমাত্রা ২০২৪২০২৫-				
					অসাধারণ	অতি উত্তম	উত্তম	চলতি মান	চলতি মানের নিম্নে
					১০০%	৯০%	৮০%	৭০%	৬০%
০১	[১.১] সেবা সহজিকরণ/ ডিজিটাইজেশনের মাধ্যমে উদ্ভাবনী ধারণা বাস্তবায়ন	[[১.১.১] সেবা/অফিস ব্যবস্থাপনা সহজিকরণ/ডিজিটাইজেশনের মাধ্যমে ন্যূনতম একটি উদ্ভাবনী ধারণা বাস্তবায়িত	তারিখ	১০	১৬/০৩/২৫	২৩/০৩/২৫	৩০/০৩/২৫	০৬/০৪/২৫	১৩/০৪/২৫
০২	[২.১] ইতঃপূর্বে বাস্তবায়িত সহজিকৃত ও ডিজিটাইজকৃত সেবাসমূহের ডাটাবেজ হালনাগাদকরণ ও সেবাসমূহ চলমান রাখা	[২.১.১] নিজ অফিসসহ আওতাধীন দপ্তর/সংস্থা/বিভাগসমূহে ইতঃপূর্বে উদ্ভাবিত/সহজিকৃত/ ডিজিটাইজকৃত সেবাসমূহের ডাটাবেজ হালনাগাদকরণ ও সেবাসমূহ চলমান রাখা	সংখ্যা	২	৪	৩	২	১	-
০৩	[৩.১] ইনোভেশন শোকেজিং	[৩.১.১] আওতাধীন অফিসসমূহের অংশগ্রহণে ন্যূনতম একটি ইনোভেশন প্রদর্শনী (শোকেসিং) আয়োজিত এবং শ্রেষ্ঠ উদ্ভাবনী উদ্যোগ নির্বাচিত	তারিখ	৭	০৮/০৫/২৫	১৫/০৫/২৫	২২/০৫/২৫	২৯/০৫/২৫	০৫/০৬/২৫
০৪	[৪.১] ই-ফাইলের ব্যবহার বৃদ্ধি	[৪.১.১] ই-ফাইলে নিষ্পত্তিযোগ্য নথির তালিকা নির্ধারিত	তারিখ	২	৩১/০৮/২৪	০৮/০৯/২৪	১৫/০৯/২৪	২২/০৯/২৪	২৯/০৯/২৪
		[৪.১.২] ই-ফাইলে নোট নিষ্পত্তিকৃত	%	৭	১০০%	৯০%	৮০%	৭০%	৬০%
০৫	[৫.১] তথ্য বাতায়ন হালনাগাদকরণ	[৫.১.১] নিজ তথ্য বাতায়ন হালনাগাদকৃত	সংখ্যা	৬	৪	৩	২	১	-
		[৫.১.২] আওতাধীন অফিসসমূহের তথ্য বাতায়ন হালনাগাদকরণ নিশ্চিতকরণ	সংখ্যা	৩	৪	৩	২	১	-
০৬	স্মার্ট বাংলাদেশ [১.৬]বিনির্মাণ।	[৬.১.১] স্মার্ট বাংলাদেশ বিনির্মাণ সংক্রান্ত ৪টি স্তরের আলোকে করণীয় নির্ধারণ- বিষয়ক কর্মশালা/সেমিনার আয়োজিত।	সংখ্যা	৪	৪	৩	২	১	-
০৭	[৭.১] অনলাইন রিপোর্ট ম্যানেজমেন্ট সফটওয়্যার বাস্তবায়ন	[৭.১.১] নিজ অফিস ও আওতাধীন অফিসে অনলাইন রিপোর্ট ম্যানেজমেন্ট সফটওয়্যার বাস্তবায়িত	তারিখ	৫	০১/১২/২৪	১৫/১২/২৪	২৯/১২/২৪	০৫/০১/২৫	১২/০১/২৫
০৮	[৮.১] মাইগড প্ল্যাটফর্মের ব্যবহার বৃদ্ধি	[৮.১.১] মাইগড প্ল্যাটফর্মের মাধ্যমে ডিজিটাইজেশন যোগ্য সরকারি সেবা চিহ্নিতকরণ ও ডিজিটাইজেশনের লক্ষ্য কর্মশালা আয়োজিত	সংখ্যা	৪	২	-	১	-	-

তথ্য অধিকার বিষয়ে ২০২৪-২৫ অর্থ বছরে বার্ষিক কর্ম পরিকল্পনা
কৃষি পরিসংখ্যান এবং তথ্য ও যোগাযোগ প্রযুক্তি (এএসআইসিটি) বিভাগ
বাংলাদেশ কৃষি গবেষণা ইনস্টিটিউট, গাজীপুর-১৭০১

কর্মসম্পাদনের ক্ষেত্র	মান	কার্যক্রম	কর্মসম্পাদন সূচক	একক	কর্ম সম্পাদন সূচকের মান	প্রকৃত অর্জন ২০২২-২৩	প্রকৃত অর্জন ২০২৩-২৪	লক্ষ্যমাত্রা ২০২৪-২৫				
								অসাধারণ	অতিউত্তম	উত্তম	চলতিমান	চলতিমানের নিম্নে
								১০০%	৯০%	৮০%	৭০%	৬০%
১	২	৩	৪	৫	৬	৭	৮	৯	১০	১১	১২	১৩
প্রাতিষ্ঠানিক	০৬	[১.১] তথ্য অধিকার আইন অনুযায়ী নির্ধারিত সময়ের মধ্যে তথ্য প্রাপ্তির আবেদন নিষ্পত্তি	[১.১.১] নির্ধারিত সময়ের মধ্যে তথ্য প্রাপ্তির আবেদন নিষ্পত্তি	%	০৬	১০০%	১০০%	১০০%	৯০%	৮০%	-	-
সক্ষমতাবৃদ্ধি	১৯	[২.১] স্বতঃ প্রণোদিতভাবে প্রকাশযোগ্য সকল তথ্য হালনাগাদ করে ওয়েবসাইটে প্রকাশ	[২.১.১] হালনাগাদকৃত তথ্য ওয়েবসাইটে প্রকাশিত	তারিখ	০৪	১০০%	১০০%	০১/১২/২০২৪ থেকে ৩১/১২/২০২৪	১৫/০১/২০২৫	৩১/০১/২০২৫	-	-
		[২.২] বার্ষিক প্রতিবেদন প্রকাশ	[২.২.১] নির্ধারিত সময়ে বার্ষিক প্রতিবেদন প্রকাশিত	তারিখ	০৫	১০০%	১০০%	১৫/১০/২০২৪	৩১/১০/২০২৪	৩০/১১/২০২৪	-	-
		[২.৩] তথ্য অধিকার আইন ও এর বিধিবিধান সম্পর্কে জন সচেতনতা বৃদ্ধিকরণ	[২.৩.১] প্রচার কার্যক্রম সম্পন্ন	সংখ্যা	০৬	১০০%	১০০%	৩	২	১	-	-
		[২.৪] তথ্য অধিকার আইন, ২০০৯ ও এর বিধিমালা, প্রবিধানমালা, স্বতঃপ্রণোদিত তথ্য প্রকাশ নির্দেশিকাসহ সংশ্লিষ্ট বিষয়ে কর্মকর্তা/কর্মচারীদের প্রশিক্ষণ আয়োজন	[২.৪.১] প্রশিক্ষণ আয়োজিত	সংখ্যা	০৪	১০০%	১০০%	২	১	-	-	-

PROPOSED SERVICES 2024-2025

The proposed services of ASICT Division for the period of 2024-25 are listed below (Table 1) along with the primarily responsible Scientists and Officers:

Table 1. Proposed services of ASICT Division for the period of 2024-2025

Sl. No.	Name of Service	Responsible Scientist
1.	Web portal update and maintenance	Nur Mohammad, SSO Kazi Saidur Rahman, SSO Mohammad Rasel, SO Jahangir Hossain, Asst. Prog.
2.	E-agriculture services (<i>Question & Answer</i>) through web portal and Mobile Apps	Nur Mohammad, SSO Istiak Ahmed, SO
3.	Update the contents and technology version of BARI Mobile App (কৃষি প্রযুক্তি ভান্ডার)	Mohammad Rasel, SO
4.	E-governance and Innovation	Kowshik K. Saha, Agril. Engr. Dr. M. Mukhlesur Rahman, SSO Nur Mohammad, SSO Kazi Saidur Rahman, SSO Istiak Ahmed, SO Mohammad Rasel, SO Md. Shakil Hossain, SO Jahangir Hossain, Asst. Prog.
5.	Right to Information (RTI)	Nur Mohammad, SSO Mohammad Rasel, SO Jahangir Hossain, Asst. Prog.
7.	Allocation and support for BARI's official e-mail for all BARI scientists	Kowshik K. Saha, Agril. Engr. Mohammad Rasel, SO Jahangir Hossain, Asst. Prog.
8.	Social networking (You tube, Facebook)	Istiak Ahmed, SO Jamila Khatun Prioty, SO
9.	Maintenance and up gradation of BARI LAN, data center and Internet Bandwidth	Dr. M.Mukhlesur Rahman, SSO Md.Redwanul Islam, Lab Tech.
10.	e-filing and e-tendering activities at BARI	Kazi Saidur Rahman, SSO Istiak Ahmad, SO Mohammad Rasel, SO
11.	PMIS, Labour management system, Payroll system, Loan management system, and BARI Tel. Directory apps	Kazi Saidur Rahman, SSO Jamila Khatun Prioty, SO
12.	ARSAM Lab and production of GIS Maps	Dr. M.Mukhlesur Rahman, SSO Nur Mohammad, SSO Istiak Ahmad, SO
13.	Central antivirus maintenance	Dr. M.Mukhlesur Rahman, SSO
14.	LAN troubleshooting and internet connectivity	Istiak Ahmad, SO Md. Redwanul Islam, Lab Tech.
15.	Conducting ICT fair and field days	Nur Mohammad, SSO Kazi Saidur Rahman, SSO Mohammad Rasel, SO Jamila Khatun Prioty, SO
16.	Online meeting scheduling on Zoom platform	Kazi Saidur Rahman, SSO Istiak Ahmed, SO Mohammad Rasel, SO Md. Shakil Hossain, SO Jahangir Hossain, Asst. Prog.
17.	APA Implementation	Kowshik K. Saha, Agril. Engr. Dr. M.Mukhlesur Rahman, SSO Nur Mohammad, SSO Jamila Khatun Prioty, SO Md. Shakil Hossain, SO
18.	Human resources development	All Scientists
19.	Analysis of experimental data for BARI scientists	

NEW RESEARCH PROGRAMS

Program	:	Agricultural Economics, Data Science and Information & Communication Technology
Project	:	Data Science and Information & Communication Technology
Execution Center/ Division	:	ASICT Division
Lead Center/ Division	:	ASICT Division
Experiment-01	:	Crop-type mapping acreage and yield estimation of major crop in dry seasons using remote sensing and machine learning algorithms
Objectives	:	<ul style="list-style-type: none"> i. To develop crop-type map using remote sensing and machine learning algorithm for selected locations ii. To develop dry season acreage mapping for selected major crop using remote sensing and machine learning algorithm iii. To generate yield prediction model for major crop using remote sensing and machine learning algorithm
Rationale	:	<p>Agriculture is the largest and important economic sector in Bangladesh because of its production environments such as weather condition, soil fertility, water availability and comparatively cheaper labor supply. Crop acreage analysis and yield estimation are of prime importance in field-level agricultural monitoring and management. This enables prudent decision making during any crop failure event and for ensuing crop insurance (Hudait and Patel, 2022).</p> <p>Accurate and timely mapping of crops plays a pivotal role in ensuring food security, shaping economic strategies, and guiding environmental policies (Hegde et al., 2023). Accurate mapping of smallholding agricultural plots is complex due to the diversity of smallholder farming systems, constrained plot size, crop heterogeneity and the lack of clearly defined, updated field boundaries in most land management systems (Liu et al., 2020). However, such mapping remains the foremost step towards monitoring smallholder1 cultivators' farms, their operation and crop acreage spatial distribution (Hudait and Patel, 2018). The growing demand for crop insurance as part of micro-level agricultural planning, which requires plot-level crop statistics, acreage and yield estimation at the Tehsil/Block-level, has also augmented the need for such maps. However, conducting crop surveys in the field or making estimates based on interpolation of older/sampled information, is time consuming, expensive and erroneous.</p> <p>Advancements in remote sensing now provide accurate, recurring and timely estimations of crop acreages and yields for effectively supporting agricultural decision support systems (Verhulp and Van Niekerk, 2016). While earlier, it was challenging to differentiate smallholding plots from medium/coarser images (e.g. from 30 m Landsat or 23.5 m LISS-III images- Liu et al., 2020), its weekly availability allows change detection in near real-time (ESA 2016). These images have thus been much used for crop area/type delineation and yield prediction (Noi and Kappas, 2018; Saini and Ghosh, 2018; Neetu and Ray, 2019). Manual supervised classification of high resolution images is often error-prone due to the diversity of objects and varying image tones/textures. The development of machine learning algorithms (MLAs) has facilitated auto extraction of different land use and land cover (LULC) attributes. MLA is an automated, data-driven, self-adaptive process that does not require awareness of the physical relationships or systems that generate the data (Lina et al., 2017). This techniques provide extremely accurate and simple ways to identify patterns and rules within big data sets containing numerous predictor-variables that have nonlinear relationships with the target variable (Mongkolnithithada et al., 2023). The most common MLAs used which are more accurate than manual supervised methods (Neetu and Ray, 2019).</p>

		<p>On the other hand, accurate information regarding the productivity of staple crops at their scale is highly essential for successful national planning as well as for ensuring food security at the country level (Gumma et al., 2024). The prediction of crop yield before the harvest is one of the most significant concerns in agriculture since variations in crop yield from year to-year impact international trade, food supply, and market prices. Satellite based remote sensing is one of the best tools to provide vital information about the distribution of crops and its growing conditions over large areas, it can be applied for crop growth monitoring and yield forecast. Machine learning, however, has improved the capability to precisely anticipate agricultural yields (Archontoulis et al. 2020; Bogard et al. 2020; Washburn et al. 2020). Several machine learning algorithms such as linear regression, decision tree, and random forest were employed for the prediction of agronomic variables (Haque et al. 2020; Khaki et al. 2020). Remotely sensed data and machine learning can be effectively used in estimating the crop yield (Marcelo et al., 2022; Gowhar et al., 2022 and Thanh et al., 2020). The application of remote sensing along with MLAs in estimating agricultural performance indicators is increasing as it offers a time and cost-effective reproducible method for measurement that can cover larger physical areas as compared to in-situ methods.</p>
Materials and Methods	:	<p>The methodology essentially consisted of selection of the datasets, processing of the satellite data, incorporation of ground information, analysis of the satellite data, and generation of the output products. Field-based ground trothing will be done using ground control points (GCPs) obtained with a handheld GPS. GCPs will be collected from each LULC class (e.g. crop fields, vegetable patches, barren, gullied or excavated lands) and marked in Google Earth for Supplementary Information file (Hudait and Patel, 2022). The Google Earth image dates varied just before the survey period. A total maximum points will generated randomly in this way, which comprised the training and test datasets for accuracy assessment of the MLA-based classifications. Multi-temporal and multi-spectral Sentinel-2/Landsat 8 or 9 images will be used to extract LULC classes and map extents under different crop types, particularly smallholder plots, which require higher spatial resolution data (10 m or 30 m) for accurate delineation. Natural vegetation (tree groves) had a rough texture and built-up areas, rivers and other water bodies will be also clearly identifiable based on their respective tone/texture and associative elements (Zhou, 2019).</p> <p>Remote Sensing technique will provide a methodology to map areas of major crops field with the help of Satellite data and GIS (Geographical Information System) database. In this study, satellite data, field-based survey data will be used for crop yield prediction before harvest, and yield forecasting in future along with adaptation strategies. In particular, the Sentinel-2/Landsat 8 or 9 satellite data will be utilized for crop yield estimation. Extensive ground reference data using Hand Held GPS and GPS Camera will be used to collect ground reference data from farmer’s fields to validate the outputs (accuracy at maps). Based on yield data from the farmer's field and vegetation indices (e.g. NDVI, EVI/GNDVI) value generated from the same fields using Sentinel-2/Landsat 8 or 9 imageries, a regression model will be developed, which will be applied further to obtain major crops yield maps from the NDVI maps. MLAs will be employed in this study, utilizing a stack of NDVI layers as input features.</p> <p>Remote sensing image analysis, MLAs and statistical analysis will be covered by open source software like QGIS, R and Python. The entire laboratory works e.g. image geo referencing, processing, classification etc. will be conducted at Agro-Environmental Remote Sensing and Modeling (ARSAM) Laboratory of ASICT Division, BARI.</p>
Crop/Variety	:	Major crops of dry seasons
Design	:	N/A

Plot Size	:	N/A
Planting System/spacing	:	N/A
Fertilizer dose	:	N/A
Irrigated/Rainfed	:	N/A
Data to be recorded	:	Landsat 8 or 9/ Sentinel-2 images and farmer's yield data etc.
Investigators	:	Nur Mohammad, SSO, ASICT Division, BARI, Gazipur Dr. Mohammad Mukhlesur Rahman, SSO, ASICT Division, BARI, Gazipur Kaushik Kumar Saha, Agril. Engineer, ASICT Division, BARI, Gazipur Istiaq Ahmed, SO, ASICT Division, BARI, Gazipur Mohammad Rasel, SO, ASICT Division, BARI, Gazipur
Season	:	Rabi, 2024-2027
Date of initiation	:	October, 2024
Date of completion	:	May, 2027
Expected outputs/Benefit	:	<ul style="list-style-type: none"> ▪ The methods will be employed on successive new image datasets to create a detailed up-to-date crop acreage inventory for dry seasons, which will surely better inform agricultural policy/planning decisions. ▪ This information will be leveraged for informed agricultural planning to optimize cropland usage efficiently. ▪ This study is expected to report improved methods of yield prediction for major crop through combined use of remote sensing and MLAs. ▪ These results are benefited to Bangladesh Bureau of Statistics (BBS) and also Department of Agriculture (DAE) etc.
Locations	:	Sujanagar, Pabna
Status	:	New
Estimated Cost	:	Tk. 100,000/=
Source of fund	:	BARI
Priority	:	1 st

Program	:	Agricultural Economics, Data Science and Information & Communication Technology
Project	:	Data Science and Information & Communication Technology
Execution Center/ Division	:	ASICT Division
Lead Center/ Division	:	ASICT Division
Experiment-02	:	Genome-wide identification, characterization, and bioinformatics analysis of the major functional regulatory elements of the RNAi genes in <i>Brassica napus</i> L.
Objectives	:	<ol style="list-style-type: none"> i. To identify and characterize the major regulatory components of DCL, AGO, and RDR genes in <i>B. napus</i> genome ii. To analyze motif structure, chromosomal map, 3D protein structure, and major regulatory elements of the genes/proteins using bioinformatic approaches
Rationale	:	In Bangladesh oilseed crops (rapeseed-mustard) are very important due to their several economic values such as their great source of vegetable oil for human consumption and industrial purposes. They are used as fodder, and biodiesel, and young leaves are also used as human food as green vegetables. In

Bangladesh, according to the commerce ministry yearly 18-20 lac metric tons of oil are being imported to fulfill the demand which costs about Tk. 20000-25000 crore and only 2 lac metric tons are produced domestically (01 May 2023, Prothom-Alo). The expansion of cultivation of oilseed crops is increasing gradually in Bangladesh. However, it is necessary to strengthen the production of oilseed crops on a large scale in Bangladesh to fulfill our in-country demand and reduce the import rate of edible oil. Therefore, to satisfy the increasing demand, sustainable oilseed production through classical/traditional breeding efforts needs to be combined with biotechnological and genetic engineering/genomic approaches or interventions to facilitate oilseed yield production. Recently, genetic manipulation has been employed as a new way to overcome the intrinsic constraints of traditional methods, and genetic engineering methods based on the introduction of transgenes and the development of transgenic plants have been successfully adopted to improve crops (Sun et al., 2019). Genetic modification has started its journey for designer oil crops and has created opportunities for sustainable oilseed crop production around the world (Rahman et al., 2016). Genetically modification will allow not only the sustainable production of oilseed crops but also enhanced nutritional value as well as enhanced quality for industrial purposes.

Brassica is the second-largest oilseed crop after soybean (*Glycine max* L.) in the world's oilseed production (J.W. Fahey, 2003). Among the 37 species in the *Brassica* genus, the four most widely cultivated species for oilseed are *Brassica rapa* L., *B. juncea* L., *B. napus* L., and *B. carinata* A. Braun. The two species *B. napus* and *B. rapa* are the third leading source of vegetable oil in the world after soybean and palm and the world's second-leading source of protein meal (Gupta, 2015). Production of oilseeds from these *Brassica* species is frequently experiencing yield loss in Bangladesh in the field condition to different environmental factors mostly bacterial, viral, and fungal diseases along with insects, and pests. To overcome these situations new transgenic approaches (RNAi/RNA silencing and CRISPR/Cas9) can be initiated to develop transgenic mustard crops against such diseases and different environmental stresses. It is well-studied in different crops that RNA silencing plays an important molecular mechanism in plants to fight against different pathogenic and abiotic stressors (Ved Prakash, 2017; Ding and Lu, 2011, Jia-Yi Cao, 2016, Xu Xhao, 2017, Lei Qin, 2018). The RNA-interference (RNAi) mechanism not only helps plants protect themselves from different pathogenic diseases but also keeps transposons and endogenous genes silenced epigenetically (Ved Prakash, 2017).

Brassica napus (AC; n=19) is allopolyploid and originated, probably several times independently, from hybridization between the diploid *B. rapa* (A-genome; n = 10) and *B. oleracea* (C-genome; n=9) genome donors about 7500 years ago (Chalhoub et al., 2014). *B. napus* is cultivated and bred in several regions of the world and developed globally into one of the major oil crops (oilseed rape) (Basunanda et al., 2010). Studies suggested that the RNA silencing genes (DCL, AGO, and RDR) in plants play numerous roles to regulate growth and development as well as important biotic and abiotic stress responses (Akond et al., 2022; Yun and Zhang, 2023). The in-depth analysis of the genomic functions of these gene groups and their associated regulatory elements in *B. napus* is little known. The current study will be carried out for identification, characterization, and bioinformatic analyses of DCL, AGO, and RDR gene families in the *B. napus* genome. These results will provide important clues to molecular plant breeders and biotechnological researchers for the implementation of gene silencing pathways and RNAi-mediated host immunity in different BARI-developed rapeseed-mustard varieties for the development of improved nutrient-enriched climate-change-ready cultivars against different biotic and abiotic factors that will ultimately contribute

		significantly to the increased oil seed crop production for the sustainability of agricultural development as a whole in Bangladesh.
Materials and Methods	:	The genomic/proteomic data will be extracted from the NCBI/Phytozome/EnsemblePlants databases including genes DNA, mRNA, CDS, and proteins. <i>Arabidopsis thaliana</i> protein sequences will be used as query sequences in the BLAST process. Predicted RNAi genes/proteins will be used/investigated for bioinformatics analysis including motif analysis, chromosomal mapping, 3D protein structure analysis, cis-regulatory element analysis, transcription factor (TF) analysis, etc. Web-based bioinformatics pipelines/tools/software and R programming will be used for detailed analysis.
Variety	:	-
Design	:	-
Plot size	:	-
Planting system	:	-
Data to be recorded	:	Online databases
Investigators	:	Dr. Zobaer Akond, SSO, HRC, BARI, Gazipur Dr. Sheikh Hasna Habib, SSO, ORC, BARI, Gazipur Md. Shakil Hossain, SO, ASICT, BARI, Gazipur Mohammad Rasel, SO, ASICT, BARI, Gazipur Professor Dr. Nurul Haque Mollah, Bioinformatics Lab, Dept. of Statistics, University of Rajshahi.
Season	:	Rabi
Date of initiation	:	November 2024
Date of completion	:	June 2025
Expected output/benefit	:	This genomic research work will help ultimately to develop oilseed (rapeseed-mustard) varieties to increase production and will provide food security in Bangladesh.
Location	:	BARI
Status	:	New
Estimated cost	:	Estimated Cost: BDT.1,00,000/-
Source of fund	:	The fund will be pursued from BARI
Priority	:	First

Program	:	Agriculture Economics, Data Science and Information & Communication Technology
Project	:	Data Science and Information & Communication Technology
Experiment-03	:	Calibration and performance evaluation of IoT-based sensors for precision monitoring of horticultural crops
Execution Center/ Division	:	ASICT Division
Lead Center/ Division	:	ASICT Division
Objective(s)	:	<ul style="list-style-type: none"> i. To select and calibrate available IoT sensors for different crop growing parameters such as temperature, humidity, soil moisture, and light intensity etc. ii. To test and evaluate the sensor performance in both green house and field conditions for cultivating horticultural crops iii. To assess the impact of sensor precision on crop yield and health

		monitoring using machine learning approach
Rationale	:	<p>In Bangladesh, sustaining food production faces persistent challenges due to climate change, which has led to issues such as droughts, flash floods, tidal surges, soil salinization, and population pressure. The ongoing shift of the labor force from agriculture to industry further threatens agricultural productivity and food security. In response, modern advancements, particularly in IoT (Internet of Things)-based technologies, offer innovative solutions for precision monitoring and management of agricultural systems, reducing labor demands while enhancing efficiency. The integration of IoT-based sensors in horticultural crop monitoring presents an opportunity to precisely track key growing parameters such as temperature, humidity, soil moisture, and light intensity. These sensors, when properly calibrated and tested, can significantly improve crop management in both greenhouse and field conditions. By collecting and analyzing real-time data, IoT technologies enable farmers to make informed decisions that optimize irrigation, fertilization, and pest control, ultimately enhancing crop yield and health.</p> <p>This research program focuses on the calibration and performance evaluation of IoT sensors to ensure accurate and reliable data collection for precision horticulture. By assessing the impact of sensor precision on crop outcomes, particularly through machine learning approaches, this study aims to contribute to more sustainable, data-driven agricultural practices that can mitigate the effects of climate change while enhancing productivity.</p>
Materials and Methods	:	<p>This study incorporates IoT-based sensors (such as those for temperature, humidity, soil moisture, and light intensity) to monitor key growing parameters for horticultural crops. Weather sensors, including those for solar radiation, air temperature, and precipitation, will also be integrated. Machine learning algorithms will be applied to analyze data collected from these sensors, with the goal of improving crop management and enhancing yield. Key materials for this research include IoT sensors for temperature, humidity, and soil moisture monitoring, as well as communication infrastructure such as Wi-Fi or LoRaWAN for data transmission. IoT-enabled microcontrollers, such as Arduino or Raspberry Pi, will be used for sensor integration and data processing. Site selection will be based on crop-specific parameters, considering factors like soil type, water requirements, and environmental conditions in both greenhouse and open-field. The IoT infrastructure will be installed by deploying sensors and configuring communication networks to ensure seamless data collection and transfer. Real-time data on crop conditions will be continuously monitored and analyzed, with particular focus on the performance of the sensors in terms of precision and reliability. Calibration of these sensors will be carried out prior to deployment to ensure accuracy. Performance evaluation will include measuring crop yield, plant health, and resource use efficiency under different environmental conditions. This will be followed by assessing the economic viability of adopting these technologies. This approach aims to address challenges related to climate change and resource scarcity by improving decision-making in crop management.</p>
Crop/variety	:	Capsicum (BARI Misti Morich-1), Tomato (BARI Hybrid Tomato-10)
Design i) Treatment ii) Replications	:	RCBD i) Treatment = 04 ii) Replication = 03
Plot size	:	In 20 pots (in greenhouse) and 12 plots of size 2.5 m × 3 m (in field)
Planting system/spacing	:	No of plants = 270 Plant to plant distant = 50 cm

Fertilizer dose and methods of application	:	Drip fertigation (BARI recommended)
Irrigated/rainfed	:	Drip irrigated
Data to be recorded	:	Soil data, plant parameter data, weather data
Investigator(s)	:	Kowshik Kumar Saha, <i>Ag. Eng., ASICT Division, BARI, Gazipur</i> Istiaq Ahmed, <i>SO, ASICT Division, BARI, Gazipur</i> Dilip Kumar Roy, <i>SSO, IWM Division, BARI, Gazipur</i> Md. Abdur Rab Gazi, <i>SO, HRC, BARI, Gazipur</i> Md. Ashrafuzzaman Gulandaz, <i>SO, FMPE Division, BARI, Gazipur</i>
Season	:	Rabi and Kharif
Date of initiation	:	01.07.2024
Date of completion	:	30.06.2025
Expected output/benefit	:	i. IoT based low-cost irrigation advisory system ii. IoT based plant monitoring system for fertilizer and pesticide application
Location(s)	:	Gazipur
Status (New or 1 st year/2 nd year/...)	:	New
Estimated cost	:	10,00,000 BDT
Source of fund	:	PARTNER 4IR Program (DLI-3)
Priority	:	1 st

Programme	:	Agriculture Economics, Data Science and Information & Communication Technology
Project	:	Data Science and Information & Communication Technology
Experiment-4	:	Developing a predictive model for the field emergence of Bt eggplant seed lots integrating the vigor test
Execution Center/ Division	:	ASICT Division
Lead Center/ Division	:	ASICT Division
Objectives	:	i. To assessment of the vigor of different Bt eggplant seed lots ii. To unify the suitable vigor test with field emergence, and iii. To foresee the field emergence of Bt eggplant
Rationale	:	Healthy and strong plants are produced from high vigor seeds that ensure uniform crop establishment in fields. The inability of a seed to germinate is called seed aging and it causes variances in seed vigor (Powell, 2006; Sun et al., 2007; Mokhtari and Emeklier, 2018). The main cause of variations in vigor that result in poor emergence of seedlings both in the field and laboratories is seed deterioration that culminates from factors affecting production and seed storage. Seed vigor is defined by ISTA as the sum of those properties of the seed which determine the level of activity and performance of the seed of a seed lot during germination and seedling emergence. Vigor tests can identify seed lot aging and variances in deterioration levels. Hence, testing seed vigor has increasingly become vital in the classification of

		seed lots in accordance with physiological potential (Fatonah et al., 2017). The sensitivity of different vigor testing methods has shown high dependency on crop plants and species. Predicting vigor requires reliability and effectiveness and any test carried out must be reproducible, recapitulative, and meet the conditions of vigor tests for plant species mentioned in the ISTA Rules (ISTA, 2020). However, each test must be proved to be fit for the desired purpose, which essentially means that tests conducted must show evident distinctions between seed lots during field emergence with reference to storage potential, seedling uniformity and size, final emergence, and rate of emergence (Powell, 2022). Several studies showed the development of vigor tests in seeds, and aging or deterioration levels in seeds i.e. standard germination tests, electrical conductivity (EC), controlled deterioration test (CD) and accelerated aging (AA) just alike methods of vigor testing (Powell and Matthews, 2005; Mokhtari and Kizilsimsek, 2019). However, these tests are laborious, require a long time, and involve a number of steps. Standard germination test which is less sensitive to assessing physiological seed quality, only provides predictive information in seedling emergence under ideal conditions which cannot represent field conditions for different plant species (Soares <i>et al.</i> , 2018; Alahakoon <i>et al.</i> , 2021). Keeping in view the importance, this research aimed to unify the suitable vigor test result for foreseeing field emergence of bt brinjal seed.
Materials and Methods	:	<p>Data Source</p> <p>An experiment measuring the vigor of Bt brinjal seed lots with several tests mentioned earlier will be conducted in the laboratory of the Seed Technology division of Bangladesh Agriculture Research Institute-Gazipur, as well as a field trial of emergence. Data required for this research will be obtained from this experiment.</p> <p>Analytical methods</p> <p>Various suitable statistical methods, such as Exploratory Descriptive Statistics (EDS) and Analysis of Variance (ANOVA), will be used to compare the germination rate of different vigor test methods. Additionally, an appropriate regression model will be developed to determine the relationship between seed lot vigor and field emergence. Data collection, compilation, editing, and cleaning will be done in Excel. For further analysis, the latest version of R-Studio will be used in this research.</p>
Crop/ variety	:	BARI Bt Begun-4
Design: Treatment Replication	: : :	CRD 3
Plot size	:	1m × 1m
Planting system/spacing	:	N/A
Fertilizer dose and methods of application	:	N/A
Irrigated/rainfed	:	N/A
Data to be recorded	:	Electrical conductivity, viability, germination, germination rate, radicle emergence rate, field emergence
Investigator(s)	:	Mohammad Rasel, SO, ASICT Md. Sadiqur Rahman, SO, ST Istiak Ahmed, SO, ASICT Jamila Khatun Prioty, SO, ASICT Nur Mohammad, SSO, ASICT
Season	:	Rabi 2024

Date of initiation	:	October 2024
Date of completion	:	June 2025
Expected output/benefit	:	A suitable result of vigor test will be unified to foresee field emergence of Bt eggplant seed lots
Location	:	BARI, Gazipur
Status (New or 1 st year/2 nd year/..)	:	New
Estimated cost	:	1,00,000/-
Source of fund	:	BARI
Program Proposed from	:	Agricultural Statistics and Information & Communication Division (ASICT), BARI, Gazipur
Priority	:	1 st

Experiment No. 5	:	Potential Use of Remote Sensing Platforms for Garlic Yield Prediction
Objective(s)	:	<ul style="list-style-type: none"> i. To identify suitable spectral vegetation indices and data sources relevant to garlic crop monitoring. ii. To develop and validate predictive models for garlic yield using remote sensing data. iii. To compare the accuracy and efficiency of remote sensing-based predictions with traditional methods.
Rationale	:	<p>Timely and accurate garlic yield prediction is highly essential for policymakers, as they enable them to prepare for crop procurement, distribution, determining price structure and strategizing import/export decisions. For farmers, this helps to determine their optimum area allocation under different crops and ensure they can maximize their production and income. Traditionally, the information on garlic planting has been obtained mainly based on field surveys. This method is not only vulnerable to subjective factors, but also has a long cycle and is labor-intensive and time-consuming. The application of satellite-based remote sensing emerges as a practical rapid, extensive, and cost-effective strategy for thorough crop monitoring, both at regional and national levels. Remote sensing has proven to be a highly effective method for tracking the spatial distribution of agricultural croplands. Remote sensing has widespread applications globally in estimating crop yields. The estimations derived from remote sensing commonly rely on vegetation indices (VIs), employing a simple regression. However, considering the timely and accurate information on earliest seasonal garlic yield, this study is aimed to explore the potential use of remote sensing technologies for predicting garlic yield, enhancing precision agriculture practices, and improving decision-making processes. The major goal of this study is to map garlic areas in the study area, followed by location-specific yield estimation using satellite based remote sensing application and compare their findings.</p>
Materials and methods	:	<p>The methodological workflow consists of four sequential steps. (1) data collection; (2) dataset creation; (3) vegetation indices (VIs) calculation and model development; and (4) model evaluation. The details of the four-step approach are provided in the subsequent subsections. Sentinel-2 satellite imagery dataset will be used for this study. Sentinel-2 was developed by the European Space Agency (ESA) and provides multispectral imagery at a resolution of 10 m. This is the best resolution imagery available for free today. As a part of dataset creation, the acquired satellite images need to be</p>

		processed to normalize the raw spatial imagery data before their various uses in spatial analysis. The pre-processing process of raw images is distributed into four main functions: radiometric corrections, geometric corrections, enhancement and transformation. Several different spectral vegetation indices will be computed from different forms of algebraic ratios between red (R), green (G) and near-infrared bands (NIR) with 10 m spatial resolutions Sentinel-2 satellite imagery dataset. The goal for using VIs is to highlight vegetation cover detail in the image and making the image more visually appealing. ArcGIS software (version 10.8) was used as a tool to execute the mentioned methodological workflow while Microsoft Office (version 2019) was used for database preparation, statistical tables and graphs generation etc.
Design	:	N/A
Treatment	:	N/A
Replications	:	N/A
Plot size	:	N/A
Planting system/spacing	:	N/A
Fertilizer	:	N/A
Irrigated/rainfed	:	N/A
Data to be recorded	:	GPS reading, Sentinel-2 Satellite imagery, garlic yield data
Investigator(s)	:	MA Mottalib, KK Saha, MA Alam, AHF Fahim, MA Rahman, MA Islam, MM Hasan, MM Alam, M65Z Hasan, MA Hoque, MA Rahman, K Hassan, and ZH Prodhan
Season	:	Rabi
Date of initiation	:	November, 2024
Date of completion	:	June 2027
Expected output/benefit	:	Early forecasting of garlic yield before harvest might be useful for government planners and decision makers to prepare crop procurement, distribution, determining price structure as well as implement onion export/imports policies in relation to domestic demand and estimating the revenue
Location	:	Zajira Upazila of Shariatpur, Chatmohor Upazila of Pabna and Khanshama Upazila of Dinajpur district
Status	:	New
Estimated cost	:	Tk. 300,000
Source of fund	:	BARI
Priority	:	1 st

Experiment No. 6	:	Land Suitability Assessment for spices crop Production through Remote Sensing and GIS in southern saline region of Bangladesh
Objective(s)	:	<ul style="list-style-type: none"> • To assess potential land areas for spices crop production • To create salinity-based land zoning map for southern areas of Bangladesh • To compare satellite-based data with field data
Rationale	:	Spices are very important crop and commonly used for cooking and seasoning of foods. Now-a-days, spices are valuable trade commodities in the world. They are expensive but widely used. In Bangladesh, the area under the spice's cultivation is 3.96 lakh hectares with annual production of 24.88 lakh metric tons (BBS, 2016) and the annual demand of spices are 30 lakh metric tons. Spices cover almost 2.60 % of total cropped area in Bangladesh (BBS, 2016). But, the gap between demand and supply is also increasing day by day with the increase of per capita purchasing supremacy.

		<p>it is reality that a good quantity of spices is being imported every year to meet the huge demand of people of the country at the cost of foreign currency. With this point of view, the government of Bangladesh has been trying to extend the area of spices production both horizontally and vertically since 1997. Southern region of Bangladesh has become a grave need for the nation for growing spices where a vast area (about 30-50% of net cropped areas) remains fallow specially in rabi (Dry winter) and kharif-1 (Pre-monsoon) seasons. Agro-ecology of this region is different from other areas of Bangladesh which is characterized by low productivity due to salinity, water logging, improper drainage network, drought, less practice of modern technologies, and repeated crop losses due to natural calamities. However, above all of those problems, soil salinity is the single most significant problem due to low rainfall, excessive evaporation of shallow groundwater and high soluble salt content that has adverse effects on both agriculture and aquaculture production. So, the contrast of this problem accurate, cost-effective, detailed, and timely soil salinity information along with its regime is needed for proper management of saline soils in this region. But, determining and monitoring soil salinity with traditional methods (laboratory analysis) is costly and time-consuming. Unlike conventional methods, remote sensing technologies offer significant, cost-effective and less time-consuming advantages in determining soil salinity for large areas at high accuracy. Therefore, the present study aims to apply advanced remote sensing (RS) and geographic information system (GIS) technologies to investigate, identification, delineation and map of salt affected area which are fundamental to land-use planning aimed at the agricultural land i.e. highly suitable and less suitable for expansion of specific spices crops.</p>
Materials and methods	:	<p>The methodology of the study will include RS and GIS assisted spatial modeling, regression model and validation of the methods which used to determine the feasibility of RS and GIS to map soil salinity directly from the soil and indirectly from vegetation. Datasets will be collected and prepared using Sentinel-2 satellite imagery (10 m) of scenes and soil salinity map from SRDI along with field soil salinity data. Extensive field works will be done in the rabi season to identify the training sites (field) with the help of Global Positioning System (GPS). Different remote sensing spectral indices such as Salinity index (SI), Normalized difference salinity index (NDSI), Vegetation Soil Salinity Index (VSSI), Normalized differential vegetation index (NDVI), Soil adjusted vegetation index (SAVI) formula will be used to analyze, discriminate and map salt affected soils from original bands of Sentinel-2 satellite images. All the datasets will be processed into raster images and then reclassified into four classes provided by Food and Agriculture Organization (FAO) suitability class guidelines i.e. Highly Suitable (S₁), Moderately Suitable (S₂), Marginally Suitable (S₃) and Not Suitable (NS) using multicriteria decision-making approach like Analytical Hierarchy Process (AHP) model. Statistical correlation between field measurements of Electrical Conductivity (EC) and remote sensing spectral indices will be examined. All spatial analysis and digitization works will be carried out using ArcGIS 10.7 software.</p>
Design	:	N/A
Treatment	:	N/A
Replications	:	N/A
Plot size	:	N/A
Planting system/spacing	:	N/A
Fertilizer	:	N/A
Irrigated/rainfed	:	N/A
Data to be	:	Soil salinity, GPS reading, satellite image, slope and elevation, rainfall, land

recorded		surface temperature, soil pH, soil depth, topsoil texture, soil drainage, etc.
Investigator(s)	:	MA Mottalib, KK Saha, MA Rahman, MA Alam, AHF Fahim, MZ Hasan, MA Hoque, MM Hasan, and ZH Prodhan
Season	:	2024-2025
Date of initiation	:	February, 2025
Date of completion	:	June, 2026
Expected output/benefit	:	The findings of this study will facilitate the policymaker in their land-use planning for maximizing the land use and achieving a sustainable spice farming in the southern area of Bangladesh.
Location	:	Subarnachar upazila of Noakhali and Kolapara upazila of Patuakhali district
Status	:	New
Estimated cost	:	Tk. 200,000
Source of fund	:	BARI
Priority	:	1 st

Experiment No. 7	:	Delineation of Surface Waterlogged Cropland in Parts of Chalanbil Areas and Strategic Mitigation Using Remote Sensing Techniques
Objective(s)	:	<ul style="list-style-type: none"> i. To delineate surface waterlogged areas in Chalanbil's cropland using remote sensing techniques. ii. To assess the severity and temporal patterns of waterlogging across different cropland zones. iii. To identify the primary drivers of waterlogging, including topography, drainage systems, and precipitation trends. iv. To develop a strategic mitigation plan to guide sustainable management practices for affected croplands.
Rationale	:	Waterlogging in cropland areas poses a significant threat to agricultural productivity and local economies in the wetland regions of Bangladesh, such as Chalanbil. Parts of Chalanbil in northwestern Bangladesh, primarily focusing on agricultural regions affected by seasonal waterlogging. Annual flooding and seasonal surface waterlogging in Chalanbil hinder crop growth, reduce soil fertility, and impact the livelihoods of farming communities. The reliance on traditional methods to assess waterlogged areas is often inadequate to provide a timely and comprehensive understanding of the extent and severity of waterlogging. This proposal aims to utilize remote sensing (RS) and Geographic Information Systems (GIS) to monitor and assess waterlogged croplands in Chalanbil, providing accurate data and analysis to support strategic mitigation. By using satellite imagery and spatial analysis, this project seeks to develop a sustainable, data-driven approach to identifying and addressing waterlogging, empowering local authorities and farmers to implement effective solutions
Materials and methods	:	<p>The methodological workflow consists of following sequential steps: -</p> <ol style="list-style-type: none"> 1. Acquisition of high-resolution satellite imagery from Sentinel-2 to assess water coverage, soil moisture, and crop health. 2. Historical rainfall and temperature data to correlate weather patterns with waterlogging. 3. Use of digital elevation models (DEMs) and soil permeability data to analyze natural drainage patterns. 4. Employing remote sensing unsupervised image classification methods to categorize land cover types and identify cropland affected by waterlogging. 5. Using GIS to analyze seasonal changes, create overlay maps, and highlight patterns of waterlogging. 6. Temporal analysis of data over multiple years to track recurring waterlogging patterns and assess changes.

		<p>7. Field-based GPS validation of classified satellite data to ensure accuracy. 8. Confusion matrix analysis for model performance and reliability</p> <p>ArcGIS software (version 10.8) was used as a tool to execute the mentioned methodological workflow while Microsoft Office (version 2019) was used for database preparation, statistical tables and graphs generation etc.</p> <p>Mitigation Strategy Plan</p> <ol style="list-style-type: none"> 1. Assessment of risk levels across different areas based on waterlogging frequency, duration, and proximity to agricultural zone 2. Improving drainage infrastructure, designing temporary water diversion channels, and promoting raised-bed farming for flood-resistant cropping 3. Encouraging sustainable land-use practices, implementing conservation farming techniques, and introducing drought and flood-resistant crop varieties.
Design	:	N/A
Treatment	:	N/A
Replications	:	N/A
Plot size	:	N/A
Planting system/spacing	:	N/A
Fertilizer	:	N/A
Irrigated/rainfed	:	N/A
Data to be recorded	:	GPS reading, Sentinel-2 Satellite imagery
Investigator(s)	:	MA Mottalib, KK Saha, MA Alam, AHF Fahim, MA Rahman, MA Islam, MM Hasan, MM Alam, MZ Hasan, MA Hoque, MA Rahman, K Hassan, and ZH Prodhan
Season	:	Rabi
Date of initiation	:	November, 2024
Date of completion	:	June 2027
Expected output/benefit	:	This project offers a cost-effective and technologically advanced approach to tackling the persistent issue of waterlogging in Chalanbil's croplands. By combining remote sensing and GIS analysis, this research will deliver actionable insights into the scope and severity of waterlogging, providing a foundation for effective, sustainable mitigation strategies. Actionable insights for policymakers on resource allocation and investment in sustainable agriculture and water management infrastructure. Empowered by data and supported by local stakeholders, this project promises to enhance agricultural resilience, protect local livelihoods, and contribute to food security in one of Bangladesh's most vulnerable agricultural areas.
Location	:	Chatmohor Upazila of Pabna and Shingra Upazila of Natore district
Status	:	New
Estimated cost	:	Tk. 300,000
Source of fund	:	BARI
Priority	:	1 st

Program	:	Agriculture Economics, Data Science and Information & Communication Technology
Project	:	Data Science and Information & Communication Technology
Experiment-8	:	Efficiency of Selected Agricultural Practices in Barind Region of Bangladesh

Execution Center/ Division	:	ASICT Division
Lead Center/ Division	:	ASICT Division
Objective(s)	:	<ul style="list-style-type: none"> i. To explore the major agricultural practices adopted in the Barind region ii. To measure the technical efficiency of selected promising agricultural practices in Barind region
Rationale	:	<p>Bangladesh, a densely populated country with limited arable land, faces challenges in ensuring food security for its growing population (Muniruzzaman, 2013). The agricultural sector plays a crucial role in meeting the nutritional needs of the population and alleviating poverty in rural areas. However, the efficiency of agriculture practices in country's one of the six hotspot region Barind remains critical concern, as suboptimal practices can lead to reduced productivity and environmental degradation and food insecurity (Reza et al., 2020).</p> <p>The Sustainable Development Goals (SDGs) particularly goal 2, aim to end hunger, achieve food security, improve nutrition and promote sustainable agriculture by 2030 (Aliyu et al., 2021). Bangladesh is committed to achieve these goals but the efficiency of agricultural practices in hotspot regions is essential to attain sustainable food security. Recent studies have highlighted the vulnerability of agricultural systems in hotspot regions to climate change, soil degradation, water scarcity and socio-economic factors (Hussain et al., 2020' Alam et al., 2021). These challenges exacerbate food insecurity and hinder efforts to enhance agricultural productivity and sustainability (Riches, 2018).</p> <p>Therefore, this proposed study seeks to investigate the efficiency of agricultural practices in Barind region of Bangladesh and their contribution to food security. This study employ multi-disciplinary approach, integrating concept from agronomy, agricultural economics, environmental science and food security studies. It will involve field surveys, data collection and analysis to access the efficiency of various agriculture practices, including crop cultivation, irrigation methods, use of fertilizers and pesticides and post-harvest management techniques. By identifying the factors influencing agricultural efficiency and food security in this Barind region. The study aims to generate valuable insights for policy makers, agricultural practitioner, and stakeholders. The findings will inform the development of evidence-based Strategies and interventions to improve agricultural productivity, residence and sustainability in the face of ongoing challenges.</p> <p>In summary, this study on the efficiency of agricultural practices in the Barind of Banglad.sh holds significant potential to address critical issues related to food security, agricultural sustainability, and rural development. Through rigorous research and analysis, it aims to contribute towards building resilient and inclusive agricultural systems that can meet the nutritional needs of present and future generations in Bangladesh and beyond.</p>
Materials and Methods	:	<p>Data Source</p> <p>Data will be collected from both primary and secondary. Primary data will be collected from selected farmers with the aid of a pre tested interview schedule. Personnel involved in the agricultural practices and DAE (Department of Agricultural Extension) personnel will assist researchers and animators in collecting primary data. Secondary data will be collected from different sources such as BBS, journal articles, institutional websites, etc. The face to face interview method will be used in collecting data with a survey questionnaire. Major socio economic data, cropping patterns, details prices, input use pattern, opportunities and challenges of agriculture, and output and their market prices will be collected in this research. Total 100 samples from one Upazila from 5</p>

		blocks each having 20 samples will be obtained. Analytical methods Various suitable statistical methods, such as Exploratory Descriptive Statistics (EDS) and appropriate econometric models (probably Cobb-Dauglas and Logit model) will be used to identify the factors of affecting the efficiency of the agricultural practices and contribution on food security. Data collection, compilation, editing, and cleaning will be done in Excel. For further analysis, the latest version of R-Studio will be used in this research.
Crop/ variety	:	N/A
Design: Treatment Replication	:	N/A
Plot size	:	N/A
Planting system/spacing	:	N/A
Fertilizer dose and methods of application	:	N/A
Irrigated/rainfed	:	N/A
Data to be recorded	:	Socio-economic, agronomic practices, fertilizer uses, management practices, marketing practices etc.
Investigator(s)	:	Mohammad Rasel, SO, ASICT Kazi Saidur Rahman, SSO, ASICT Jamila Khatun Prioty, SO, ASICT
Season	:	Rabi 2024
Date of initiation	:	October 2024
Date of completion	:	June 2026
Expected output/benefit	:	Efficient agricultural practices in Barind region will be identified.
Location	:	Naogaon, Rajshahi
Status (New or 1 st year/2 nd year/..)	:	New
Estimated cost	:	100000/-
Source of fund	:	BARI
Program Proposed from	:	Agricultural Statistics and Information & Communication Division (ASICT), BARI, Gazipur
Priority	:	1 st

Program	:	Agriculture Economics, Data Science and Information & Communication Technology
Project	:	Data Science and Information & Communication Technology
Experiment-9	:	A statistical investigation of climate parameters on the Mango yield of Rajshahi District
Execution Center/ Division	:	ASICT Division

Lead Center/ Division	:	ASICT Division
Objectives	:	<ol style="list-style-type: none"> i. To Collect and analyze historical mango yield data along with climate parameters; ii. To investigate the relationship between climate parameters and mango yield; iii. To evaluate appropriate statistical models for forecasting Mango and iv. To identifying the most significant climatic factor.
Rationale	:	Mango is one of the most economically important fruits in Bangladesh. It is also a significant source of nutrition for the local population. Ensuring stable mango production contributes to food security. Accurate models can help optimize the supply chain, reduce post-harvest losses, and improve market prices. Reliable yield forecasts enable policymakers and agricultural planners to make informed decisions, contributing to better resource allocation and planning. Primary hypothesis of this study is Climate parameters such as temperature, rainfall, and humidity have a significant impact on the mango yield in Bangladesh, and statistical models can accurately forecast future yields based on these parameters.
Materials and Methods	:	<p><i>Data and its sources:</i> Mango yield data will be collected from various issues of Yearbook of Agricultural Statistics in Bangladesh from 1993 to 2023. Climate parameters viz., maximum temperature (°C), minimum temperature (°C), relative humidity (fraction), precipitation (mm) and wind speed (miles per second) and solar radiation (mega Joules per square meter) were obtained through statistical downscaling of ECMWF ERAS and CMIP6 data.</p> <p><i>Analytical procedures:</i> In this work, number of statistical techniques viz., regression model, weather indices, ARIMA, ANN, NLSVR and proposed hybrid methodology are used to forecast the yield of mango of Bangladesh. After that, the estimated models will be validated by using independent datasets and evaluated their accuracy and reliability.</p>
Crop/variety	:	Mango
Design	:	N/A
Plot size	:	N/A
Planting system	:	N/A
Fertilizer dose	:	N/A
Irrigated/rainfed	:	N/A
Data to be recorded	:	Historical climate data on temperature, humidity and precipitation etc.
Investigators	:	Jamila Khatun Prioty, SO Istiaq Ahmed, SO Mohammad Rasel, SO
Season	:	N/A
Date of initiation	:	October, 2024
Date of completion	:	July, 2025
Expected output	:	<ol style="list-style-type: none"> 1. Accurate Yield prediction 2. Insights into Climate-Mango Relationship 3. Recommendations for Policy and Practices
Locations	:	All over Bangladesh
Status	:	New
Estimated cost	:	N/A
Source of fund	:	N/A
Priority	:	1 st

Program	:	Agriculture Economics, Data Science and Information & Communication Technology
Project	:	Data Science and Information & Communication Technology
Experiment-10	:	Efficiency of Agricultural Practices for Food Security in char land Region of Bangladesh
Execution Center/ Division	:	ASICT Division
Lead Center/ Division	:	ASICT Division
Objective(s)	:	<ol style="list-style-type: none"> i. Investigate the agricultural practices adopted in the char land region ii. Measure the economical efficiency agricultural practices in char land region iii. Evaluate the likely influence of agricultural practices on food security in Bangladesh
Rationale	:	<p>Bangladesh, a densely populated country with limited arable land, faces challenges in ensuring food security for its growing population (Muniruzzaman, 2013). The agricultural sector plays a crucial role in meeting the nutritional needs of the population and alleviating poverty in rural areas. However, the efficiency of agriculture practices in country's one of the six hotspot region char land remains critical concern, as suboptimal practices can lead to reduced productivity and environmental degradation and food insecurity (Reza et al., 2020).</p> <p>The Sustainable Development Goals (SDGs) particularly goal 2, aim to end hunger, achieve food security, improve nutrition and promote sustainable agriculture by 2030 (Aliyu et al., 2021). Bangladesh is committed to achieve these goals but the efficiency of agricultural practices in hotspot regions is essential to attain sustainable food security. Recent studies have highlighted the vulnerability of agricultural systems in hotspot regions to climate change, soil degradation, water scarcity and socio-economic factors (Hussain et al., 2020' Alam et al., 2021). These challenges exacerbate food insecurity and hinder efforts to enhance agricultural productivity and sustainability (Riches, 2018).</p> <p>Therefore, this proposed study seeks to investigate the efficiency of agricultural practices in Char land region of Bangladesh and their contribution to food security. This study employ multi-disciplinary approach, integrating concept from agronomy, agricultural economics, environmental science and food security studies. It will involve field surveys, data collection and analysis to access the efficiency of various agriculture practices, including crop cultivation, irrigation methods, use of fertilizers and pesticides and post-harvest management techniques. By identifying the factors influencing agricultural efficiency and food security in this Char land region. The study aims to generate valuable insights for policy makers, agricultural practitioner, and stakeholders. The findings will inform the development of evidence-based Strategies and interventions to improve agricultural productivity, residence and sustainability in the face of ongoing challenges.</p> <p>In summary, this study on the efficiency of agricultural practices in the Char land of Banglad.sh holds significant potential to address critical issues related to food security, agricultural sustainability, and rural development. Through rigorous research and analysis, it aims to contribute towards building resilient and inclusive agricultural systems that can meet the nutritional needs of present and future generations in Bangladesh and beyond.</p>
Materials and Methods	:	<p>Data Source</p> <p>Data will be collected from both primary and secondary. Primary data will be collected from selected farmers with the aid of a pre tested interview schedule. Personnel involved in the agricultural practices and DAE (Department of Agricultural Extension) personnel will assist researchers and animators in</p>

		<p>collecting primary data. Secondary data will be collected from different sources such as BBS, journal articles, institutional websites, etc. The face to face interview method will be used in collecting data with a survey questionnaire. Major socio economic data, cropping patterns, details prices, input use pattern, opportunities and challenges of agriculture, and output and their market prices will be collected in this research. Total 100 samples from one Upazila from 5 blocks each having 20 samples will be obtained.</p> <p>Analytical methods Various suitable statistical methods, such as Exploratory Descriptive Statistics (EDS) and appropriate econometric models (probably Cobb-Dauglas and Logit model) will be used to identify the factors of affecting the efficiency of the agricultural practices and contribution on food security. Data collection, compilation, editing, and cleaning will be done in Excel. For further analysis, the latest version of R-Studio will be used in this research.</p>
Crop/ variety	:	N/A
Design: Treatment Replication	:	N/A
Plot size	:	N/A
Planting system/spacing	:	N/A
Fertilizer dose and methods of application	:	N/A
Irrigated/rainfed	:	N/A
Data to be recorded	:	Socio-economic, agronomic practices, fertilizer uses, management practices, marketing practices etc.
Investigator(s)	:	Jamila Khatun Prioty, SO, ASICT Kazi Saidur Rahman, SSO, ASICT Mohammad Rasel, SO, ASICT
Season	:	Rabi 2024
Date of initiation	:	October 2024
Date of completion	:	June 2026
Expected output/benefit	:	Efficient agricultural practices in Char land region will be identified.
Location	:	Gaibandtha, Bogura
Status (New or 1 st year/2 nd year/..)	:	New
Estimated cost	:	100000/-
Source of fund	:	BARI
Program Proposed from	:	Agricultural Statistics and Information & Communication Division (ASICT), BARI, Gazipur
Priority	:	1 st

Program	:	Agriculture Economics, Data Science and Information & Communication Technology
Project	:	Data Science and Information & Communication Technology
Experiment-11	:	Bioinformatics analysis of the Dicer-like (DCL), Argonaute (AGO), and RNA-dependent RNA Polymerase (RDR) gene families in <i>Lens culinaris</i> L.
Execution Center/ Division	:	ASICT Division
Lead Center/ Division	:	ASICT Division
Objective(s)	:	<ul style="list-style-type: none"> i. To identify the DCL, AGO, and RDR gene families in the lentil (<i>Lens culinaris</i>) genome using homology-based search approaches; and ii. To analyze the gene structure, domain composition, and chromosomal localization of identified genes.
Rationale	:	<p>Lentil is one of the oldest and most popular pulse crops in Bangladesh. It provides affordable source of dietary proteins (22–35%), minerals, fiber, and carbohydrates to poor people and plays a vital role in alleviating malnutrition and micronutrient deficiencies in developing countries. It occupies 40.23% of the cultivation area of pulse crops getting the first position (BBS, 2023). Lentil is cultivated during winter (rabi or post rainy season; Nov-Mar.). They are frequently combined with rice providing more complete protein. In addition to its food value lentil also plays an important role in cropping systems because of its ability to fix nitrogen and thereby enrich the soil. Lentil contains carbohydrates, mainly starches (55-65%); proteins, including essential amino acids (24-28%), and fat (1 - 4 %). Domestic pulse production satisfies less than half of the country's needs and some 419648 m tons is imported at a cost of about 12307 million US\$ (FAO, 2022). Lentil is purchased mostly from Australia, Nepal, Turkey and Canada, accounts for US\$ 17.6 million (MOA, 2022). It is grown on about 334429 acre, producing 196829 m. tons of grain (BBS, 2023).</p> <p>Lentil cultivation often provides rotational benefits to cereal-based cropping systems through biological nitrogen fixation, carbon sequestration, and through effective control of weeds, diseases, and insect pests. However, the lentil yields remain low in Bangladesh as it is often cultivated as a rain fed crop under difficult edaphic conditions and subjected to terminal drought, heat stress, low soil fertility, and various diseases including ascochyta blight, fusarium wilt, anthracnose, stemphylium blight, rust, collar rot, root rot, and white mold. Genetic modification has started its journey for designer pulse crops and has created opportunities for sustainable pulse crop production around the world. Genetically modification will allow not only the sustainable production of pulse crops but also enhanced nutritional value as well as enhanced quality for industrial purposes.</p> <p>Lentil (<i>Lens culinaris</i>) is a diploid (2n=2X=14) self-pollinating crop with a genome size of approximately 4 Gbp. In comparison to major legume crops such as soybean, common bean, pigeon pea, and chickpea, the pace of development of genomic resources is slow in lentil. Large genome size, narrow genetic base, lack of candidate genes, low density linkage map, and the difficulty in identifying beneficial alleles are the main limiting factors in genomics enabled improvement in lentil. But in the advancement of bioinformatics tools the genomic data are available in online database. Studies suggested that the RNA silencing genes (DCL, AGO, and RDR) in plants play numerous roles to regulate growth and development as well as important biotic and abiotic stress responses (Akond et al., 2022; Yun and Zhang, 2023). The in-depth analysis of the genomic functions of these gene groups and their associated regulatory elements in <i>Lens culinaris</i> is little known. The current study will be carried out for identification, characterization, and bioinformatics</p>

		analyses of DCL, AGO, and RDR gene families in the <i>Lens culinaris</i> genome. These results will provide important clues to molecular plant breeders and biotechnological researchers for the implementation of gene silencing pathways and RNAi-mediated host immunity in different BARI-developed lentil varieties for the development of improved nutrient-enriched climate-change-ready cultivars against different biotic and abiotic factors that will ultimately contribute significantly to the increased pulse crop production for the sustainability of agricultural development as a whole in Bangladesh.
Materials and Methods	:	All genomic and proteomic data/info will be collected/identified from the NCBI/Phytozome online databases including genes DNA, CDS, mRNA, and proteins. <i>Arabidopsis thaliana</i> protein sequences will be used as query sequences in the BLAST process. Predicted RNAi genes/proteins will be used/investigated for bioinformatics analysis including multiple sequence alignment, phylogenetic analysis. Web-based bioinformatics pipelines/tools/software and R programming will be used for detailed analysis.
Variety	:	-
Design	:	-
Plot size	:	-
Planting system	:	-
Data to be recorded	:	Online databases
Investigators	:	Md. Shakil Hossain, SO, ASICT, BARI, Gazipur Dr. ZobaerAkond, SSO, Agricultural Economics and Statistics Section, HRC, BARI, Gazipur Dr. Mohammad Zahirul Alom Talukder, SSO, Plant Breeding, Gaziur Dr. Saiful Islam, SSO, Biotechnology Division, BARI, Gazipur
Season	:	Rabi
Date of initiation	:	November 2024
Date of completion	:	June 2025
Expected output	:	This bioinformatics research work will provide valuable information for future investigations and potential applications in improving lentil crop traits and stress tolerance varieties at BARI.
Location	:	BARI
Status	:	New
Estimated cost	:	N/A
Source of fund	:	N/A
Priority	:	First

ON-GOING RESEARCH PROGRAMS

Program	:	Agro-Environmental Remote Sensing & Modeling
Project	:	-
Experiment 12	:	Forecasting onion yield by using satellite-based remote sensing technique in Bangladesh
Objectives	:	<ul style="list-style-type: none"> i. To identify suitable yield prediction model for onion crop using remote sensing technique; and ii. To forecast onion yield by satellite-based remote sensing technique.
Rationale	:	Bangladesh is basically an agrarian country. Agriculture is the largest and important economic sector of Bangladesh because of its sound production

	<p>environments such as good weather condition, fertile soil, available water, and low-cost labour. Most people in the rural areas depend on agriculture for their earnings through growing different crops, livestock, and fisheries.</p> <p>Onion (<i>Allium cepa</i>) is one of the most important and profitable spice crops which is extensively used in our daily life. Onion can be used in both mature and immature stages as vegetable and spices. It increases the taste of food to a great extent by its flavor. It is also used as medicine to recover from insect injury and raw throat (Bose and Som, 1990). Onion contains protein, calcium, carbohydrates, and vitamin C. In terms of production, onion ranks top among all the spices crops in Bangladesh (BBS, 2020) and ranks second in the world among the 15 vegetables specified by FAO (Pathak, 2000). It is extensively cultivated all over the country in the winter season. Although the production of onion is increasing day by day, but in a land hungry country like Bangladesh it may not be possible to meet the domestic demand due to increase in population. There is an acute shortage of onion in relation to its requirement. Every year, Bangladesh has to import a big amount of onion from neighbouring as well as other countries to meet up its demand (Haque et al., 2011). For these reasons, the accurate forecasting of onion yield is crucial forestimating the accurate information about the total supply of onion in Bangladesh.</p> <p>The precise and timely monitoring of potential yields is crucial for decision making as it influences markets, export–import decisions and farm income budgeting (Zhao et al., 2020). Currently crop statistics in Bangladesh are mostly gathered by the accumulation of representative field sampling data which is time consuming and missing with information from spatial distribution of field variability. On the other hand, the prediction of crop yield before the harvest is one of the most significant concerns in agriculture since variations in crop yields from year to-year impact international trade, food supply, and market prices. However, both crop statistics and yield estimation are estimated usually through conventional methods (field experiments or surveys).</p> <p>Currently, remote sensing techniques are using to measure these statistics at high spatial and temporal resolutions. Remote sensing technology plays a vital role in the agriculture sector by providing timely and accurate information (Atzberger, 2013). Satellite-based remote sensing is one of the best tools to provide vital information about the distribution of crops and its growing conditions over large areas. It can be applied for onion growth monitoring and yield forecast. The application of remote sensing in estimating agricultural performance indicators is increasing as it offers a time and cost-effective reproducible method for measurement that can cover larger physical areas as compared to <i>in-situ</i> methods (Sadras et al., 2015). Such limitations could be overcome by combined use of satellite-based Remote Sensing (RS), GIS and ground sampling but yet to be exploited for onion in Bangladesh.</p>
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Materials and Methods	:	<p>The methodology essentially consisted of selection of the datasets, processing of the satellite data, incorporation of ground information, analysis of the satellite data, and generation of the output products. Remote Sensing technique provides a methodology to map areas of Onion field with the help of Satellite data and GIS (Geographical Information System) database. Satellite In this study, satellite data, field-based survey data will be used for mustard crop yield prediction before harvest, and yield forecasting in future along with adaptation strategies. In particular, the Sentinel-2/Landsat 9 satellite data will be utilized for mustard yield estimation. Extensive ground reference data using Hand Held GPS and GPS Camera will be used to collect ground reference data from farmer's fields to validate the outputs (accuracy at maps). Based on yield data from the farmer's field and vegetation indices (e.g., NDVI) value generated from the same fields using Sentinel-2/Landsat 9 imageries, a regression model will be developed, which will be applied further to obtain onion yield maps from the NDVI maps.</p> <p>Remote sensing image analysis and statistical analysis will be covered by open-source software like QGIS and R. The entire laboratory works e.g., image georeferencing, processing, classification etc. will be conducted at Agro-Environmental Remote Sensing and Modeling (ARSAM) Laboratory of ASICT Division, BARI.</p>
Crop/variety	:	Onion
Design	:	N/A
Plot size	:	N/A
Planting system	:	N/A
Fertilizer dose	:	N/A
Irrigated/rainfed	:	N/A
Data to be recorded	:	Landsat 8 OLI satellite images and farmer's yield data etc.
Investigators	:	<p>Nur Mohammad, SSO Mohammad Mukhlesur Rahman, SSO Istiak Ahmed, SO Mohammad Rasel, SO Dr. M. A. Monayem Miah, CSO</p>
Season	:	Rabi, 2022-2025
Date of initiation	:	November, 2022
Date of completion	:	April, 2025
Expected output	:	This study is expected to report improved methods of onion yield prediction through the combined use of remote sensing and GIS statistical techniques. These results will benefit to the scientists/personnel of BARI, BBS, and Department of Agriculture Extension (DAE).
Locations	:	Pabna, Rajbari and Rajshahi
Status	:	On going (3 rd Year)
Estimated cost	:	Tk. 100,000/=
Source of fund	:	BARI
Priority	:	1 st

Program	:	Agro-Environmental Remote Sensing & Modeling
Project	:	-
Experiment- 13	:	Prediction of mustard yield in Bangladesh using satellite-based remote sensing techniques
Objectives	:	(i) To create a map of selected mustard fields by using satellite images; and

		(ii) To estimate mustard yield by using satellite-based remote sensing technique.
Rationale	:	<p>Mustard (<i>Brassica</i> spp.) is one of the oldest oilseed crops of Bangladesh. Mustard, collectively known as rapeseed, has potential demand as preferred edible oil for one-thirds of the world population. Edible oils play vital roles in human nutrition by providing calories and aiding in digestion of several fat-soluble vitamins, for example Vitamin A (National Research Council, 1989). The per capita recommended dietary allowance of oil is 6 gm/day for a diet with 2700 Kcal (BNNC, 1984). Mustard is the most dominant oilseed crop in Bangladesh and has experienced expansion in area, production and yield over time while facing fierce competition of land for production of cereals, e.g., rice, wheat and maize. Mustard is a cold loving Rabi crop grows during November-January usually under rain fed and low input condition in Bangladesh.</p> <p>Mustard (<i>Brassica</i> spp.) is one of the oldest oilseed crops of Bangladesh. Mustard, collectively known as rapeseed, has potential demand as preferred edible oil for one-thirds of the world population. Edible oils play vital roles in human nutrition by providing calories and aiding in digestion of several fat soluble vitamins, for example Vitamin A (National Research Council, 1989). The per capita recommended dietary allowance of oil is 6 gm/day for a diet with 2700 Kcal (BNNC, 1984). Mustard is the most dominant oilseed crop in Bangladesh and has experienced expansion in area, production and yield over time while facing fierce competition of land for production of cereals, e.g., rice, wheat and maize. Mustard is a cold loving Rabi crop grows during November-January usually under rain fed and low input condition in Bangladesh.</p> <p>Crop production forecasts/estimates are generally portrayed as the product of two components: area (to be) harvested and (expected) yield per unit area. The accurate forecasting/estimation of both harvested area and yield are equally important in ensuring the accurate determination of their product. Crop statistics in Bangladesh are now largely acquired through the accumulation of representative field sample data, which is time-consuming and missing information from the spatial distribution of field variability (FAO,2015). On the other hand, the prediction of crop yield before the harvest is one of the most significant concerns in agriculture since variations in crop yields from year to-year impact international trade, food supply, and market prices. However, both crop statistics and yield estimation are estimated usually through conventional means (field experiments or surveys). At this time, remote sensing techniques are using to measure these statistics at high spatial and temporal resolutions. Remote sensing is used to forecast the expected crop production and yield over a given area and determine how much of the crop will be harvested under specific conditions. Researchers can be able to predict the production of crops that will be produced on a given farmland over a given period of time. Remote sensing also allows farmers and experts to predict the expected crop yield from a given farmland by estimating the quality of the crop and the extent of the farmland. This is then used to determine the overall expected yield of the crop (Grind, 2018). Remote sensing is used to estimate agricultural performance indicators because it is a technology that takes less time and costs less money and can cover larger areas than methods done in person (Sadras et al., 2015). Combining satellite-based Remote Sensing (RS), GIS (Geographic Information System), and ground sampling could overcome these limitations for mustard in Bangladesh.</p>
Materials and Methods	:	The technique primarily consisted of selecting datasets, processing satellite data, integrating ground information, analyzing satellite data, and producing output products. Using Satellite data and a GIS database, the Remote Sensing technique provides a tool for mapping areas of Mustard field. In this research,

		yield predictions for the mustard crop before harvest as well as yield forecasting in the future along with adaption techniques will be made using satellite data and survey data collected in the field. For the purpose of estimating mustard yield, Sentinel-2/Landsat 9 satellite data will be specifically used. To verify the results, a significant amount of ground reference data will be collected from farmer fields using handheld GPS and GPS cameras (accuracy at maps). A regression model will be created based on yield data from the farmer's field and vegetation indices (e.g., NDVI) value derived from the same fields using Sentinel-2/Landsat 9 imageries. This model will then be used to obtain mustard yield predicting. Open-source software like QGIS and R will cover remote sensing image and statistical analysis. The Agro-Environmental Remote Sensing and Modeling (ARSAM) Laboratory of the ASICT Division at BARI will be the basis of all laboratory activities, such as image processing, classification, etc.
Crop/variety	:	Mustard
Design	:	N/A
Plot size	:	N/A
Planting system	:	N/A
Fertilizer dose	:	N/A
Irrigated/rainfed	:	N/A
Data to be recorded	:	Landsat 9/ Sentinel-2 images and farmer's yield data
Investigators	:	Mohammad Mukhlesur Rahman, SSO Nur Mohammad, SSO Istiaq Ahmed, SO Dr. M. A. Monayem Miah, CSO
Season	:	Rabi
Date of initiation	:	November, 2022
Date of completion	:	January, 2025
Expected output	:	It is expected that this research would present new methods for predicting mustard yield using GIS and remote sensing technique. This outcome will benefit BARI, BBS, and the Department of Agricultural Extension (DAE).
Locations	:	Tangail, Sirajganj and Manikgonj districts
Status	:	On going (3 rd Year)
Estimated cost	:	Tk. 100,000/=
Source of fund	:	BARI
Priority	:	1 st

Program	:	Agriculture Economics, Data Science and Information & Communication Technology
Project	:	Data Science and Information & Communication Technology
Experiment-14	:	Detection of Differences in Vegetation and Chlorophyll Content in Agricultural Field Using Unmanned Aerial Vehicles
Execution Center/ Division	:	ASICT Division
Lead Center/ Division	:	ASICT Division
Objectives	:	<ul style="list-style-type: none"> i. To identify crop classification and develop a digital map for selected vegetables from crop fields ii. To generate a chlorophyll content map for selected vegetable crops iii. To identify particular chlorophyll deficiency areas for selected vegetable crops using machine learning algorithms.
Rationale	:	Chlorophyll is a pigment that gives plants their green color, and it helps plants create their own food through photosynthesis. Chlorophyll enables plants to use light to get energy. Chlorophyll is what gives many plants and algae their green

	<p>color. When you look at an organism through a microscope, you can see that chlorophyll is mostly found in structures called chloroplasts, which are shown here grouped together inside plant cells. In plants, the job of chlorophyll is to take in light, usually sunlight. Light energy is passed to two types of molecules that can store energy. The plant uses the stored energy to turn carbon dioxide and water into glucose, a type of sugar. Chlorophyll content is an important indicator of plant photosynthesis ability and growth status, so the detection of crop chlorophyll content is of great significance in agricultural production (Sun <i>et al.</i> 2010)</p> <p>The traditional method of crop chlorophyll detection is mainly carried out by chemical analysis, which is time-consuming and labor-intensive. It is not conducive to efficient analysis of large-area field data. The theory research reported that the chlorophyll of plant absorbs the blue light and red light, and reflects green light during the photosynthesis. The phenomenon could be observed and analyzed by visible imagery. So that, the optical imaging analysis of visible light reflection could support the rapid in-situ analysis of chlorophyll content in field crops, and has been widely applied. Many researcher used the RGB (red, green, blue) image in the visible light range to detect chlorophyll content on different scales of field crop (Sun Wenhui <i>et al.</i> 2012)</p> <p>With the development of remote sensing technology, the advantages of UAV_s acquiring farmland images are fast and convenient. Furthermore, the scope of acquisition is gradually becoming an important means and research hotspot for farmland information acquisition (Zhihui <i>et al.</i> 2019)</p> <p>Farmers are motivated to use new tools because they need to improve the quality and profitability of their crops. In the last few years, robotic unmanned aerial vehicles (UAVs) have become a common tool for managing farms. As an example, UAV monitoring can be used to make maps for early-season soil analysis, which can help plan when to plant seeds. It's a step in the right direction for the evolution of agricultural management techniques toward better use of land (Whelan and McBratney, 2012).</p> <p>At the center of the smart agriculture expansion are agricultural robots, among which, unmanned aerial vehicles (UAV) have been extensively applied (Ju and Son, 2018). UAVs have significantly reduced working hours, resulting in increased stability, measurement accuracy, and productivity. UAVs are not only less expensive than most other agricultural machines, but also they are easily operated. Moreover, their applications have contributed to the expansion of many areas of agriculture, including insecticide and fertilizer prospecting and spraying, seed planting, weed recognition, fertility assessment, mapping, and crop forecasting (Mogili and Deepak, 2018)</p> <p>The use of NDVI and other indices in agriculture is starting to grow quickly, and it is becoming more important to get these tools into the field. Modern tools, like multispectral cameras, make remote analysis much more useful and give it a much wider range of purposes (Boiarskii and Hasegawa, 2017).The multispectral camera is a useful tool for field monitoring because it can collect data that can be used for crop forecasting, yield predictions, crop indicator mapping, and finding weeds, diseases, and deficiencies in nutrients (Berni <i>et al.</i>, 2009).Indices are defined as a ratio of the difference between the reflectance of different spectral bands, which provide different data layers. Decreasing photosynthesis rates and changes in leaf mesophyll are usually associated with decreasing reflectance of wavelengths within the NIR spectral range (Carter and Knapp, 2001).</p> <p>Many countries already use UAVs in agriculture sector South Korea using drones for approximately 30% of their agriculture spraying. Japan always stays ahead. Japan had 11 million farmers in 1965 but that figure has fallen to less than 2 million today. Japan's government has set a goal to introduce agricultural</p>
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	<p>UAVs for more than half of the land area planted with rice, wheat, and soy across Japan by fiscal 2022, for promoting labor-saving and increasing productivity. Malaysia is drastically changing the current path of agriculture by introducing UAVs. In the last few years, Drones are widely used in Malaysia for paddy fertilizing, oil palm mapping, pest monitoring, and yield monitoring. Thailand is using UAV to grow rice (the biggest crop), staples include tapioca, rubber, and sugar. Younger farmers in Thailand are embracing the opportunity to use drones. Farmers monitor their crops, distribute seeds, and fertilize more efficiently. The use of unmanned aerial vehicles or drones in agriculture is expanding in China at a speed unmatched in other countries thanks to advances in autonomous navigation technology and the presence of competent operators (Digital Marketer, Oct 27, 2020). There are a number of barriers to the use of drones in agriculture in Bangladesh, including a lack of technical knowledge, skilled personnel for drone operations and data analysis, and expensive Internet infrastructure. Therefore, if we can increase the use of technology such as drones, we can make agriculture more appealing to the younger generation. This agricultural practice is commonly referred to as smart farming (Daily sun, Jun 06, 2022)</p> <p>Traditional methods to calculate the chlorophyll content include a destructive chemical extraction and a non-destructive measurement of chlorophyll fluorescence. The former method, while direct, is tedious and unsuitable for continuous monitoring individual plants because of its destructive manner. The latter method needs expensive instruments of which none are presently suitable for small leaves such as the commonly used Arabidopsis cotyledons. It is important to develop a non-destructive method to estimate chlorophyll content for Arabidopsis because it is a genetic model plant, however traditional chlorophyll extraction is not useful due to the small size of the Arabidopsis leaves grown on agar plates. Recently, digital photographic imaging showed great promise for quantitating plant phenotypes (Zhang <i>et al.</i>, 2014). Measuring a crop's physiological parameters provides information for interpreting its response to the environment. Remote sensing is quickly becoming recognized as a valuable tool that has the potential to assess a wide variety of physiological properties over a large area in a short amount of time (Schlemmer <i>et al.</i>, 2005)</p> <p>Drone surveys back farmers with accurate data processing that encourages them to make quick and mindful decisions without second-guessing, allowing farmers to save the time invested in crop scouting. Various sensors of the drone enable capturing and analyzing data from the entire field. The data can focus on problematic areas such as infected crops/unhealthy crops, different colored crops, moisture levels, etc. The drone can be fixed with several sensors for other crops, allowing a more accurate and diverse crop management system</p>
Materials and Methods	<p>Study area: This study area will be conducted at the vegetable research field of BARI, Gazipur</p> <p>Identification of crop type's map: An automated flight mission will be launched to collect air images of the study area. This method made it possible to acquire high-resolution imagery, which was crucial in generating the orthomosaic and DEM. This work will conduct by random forest model.</p> <p>Making a chlorophyll content map: The additional bands of the UAVs camera are REDGE and NIR. The NIR band is in the spectral region behind the red band and is useful in detecting state of plant health. Another constituent spectral region is the REDGE. This band is located between the red band and the NIR band. Plants increase the reflection coefficient between the red and NIR region, which leads to a sharp increase in the reflection coefficient through the REDGE band. Different combination of the band allowed us to observe different</p>

		<p>analytical layers. In this research we use NDVI, NDRE and NDCI indices to evaluate crop vegetation activity and chlorophyll content.</p> <p>Identification of chlorophyll deficient area: The UAVs multispectral camera is a useful tool for field monitoring because it can collect data that can be used for crop forecasting, yield predictions, crop indicator mapping, and finding weeds, diseases, and deficiencies in nutrients (Berni et al., 2009). This research are completed we used UAV model Phantom 4 Multispectral, manufactured by DJI, China. The DJI Phantom 4 Multispectral makes it easier and faster than ever to collect images for agricultural field and will the help of machine learning algorithms.</p> <p>UAV image analysis and statistical analysis will be covered by license version Software Agirsoft, open source software QGIS and R. The entire laboratory works e.g. image geo-referencing, processing, classification etc. will be conducted at Agro-Environmental Remote Sensing and Modeling (ARSAM) Laboratory of ASICT Division, BARI.</p>
Crop/Variety	:	Vegetable crops
Design	:	N/A
Plot Size	:	N/A
Planting System/spacing	:	N/A
Fertilizer dose	:	N/A
Irrigated/Rainfed	:	N/A
Data to be recorded	:	NDVI, NDRE, NDCI, EVI and Others indices
Investigators	:	<p>Mohammad Mukhlesur Rahman, SSO, ASICT Division, BARI, Gazipur</p> <p>Nur Mohammad, SSO, ASICT Division, BARI, Gazipur</p> <p>Istiaq Ahmed, SO, ASICT Division, BARI, Gazipur</p> <p>Dr. Md. Monirul Islam, PSO, Plant Pathology Division, BARI, Gazipur</p> <p>Dr. Syed.Md. Abdullah Shiblee, CSO, ASICT Division, BARI, Gazipur</p>
Season	:	Rabi, 2023-2024
Date of initiation	:	November, 2023
Date of completion	:	April, 2024
Expected outputs/Benefit	:	This study is expected to develop chlorophyll content map for selected vegetables fields and to identify the chlorophyll deficiency area for particular field. This study is benefited to Bangladesh Agricultural Research Institute (BARI), Department of Agriculture Extension (DAE) and also endures.
Locations	:	Vegetable Research field at BARI, Gazipur
Status	:	On going
Estimated Cost	:	Tk. 10,000/=
Source of fund	:	BARI
Priority	:	1 st
Program	:	Agro-Environmental Remote Sensing & Modeling
Project	:	-
Experiment-15	:	Combination of soil sampling and drone mapping effects on fertilizer recommendation for crop production
Objectives	:	<p>The objectives of the study are as follows:</p> <ol style="list-style-type: none"> i. To assess soil nutrient variability within crop fields. ii. To generate a detailed map of soil nutrient variability across the fields. iii. To correlate drone-derived vegetation imaging indices with soil nutrient

		content. iv. To develop a fertilizer recommendation map for nutrient application.
Rationale	:	Crop cultivation is a crucial aspect of agriculture in Bangladesh, contributing significantly to food security and income generation. However, inefficient nutrient management practices can lead to decreased crop productivity, environmental degradation, and higher production costs. To address these challenges, precise mapping of soil nutrient variability and the development of targeted fertilizer management strategies are necessary. Conventional blanket fertilizer application methods often overlook the spatial variations in soil nutrient levels within crop fields. This results in the improper application of fertilizers, leading to nutrient imbalances, reduced crop yields, and potential nutrient losses to the environment. This study proposes the utilization of the DJI (Da-Jiang Innovations) Phantom 4 multispectral drone for mapping soil nutrient variability in crop fields. The drone's multispectral imaging capabilities enable the capture of data related to vegetation indices, which serve as indicators of soil nutrient content. By establishing correlations between these indices and laboratory analysis of soil samples, a detailed map of soil nutrient variability can be generated. This map, in turn, can guide the implementation of site-specific fertilizer application strategies, thereby enhancing nutrient-use efficiency and crop productivity.
Materials and Methods	:	<p>This study is collaboration between the Laboratory of the ASICT Division and the Soil Science Division at BARI, Gazipur. The Soil Science Division will provide analytical support, while the ASICT Division will offer technical support. The research will conduct in the experimental field of the Soil Science Division, along with representative fields in diverse regions and soil types within BARI. Factors such as crop rotation, previous fertilizer practices, and field size will be considered.</p> <p>The study will plan drone flights with the DJI Phantom 4 multispectral drone at a consistent altitude and speed just before sowing or planting. These flights will capture multispectral images, which will be processed to generate vegetation indices such as NDVI or NDRE. The study will also investigate the integration of satellite imagery with drone imagery for enhanced analysis.</p> <p>Soil samples will be collected from various locations within the BARI experimental fields, ensuring adequate coverage. These samples will be analyzed in the laboratory for essential nutrients like nitrogen, phosphorus, potassium, and other relevant elements. The study will investigate the relationship between drone-derived vegetation indices (e.g., NDVI or NDRE) and soil nutrient levels. By integrating these indices with laboratory analysis, a detailed map of soil nutrient variability will be created. The fields will be classified into nutrient-deficient, sufficient, and nutrient-rich zones, and a fertilizer prescription map will be developed, providing recommended nutrient application rates and locations.</p> <p>The study will employ open-source software like QGIS, R, or Python for remote sensing image analysis and statistical analysis. Image georeferencing, processing, classification, and other related tasks will be conducted at the Agro-Environmental Remote Sensing and Modeling (ARSAM) Laboratory of the ASICT Division at BARI.</p>
Crop/variety	:	N/A
Design	:	N/A
Plot size	:	N/A
Planting system	:	N/A
Fertilizer dose	:	N/A
Irrigated/rainfed	:	N/A

Data to be recorded	:	Soil chemical properties, UAS imageries, Satellite images etc.
Investigators	:	Istiak Ahmed, SO, ASICT Division, BARI Dr. Mohammad Masuduzzaman Masud, SSO, SSD, BARI Mohammad Mukhlesur Rahman, SSO, ASICT Division, BARI Nur Mohammad, SSO, ASICT Division, BARI Dr. Habib Mohammad Naser, CSO, Soil Science Division, BARI
Season	:	Rabi, 2023-2025
Date of initiation	:	November, 2023
Date of completion	:	April, 2025
Expected output	:	The expected output of this study is the precise mapping of soil nutrient variability, which will inform optimized fertilizer management practices and enhance crop yields. This will result in reduced fertilizer wastage and potential environmental impacts. Applying the findings to farmers' fields will improve nutrient-use efficiency, leading to cost savings and increased sustainability in crop production.
Locations	:	BARI, Gazipur
Status	:	On going (2 nd Year)
Estimated cost	:	Tk. 100,000/=
Source of fund	:	BARI
Priority	:	1 st