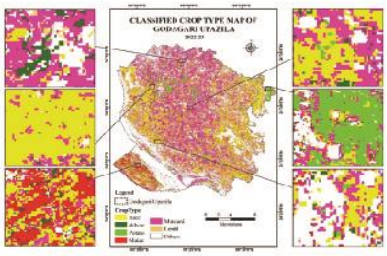
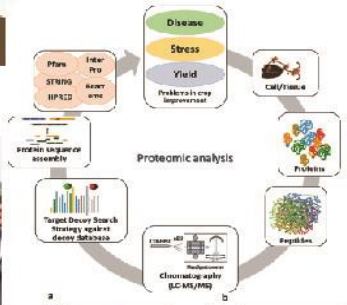
RESEARCH ABSTRACTS
2011-2023

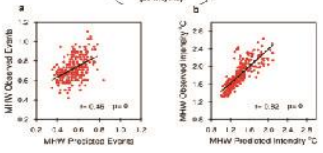


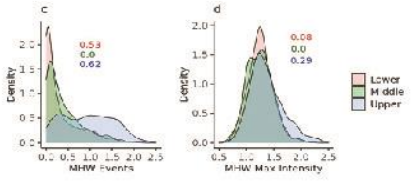
Programme Leader

Dr. M. A. Monayem Miah

Chief Scientific officer & Head
ASICT Division, BARI







Bangladesh Agricultural Research Institute
Agricultural Statistics and ICT Division
Gazipur 1701

Research Abstracts

Agricultural Statistics and ICT Division
(2011-2023)

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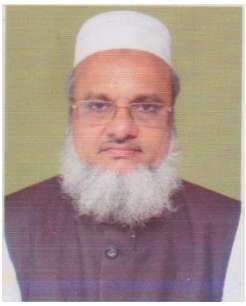
Foreword

Bangladesh Agricultural Research Institute (BARI) is one of the largest multi-crop research institutes in our country. Agricultural Statistics and Information & Communication Technology (ASICT) Division, one of the most monumental divisions of Bangladesh Agricultural Research Institute (BARI), signifies its role in the agricultural sector of Bangladesh. The emergence of ICT is one of the wonderful gifts of modern science and technology, which has brought a tremendous changes in the scientific community. Ever since its inception in 2012, it has grown in stature and made its presence felt both nationally and internationally. The diversified research works of this division on Remote Sensing & GIS mapping, IoT, Bioinformatics, Biostatistics, Experimental design, Data Science, General Statistics, and Computer application in agriculture bridge the gap in the existing knowledge.

Abstract reflects the whole research at a glance, the initiative of compiling all of the abstracts of past research works conducted by this division is a tough and highly appreciable job. To spread the knowledge gained from research output is another important task for a researcher, this abstract compilation can help in this regard. The stakeholders, researchers, policymakers of the country, and interested people from home and abroad can get information, and research ideas from this compilation.

My heartfelt thanks and gratitude towards the programme leader, the scientists of the division, and others engaged in compiling the research abstracts of the past ten years.

Dr. Debasish Sarker
Director General (Grade-1)
Bangladesh Agricultural Research Institute



Preface

For the time being, in the era of data-driven decision-making and the digital revolution, Statistics and Information Communication Technology dominate all the sectors. The agricultural sector cannot be kept far from its light. Hence, the Agricultural Statistics and Information & Communication Technology (ASICT) Division is considerably an important division of the Bangladesh Agricultural Research Institute (BARI). At the outset, it served as the section of the Agricultural Economics Division, and afterward, on 9th April 2012 it was declared as a separate division under the Training & Communication wing of BARI. The ASICT division is responsible for conducting various Agricultural Statistical and ICT-related research based on the mandated crops of BARI.

This division focuses research on Remote Sensing & GIS mapping, Biostatistics, Bioinformatics, IoT, Crop modeling, Prediction and Forecasting, General Statistics, and developing & innovating technology for agricultural purposes. To meet the challenges of climate change in the agricultural sector, the ASICT division plays a significant role through conducting various types of research and providing knowledge on how to reduce the harmful effect of climate change on the agriculture sector in Bangladesh.

Along with its diverse research works, it provides ICT support, internet support to all BARI scientists and officials, and maintains all the computers installed in the headquarters of BARI. We also support agricultural scientists in performing various kinds of statistical analyses for their research.

As a part of the enrichment of the BARI, the ASICT division has taken the initiative of compiling the abstracts of the past ten years which will widen the output, knowledge, and research ideas for others and help the policymakers of Bangladesh.

Dr. Md. Abdul Monayem Miah
Chief Scientific Officer and Head
ASICT Division, BARI

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Abstract 2011-2012

DEVELOPING UNION-LEVEL DIGITAL DATABASES AND MAPS OF MAIZE USING ICT

M. Azim Uddin, M. S. Yasmin, M. Mukhlesur Rahman, and Nur Mohammad

The study was conducted during 2011-12 using both primary and secondary data to build the union-level digital databases and maps of maize. Primary data were collected from maize growing areas of three Upazilas, such as Saturia (Manikganj), Pirganj (Thakurgaon), and Hatibandha (Lalmonirhat)). Union, Upazila, district, and country-level digitized maps were utilized in the program. GIS, GPS, and MIS-related IT were used. Out of the total cultivable land (60108 ha) in three Upazilas, the area and production of maize were 4297 ha and 25476.68 t, respectively. Out of twenty (20) varieties of maize, one BARI variety and 19 foreign varieties were cultivated in the study areas. Maximum area (99%) was covered by foreign varieties e.g. NK40, 900M, and 749. At Saturia and Pirganj, maize areas were covered only by foreign varieties. The average maize yield of Upazilas was 5.79 t/ha and the maximum yield at Pirganj was 7.00 t/ha during 2011-12. Production cost and selling price were Tk. 8.81/kg and Tk.15.04/kg at the time of harvest, respectively, in 2011. The benefit-cost ratio (BCR) of maize was 1.71 and the maximum (was 1.90) at Hatibandha. Digital databases of different items such as area, production, yield, varietal information, etc. of maize were obtained. It is globally representable and upgradeable. Through the study union, Upazila, and district maps of maize were developed. Besides adopting HYVs, management practices should be improved. The study reveals that an increase in maize production in those areas by vertical and horizontal expansion is possible.

DEVELOPING MOUZA-LEVEL DIGITAL DATABASES AND MAPS OF POTATOES USING ICT

M. Azim Uddin, M. S. Yasmin, and M. Mukhlesur Rahman

The study was conducted during 2011-12 using both primary and secondary data to build the union-level digital database and maps of potatoes. Primary data were collected from potato growers of three Upazilas, namely Gazaria (Munshigonj), Shibganj (Bogra), and Pirganj (Rangpur). Mouza, Union, Upazila, district, and country-level digitized maps were utilized in the program. GIS, GPS, MIS, Modem, and mobile phone Technology were used. The average yield of potatoes was 17.45 t/ha and the highest yield was 29.88 t/ha at Gazaria, Munshiganj during the period 2011-12. Out of the total potato area, 69.06% was cultivated by HYVs, and the rest 30.94% by local varieties during the period 2011-2012. Out of 42 HYVs developed by BARI, 6, 7, and 8 varieties were cultivated in the study areas of Gazaria, Shibganj, and Pirganj in 2011-12. More than eighty percent (80.41%) area of HYVs potato was covered by three varieties Diamante, Cardinal, and Granola. Production cost and selling price were Tk.7.25 /kg and Tk.10.48 /kg at the time of harvest, respectively in 2012. Benefit Cost Ratio (BCR) of potatoes was 1.45 whereas the maximum BCR was 1.46 at Shibganj. A digital database of different items such as area, production, yield, varietal information, etc. of potatoes was obtained. It is globally representable and upgradeable. Through the study union, Upazila, and district maps of potatoes were developed. Besides adopting HYVs, management practices should be improved. It is a system development program for data collection, generating digital databases and maps, and identifying variety-wise area coverage of potatoes as well as for other crops.

STANDARDIZATION OF PLOT SIZE FOR POTATO EXPERIMENTATION

Z. Akond, Nur Mohammad, K. S. Rahaman, M. S. Islam,
and Sajeda Akhter

A field experiment for the determination of standard (optimum) plot size for potato experimentation was conducted during the Rabi season of 2011-2012. Five different plot sizes (Treatments) viz., 3m × 3m=9m^2, 3.5m × 3m=10.5m^2, 4.25m × 3m=12.75m^2, 5m × 3m=15m^2 and 5m × 3.6m=18m^2 were evaluated in the present study. The mean yield of five different plot sizes (Treatments) was not so different from each other. The highest yield (24.84 t/ha) was from plot size 4.25m×3m=12.75m^2 and the lowest yield (22.00 t/ha) was from plot size 5m×3m=15m^2.On the other hand, the yield range variability was almost the same for all plot

sizes except the plot size 3m×3m. Regarding experimental precision and resources (money, labor, land, time, etc.) point of view, plot size 3m ×3m appeared as standard for talking measurement on yield and yield contributing characters of potato.

IDENTIFICATION OF POTENTIAL EXOTIC VARIETIES WITH YIELD AND YIELD CONTRIBUTING CHARACTERS OF POTATO BY MULTIVARIATE ANALYSIS

Z. Akond, Suraiya Yasmin, Nur Mohammad, K. S. Rahaman, and Sajeda Akhter

This study was carried out to identify the potential exotic varieties with the important yield and yield contributing characteristics of potatoes which are used in routine selection of varietal development or selection purposes and which also account for the major variation in the yield of potatoes. Potatoes with 20 varieties were analyzed using Karl Pearson's (1901) principal component analysis and Hoteling's (1993) computing method for the 10 characters. Three principal components were chosen to contribute major variation in this potato experiment. To describe twenty varieties, these first three PCA ordinations on axes I, II, and III accounted for 78.8% of the total variation among the characters. The main characteristics that differentiate among exotic potato varieties were tuber weight (TW) 28mm-55mm, percentage of emergence (PE), tuber number (TN) 28mm-55mm, stem number (SN), and plant yield (PY). Entries 6 (Diamant), 18 (Daisy), 20 (Cardinal), 13 (Flova) 17 (Pamela), & 5 (Destiny) performed better with respect to these characters based on positive loadings in the first three principal components contributing 78.8 % variation.

SPECTRAL SIGNATURE IDENTIFICATION OF CROPS THROUGH GROUND AND SATELLITE REMOTE SENSING

A.F.M. Tariqul Islam, M. Lutfur Rahman, M. S. Islam, A.K.M. Saiful Islam,
S. K. Bala, T. Islam, and M. S. Rahman

Spectral reflectance indices provide a useful tool for monitoring crop-growing status. This study was conducted during the year 2010-2012 to identify the spectral signature of crops as well as to compare Vegetation Indices (VI) of crops derived from both satellite images and ground-based measurements taken by the Spectroradiometer. A series of spectral data were collected using a Spectroradiometer from different crop fields such as Potato, Wheat, Maize, and Mustard over the crop growing season. The Normalized Difference Vegetative Index (NDVI) based growth curve of those crops showed the expected crop growth cycle. The NDVI values of potatoes were calculated from both systems i.e. MODIS satellites and Spectroradiometer-generated spectral data. The VI of potatoes derived from both systems were different through the growing stage of the crop. The VI values calculated from the Spectroradiometer measurements were higher than those from the satellite image. The vegetation indices derived from both systems followed the expected trend of crop growing pattern over time. The information derived from multispectral images seemed to possess the potential for monitoring the general growth status of crop fields.

QUANTIFYING THE CROPPING INTENSITY USING A REMOTE SENSING TECHNIQUE

A.F.M. Tariqul Islam, M. A. Hadi, M. Saiful Islam, M. Lutfur Rahman,
Faruque Ahmed, and H. M. Naser

Agricultural statistics contain much information on the distribution of crop types and land area used where limited information is available on cropping intensity with reference to the spatial distribution of single, double, and triple cropping fields. To generate this sort of information, multi-temporal Moderate Resolution Imaging Spectro-radiometer (MODIS) satellite images were used in 2011 to identify single, double, and triple cropping areas in Tangail, Mymensingh, and Gazipur districts. A model was developed based on the temporal profile analysis of the Normalized Difference Vegetation Index (NDVI). The MODIS-based model estimated net cropland of 601 thousand ha cropping fields in 2011, which is about 5% less than the BBS estimated cropland area (630.44 thousand ha) in the year 2009. The cropping intensity was quantified

as 201% based on remotely sensed data in the study area. The results of this study showed the potentiality of Remote Sensing in delineating cropping land in Bangladesh agriculture.

ASSESSMENT OF THE EFFECTS OF CLIMATE CHANGE ON WHEAT AND POTATO CULTIVATION USING DSSAT MODEL

A.F.M. Tariqul Islam, M. M. Rahman, M. Lutfur Rahman, M. Azim Uddin, M. Suraiya Begum, A.F.M. Shamim Ahsan, and M. Mukhlesur Rahman

Weather and climate change are key factors in the agricultural productivity of Bangladesh. This study was taken to assess the future climate change trend as well as to assess the effect of these changes on wheat and potato production using a crop growth model. In this study, the trends of changes in temperature and precipitation patterns in the dry season (November and April) have been assessed for the period 1976-2005. Future climate trends were assessed for the years 2030, 2050, and 2070. Analysis of the monthly average maximum and minimum temperatures at Dinajpur showed an increasing trend for all months of dry season except January and November respectively. Total rainfall during pre-monsoon showed an increasing trend as well; From the future prediction analysis of the years 2030, 2050, and 2070, it was observed that both the maximum and minimum monthly temperatures were increasing trend except in January. Almost the same climatic scenarios were observed for the Bogura district as well. DSSAT v4 crop model simulated results showed that the yield of both the Prodip wheat variety at Dinajpur district and the Granola potato variety at Bogura district would be decreased for the years 2030,2050 and 2070 under these changed climatic conditions. This is the preliminary model output so the DSSAT crop model needs more simulation to get the expected output.

Abstract 2012-2013

ASSESSMENT OF THE EFFECTS OF CLIMATE CHANGE ON WHEAT AND POTATO CULTIVATION USING DSSAT MODEL

A.F.M. Tariqul Islam, M. Mohaimenur Rahman, M. S. Yasmin, and M. Mukhlesur Rahman

Weather and climate changes are key factors in the agricultural productivity of Bangladesh. This study was taken to assess the future climate change trend as well as to assess the effect of these changes on wheat and potato production using the crop growth model in this study. The trend of changes in temperature and precipitation patterns in the dry season (November- April) have been assessed through analysis of data on temperature. Solar radiation and precipitation for the period 1976-2005. Future climate scenarios were assessed for the years 2030, 2050, and 2070. Analysis of the monthly average maximum and minimum temperatures at Dinajpur showed an increasing trend for all months of dry season except January and November respectively. Total rainfall during the dry period showed a variation in trend as well. From the future prediction analysis of 2030, 2050, and 2070, it was observed that both the maximum and minimum monthly temperatures were increasing trends except for January. Almost the same climate scenarios were observed for the Bogura districts as well. DSSAT v4 .0 crop model simulated results showed that the yield of wheat variety BARI Gom 24 (prodip) at Dinajpur district would be decreased for the years 2030, 2050, and 2070 under these changed climatic conditions. Yield reduction due to higher temperatures could climatic conditions. Yield reductions due to higher temperatures could substantially undermine future global food security. Therefore, adaption strategies need to be considered now to prevent substantial yield losses for crops from future global warming.

THE EFFECT OF RAINFALL, TEMPERATURE, AND HUMIDITY ON SALINITY IN THE SOUTHERN AREA OF BANGLADESH

M.M. Rahman, A.F.M. Tarikul Islam, N. Mohammad, K.S. Rahman and M.H. Rashid

A study was taken to measure the effect of rainfall, temperature, and humidity on salinity areas as well as to project the future trend of increasing saline areas in the southern area of Bangladesh. Patuakhali district was selected as a study area for the study. Secondary data such as temperature saline area, relative humidity rainfall, etc. were used in the experiment the results showed that minimum temperature and relative humidity have a positive effect whereas rainfall and maximum temperature have a negative effect on decreasing the soil salinity. The study projects that the saline area will be increasing trend in the future. Therefore, mitigation measures could be taken to prevent the salinity in the coastal area.

DETERMINATION OF OPTIMUM SAMPLE SIZE USING YIELD AND YIELD CONTRIBUTING CHARACTERS OF BOTTLE GOURD

N. Mohammad, K.S. Rahman, M.M. Rahman, M.S. Islam, and T. Rahman

To improve efficiency in collecting data on fruit attributes of bottle gourd, the sampling technique (size) was studied at the Olericulture division, Horticulture Research Centre of Bangladesh Agricultural Research Institute Gazipur during 2012-13. A sampling plan of selecting 4 plants at random and measuring 2 fruits per selected plant i.e. (8 fruits per plot) appeared optimum and economical for taking measurements of fruit attributes in field experiments of bottle gourd.

STANDARDIZATION OF PLOT SIZE FOR POTATO EXPERIMENTATION

Zobaer Akond, Sajeda Akhter, Nur Mohammad, Suraiya Yasmin, and M. Saiful Islam

A field experiment for the determination of standard (optimum) plot size for potato experimentation was conducted during the Rabi season of 2012-2013. Six different plot sizes (Treatments) viz., T_1=1.8m×3m= 5.4m^2, T_2=2.4m×3m=7.20m^2, T_3=3m×3m=9m^2, T_4=3.6m×3m=10.80m^2, T_5=4.2m×3m=12.60m^2, T_6 = 4.80m×3m=14.40m^2 were evaluated in the present study. The difference among the mean yields of six different plot sizes was statistically significant at a 5% level of significance. The highest mean yield (3.38 kg/m^2) was for T_2 and the lowest mean yield (2.36 kg/m^2) was for T_5 On the other hand, the mean yield range variability was almost the same for all plot sizes. With respect to experimental precision and resources (cost, labor, land time, etc.) as well as the statistical point of view, the plot size is 2.40m×3m=7. 20m^2 appeared as standard for talking measurement on yield and yield contributing characters of potato.

DEVELOPMENT OF UNION-LEVEL DIGITAL DATABASES AND MAPS OF MAJOR MAIZE-GROWING AREAS

M. Azim Uddin and Suraiya Yesmin

A study was conducted to build level digital databases and maps of maize growing areas using both primary and secondary data during 2011-12. Primary data were collected from maize-growing areas of three Upazilas namely Shaturia (Manikganj), Pirganj (Thakurgaon), and Hatibandha (Lalmonirhat). For summer and winter maize: union, Upazila, district, and country-level digitized maps were used in the study. GIS, GPS, and MIS-related IT were utilized. Out of the total cultivable land (60108 ha) in three Upazilas, the area and production of maize were 17,294 ha and 120620 t, respectively. Thirty-six (36) varieties were cultivated in the study areas of which a maximum (27) were found at Hatibandha, Lalmonirhat, and seven at Shaturia, Manikganj. The maximum area (27.05%) was covered by the varieties NK40, 900M, pacific 984, and Dekalb 98 land elite. The average maize yield of the study areas was 6.97 during 2011-12. Digital databases and maps developed by collected data from the root level (in the block, union Upazila, and district) may help to identify variety-wise area coverage of maize.

DEVELOPMENT OF MOUZA-LEVEL DIGITAL DATABASES AND MAPS OF POTATO

M. Azim Uddin and Suraiya Yasmin

A study was conducted to build the Mouza and union-level digital databases and maps of potatoes during 2011-12 using both primary and secondary data. Primary data were collected from potato growers of unions of three Upazilas, namely Vober char, (Gazaria, Munshigonj), Atmul, (Shibganj, Bogra), and Mittipur (Pirganj, Rangpur) respectively. Mouza, union, Upazila, and district-level digitized maps of Bangladesh were used in the program. GIS, GPS, MPS modern, and mobile phone technology were used. Digital databases of different parameters such as area, production, yield, varietal information, etc. of potatoes were obtained. Mouza, union, Upazila, and district maps of potatoes were developed. Mouza should be used as the smallest unit of land use management for agriculture because it has administrative boundaries and soil identity. The average yield of potatoes was 17.45 t/ha in the study areas during 2011-12. Out of the total potato areas, 69.06% was cultivated by HYVs and the rest 30.94% by local varieties. Out of 46 HYVs released by BARI, 11 varieties were cultivated in the study areas during the same period. Digital databases and maps developed by data collection from root level (i.e. Farmers Mouza, block, and union, etc.) may help to identify variety-wise area coverage of potatoes.

Abstract 2013-2014

DEVELOPMENT OF UNION-LEVEL DIGITAL DATABASES AND MAPS OF MAJOR MAIZE-GROWING AREAS

M. Azim Uddin, Suraiya Yasmin, M. Mukhlesur Rahaman,
K. Saidur Rahman, and Zobaer Akond

A study was conducted during 2014-13 to build union-level digital databases and maps of maize growing areas using both primary and secondary data. Primary data were collected from maize growing areas of three Upazilas namely, Shaturia, Pirganj, and Hatibanda of three districts Manikganj, Thakurgaon, and Lalmonirhat respectively. For summer and winter maize, union Upazila, district, and country-level digitized maps were used in the study. Geographical Information System (GIS), Global Positioning System (GPS), and Management Information System (MIS) related Information Technology (IT) were utilized in this study. Out of the total cultivable land (60108 ha) in three Upazilas, the area and production of maize were 18296 ha and 129501.65t respectively. Twenty-eight (28) varieties were cultivated in the study areas of which a maximum (of 16) were found at Hatibanda, Lalmonirhat, and Shaturia, Manikganj. The maximum area (69.53%) was covered by the varieties NK40, Pacific 984, Dekalb-981, and 900M Gold. Miracles and Sunshine. The average maize yield of the study areas was 7.08 t/ha during 2012-13. A website was developed for variety-wise area coverage data collection of maize as well as for other crops. This website can also be used on mobile phones.

CROP FORECASTING AND LOSS ASSESSMENT IN FLASH-FLOOD PRONE HAOR REGIONS THROUGH REMOTE SENSING TECHNIQUE

M. G. Mahboob, L. Deshapriya, A.F.M. Tariqul Islam, and M. K. Hazrika

Knowledge of the distribution of crop types as well as crop yield forecasting is important for land management and trade decisions and is needed to constrain remotely sensed estimates of variables, such as productivity. Satellite data from Moderate Resolution Imaging Spectroradiometer (MODIS) is freely available and offers a unique combination of spectral, temporal, and spatial resolution compared to previous global sensors, making it a good candidate for large-scale crop-type mapping. A long-term (5-year) study was formulated to forecast crop production as well as to assess the loss using MODIS satellite imagery in the Haor region of Bangladesh. In the first year of this experiment, mapping and monitoring of the most important field crop (i.e. rice) was attempted to be done using satellite remote sensing. In this research, we used a MODIS-derived 8-day composite of normalized difference vegetation index (NDVI) at 250 m spatial

resolution in conjunction with ancillary data sets during the period 2006-2012. For the first-year study, the Boro, Aman, and Aus areas were found 466194, 334256, and 45294 hectares in the Haor region in 2012, respectively. The research results show that the Boro and Aman rice area estimated from MODIS data was closely matched with the area reported by the Bangladesh Bureau of Statistics (BBS). Whereas, the Aus rice area depicted by satellite was largely underestimated. To overcome this problem, in the next year land use classification map will be produced for the Haor region. A linear regression model was established based on the mean of seasonal average of monthly maximum NDVI and BBS rice production data to predict the future rice production in the Haor region. Therefore, satellite data of appropriate time frame, coverage & technology for rice crop mapping and monitoring.

DEVELOPMENT OF USER-FRIENDLY STATISTICAL SOFTWARE INTERFACE FOR AGRICULTURAL RESEARCH

M. G. Mahboob, M. B. R. Mollah, A.F.M Tariqul Islam,
Suraiya Yasmin, and M. Saiful Islam

The development of a user-friendly menu-based Graphical User Interface (GUI) might bring the power of R within the reach of common users in the field of agricultural research in our country. A program was taken to develop a user-friendly graphical menu-based open-source statistical software interface of R for the common users in the field of agricultural research. A demo version of BARIStat has been developed which shows the power of advanced statistical analysis using open source by means of a user-friendly menu-based graphical user interface. Hopefully next year we will get the final version.

Abstract 2014-15

THE EFFECT OF RAINFALL, TEMPERATURE, AND HUMIDITY ON THE SALINE AREA IN THE SOUTHERN REGION OF BANGLADESH

M.M. Rahman, A.F.M. Tarikul Islam, Nur Mohammad, K.S. Rahman, and M.H. Rashid

A study was taken to measure the effect of rainfall, temperature, and humidity on saline areas as well as to project the future trend of increasing saline areas in the southern area of Bangladesh. Patuakhali district was selected as a study area for the study. Secondary data such as temperature, saline area, relative humidity, rainfall, etc. were used in this study. The results showed that maximum temperature and relative humidity have a positive effect whereas rainfall and minimum temperature have a negative effect on decreasing the saline area. The study projects that the saline area will be increasing trend in the future. Therefore, mitigation measures could be taken to prevent the salinity.

DETERMINATION OF OPTIMUM SAMPLE SIZE USING YIELD AND YIELD CONTRIBUTING CHARACTERS OF POINTED GOURD

Nur Mohammad, K.S. Rahman, M.M. Rahman, M.S. Islam, and M.H.A. Mamun

To improve efficiency in collecting data from field experiments on fruit attributes of a pointed gourd (patal) the sample size was studied at the Olericulture Division, Horticulture Research Centre (HRC) of Bangladesh Agricultural Research Institute (BARI) Gazipur during 2013-14. Fruit length, breadth, and weight of pointed gourd (Patal) data were collected from the experimental plot. The data were used to design an optimum sampling plan from an equal number of observations per cell. The observation on fruit length (cm), breadth (cm), and weight (gm) were taken from 7 plots//treatments at random. A Randomized Complete Block Design (RCBD) with 2 replications and seven treatments/varieties was used in this experiment. Three (3) plants per plot and 10 fruits per plant (30 fruits per plot) were the original sampling plan for this experiment. Three 3 plants at random and measuring 7 fruits per selected plant (21 fruits per plot and plots were $5m^2$ i.e. 2.5m long and 2m wide) were found to be optimum and economical for taking

measurements of fruit attributes in field experiments on the pointed gourd. It saves time required for constant vigilance in the opening of flowers and subsequent observations.

COMPARISON OF SPECTRO-TEMPORAL SIGNATURE OF MAJOR AGRICULTURAL CROPS OF BANGLADESH

A.F.M. Tariqul Islam, M. G. Mahboob, A.K.M. Saiful Islam, S. K. Bala,
G.M.T. Islam, M. Azim Uddin, and A. H. Sarwar Jahan

Spectral reflectance indices provide a useful tool for monitoring crop-growing status. This study was conducted during 2014-2015 to identify the spectral signature of crops as well as to identify features in distinguishing spectra-temporal signature for classifying major crops. A series of spectral data were collected using a Spectroradiometer from different crop fields such as potato, Wheat, Maize, and pulses over the crop growing (Rabi) season at the BARI research field. The Normalized Difference Vegetative Index (NDVI) of the crop was calculated using Spectroradiometer generated spectral data. Besides, a handheld Green Seeker was used to measure NDVI directly. The results showed that the vegetation indices followed the expected trend of crop growing pattern over time for all the crops. The information derived from the hyperspectral radiometer seemed to possess the potential for monitoring the general growth status of a crop field.

GIS-BASED LAND SUITABILITY ASSESSMENT FOR MAJOR CROPS

A.F.M. Tariqul Islam, M. G. Mahboob, and M. Azim Uddin

Crop-land suitability analysis is a prerequisite to achieving optimum utilization of the available land resources for sustainable agricultural production. Lack of knowledge on the best combination of factors that suit crop production might contribute to the low production. A GIS-based land suitability assessment study was taken to assess the suitability of major crops (e.g. wheat, potato, maize, rice, etc.) in Delduar Upazila of Tangail district. The Crop Suitability Assessment Model (CSAM) was used to analyze agro-edaphic and agro-climatic parameters of Delduar Upazila. The model presented the wheat suitability and Aus-Aman-Wheat suitability map for the study area. In the next two years, we will find out the suitability map for major crops and cropping patterns as well.

CROP-TYPE MAPPING BY USING VERY HIGH-RESOLUTION SATELLITE AND AIRBORNE REMOTE SENSING DATA IN THE SOUTHERN DELTA

A.F.M. Tariqul Islam, M. G. Mahboob, and Z. U. Ahmed

Remote sensing is a powerful tool for monitoring and identification of crop types in certain areas. Bangladesh is an agricultural country with a large variety of crops. Hence it is very important to map different crop types in order to have accurate yield statistics. A study was taken to map crop types by using satellite remote sensing in the southern delta. High and very high-resolution satellite imagery (e.g. RapidEye, WorldView 2) and state-of-the-art or-borne RGB, Multi-Spectral and Thermal data from Unmanned Air Vehicle (UAV) platform (Octocopter) supplied by STARS project of International Maize and Wheat Improvement Center (CIMMYT) were used to identify crop types and precisely delineating the crop boundary in Southern Bangladesh. This is the first year of the 3 (three) years study plan and satellite data collection and processing are still being conducted.

DEVELOPMENT OF AN ONLINE SYSTEM FOR DATA COLLECTION, DOCUMENTATION, AND MAPPING OF MUSTARD IN THE CHALAN BEEL AREA OF BANGLADESH

M. Azim Uddin, K. Saidur Rahman, and M. Mukhlesur Rahman

A study was conducted during 2014-15 to build union-level digital databases and maps of mustard growing areas in the Chalan Beel area, using both primary and secondary data. Primary data were collected from mustard growing areas of three Upazilas namely Taras of Sirajganj district and Singra and Gurdaspur of Natore district. For mustard: union, Upazila, district, and country-level digitized maps were used in the study. Geographical Information System (GIS), Global Positioning System (GPS) and Management Information System (MI(S) related Information Technology (IT) were utilized in this study. The total cultivable land in the study areas was 77693ha; the area and production of mustard were 8552ha and 9466t respectively. Nine (9) mustard varieties were cultivated in the study areas; among them maximum (8) varieties were cultivated at Singra and a minimum of six varieties at Tears (Sirajganj). Out of 9 varieties of mustard 96.64% area was covered by four varieties Tori-7, BARI Sarisha-9, BARI Sarisha-14, and BARI Sarish-15. Among the total mustard growing area, 78.3% was covered solely by Tori-7 variety which contributed 74.67% of the total production. Average mustard yield of the study areas was 1.107 t/ha during 2014-15. A website (www.asictbari.net) was developed for variety-wise area coverage data collection of mustard as well as for other crops. This website can also be used on mobile phones.

DEVELOPMENT AND IMPLEMENTATION OF BARI LABOUR MANAGEMENT SYSTEM

K. Saidur Rahman, M.S. Islam, M.K.R. Bhuiyan, M.A. Uddin,
M.M. Rahman, and N. Mohammad

The research titled “Development of BARI Labour Management System” is labour management software for monitoring and controlling labour at BARI. This Labour Management System software was developed using MySOL database which mainly focuses on basic operations in labour like adding new labour, updating new information, salary sheet, etc. This software is a Windows-based application for 32-bit Windows operating systems, designed to help users maintain and organize labour. This software has been designed to be used for both beginners and advanced users.

INFORMATION OF BARI TECHNOLOGY AT THE FARMER’S DOORSTEP THROUGH MOBILE APPS

M. Saiful Islam, M. Faruque Ahmed, and A.F.M. Tariqul Islam

A mobile app has been developed for disseminating BARI-developed technology to make the crop production package available at the right time at the stakeholder’s doorstep. A system has been also developed for the end users to get technology-related question-answering through this mobile app. This app has been named BARI Application কৃষি প্রযুক্তি ভান্ডার can be downloaded from the Google Play Store and then can be used through android based mobile in offline.

DEVELOPMENT OF GEODATABASE FOR HAOR REGION FOR SUSTAINABLE INTENSIFICATION OF AGRICULTURE

M. G. Mahboob, H. M. Abdullalh, and A.F.M. Tariqul Islam

Monitoring land-use/cover change (LU/CC) and exploring its mechanisms are important processes in the environmental management of the Haor area. A study has been initiated for the development of a Geodatabase for the Haor Region for Sustainable Intensification of Agriculture specially to develop thematic map layers of seasonal land/cover dynamics to identify fallow Kanda lands and to suggest suitable crop (s) for the Haor for sustainable intensification regions using remote sensing and GIS. Landsat 4/5/8 multi-spectral data/MODIS time series composite data product during the years 2012-2015 and other available satellite data have been used in association with a comprehensive ground survey to identify land

use/cover, and Kanda land in the Haor area. Ancillary geospatial data from other secondary sources such as topographic maps, communication networks, water levels, etc. also have been used to improve the accuracy of the maps. Sixteen (16) days of composite Aqua and Terra MODIS images during 2011-2012 were processed and found that most of the Haor area had gone underwater from June to November. Then the land (e.g. Kanda) became available from December-January to April-May. We also found that most of the land in the Haor districts was available for agriculture during Rabi Seasons. So remote sensing could identify the Kanda land in the Haor area.

Abstract 2015-2016

DEVELOPMENT OF AN ONLINE SYSTEM FOR DATA COLLECTION, DOCUMENTATION, AND MAPPING OF MUSTARD IN THE CHALAN BEEL AREA OF BANGLADESH

M. Azim Uddin, K. Saidur. Rahman, M. Mukhlesur Rahman, and Nur Mohammad

A study was conducted during 2015-16 to build union-level digital databases and maps of mustard growing areas in the Chalan Beel area, using both primary and secondary data. Primary data were collected from mustard growing areas of three Upazilas namely Taras of Sirajganj district and Singra and Gurdaspur of Natore district. For mustard: union, Upazila, district, and country-level digitized maps were used in the study. Geographical Information System (GIS), Global Positioning System (GPS), and Management Information System (MIS) related Information Technology (IT) were used in this study. The total cultivable land in the study areas was 77,693 ha; the area and production of mustard were 8552 ha and 10564 MT respectively. Five mustard varieties were cultivated in the study areas; among them, a maximum of five varieties were cultivated at Sigra and Gurdaspur; and a minimum of three varieties at Taras. Out of 5 varieties of mustard 93.91% area was covered by two varieties Tori-7 and BARI Sarisha-14 and the rest by others. It was found that 83.12% area of mustard was covered by Tori-7 which contributed 79.53% of the total production. The average mustard yield of the study areas was 1.59 t/ha during 2015-16. A website (www.asictbari.net) was developed for variety-wise area coverage data collection of mustard as well as for other crops. This website could be used on a smartphone.

DEVELOPMENT AND IMPLEMENTATION OF BARI LABOUR MANAGEMENT SYSTEM

K. Saidur Rahman, M. M. Rahman and Nur Mohammad

Labour Management System can manage the labour of an organization effectively and efficiently. A labour management software was developed for monitoring and controlling labour at BARI. This Labour Management System software was developed using MySQL database which mainly focuses on basic operations in labour like adding new labour, updating new information, salary sheet, etc. This software is a Windows-based application for 32-bit Windows operating systems, designed to help users maintain and organize labor. This software has been designed to be used for both beginners and advanced users.

COMPARISON OF SPECTRO-TEMPORAL SIGNATURE OF MAJOR AGRICULTURAL CROPS OF BANGLADESH

A.F.M. Tariqul Islam, M. G. Mahboob, A.K.M. Saiful Islam, S. K. Bala, G.M. Tarekul Islam, M. Azim Uddin, and A. H. Sarwar Jahan

Spectral reflectance indices provide a useful tool for monitoring crop-growing status. This study was conducted during 2015-2016 to identify the features in distinguishing spectro-temporal signatures for classifying major crops. A series of spectral data were collected using a Spectroradiometer from different crop fields such as Potato, Wheat, and Lentil over the crop growing (Rabi) season at BARI crop museum. Analysis was done to assess the spectral separability of various crop types under two scenarios; scenario 1 involved testing separability based on a number of days after planting and scenario 2 involved testing separability at specific dates across the growing season. The results indicate that although crop classification could be achieved at any point during the growing season, the optimal time for separation is in mid-January.

The information derived from a hyperspectral radiometer seemed to possess the potential for monitoring the general growth status of crop fields.

GIS-BASED LAND SUITABILITY ASSESSMENT FOR MAJOR CROPS

A.F.M Tariqul Islam, M. G. Mahboob, and M. Azim Uddin

Crop-land suitability analysis is a prerequisite to achieving optimum utilization of the available land resources for sustainable agricultural production. Lack of knowledge on the best combination of factors that suit crop production might contribute to the low production. Therefore, multi-factor analysis of different aspects of land, climate, and socio-economic factors is a must to achieve suitable crops for sustainable production. A GIS-based Crop Suitability Assessment Model (CSAM) was used to assess the suitability of major crops (e.g. wheat, potato, maize, rice, etc.) in Delduar Upazila of Tangail district. Land/crop suitability was determined through a multi-factor analysis of different aspects of land, climate, and economic factors of the study area. The agro-edaphic and agro-climate suitability was determined separately based on the soil/land factors and climatic factors, respectively. Afterward, land suitability (e.g. very suitable, suitable, moderately suitable, marginally suitable, and not suitable) for different crops was performed through overlaying of agro-edaphic and agro-climatic suitability layers using CSAM. The model-derived results provided the suitability maps of major crops (such as rice, wheat, maize, pulses oilseeds, etc.) of Delduar Upazila and cropping patterns as well. Finally, CSAM provided the best cropping pattern for Delduar Upazila as well. This GIS-based model is a user-friendly and flexible application software that will be useful for agricultural scientists, planners, and decision-makers.

DEVELOPMENT OF GEODATABASE FOR HAOR REGION OF SUSTAINABLE INTENSIFICATION OF AGRICULTURE

M. G. Mahboob, H. M. Abdullah, and A.F.M. Tariqul Islam

A study has been conducted for the development of the Geodatabase of the Haor Region located in the northeastern part of Bangladesh for sustainable intensification of Agriculture. Scopes of this research include the accumulation of existing geodatabases of the Haor region from different sources or organizations, adding values to them, conducting new analyses, and generating geospatial data from satellite imagery. To procure relevant geodata from a wide range of public/autonomous organizations including the Department of Bangladesh Haor and Wetland Development, Center for Environmental and Geographic Information Services, Bangladesh Water Development Board, Institute of Water Modeling, Local Government Engineering Department, Soil Resources Development Institute, Bangladesh Agricultural Research Council, Survey of Bangladesh were approached. Some of the organizations responded positively and shared or were in the process of sharing geodata from their repository. However, most of the available geodata are not up-to-date and are of coarse spatial resolution. To generate up-to-date and moderate spatial resolution land use and cover maps, Landsat 8 multi-spectral satellite data of Rabi season was classified. The extensive ground survey was conducted to accumulate primary reference data for training of classification algorithms as well as validation of classification results. Follow Kanda lands were successfully identified for a certain instance from the initial classification of Landsat 8 satellite image. However, further analysis is necessary to depict the dynamic feature of the temporal availability of such fallow lands and suggest suitable agricultural crops in those lands.

INFORMATION ON BARI TECHNOLOGY AT THE FARMERS' DOORSTEP THROUGH MOBILE APPS

M. Saiful Islam, M. Faruque Ahmed, and A.F.M. Tariqul Islam

A mobile app named BARI application *কৃষি প্রযুক্তি ভান্ডার* was developed to make available crop production packages at the right time at farmer's doorstep in a cost-effective way. The entire contents of this app are in Bangla language. BARI apps *কৃষি প্রযুক্তি ভান্ডার* has five options namely (i) Crops, (ii) Other technology (iii) Query, (iv) Answer and (v) Communication. At present about 1000 technologies are hosted in the mobile

apps which include oilseed crops, pulse crops, tuber crops, wheat, maize, fruits, vegetables, flowers, spices crops, rice, jute, cotton and sugarcane, etc. Any farmer can ask/inquire about related technology through the query option. Answers to the queries are sent to farmers through SMS and e-mail. Answers are also stored in the feedback option which is open for public access. The farmer can directly contact related specialists through the communication option. Mobile apps *কৃষি প্রযুক্তি ভান্ডার* are regularly updated with maintenance and newly developed technologies are added as well. This app can be downloaded from the Google Play Store and Windows Store using Android and Windows phones respectively. This app can be used offline. The apps can also be shared with other Android-based mobile phones using SHAREit apps even without the internet.

Abstract 2016-2017

DEVELOPMENT OF AN ONLINE SYSTEM FOR DATA COLLECTION, DOCUMENTATION, AND MAPPING OF MUSTARD IN THE CHALAN BEEL AREA OF BANGLADESH

M. Azim Uddin, K. Saidur. Rahman, M. Mukhlesur Rahman, and Nur Mohammad

A study was conducted during 2014-17 to build union-level digital databases and maps of mustard growing areas in the Chalan Beel area, using primary and secondary data. The results of the study for the years 2014-15 and 2015-16 were presented. The result of the study for the year 2016-17 is presented in this report. Primary data were collected from mustard growing areas of three Upazilas namely Taras of Sirajganj district and Singra and Gurdaspur of Natore district. For mustard: union, Upazila, district, and country-level digitized maps were used in the study. Geographical Information System (GIS), Global Positioning System (GPS), and Management Information System (MIS) related Information Technology (IT) were used in this study. The area and production of mustard were 5415ha and 7488.42t respectively. Five (5) mustard varieties were cultivated in the study areas; among them, a maximum of 5 varieties were cultivated at Singra and a minimum of three varieties at Gurdaspur and Taras respectively. Out of 5 varieties of mustard 70.15% area was covered by Tori-7, 17.26% by BARI Sarisha-14, 7.74% by BARI Sarisha-15, and the rest by others. The average mustard yield of the study areas was 1.38 t/ha during 2016-17. It was found that cultivation of BARI mustard varieties is increasing in the Chalan Beel area. A website (www.asictbari.net) was developed for variety-wise area coverage data collection of mustard as well as for other crops. This website could be used on a smartphone.

GIS-BASED DIGITAL DATABASES AND MAPS OF OILSEED CROPS IN BANGLADESH

Dr. Md. Azim Uddin, K. Saidur Rahman, Md. Mukhlesur Rahman, and Nur Mohammad

A study was conducted during 2016-17 to build district-level digital databases, maps, indexing, and availability of major oilseed crops in Bangladesh. Both primary and secondary data were used in the study. In 1969-70, the area, production, and yield of oilseed crops were 348178 ha, 290600t, and 0.83t/ha but in 2015-16 those were 452065 ha, 1080662 t, and 2.39 t/ha respectively. After 47 years the area, production, and yield of oilseed crops have increased 1.30, 3.72, and 2.86 times respectively. In 1969-70, oilseeds availability was 11.55 gm/h/d but in 2015-16 it was 18.43 gm/h/d but the population increased more than double times (2.33) in this period. Digital databases of different parameters such as area, production, and yield of oilseed crops were obtained.

DEVELOPMENT AND IMPLEMENTATION OF BARI LABOUR MANAGEMENT SYSTEM

Kazi Saidur Rahman, Md. Mukhlesur Rahman and Nur Mohammad

Labour Management System can manage the labour of an organization effectively and efficiently. A labour management software was developed for monitoring and controlling labour at BARI. This Labour Management System software was developed using MySQL database which mainly focuses on basic operations in labour like adding new labor, updating new information, salary sheet, etc. This software is a

Windows-based application for 32-bit Windows operating systems, designed to help users maintain and organize labor. This software has been designed to be used for both beginners and advanced users.

COMPARISON OF SPECTRO-TEMPORAL SIGNATURE OF MAJOR AGRICULTURAL CROPS OF BANGLADESH

A.F.M Tariqul Islam, M. G. Mahboob, A.K.M. Saiful Islam, Sujit K Bala, G.M Tarekul Islam, M. Azim Uddin, and A. H. Sarwar Jahan

Spectral reflectance indices provide a useful tool for monitoring crop-growing status. This study was conducted during 2014-2017 to identify the features in distinguishing spectro-temporal signatures for classifying major crops. A series of spectral data were collected using a Spectroradiometer from different crop fields such as Potato, Wheat, and Lentil over the crop growing (Rabi) season at the BARI research field ancrop museum. Analysis was done to assess the spectral separability of various crop types under two scenarios; scenario 1 involved testing separability based on a number of days after planting and scenario 2 involved testing separability at specific dates across the growing season. The results indicate that although crop classification could be achieved at any point during the growing season, the optimal time for separation is in mid-January. The information derived from a hyperspectral radiometer seemed to possess the potential for monitoring the general growth status of a crop field.

ASSESSMENT AND MONITORING OF DROUGHT IN BANGLADESH USING REMOTE SENSING AND GIS TECHNIQUES

A.F.M Tariqul Islam, M. G. Mahboob, and K. Kumar Saha

Drought is a natural hazard that has caused several impacts, such as a decrease in land degradation, forest fires, and a decrease in agricultural crop production. Drought assessment using drought indices has been widely conducted for drought monitoring. Besides meteorological data-based indexes such as the Standardized Precipitation Index (SPI), Remote-sensing-based indices defined as an index that uses remote sensing data for mapping the drought conditions in particular areas or regions were used in this study. This research aims to determine remote-sensing-based drought indices, namely Temperature Condition Index (TCI), Vegetation Condition Index (VCI) Vegetation Health Index (VHI), and SPI for monitoring drought in Bangladesh from 2000-2016. LST and NDVI data were used to construct the indices.

MAPPING AND MONITORING OF MANGO ORCHARDS IN THE RAJSHAHI REGION USING SATELLITE REMOTE SENSING TECHNIQUES

A.F.M Tariqul Islam, M. G. Mahboob, K. Kumar Saha, and M. Sorof Uddin

The study was conducted to develop an effective technique to extract and monitor mango orchard areas from freely available satellite imagery. The current report presents the results initial study that was conducted in 2016-17 with internal funding of BARI as a test case in the Shibganj Upazila, one of the most important mango-producing Upazilas in Bangladesh. Landsat 8 OLI data was classified using an SVM data mining approach with the support of field-derived ground data and Google Earth imagery. Initial outputs show an encouraging result with an overall 96.4% classification accuracy of the land use maps. The results of the initial study could be improved by using an advanced remote sensing image analysis method for the entire greater Rajshahi districts of Bangladesh with support from a newly awarded grant under the innovation fund of 2016-17 3rd Round by the ICT Division.

INFORMATION OF BARI TECHNOLOGY AT THE FARMERS' DOORSTEP THROUGH MOBILE APPS

M. Saiful Islam, M. Faruque Ahmed, and A.F.M Tariqul Islam

A mobile app named BARI application কৃষি প্রযুক্তি ভান্ডার was developed to make available crop production packages at the right time at farmer's doorstep in a cost-effective way. The entire contents of this app are in Bangla language. BARI apps কৃষি প্রযুক্তি ভান্ডার has five options namely (i) Crops, (ii) Other technology, (iii) Query, (iv) Answer, and (v) Communication. At present about 1200 technologies are hosted in the mobile apps which include oilseed crops, pulse crops, tuber crops, wheat, maize, fruits, vegetables, flowers, spices crops, rice, jute, cotton, and sugarcane, etc. Any farmer can ask/inquire about related technology through the query option. Answers to the queries are sent to farmers through SMS and e-mail. Answers are also stored in the feedback (answer) option which is open for public access. The farmer can directly contact related specialists through a communication option. Mobile apps কৃষি প্রযুক্তি ভান্ডার is regularly updated with several version and newly developed technologies are added as well. These apps can be downloaded from the Google Play Store and Windows Store using Windows phones. These apps can be used offline.

DEVELOPMENT OF GEODATABASE FOR HAOR REGION OF SUSTAINABLE INTENSIFICATION OF AGRICULTURE

M.G. Mahboob, H. Muhammad Abdullah and A.F.M. Tariqul Islam

A study has been conducted for the development of the Geodatabase of the Haor Region located in the northeastern part of Bangladesh for sustainable intensification of Agriculture. Scopes of this research include accumulation of existing geodatabase of Haor region from different sources or organizations, adding values to them, conducting new analysis (viz. crop suitability mapping), and generating geospatial data from satellite imagery (viz. seasonal availability mapping of Kanda land). To procure relevant geodata from a wide range of public/autonomous organizations including the Department of Bangladesh Haor and Wetland Development, Center for Environmental and Geographic Information Services, Bangladesh Water Development Board, Institute of Water Modeling, Local Government Engineering Department, Soil Resources Development Institute, Bangladesh Agricultural Research Council, Survey of Bangladesh were approached. Some of the organizations responded positively and shared or were in the process of sharing geodata from their repository. However, most of the available geodata are not up-to-date and are of coarse spatial resolution. To generate up-to-date and moderate spatial resolution land use and cover maps, Landsat 8 multi-spectral satellite data of Rabi season was classified. The extensive ground survey was conducted to accumulate primary reference data for training of classification algorithms as well as validation of classification results. Follow Kanda lands were successfully identified for a certain instance from the initial classification of Landsat 8 satellite image. For sustainable intensification, a GIS-based Crop Suitability Assessment Model (CSAM) was used to assess the suitability of major crops (e.g. wheat, potato, maize, rice, etc.) in Tahirpur Upazila of Sunamgonj district. Land suitability (e.g. very suitable, suitable, moderately suitable, marginally suitable, and not suitable) for different crops was performed through using GIS technique. The model-derived results provided the suitability maps of major crops (such as rice, wheat, maize, pulses oilseeds, etc.) of Upazila and cropping patterns as well. Finally, this model provided the best cropping pattern for this Upazila as well. This GIS-based model is a user-friendly and flexible application software that will be useful for agricultural scientists, planners, and decision-makers.

Abstract 2017-2018

MAPPING AND MONITORING OF MANGO ORCHARDS IN RAJSHAHI REGION USING SATELLITE REMOTE SENSING TECHNIQUES

M. G. Mahboob, K. Kumar Saha, A.F.M Tariqul Islam, M. Sorof Uddin, and M. Aktar Maya

The study was conducted to develop an effective technique to extract and monitor mango orchard areas from freely available satellite imagery. The current report presents the results of an initial study that was

conducted in the first year (2016-17) with internal funding of BARI as a test case in the Shibganj Upazila, one of the most important mango-producing Upazila in Bangladesh. Landsat 8 OLI data was classified using an SVM data mining approach with the support of field-derived ground data and Google Earth imagery. Initial outputs show an encouraging result with an overall 96.4% classification accuracy of the land use maps. Then based on the first year's developed techniques, this year (2017-2018) we have been trying to cover the entire study area to map and monitor mango orchards with support from a newly awarded grant under the innovation fund of 2016-17) 3rd Round by ICT Division under Ministry of ICT and Telecommunication. With the 1st installment (released in July/2017) of the innovation fund, extensive ground truth data were collected from all four districts (namely, Rajshahi, Naogaon, and Natore some laboratory equipment were procured. Processing and classification of satellite images for greater Rajshahi are going on. With the 2nd installment (released in July/20187) of the fund, newly generated mango orchard maps will be shared with the stakeholders through a web interface (WebGIS/Mango Map/Geowiki) for validation, improvement, and further utilization.

CHARACTERIZING DRY SEASON'S AGRICULTURAL LAND USE IN NORTHWEST BANGLADESH: SPATIAL DYNAMICS AND WATER USE

M. G. Mahboob, A.F.M. Tariqul Islam, Kowshik K. Saha, K. Faisal Ibn Murad, Akbar Hossain,and J. Pena Arancibia

The northwest region of Bangladesh has experienced changes in cropping patterns, an increase in irrigated areas, and associated water demand. The large increase of irrigated dry season Boro rice has only been possible because of the concurrent large extraction of groundwater. Tracking historical changes in irrigated crops and their associated water use at the local scale (say), from individual farms to areas less than 1,000 km^2) can only be practically achieved using remote sensing technologies. The evolution of suitable crop classification methods and the estimation of water via remote sensing, alongside cloud-based geospatial processing and peta-bite repositories of remote sensing data has enabled effective mapping, monitoring, and management of irrigated agriculture. This has been achieved at the local scale to the regional (say,> 100,000 km2) and even at the global scale. The Bangladeshi Agricultural Institute (BARI) and CSIRO Australia are developing methods to map dry season crops and estimate their water use using the freely accessible Google Earth Engine (GEE) geospatial processing platform. The team has processed and estimated crop phenology and month evapotranspiration for the whole of the northwest region in Bangladesh at scales ranging from 30 m to 500 m horizontal resolution. The objective is to generate yearly crop maps and monthly associated water use at 30 m resolution for the 1991-2017 period using a combination of remote sensing data, machine learning algorithms, and field survey data. The outputs will be used by other project components either as inputs or for comparative purposes.

DEVELOPMENT AND IMPLEMENTATION OF THE BARI PAYROLL MANAGEMENT SYSTEM

K. Saidur Rahman, M. Saiful Islam, M.A. Monayem Miah and M. Kamrul Hasan

The Research titled "Development and implementation of BARI payroll management system" is a payroll management software for the automated Salary of employees at BARI. This Payroll Management System software was developed using MySQL database which mainly focuses on basic operations in employees like adding new employees, updating new information salary sheet, etc. this software is a Windows-based application for 32-bit windows operating systems, designed to help users maintain and organize employees. This software has been designed to be used for both beginners and advanced users.

STRENGTHEN AND DISSEMINATION OF AGRICULTURAL TECHNOLOGY INFORMATION AT THE FARMERS' DOORSTEP THROUGH BARI APPS

M. Saiful Islam, M. Mukhlesur Rahman and Nur Mohammad

A mobile app named BARI application কৃষি প্রযুক্তি ভান্ডার was developed to make available crop production packages at the right time at farmer's doorstep in a cost-effective way. The entire contents of this app are

in Bangla language. BARI apps কৃষি প্রযুক্তি ভান্ডার has five options namely (i) Crop, (ii) Other technology, (ii) Query, (iv) Answer, and (v) Communication. At present about 1400 technologies are hosted in the mobile apps which include oilseed crops, pulse crops, tuber crops, wheat, maize, fruits, vegetables, flowers, spices crops, rice, jute, cotton and sugarcane, etc. Any farmer can ask/inquire about related technology through the query option. Answers to the queries are sent to farmers through SMS and e-mail. Answers are also stored in the feedback (answer) option which is open for public access. The farmer can directly contact related specialists through a communication option. Mobile apps কৃষি প্রযুক্তি ভান্ডার is regularly updated with several versions (lasted 6.9) and newly developed technologies are added as well. This app can be downloaded from Google play store and Windows store using Android and Windows phones respectively. This app can be used offline. The apps can also be shared with other Android based mobile phones using SHAREit apps even without the internet. The apps have been disseminated in different locations.

Abstract 2018-2019

MAPPING AND MONITORING OF MANGO ORCHARDS IN RAJSHAHI REGION USING SATELLITE REMOTE SENSING TECHNIQUES

M.G. Mahboob, M.S. Uddin, M.A. Maya, A.F.M Tarikul Islam, and Kowshik K. Saha

The study was conducted to develop an effective technique to extract and monitor mango orchard areas from freely available satellite imagery. The goal of this study was to produce accurate Sentinel-2 derived mango orchard extent product for the Grater Rajshahi region. A pixel-based supervised classification approach with the CART (Classification and Regression Trees for classification) and SVM (Support Vector Machine) classifier on the Google Earth Engine (GEE) cloud computing platform was used to develop mango orchard extent product for the study area using Sentinel-2 10-m, time-series data for the 2015-2018 time-period. At first, a machine learning classifier CART was adopted to identify 7(seven) common classes (namely, trees, water, char land, built-up area, bare lands, and cropland). The area under tree coverage was then extracted for further classification into mango orchards and others using the SVM algorithm. An interactive prototype of a web-based geo-portal namely. GeoMango has been developed to semi-automatically map mango orchards in the greater Rajshahi region. Results showed that the system could successfully map the mango orchards in this region with high accuracy. Remote Sensing based results showed good agreement with the data reported by the Bangladesh Bureau of Statistics (BBS). Results of mango orchards area derived from the Geo Mango platform have been compared with the statistics reported by BBS. While both results show an increasing trend of mango orchard coverage with time, the RS-based technique overestimated (3.8-12.3%) the area compared to BBS. Output yielded from GEE has been rendered in the GeoMango portal for public sharing and accumulation of feedback for further improvement.

CHARACTERISING DRY SEASON'S AGRICULTURAL LANDUSE IN NORTHWEST BANGLADESH: SPATIAL DYNAMICS AND WATER USE

M.G. Mahboob, A.F.M. Tarikul Islam, Kowshik K. Saha, K.F.Ibn Murad, A. Hossain, and J.P. Arancibia

The northwest region of Bangladesh has experienced changes in cropping patterns, an increase in irrigated areas, and associated water demand. Tracking historical changes in irrigated crops and their associated water use at the local-scale can only be practically achieved using remote and sensing technologies. Bangladesh Agricultural Institute (BARI) and CSIRO have been developing methods to map dry season crops and estimate their water use from freely accessible satellite data supported by ground sampling, expert knowledge, machine learning image processing algorithms, and high-performance computing systems. The overall aim of the research is to make a diagnosis and analysis of data and methodologies for crop mapping and water use estimation via remote sensing. Crop phenology and monthly evapotranspiration for the whole of the northwest region in Bangladesh were processed and estimated at scales ranging from 30 m to 500 m horizontal resolution for the 1991-2016 period using a combination of remote sensing data, machine learning algorithms, and field survey data. A supervised classification algorithm using multi-temporal vegetation indices (Vis) such as EVI, GVMI, and NDWI to map crop types and their water use was

implemented. The idea is to capture the phenology and associate it with known/inferred crop types. Some 14 cropping patterns including major crops such as rice, wheat, maize, and potatoes of this region were estimated for this research. For water use estimation, vegetation Indices were processed from the spectral data and downloaded on a monthly time-step to estimate actual evapotranspiration (Eta) at 250 m spatial resolution through the CSIRO CMRSET (Csiro Modis ReScaled EvapoTranspiration) algorithm. Monthly Eta was estimated by scaling Priestley-Taylor potential evapotranspiration (ETa) via a crop factor obtained from EVI and GVMI. The crop type mapping for the dry season (Oct to Apr) for the years 2006-07 and 2015-16 and monthly water use estimation for 2000 to 2016 using remote sensing techniques showed satisfactory results for the north-west 16 districts cropping area.

ASSESSMENT OF CROPPING PATTERNS FOR SUSTAINABLE INTENSIFICATION IN DROUGHT-PRONE ECOSYSTEMS USING REMOTE SENSING AND GEOSPATIAL MODELING

M.G. Mahboob, A.F.M. Tariqul Islam, Kowshik. K. Saha and M.Moniruzzaman

Bangladesh Government has given high priority to sustaining groundwater use for irrigation. Hence, it is important to conduct agricultural land use and cropping patterns analysis and their implication to foster sustainable intensification (SI) strategies in the drought-prone regions of Bangladesh. Remote sensing and geospatial modeling can play a vital role in assessing cropping patterns and the availability of natural resources on the ground and allocating them judiciary for SI in agriculture. Geospatial modeling can help allocate an appropriate cropping-pattern based on the best judicial use of available natural resources. Hence, in order to facilitate sustainable cropping intensification in the problem agro-environments of Bangladesh, a current research project has been initiated to carry out in the drought-prone agro-ecosystems prevailing in the Barind Tract region of Bangladesh. Historical land use/cover change analysis at a time-lapse of every ten years since 2001 will be conducted for dry season cropping practices mostly by using Landsat data archives. Daily 250m NDVI and EVI composite available from MODIS sensors on-board Terra and Aqua satellites will be used to complement data requirements for crop monitoring. For recent crop types and cropping pattern mapping, data from Sentinel 1 and 2 satellites will be exploited. Very high-resolution satellite data and imagery collected by Unmanned aerial vehicles (UAV) will be used as a reference for training algorithms for the classification of satellite imagery. Crowd sourcing geo-visual web-interface will be developed to collect ground reference data and validate map outputs with multi-stakeholder involvement. Post-classification land use-cover change analysis will be performed to depict winter seasons' land use/cover changes in the study area. Historical land use/cover maps developed for every ten (10) years intervals will be used to find the relationship between irrigation water availability from surface water sources in the High Barind area. Surface water maps will be generated as a part of land use analysis. Implication of current dry-season agricultural practices on water and other natural resources will be quantified within the GIS. Available major alternative technologies (crop types, varieties, management options, etc.) will be listed and their selection/suitability criteria to comprise a suitable cropping pattern and fit in any particular locality will be scored. Finally, an integrated geospatial model will be developed for decision support to target the expansion of specific cropping patterns suitable for SI at a particular location.

DETERMINANTS OF HOUSEHOLD FOOD SECURITY IN RURAL BANGLADESH: AN EMPIRICAL ANALYSIS OF FARM-LEVEL DATA

K. Saidur Rahman and M. Kamrul Hasan

The study endeavors to estimate the food security status and identify the determinants of food security among households at Hakimpur Upazila of Dinajpur district, Bangladesh. It was found that the households of Hakimpur Upazila in Dinajpur district were food insecure during the period of the survey. The number of dependents, income of household head, age of household head, and level of education were found to significantly influence household head food security in the study area positively. It is recommended that social security measures ensure that the benefits of public efforts to improve food security and nutrition are universal. Human rights-based practices are preferable.

EFFECTS OF CLIMATIC FACTORS ON THE YIELD OF EXOTIC POTATO GERMPLASM

Istiak Ahmed, Suman Biswas and M. Kamrul Hasan

Some new potato varieties (viz. Alberta, AlRusset, Arizona, Dunstar, Fontane, HZD 1249, Innovator, Ottawa, Primavera, Sayada, and Tiamo) were introduced one year back in the country by private sectors for evaluation and selection as well as to release for mass cultivation. This study was conducted at the BARI headquarters and five other potato growing stations (Jamalpur, Jashore, Munshigonj, Bogura, and Panchagarh) of BARI during the Rabi 2018-19 seasons to see the yield potentiality as a commercial variety in Bangladesh's climatic condition. A simple linear regression model was used to analyze the effect of the climatic factors of maximum temperature, minimum temperature, humidity, rainfall, and sunshine on the yield of the varieties or lines. The average maximum temperature has a positive effect on the yield of all the varieties or lines. Other climate factors like average minimum temperature, average humidity, and average sunshine hour have a positive effect on the yield of most of the varieties or lines. Al. Russet and Primavera showed a significant positive effect for the average maximum temperature. However, the other variables have no significant effect. Although the intercept of most of the varieties or lines for the Rainfall variable was significant.

SCIENTISTS' PERCEPTIONS OF THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN AGRICULTURE

Suman Biswas, Istiak Ahmed and M. Saiful Islam

The study was conducted to appraise the perception of agricultural scientists on the role of Information and Communication Technologies (ICTs) in agriculture. Data were solicited from 142 selected agricultural scientists from two research institutions, e.g. Bangladesh Agriculture Research Institute (BARI) and Bangladesh Rice Research Institute (BRRI) through a proportionate random sampling technique. Along with data on the personal characteristics of scientists and the types of ICTs they used, the collection of perception-related data was performed using a Likert-type scale on a 5-point continuum. Factor analysis with polychoric correlation matrix was applied to obtain factor score and this score was used (as an index of all perception-related variables) for further analysis. Multiple linear regression model applied for measuring the effect of personal variables on the perception level of scientists. Scientists expressed their positive perception of using ICT tools for agricultural research activities and its dissemination. Higher education level, foreign degree/diploma/training of more than 6 months, and training on ICTs had a positive significant influence on perception, while scientists' designation, age, and working experience had a negative influence. Hence, scientists may be highly encouraged for higher education especially abroad, and capacity building on ICTs.

DEVELOPMENT AND IMPLEMENTATION OF BARI PERSONNEL MANAGEMENT, PAYROLL, LOAN MANAGEMENT AND APA REPORTING SYSTEM

K. Saidur Rahman and M. Kamrul Hasan

The development and initiatives titled "Development and implementation of BARI personnel management, payroll, loan management and annual performance agreement (APA) reporting system" are various management software for automated personnel management, preparation of monthly salary of the employee, loan management, and APA reporting of the institute. These personnel, loan, payroll, and APA software were developed using MySQL database which mainly focuses on basic operations in employees like adding new employees, updating new information, salary sheets, etc. This software is a Windows-based application for 32-bit Windows operating systems, designed to help users maintain and organize employees. This software has been designed to be used for both beginners and advanced users.

Abstract 2019-2020

NON-DESTRUCTIVE DETERMINATION OF MONGO MATURITY USING HYPERSPECTRAL REMOTE SENSING TECHNIQUES

Suman Biswas, T. A. Aktar Nasrin, M. Sorof Uddin, A.F.M. Tariqul Islam, and M.G. Mahboob

The non-destructive on-plant assessment of fruit ripeness has received increasing interest as it provides several advantages compared with traditional destructive methods. Hyperspectral remote sensing technology is a promising field of research for nondestructive quality assessment. This work aims to evaluate the use of the hyperspectral technique for detecting the maturity of mango (BARI Aam-4) based on its major Physico-chemical parameters. Diffuse reflectance spectra in the region of 400-1075 nm were used to develop calibration models for firmness, total soluble solids (TSS), pH, Sugar content, ripening index, and other Physico-chemical parameters. Before estimating these calibration models, spectral data were pre-treated through different transformation techniques to improve the predictability of the models as these transformations can reduce the problems associated with noise, light scattering, and external effects in raw spectrals. One linear method included partial least squares regression (PLSR) and one machine learning method included least-squares support vector machine (LS-SVM) will be investigated after obtaining the data from the destructive analysis as the data from the destructive analysis was not completely prepared at the time of writing this report. A robust technique will be developed for predicting mango maturity conditions in this study.

DETERMINATION OF HOUSEHOLD FOOD SECURITY IN RURAL BANGLADESH: AN EMPIRICAL ANALYSIS OF FARM-LEVEL DATA

K. Saidur Rahman1, M. Kamrul Hasan and M. Saiful Islam

The study endeavors to estimate the food security status and identify the determinants of food security among households located at Hakimpur Upazila of Dinajpur district, Aditmari Upazila of Lalmonirhat district, Saghata Upazila of Gaibandha district, and Domer Upazila of Nilphamari district in Bangladesh. It was found that the households of Hakimpur Upazila in Dinajpur, Aditmari Upazila in Lalmonirhat district, Saghata Upazila in Gaibandha district, and Domer Upazila in Nilphamari district were food insecure during the period of the survey. The number of dependents, income of household head, age of household head, and level of education were found to significantly influence household head food security in the study area positively. It is recommended that social security measures must ensure that the benefits of public effects to improve food security and nutrition are universal. Human rights-based practices are preferable.

EFFECTS OF CLIMATIC EXTREME INDICATOR ON POTATO YIELD OF BANGLADESH

Istiak Ahmed, Asim Ishtiaque, and M. Saiful Islam

Extreme climate events have a great impact on the agriculture-based economy like Bangladesh. This study is conducted mainly to gain insight into the overall condition of an extreme air temperature of a suitable potato growing area in Bangladesh and the effects of some climate extreme indices on potato yield. The result of the trend analysis of extreme climate indices indicated that the monthly maximum value and daily minimum temperature have continued to increase. While the monthly minimum value of both the minimum and the maximum temperature has continued to decrease. It is not possible to identify any specific trend for both monthly maximum value of daily maximum temperature. And for the precipitation variable, monthly maximum 1-day precipitation also does not follow any particular pattern. Investigating the effects of these extreme indices, it is found that the monthly maximum of daily maximum temperature and a monthly maximum of daily minimum temperature have a significant positive impact on potato yield. And the other three extreme indicators have negative effects. These positive factors are much more significant in potato yield than those negative factors. Positive factors follow the positive trend and negative factors follow the negative trend or do not follow any trend at all. Based on this study, it can be said that the yield of potatoes

is increasing not only due to high-yielding variety and soil conditions but also because climate extreme has some positive impact on the increasing trend of potato yield.

DEVELOPMENT OF AN INTERFACE OR A PACKAGE FOR GENOTYPE, X ENVIRONMENT (GE) INTERACTION ANALYSIS USING R

Istiak Ahmed, Zobaer Akond, M. Shalim Uddin and M. Saiful Islam

This study was undertaken to develop a user-friendly interface using R software or a package for R which gives an output for genotype stability and location value using univariate and multivariate models. At that time there was some paid software that could do these analyses. Also, some complex R packages were available but they lacked some features. So, it was needed to develop a simple package and later, a user-friendly interface to do this analysis. But in February 2020. Tiago Olivoto and Alessandro Dal' Col Lucio, Department of Crop Science, Federal University of Santa Maria, Santo Maria, Rio Grande do Sul, Brazil have introduced an R package called 'metan' on multi-environment trial analysis. Using this package one can analyze what this proposed study is intended to do. It covers not only this GE interaction analysis but also the whole stability analysis as well. Using this package one can do:

GENOME-WIDE IDENTIFICATION, CHARACTERIZATION, AND DIVERSITY ANALYSIS OF RNA SILENCING MACHINERY GENES IN BRASSICA SPECIES AND THEIR FUNCTIONAL ANALYSIS IN RESPONSE TO ALTERNARIA BLIGHT DISEASE AND SALT STRESS

Zobaer Akond, Hafizur Rahaman, M. Hasan Tipu, A.B.M. Khaldun Sohel,
S. Hasna Habib, and N. Haque Mollah

Dicer-Like (DCL), Argonaute (AGO), and RNA-dependent RNA polymerase (RDR) gene families are known as RNA silencing machinery genes or RNAi genes. They have essential roles at both the posttranscriptional and chromatin modification levels. These genes generally control the expression of genes against different biotic and abiotic stresses during plant growth and development. A whole round of gene silencing takes place by the contribution of the members of these three gene families. However, these gene families have not been yet rigorously studied in the genome of the economically important oilseed crop Brassica rapa species. In this work, the bioinformatics analysis-based genome-wide identification, characterization, and diversification of the RNAi genes revealed 4 BrDCL, 13 BrAGO, and 6 BrRDR genes from the B. rapa genome against the RNAi genes of Arabidopsis thaliana using BLAST. Phylogenetic analysis with Arabidopsis RNAi genes showed that BrDCL, BrAGO, and BrRDR proteins clustered into four, nine, and five groups respectively. Domain composition analysis revealed that the BrDCL, BrAGO, and BrRDR protein members of these three groups have conserved identical domain characteristics within each group of their Arabidopsis counterpart. Cis-regulatory components in the promoter regions of the BrDCL, BrAGO, and BrRDR protein members are predicted to act as regulatory components by binding particular transcription factors for performing various biological and molecular actions for the regulation of specific gene expression by confronting different environmental factors. Expressed sequence tag (EST) analysis showed that the maximum 11 B. rapa RNAi out of 23 genes are predicted to express in flower/floral bud followed by leaf, root silique, and ovule but in B. rapa genome the maximum proteins are predicted to express in seed/seed coat followed by flower/flower bud. Overall results would therefore help oilseed molecular breeders and biotechnologists for more in-depth biological and molecular investigations about the important functionalities of B. rapa RNAi genes for oilseed crop improvement and disease control of the BARI developed different varieties.

CHARACTERISING DRY SEASON'S AGRICULTURAL LANDUSE IN NORTHWEST BANGLADESH: SPATIAL DYNAMICS AND WATER USE

M. G. Mahboob, A.F.M. Tariqul Islam, Kowshik K. Saha, K. F. Ibn Murad, Akbar Hossain, and J. Penna Arancibia

The northern region of Bangladesh has experienced changes in cropping patterns, an increase in irrigated areas and associated water demand. Tracking historical changes in irrigated crops and their associated water use at the local scale can only be practically achieved using remote sensing technologies. Bangladesh Agricultural Research Institute (BARI) and Commonwealth Scientific and Industrial Research Organization (CSIRO) have developed methods to map dry season crops including wet season Aman rice and estimate their water use from freely accessible satellite data supported by ground sampling, expert knowledge, machine learning image processing algorithms, and high-performance computing system. In this report, the implementation/ development and evaluation of two models for land cover and cropping system analysis underpinned by remote sensing data are described. The models provide information on crop types and water use, as well as other land covers relevant to environmental monitoring in northwest Bangladesh. This is instrumental to assessing changes in water use and crop area extent that may lead to groundwater level declines as a result of a combination of factors including rainfall declines and over-use, particularly in the Barind tract of northwest Bangladesh. Both models developed her relying on freely available remote sensing reflectance data archives via Google Earth Engine (GEE). Much of the pre-processing was performed in the GEE, thus facilitating the implementation of the models in this large geographical domain. The data underpinning both models were the Enhanced Vegetation Index (EVI) and the Global Vegetation Moisture Index (GVMI). First, a monthly actual evapotranspiration (ET_a) model based on the CMRSET m (CSIRO MODIS ReScaled EvapoTranspiration) model, driven by MODIS reflectance data (500^m), was implemented from 2000 to 2016. CMRSET only requires multi-temporal EVI and GVMI to derive a crop factor and meteorological data for its implementation. The model provides the first long-term (> 15 years) consistent ET_a time series for the entire northwest Bangladesh region, at spatial (500_m) and temporal resolutions (monthly) that are useful to assess ET_a changes. The ET_a estimates were evaluated against a crop factor model driven by areal crop data aggregated at the district scale (second administrative tier). Both models were similar in terms of seasonality and magnitude, and the largest difference between models in any month assessed was around 5%. The model's estimates being similar while having different rationales provide a level of confidence for them to be used as inputs to other hydrological models. Second, a machine learning supervised Random Forest (RF) model, driven by Landsat reflectance data (30_m) was developed. The RF model can predict the two main rice types in northwest Bangladesh, wet season Aman rice and dry season Boro rice and other land covers of interest using both EVI and GVMI from 1989 to 2016. The model relied heavily on local expert knowledge and field data to understand the phonological stages of the main rice types. The process followed a semi-supervised approach that used unsupervised K-means clustering to obtain a representative training dataset to train a supervised RF learner. The training data captured the geographical and temporal characteristics of rice types and other land cover dynamics. Using covariates other than the monthly EVI and GVMI, the RF evaluation rendered accuracies generally >90%. The RF Boro and Aman maps were compared against areal statistics from agricultural surveys and the error was generally 20%. These maps are the first maps to capture the large area increase in irrigated Boro rice in the northwest since the 1980s. The spatial ET_a estimates revealed that there are parts of the landscape where significant ETa increases (>20 mm/yr per year) during the assessment period, coincide with areas where large groundwater declines have occurred in the last few decades. This is noticeable in the Barind tract decreases (>5mm/yr per year), and this was noticeable in the Chalan wetland (or Beel), where there are reports of a decreased wetland area. On the other hand, the maps showed that a large area expansion of Boro rice occurred within districts overlying the Barind tract like Chapai Nawabganj, Naogaon, Natore, and Rajshahi, districts where the groundwater level is significantly decreasing. The use of the historical data for Boro and Aman, and historical standing water data, alongside other datasets such as groundwater levels, rainfall, and actual ET_a can be used to underpin more detailed statistical, groundwater, and landscape modeling to assess the role of these in declining groundwater levels in northwest Bangladesh.

ASSESSMENT OF CROPPING PATTERNS FOR SUSTAINABLE INTENSIFICATION IN DROUGHT-PRONE ECOSYSTEMS USING REMOTE SENSING AND GEOSPATIAL MODELING

M. G. Mahboob, A.F.M. Tariqul Islam, Kowshik K. Saha and Moniruzzaman

Bangladesh Government has given high priority to sustaining groundwater use for irrigation. Hence, it is important to conduct agricultural land use and cropping patterns analysis and their implication to foster sustainable intensification (SI) strategies in the drought-prone regions of Bangladesh. Remote sensing and geospatial modeling can play a vital role in assessing cropping patterns and the availability of natural resources on the ground and allocating them judiciary for SI in agriculture. Hence, in order to facilitate sustainable cropping intensification in the problem agro-environments of Bangladesh, the current research project has been initiated to carry out in the drought-prone agro-ecosystems prevailing in the Barind Tract region of Bangladesh. During the reporting period (July 2020-June 2021), necessary ground data were collected from the study area to train satellite images for crop-type mapping. A crop inventory for the entire Barind Tract region was prepared according to the methodological framework. Six major crop types, predominant in the area, were chosen for delineation from satellite image classification namely: maize, lentil, mustard, potato, Boro rice, and wheat. A total of 28 cloud-free Sentinel 2A (MSS, level-IC) satellite imagery (10_m spatial 10 days and temporal resolution) were downloaded (https://scihub.copernicus.eu/) of the year 2019-2020 for the dry season (October-March). An algorithm was developed to delineate dry season crops using Sentinel-2 imageries in a pilot area (Godagari upazila). The maximum likelihood classification (MLC) technique was employed to classify the NDVI composite image and final classified image including six crops. The results show that Boro rice and lentil occupied most of the area with 8,543.12 ha (17.35% of the total Upazila) and 8381.55 ha (3.52%) 798.76 (1.62%) and 658.58 ha (1.34%), respectively during 2019-2020 Rabi season. Other areas (water bodies, other crops, orchards, settlements, etc.) shared the maximum area coverage with 27.052.42 ha (54.92%). The overall accuracy of the classified map was found 75% when compared with the ground truth data, which indicated satisfactory results. However, during the reporting period of July 2020-June 2021, an enormous fieldwork was conducted to collect reference data for the same crops to improve the crop type mapping. Besides, a set of agro-environmental resources geo-data vases from image analysis were developed such as the digital elevation model, slope map, aspect map, soil map, topsoil texture, soil reaction, water body, soil consistency and land type of the Godagari Upazila to be used as input data in further analysis towards achieving final objective location-specific cropping pattern modeling in GIS environment. Moreover, a digitized land use land cover map of the study area is under development. In spite of the emergence of the COVID-19 pandemic, the objectives of this research project are expected to be achieved within the project period.

SATELLITES AND ICT BASED LOCATION AND CROP-SPECIFIC IRRIGATION ADVISORY SYSTEM FOR GROWING MORE WITH LESS WATER

M. G. Mahboob , A.F.M. Tariqul Islam, K. F. Ibn Murad,.S. Asim Ishtiaque, M. Zannatul Ferdaus, M. Shakhawat Hossain, J. Al Mahmud, and Faisal Hossain

Creative approaches can be devised to ensure optimal use of irrigation water in crop production through integrated satellite monitoring and ICT use for monitoring and forecasting of croplands, which will help in increasing crop production by applying less irrigation water. Such technology exists in the developed world. However, it is not directly usable in the context of our country. The University of Washington in the United States has successfully tested such an irrigation consultancy system called Provision for Advisory on Necessary Irrigation (PANI) in India and other Asian countries, which can be applied to Bangladesh with necessary modifications. The system analyzes the demand for crop water and the amount of natural water supply (e.g. rainfall) using the existing satellite-based climate forecasting and forecasting model to determine the amount of irrigation water available in the land and provide irrigation advice to the farmers mobile. Using this integrated pilot project using integrated sensors, remote sensing (space and ground), and ICT technology, a farmer can use this information on his mobile device to know when to irrigate and to produce more crops using less irrigation water by providing moderate irrigation to the crop-land

Abstract 2020-2021

ASSESSMENT OF WATER RECESSION DYNAMICS IN SELECTED HAORS FOR DRY SEASON CROPPING INTENSIFICATION USING SPATIAL DATA MODELING

A.F.M. Tariqul Islam, M. G. Mahboob, and Jatish Biswas

Monitoring Spatiotemporal dynamics of hydrology including land use land cover (LULC) changes and knowing the availability of agricultural land in limited time windows in a region are important for local food security and livelihood improvement. In this context, the use of geospatial modeling can play an important role in monitoring seasonal hydrology, and LULC changes as well as locating and planning the available land for agricultural intensification. This study aims to monitor the long-term dynamics of seasonal water recession and land use patterns, to assess the impact of extreme flooding on dry-season crop production, and to outline current fallow lands along with its utilization strategies using geospatial modeling for dry-season cropping intensification using satellite images. The preliminary results show that most of the haor area goes underwater from May to October and becomes available again from December January to April. Results also show that significant land in the Sunamganj district was retained fallow during the 2019 Rabi season. Monthly flooding and recession dynamics during 2000-2021 to know the availability of agricultural land along with its utilization strategies would be analyzed for the dry season cropping intensification during the next two years' research period.

SPATIO-TEMPORAL ASSESSMENT OF CULTIVABLE LAND IN SELECTED CHAR LANDS OF NORTHERN BANGLADESH

A.F.M. Tariqul Islam, and M. G. Mahboob

The Ganges-Brahmaputra is characterized by its highly braided channel pattern, which has given rise to the number of river islands (chars) of various sizes and shapes. These chars have the potential for agriculture expansion in the non-flooding Rabi seasons, as the soil is fertile and productive. However, the dynamics of these Char lands are important to understand properly in this case for better utilization in crop production. The study aims to understand the spatiotemporal dynamics of the char lands in northern Bangladesh for agriculture crop expansion using the decadal multispectral satellite data. During the first year of study, MODIS satellite data have been downloaded and analyzed to assess the decadal extent (2000-2020) of river and char-lands along the Jamuna-Padma Rivers. Results show that the patterns of these meandering river systems are similar over the decades whereas the water and char lands are very dynamic. The classified NDVI images of these river systems show that there are significant lands, that are undefined characters, i.e. they could have dry sand, moist sand, wetland, or fallow lands. These fallow lands would be classified along with utilization strategies during the next two years' research period.

NON-DESTRUCTIVE DETERMINATION OF MANGO MATURITY USING HYPERSPECTRAL SPECTROSCOPY

Suman Biswas, M. Sorof Uddin, T. A. Aktar Nasrin and M. G. Mahboob

The non-destructive on-plant assessment of fruit ripeness has received increasing interest as it provides several advantages compared with traditional destructive methods. Hyperspectral remote sensing technology is a promising field of research for nondestructive quality assessment. The aim of this work was to evaluate the use of the hyper-spectral technique for detecting the maturity of mango (BARI Am 4) based on its major physic-chemical parameters. Diffuse reflectance spectra in the region of 400-1075 nm were used to develop calibration models for firmness, total soluble solids, treatable acidity, sugar content, and multifactor ripening index. Prior to estimating these calibration models, spectral data were pre-treated through different transformation techniques to improve the predictability of the models as this transformation can reduce the problems associated with noise, light scattering, and external effects in raw spectra. One of the best linear methods termed partial least squares regression was employed to detect the effective wavelength for determining the quality attributes of mangoes. Findings revealed that relationships

between wavelengths and quality parameters could be assessed by using SNV pretreated spectra as variables, which yielded more than 80% accuracy. The effective number of wavelengths was selected for accurately predicting the quality parameters as well as a multifactorial ripening index, which concludes that wavelengths could be used as a rapid, non-destructive method for measuring the mango maturity index.

EARLY DETECTION OF LEAF PHYSIOLOGICAL AND CHEMICAL TRAITS TO SALT STRESS IN WHEAT USING HYPERSPECTRAL REFLECTANCE SPECTROSCOPY

Suman Biswas, I. Mosaddek Ahmad, A.F.M. Tariqul Islam, and M. G. Mahboob

Salt stress is the most widespread abiotic stress that limits plant growth, physiology, and productivity mainly affecting the ionic balance and plant water relations. The maintenance of agricultural productivity implies better agricultural practices and a careful selection of resistant crops. Proper monitoring of the physiological status of plants can lead to better knowledge of plant nutritional requirements. Visible and near-infrared (VNIR) radiometry provides a non-destructive and quantitative method to monitor vegetation status by quantifying chemical properties using spectroscopic techniques. In this study, the capability of (VNIR) spectral measurements to detect salinity effects on wheat plants was tested. Wheat plants were cultivated at 60L reservoir containers containing 50L basal nutrient solution (mgl-1). Spectral data of leaves were transformed into vegetation indices indicative of the physiological status of the plants. The results showed differences (decreasing tendency) for PH, K, KNaR SDW, RDW, SFW, and RFW ($p<0.001$) due to salinity suggesting different digress of salt stress on the plants. On the contrary, the Na leaf content showed a significant increasing trend with salinity. The capabilities of VNR radiometry to assess the influence of soil salinity on wheat physiology using a non-destructive method were demonstrated. A normalized difference vegetation index [(R_{800}-R_{680})/root (R_{800}+R_{680})], and the salinity and water stress index [(R_{803}-R_{681})/root (R_{905}-R_{972})] showed significant relationships ($p<0.001$) with the salinity. Therefore, this method could be used for in-situ early detection of salinity stress effects.

DETERMINANTS OF HOUSEHOLD FOOD SECURITY IN RURAL BANGLADESH: AN EMPIRICAL ANALYSIS OF FARM-LEVEL DATA

K. Saidur Rahman, Istiak Ahmed, Suman Biswas, M. Saiful Islam, and M. Kamrul Hasan

The world faces a tremendous challenge in providing food security to the increasing population. It is important therefore to increase food production in order to meet the growing demand for food emanating from population growth. Although there are significant achievements in food grain production, food insecurity both at the national and household level remains a matter of major concern in Bangladesh. The study endeavors to estimate the food security status and identify the determinants of food security among households in Hakimpur Upazila in Dinajpur, Aditmari Upazila in Lalmonirhat, Saghata Upazila in Gaibandha, Domer Upazila in Nilphamari and Sador Upazila in Bandarban district of Bangladesh. Primary data were collected from the field level through a questionnaire survey from each Upazila and secondary data were collected from various published sources e.g. BBS, FAO Stat, research reports, etc. Data were analyzed by applying descriptive statistics and logistic regression analysis. Results show that households of Hakimpur Upazila. Aditmari Upazila, Saghata Upazila, Domer Upazila, Ramgarh Upazila, and Bangdar Sadar Upazila were food insecure during the period of the survey. The number of dependents the income of the household head, the age of the household head, and the level of education were found to significantly influence household head food security in the study area positively. It is recommended that social security measures ensure that the benefits of public efforts to improve food security and nutrition are universal. Human rights-based practices are preferable.

DATA SCIENCE AND ANALYTIC TECHNOLOGY IN AGRICULTURAL PRODUCTION IN BANGLADESH

K. Saidur Rahman, Istiak Ahmed, Suman Biswas and M. Saiful Islam

Data science can provide actionable insights bespoke to farmer's land and ownership patterns on what to plant when to plant, and what farm practices to deploy. Making well-informed decisions could save costs and enhance a farmer's profitability and income. Currently, the demand by consumption of agricultural products could be predicted quantitatively, however, the variation of harvest and production by the change of farm's cultivated area, weather change, disease and insect damage, etc. could not be predicted, so the supply and demand of agricultural problem have not been controlled properly. This study presents an analysis of the agricultural production system for stabilizing the supply and demand of agricultural products. The results show that the Data analytic-based agricultural production system through correlation analysis between the crop statistical information and agricultural environment information has enhanced the ability of farmers, researchers, and government officials to analyze current conditions and predict future cereals and grains. This correlation appears to be positive implying that if we know that one crop had a pumper production, the correlated crop would have a bumper production as well. There also appears to be a moderate dependence on rainfall for food production. Additionally, agricultural product quality can be improved because farmers observe the whole cycle from seeding to selling using this Data science & analytics-based decision support system.

GENOME-WIDE ANALYSIS OF DCL, AGO, AND RDR GENE FAMILIES IN BRASSICA SPECIES USING INTEGRATED BIOINFORMATIC APPROACHES

Zobaer akond, Hafizur Rahaman, M. Hasan Tipu, A. Khaldun Sohel,
S. Hasna Habib, and N. Haque Mollah

RNA silencing is a conserved mechanism in eukaryotic organisms to regulate gene expression. It is controlled by the dicer-Like (DCL), argonaute (AGO), and RNA-dependent RNA polymerase (RDR) gene families' also known as RNAi-related genes. These genes regulate gene expression against different biotic and abiotic stressors during plant growth and development. They also play roles at posttranscriptional and chromatin modification levels. A complete cycle of this technique occurs by the contribution of the members of these three gene families. However, these gene families have not been yet rigorously studied in the genome of the economically important oilseed crop Brassica rapa. Genome-wide identification, characterization, and diversity analysis revealed 4 BrDCLl, 13 BrAGO, and 6 BrRDR genes from the B. rapa genome against the RNAi-related genes of Arabidopsis thaliana using BLASTp search. Phylogenetic analysis with Arabidopsis RNAi-related genes showed that RrDCL, BrAGO, and BrRDR proteins clustered into four, eight, and five groups respectively. Domain composition analysis showed that the proteins conserved identical domain characteristics of their Arabidopsis homologs. The exon-intron structure of the genes was almost similar to their Arabidopsis counterparts. CREs showed that they are mostly hormone, light, and stress-responsive. In silico expression analysis showed that the maximum of 11 genes out of 23 was predicted to express in flowers/floral buds followed by leaf, root silique, and ovule but in the B. napus genome the maximum protein was predicted to express in seed/seed coat followed by flower/flower buds. Overall results would therefore help oilseed molecular breeders and biotechnologists for more in-depth biological and molecular investigations about the important functionalities of B. rapa RNAi-related genes for oilseed crop improvement of BARI-developed different varieties.

Abstract 2021-2022

ASSESSMENT OF CROPPING PATTERNS FOR SUSTAINABLE INTENSIFICATION IN DROUGHT-PRONE ECOSYSTEMS USING REMOTE SENSING AND GEOSPATIAL MODELING

Suman Biswas, M. G. Mahboob, |A.F.M. Tariqul Islam, Shakhawat Hossain,
M. Hasnain and M. Hasan Rashid

Bangladesh Government has given high priority to sustaining groundwater use for irrigation. Hence, it is important to conduct agricultural land use and cropping patterns analysis and their implication to foster sustainable intensification (SI) strategies in the drought-prone regions of Bangladesh. Remote sensing and geospatial (SI) strategies modeling can play a vital role in assessing cropping patterns and the availability of natural resources on the ground and allocating them judiciary for SI in agriculture. Geospatial modeling can allocate an appropriate cropping pattern based on the best judicial use of available natural resources. Hence to facilitate sustainable cropping intensification in the agro-environments of Bangladesh, the current research project has been initiated to carry out in the drought-prone agro-ecosystems prevailing in the Barind tract region of Bangladesh During the reporting period (2021-2022), an extensive survey (6th) was conducted for collecting necessary ground data form the study area. These reference data were pre-processed in the GIS domain and split into 70:30 ratios to train and validate the algorithms for crop type mapping. A crop inventory for the entire Barind tract region was prepared in previous years according to the methodological framework. Six major crop types, predominant in the area, were chosen for delineation from satellite image classification namely: maize, lentil, mustard, potato, Boro rice, and whet. A total of 45 sentinel-2A images were available in Google Earth Engine during the dry months (Oct-Mar) of the 2020-21 cropping season. Although the cloud was masked out, these images were filtered to ensure the cloud percent was less than or equal to 20% After resampling all the bands into 10 meters, visible, NIR Red edge, and short-wave IR bands were used to classify crop types along with two vegetation indices NDVI and EVI. Seasonal composite (Oct-Marc) of these bands and indices were derived in GEE based on median statistics. Three machine learning algorithms (Random forest, CART, and Support Vector Machine) along with different band combinations were experimented with during this reporting period to improve the classification algorithm. Among several experimental trials, Random Forest with scheme 5 band combinations was found to be the best model to classify the crop type of the study area. The classification result showed that rice occupied a maximum area coverage of 22253.46 ha (45.17%) followed by others (14107.45 ha), potato (4588.745 ha), wheat (3326.96 ha), lentil (2535.75 ha), maize (42296.02 ha) and mustard (159.63 ha) accordingly. Concerning the reference data. The overall accuracy and kappa coefficient of the classified map were found around 86% and 0.81 indicating satisfactory results. The FI score for all crop types was also satisfactory in RF and scheme 5. Area coverage of the classified crop type map was also compared to the DAE area dataset for the 2020-21 cropping season. The area covered by rice and wheat was relatively better than other classified crop fields. Besides, a set of agro-environment resources geo-database for image analysis were developed such as the digital elevation model, slope map, soil map, texture, soil reaction, water body, soil consistency and land type of the Godagari Upazila to be used as input data in further analysis towards achieving final objective location-specific cropping pattern modeling in GIS environment. Moreover, the digitized land use land cover map of the study area is under development.

GENOME-WIDE ANALYSIS OF DCL, AGO, AND RDR GENE FAMILIES IN BRASSICA SPECIES USING INTEGRATED BIOINFORMATICS APPROACHES

Zobayer Akond, Hafizur Rahman, S. Hasna Habib, and M. N. Haque Mollah

Dicer-like (DCL), Argonaute (AGO), and RNA-dependent RAN polymerase (RDR) are known as three major gene families that act as the critical components of RNA interference or gene silencing mechanisms through the non-coding small RAN molecules (miRNA and siRNA) to regulate the expression of protein-coding genes in eukaryotic organisms. These genes regulate gene expression against different biotic and abiotic stressors during plant growth and development. However, most of their characteristics including evolutionary relationship, domain structures, chromosomal location, functional pathways, subcellular

location, 3D protein structures, and non-synonymous and synonymous mutation ratio (Ka/Ks) were not rigorously studied. Therefore, the present study was carried out for genome-wide identification, characterization, and functional analyses of all the members of DCL, AGO, and RDR gene families and their regulatory components in Brassica rapa (B. rapa) using integrated bioinformatics approaches. The study identified 4 BrDCL, 13 BrAGA, and 6 BrRDR genes as RNA interference (RNAi) genes from the B. rapa genome. The phylogenetic analysis of predicted RNAi proteins with the of Arabidopsis showed that the predicted proteins BrDCL, BrAGO, and BrRDR are clustered into four, eight, and five subgroups, respectively. Domain, 3D protein structure analyses showed that these proteins conserve identical characteristics within groups and maintain differences between groups. Non-synonymous/ synonymous mutation ratio (Ka/Ks). It is suggested that these protein sequences conserve some purifying function Go analysis implied that several potential biological processes. Molecular function and pathways are linked to the RNAi mechanisms. Overall results would therefore provide an excellent basis for in-depth molecular investigation of these genes and their regulatory elements for rapeseed-mustard crop improvement against different stressors.

IMPACT OF AND RETURNS ON INVESTMENT FROM LENTIL RESEARCH AND DEVELOPMENT IN BANGLADESH

M.A. Monayem Miah, M. A. Rashid and S.M.A Shiblee

There is a need for better evidence for the impact of plant breeding research on pulses to guide policy-making and investment lentil (*Lens culinaris*) is one of the major pulses in Bangladesh that has an important contribution to food security and agricultural sustainability. The objectives of this study are to quantify the impact of and returns on investment from lentil research and development (R&D) for Bangladesh. This study applies the economic surplus model, which is a widely applied method to quantify the economic impact of agricultural technology adoption at the aggregate level both primary and Secondary data are used in this study. The study reveals that the most adopted lentil variety is BARI Masur-6 (24.4%) About 85% of areas are covered by BARY lentil varieties and 13% by local cultivars. The adoption of improved lentil varieties has created numerous socioeconomic impacts in Bangladesh improved variety adoptions have increased lentil yield by 33.5%, farmers' net profit by 169.56%, and ensured comparative advantage of production (DRC=0.72). During the period from 1992/93 to 2020-21, these adoptions have added 75401 tons of nitrogenous fertilizers to the soil, produced 260.13 thousand tons of livestock feed, and created 16.97 million man–days of additional employment. The increased production of lentils attributed to research and development, has saved foreign exchange Tk. 30.66 billion. The returns on investment reveal an encouraging scenario of the investment in lentil R&D since the estimated IRR (71.20%), NPV (TK.424.339 billion), and BCR (2.73) were much higher compared to other rates of returns estimated for other crops in Bangladesh.

DATA SCIENCE AND ANALYTIC TECHNOLOGY IN AGRICULTURAL PRODUCTION OF BANGLADESH

Istiak Ahmed, K. Saidur Rahman, Suman Biswas and M.A. Monayem Miah

Data Science and Analytic systems for agriculture provide policymakers with a wealth of data and Information for making prudent decisions. As an additional benefit, it can also help boost the yield of Crops by analyzing environmental conditions and providing farmers with relevant information in this study, there are several drawbacks. To begin with, clustering did not make use of many parameters. This is due to a lack of data. This study aimed to gather relevant information about a potato variety developed by Bangladesh Agricultural Research Institute (BARI). The study revealed that the majority of the varieties were released after 2011, with the greatest number of varieties being released in 2014. In terms of yield, most varieties released in the same year are quite normal. The release of a single variety isn't uncommon. Those years will not be included in this analysis. Most varieties released before 2012 are low-yielding, whereas high-yielding varieties are beginning to be developed in 2012. The high-yielding varieties, on the other hand, are released irregularly. BARI potato -74 which was released in 2017, is among the low–yielding varieties that have been released since 2011. To improve crop yields, a Trustworthy system must be created that makes

use of historical data analysis and provides more precise results. As a result of this system's clustering, data and analysis are compared and analyzed, including the amount of seed, the method of watering, and the type of seed.

POTATO YIELD FORECASTING USING SATELLITE IMAGES AND CROP SIMULATION MODEL UNDER CHANGING CLIMATE

Istiak Ahmed, Suman Biswas, A.F.M. Tariqul Islam, M. G. Mahboob, A. Kanti Choudhury, and M. A. Monayem Miah

The Munshiganj District of Bangladesh is well-known for its potato dominance and this study attempted to evaluate the yield estimating capacity of remote sensing data for tomato crops. At first, the reflectance is low. But it steadily rises over time. The reflectivity is at its highest point on February 20. Afterward, it began to decline. The EVI, like the NDVI, follows a similar pattern. Root mean Square Error (RMSE) is the best model for the minimum, maximum, and standard deviation statistics, SVM (RMSE). In addition, the standard deviation is the best statistic because the RMSE of all models is low compared to the lowest and maximum statistics. The second-place statistic is the maximum statistic, followed by the lowest.

DEVELOPMENT AND IMPLEMENTATION BARI PENSION MANAGEMENT SYSTEM

K. Saidur Rahman, M.S.A. Mridha, Istiak Ahmed and Suman Biswas

Receiving pension as well as its management should be hassle free, quick and friendly to its users. There is no such an Apps on pension Management System (PMS) at BARI. The ASICT Division in association with Accounts and finance Section developed a software on BARI PMIS. This PMS software was developed using MySQL database which mainly focuses on basic operation in pension. This software is a windows-based application for 32-bit windows operating systems, designed to help users maintain and employee. This software has been designed to use for both beginners and advanced users.

Abstract 2022-2023

ASSESSMENT OF RABI CROPS FOR SUSTAINABILITY INTENSIFICATION IN DROUGHT PRONE ECOSYSTEM USING REMOTE SENSING AND GEOSPATIAL MODELING

M. Mukhlesur Rahman, M. G. Mahboob, A.F.M. Tariqul Islam, M. Hasnain Ahmed, M. Hasan Rashid, S. Mubashsir Khan, and Suman Biswas

Bangladesh Government has given high priority to sustaining groundwater use for irrigation. Hence, it is important to conduct agricultural land use and cropping patterns analysis and their implication to foster sustainable intensification (SI) strategies in the drought-prone regions of Bangladesh. Remote sensing and geospatial modeling can play a vital role to assess the cropping patterns and availability of natural resources on the ground and allocate them to the judiciary for SI in agriculture. Geospatial modeling can help allocate an appropriate cropping pattern based on the best judicial use of available natural resources. Hence, to facilitate sustainable cropping intensification in the agro-environments of Bangladesh, the current research project has been initiated to carry out in the drought-prone agro-ecosystems prevailing in the Barind Tract region of Bangladesh. During the project period (2018-2023), a total of seven extensive surveys were conducted for collecting necessary ground data from the study area. These reference data were pre-processed in the GIS domain and split into 70:30 ratios to train and validate the algorithms for crop type mapping. A crop inventory for the entire Barind Tract region was prepared in previous years according to the methodological framework. Six major crop types, predominant in the area, were chosen for delineation from satellite image classification namely: maize, lentil, mustard, potato, Boro rice, and wheat. Sentinel-2A images were collected through Google Earth Engine during the dry months (Oct-Mar) of each cropping season. Although the cloud was masked out, these images were filtered to ensure the cloud percent was less than or equal to 20 percent. After resampling all the bands into 10 meters, visible, NIR, Red edge, and short-

wave IR bands were used to classify crop types along with two vegetation indices NDVI and EVI. Seasonal composite (Oct-Mar) of these bands and indices were derived in GEE based on median statistics. Three machine learning algorithms (Random Forest, CART, and Support Vector Machine) along with different band combinations were experimented with during this reporting period to improve the classification algorithm. Among several experimental trials, Random Forest with scheme 5 band combinations was found to be the best model to classify the crop type of the study area. The classification result showed that the area covered by rice, 22253.46 ha (45.17%), was relatively better than other classified crop fields initially during 2020-21 cropping season, but over time it gradually dropped and replaced with significant portion of the maize field which occupied 2296.02 ha (9.31%), 6033 ha (12.38%), and 13247 ha (26.89%) during 2020-21, 2021-22, 2022-23 cropping season accordingly. Concerning the reference data, the overall accuracy and Kappa coefficient of the classified map were found to be around 86%, 91% and 89%, and 0.81, 0.89, and 0.86 during the 2020-21, 2021-22, 2022-23 cropping season accordingly indicating satisfactory results. The F1 score for all crop types was also satisfactory in RF and scheme 5. Area coverage of the classified crop type map was also compared to the DAE area dataset for each cropping season. Besides, a set of agro-environmental resources geo-database was developed including the digital elevation model, slope map, aspect map, soil map, topsoil texture, soil reaction, soil consistency and land type of the Godagari Upazila to be used as input data in further analysis towards achieving final objective location-specific cropping pattern modeling in GIS environment. To obtain sustainable cropping pattern, crops suitability analysis for major Rabi crops by integrating Analytic Hierarchy Process (AHP) and geographic information system (GIS) technique with multiple factors, which are initially developed for geo-database development. The highest two crops that occupied S1 (Highly Suitable) class were Wheat with 5243.6 ha (10.67 %) and Potato with 4389.25 ha (8.9%) of the study area. In S2 (Moderately Suitable) class, Wheat with 30304.16 ha (61.71%) and Lentils with 29654.53 ha (60.39%) of the total study area occupied respectively. The lowest suitability areas in the study areas N (Not Suitable) class were occupied by mustard and potatoes, with 8128.52 ha (16.55%) and 6534.55 ha (13.30%), respectively. The results revealed that the integration of Remote sensing, geospatial modeling for crop type mapping, and crop suitability analysis made an appropriate approach for the evaluation of suitable cropping patterns of this area for optimized land use planning.

CHANGE AND INSTABILITY ANALYSIS IN AREA AND PRODUCTION OF MAJOR PULSES IN BANGLADESH

K. Saidur Rahman, J. K. Prioty and M. A. Monayem Miah

Instability is a crucial characteristic of agriculture. Since agriculture is dependent on weather conditions, the area, production, and yield of the crops are subject to significant variations over time. Pulses are not only a vital ingredient of the human diet; they are equally important to the health of humans and agricultural soils as well. This study examined the changes in area, production, and yield of major pulses in Bangladesh through growth rate and instability analysis based on secondary data for the last 40 years (1981-2020). The entire period was divided into three sub-periods: 1981-1990, 1991-2000, and 2001-2010 for analysis through different statistical tools. Growth rates were calculated by fitting an exponential growth function, and instability was analyzed by generating the Cuddy-Della Valle index for the six major pulses of Bangladesh and pulses as a whole. The analysis revealed that the area and production of pulses were not increased satisfactorily. Though the pulse yields have increased significantly, the rate of growth is slow, and it is insufficient to meet our country's demand. The analysis also revealed that the area, production, and yield of pulses were not stable during the study period.

FORECASTING ONION YIELD BY USING SATELLITE-BASED REMOTE SENSING TECHNIQUE IN BANGLADESH

Nur Mohammad, M. Mukhlesur Rahman, Istiak Ahmed, Mohammad Rasel
and M. A. Monayem Miah

Onion is one of the major vegetables as well as spices crops with the largest production worldwide. Onion plays a major contribution as a spices crop which is used in daily meals in Bangladesh. Therefore, it is imperative to do research aimed at forecasting the yield of onion crops. Pre-harvest prediction of a crop yield may prevent a disastrous situation and help decision-makers apply more reliable and accurate strategies regarding food security. Remote sensing can be used for yield estimation prior to harvest at the field level to provide helpful information for agricultural decision-making. Remote sensing images are capable of identifying crop health, as well as predicting its yield. Vegetation indices (VIs), such as the normalized difference vegetation index (NDVI) calculated from remotely sensed data have been widely used to predict crop yield. Yield prediction models based on a time series of satellite images and high-density yield data, to indicate the best phonological stage of onion crop to obtain satellite images for this purpose. The study used 16-day (~ 30 m) Landsat 8 OLI (Operational Land Imager) high-resolution reflectance data for the first year 2022-2023 at three different locations viz. Sujanagar, Pabna; Baliakandi, Rajbari and Durgapur, Rajshahi in Bangladesh. The single date of cloud-free image acquisition based on maximum NDVI for Landsat 8 OLI satellite image was used for the 2022-2023 onion growing period to develop the yield prediction model. A regression model was performed between NDVI values and 35 farmers-level onion yields for all locations. The yield vs. NDVI relationship for Landsat 8 image exposed that the multiple determination of coefficient (R^2) which is highest (84.1%) for Baliakandi, Rajbari followed by R^2=83.8% for Sujanagar, Pabna, and R^2=72.3% for Durgapur, Rajshahi for first-year onion growing season i.e., 2022-2023.

YIELD PREDICTION OF MUSTARD CROP BY USING SATELLITE-BASED REMOTE SENSING TECHNIQUE IN BANGLADESH

M. Mukhlesur Rahman, Nur Mohammad, Istiak Ahmed,
M. A. Monayem Miah and Suman Biswas

Mustard (*Brassica spp*.) is one of the important oilseed crops that has potential demand as the preferred edible oil for the majority of people of Bangladesh. The accurate estimation of both harvested area and yield of mustard are equally important in ensuring the accurate determination of their product. The traditional measurement of these statistics is time-consuming, tedious, and costly. Whereas remote sensing techniques are being used to easily measure these statistics at high spatial and temporal resolutions. Therefore, an attempt was made to predict the mustard yield through satellite-based remote sensing techniques before its harvesting. To get this done, the high spatial-temporal resolution Satellite imageries of Sentinel 2A (~10m) and Landsat 8 (~30m) were acquired for the three study locations after setting the experiment in a farmer's field for three consecutive mustard growing seasons of 2022-23, 2023-24 and 2024-25. The mean Normalized Difference Vegetation Index (NDVI) was extracted from the maximum NDVI-produced temporal satellite imageries within the growing season from 20 farmer's mustard fields of each study location. The first year's results revealed that in most cases the yield was maximum for the field where the NDVI values were not maximum and vice-versa. However, the relationships of the extracted mean NDVI and yields will be established using the classical linear regression model where the model will be developed using the first two years' data and will be validated using the data of the last study period.

POTATO YIELD FORECASTING USING SATELLITE IMAGES AND CROP SIMULATION MODEL UNDER CHANGING CLIMATE

Istiak Ahmed, S. Biswas, A.F.M Tariqul Islam, M. G. Mahboob, A. K. Choudhury
and M. A. Monayem Miah

Traditional methods of yield estimation often rely on laborious field surveys and manual data collection,

which can be time-consuming and resource-intensive. This study presents a comprehensive investigation into forecasting potato yield using satellite imagery and the AquaCrop model, with a specific focus on the utilization of the Normalized Difference Vegetation Index (NDVI) as a vital indicator of vegetation health and productivity. The research aims to address the challenges posed by climate variability in agriculture and offers valuable insights into crop dynamics, yield estimation, and the potential benefits of remote sensing and machine learning techniques. To achieve these objectives, nine Sentinel-2 satellite images were analyzed during the ingestion period between December 2022 and February 2023. Five images with less than 40% cloud cover were selected for further analysis. The research demonstrated the effectiveness of machine learning approaches, specifically Support Vector Machine (SVM) and Random Forest (RF) models, for yield prediction. The exploratory data analysis (EDA) revealed a significant correlation between potato yield and the NDVI, particularly during the full vegetative stage observed in February. The AquaCrop simulated yield of potatoes showed an increasing trend over time, aligning with the mean yield during the harvesting period. Notably, as the crop approached maturity, AquaCrop outperformed machine learning models in yield estimation. The study serves as a stepping stone towards enhancing crop productivity and resilience, empowering farmers, agronomists, and policymakers to make informed decisions for a sustainable agricultural future.

BIOINFORMATIC ANALYSIS OF DICER-LIKE (DCL), ARGONAUTE (AGO), AND RNA-DEPENDENT RNA POLYMERASE (RDR) GENES AND THEIR ASSOCIATED REGULATORY ELEMENTS IN BRASSICA SPECIES

Zobaer Akond, S. Hasna Habib, and N. Haque Mollah

RNA interference (RNAi) or gene silencing in eukaryotes is a commonly occurring mechanism. It is controlled by the three main gene families Dicer-like (DCL), Argonaute (AGO), and RNA-dependent RNA polymerase (RDR). They control gene expression at the transcriptional or post-transcriptional level and often maintain plant growth and development. They also play an important role in regulating gene expression in response to different biotic and abiotic factors. This mechanism is actually maintained by the 19-24 nt non-coding small RNA molecules (miRNA and siRNA). However, how these genes function, their structures and the associated regulatory elements have not been analyzed in detail. Our analysis identified 4 BrDCL, 13 BrAGO, and 6 BrRDR RNAi-related genes from the Brassica rapa genome. Motif structure analysis showed that the predicted proteins conserve motif characteristics similar to their paralog RNAi genes of Arabidopsis. Moreover, sequence logo and relative frequency analysis showed that Lysine (K), Serine(S), Valine(V), Leucine(L), and Glutamic acid(E) were the prevalent amino acids of the predicted motifs in the identified proteins. The trans-regulatory analysis showed that the top-ranked 10 TF families (Dof, bZIP, C2H2, ERF, BBR-BPC, MICK-MADS, MYB, TCP, WRKY, and AP2) consisted of 393 (78%) regulators of which Dof 115 (23%), bZIP 58 (11.55%), C2H2 49 (9.76%), ERF 30 (6%), BBR-BPC 29 (5.77%), MICK-MADS 23 (4.58%), MYB, TCP and WRKY each 23 (4.58%) and AP2 regulate 21 (4.18%) TFs. RNAi genes-TFs network analysis illustrated that eight key TF families were highly connected with the identified RNAi genes in B. rapa with some exceptions of ERF, MYB, TCP, and, WRKY. Overall results would therefore provide an excellent basis for in-depth molecular investigation of these genes and their regulatory elements for rapeseed-mustard crop improvement against different stressors.

DEVELOPMENT OF ONLINE-BASED BARI VEHICLE MANAGEMENT AND REQUISITION SYSTEM

Zobaer. Akond, M.A. Monayem Miah and M. Z. Hasan

Scientists and other officials at BARI often travel intra-district and inter-district for research activities and other official purposes. But at present the vehicle management and requisition method is done manually in paper form. In line with the mission and vision of the development of digital and smart Bangladesh and APA targets, we have developed an online-based transport management and vehicle requisition system called BARI Vehicle Management System (BVMS) for the complete replacement of the high level of labor, cost, and time. In this digital system, all relevant info and data about all vehicles of BARI HQ and outer stations are recorded and stored. Moreover, a user-friendly web-based digital system has been developed

to approve the required vehicle to the employee of BARI as per their choice. This digital system has been established following the previously approved BARI vehicle/transport requisition form. For accurate development of the system, an outsourcing platform was involved. MySQL database, PHP scripting language, and HTML were used for the smart and easy operation and web-enabled view. Any employee will be able to access and use this system using an internet-connected device. This digital system, however, will promote the vehicle requisition very quickly and transparently and it help to create a good operational environment for BARI vehicles for BARI authority as a whole

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