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Sustainable Rice Productivity through IRAS

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Bangladesh is predominantly an agricultural country where the agricultural sector plays a vital role in accelerating economic growth. The contribution of agriculture and the crop sub-sector to gross domestic product (GDP) are about 13.47% and 6.77%, respectively according to Bangladesh Economic Review (BER) 2021. Bangladesh Bureau of Statistics (BBS) 2020 and Food Planning and Monitoring Unit (FMPU) 2020 informed that rice is Bangladesh's largest crop; for more than 166.5 million people in Bangladesh, it is also the main staple food, contributing 97% of total food grain production. Brolley, 2015 mentioned that food security is essentially a reflection of rice security in Bangladesh as in many other rice-growing countries and the livelihood of the people. Bangladesh consumes about 6.50% of the globally produced rice. According to the United Nations Sustainable Development Goal (SDG) 2, "Zero Hunger" has set the target of doubling agricultural productivity through sustainable agricultural development by 2030. To implement this goal, the government of Bangladesh and related agencies are working on short, medium, and long-term plans. The benefit of this is that Bangladesh is ahead of the developing countries in the face of multifaceted challenges. In this case, the development of agriculture is adding a new dimension to the success of the country. However, both short-term and long-term climate change have emerged as major problems in agricultural development as well as in the reduction of arable land. This is a major challenge in ensuring food security for a growing population. Therefore, it is necessary to innovate, develop, and expand weather and climate-sustainable agricultural technologies at the farmer level by mitigating the effects of this increasingly extreme climate on agriculture.

A recent study by Gonzalo Rizzo et al., (Climate and agronomy, not genetics, underpin recent maize yield gains in favorable environments | PNAS) which was published in the Proceedings of the National Academy of Sciences of the United States of America on January 18, 2022 on the importance of changing climate and new agronomic and genetic technologies to yield advancements. He distinguished the separate contributions of those three factors to yield advancements. He discovered that a decadal climate trend accounted for 48 percent of the yield gain, agronomic improvements accounted for 39 percent, and genetic yield potential accounted for just 13 percent. Because of these findings, all other main food crops should review their contributions to yield advances in order to ensure long-term global food security.

In 2016, the Bangladesh Rice Research Institute (BRRI) established a successful and sustainable agro-meteorology and crop modeling laboratory to increase rice productivity through quality weather forecasting and crop modeling research. The laboratory is made up of a team of multi-disciplinary researchers. The aim is to conduct research activities on rice crop-weather relations and the weather susceptibility of rice crops to insects and diseases in order to produce weather-stable rice for sustainable food security. At the same time, to provide a weather forecast-based action plan to the field level extension officers for mitigation of disaster damage to the farmers. Above all, to introduce weather-sustainable rice cultivation in Bangladesh in order to increase the productivity of rice and ensure sustainable food security by applying the results obtained from weather forecasting and crop modeling studies.

The maximum, minimum, and rainfall data (1971-2020) collected from the Bangladesh Meteorological Department (BMD) were evaluated by Agromet lab of BRRI, and it was discovered that the maximum temperature is rising over time, with the tendency increasing from southwest to north, central, and south-east. Similarly, the minimum temperature rise is spreading from south to north. From the south-east to the northwest, and from the north-east to the south-west direction, average total rainfall is increasing. In summary we can conclude that the type and magnitude of the weather and climate of Bangladesh are changing spatially. Therefore, in order to ensure sustainable food security in the face of weather and climate change, it is necessary to provide weather forecast-based advisory services to farmers in order to produce weather and climate-stable crops.

A study entitled "Integrated Rice Advisory System (IRAS) for Sustainable Productivity in Bangladesh" was recently conducted by BRRI Agromet and Crop Modeling Lab under the "Partnerships for Enhanced Engagement in Research (PEER)" program in collaboration with USAID. The study found significant differences in yields between weather forecast-based advisory services (WFBAS) and usual farmer's practice. The average yield per hectare for WFBAS farmers is about half a ton more than the usual farmer's practice. The study also discovered that by implementing WFBAS technology, rice yield might be boosted by 7–10 percent. The reason for the difference in yield is the application of fertilizer to the field at the right time, considering the application time and quantity prescribed by BRRI.

In addition, the relationship between temperature and rainfall was taken into account when fertilizing. Apply irrigation to the field using the AWD method and rainfall forecast. The application of herbicides, pesticides, and fungicides to the field takes into account the relationship of different forecasted weather parameters such as temperature, rainfall, and humidity with different stages of growth of rice. Furthermore, implementing weather forecasting-based advisory service can lower production costs by 15% on average while increasing total income on average by 31–36 percent. The reasonable and optimal use of irrigation water, labor, fuel, fertilizers, irrigation, herbicides, pesticides, and fungicides are the major reasons for the decrease in production costs and increase in overall revenue of WFBAS farmers as compared to usual farmers. Simultaneously, proper use of agricultural inputs will be ensured, and also helping to reduce environmental pollution. According to the study, if cultivation is done according to WFBAS, will add 0.17 million tons of rice to the national food basket. In this case, if invests 1 BDT, the return will be 51-73 BDT. If 5% of farmers can be brought under this technology by 2030, then the country will produce an additional 0.21 million tons of rice.

The WFBAS system will be successfully implemented through an integrated platform called "Integrated Rice Advisory System (IRAS)" with the successful coordination of the Bangladesh Rice Research Institute (BRRI), the Bangladesh Meteorological Department (BMD), and the Department of Agricultural Extension (DAE). The "Integrated Rice Advisory System (IRAS)" is a web-based platform that provides location-specific rice production management advice and services, taking into account the weather forecast for different stages of rice growth. The platform automatically generates location-specific and growth-stage wise weekly bulletins on weather forecasts by taking inputs from multidisciplinary scientists and disseminates them automatically via email to the respective extension officials.

The basis for building the IRAS platform is our various national government policies. Bangladesh's government has devised a number of short-, medium-, and long-term plans to achieve this. The Bangladesh Delta Plan 2021, for example, focuses on ensuring long-term water and food security, economic growth, and environmental sustainability, as well as effectively reducing the risk of natural disasters and resilience to climate change and other delta challenges through robust, adaptive, and integrated strategies. Implementing resilient agricultural practices that increase productivity and production by 2030, thereby aiding ecosystem sustainability and strengthening its ability to adapt to climate change, extreme weather, droughts, floods, and other disasters is mentioned in the United Nations Sustainable Development Goals (SDGs). In addition, according to the National Agricultural Extension Policy 2020, using appropriate technology and crop production knowledge through the application of new information technology to improve the early warning system by automatically evaluating and analyzing relevant data with an agrometeorological forecast will help reduce the damage caused by natural disasters. In this context, Bangladesh and the National Agricultural Policy have emphasized on strengthening the warning system for advising farmers through weather forecasting and the government has taken several important initiatives in its implementation.

We have some future plans for the IRAS platform. Our plan is to integrate voice SMS into the IRAS system in the future, which will enable the efficient and effective transfer of advisory messages to users (farmers and extension officers). To enhance the productivity and profit from rice yield, a massive and efficient program for wider demonstration, refinement, and dissemination of weather forecast-based advisory service in an integrated way across the country should be taken. To make the IRAS system successful, we need to strengthen the capacity of BRRI, DAE, and develop the personnel accordingly through national and international expert linkage/training. A strong collaboration is also required among the BRRI, Bangladesh Meteorological Department (BMD), Bangladesh Water Development Board (BWDB), DAE, and end-users. As the farmers are the end-users of this technology, they should be well trained in Weather Forecast Based Advisory Service (WFBAS) system. We place a target here to bring only 5% of total farmers under this technology by 2030, which will contribute significantly as one of the vital factors for achieving the SDG target 2.3: doubling the agricultural productivity under goal 2: zero hunger. The results of this study will provide suitable guidelines to the policymakers towards formulating policy decisions on implementing WFBAS.

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