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Preservation of High-Quality Rice Seeds at Farmers Level Ensuring Sustainable Food Production: A Case from Bangladesh's Southern Region

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ABSTRACT

The lack of good seeds is one of the significant obstacles to Grain Production. This study intends to investigate the circumstances surrounding the availability of quality seeds for rice cultivation and establish policy strategies for quality seed production at the farmer level. The study focused on rice and a significant grain crop, and data were gathered using several survey questionnaires and in-person interviews. The acquired data was gathered and reviewed to write a paper utilizing the quantitative technique. The findings showed that farmers utilize between 70 and 80 percent of their rice seed throughout the research regions. Farmers (20–30%) can acquire rice seeds from NGOs, seed dealers, Bangladesh Agricultural Development Corporation (BADC), the Department of Agricultural Extension (DAE), and other external sources in the most extensive quantities. However, practically all farmers rely entirely on seed dealers or companies for their hybrid rice seeds.

KEYWORDS: High-Quality Seeds; Rice; Food Security; Yield.

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INTRODUCTION

Most of the crops grown in Bangladesh have substantial yield gaps. So, to achieve national food security, the nation must improve grain production. The issue at hand has to do with sustainable development. In terms of cereal crops, rice is the staple food that accounts for more than 65% of overall calorie consumption. Lower yield is mainly caused by a lack of high-quality cereal seed supplies. The most fundamental input, good seed, affects how the crop responds to all other elements necessary for effective rice production. Farmers can benefit from various advantages of good quality seed, including lower seed rates, more uniform crops, better seed vigour and germination, reduced replanting, and stronger resistance to pests and diseases. If other production factors remain constant, the nation can boost crop yields by 15% to 20% by ensuring high-quality seeds. According to farmer-participated trials conducted in Bangladesh, good-quality seeds can instantly enhance rice yield by 8–10% (Sarwar & Biswas 2021). The main factors influencing food self-sufficiency and reducing countrified penury in emerging nations are the use, accessibility, and availability of seeds of adaptable kinds. Using other components such as manure, water, and synthetic chemicals is advantageous if the seed can provide a better yield; otherwise, any input utilization is a waste. Farmers may grow and maintain high-quality seeds using modern methods to minimize storage losses and the seed shortage. The farmers may also trade their extra high-quality seed with their neighbours, loved ones, and other growers. These activities would increase grain output while preventing the massive drain on foreign exchange used for seed import. Three separate study sites were used to gather crucial data for seed conservation. The locations were considered convenient for the researcher to gather data and were well-known in Bangladesh for producing rice. Multiple survey questionnaires and in-person interviews were employed to gather the data. The retrieved information was analyzed and scrutinized in order to construct a paper using the quantitative approach. The DAE has been the principal source of information for the farmers. Aside from their source, farmers also acquired seed from nearby sources like the BADC, BRRI regional stations, seed companies, seed dealers, and others. Farmers' efforts to increase rice output are being hampered by a lack of improved seeds, improper seed handling, and other issues. Moreover, farmers'

disregard for seed preservation is apparent. Without the requisite technical expertise and training, farmers cannot receive the proper assistance. One of the obstacles to getting high yields is that they are unaware of the benefits of delivering balanced fertilizers at the convenient stages for each crop. The issue is made worse by an inadequate monitoring mechanism at the level of the farmers and a dysfunctional market system.

Objectives of the Study

The study is designed to achieve two objectives which are:

i) To evaluate the farmers' post-harvest practices for rice harvests, including seed production; and

ii) To gain knowledge of the existing state of high-quality seed preservation and to establish policy solutions for seed production at the farmer level to increase rice productivity.

LITERATURE REVIEW

The first step in increasing rice output is to use high-grade seeds. Instead of using the actual amount of seed, farmers use nearly twice as much. Therefore, there was seed wastage, which led to increased production costs and, ultimately, decreased output. However, activities aimed at producing high-quality seeds could raise the standard of farmers' seeds (Karmakar & Ali 2019). Hossain (2020) mentioned that less than 50% of farmers could utilize high-quality seeds, and the remaining farmers need help resisting using inferior seeds. Public and private groups provide 60% of the market's need for premium rice seeds. The seeds that farmers usually plant the rest of the time are considered inferior and unofficial.

High Yielding Varieties, in particular, are now significantly more readily available and accessible in Bangladesh than 20 years ago. As a result, more rice is being produced in Bangladesh. In Bangladesh, the amount of rice produced climbed from over 18 million tons in 1990–1991 to almost 35 million tons in 2011–2012 (Singh & Kumar 2014). Due to the lack of native seeds, Indian varieties occupied roughly 41.62 percent and 69.06 percent of the rice lands during the wet and dry seasons, respectively. The high adoption rate of Indian rice varieties compared to the domestic high-yielding varieties can be attributed to the larger yield, higher quality grain, and better price, which result in a significant rise in profitability in

both seasons. (Rouf Sarkar et al. 2021). Substantial empirical evidence supports the notion that improved crop varieties or cultivars increase agricultural productivity when developed and adopted (Alston & Venner, 2000).

The nation's grain yields must rise by 20–25% keeping other aspects constant to satisfy the requirements of the growing population. According to participatory experiments with farmers in Bangladesh, high-quality seeds can increase rice harvest by 10% to 12%. For the majority of crops, Bangladesh has a larger yield gap than other nations, and one of the major causes limiting Bangladesh's output is the lack of a sufficient supply of high-quality seeds. Only 46% of farmers have access to high-quality seeds, while 54% rely on inferior seeds. Public and commercial organizations supplied sixty percent of the overall demand for high-quality rice cereal seeds. The other forty percent was traditionally generated by farmers and is regarded as subpar and an informal seed. Formal seeds are those provided by the BADC, the private sector (PS), and non-governmental organizations (NGOs). Formal seeds are those that the BADC and private sector generate from foundation seed that was produced from breeder seed in their farm of seed multiplication and certified seed that was produced from the foundation seed in contract farmers' fields after going through the certification process. Private seed firms import a certain amount of hybrid rice seeds. The "informal" seed, which farmers save as seed and utilize conventionally for developing subsequent crops, is another crucial source of seed. These seeds have never been put through a quality check or seed production process.

For a country to have a sustainable seed supply, national seed plan systems should discover strategies to strengthen both the formal and informal seed networks. In Bangladesh, the net cropped area is diminishing, while the total cropped area is expanding as crop intensity rises. With a cropping intensity of 215% in the 2017–18 growing season, the cultivable land under the three principal cereal crops of rice, wheat, and maize was 120.95 lac hectares. A large percentage of crop production systems today practice intensive rice farming. During the boro season, 21% of the area is covered by hybrid rice varieties, while HYV covers 75% of the area. About 73% of the territory in Aman is dedicated to HYV and 27% to native varieties. Around 3 33,120 MT of cereal seed is needed to cultivate the land for the aforementioned crops; however, only 2,

01,794 MT of high-quality seed has been delivered as opposed to the needed amount.

Hybrid rice seed makes up about 3.5 percent of the total seed demand. Bangladesh's population is expected to increase, reaching 186 million by 2030. By 2025, Bangladesh will have to provide for 182.3 million people if the amount of arable land remains roughly constant. Because of this, formal seed of high quality is exceptionally scarce in the nation. With the current trend of population expansion, it is necessary to plan for long-term food security. To guarantee food availability for the growing population, enough supply of high-quality cereal seeds is a must. Lack of quality cereal seeds in the market will result in decreased productivity, mass unemployment, and weak economic advancement, ultimately reflecting poorly on the GDP. By substituting high-quality seeds for those of lower quality, productivity will rise. Due to the poor quality of farmers' conserved seeds, having access to quality seeds will not only increase the rate at which seeds are replaced but will also enable farmers to conserve seeds by using fewer seeds per unit area. After receiving high-producing variety seeds from seed organizations, farmers grow them, make seed, and store it for use the following season. Only when that cultivar's yield potential significantly decreased did most of them hardly ever come for replenishment of the seed stock. The food supply for the expanding population will be in grave danger if high-quality grain seeds are not guaranteed. To achieve sustainable development goals and build a nation with a sustainable agricultural system, Bangladesh must act quickly to ensure the quality of its cereal seed (Hossain & Ahmed 2019).

Hossain et al. (2001) stated that the emergence of public & private sector interface and adequacy of the policy environment is needed for further development of the rice seed market. The informal seed system is based on the implicit assumption that farmers who use it rely on inferior selection and processing techniques and lack access to suitable storage facilities, which results in seeds of poor quality, particularly in terms of genetic purity and germination. However, there is research that challenges this concept (Biemond et al. 2013; Bishaw et al. 2012)

METHODOLOGY

The study aimed to assess the production, handling, and storage of rice seeds at the farmer level. During the period between June 5 to June 9,

2022, in the selected area, the data collection was carried out. An interview schedule served as the data collection tool. The interview schedule was carefully created with the study's aims in mind. A draft structured questionnaire was evaluated with a small group of informants in the study region to see if the informants could grasp it and if any revisions and amendments were required. The following stage was to design a methodical questionnaire. The questionnaire was translated into Bengali, the informants' native tongue, before being given to them so they could easily comprehend the questions.

Additionally, data were gathered through in-person interviews. The research sites were *KushtiaSadar, Damurhuda*, and *Alamdanga*. Bangladesh's main grain crop, rice, was considered for the study. The research locations were chosen because they are regarded as one of Bangladesh's most important agricultural centres. The locations were also chosen because they made it easy for the researcher to collect data. Farmers were chosen at random to participate in extensive research in this area. The office of the Upazila Agriculture Officer has supplied a current list of all farmers who take advantage of extension services from the Department of Agricultural Extension (DAE). A straightforward random selection technique was used to choose 40 sample farmers from each site for 120. Farmers are chosen at random without considering their age, education, economic standing, the size of their farms, or expertise. The data was collected through interviews, and different types of survey questionnaires were examined and assembled to write the paper. Both closed-ended and open-ended interview questions were used.

Farmers were asked 12 types of questions about rice seed storage. For question no. 1, farmers' preference information sources were mentioned as the source of information. They were asked to rate each source out of 25. The evaluations given by all participants are then arranged to rank the sources of information. The 2nd question was a close-ended question where the participants were asked to tick the appropriate box. Participants' opinions are then calculated as percentages. The third query was an open-ended one. Farmers were asked to describe any issues they had with their agriculture. Their issues are quantified in percentages. The exact process is used to obtain data for the following query; the result is expressed through a pie chart. Then, over the Aush,

Aman, and Boro seasons, farmers' amount of seed saved in each experimental site was averaged. The typical amount of seed preserved for each season is determined. Farmers were asked to select their preferred response from one of three alternatives for questions 7 through 12, and the results are presented in percentages. A Focus Group Discussion with the farmers was organized at the conclusion to verify the data gathered and aid in the creation of recommendations.

RESULTS and Discussion

The study found that the farmers mostly rely on the DAE, nearby farmers, seed dealers, radio, TV, newspapers, businesses, and non-profit organizations for their information (Table-4.1). The respondents scored and rated the information sources. They gave DAE 78 points, which put it first, and the surrounding farmer 71 points. With a score of 65, farmers received information from dealers, businesses, and NGOs as their third preference. With 43 points, print and electronic media took fourth place.

Table 4.1: *Ranking of the Rice Farmers' Preference Information Sources*

Source of Information	Score	Rank
DAE	78	1st
Neighbouring farmer	71	2nd
Seed dealers, companies and NGO	65	3rd
Radio, TV, newspaper	43	4th

The results of the survey demonstrate that, in addition to their personal source (locally sourced rice seed), a tiny percentage of rice-growing farmers also acquired seed (Foundation, Certified, TLS, etc.) from sources in their nearby surroundings, including other farmers, NGOs, DAE seed growers, and BADC Regional Stations. Farmers reported that the BADC seeds' quality was subpar.

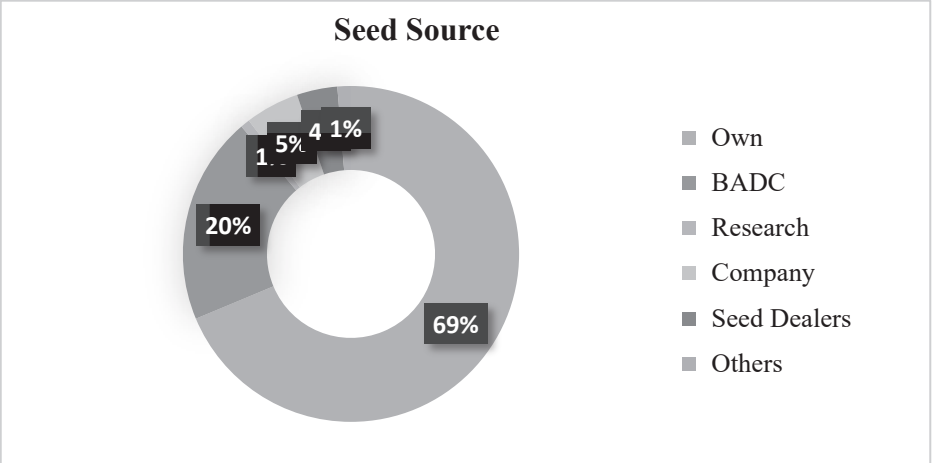

Figure 4.1: *Farmers' Seed Sources for the Production of Rice Grain*

Regarding the production of rice grain and seeds, farmers in the research regions encountered a variety of issues, including a shortage of seed supply, delayed seed supply, difficulty applying fertilizer, inadequate information regarding the most suitable production method, etc. Small farmers experienced the most trouble among the farmer types (42%), followed by medium farmers (36%); however, the proportion of large farmers in this respect is relatively modest (23 percent).

Table 4.2: *The Challenges Rice Farmers Face*

Problems faced by the rice farmers	**Percentage**
No availability of seed	42
Shortage of fertilizer	35
Lack of capital	12
Lack of irrigation water	9
inadequate guidance on choosing the right production technology	2
Total	**100**

The clay jar was utilized by a good number of farmers (31.66%) to preserve their rice seeds across all sites. According to the survey results, a significant fraction of sample farmers (18.33, 15, 12.5, 10, 7.5, and 5%, respectively) kept their rice seed in conventional storage containers such as jute bags, dulees, plastic bags, drums, and polythene. However, because of their porous surfaces, which enable moisture to seep in and raise the stored seed's moisture content, these storage containers were not suitable for maintaining the seed quality of stored rice seed.

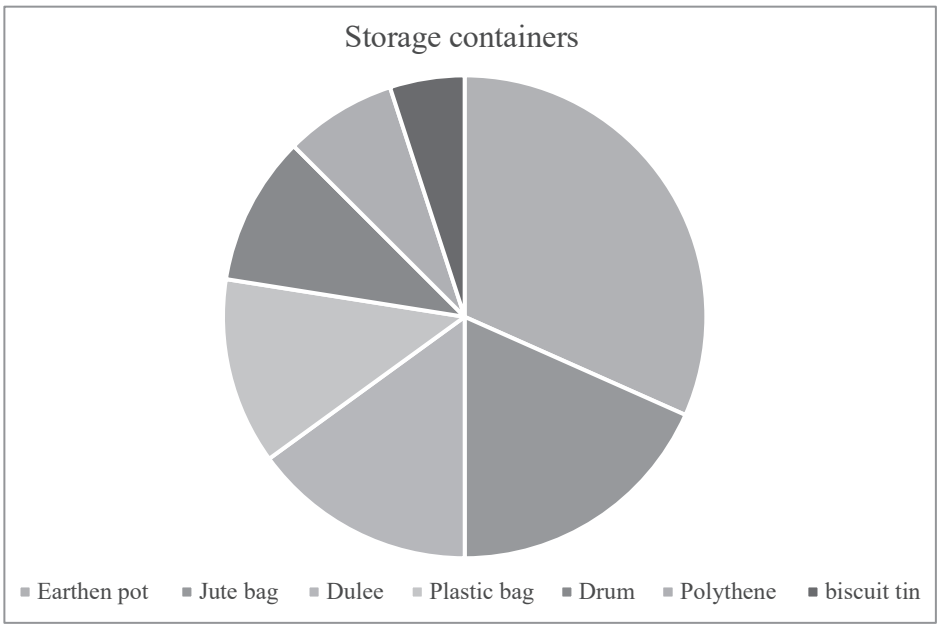

Figure 4.2: *Utilization of Rice Seed Storage Containers by Farmers*

The table-4.3 below displays the number and percentage of survey participants who selected "constraints to rice seed production." The lowest percentage (31.66%) was found in farmers' seeds' market price, followed by the highest price of inputs (22.5 %). The chart also shows that the percentages for lack of storage space, cash, marketing issues, and technological ignorance were 20, 15, 10, and 0.83, respectively.

Table 4.3: *Production Restrictions for Rice Seeds*

Obstacles to the generation of rice seeds	Number	Percentage
Farmers' seed has a low market price.	38	31.66
The high price of inputs	27	22.5
Lack of storage facilities	24	20
Lack of capital	18	15
Marketing problem	12	10
Lack of technological knowledge	1	0.83
Total	**120**	**100**

The average amount of saved Boro, T.aman, and Aus rice seed per farm family was 91.33 kg, 76.66 kg, and 53.33 kg, respectively.

Table 4.4: *Farmers' Storage of Rice Seed*

Research areas	Amount of rice seed stored (kg/farm family)		
	Boro	Aman	Aus
Alamdanga	92	75	44
Damurhuda	80	68	39
Kushtia sadar	102	87	77
Average (kg)	91.33	76.66	53.33

Table 5: *Other Questions Regarding Seed Production*

Question	Yes (%)	No (%)	Not informed (%)
Do you get the proper seed supply from BADC?	33.33	31.66	35
Does SCA regularly monitor seed production methods?	22.5	37.5	40
Do you apply the necessary amount of fertilizer for the growth of seed crops?	45.83	50	4.16
Do you face any marketing problems?	70.83	16.67	12.5
have you received any training in seed production?	95	5	0
Do you lack technological knowledge for seed production?	55.83	15.83	28.33

DISCUSSION

Regarding grain cultivation and seed production, the farmers heavily rely on the DAE, nearby farms, and seed traders as information sources. However, due to the system's complexity as a whole, the information sources occasionally cannot offer the necessary technical help. As a result, steps should be taken to improve connections between farmers, research institutions, and DAE. Although homegrown seed from farmers makes up a large portion of the seed supply, farmers prefer to utilize their own seed sparingly. Many of them admitted that, in terms of yielding capacity, their seed is only fair and needs to catch up to the seeds from the research and other key stakeholders. Because they do not adhere to the seed manufacturing package criteria established by SCA, and their seed degradation is quite severe during storage. The two significant issues facing rice growers are the lack of seeds and fertilizer. Most farmers use locally accessible containers to store rice seeds, such as poly bags, plastic drums, gunny bags, metallic drums, homemade clay pots, and polythene bags. However, adequately dried seeds may be kept in an sair-tight container for two to three months before more drying and chilling are required. Therefore, 2-3 intermittent drying and chilling procedures are needed up to the following planting season. However, because the farmers do not adhere to this procedure correctly, there are problems.

The production of rice seeds is limited by several factors, including the low market price of farmers' seeds, high input costs, a lack of storage space, funding, and marketing issues. At the farmer level, the storage conditions for rice seeds are subpar. The storage methods employed by Bangladeshi farmers need to be improved, particularly concerning seed moisture preservation. While encouraging the use of current storage devices like the USA organic cocoon, Germax cocoon, IRRI manufactured storage bag, rexine cocoon, thick poly bag, and Ferro-cement bins, appropriate research should be done to improve the local storage facilities.

In contrast to the farmers' enormous demand, the public seed sector (BADC) now only has a tiny quantity of high-quality seeds available. Therefore, BADC's capacity for producing seeds should be increased via careful planning. Additionally, the private sector has to be helped to manufacture and market high-quality seeds. The creation of neighbourhood storage facilities might lower the cost of seeds while also

improving system efficiency. Additionally, the Seed Certificate Agency (SCA) should conduct a thorough examination before beginning the farmers' community-level seed production program. This would lower the cost of the farmers' access to high-quality seeds. Due to a shortage of technical staff and up-to-date testing lab facilities, SCA's present quality control of seed activities is restricted. At the very least, a sophisticated seed testing laboratory should be established in each District, and more technical staff should be added to reinforce the seed certification system across the nation. For the cultivation of seed crops, farmers use fertilizers at different rates. Therefore, steps should be taken to reduce farmers' ignorance of seed production and the usage of balanced fertilizers. In addition to regular motivating programs like Farmers' Day, Field Day, ICM, Community level Awareness program, Community discussion, the establishment of Seed Society, Radio talk shows, and Television programs, farmers must get adequate training from agriculture service providers. The majority of farmers struggle with marketing their seed products. Most farmers have received seed production instruction from governmental or non-governmental organizations. The agricultural training institutes should provide farmers with the necessary instruction in areas relevant to post-harvest loss reduction, particularly at the time of cereal seed storage. There needs to be more training for farmers to produce crops, seeds, and grains. More instruction should be given on how to manage a seed crop, particularly with regard to utilizing high-quality seed, plant protection techniques, and water to ensure that the crop grows well and yields seeds with high vigour and good quality.

The following topics are recommended for priority-based further investigation based on the study's experiences and findings.

- To evaluate the quality of seed production and preservation situation of rice, the current research was only carried out in three places for each crop. To conclude with broader applicability, the study should also consider other regions of the nation that are important for these crops.
- Research is essential for creating seed storage devices that are more advanced than conventional storage containers for farmers' homegrown seeds. This study project should be connected to the farmers' socioeconomic circumstances.

- Many different seed companies provide hybrid rice seeds. A study should be done to determine the quality status of these hybrid seeds.

CONCLUSION

Among other inputs, a reliable supply of high-quality seeds is necessary for sustainable agriculture. The availability of high-quality cereal seeds increases food production, but the goal should be to produce more with less. It is not ideal to just rely on the private sector to produce and provide high-quality seeds. Under certain circumstances, they may be assigned responsibility for a particular portion of the seed needed. Policy support is required to deliver high-quality cereal seeds on schedule and at a reasonable cost. However, there should be more than one endeavour; there should be a holistic approach. All development initiatives could not be adequately monitored and, therefore, could only be ensured with a robust monitoring structure. Raising agricultural output, guaranteeing food security, and enhancing farmer livelihoods depend on the availability, accessibility, and use of high-quality seeds from adaptable crop types. Only if farmers have better access to high-quality seeds of new crop cultivars will they be able to benefit from agricultural research. The seed supply situation examined in the current study for rice production in Bangladesh paints a picture for us analytically. The supply and demand of rice in the country's government and private sectors are vastly out of balance. It is observed that the public and private sectors can meet below 31% of the national rice seed demand. Thus, if it is possible to ensure a higher amount of quality rice seeds by BADC and other reputed seed companies, that might increase rice production substantially in the country. To let it happen this is crucial to formulate realistic policy and functional measures to create a level playing field between the public and private sectors in the production and distribution of quality.

Strengthening a robust monitoring mechanism by the relevant agencies at the seed distribution stations through the Seed Certification Agency (SCA) is also crucial. Increased infrastructure and technical staff are required in the public sector (BADC and SCA) to meet the rising demand for high-quality seeds. Department of Agricultural Extension (DAE) should strengthen its supervision activities to ensure the supply of quality rice seeds to the growers before the cropping season with functional

coordination with the Seed Certification Agency (SCA) and BADC. Finally, it is recommended that DAE need to impart training to the farmers on quality rice seed production and preservation. It is necessary to implement policies to increase the production of high-quality seeds through budgetary allocation or financial assistance, updating data on crop-specific arable land and seed production, and other measures. Additionally, the focus should be given to seed quality testing facilities at the field-level agricultural office. As the seed dealers are the essential stakeholders in this rice seed supply system, thus this also important to train them on quality seed preservation and distribution. To ensure the seed quality; status of farmers' homegrown seeds deemed practical, a few methods may be proposed to improve seed quality during the production, processing, and storage stages. The current study yields several significant findings, followed by crucial policy suggestions for enhancing seed production quality at the farmer level.

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CONFLICT OF INTEREST

There are no conflicts of interest.

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