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A BRIEF REVIEW ON THE PRESENT STATUS, PROBLEMS AND PROSPECTS OF MAIZE PRODUCTION IN BANGLADESH

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ABSTRACT

Maize is one of the promising crops for foods, green forage and industrial uses. There is lot of research about maize regarding various aspects in Bangladesh. However, no published review report on the present status, problems and prospects of maize production in Bangladesh has been found. In this review, we provided intensive information to increase maize production and profitability in Bangladesh from all the available resources i.e., journal article, book, proceeding and electronic sources. This paper showed that maize cultivation was more profitable in Bangladesh and indicated some problems with maize cultivation as well as suggested some recommendations to improve maize production. Understanding all the facts about this paper will boost to maize production in Bangladesh and assist to researchers to choose advance topics about the improvement of maize cultivation.

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INTRODUCTION

Maize is the most important cereal crop in Bangladesh after rice and wheat. It has potential nutritional values i.e., 100 grams of mature maize seeds contain 9.42 g of protein, 74.26 g carbohydrates, 0.64 g sugar, 7.3 g dietary fiber, 365 kcal energy (Wikifarmer, 2022). Maize helps to boost kidney function and bone health, regulates the heart rate, prevents constipation and reduces stomach acidity. Besides, maize reduces LDL cholesterol and guards against cardiac diseases, diabetes and hypertension. Thus, maize has numerous health benefits, which help to overcome malnutrition in the country's population.

At present, the annual demand for maize in Bangladesh is around two million tons, but production is 4,700 thousand tonnes (BBS, 2021) which is a big gap between demand and production. To fulfill the demand, huge amount of money drains to import maize seeds and products. The consumption of maize in Bangladesh both as human food, livestock and poultry feed overall in all the segments will be increased in the future. In addition, Maize has a potential prospect in Bangladesh and annual average weather had a positive effect on maize production in Bangladesh. Maize has a wide genetic variability and able to grow successfully in any environment in Bangladesh. It generally grows both in winter and summer time in Bangladesh and shows potential yield. Recently, the yield of maize has experienced explosive growth in Bangladesh. Maize has now positioned itself as the first among the cereals in terms of yield (6.15 t/ha) as compared to boro rice (3.90 t/ha) and wheat (2.60 t/ha) (BBS, 2020). However, there was no review paper made on maize cultivation in Bangladesh considering the overall aspects i.e., present status, advantages and disadvantages of maize production in Bangladesh.

Few reports revealed that maize is more profitable crop than rice (Fokhrul and Haque, 1995; Hussain et al., 1995). Haque (1999) reported that maize is more economically profitable than mustard. Rahman et al. (2010) reported that maize production has a much higher profit than wheat. Although the rice-based green revolution technology in Bangladesh is a common practice, there is an urgent need to crop diversification due to sustaining its growth (Rahman, 2010). The government of Bangladesh is also seeking to diversify crops to other cereals than rice. The rate of adoption and sustainability of any crop depends upon its economic profitability. Economic profitability is one of the important criteria for assessing the suitability of a new crop technology considering this point maize will be the best option for crop diversification. Regarding the overall backdrop, the present study systematically mentioned the present status, pros and cons of maize production in Bangladesh.

PRESENT STATUS OF MAIZE PRODUCTION IN BANGLADESH

Maize cultivation started in Bangladesh since 19th century in the Rangpur and Dinajpur districts (Begum and Khatun, 2006). The governor of erstwhile East Pakistan (Bangladesh) in 1962 tried to spread maize in Bangladesh. However, the Bangladesh Agricultural Research Institute (BARI) and Bangladesh Wheat and Maize Research Institute (BWMRI) have been working on research on maize since its establishment. To date, BARI and BWMRI have developed twenty-seven varieties and the yield potential of the released composite varieties are 7.4–13.0 t/ha (BARI, 2022; BWMRI, 2022). Maize production and yield have experienced an explosive growth in Bangladesh in recent years. The cropped area of maize has increased from only 2,654 ha in 1972 to 165,510 ha in 2018; production from 2,249 t to 1,018,000 t; and yield from 0.85 t/ha to 6.15 t/ha during the same period. Thus, maize is becoming apparently important in Bangladesh. In 1971–1972, the coverage and total production were 0.0028 m ha which increased to 0.445 m ha in 2019 (Sarwar and Jiban, 2019). Bandarban, Rangamati, Dinajpur, and Rajshahi districts are the major maize-producing areas, recently areas namely Dhaka, Chuadanga, Bogra and Lalmonirhat also produced a significant amount of maize (BBS, 2021). Besides, the low-lying flood-prone districts of Comilla, Noakhali, Sylhet, Faridpur, Jamalpur, Kishoreganj, Tangail, Barisal and Khulna do not grow maize or grow only negligible quantities.

At present all agriculture-related organizations are involved in maize improvement in Bangladesh. Ministry of Agriculture, Bangladesh Agriculture Development Corporation, International Maize and Wheat Improvement Centre, BARI and BWMRI are the main organization in Bangladesh those are working with maize research. Maize is generally grown in both kharif (March-June) and rabi (November-February) seasons. It is grown mainly in the kharif season at northern and western districts and rabi season in the central and eastern districts. The common cultivars that are generally grown in Bangladesh and their growing season as well as yield are shown in Table 1.

Table1. Maize cultivars that are commonly grown in Bangladesh and their growing season and yield

Sl. No.	Cultivars	Growing Season	Yield (t ha ⁻¹)
1	Shuvra	Rabi	4.5-5.5
2	Khoibhutta	Rabi, kharif	Rabi-5.5, Kharif-4.0-4.5
3	Barnali	Rabi, kharif	Rabi-5.5-6.0, kharif-4.0-4.5
4	Mohor	Rabi, kharif	Rabi-5.0-5.5, Kharif-3.5-4.5
5	BARI Bhutta-5	Rabi, Kharif	Rabi-6.5-7.5, Kharif-5.0-6.0
6	BARI Bhutta-5	Rabi, Kharif	Rabi-6.5-7.5, Kharif-5.0-6.0
7	BARI Bhutta-6	Rabi, Kharif	Rabi-6.5-7.5, Kharif-5.0-6.0
8	BARI Bhutta-7	Rabi, Kharif	Rabi-6.5-7.5, Kharif-5.0-6.0
9	BARI Misty Bhutta -1	Rabi	14.0
10	BARI Hybrid Bhutta -1	Rabi, Kharif	Rabi-7.5-8.5, Kharif-6.5-7.0
11	BARI Hybrid Bhutta -2	Rabi, Kharif	Rabi-9.0-9.5, Kharif-7.0-7.5
12	BARI Hybrid Bhutta -3	Rabi, Kharif	Rabi- 10-10.5, Kharif-7.0-7.5
13	BARI Hybrid Bhutta -5	Rabi, Kharif	Rabi- 10-10.5, Kharif-7.0-7.5
14	BARI Top Cross Hybrid Bhutta -1	Rabi, Kharif	Rabi- 9.0-9.5, Kharif-7-7.5
15	BARI Hybrid Bhutta – 6	Rabi, Kharif	Rabi- 9.0-9.5, Kharif-7-7.5
16	BARI Hybrid Bhutta-7	Rabi, Kharif	Rabi- 10.0-11.0, Kharif-7-7.5
17	BARI Hybrid Bhutta – 8	Rabi, Kharif	Rabi- 10.0-11.0, Kharif-7-7.5
18	BARI Hybrid Bhutta – 9	Rabi, Kharif	Rabi- 10.0-11.0, Kharif-7-7.5
19	BARI Hybrid Bhutta – 10	Rabi	9.0-12.48
20	BARI Hybrid Bhutta -11	Rabi, Kharif	Rabi-9.5-11.5, kharif-9.5-10
21	BARI Hybrid Bhutta-12	Rabi	10-11.1
22	BARI Hybrid Bhutta-13	Rabi	8.2-8.9
23	BARI Hybrid Bhutta-14	Rabi, Kharif	Rabi-10.84, kharif-10.52
24	BARI Hybrid Bhutta-15	Rabi, Kharif	Rabi-12.75, kharif-12.07
25	BARI Hybrid Bhutta-16	Rabi	7.06

Source: Handbook on Agro-Technology, 2019

Presently utmost priority has been given to agricultural mechanization due to saving time and labor costs. From this point of view, Bangladesh needs to adopt all possible farm mechanization and management techniques. Considering the advantages of mechanization, some research institutes like BARI, BRRI have taken programmes on adopting mechanization technology in the farmers field. Department of Agriculture Extension already started maize mechanization system in some areas in Bangladesh. Hossain (2017) noted maize base mechanization activities need to be strengthened for economic benefit and this author also reported that CIMMYT-Bangladesh has also been trying to adopt maize mechanization since the late 90's.

Selling is the first step after producing crops. The selling of maize was the biggest problem when introducing maize in Bangladesh. At present time, maize has become the major good for the Bangladeshi market. Kausar and Alam (2016) studied about the marketing efficiency of maize in Bangladesh and documented that there are few maize marketing channels in Bangladesh. Among them Farmers-Artdars-Feed mills are the most efficient channel. Therefore, at present time maize is a demandable goods and it has a big market in Bangladesh.

PROBLEMS OF MAIZE PRODUCTION IN BANGLADESH

The problem of maize production that farmers have to deal with: Lack of proper knowledge for maize cultivation, unstable weather, the high price of maize seed, short-duration high yielding dwarf maize varieties, lack of financial support, insect and pest attack, unavailability of fertilizer during pick period, adulterated fertilizers and pesticides, market instability. These matters are briefly discussed in below-

Lack of proper knowledge of maize cultivation

Maize cultivation in Bangladesh has several constraints which lead the limited growth. Lack of proper knowledge for maize cultivation i.e., planting time, seed rate, plant spacing, fertilization, irrigation, diseases and insect management are the main drawback in Bangladesh. Paul et al. (2015) reported similar statement that maize cultivators of Bangladesh face several challenges and problems including appropriate timings of cultivation, appropriate pesticides and fertilizers, post production activities and marketing system. Besides, many farmers do not know about the improved methods of maize cultivation. Farmers need proper training for potential maize cultivation. Government can take proper training about the production technology of maize.

Unstable weather

Bangladeshi farmers faced very unsuitable weather during crop cultivation (Miah and Mondal, 2017). Potential maize production depends on good weather conditions, but Bangladesh has very unstable rainfall and temperature which are detrimental to maize production. Webster et al. (2010) reported there is a very uncertainty of weather forecast in Bangladesh. Besides, flood is also a big barrier to maize production in many regions of Bangladesh. Therefore, it may be stated that weather variability is the biggest threat to maize production in Bangladesh.

The high price of maize seed

The high price of seeds is another serious problem in maize production in Bangladesh (Hasan, 2008). Globally, maize seed prices increased to \$264 per ton in December 2021 from \$248.7 the previous month, according to World Bank Commodities Data. Maize seed prices rose in Bangladesh for synergizing with international price. Most of the small and marginal farmers of Bangladesh do not want to invest high during the preliminary stage. Additionally, responding due to increasing demand from poultry and fish feed industries, maize price is increasing (Mahesh et al. 2016). By considering overall aspect in this paragraph, it can be stated that the supply of seeds at a fair price at the time when required is essential for expanding the maize production in Bangladesh.

Lack of short-duration high yielding dwarf maize varieties

There is a huge demand for short-duration high yielding dwarf maize varieties. Dwarf varieties (short stature) are stronger and hence can withstand strong winds resulting in fewer problems of lodging. Besides, the high-yielding dwarf varieties of crops take less time for maturing and save time. Ali and Hossain (2019) reported that maize is a long duration (about 150 days) spaced crop and there is a lack of high yielding hybrid maize cultivars in Bangladesh.

Lack of financial support

In Bangladesh, most of the farmers are small and marginal. The fund crisis is the main problem for small and marginal farmers for crop production. Therefore, a lack of cash leads to inferior goods purchases and improper post-harvest management resulting in low yield. Agricultural production in Bangladesh hampers due to scarcity of financial support from government and nongovernment organization (Ali et al. 2021). Thus, lack of financial support by the government or other organizations is a big barrier for the expansion of maize production. New dimensions or policies supposed to take by the government and NGO to solve these problems.

Insect and pest attack

Insects and pests are another severe problem for maize production. The activities of insect pests may damage 100% yield in maize. The major insects are borers, aphids, caterpillars, grasshoppers, weevils and armyworms, which affecting severely on maize production (Azad et al., 2020). There are some (root rot of seedling, leaf blight, maize streak, downy mildew, purple leaf sheath, different kinds of spots in leaves) deadly pathogens in maize production, which severely damage maize (Azad et al., 2020). Therefore, the management of the insect-diseases is very essential for maize production in Bangladesh.

Unavailability of fertilizer during pick period

The availability of fertilizer during crop production is very much uncertain and vulnerable. Besides, the price of fertilizer is very high compared with the price of maize grain (Hasan, 2008). Many unscrupulous businessmen make the artificial crisis of fertilizer during the pick period of crop production, which is another cause of price hikes (BSS, 2021).

Adulterated fertilizers and pesticides

Good quality fertilizers, insecticides and fungicides are essential for higher yield. In Bangladesh unlicensed adulterated fungicides and pesticides are available, consequently maize production may fail. Azmat and Coghil (2005) reported that some unscrupulous Bangladeshi businessmen are selling adulterated fertilizers and pesticides. To solve this problem, the government needs to launch several campaigns against sellers of adulterated fertilizers and pesticides.

Market instability

Market factors influencing maize price instability and networking. Generally, incomplete economic paradigm has been occurred by market instability of maize. Price instability in maize could be regarded as a market failure. There is an instability found in the maize market in Bangladesh (Miah et al. 2014). Therefore, it can be suggested that price stabilization will be one of the top priorities of the Bangladesh government to explore maize production.

PROSPECTS OF MAIZE PRODUCTION IN BANGLADESH

Maize is important to the economy in Bangladesh due to its various causes and there is a tremendous prospect to grow maize. Reasonable causes of maize production in Bangladesh are briefly discussed below-

The exponential growth of demand for maize in Bangladesh

The main raw materials for poultry, fish and animal feed are maize. Recently, in Bangladesh, the number of poultry, fish and animal industries has raising. These sectors have been growing at an annual rate of approximately 20% for the last two decades (Islam, 2014). In the past ten years, demand for maize is increasing from time to time due to feed ingredient for fish and livestock (Islam and Knan, 2021). Thus, maize has become one of the major commodities for fish and animal feed in recent days.

Economic of maize cultivation

Adnan et al. (2021) examined a study in order to determine the profit efficiency of maize in Bangladesh. This report noted that maize production is profitable in Bangladesh. The average net return is 32392 BDT/acre and the benefit-cost ratio was more than 2. The outcomes also disclosed a profit efficiency score of 0.71. The average net benefit was 32392.40 BDT/ acre and profit-loss 16975.99 BDT/acre. Sayedur Rahman (2014) explored the potential of maize production in Bangladesh by using a stochastic cost frontier model. They calculated the profitability and economic efficiency of maize and noted that maize production is highly profitable in Bangladesh. Hasan et al. (2017) carried out research about maize production cost and profitability in Bangladesh and reported that maize production is profitable. Financial returns for summer maize are more profitable compared with alternative summer crops (aus rice) in Bangladesh (Table 2). Assefa et al. (2021) conducted experiment for three years in Bangladesh using rice, maize, mungbean and sunflower and concluded that maize have the highest net income compared with other.

Table 2. Summary financial returns for summer maize compared with alternative summer crops (aus rice) in Bangladesh

Name of the crops	Total cost (Tk/ha)	Net return (Tk/ha)	BCR
Summer maize	90,583	18493	1.20
Aus rice	65,217	6382	1.09

BCR denotes benefit cost ratio, Source: Waddington, 2018

Apt for suitable land for maize production

Mottaleb et al. (2018) noted that Bangladeshi land is most suitable for maize cultivation. Well-drained, well-aerated, deep soils containing adequate organic matter are good for maize cultivation. Maize can be grown wide range of land even grow successfully on soils with a moderately acid environment. The minimum daily temperature of 20°C (average) is adequate for maize cultivation. Considering all the available factors maize could be grown twice a year (spring and autumn) in Bangladesh and it is a profitable crop (Rahman and Rahman, 2013). Therefore, considering this background it can be stated that Bangladeshi land is good for maize cultivation.

The comparative advantage of maize production rather than import

The maize production opportunity in Bangladesh is enormous. The demand for maize per year is 1.8-million-tons where only 70% is grown in the state and the rest of the amount is imported from different countries (IFPRI, 2013). This is a clear gap between production and demand. Domestic resources are human labor, power tiller, seed, land rent and interest on operating capital while traded inputs were fertilizer and manure. Using domestic inputs production cost is less. Therefore, it is visible that the production of maize in Bangladesh has a comparative advantage rather than an import.

Farmers acceptance

Bangladeshi farmers interested to expand maize production due to various advantages for the high demand, higher profit, less production cost, produce higher yield, adaptable with climate change and increase soil fertility by adding plant Debris (CIMMYT, 2019). Besides, all activities from sowing to harvesting are done by mechanization and this assist in timely operations which avoid risks associated with adverse climate, saves labour and cultivation cost.

Boosting of crop diversification

There is a high possibility to become more remunerative than rice in the areas of the scarcity of water. The adoption of maize under these situations is increasing at a very fast rate in the country. It has been noted that many farmers are converting maize cultivation rather than rice (Dass et al., 2012). Additionally, maize is a most versatile crop having wider adaptability grown in diverse seasons. Regarding all facilities, it can be stated that maize is playing the key rule in crop diversification in Bangladesh.

Conservation agriculture

The maize plant is more vigorous and able to establish well under zero-till cultivation. The rice follow zero-till hybrid maize in India becomes a success story (Dass et al., 2012). Similarly, Bangladesh can follow in their footsteps. This system is advancing the sowing time, saving water, fuel, reducing cost of cultivation and improves farm profitability. This system increases soil organic matter, improved soil health, and reduce soil erosion.

CONCLUSION

Maize cultivation has been started since 19th century in Bangladesh, to date, it has positioned itself as the 1st among the cereals in terms of yield rate (6.15 t/ha) as compared to boro rice (3.90 t/ha) and wheat (2.60 t/ha). Considering return and investment this review noted that maize is the highly profitable crop in Bangladesh. The demand for fish and animal feed is increasing with time in Bangladesh, indicating big scope to increase domestic production of maize. At the present time many organizations namely Bangladesh Agriculture Research Institute, Ministry of Agriculture, Bangladesh agricultural Development Corporation, CIMMYT-Bangladesh, International Maize and Wheat Improvement Centre are working on maize improvement. These organizations are trying to adapt mechanization technology in the farmers field. The main drawback of maize production in Bangladesh is lack of proper knowledge for maize cultivation, unstable weather, the high price of maize seed, short-duration high yielding dwarf maize varieties, lack of financial support, insect and pest attack, unavailability of fertilizer during pick period, adulterated fertilizers and pesticides, market instability. Updating the technical knowledge to the farmers on maize production technologies by training through Government and Non-government Organization will be highly beneficial for maize enhancement in Bangladesh. Seed production and storing would be emphasized to meet up the problem of seed crisis and high price of the seed. Fertilizer distribution system should be strengthened and regularly monitored by Department of Agricultural Extension personnel. Maize production is more advantageous rather than an import. Maize is playing the key rule in crop diversification in Bangladesh. Crop base mechanization activities, training to young farmers, manufacturers and extension

workers need to be strengthened for the expansion of maize in Bangladesh. Overall, there is tremendous scope to increase the area production and productivity of maize in Bangladesh. However, to boost of maize production both varietal development and crop management research need to be implemented in an integrated approach. Therefore, the future focus of research is development of insect and disease-resistant dwarf high-yielding hybrids varieties of maize adaptable throughout the country in year round.

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