Journal of Agriculture, Food, Environment and Animal Sciences
Tarım, Gıda, Çevre ve Hayvancılık Bilimleri Dergisi
http://www.jafeas.com, ISSN: 2757-5659

J. Agric. Food, Environ. Anim. Sci.
6(2): 688-704, 2025

Trends and Growth Patterns of Rice, Wheat and Maize Production in Bangladesh, 2015-2023

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Research Article

Article History:
Received: 13 May 2024
Accepted: 24 July 2025
Published online: 15 December 2025

***Keywords*:**
Production Trends
Growth Pattern
Cereals
Bangladesh
Linear Regression

ABSTRACT

The sustainability of cereal production has a great impact on food security in Bangladesh. To understand these impacts it is important to study trends in cereal production both in the short-term and the long-term. This study examined the growth of the three major cereal crops, rice, wheat and maize. The current study used a linear regression model for estimating production and yield at national level. Arc GIS was applied for regional level data analysis. The study shows the largest growth of production occurred for rice followed by maize. On the other hand, wheat shows a negative growth rate in terms of production that can be attributed to decline in the area of wheat. It is notable that the growth of maize area, production and yield outpaced wheat. The growth rate of rice, maize and wheat production were 596.2, 293.9 and – 33.5 respectively. The district of Mymensing had the highest production of rice during the study period. The number of high producing districts of wheat have not increased, but high maize production districts have doubled. The study suggests policy must be adopted to revive wheat production for national food security purposes and emphasis must be given for maintaining stability of rice and maize production.

To Cite : Syem MA, Muhibbullah M, Rahman Md.H., 2025. Trends and Growth Patterns of Rice, Wheat and Maize Production in Bangladesh, 2015-2023. Agriculture, Food, Environment and Animal Sciences, 6(2): 688-704.

INTRODUCTION

Agriculture has a crucial role in the economy of Bangladesh, with rice, wheat, and maize being the primary staple crops. Understanding the growth rates of these crops at national and regional levels is essential for policy makers, farmers, and stakeholders to improve productivity, ensure food security, and implement sustainable agricultural practices. Rice is the principal staple food in Bangladesh, serving as the primary source of nutrition for the majority of the population. The country has a long history of rice cultivation, and its production plays a significant role in both food security and the economic development of the nation. Over the years, numerous studies have been conducted to analyze the growth of rice production in Bangladesh, exploring factors such as agricultural policies, technological advancements, climate change, land use, and socioeconomic influences (Kamruzzaman et al., 2006; Hassan et al., 2008; Hussain, 2010; Rahman, 2010; Amin et al., 2015; Rahman and Barmon, 2015). An understanding of the likely magnitude and distribution of future cereal yields is required to prevent or prepare for future food shortages (Hafner, 2003).

Hafner (2003) analyzed the growth of maize, rice and wheat yields of 188 nations, recording average global growth of 62 kg per hectare (maize), 43 kg per hectare (wheat), and 57 kg per hectare (rice) respectively. Finger's (2010) study showed a slower growth of cereals in Switzerland. Brisson et al. (2010) explained the climatic and agronomic factors responsible for slowing yield growth of cereals in France.

Al Mamun et al. (2024) highlight that Boro rice production contributes nearly one percent to the national rice output with its growth rate surpassing that of Aus and Aman rice, which each grow at a rate of less than 0.5 percent annually. Khushi et al. (2020) further emphasize the increasing trend in Boro rice cultivation, which has seen a growth rate of 4.4 percent per year, outpacing both Aus and Aman varieties. At the regional level, Al Mamun et al. (2024) observed that Mymensing, Rangpur, Bogura, Jashore, Rajshahi, and Chattogram were the top rice-producing regions in Bangladesh. Similarly, Syem and Chowdhury (2011) identified Rangpur, Sylhet, Rajshahi, Mymensing, and Comilla as key rice-producing areas. These studies collectively reflect the regional disparities in rice production, with certain areas emerging as major contributors. Moreover, Al Mamun et al. (2024) found that Gopalgonj and Dhaka had the highest average yields, whereas Patuakhali recorded the lowest. This suggests that regional variations in climatic and soil conditions, as well as farming practices, influence rice productivity across Bangladesh.

Wheat production in Bangladesh has experienced slower growth compared with rice and maize. Rahman and Hasan (2009) reported a modest increase in wheat yields from 0.9 tons per hectare (t/ha) to 1.5 t/ha over a 36-year period. They noted that environmental factors and farming conditions play a significant role in influencing wheat productivity. Despite this growth, wheat remains a secondary crop in Bangladesh, with production growth lagging behind that of other cereals. Poudel and Chen (2012) examined the yield trends of wheat, rice, and maize in South Asia, noting that wheat experienced slower growth compared with maize. Their findings highlight the need for policy interventions to boost wheat yields and address the challenges posed by stagnating growth in the country's wheat sector.

Maize production has gained increasing importance in Bangladesh in recent years. Hasan et al. (2008) found a significant growth in maize production, outpacing wheat in terms of yield at the national level. Similarly, Rahman and Rahman (2014) conducted a study involving 300 farmers and found that maize ranked first in terms of yield and return, surpassing both rice and wheat. This trend is indicative of maize's rising importance as a food and feed crop in Bangladesh. The studies by Poudel and Chen (2012) also highlighted that maize exhibited a faster growth rate compared with wheat, contributing positively to food security. However, challenges remain in stabilizing maize yields to ensure a consistent supply for the growing demand. The role of these cereals in ensuring food security in Bangladesh has been widely discussed in the literature. Sers and Mughal (2020) identified that increases in cereal production and yield are significantly linked to reductions in the prevalence of undernourishment. Specifically, one percent increase in cereal production is associated with up to a 0.84 percent decrease in undernourishment rates. This underscores the critical role that improved productivity of rice, wheat, and maize plays in addressing food insecurity in the country. The current study will investigate the production pattern of rice, wheat and maize as these cereals make a major contribution to the supply side of food security in Bangladesh.

MATERIALS and METHODS

Bangladesh is located in South Asia, sharing borders with India to the west, north, and east, and with Myanmar to the southeast. The country is bounded to the south by the Bay of Bengal. Geographically lies between 20°34' and 26°38' North latitude and 88°01' and 92°41' East longitude, encompassing an area of approximately 147,570 square kilometers. Administratively, Bangladesh is divided into 64 districts. The country is characterized by a tropical monsoon climate, and nearly 80% of its land area is composed of floodplains, making it highly conducive to agriculture. According to global production rankings in 2022, Bangladesh was the third-largest producer of rice, ranked 49th in wheat production, and 27th in maize production.

This study utilizes time series data on the production of rice (Oryza sativa), wheat (Triticum aestivum), and maize (Zea mays), collected from the Bangladesh Bureau of Statistics (BBS) at both national and district levels. The dataset spans the period from 2014–15 to 2022–23. We have collected rice,wheat and maize data from the Yearbook Book of Agricultural Statistics and then these data have been aggregated and processed by SPSS (Statistical Package for the Social Sciences) and Microsoft Excel.

For regional-level analysis, ArcView GIS software was applied. It has been used ArcMap version 10.8 to produce the maps and quantities classification (in symbology) tools have been used for regional production analysis.

To analyze the correlation at the national level, a Linear Regression Model was fitted to the data. The model used is based on the one suggested by Hafner (2003) and Finger (2010), as follows:

$$Yt = \beta0 + \beta1\ t \qquad (1)$$

where,

Yt = Predicted value of t, t = Time index, $\beta0$ = Model intercept, $\beta1$ = Annual Change

RESULTS and DISCUSSION

National Trend of Cereal Production

Rice production has experienced significant growth from 2014-15 to 2022-23, with an average growth rate 596,200 metric tons per year during this time (Figure 1). Although the total area for rice cultivation did not increase remarkably, substantial improvements were seen in both production and yield of rice. For Boro rice, on average production increased by 230,900 metric tons per year, and the yield by 15.46 kg /acre during this period (Figure 2), though the cultivated area did not expand notably. In contrast, the average growth rate for Aman rice production was 252,300 metric tons per year, with a yield rate of 14.78 kg/acre. The area for Aman rice cultivation increased on average 44,910 acres per year, much higher than that of Boro (Figure 3). For Aus rice, production increased by 112.900 metric tons per year, but the area increased by 50,750 acres during the study period. However, the yield rate for Aus rice remained relatively low at 10.33 kg/acre (Figure 4).

Among the three rice varieties, Aman experienced the highest growth rate in production with 252,300 metric tons per year (Table 1), while Aus had the largest increase in area. Interestingly, the yield rates of Aman and Boro were almost identical.

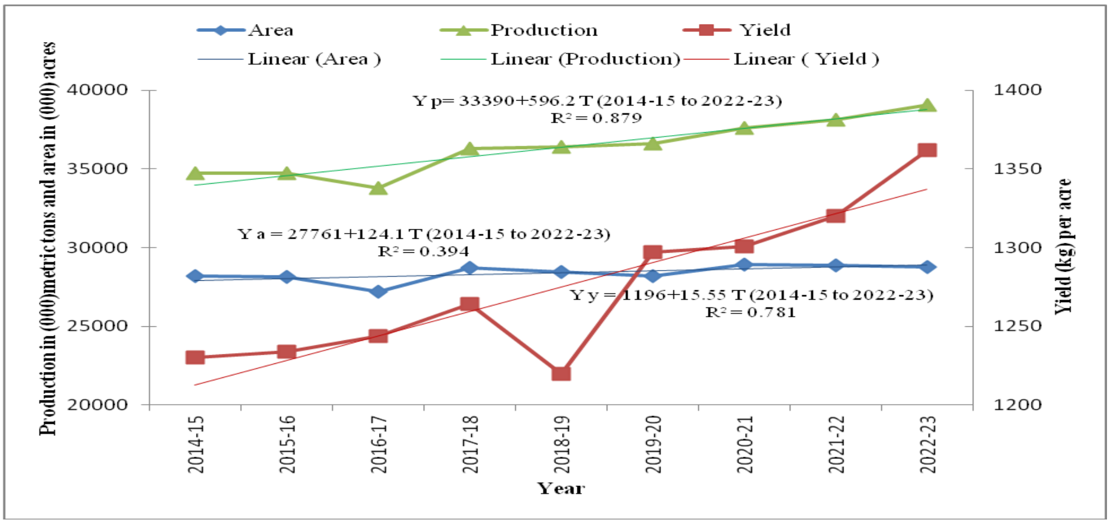

Figure 1. Total area, production and yield of Rice 2014-2015 to 2022-2023 (Source: Produced using BBS data, 2016, 2018 and 2023)

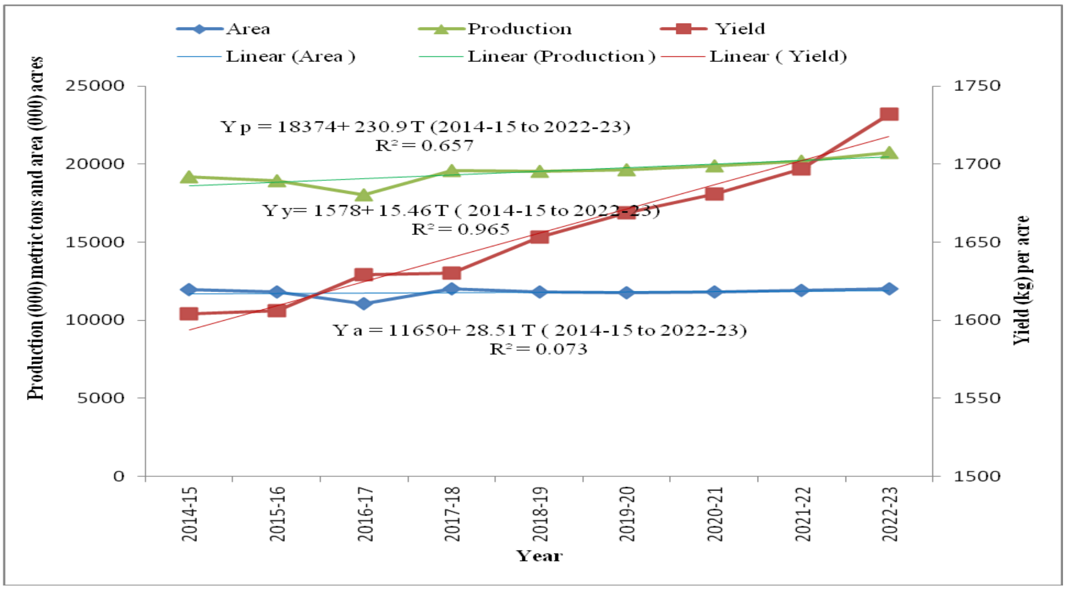

Figure 2. Total area, production and yield of Boro Rice 2014-2015 to 2022-2023 (Source: Produced using BBS data, 2016, 2018 and 2023)

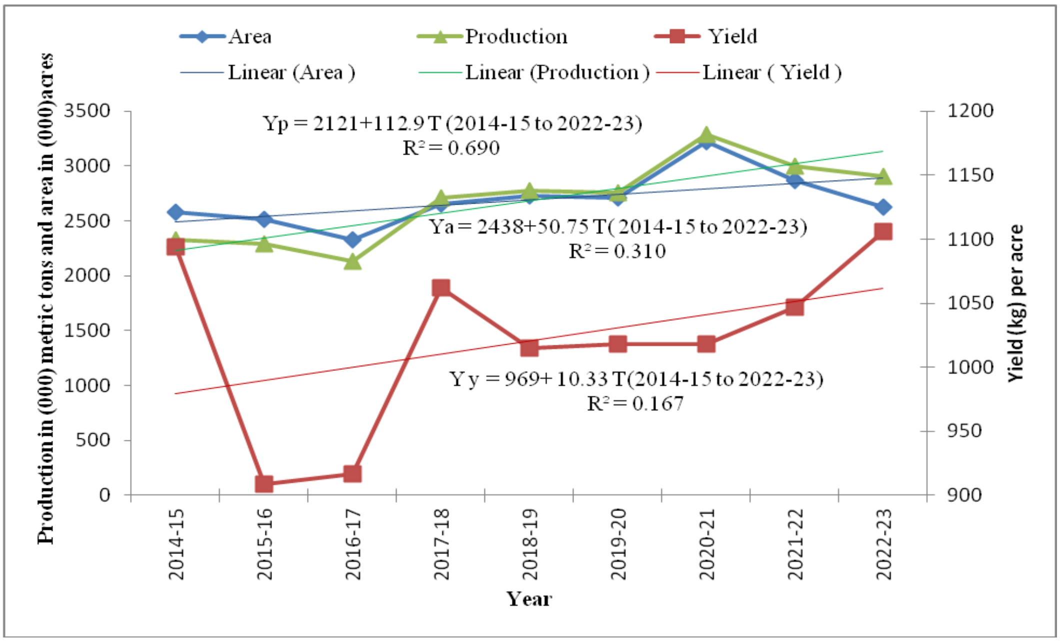

Figure 3. Total area, production and yield of Aman Rice 2014-2015 to 2022-2023 (Source: Produced using BBS data 2016, 2018 and 2023)

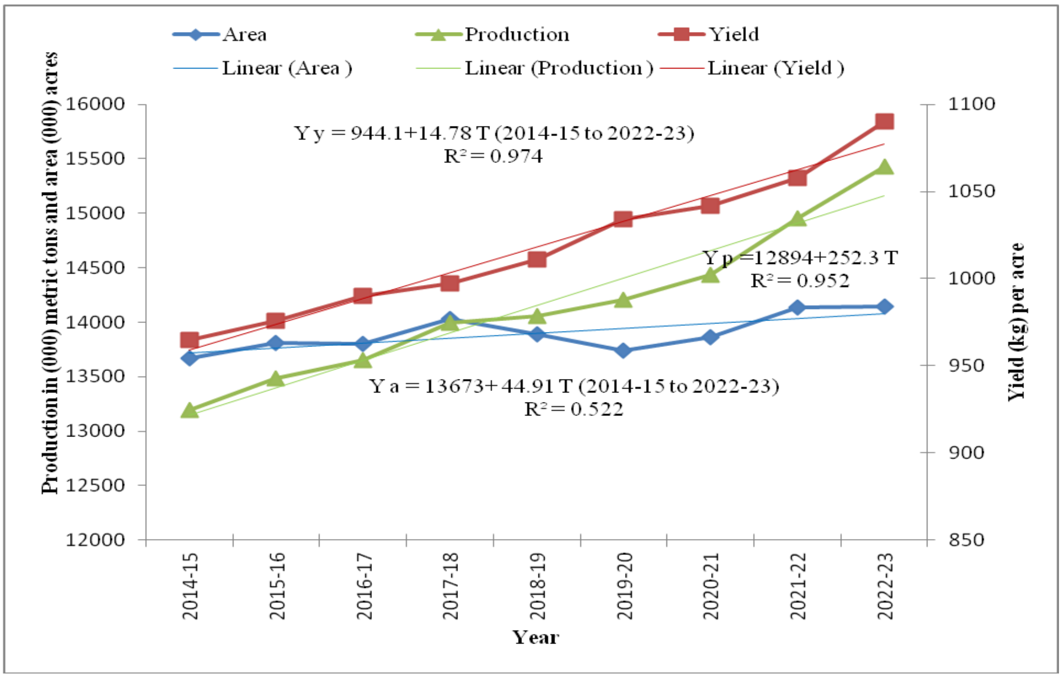

Figure 4. Total area, production and yield of Aus Rice 2014-2015 to 2022-2023 (Source: Produced using BBS data 2016, 2018 and 2023)

In contrast, negative slope coefficients of both area and production for wheat showed declining trends over the study period (Figure 5). However, the yield of wheat increased by 26.45 kg/acre. In the case of maize, slope coefficients of area, production and yield are 56,350 acres, 293,900000 metric tons, and 106.3 kg/acre respectively. These values indicate their rapid growth in the period. The yield rate of maize grew more than four times higher than that of wheat (Table 1). In the case of wheat, the result is consistent with BARI (2010), Larson et al. (2004), Poudel and Chen (2012), and Calderini and Slafer (1998). In the case of maize, the result is consistent with Hafner (2003), Podel and Chen (2012), and Larson et al. (2004). Boro rice and wheat are competing against each other, but Boro rice is more profitable compared with wheat (Morris et al., 1996; Morris et al.,1997; BARI, 2010). In addition, farmers allocate more fertile land to Boro rice which result less productivity of wheat (Poudel and Chen, 2012).

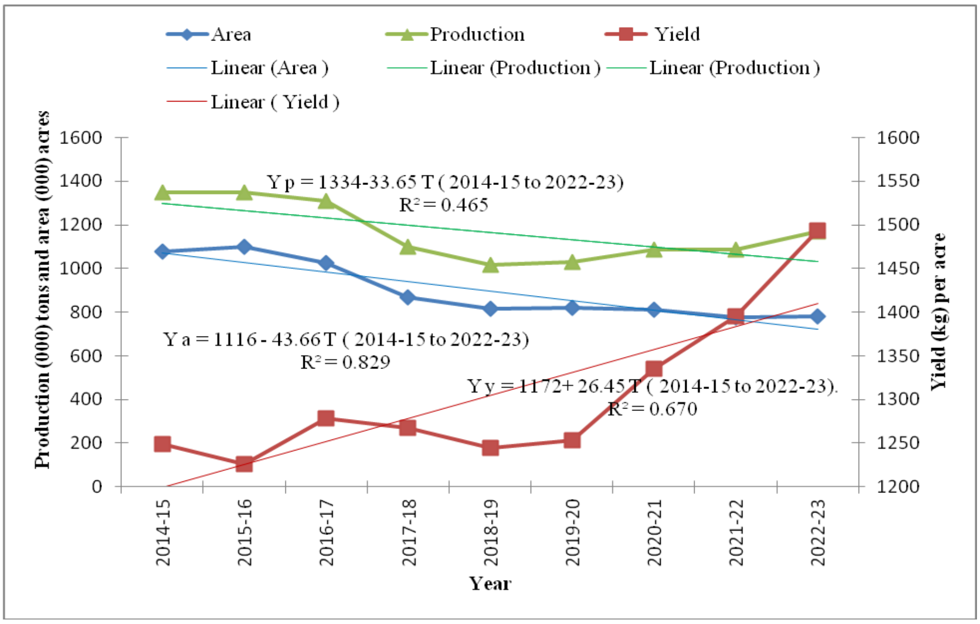

Figure 5. Total area, production and yield of wheat, 2014-2015 to 2022-2023 (Source: Produced using BBS data 2016, 2018 and 2023)

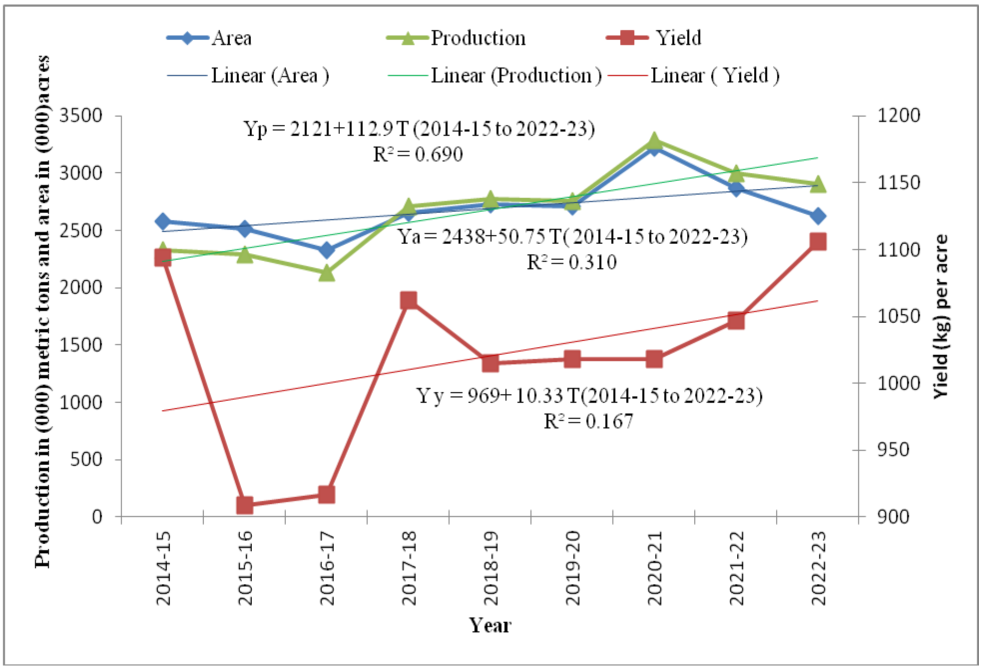

Figure 6. Total area, production and yield of maize, 2014-2015 to 2022-2023 (Source: Produced using BBS data 2016, 2018 and 2023)

Table 1. Annual growth rate of cereal production, area and yield in Bangladesh by fitting linear trend line, 2014-15 to 2022-23

Periods	Cereal	Production	Area	Yield
	Rice	596.2	124.1	15.55
2014-15 to 2022-23	Wheat	-33.65	-43.66	26.45
	Maize	293.9	56.35	106.3
	Aus	112.9	50.75	10.33
2014-15 to 2022-23	Aman	252.3	44.91	14.78
	Boro	230.9	28.51	15.46

Finally, rice exhibited the highest growth in both area and production among the three major cereals during the period from 2014-15 to 2022-23 followed by maize and wheat. Notably, wheat experienced negative growth in both area and production.

Regional Production Patterns

Rice has been produced throughout Bangladesh. However, rice production is varied geographically due to variation of agro-ecology. In addition, regional changes in cereal production affect food security at local levels.

Rice production is presented for the period between 2014-15 and 2022-23. Production is classified into five categories: namely, low (<400 thousand metric tons), lower medium (400-800 thousand metric tons), medium (800-1200 thousand metric tons), upper medium (1200-1600 thousand metric tons), high (> 1600 thousand metric tons). There is only one district (Mymensing) that is a high producing region, indicating more than 1600 thousand metric tons in 2014-15 (Figure 7a). There were three districts (Nagaon, Dinajpur, Bogura) where production was more than average (800-1200 thousand metric tons) in 2014-15. It is notable that production in most districts was below average (800-1200 thousand metric tons). The high producing region (Mymensing) remained in this category in 2022-23 (Figure 7b). Two districts (Jessore and Sunamgonj) were added to the 1200-1600 thousand metric tons production range in 2022-23. However, the number of low producing districts was reduced and upgraded into the lower medium range in 2022-23 (Cox's Bazar, and Bagerhat). Some districts were upgraded from lower medium production to the medium production range (Bhola and Noakhali).

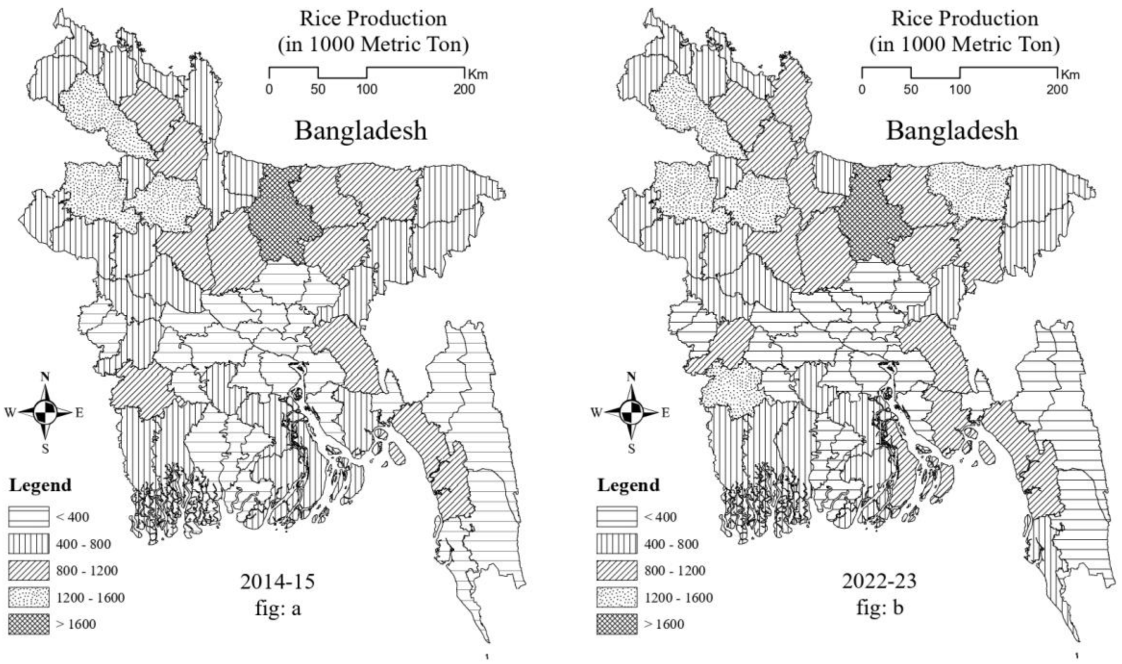

Figure 7(a,b). Patterns of Rice Production in Bangladesh, 2014-15 and 2022-23 (figure a, rice production, 2014-15 and figure b, rice production, 2022-23) (Source: Produced using BBS, 2016 and 2023)

Wheat production regions are also categorized as low (<50 thousand metric tons), lower medium (50-75 thousand metric tons), upper medium (75-100 thousand metric tons) and high (> 100 thousand metric tons) (Figure 7c and 7d). Some districts of the north-western region, like Pabna, Faridpur and Thakurgaon, showed high performance in terms of wheat production (> 100 thousand metric tons) in 2014-15. Some districts (Chapainawabgonj, Rajshahi, Natore, Maherpur, Kushtia, Naogaon, Dinajpur and Panchgar) ranked from higher medium to lower medium in terms of wheat production in 2014-15. However, with the exception of these eleven districts, the remainder was below 50 thousand metric tons. In 2022-23, there was no change in the high producing regions. It is remarkable that the number of lower medium and higher medium production regions decreased in 2022-23 (Figure 8d). This implies that, overall, wheat production decreased in different districts of Bangladesh during the nine years. It also shows that the north-eastern, south-western and south-eastern regions continued to exhibit low performance in terms of wheat production during the reference period (Figure 8d).

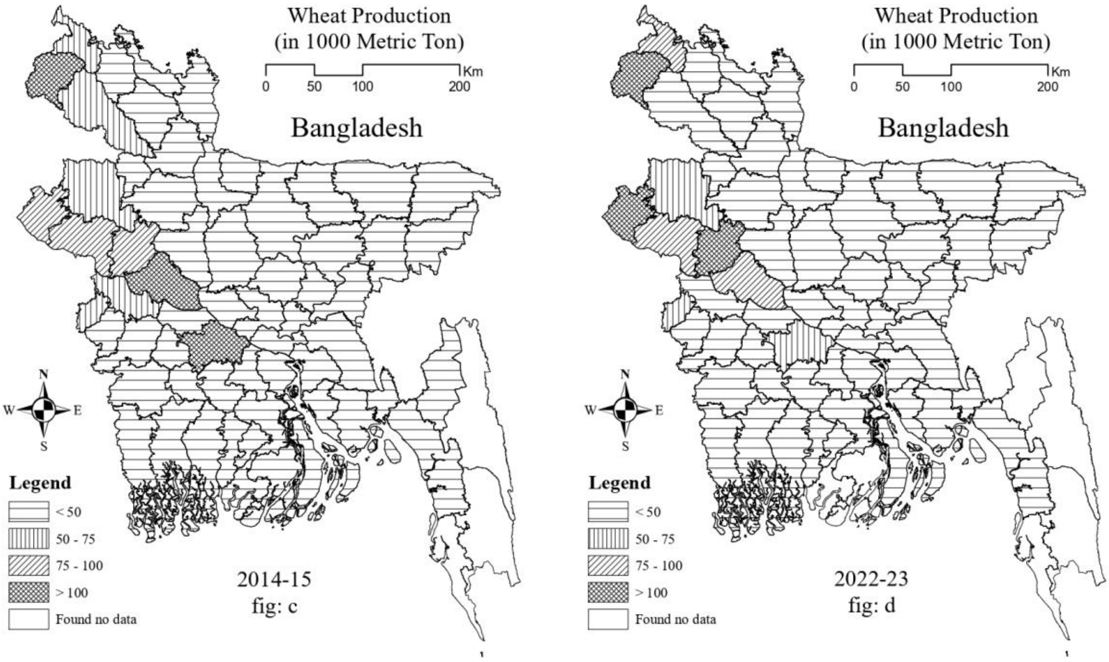

Figure 8 (c, d). Patterns of Wheat Production in Bangladesh, 2014-15 and 2022-23 (figure c, wheat production, 2014-15 and figure d, wheat production, 2022-23) (Source: Produced using BBS, 2016 and 2023)

Maize production has been classified into four categories: namely, low (<50 thousand metric tons), lower medium (50-75 thousand metric tons), upper medium (75-100 thousand metric tons) and high (> 100 thousand metric tons) (Figure 9e and 9f). In 2014-15, seven districts (Thakurgaon, Nilphamari, Dinajpur, Rangpur, Lalmonirhat, Manikganj, and Chuadanga) were in the high performance category in terms of maize production. Jhenaidah and Rajshahi districts were in the upper medium production range in 2014-15 and four districts Comilla, Bogura, Gaibandha and Panchagar were in the lower medium production regions in 2014-15 (Figure 9e). Except for these thirteen districts, the remainder were in low production regions (<50 thousand metric tons). It is notable that the high producing districts of maize doubled in 2022-23 (Figure 9f), and the lower and upper medium producing districts also increased in 2022-23. Spatio-temporal analysis shows that overall maize production has increased when compared with wheat production during the reference period at the regional level.

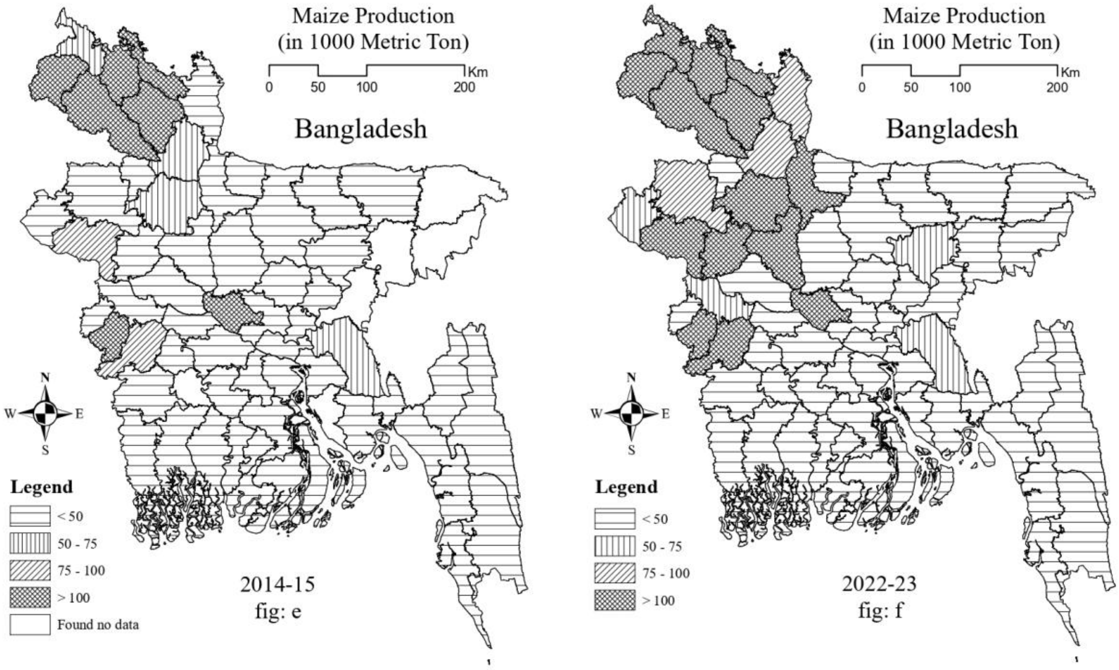

Figure 9 (e, f). Patterns of Maize Production in Bangladesh, 2014-15 and 2022-23 (figure e, maize production, 2014-15 and figure f, maize production, 2022-23) (Source: Produced using BBS, 2016 and 2023)

Implications for Sustainable Development Goals (SDGs) and Food Security

Bangladesh has been actively pursuing the objectives outlined in Sustainable Development Goal 2 (SDG 2), which seeks to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture. The concept of food security is multidimensional and exists when all individuals, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life. The Committee on World Food Security (CFS) identifies four essential pillars of food security: availability, access, utilization, and stability (CFS Reform Document, 2009). Among these, availability refers to the consistent supply of adequate quantities and quality of food through domestic production, imports, or food assistance.

In the context of Bangladesh, the availability dimension of food security—particularly in terms of cereal production—plays a foundational role. The country has witnessed notable improvements in rice production over recent decades, positioning "rice security" as a cornerstone of overall food security (Kabir et al., 2021). While rice self-sufficiency has been largely achieved, the production trends of other staple cereals have shown a mixed trajectory. Wheat production has stagnated or declined in recent years, while maize cultivation has experienced a notable increase, driven largely by rising demand from the poultry and feed industries.

Ensuring long-term cereal production stability and sustainability is crucial for maintaining food security in Bangladesh. Stability, as one of the core pillars of food security, implies that individuals should have consistent and uninterrupted access to food throughout the year, regardless of seasonal or economic fluctuations. However, this pillar is increasingly threatened by climate change, which poses severe risks to agricultural sustainability in the country. Bangladesh is recognized as one of the countries that is most vulnerable to climate change due to its geographic location, low elevation, high population density, and dependency on climate-sensitive sectors like agriculture. Variations in temperature, rainfall patterns, solar radiation, and atmospheric carbon dioxide (CO_2) levels have significant effects on crop growth and yields (Li et al., 2024). These changes, particularly rising temperatures and erratic rainfall, pose direct threats to rice production—the mainstay of the country's food supply. Research indicates that the average surface air temperature in Bangladesh has been rising consistently over the past four decades, with observed increases ranging from 0.4°C to 0.65°C (Nishat and Mukherjee, 2013). Forecasts suggest that the average daytime temperature may increase by 1.0°C by 2030 and by 1.4°C by 2050 (FAO, 2006; IPCC, 2007). Rainfall patterns have also become more unpredictable, with a rise in the number of dry days, even though total annual rainfall has remained relatively constant. This uneven distribution has led to increased incidences of droughts and floods, adversely affecting rice yields (Alauddin & Hossain, 2001; UNDP, 2008).

The potential impact of climate change on rice production is particularly alarming. Projections estimate that rice yields could decline by 8–17% by 2050 if adaptive measures are not implemented (BBS, 2005; IPCC, 2007). This decline threatens to reverse the gains made in achieving rice self-sufficiency, exacerbating the risks of food insecurity. Wheat production has declined due to various environmental stresses, with drought having particularly severe effects on winter wheat crops in the northern and central regions of Bangladesh (Hossain and Silva, 2013). Developing drought-tolerant wheat varieties is a crucial strategy for protecting the crop from the adverse impacts of drought (Hannan et al., 2022).

In addition to long-term climate trends, Bangladesh is frequently affected by acute natural disasters, including floods, flash floods, cyclones, droughts, and the seasonal nor 'wester storms (Kal-Baisakhi) (Banerjee, 2010). These events disproportionately affect agricultural regions, destroying standing crops, damaging infrastructure, and disrupting supply chains. The southern coastal belt is particularly vulnerable due to its exposure to sea-level rise and saline water intrusion, which severely compromises rice cultivation. Salinity reduces soil fertility, hinders seed germination, and limits the range of crops that can be successfully grown. Furthermore, frequent waterlogging and prolonged flooding events disrupt planting schedules and reduce crop yields.

These environmental challenges necessitate targeted interventions and the development of climate-resilient agricultural systems.

To address these multifaceted challenges, it is imperative that sustainability and stability considerations be integrated into Bangladesh's agricultural policies. Enhancing cereal production resilience will require a combination of technological innovation, infrastructural development, and institutional support. The development and dissemination of stress-tolerant crop varieties—such as drought-resistant rice, salinity-tolerant wheat, and flood-resilient maize—should be prioritized. Public and private sector research institutions need to collaborate in scaling up these innovations. Reducing the over-reliance on rice by promoting crop diversification can mitigate risks associated with mono-cropping. Introducing high-nutrition, climate-resilient alternatives such as legumes, oilseeds, and root crops can enhance food security and nutritional outcomes. Efficient irrigation practices, rainwater harvesting, and investments in water management infrastructure are critical for adapting to erratic rainfall patterns. This includes modernizing flood control systems and ensuring equitable distribution of irrigation facilities. Expanding agricultural extension services to disseminate knowledge about climate-smart agriculture, integrated pest management, and sustainable land use practices can empower farmers to adapt more effectively to changing climatic conditions. Strengthening meteorological services and establishing community-based early warning systems can enhance preparedness and reduce the damage caused by extreme weather events. Coordination among ministries of agriculture, environment, and disaster management is essential for formulating holistic policies. Integrating SDG-2 goals into national development plans can help align efforts across sectors.

Bangladesh has made commendable progress in achieving food security, particularly through increased rice production. However, this success remains fragile in the face of mounting threats from climate change and natural disasters. Sustainable food security, aligned with the objectives of SDG-2, will require not just production-focused strategies but systemic reforms that address the broader socio-environmental context of agriculture. Ensuring the stability and sustainability of cereal production is both a policy challenge and an opportunity. Through the adoption of climate-resilient technologies, crop diversification, and improved risk management, Bangladesh can build a more robust and sustainable food system. These efforts will be pivotal not only in securing the country’s food supply but also in advancing broader sustainable development goals, including poverty alleviation, improved nutrition, and ecological resilience.

CONCLUSION

Rice, wheat and maize are the major food grains of Bangladesh. The available supply of these grains can promote food security in Bangladesh. Positive coefficients in the regression models in case of rice and maize, imply sustainability of these cereals in terms of output. However, negative coefficients in the case of wheat, indicate a declining trend of this cereal which might affect the supply side of food security of Bangladesh. In this scenario, incentives for use of high technology and seed could be adopted to restore production and yield of wheat. In addition, studies on the impact of climate change, and farmers' adaptation strategy can be also conducted aimed at maintaining stability of wheat production. Moreover, to improve growth of this cereal some measures addressing land use, price changes, policy reforms, intensive and extensive agriculture, and environmentally friendly cereal production can be introduced, as suggested by Finger (2010). Region-specific policy should be considered to overcome regional constraints relating to soil, rainfall, and temperature. In addition, policy should be formulated involving farmers' financial capacity, land ownerships, and local marketing. In addition, policy must be implemented to manage natural disasters like drought, flood, salinity, flash floods, and tidal floods at a regional level. Policy should be introduced to increase regional-level production of rice, wheat and maize, especially where rice and wheat production is insufficient at regional level, as indicated where by the high production districts not increasing over time.

ACKNOWLEDGEMENTS

I am very much grateful to reviewers Professor Guy M Robinson, Department of Geography, Environment and Population, University of Adelaide, South Australia and Dr Mohammad Abu Taiyeb Chowdhury, Professor (Ex.), Department of Geography and Environmental Studies, University of Chittagong, Bangladesh for their valuable comments and queries.

Conflict of Interest

No potential conflict of interest was reported by the author(s).

Contribution of the Authors

Authors declares the contribution of the authors is equal.

REFERENCES

Al Mamun MA, Nihad SHI, Sarker MR, Sarker MAR, Hossain MI, Kabir MS., 2024. Spatiotemporal mapping of rice acreage and productivity growth in Bangladesh. PLoS One, 19(3): e0300648. https://doi.org/10.1371/journal.pone.0300648

Alauddin M, Hossain M., 2001. Environment and agriculture in a developing economy: Problems and prospects for Bangladesh. Edward Elgar, Cheltenham, UK and Northampton, MA.

Amin MR, Zhang J, Yang M., 2015. Effects of climate change on the yield and cropping area of major food crops: A case of Bangladesh. Sustainability, 7(1): 898–915. https://doi.org/10.3390/su7010898

Banerjee L., 2010. Effects of flood on agricultural productivity in Bangladesh. Oxford Development Studies, 38(3): 339-356.

BARI., 2010. Wheat production in Bangladesh: A success story. Bangladesh Agricultural Research Institute, Dhaka.

BBS (Bangladesh Bureau of Statistics)., 2005. Compendium of environment statistics of Bangladesh. Government of Bangladesh, Dhaka.

BBS (Bangladesh Bureau of Statistics)., 2016. Yearbook of agricultural statistics of Bangladesh. Government of Bangladesh, Dhaka.

BBS (Bangladesh Bureau of Statistics)., 2018. Yearbook of agricultural statistics of Bangladesh. Government of Bangladesh, Dhaka.

BBS (Bangladesh Bureau of Statistics)., 2023. Yearbook of agricultural statistics of Bangladesh. Government of Bangladesh, Dhaka.

Brisson N, Gate P, Gouache D, Charmet G, Oury FX, Huard F., 2010. Why are wheat yields stagnating in Europe? A comprehensive data analysis for France. Field Crops Research, 119: 201–212.

Calderini DF, Slafer GA., 1998. Changes in yield and yield stability in wheat during the 20th century. Field Crops Research, 57: 335–347.

FAO., 2006. Food and Agriculture Organization. Livelihood adaptation to climate variability and changes in drought-prone areas of Bangladesh. FAO, Rome.

Finger R., 2010. Evidence of slowing yield growth: The example of Swiss cereal yields. Food Policy, 35(2): 175–182. https://doi.org/10.1016/j.foodpol.2010.06.004

Hafner S., 2003. Trends in maize, rice, and wheat yields for 188 nations over the past years: Prevalence of linear growth. Agriculture, Ecosystems and Environment, 97: 275–283.

Hannan A, Najmol Hoque M, Hassan L, Hasan Khan Robin A., 2022. Drought-affected wheat production in Bangladesh and breeding strategies for drought tolerance. In: IntechOpen. https://doi.org/10.5772/intechopen.95283

Hasan MN, Miah MAM, Islam MS, Alam QM, Hossain MI., 2008. Change and instability in area and production of wheat and maize in Bangladesh. Bangladesh Journal of Agricultural Research, 33(3): 409–417. https://doi.org/10.3329/bjar.v33i3.1600

Hossain A, Teixeira da Silva JA., 2013. Wheat production in Bangladesh: Its future in the light of global warming. AoB Plants, 5: pls042. https://doi.org/10.1093/aobpla/pls042

Hussain SG., 2010. Assessing impacts of climate change on cereal production and food security in Bangladesh. In: Lal R, Sivakumar M, Faiz S, Rahman AM, Islam K (eds), Climate change and food security in South Asia. Springer, Dordrecht. https://doi.org/10.1007/978-90-481-9516-9_28

IPCC., 2007. Fourth assessment report of the Intergovernmental Panel on Climate Change: Impacts, adaptation and vulnerability (Working Group III). Cambridge University Press, Cambridge, UK and New York, USA.

Kabir MS, Salam M, Islam A, Sarkar MAR, Mamun M, Rahman M, Rahman N., 2021. Doubling rice productivity in Bangladesh: A way to achieving SDG 2 and moving forward. Bangladesh Rice Journal, 24(2): 1–47. https://doi.org/10.3329/brj.v24i2.53447

Kamruzzaman M, Manos B, Psychoudakis A, Martika M., 2006. Food policy in Bangladesh 2010: Impacts of domestic wheat productivity growth. International Journal of Social Economics, 33(4): 298–315. https://doi.org/10.1108/03068290610651625

Khushi H, Moniruzzaman M, Tabassum N., 2020. Growth scenarios of area, production and yield of rice in Bangladesh. Bangladesh Journal of Agricultural Economics, 41(2): 81–97.

Larson DW, Jones E, Pannu RS, Sheokand RS., 2004. Instability in Indian agriculture: A challenge to the Green Revolution technology. Food Policy, 29: 257–273.

Li , Zhao Y, Han J, Yang Q, Liang J, Liu X, Huang Z., 2024. Impacts of future climate change on rice yield based on crop model simulation—A meta-analysis. Science of The Total Environment, 949: 175038. https://doi.org/10.1016/j.scitotenv.2024.175038

Morris ML, Chowdhury N, Meisner C., 1996. Economics of wheat production in Bangladesh. Food Policy, 21: 541–560.

Morris ML, Chowdhury N, Meisner C., 1997. Wheat production in Bangladesh: Technological, economic, and policy issues. International Food Policy Research Institute, Washington, DC.

Nishat A, Mukherjee N., 2013. Climate Change in Bangladesh: Temperature Trends and Impacts. Journal of Environmental Studies, 22(1): 45–58.

Poudel MP, Chen S-E., 2012. Trends and variability of rice, maize and wheat yields in South Asian countries: A challenge for food security. Asian Journal of Agriculture and Rural Development, 2(4): 584–597.

Rahman S, Barmon BK., 2015. Productivity and efficiency impacts of urea deep placement technology in modern rice production: An empirical analysis from Bangladesh. Journal of Developing Areas, 49(3): 119–134. https://doi.org/10.1353/jda.2015.0158

Rahman S, Hasan MK., 2009. Wheat in Bangladesh: Yield growth, production performance and determinants. In: Evans G, Davies S (eds), Soybean and wheat crops: Growth, fertilization and yield. Nova Science Publishers, New York, pp. 315–331.

Rahman S, Rahman MS., 2014. Exploring the potential and performance of maize production in Bangladesh. International Journal of Agricultural Management, 3(2): 99–107.

Rahman S., 2010. Six decades of agricultural land use change in Bangladesh: Effects on crop diversity, productivity, food availability and the environment, 1948–2006. Singapore Journal of Tropical Geography, 31(2): 254–269.

Sers CF, Mughal M., 2020. Cereal production, undernourishment and food insecurity in South Asia. Review of Development Economics, 24(2): 524–545.

Syem MA, Chowdhury MAT., 2011. Regional patterns of foodgrain production in Bangladesh: Implications for national food security and the environment. Asian Profile, 39(4): 331–349.

UNDP., 2009. GOB (Government of Bangladesh) and United Nations Development Program. The probable impacts of climate change on poverty and economic growth and options of coping with adverse effects of climate change in Bangladesh, Dhaka.