



ISSN: 2617 – 8338 (Online)
: 2617 – 832X (Print)

EBAUB Journal

An Academic Journal of
EXIM Bank Agricultural University Bangladesh

An Economic Analysis of Growth and Variability in Area, Production and Yield of Selected Fruits in Bangladesh

Mousumi Saha^{1*}, Mst. Anila Khatun²

¹Department of Statistics, EXIM Bank Agricultural University Bangladesh, Chapainawabganj-6300, Bangladesh

²Faculty of Agricultural Economics and Rural Development, EXIM Bank Agricultural University Bangladesh, Chapainawabganj-6300, Bangladesh

ARTICLE INFO	ABSTRACT
Received date: Sep. 30, 2022 Accepted date: Dec. 29, 2022	To comprehend how output varies over time, it is crucial to measure the trends of growth and variability in agricultural production. The purpose of this study was to look into the trend, instability, and decomposition analysis of a selected fruits in Bangladesh from 2007 to 2020. Banana, mango, pineapple, jackfruit, papaya and watermelon which make up more than 50% of the total area cultivated were used for collecting data in the present study. The study employs time series data from secondary sources on their area, production, and yield. The annual growth was estimated using the compound annual growth rate function and Cuddy Della index was used to measure instability. According to the study, papaya, mango, and watermelon experienced the highest growth rates in terms of area, output, and yield. With a negative compound growth rate and a falling cyclical trend in yield, mango, jackfruit, and papaya displayed poor productivity during the study period. Mango, watermelon, and pineapple, in that order, had the highest levels of production, area, and productivity instability. The decomposition analysis reveals that the area impact, which more than offset the negative yield effect of these fruits, contributed to the growth of banana, mango, jackfruit, and papaya. The study's findings are crucial for horticulturists, researchers, extension specialists, and policymakers who want to increase fruit output in the country.

Keywords: Banana, Growth and variability, Jackfruit, Mango, Papaya, Productivity instability

*CORRESPONDENCE

mousumisaha559@gmail.com

Department of Statistics, EXIM Bank Agricultural University Bangladesh, Chapainawabganj-6300, Bangladesh

1. INTRODUCTION

Bangladesh is fortunate to have a plethora of fruits and vegetables available throughout the year. Fruits in Bangladesh cover an area of 242.8 thousand hectares with a total production of 36.44 lakh metric tons (BBS, 2021). According to the latest data from the Food and Agriculture Organization of the United Nations (FAO), fruit production in Bangladesh has been increasing at a rate of 12.5 percent for 20 years. Bangladesh has already reached a unique peak in fruit production. Every year, the country is surpassing the previous record in fruit production. It has also been among

the top 10 largest countries to yield a number of significant fruits- second in jackfruits, seventh in mangoes, eighth in guavas (Prothom Alo, 2021). The initial goal of this study is to look at the patterns in the area, production, and yield of selected fruits grown in Bangladesh.

The need for agricultural growth is very vital in the development of an economy. Some researchers have found out that it is necessary to maintain a sustainable agriculture growth regardless of how fast the nonagricultural sector grows. Mostly economists agree that agricultural growth is not only an essential component but also a precondition for growth in the rest of economy. To keep pace of sustainable

To Cite: Saha, M., & Khatun, M. A. (2023). An economic analysis of growth and variability in area, production and yield of selected fruits in Bangladesh. *EBAUB J.*, 5, 83-91.

economic growth, quantitative assessment of the contribution of various factors to growth of agricultural output is important. There are many factors responsible for the agriculture growth. Among these, area and yield are the one (Singh 1981). These sources of growth are very important for agricultural development programs and for investment priorities (Ranade, 1980). Knowledge of difference in growth rates is important to remove the bottlenecks in achieving the speedy development in agriculture sector (Sikka & Vaidya, 1985).

Growth decomposition in agriculture output has remained very important issue for researchers and policy makers. To facilitate output project with alternative targets and policies, the breakdown of growth into various components such as area, yield and cropping pattern is important (Jamal & Zaman, 1992).

Understanding the state of fruit development in Bangladesh requires an investigation of productivity changes in addition to growth. The level of fluctuations is influenced by a variety of related elements, including fruit production technology, weather sensitivity, the overall economic climate, input availability, and many more. The area, production, and yield growth rates for fruits could make it easier to predict how they will develop in our nation in the future.

The trend of fruit production in the past and the estimation of its growth rates can provide a basis for future projections of agricultural output. Analyzing the expansion and instability in the region, as well as the productivity and output of particular fruits, is the research's next goal. Thus, the current study attempts to assess the growth and variability of a few fruits in Bangladesh as well as the contribution of different components to the rise of total output from 2007 to 2020.

The paper has been organized in the given manner. The methodology section defines the data sources and techniques used in the study. After that, empirical results are given. Finally, the paper deals with conclusions and policy recommendations.

2. MATERIALS AND METHODS

2.1. Data Sources

Time series data on the area, production, and yield of specific fruits, such as banana, mango, pineapple, jackfruit, papaya, and watermelon, were gathered from secondary sources, such as various issues of the Yearbook of Agricultural Statistics, over the course of 13 years, from 2007 to 2020. The selection of the study period was mainly due to availability of data for this period of time. Only the chosen fruit crops were included in this analysis because they make up more than 50% of the total planted area. In order to fulfill the objectives of the study, the successive methodologies have been used:

2.2. Estimation of Growth Rates

Table 1 Percentage change in area, production and yield of major fruits in Bangladesh over the period of 2007-08 to 2019-20

Based on the following formula given by Rehman et al., 2011, the compound growth rate (CGR) function was estimated by fitting a semi-log trend equation as follows:

$$\ln Y = a + bt + e \quad (1)$$

where Y is the harvested area (acres)/production (MT)/yield (Kg. /acre); t is the period in the year; a is the constant; $b = (1 + r)$ is the slope coefficient that measures the instantaneous relative change in Y for a given absolute change in the value of an explanatory variable; r is growth rate; ln is the natural logarithm, and e is the error term.

The value of coefficients a and b was gotten by using the technique of Ordinary Least Squares (OLS) estimation. The study considered that the change in agricultural production in year was depended upon the production of the preceding year. Therefore, estimating growth of agricultural output over time by using linear function may turn out to be less efficient than log linear.

According to Gujarati (2003), the Compound Growth Rate (CGR) which represents a uniform rate of change from year to year is calculated by taking Antilog of estimated value of b for the time period (t), subtracting 1 from it and converts the results into percentages.

$$CGR = (\text{antilog } b - 1) \times 100 = (e^b - 1) \times 100 \quad (2)$$

The positive value of b ($b > 0$) indicated the growth overtime while the negative value of b ($b < 0$) showed a deceleration in the growth. A value of b close to zero indicates absence of any trend Growth rates were tested for their significance using the Students t-test. The t-test was used to check whether there were statistically significant differences over the study periods in the harvested area, production, and yield of selected fruits.

2.3. Instability Analysis

Agricultural instability in harvested area, production, and yield can be measured by different methods. The three commonly used methods are coefficient of variation (CV), Cuddy -Della Valle Index (CDVI), and Coppock Instability Index (CII), each having their merits and demerits. Although these three methods overwhelmingly dominate the applications literature in measuring risk and instability of agricultural production, CV has been widely criticized because it overestimates instability, i.e., if CV is used to measure instability, a region with a constant rate of production growth will score a high level of instability. The present study deployed CDVI to measure instability in area, production and yield of six fruits in Bangladesh since it corrects the problem of CV, i.e., overestimation of the level of instability in time-series data by long-term trends. As against, In contrast, CDVI tries to offset the trend of the CV by actually showing the precise direction of the instability and using the coefficient of determination. (Cuddy & Valle, 1978). The CDVI is obtained from CV. According to Ikuemonisan et al., 2020, CDVI to measure the variability in the time-series data was calculated as:

$$CDVI = CV \times \sqrt{1 - R^2} \quad (3)$$

$$\text{With } CV = \frac{\sigma}{\bar{X}} \times 100 \quad (4)$$

Fruits	Average area (acre) over 2007-08 to 2019-20	Percentage change over 2007-08	Average production (acre) over 2007-08 to 2019-20	Percentage change over 2007-08	Average yield (Kg. /acre) over 2007-08 to 2019-20	Percentage change over 2007-08
Banana	123086.308	-7.490	803496.769	-6.751	6537.437	0.799
Mango	172099.31	200.972	1025568.615	52.273	10342.759	-49.406
Pineapple	34006.077	-5.594	208547.462	3.693	7890.694	9.836
Jackfruit	28475.923	66.102	1005058.538	2.605	36749.564	-38.228
Papaya	4917.8462	83.083	126330.077	26.127	33102.112	-31.109
Watermelon	30644.769	-2.337	239942.615	24.547	7862.452	27.526

Where: CDVI is coefficient of variation (CV) around trend (instability index); CV is coefficient of variation in percent; $\bar{R}^2$ is coefficient of determination from a time-trend

regression adjusted for its degrees of freedom; σ is Standard Deviation; and $\bar{X}$ is mean. A higher numerical value for the index represents greater instability and vice-versa.

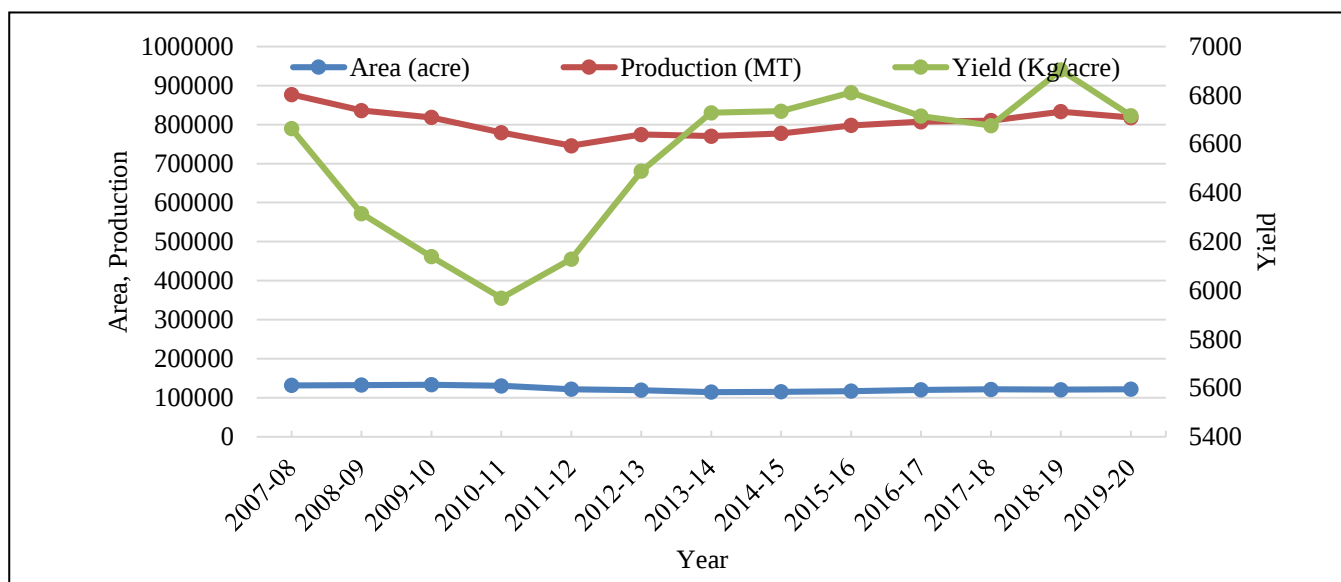


Fig.1 Trends in harvested area, production and productivity of banana.

2.4. Decomposition Analysis

Any change in the production of a crop in physical terms depends fundamentally on the changes in the harvested area under the crop and its average yield. A decomposition analysis model was used to measure the relative contribution of harvested area and yield and the interaction of the two in total production. As used by many researchers (e.g., Kakali & Basu, 2006; Dupare *et al.*, 2014; Pattnaik & Shah, 2015; Verma *et al.*, 2017; Sharma *et al.*, 2017), the decomposition analysis in this study was performed by using the following equation:

$$\Delta P = Y_b \Delta A + A_b \Delta Y + \Delta A \Delta Y \quad (5)$$

where, $\Delta P = P_c - P_b$ = change in production; $\Delta Y = Y_c - Y_b$ = change in yield; $\Delta A = A_c - A_b$ = change in area. P_b , Y_b , and A_b are the production, yield, and harvested area for the base year respectively; P_c , Y_c , and A_c are the production, yield and harvested area for the current year respectively.

The first term on the right hand side is considered as yield effect, second term as the area effect, and the third as the interaction effect. Thus, total change in output can be decomposed into three effects; yield effect, area effect, and interaction effect due to change in yield and area. The contributions of yield, harvested area and their interaction are estimated by applying the formula: $A_b \frac{\Delta Y}{\Delta P}$, $Y_b \frac{\Delta A}{\Delta P}$ and $\Delta A \frac{\Delta Y}{\Delta P}$, respectively.

3. RESULTS

Table 1 shows that, with the exception of bananas, pineapples, and watermelons, all fruits saw an increase in area during the time period. The highest increase in area was recorded for mango (200.972%), while the lowest for jackfruit (66.102%). Banana (-7.490%) recorded the highest decrease in area, while the lowest decrease was in water melon (-2.337%). The average production of all fruits

Table 2 Average annual growth rates of area

Fruits	Intercept	Compound Growth Rate (%)	t-ratio	P- value	F-ratio	P- value	R ²
Banana	11.783	-0.900	327.568***	0.000	8.955**	0.012	0.449
Mango	11.155	7.400	18.025***	0.000	1.640	0.227	0.130
Pineapple	10.477	-1.700	25.604***	0.000	0.186	0.674	0.017
Jackfruit	9.946	4.200	85.344***	0.000	12.286***	0.005	0.528
Papaya	7.689	10.000	32.863***	0.000	9.870***	0.009	0.473
Watermelon	10.409	-1.200	169.781***	0.000	4.006*	0.071	0.267

Note: ***, ** and * indicates significant at 1%, 5% and 10% level respectively

Table 3 Average annual growth rate of production

Fruits	Intercept	Compound Growth Rate (%)	t-ratio	P- value	F-ratio	P- value	R ²
Banana	13.605	-0.100	303.102***	0.000	0.149	0.707	0.013
Mango	13.546	4.100	289.759***	0.000	136.742***	0.000	0.926
Pineapple	12.259	-0.200	171.326***	0.000	0.111	0.745	0.010
Jackfruit	13.769	0.700	379.063***	0.000	7.459**	0.020	0.404
Papaya	11.639	1.500	247.204***	0.000	13.661***	0.004	0.554
Watermelon	12.311	1.000	87.756***	0.000	0.697	0.422	0.060

Note: ***, ** and * indicates significant at 1%, 5% and 10% level respectively

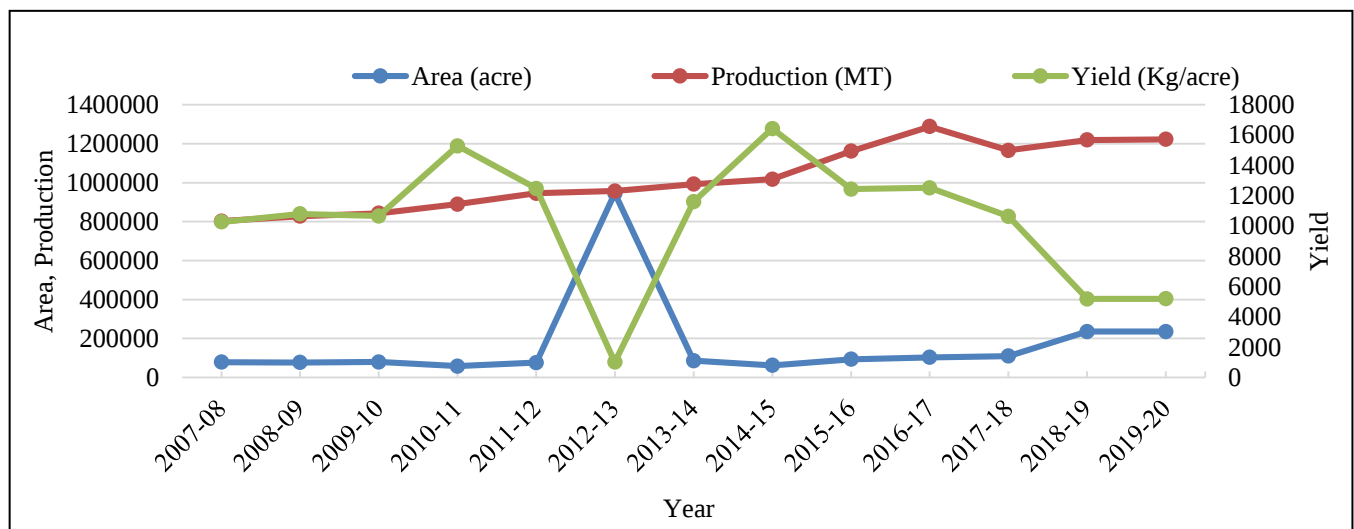


Fig. 2 Trends in harvested area, production and productivity of mango.

increased except banana. The highest increase in production was recorded for mangoes (52.273%) while the lowest for jackfruit (2.605%). The average yield of all fruits increased except mango, jackfruit and papaya over the base year (2007-08).

The trend in area, production and yield of banana for different years is presented in the Fig. 1. In Fig. 1, it has been shown that area under banana cultivation was more or less same but in the last few years it was slightly decreasing year by year after the period 2009-10. Production of banana followed more or less similar trend of area of banana. But the yield of banana was decreasing up to 2010-11 after that yield of it exhibited fluctuating trend. Fig. 2 displays the trend in mango production, yield, and area over several

years. The area used for mango cultivation first decreased for a few years before progressively increasing from 2013-2014 to 2019-2020. Production of mango followed increasing trend over the overall period (2007-08 to 2019-20). On the other hand, yield of mango exhibited fluctuating trend during the whole period.

In Fig. 3, the trend in pineapple area, production, and yield for several years is displayed. Up until 2014-2015, the area used for pineapple cultivation was declining; however, after that, it began to increase and followed a more-or-less similar pattern. Production of pineapple drastically decreases after 2009-10. Although its production increased after 2011-12 but the trend was not so high. Yield of pineapple was increasing up to 2014-15, then decrease in

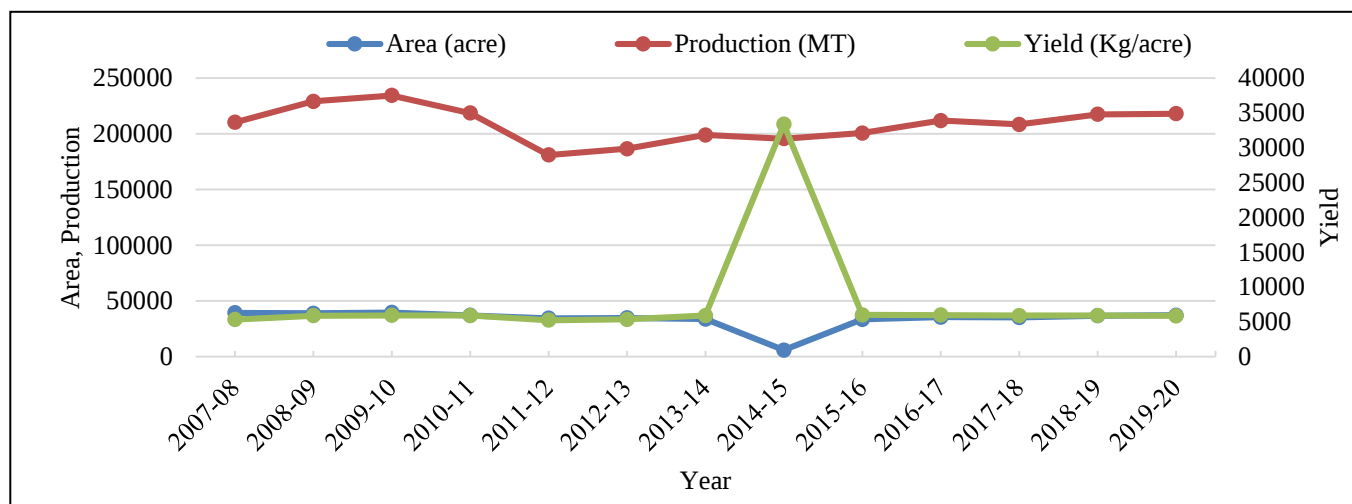


Fig. 3 Trends in harvested area, production and yield of pineapple

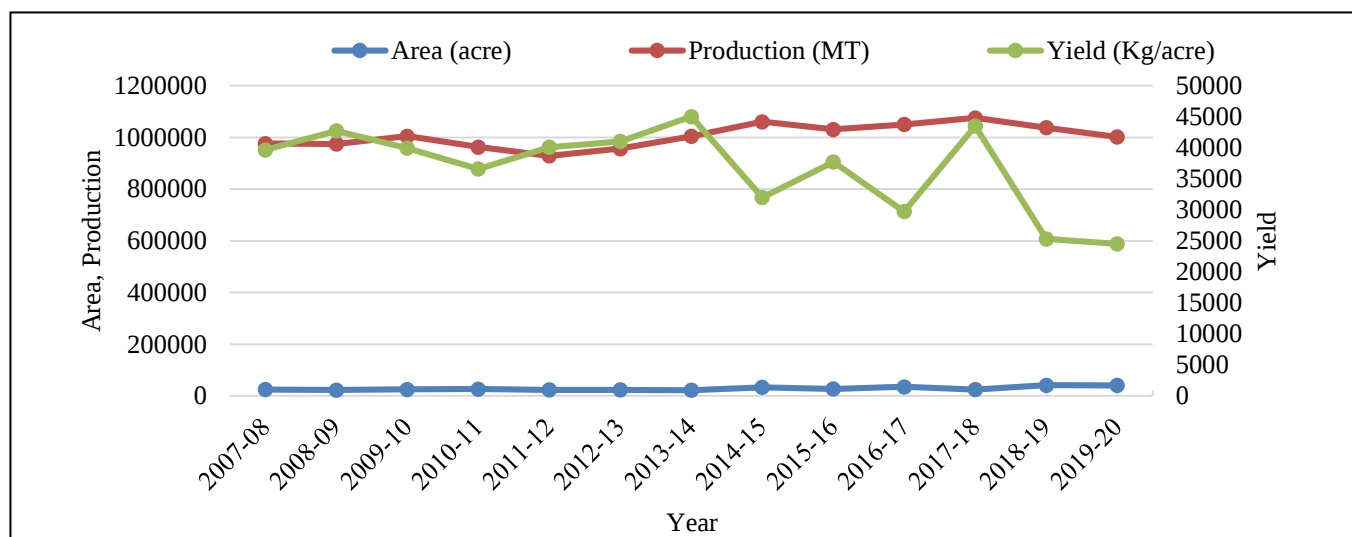


Fig. 4 Trends in harvested area, production and yield of jackfruit.

Table 4. Average annual growth rate of yield.

Fruits	Intercept	Compound Growth Rate (%)	t-ratio	P- value	F-ratio	P- value	R ²
Banana	8.729	0.800	364.768	0.000	8.227**	0.015	0.428
Mango	9.299	-3.000	17.776	0.000	0.297	0.596	0.026
Pineapple	8.690	1.500	26.569	0.000	0.157	0.700	0.014
Jackfruit	10.731	-3.300	84.469	0.000	8.183**	0.015	0.427
Papaya	10.858	-7.700	30.755	0.000	6.152**	0.031	0.359
Watermelon	8.810	2.200	100.156	0.000	4.553*	0.056	0.293

Note: ***, ** and * indicates significant at 1%, 5% and 10% level respectively

2015-16 after that yield of pineapple exhibited more or less similar trend over the period 2015-16 to 2019-20. Area, production and yield of jackfruit for the period 2007-08 to 2019-20 is shown in Fig. 4. Area under jackfruit was more or less same but in the last few years it was slightly increasing year by year. Production of jackfruit follows

increasing trend over the overall period and yield of jackfruit exhibited fluctuating trend during the whole period.

Fig. 5 depicts the trend in papaya area, production, and yield for several years. Area under papayas was roughly the same, but over the past few years, it has been gradually growing. Production of papaya followed

Table 4 Average annual growth rate of yield

Fruits	Intercept	Compound Growth Rate (%)	t-ratio	P- value	F-ratio	P- value	R ²
Banana	8.729	0.800	364.768	0.000	8.227**	0.015	0.428
Mango	9.299	-3.000	17.776	0.000	0.297	0.596	0.026
Pineapple	8.690	1.500	26.569	0.000	0.157	0.700	0.014
Jackfruit	10.731	-3.300	84.469	0.000	8.183**	0.015	0.427
Papaya	10.858	-7.700	30.755	0.000	6.152**	0.031	0.359
Watermelon	8.810	2.200	100.156	0.000	4.553*	0.056	0.293

Note: ***, ** and * indicates significant at 1%, 5% and 10% level respectively

Table 5 Instability in area, production and yield of major fruits in Bangladesh

Fruits	Area		Production		Yield	
	CV	CDVI	CV	CDVI	CV	CDVI
Banana	5.365	4.159	4.316	4.477	4.601	3.634
Mango	139.210	135.113	16.333	4.649	41.127	42.382
Pineapple	25.590	26.507	7.502	7.797	97.123	100.747
Jackfruit	23.796	17.077	4.406	3.553	18.449	14.597
Papaya	57.729	43.775	7.421	5.179	44.345	37.102
Watermelon	9.385	8.395	15.156	15.352	15.661	13.761

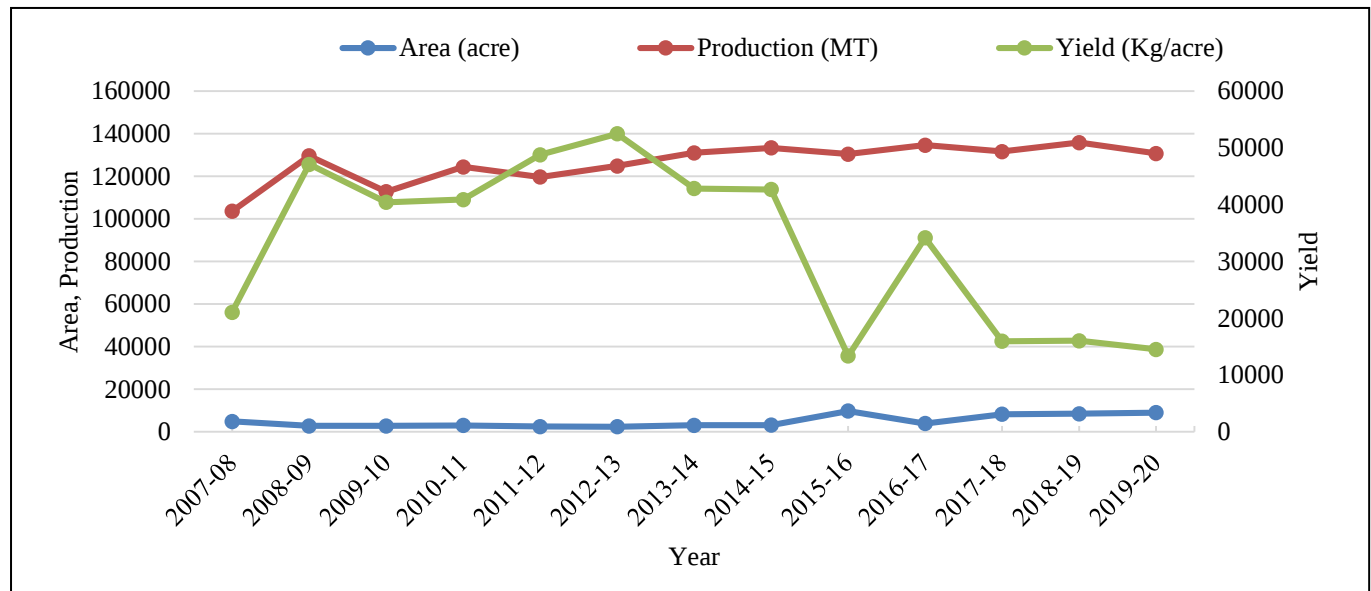


Fig. 5 Trends in harvested area, production and yield of papaya.

increasing trend over the overall period. On the other hand, yield of papaya was increasing up to 2012-13 after that it was decreasing and exhibited a fluctuating trend.

Fig. 6 displays the area, production, and yield of water melons from 2007–2008 through 2019–2020. The area beneath the water melon remained largely unchanged over the course of the period, and its production followed a roughly similar pattern to its yield.

Compound annual growth rates of area of six fruits in Bangladesh over the study period from 2007-08 to 2019-20 have been examined and are presented in Table 2. The results of F-statistic show that the growth models of area were significant except mango and pineapple. The magnitude of the growth rates varied significantly among all

the fruits. The growth rate of area was found to be highest for papaya followed by mango and jackfruit. This might be because farmers have undertaken more area for the cultivation of papaya, mango and jackfruit as these fruits have gained popularity in recent years and because of the fact that it fetches higher price. There was significant annual decrease of area for banana, pineapple and watermelon.

Table 3 encapsulates the growth rates of production of the studied fruits over the study periods from 2007-08 to 2019-20. The results of F-statistic show that the growth models of production were significant for mango, jackfruit and papaya. The magnitudes of the growth rates varied significantly among all the fruits. The growth rate of production was found to be highest for mango followed by

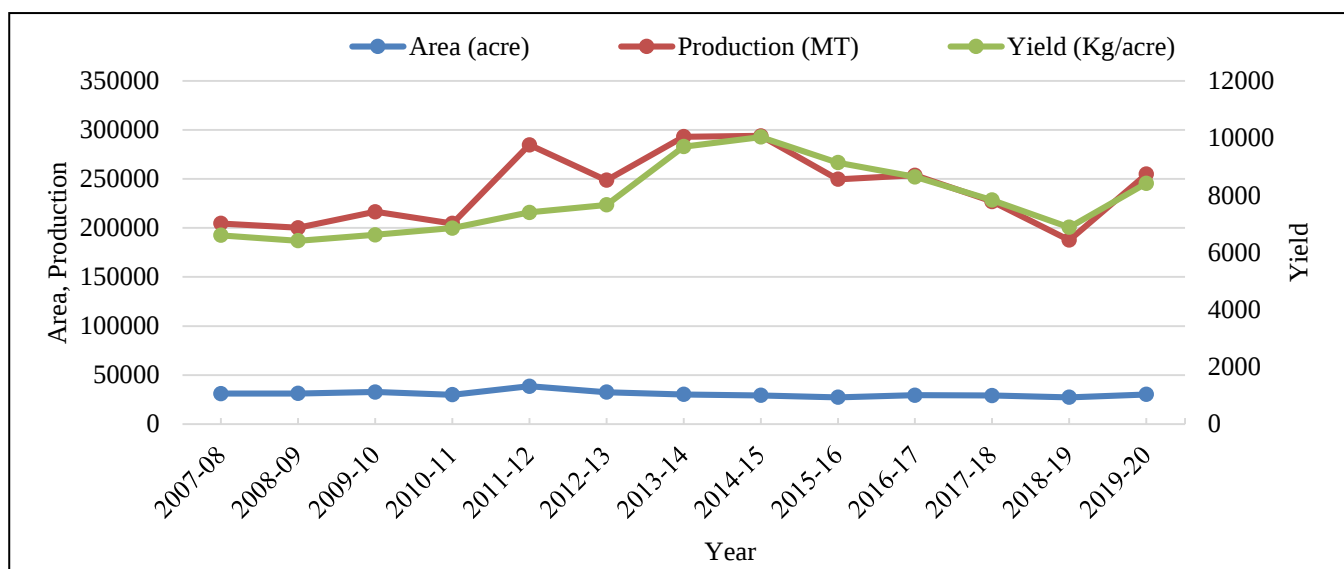


Fig. 6 Trends in harvested area, production and yield of water melon.

papaya and watermelon. It's worth mentioning that although the growth rate of area for watermelon decreases significantly, the growth rate of production for watermelon increases significantly. This might be due to adopt improved varieties of mango, papaya and watermelon. There was significant annual decrease of production for banana and pineapple and it is due to significant annual decrease of area for these fruits.

Table 6 Growth decomposition in production of banana, mango, pineapple, jackfruit, papaya and water melon

Fruits	Yield effect (%)	Area effect (%)	Interaction effect (%)
Banana	-11.835	110.948	0.886
Mango	-94.517	384.469	-189.952
Pineapple	266.377	-151.477	-14.900
Jackfruit	-1467.304	2537.223	-969.919
Papaya	-119.069	317.994	-98.925
Water Melon	112.139	-9.519	-2.620

The growth rate results of yield of six selected fruits in Bangladesh estimated using the CGR are presented in Table 4. The results of F-statistic show that the growth models of yield were significant except mango and pineapple. The magnitudes of the growth rates varied significantly among all the fruits. The growth rate of yield was found to be highest for watermelon followed by pineapple and banana. There was significant annual decrease of yield for mango, jackfruit and papaya, although the growth rate of area of these crops increases significantly. This might be happened due to improper management against the pest and diseases by the farmers.

The results of instability in area, production and productivity of six selected fruits have been presented in Table 5. The table shows that the CDVI values of instability of the harvested area of mango (135.113%), jackfruit (17.077%) and papaya (43.775%) are more volatile and

uncertain compared to the CDVI values of production and yield of that fruits. The instability was mainly due to the fluctuation in prices which causes in shifting of area under cultivation to other substitute crops etc.

Table 5 displays that the instability in area was high in mango (135.113%), followed by papaya (43.775%) pineapple (26.507%), jackfruit (17.077%), watermelon (8.395%) and banana (4.159%). The highest instability in crop production was seen in watermelon (15.352%) while lowest instability was found in jackfruit (3.553%). Regarding to the productivity, the highest magnitude of instability was noticed in pineapple (100.747%) and lowest instability was found in banana (3.634%).

Apart from climate variations, these instabilities can be attributed to the agricultural reform: the quantity and quality of improved seeds, fertilizers and pesticides use, agricultural mechanization practices and Land Use Consolidation through Crop Intensification program can be seen as main driver of grain crops instability.

The growth analysis (area, production and yield) of selected fruits revealed the general pattern of growth and direction of changes in yield and area. But this analysis does not evaluate the contribution of area and yield towards the production growth. So, it is necessary to examine the sources of output growth. To appraise the sources of output growth for major crops, the change in production is divided into three effects i.e., area effect, yield effect and interaction effect. The relative contribution of area, yield and their interaction to changes in production of individual crops is presented in Table 6.

Table 6 demonstrates that an increase in output for pineapple and water melon was mainly due to increase in yield with the respective yield contribution towards productivity for these crops of 266.377%, and 112.139%. The area effect was the major driving force for output growth of banana, mango, pineapple, jackfruit and papaya. About 110.948% growth in banana, 384.469% growth in

mango, 2537.223% growth in jackfruit and 317.994% growth in papaya were due to area effect which more than offset the negative yield effect of these fruits.

4. DISCUSSION

The study was an attempt to assess the trend, instability and decomposition analysis of selected fruits (Banana, mango, pineapple, jackfruit, papaya and watermelon) in Bangladesh for the period of 2007 to 2020. Area, production and productivity of selected fruits in Bangladesh had experienced significant growth over the periods. Highest positive significant growth rate of area was found for papaya followed by mango and jackfruit. Mango garden of 100-300 ha covered the highest area (27.98%) and jackfruit garden in the range of 100-300 ha covers about 22% areas of the country (Biswas et al., 2021). On the other hand, the average growth rate of yield of these fruits decreased significantly. So, improved fruit technology should be disseminated throughout the country. The growth rate of production was found to be highest for mango followed by papaya, watermelon and jackfruit. The growth rates of production for mango were found to be highest in the period 2004-05 to 2009-10 (Uddin et al., 2016). Because farmers had undertaken more area for the cultivation of these fruits as they fetch higher price. Significant annual decrease of production of banana and pineapple was attributed to significant annual decrease of area for these fruits. It is worth mentioning that the growth rate of production for watermelon increased significantly, although the growth rate of area for watermelon decreased significantly. It suggests a good potential by allocating more land in cultivation of this fruit. The area instabilities were higher for mango, jackfruit and papaya compared to the production and yield instabilities of that fruits. The area effect was the major driving force for output growth of banana, mango, pineapple, jackfruit and papaya.

9. CONCLUSION

Considering area coverage, papaya, mango and jackfruit are the dominant fruit crops in Bangladesh. The country's nutritional security depends on effective distribution because the total fruit production from gardens and individual trees varies substantially among places. In order to increase the production of fruits, improved variety and management practices could be disseminated through undertaking special program. The study's conclusions are essential for horticulturists, scientists, extension agents, and lawmakers who seek to boost fruit production in the country and people.

REFERENCES

- BBS, (2021). *Yearbook of Agricultural Statistics of Bangladesh*, Statistical Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.
- Biswas, J. C., Maniruzzaman, M., Haque, M. M., Hossain, M. B., Hamid, A., & Kalra, N. (2021). Major fruit crops production in Bangladesh and their relationships with socio-ecological vulnerabilities. *Journal of Food Science and Nutrition Research*, 4(2), 131-143.
- Cuddy, J. D., & Valle, P. D. (1978). Measuring the instability of time series data. *Oxf. Bull. Econ. Stat.*, 40 (1), 79–85.
- Dey, A., Dinesh, & Rashmi (2020). Rice and wheat production in India; An overtime study on growth and instability. *Journal of Pharmacognosy and Phytochemistry*, 9(2), 158-161.
- Dupare, B. U., Billore, S. D., Sharma, A. N., & Joshi, O. P. (2014). Contribution of area, yield and their interaction towards changing oilseeds and soybean production scenario in India. *Legume Res.*, 37(6), 635–640.
- Gujarati, D. N. (2003). *Basic econometrics*. McGraw Hill, New York.
- Ikuemonisan, E. S., Mafimisebi, T. E., Ajibefun, I., & Adenegan, K. (2020). Cassava production in Nigeria: trends, instability and decomposition analysis (1970–2018). *Heliyon*, 6(2020), 1-5.
- Jamal, H., & Zaman, A. (1992). Decomposition of growth trend in agriculture: Another approach. *Indian J. Agric. Econ.*, 47(4), 644-651.
- Kakali, M., & Basu, P. (2006). Measurement of growth trend: An econometric study of food grains production in west Bangladesh. *J. Agric. Econ*, 3(3), 44–55.
- Pattnaik, I., & Shah, A. (2015). Trends and decomposition of agricultural growth and crop output in Gujarat: Recent evidence. *Indian J. Agric. Econ.*, 70(2), 182–197.
- Prothom Alo (2021). “Bangladesh among world’s top 10 in 13 sectors”, available at: <https://en.prothomalo.com/business/bangladesh-among-worlds-top-10-in-13-sectors> (accessed 30 November 2021).
- Ranade, C. G. (1980). Impact of cropping pattern on agricultural production. *Indian J. Agric. Econ.* 35(2), 85-92.
- Rehman, F. U., Saeed, I., & Salam, A. (2011). Estimating growth rates and decomposition analysis of agriculture production in Pakistan: Pre and post sap analysis. *Sarhad J. Agric.*, 27(1), 125-131.
- Sharma, H., Parihar, T. B., & Kapadia, K. (2017). Growth rates and decomposition analysis of onion production in Rajasthan state of India. *Economic Affairs*, 62(1), 157-161.
- Sikka, B. K., & Vaidya, C. S. (1985). Growth rates and cropping pattern changes in agriculture in Himachal Pradesh, Agricultural Situation in India. *Indian Journal of Agricultural Economics*, 39(11), 843-846.
- Singh, D. V. (1981). A component analysis and value productivity growth of important crops in Himachal Pradesh. *Indian Journal of Agricultural Economics*, 36(6), 479-484.
- Uddin, M. J., Dey, S. R., & Taslim, T. (2016). Trend and output growth analysis of major fruits in chittagong

- region of Bangladesh. *Bangladesh Journal of Agricultural Research*, 41(1), 137-150.
- Verma, S., Gulati, A., & Hussain, S. (2017). *Doubling agricultural growth in Uttar Pradesh: Sources and drivers of agricultural growth and policy lessons*. Indian Council for Research on International Economic Relations Pub, Uttar Pradesh, India.