A Comprehensive Study on Trend Analysis of Area, Production and Productivity of Major Millets in India

Sandeep Kumar, Vishal Mehta, K. K. Mourya, Anil Kumar

ABSTRACT

The present study was carried out to estimate the trend value of area, production and productivity and to measure growth rate of major millets viz., Pearl Millet, Sorghum, Finger Millet and Small Millet in India. The secondary data of the area, production and productivity of millets between the periods 1966-67 to 2020-21 has been collected form https://www.milletstats.com/apy-stats/ by using descriptive statistics, simple linear regression and compound growth rate data was analyzed. The overall time series data showed that the cultivation area has been reducing with 5.22% per annum, production and productivity of pearl millet showed that increasing with 2.34% per annum, the area or production in sorghum has been reducing at 3.12%, 2.14% but productivity of sorghum has showed the increasing trend at 1.75%. In case of finger millet, the data showed the reducing trend for are and production at 1.33 or 1.75% and productivity of finger millet showed the increasing trend at 2.22%. The area, production has been reducing 4.86% and productivity of small millet has been increasing. The consumption of millets is less due to awareness about millets in peoples. The study will help to increase the consumption rate of millets and avoid the nutritional deficiency in humans.

Keywords   Millets, Trend, Area, Production, Productivity.

INTRODUCTION

Millets, the oldest domesticated cereals, have been cultivated for around 10,000 years in tropical and sub-tropical regions, These small-sized cereals from the Poaceae family were mostly used for animal feed and fodder purposes. In addition to acreage displacement, excessive use of chemicals and fertilizers in modern agriculture led to the exploitation of natural resources in terms of ground water depletion, loss of soil nutrients, emission of greenhouse gases. The prevailing lifestyle trends have proliferated various health issues like diabetes, high blood pressure, gastrointestinal, coronary, colon and esophageal disorders they are nutritionally richer than the major

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cereals such as rice, wheat and maize in terms of carbohydrates, protein, fibers, antioxidants, polyphenols, minerals, and vitamins. Millets are a group of small-seeded grains that are cultivated and consumed widely across the world, particularly in semi-arid regions of Asia and Africa. They are known for their resilience to adverse climatic conditions and their nutritional value. Some common types of millet include pearl millet, foxtail millet, finger millet, prosomillet and sorghum. Here is a general overview of millet production statistics globally. India is the largest producer of millet globally. Yamuna *et al.* (2024) explained the country produces various types of millet including pearl millet (Bajra), finger millet (Ragi), and sorghum (Jowar). According to the Indian Government's data, Singh and Singh (2024) the production of millet in India during the 2020-2021 crop years was estimated to be around 13.8 million metric tons. Millets are staple crops in many African countries, particularly in regions with dry climates. Countries like Nigeria, Niger, Mali and Sudan are significant producers of millet in Africa. China is also a major producer of millet, particularly foxtail millet. Other millets like prosomillet are also grown in some regions of China. United States is not as significant in terms of global production as India or Africa, the United States is also a producer of millets, especially in the Great Plains region. Prosomillet is the most commonly grown type in the US. Millets are cultivated in various other countries including countries in Southeast Asia, Central Asia and parts of Europe. It is important to note that specific statistical data for millet production can vary from year to year due to factors such as weather conditions, agricultural practices and market demand, Das *et al.* (2020). Additionally, data may be available at different levels of granularity, such as national, regional or global statistics. For the most accurate and up-to-date information, it's recommended to refer to agricultural organizations, government reports and international agencies such as the Food and Agriculture Organization (FAO) of the United Nations.

MATERIALS AND METHODS

The secondary data of the area, production, and productivity of major millet viz., pearl Millet, Sorghum, finger millet and small millets from 1966 to 2021 were collected for this study. The collection of data from the website of millets https://www.milletstats.com/apy-stats/ the widely used methodology descriptive statistics, simple linear regression and compound growth rate was selected for this study. The compound growth rate is estimated using linear function on time series data for millet's area, production and yield.

Linear model

$$Y = a + bX \qquad (1)$$

Where

y is area, production and yield of selected millet crop
a is constant
b is regression of Y on X
x is year

Compound growth rate $= (Anti \log b - 1)* 100$ (2)

RESULTS AND DISCUSSION

The secondary data of millets from 1966-67 to 2020-21 were used to meet the objective of the study the purposes includes trend analysis in India's area (Million hectares), production (Million tonnes) and productivity (kg/hectares) of pearl millet, sorghum, finger millet and small millets.

Table 1 described the structure of the data for the present study we collect the secondary data on the basis of area, production and productivity of millets crop. We have been selected 55 observations for the

Table 1. Descriptive statistics for pearl millet area, production, and productivity.

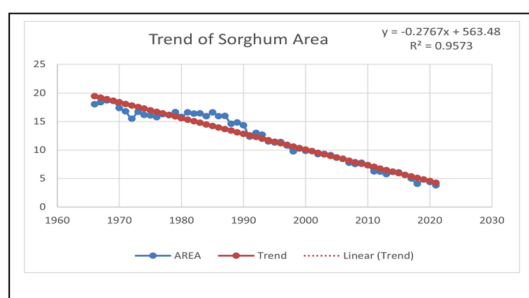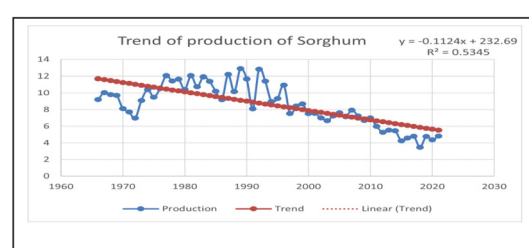| Statistic	Area	Production	Productivity
Observation	55	55	55
Average	10.0062	6.97	740.375
Median	10.005	6.92	651.5
St dev	1.745	2.19	330.11
Max	13.93	12.11	1436
Min	6.7	3.27	290
β_1	-0.10	0.207	0.618
γ_1	-0.70	-0.826	-0.833
CGR (%)	5.22	2.34	3.55
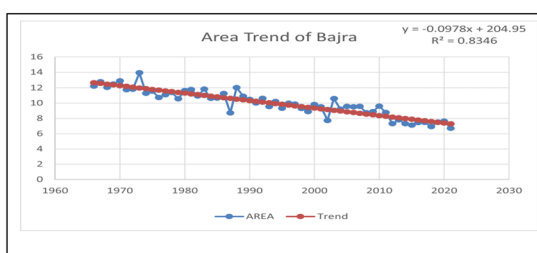
Fig. 1. Graph for area trend of bajra.
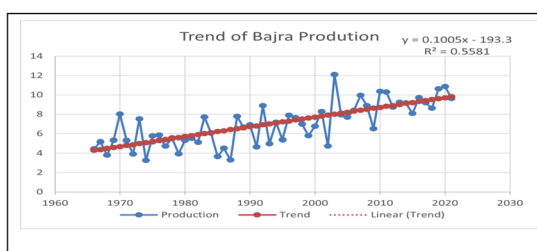
Fig. 2. Graph for production of bajra.

study during 1966 to 2021 after the compiling data we firstly showed the mean and median of the area series, mean (10.0062), median (10.005) and standard deviation (1.745) on the basis of this result we clearly defined there is no more fluctuation on area series maximum value was observed (13.93), minimum value of series was (6.7) and the value of skewness and kurtosis we clearly seen the series is least skewed and Platykurtic. Paul and Nangare (2024) described the trend analysis of productivity of pearl millet and sorghum and they found the decreasing trend in production of pearl millet. The production series measure the different aspect of statistic and explain the series data is normal and least skewed and Platykurtic, The productivity series measure the different aspect of statistic and explain the series
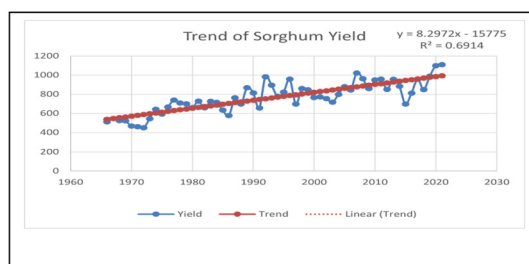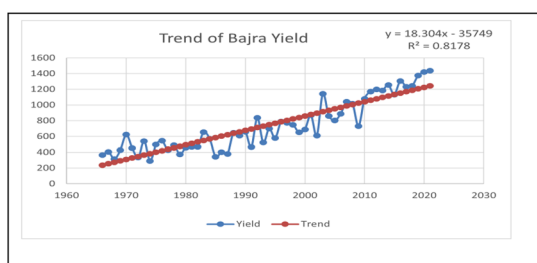

Fig. 3. Graph for yield of bajra.

Fig. 4. Graph for area of sorghum.

Fig. 5. Graph for production of sorghum.

Fig. 6. Graph for yield of sorghum.

data is normal and least skewed and Platykurtic. Tripathi *et al.* (2013) showed the different aspect of

Table 2. Descriptive statistics for Sorghum area, production, and productivity.

Statistic	Area	Production	Productivity
Observation	55	55	55
Average	11.91	8.54	765.58
Median	11.93	8.55	763
St dev	4.61	2.50	162.74
Max	18.73	12.9	1110
Min	3.808	3.47	449
β_1	-0.21	-0.137	-0.0382
γ_1	-1.38	-0.941	-0.552
CGR (%)	3.12	2.14	1.75
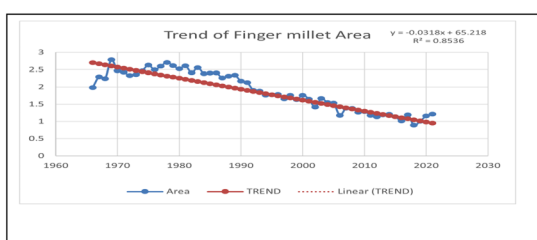
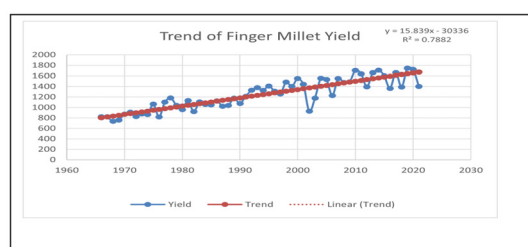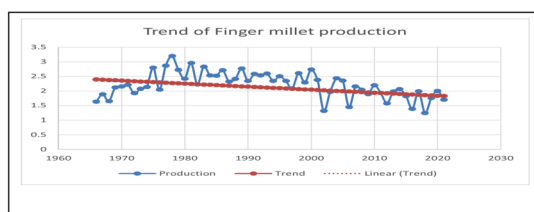**Fig. 7.** Graph for area of finger millet.

Fig. 8. Graph for production finger millet.

pearl millet production and described the past trend of production and yield of pearl millet using the trend analysis and ARIMA.

Fig. 1 showed the trend value of area of pearl millet with $R^2 = 83.46\%$ showed the continuously decreasing trend during 2010 to 2020, some time period series showed the fluctuations with different time lag we used the simple linear regression trend model y = -0.0978x+204.95, x is the time.

Fig. 2 showed the trend value of production of pearl millet with $R^2 = 55.81\%$ showed the continuously increasing trend some time period series showed the fluctuations with different time lag we used the simple linear regression trend model.

Fig. 9. Graph for yield of finger millet.

Fig. 3 showed the trend value of yield of pearl millet with $R^2 = 81.78\%$ showed the continuously increasing trend during 2010 to 2020 and the series yield showed the decreasing trend from 1990 to 2009, some time period series showed the fluctuations with different time lag. Bairwa *et al.* (2024) was analyzed the area, production and productivity of pearlmillet and showed the decreasing trend in Jodhpur region Rajasthan India.

Table 2 described the structure of the data for the present study we collect the secondary data on the basis of area, production and productivity of millets crop. We have been selected 55 observations for the
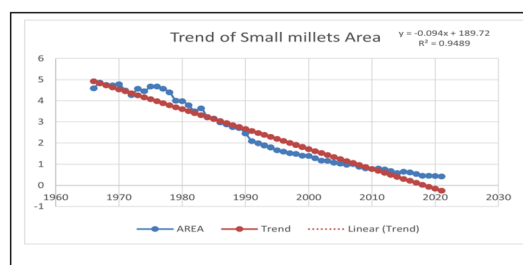

Fig. 10. Graph for area of small millet.

Table 3. Descriptive statistics for finger millet area, production and productivity.

Statistic	Area	Production	Productivity
Observation	55	55	55
Average	1.88	2.20	1239.375
Median	1.83	2.20	1219
St dev	0.56	0.43	290.98
Max	2.78	3.2	1747
Min	0.89	1.23	736
β_1	-0.11	-0.149	0.0389
γ_1	-1.42	-0.247	-1.141
CGR (%)	1.33	1.75	2.33

Table 4. Descriptive Statistics for Small Millet area, production, and productivity.

Statistic	Area	Production	Productivity
Observation	55	55	55
Average	2.36	0.99	480.65
Median	2.38	0.96	478.66
St dev	1.57	0.57	128.53
Max	4.85	2.069	885
Min	0.42	0.33	324.72
β_1	0.35	0.42	1.59
γ_1	-1.48	-1.34	1.95
CGR (%)	2.15	0.89	1.55

study during 1966 to 2021 after the compiling data we firstly showed the mean and median of the area series, mean (11.91), median (11.93) and standard deviation (4.61) on the basis of this result we clearly defined there is no more fluctuation on area series maximum value was observed (18.73), minimum value of series was (3.808), and the value of skewness and kurtosis we clearly seen the series is least skewed and Platykurtic. The production series measure the different aspect of statistic and explain the series data is normal and least skewed and Platykurtic, The productivity series measure the different aspect of statistic and explain the series data is normal and least skewed and Platykurtic.

Fig. 4 showed the trend value of area of Sorghum with $R^2 = 95.73\%$ showed the continuously decreasing trend during 1990 to 2020, and showed the increasing trend from 1980 to 1990, Some time period series showed the fluctuations with different time.

Fig. 5 showed the trend value of production of Sorghum with $R^2 = 53.45\%$ showed the continuously decreasing trend during 2000 to 2020, and showed the increasing trend from 1978 to 1999.

Fig. 6 showed the trend value of yield of Sorghum with $R^2 = 69.14\%$ showed the continuously decreasing trend during 1966 to 1970 after the we clearly seen the increasing trend next ten years 1970 to 1980, and after that series was fluctuated with some increasing or decreasing trend.

Table 3 described the structure of the data for the present study we collect the secondary data on the

Table 5. Percentage changes of millet based on area, production, and productivity.

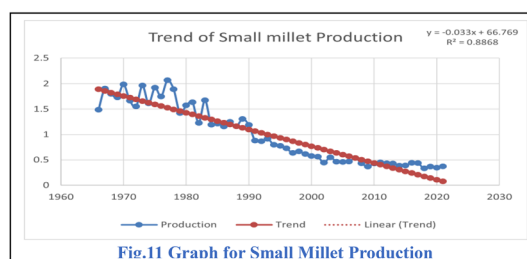| Crop	Area 1966-67-2020-21	Production 1966-67-2020-21	Productivity 1966-67-2020-21
Pearl millet	-80	48	48
Sorghum	-86	-78	40
Finger millet	-78	-57	30
Small millet	-87	-88	60

Fig. 11. Graph for small millet production.

basis of area, production and productivity of millets crop. We have been selected 55 observations for the study during 1966 to 2021 after the compiling data we firstly showed the mean and median of the area series, mean (1.88), median (1.83) and standard deviation (0.56) on the basis of this result we clearly defined there is no more fluctuation on area series maximum value was observed (2.78), minimum value of series was (0.89), and the value of skewness and kurtosis we clearly seen the series is least skewed and Platykurtic. The production series measure the different aspect of statistic and explain the series data is normal and least skewed and Platykurtic, The productivity series measure the different aspect of statistic and explain the series data is normal and least skewed and Platykurtic.

Fig. 7 showed the trend value of Area of Finger Millet with $R^2 = 85.36\%$ showed the continuously decreasing trend during 1966 to 1970 after the we clearly seen the increasing trend next twenty years 1970 to 1990 and after that series was fluctuated with some increasing or decreasing trend.

Fig. 8 showed the trend value of Production of Finger Millet with $R^2 = 88.16\%$ showed the continuously increasing trend during 1970 to 2000 after the we clearly seen the highly increasing trend for next five years 2000 to 2005, and after that series was fluctuated with some increasing or decreasing trend.

Fig. 9 showed the trend value of Yield of Finger Millet with $R^2 = 78.82\%$ showed the continuously increasing trend during 1970 to 2000 after the we clearly seen the highly increasing. trend for next five years 2000 to 2005 and after that series was fluctuated with some increasing or decreasing trend.
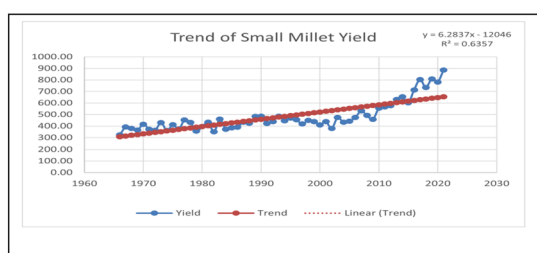
Fig. 12. Graph for small millet yield.

Table 4 described the structure of the data for the present study we collect the secondary data on the basis of area, production and productivity of millets crop. We have been selected 55 observations for the study during 1966 to 2021 after the compiling data we firstly showed the mean and median of the area series, mean (2.36), median (2.38) and standard deviation (1.57) on the basis of this result we clearly defined there is no more fluctuation on area series maximum value was observed (4.85), minimum value of series was (0.42) and the value of skewness and kurtosis we clearly seen the series is least skewed and Platykurtic. The production series measure the different aspect of statistic and explain the series data is normal and least skewed and Platykurtic, The production series measure the different aspect of statistic and explain the series data is normal and least skewed and Platykurtic, The productivity series measure the different aspect of statistic and explain the series data is normal and least skewed and Mesokurtic.

Fig.10 showed the trend value of area of Small Millet with R² = 94.89% showed the continuously decreasing trend during 1966 to 1970 after that there is no trend from 1982 to 1990, after 1990 we clearly seen the highly decreasing trend for next twenty years 1990 to 2010, and after that series was fluctuated with some increasing or decreasing trend. Kumar *et al.* (2022) described the production and productivity of minor millet in aspect of India and they found the trend was not stable and production of minor millet showing the decreasing trend.

Fig.11 showed the trend value of production of Small Millet with R² = 88.68% showed the continuously increasing trend during 1966 to 1985 after that there is no trend from 1985 to 1990, after 1990 we clearly seen the highly decreasing trend for next

twenty years 1990 to 2010, and after that series was showed the increasing trend during 2010 to 2020. Dwivedi *et al.* (2024) also explained the increasing trend in small millet production in Madhya Pradesh.

Fig.12 showed the trend value of Yield Small Millet with R² = 63.57% showed the continuously increasing trend during 1966 to 1985 after that there is no trend from 1985 to 1990, after 1990 we clearly seen the highly decreasing trend for next twenty years 1990 to 2010, and after that series was showed the highly increasing trend during 2010 to 2020.

On the behalf of our study, we can explain the different percentage change for the different crop viz., pearl millet, sorghum, finger millet and small millet. Analysis of this data is explained in Table 5.

CONCLUSION

The trend analysis of area, production and productivity of major millet viz., pearl millet, sorghum, finger millet and small millet showed significant trend in India totally 55 years of data on area, production and productivity of major millet has been collected for this study during 1966-67 to 2020-21. Even though decreasing the cultivation area but production and productivity of pearl millet has been increasing in case of sorghum there is cultivation of area and production showed the decreasing trend but productivity showed the increasing trend, similarly the area of finger millet showed the decreasing trend, production of finger millet showed the least increasing or decreasing trend but the productivity of finger millet showed the highly increasing trend. In case of small millet the area of small millet showing the continuously decreasing trend and production also showed the decreasing trend but the productivity of small millet showed the highly increasing trend. Nagraj *et al.* (2012) suggest the some policy for increasing the production of sorghum and pearl millet.

ACKNOWLEDGMENT

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