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TREND ANALYSIS OF AREA, PRODUCTION AND PRODUCTIVITY OF SMALL MILLETS IN MADHYA PRADESH, INDIA

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ABSTRACT

The present study was carried out to estimate the growth rate of area, production and productivity and to measure the contribution of different components to the growth rate of small millets in Madhya Pradesh. The secondary data of the area, production and productivity of small millets between the periods 1966-67 to 2020-2021 has been collected from dacnet.nic.in. By using descriptive statistics and linear growth rates (Compound Annual Growth Rate) data were analyzed. The overall time series data of small millets showed that the cultivation area has been reducing 5.34 percent per annum due to expanding the cultivation area of cereals, pulses and cash crops. The production of small millets has decreased 3.44 percent per annum due to shifting the cultivation area for other crop. The productivity of small millets has been increasing. Increasing by 2.00 percent per annum due to the availability of high-yielding varieties, pest and disease resistant varieties and improved cultivation practices. The consumption of millets is less due to awareness about millets among peoples. Eventually the nutritional deficiency among children's high in Madhya Pradesh. The study will help to increase the consumption rate of small millets and avoid the nutritional deficiency disease.

Key words : Small millets, Area, Production and productivity, Compound Annual Growth Rate, Trend analysis.

Introduction

The term "Millets" is used to represent many small-grained cereals. Millets crops comprise of pearl millets, sorghum, finger millets & small millets namely foxtail millets (Kagani), Kodo millets (Kodo), Proso millets (Cheena), banyard millets (Sawan) and little millets (Kutki). Millets are one of the oldest cultivated food grains known to humans and have been a stable food in Northern Africa for thousand years and was a stable food in China and India prior to popularity of fine cereals like rice and wheat. These crops have a long history of cultivation of more than 5000 years and grown in many States. Millets are highly known for rich in nutrients- vitamins, minerals and essential fatty acids, also have benefits in terms of prevention of degenerative diseases besides their known functions of preventing nutritional deficiency diseases. Being nonglutinous, millets are safe for people suffering from gluten allergy and celiac disease. They are non-acid forming, easy to digest and non-allergenic.

Millets are also rich in health-promoting phytochemicals like polyphenols, lignins, phytosterols, phytooestrogens and phytocyanins. These function as antioxidants, immune modulators, detoxifying agents etc. and hence protect against age-related degenerative diseases like cardiovascular diseases (CVD), diabetes, cancer etc.

Millets are particularly high in minerals like iron, magnesium, phosphorous and potassium. Finger millet (Ragi) is the richest in calcium content, about 10 times that of rice or wheat. Millets are high on fiber and low on calorie. Therefore, there is an urgent need to reintroduce many of the cereals, millets in our daily diets. In the food industry, cereal grains and plant nutrients are largely used as a major source of dietary nutrients worldwide.

Production and productivity of these crops to ensure food and nutritional security not only to people living in harsh and difficult terrains, but also in other area with exploring the possibility of export as they can be a good

choice for diabetes patients cooked just like rice and can be a good substitute of rice. Its fiber content is five times that of rice and contains low calorie content. Mixed with Wheat Kodo is a good diet for diabetes patients. Protein-rich Kutki is a good grain substitute for diabetics. It has 20 percent less carbohydrate than rice and wheat.

Global millet production was estimated at 27.83 million tons (FAO, 2014). India is the largest producer (41.04%) in the world followed by Nigeria (11.94%). In the last two decades their importance as staple food, particularly in Asia, has been declining due to various factors that include rising incomes, growing urbanization and government policies favouring the production and consumption of fine cereals like rice and wheat. However, the same factors are driving the demand for these crops in alternative uses like feed (cattle and poultry), starch and alcohol. More than 50% of the millet production is now finding its way to alternative uses as opposed to its consumption only as a staple. In the year 2015 area of small millets in India recorded 682.33 thousand ha, with Production of 429.9 thousand t and yield 630.00 kg/ha. Madhya Pradesh covers 33.4 percent (227.7 thousand ha) of area and contributes 26.6 percent (114.5 thousand t) of production with the average yield of only 503 kg/ha small millets in the country. Madhya Pradesh (33.4%), occupy maximum area of small millets in India, Chhattisgarh (16.5%), Uttarakhand (9.5%), Maharastra (8.4%), Gujrat (5.6%), Tamilnadu (4.8%) and Andhra Pradesh (4.1%) are found to be other major States in which cultivation of small millets are found prominent in the country.

Looking to the nutritional importance of small millets and Madhya Pradesh being the leading state in terms of area and production in the country, which forms the basis of livelihood and nutritional security in tribal dominating areas characterize by undulated topography and marginal lands, it has become imperative to understand to dynamic of small millets production in the state.

Materials and Methods

The secondary data of the area, production and productivity of small millets from 1966-67 to 2020-21 were collected for this study. The primary sources of data were government reports and the Madhya Pradesh state website. The widely used methodology Compound Annual Growth Rate was selected for this study.

The exponential compound annual growth rate is estimated using linear functions on time series data on small millets' area, production and productivity.

The semi-log exponential functional form was used to analyze the trend in growth rate. It is one of the appropriate applicable forms to estimate the growth rate. The following semi-log functional form was used to estimate the growth rate.

$\log Yt = a + bt$

This equation (1) can be elaborated in detail as:

$Yt = Yo\ (1+r)\ t$ (1)

Taking log on both sides,

We get, $\text{Log } Yt = \text{Log } Yo + t \text{ Log } (1+r)$ (2)

(2) Equation can be rewritten as

$Y = a + bt$ (3)

Where,

$Y = \text{Log } Yt$ $a = \text{Log } Yo$

$b = \text{Log } (1+r)$, in equation (3)

Yt = area/production/ productivity, as the case may be, of small millets as discussed above

A = constant

t = Time variable in year (1, 2...n)

b = Regression Coefficient that shows the rate of change or growth rates in a series

The annual compound growth rate (s) can be worked out by using:

Antilog (b) = Antilog (log (1+r)).

Antilog (b) = 1+r and

r = Antilog b-1

It gives the percentage growth rate in the area, production and productivity of small millets multiplied by 100 (Surendar and Satinder, 2014).

Compound Annual Growth Rate (CAGR) (%) = r = (Antilog B-1) × 100.

Results and Discussion

The secondary data of small millets from 1966-67 to 2020-21 were used to meet the objectives of the study. The purposes include trends analysis in Madhya Pradesh's area, production and productivity of small millets. The data of the area, production, and productivity of small millets from 1966-67 to 2020-21 were mentioned in Table 1 compound Annual Growth Rate calculated separately for the area, production and productivity of small millets.

The trend of area, production, and productivity of small millets in Madhya Pradesh has mentioned in Table 1. The overall area of cultivation of small millets has decreased from 1677.7 thousand hectares to 68 thousand hectares during the period 1966-67 to 2020-21. The reduction of 95 percent cultivation area has occurred due

Table 1 : Growth rate of area, production and productivity of small millets in Madhya Pradesh.

S. no.	Year	Area ('000 hectares)	Production ('000 tonnes)	Yield (Kg/hectare)
1	1966-67	1530.7	188.3	123.0
2	1967-68	1677.7	416.7	248.4
3	1968-69	1664.1	358.8	215.6
4	1969-70	1641.7	369.8	225.3
5	1970-71	1653.2	399.7	241.8
6	1971-72	1583.6	363.5	229.5
7	1972-73	1567.2	334.1	213.2
8	1973-74	1602.3	394.7	246.3
9	1974-75	1631.9	320.4	196.3
10	1975-76	1652.4	443.2	268.2
11	1976-77	1640.4	291.2	177.5
12	1977-78	1603.0	426.4	266.0
13	1978-79	1545.7	307.5	198.9
14	1979-80	1439.9	169.1	117.4
15	1980-81	1448.5	314.7	217.3
16	1981-82	1453.8	338.4	232.8
17	1982-83	1438.6	287.1	199.6
18	1983-84	1446.5	394.3	272.6
19	1984-85	1385.8	318.7	230.0
20	1985-86	1387.5	359.3	259.0
21	1986-87	1315.2	247.5	188.2
22	1987-88	1293.6	356.6	275.7
23	1988-89	1258.2	293.1	233.0
24	1989-90	1228.8	292.5	238.0
25	1990-91	1203.1	328.8	273.3
26	1991-92	1131.6	240.4	212.4
27	1992-93	1083.9	256.2	236.4
28	1993-94	1038.9	296.7	285.6
29	1994-95	979.8	255.4	260.7
30	1995-96	878.7	239.5	272.6
31	1996-97	593.0	171.0	288.0
32	1997-98	565.0	139.0	246.0
33	1998-99	552.0	163.0	295.0
34	1999-2000	539.0	161.0	299.0
35	2000-01	478.0	82.0	172.0
36	2001-02	460.0	117.0	254.0
37	2002-03	432.0	97.0	225.0
38	2003-04	457.0	126.0	276.0
39	2004-05	385.0	106.0	275.0
40	2005-06	352.0	104.0	295.0
41	2006-07	327.0	87.0	266.0
42	2007-08	322.0	87.5	271.7
43	2008-09	307.2	89.0	289.7
44	2009-10	268.4	73.5	273.8
45	2010-11	253.2	88.0	347.5
46	2011-12	248.8	82.4	331.2
47	2012-13	233.0	84.9	364.4
48	2013-14	227.7	114.5	503.0
49	2014-15	123.0	72.0	585.4
50	2015-16	180.0	73.3	407.0
51	2016-17	184.0	113.0	614.3
52	2017-18	148.0	144.0	973.0
53	2018-19	89.0	59.0	662.9
54	2019-20	84.0	74.0	881.0
55	2020-21	78.0	69.4	890
Total		**50292.597**	**12180.113**	**17140.206**
Mean		**914.411**	**221.457**	**311.640**
Std		**586.134**	**121.684**	**179.311**
CV		**64.10**	**54.95**	**57.540**
LOGEST		**0.946**	**0.965**	**1.020**
CAGR %		**-5.340****	**-3.446****	**2.000****

Table 1 continued...

Source: Ministry of Agriculture & Farmers Welfare, Govt. of Madhya Pradesh

Note: Std: Standard Deviation

CAGR- Compound Annual Growth Rate

** Significant at 1 percentage, * Significant at 5 percentage

to over- cultivation of major cereals, pulses and cash crops. The cultivation area of small millets has reduced 9 percent from 1966-67 to 1975-76. In the second decade from 1976-77 to 1985-86, the area has decreased another 16 percent. The third decade from 1986-87 to 1995-96 has reduced 33 percent. Forth decade from 1996-97 to 2005-06 has decrease 41 percent and last two decade from 2006-07 to 2015-16 and 2016-17 to 2020-21, area has decrease 62 and 58 percent, respectively. The result of CAGR showed that the overall cultivation areas of small millets were highly significant, and production reduced by 5.34 percent per annum. It indicated that cultivation area was decreasing in trend and it will decline further in upcoming years.

The overall production of small millets has decreased from thousand tone 443 to 59 thousand tons from 1966-67 to 2020-21. The reduction of 84 percent production has occurred due to the reduction of production. The production of small millets has reduced 58 percent during the period 1966-67 to 1975-76. In the second decade from 1976-77 to 1985-86, production has decrease 60 percent. The third decade from 1986-87 to 1995-96 has reduced 33 percent. The fourth, fifth and six decade from 1996-97 to 2005-06, 2006-07 to 2015-16 and 2016-17 to 2020-21, the production has also decrease (52, 37 and

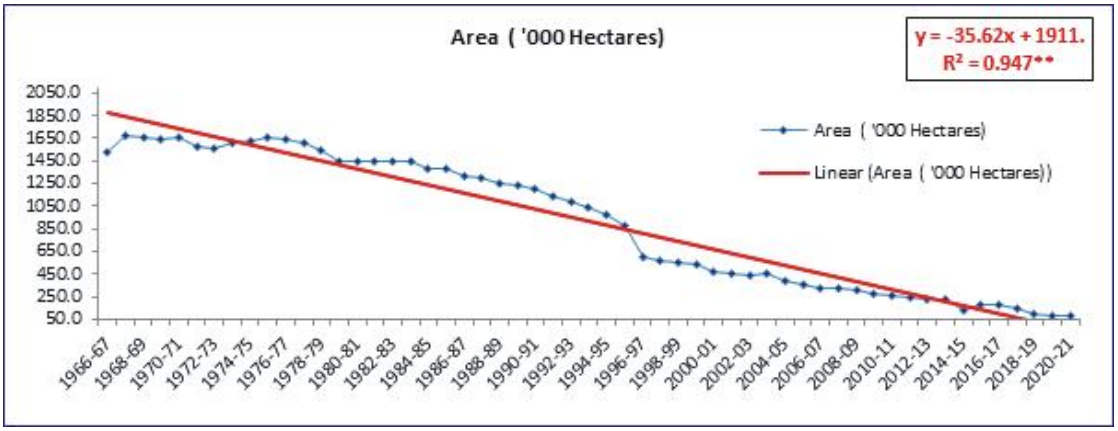

Fig. 1 : Trend of area of small millets in Madhya Pradesh.

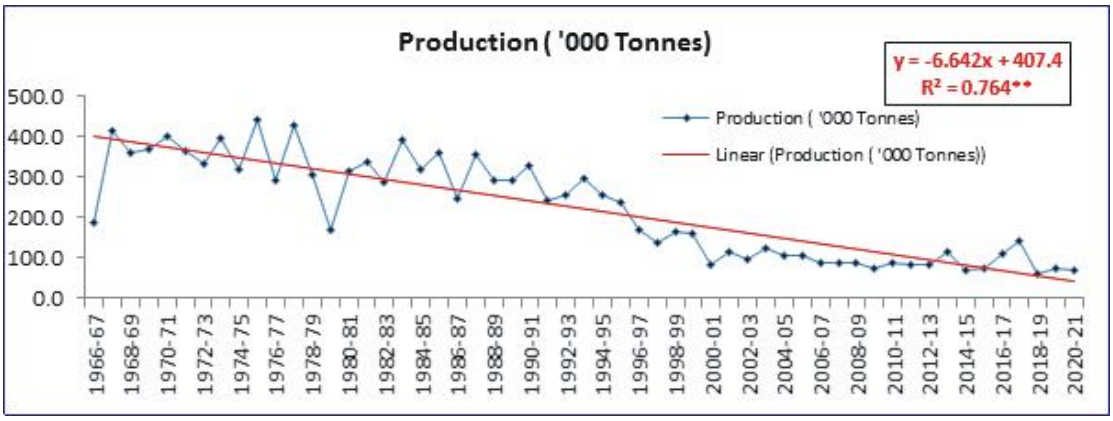

Fig. 2 : Trend of production of small millets in Madhya Pradesh.

52), respectively. The result of CAGR showed that the overall productions of small millets were highly significant and production reduced by 3.44 percent per annum. It indicated that production was decreasing in trend and it will thicken further in upcoming years. The overall productivity of small millets has increased from 117 kilogram/hectare to 973 kilogram/hectare from 1966-67 to 2020-21.

The productivity of small millets has decrease in the six decade from 1966-67 to 2020-21. The result of CAGR showed that the overall productivity of small millets were highly significant and productivity increased by 2.000 per annum. It indicates the productivity was increasing in trend even though area and production are decreased. It will increase further in upcoming years. Table 2 shows the percentage changes in area production and productivity of small millets in Madhya Pradesh from 1966-67 to 2020-21 and also calculated 10-year intervals. The coefficient of area and production has been calculated by considering the area as independent variable x and production as dependent variable y. It clearly showed that overall area and production positively related with each other.

The time-trend pattern of small millets in Madhya Pradesh is shown in Fig. 1. The area of small millets was reduced from 1677-67 to 2020-21. The largest area under small millets was observed in the year 1966-67 to 1978-89 whereas, the lowest area was observed in the year 2000-01 to 2020-21. The regression equation of the time-trend is Y= -35.62x + 1911. The R^2 value is 0.947 and was statistically highly significant@ level of 1 percent.

The time-trend analysis of small millets shows Fig. 2 that the production under small millets is negative and no significantly decreasing in Madhya Pradesh. The regression equation of the time-trend is Y= -6.642x + 407.4. The R^2 value is = 0.764 and was statistically highly significant @ level of 1 percent.

In Madhya Pradesh, the productivity of small millets during different year is shown in Fig. 3. The highest productivity of @ 973 kg/hectares and lowest productivity of @117.4 kg/hectares were observed in the year 1979-to 80 and 2017-18, respectively. The productivity was increase in the year 2016-17 to 2020-21, due to the availability of high yielding varieties, pest and disease resistant varieties, and improved practices. The time trend equation is Y= = 7.596x + 98.94 and corresponding R^2 value is 0.460 which is significant @ level of 1 percent.

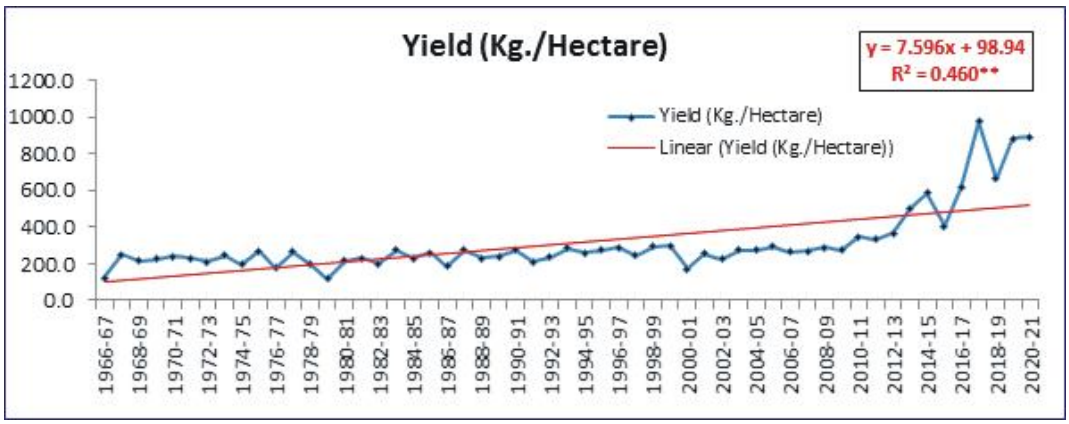

Fig. 3 : Trend of productivity of small millets in Madhya Pradesh. ** Significant at 1 percentage, * Significant at 5 percentage.

Table 2 : Percentage changes.

Year	Percentage		
	Area	Production	Productivity
1966-67-2020-21	-95	-84	-87
1966-67-1975-76	-9	-58	-54
1976-77-1985-86	-16	-60	-57
1985-86-1995-96	-33	-33	-34
1996-97-2005-06	-41	-52	-42
2006-07-2015-16	-62	-37	-55
2016-17-2020-21	-58	-52	-37

Conclusion

The trend analysis of area, production and productivity of small millets showed significant trend in Madhya Pradesh totally 55 years of data on the area, production, and productivity of small millets has been collected for this study from 1966-67 to 2020-21. Eventhough, decreasing the cultivation area and production, but productivity of small millets has been increasing. The overall time series data of small millets showed that the cultivation area has been reducing 5.34 percent per annum due to expanding the cultivation area of cereals, pulses, and cash crops. The production of small millets has decreased 3.44 percent per annum due to shifting the cultivation area for other crop. The productivity of small millets has been increasing by 2.00 percent per annum due to the availability of high-yielding varieties, pest, and disease resistant varieties, and improved cultivation practices. Analyzing the growth rate trends in the agricultural area, production and productivity across space and time have remained issues of significant concern for researchers and policymakers. It has been argued that analysis of the growth rate trends helps us identify the changing pattern of crops and land use patterns under different crops and the rate of change in area production and productivity of a crop. Further help in designing the appropriate agricultural policy for a region or state. The growth rates in the area, display and productivity of small millets crop showed exciting results. The growth rate in small millets was found noticeably negative all over Madhya Pradesh. A similar picture of the growth rate in the production of small millets was seen almost all over Madhya Pradesh.

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