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Trend, growth and instability of area, production and productivity of finger millet in India

Rajesh Khavse, Rajesh Kumar Dwivedi and Manoj Kumar Ahirwar

Krishi Vigyan Kendra, Damoh, JNKVV, Jabalpur, Madhya Pradesh, India

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Corresponding Author: Rajesh Khavse

Abstract

The present study has been analysed the trend in area, production and productivity of finger millet and the instability by Cuddy Della Valle index. The study has been carried out based on secondary data and the data was collected for the periods from 1981-82 to 2020-21, from government publications and websites. Compound annual growth rate, co- efficient of variation and instability index was computed. The growth rate of area of finger millet in India showed significant at 1 percent level with negative trend which is due to diversification of crops and production showed significant at 1 percent level with positive trend as it is the function of area and productivity. The productivity of finger millets is drastically increasing due to the availability of high-yielding varieties and new cultivation technology adoption. The growth rate of area showed significant at 1 percent level with positive trend and productivity of finger millet of Karnataka showed significant at 1 percent level with negative trend and production showed no significant with positive trend. Thus there is a need to take up productivity enhancing measures in finger millet like varietal improvement, improved cultural practices and irrigation facilities. The instability indices for area, production and productivity for finger millet is positive which indicates less risk in growing finger millet in future. The fluctuations in area are due to replacement of finger millet cultivated lands by other comparable and competitive crops such as paddy, wheat and commercial cash crops. The consumption of finger millet is less due to awareness about finger millet among the peoples. The Government intervention needs to focus on spreading finger millet as a wonder grain for dry lands and infant nutrition.

Keywords: Trend, growth rate, co-efficient of variation, instability index

Introduction

Finger millet or ragi (*Eleusine coracana* L.) is one of the common millets in several regions of India. It is also commonly known as Koracan in Srilanka and by different names in Africa and has traditionally been an important millet staple food in the parts of eastern and central Africa and India. The crop requires low input and less affected by major pests and diseases. The high rejuvenation capacity after alleviated stress condition makes this crop ideal for dry land farming. It is rich in protein, calcium, phosphorus, iron, fiber and vitamin content. The calcium content is higher than all cereals and iodine content is considered to be highest among all the food grains. Finger millet has best quality protein along with the presence of essential amino acids, vitamin A, vitamin B and phosphorus (Gopalan *et al*. 2004) [8]. Finger millet is also recognized for their health beneficial effects such as anti-diabetic, anti-tumerogenic, atherodclerogenic effects, antioxidant and antimicrobial properties. Finger millet contains about 5-8 percent protein, 1-2 percent other extractives, 65-75 percent carbohydrates, 15-20 percent dietary fiber and 2.5-3.5 minerals. In India, finger millet is grown and consumed in Karnataka, Andhra Pradesh, Tamil Nadu, Odisha, Maharashtra, Kumaon region of Uttakhand and Goa. There are significant yield variations observed among the top producing states. The total area under finger millet in India is 891 thousand hectares (2018-19) which was mainly contributed by Karnataka, Maharashtra and Uttarakhand. From this area, 1,239 thousand metric tons of finger millet was produced in 2018-19. During this period, productivity of finger millet was recorded as 1390 Kg per hectare. Identifying the existing trends in area, production and productivity plays an important role in the way of development (Sharma, 2012). By estimating the trend in area, production and productivity of finger millet, gap in demand and supply can also be worked out (Sharma, 2012) [15]. In this paper, an attempt is made to study the trend in area, production and productivity of finger millet in India.

Objective of the study

The specific objective is to study the trend in area, production and productivity of finger millet in India.

Data base and Research Methodology

The study was based on secondary data collected from various published sources (Anon., 2020) [1]. Time series data for the period from 2007-08 to 2018-19 pertaining to area, production and productivity of finger millet crop for India as a whole and state wise data were collected from Ministry of Agriculture & Farmers Welfare, Government of India. Compound annual growth rate, co-efficient of variation and instability index were analysed for separately for area, production and productivity of finger millet as a whole for India as well as major growing state of India. The

exponential compound annual growth rate is estimated using linear functions on time series data on finger millet 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.

$$\log Yt = a + bt \quad (1)$$

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

$$Yt = Yo\,(1+r)\,t \quad (i)$$

Taking log on both sides,

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

(2) Equation (ii) can be rewritten as

$$Y = a + bt \quad (ii)$$

Where

Y = Log Yt a = Log Yo

b = Log (1+r), In equation (iii)

Yt = area/production/ productivity, as the case may be, of finger millet 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

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

The significance of the regression coefficient was tested using student's 't' test.

Instability Index

The agricultural instability can be measured by various methods, such as the coefficient of variation, dispersion, Cuddy Della Valle Index, Coppock Instability index, etc. The present study applies the Cuddy Della Valle Index for measuring the instability. Cuddy Della Valle index first de-trends the given series and gives a clear direction about the instability. The use of coefficient of variation as a measure to show the instability in any time series data has some limitation. If the time series data exhibit any trend, the variation measured by coefficient of variation can be over-estimated, i.e. the region which has growing production are at constant rate will score high in instability of production if coefficient of variation is applied for measuring instability. As against that, Cuddy-Della Valle index attempts to de-trend the coefficient of variation by using coefficient of determination. Cuddy- Della Valle index was originally developed by Cuddy and Valle (1978) [5] for measuring the instability in time series data that is characterized by trend.

In order to study the instability of finger millet with respect to area, production and productivity, co-efficient of variation was estimated using the expression given below.

The coefficient of variation (CV) is a statistical measure of the dispersion of data points in a data series around the mean. The coefficient of variation represents the ratio of the standard deviation to the mean and it is a useful statistic for comparing the degree of variation from one data series to another, even if the means are drastically different from one another.

$$\text{Coefficient of variation} = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

To measure the magnitude of variability in area, production and productivity for the total period, the co-efficient of variation (%) was computed. Further the instability index was also calculated to examine the instability in area, production and productivity finger millet in country over the time period by using the following formula:

$$\text{Instability Index (I)} = CV^* \sqrt{1 - R^2}$$

Results and Discussion

To study the trend analysis in area, production and productivity of finger millet, secondary data of 40 years i.e., from 1981-82 to 2020-21 was considered. Compound annual growth rate and Instability Index were calculated separately for area, production and productivity of finger millet as a whole for India as well as major growing states.

The growth rate, co-efficient of variation and instability index of area, production and productivity of finger millet is presented in Table 1. The area under finger millet has been fluctuated from 2,610 thousand hectares in 1981-82 to 1159 thousand hectares in 2020-21 with an average area of 1664.0 thousand hectares. The compound annual growth rate (CAGR) of area for the period 1981-82 to 2020-21 was - 2.47 percent which shows significant at 1 percent level and the co-efficient of variation was found to be 29.59 percent. The R2 value was 0.95 which indicates that 95 percent of the variation in the area was explained over the years.

In case of production of finger millet during the study period was fluctuated from 2961 thousand MT in 1981-82 to 1998 thousand MT in 2020-21 with an average annual production of 2203.0 thousand MT. The compound annual growth rate (CAGR) of production for the period 1981-82 to 2020-21 was -1.27 percent which shows significant at 1 percent level. The co-efficient of variation was found to be 19.30 percent. The R^2 value was 0.50 which indicates that 50 percent of the variation in the production of finger millet was explained over the years.

Similarly, the productivity of finger millet during the study period was fluctuating over the year which was 1134 Kg per hectare in 1981-82 and 1724 Kg per hectare in 2020-21 with an average annual productivity of 1359 Kg per hectare. The compound annual growth rate (CAGR) of productivity for the period 1981-82 to 2020-21 was 1.01 percent which was found significant at 1 percent level. The co-efficient of variation was found to be 17.44 percent. The R^2 value was 0.62 which indicates that 62 percent of the variation in the productivity of finger millet was explained by finger millet

productivity in India over the years.

During the study period from 1981-82 to 2020-21, it was observed that the finger millet scenario in India has been incessantly fluctuating over the years. The results depicted that the area, production and productivity of finger millet in India has shown positive trend. The instability index for area, production and productivity for finger millet are 6.61, 13.64 and 10.72 respectively. The fluctuations in area are due to replacement of finger millet cultivated lands by other comparable and competitive crops such as paddy, pulses and vegetables and due to it's designation as a low value inferior crop alongside other millets. In case of productivity, it is due to the availability of high-yielding varieties and new cultivation technology adoption.

The data in Table 2 shows the area under finger millet in different states of India for the period from 1981-82 to 2020-21. The result depicts that the states like Karnataka, Maharashtra, Andhra Pradesh, Tamil Nadu contributes more than 50 percent of total area under finger millet in India. The area under finger millet in Karnataka has been fluctuated from 1148.3 thousand hectares in 1981-82 to 785 thousand hectares in 2020-21 with an average of 908.0 thousand hectares which contributes about 53.9 percent when compared to the average mean value of area under finger millet in India. The compound annual growth rate was found to be -1.63 percent with significant at 1 percent level and the co-efficient of variation was 20.40 percent. The area under finger millet in Maharashtra has been fluctuated from 225.2 thousand hectares in 1981-82 to 81.6 thousand hectares in 2020-21 with an average of 155.0 thousand hectares which contributes about 9.20 percent when compared to the average mean value of area under finger millet in India. The compound annual growth rate was found to be -2.54 percent with significant at 1 percent level and the co-efficient of variation was 29.55 percent. The average area under finger millet in Tamil Nadu for the period from 1981-82 to 2020-21 was 245.5 thousand hectares which contributes about 9.86 percent when compared to the average mean value of area under finger millet in India. The compound annual growth rate was found to be -2.88 percent which was found significant at 5 percent level and the co- efficient of variation was 37.46 percent. The R^2 value 0.83 indicates that 83 percent of the total variation was explained regarding the area of finger millet in Karnataka and in Maharashtra with an R^2 of 0.95 respectively. An examination of level of instability in area of finger millet over years revealed that the Tamil Nadu had registered 15.36 percent level of instability followed by Karnataka with 8.77 percent and Maharashtra with 6.23 percent respectively.

Production is a function of change in area and productivity. Growth rate of production under finger millet in different states of India for the period from 1981-82 to 2020-21 is represented in the Table 3. The production under finger millet in Karnataka has been fluctuated from 1427.8 thousand MT in 1981-82 to 1369.8 thousand MT in 2020-21 with an average of 1317 thousand MT. The compound annual growth rate was found to be -0.46 percent which was found insignificant and the co-efficient of variation was 21.26 percent. The production under finger millet in Maharashtra has been fluctuated from 228 thousand MT in 1981-82 to 94 thousand MT in 2020-21 with an average of 159 thousand MT. The compound annual growth rate was found to be -2.33 percent with significant at 1 percent level and the co-efficient of variation was 30.33 percent. The average production under finger millet in Orissa for the period from 1981-82 to 2020-21 was 251 thousand MT. The compound annual growth rate was found to be -1.01 percent which was found significant at 1 percent level and the co-efficient of variation was 30.03 percent. The R^2 value 0.12 indicates that 12 percent of the total variation was explained regarding the production of finger millet in Karnataka and Maharashtra with an R^2 of 0.04, 0.80 respectively. An examination of level of instability in production of finger millet over years revealed that the Tamil Nadu had registered 28.05 percent level of instability followed by Karnataka with 20.77 percent and Maharashtra with 13.29 percent respectively.

Growth rate of productivity under finger millet in different states of India for the period from 1981-82 to 2020-21 is represented in the Table 4. The productivity under finger millet in Maharashtra has been increased from 1012 Kg per hectare in 1981-82 to 1151 Kg per hectare in 2020-21 with an average of 1032 MT per hectare. The compound annual growth rate was found to be 0.22 percent which was found insignificant and the co-efficient of variation was 10.57 percent. The average productivity of finger millet in Karnataka for the study period was 1478 Kg per hectare with the compound annual growth rate of 1.18 percent which was found significant at 1 percent and the co-efficient of variation was 20.37 percent. The average productivity under finger millet in Tamil Nadu for the study period was 2050 Kg per hectare. The compound annual growth rate was found to be 1.88 percent which was found significant at 1 percent level and the co- efficient of variation was 32.41 percent. The R^2 value 0.52 indicates that 52 percent of the total variation was explained regarding the productivity of finger millet in Tamil Nadu and Karnataka with an R^2 of 0.52 respectively. An examination of level of instability in productivity of finger millet over years revealed that the Tamil Nadu had registered 22.25 percent level of instability followed by Karnataka with 15.47 percent and Maharashtra with 10.28 percent respectively.

The result was similar to the findings of Sivaraman *et al*. (2018) [14], which concluded that in spite of finger millets remarkable qualities like suitability to rainfed conditions, high in nutrient content like calcium, fibre, iron and methionine content and long storage life, the crop is losing in terms of area and production due to diversification of crops towards cereal crops and other competitive crops. Similar results were found by Amin *et al*. (2017) [2] which concluded that the most of the cultivated land was dominated by cereal crops.

Table 1: Growth rate of area, production and productivity of ragi in India

Year	Area ('000 ha)	Production ('000 MT)	Productivity (Kg/ha)	Year	Area ('000 ha)	Production ('000 MT)	Productivity (Kg/ha)
1981-82	2610	2961	1134	2005-06	1534	2354	1534
1982-83	2412	2223	922	2006-07	1177	1444	1226
1983-84	2558	2831	1107	2007-08	1387	2152	1552
1984-85	2387	2530	1060	2008-09	1381	2040	1477
1985-86	2401	2518	1049	2009-10	1268	1888	1489
1986-87	2405	2708	1126	2010-11	1286	2193	1705
1987-88	2262	2319	1025	2011-12	1176	1929	1641
1988-89	2317	2410	1040	2012-13	1131	1574	1392
1989-90	2343	2767	1181	2013-14	1194	1983	1661
1990-91	2171	2340	1078	2014-15	1208	2061	1706
1991-92	2130	2582	1212	2015-16	1138	1822	1601
1992-93	1905	2531	1328	2016-17	1016	1385	1363
1993-94	1884	2597	1378	2017-18	1194	1985	1662
1994-95	1764	2342	1328	2018-19	891	1239	1390
1995-96	1774	2501	1410	2019-20	1004	1755	1747
1996-97	1784	2340	1312	2020-21	1159	1998	1724
1997-98	1657	2087	1260	Total	67341	88106	54375
1998-99	1758	2608	1483	Mean	1684	2203	1359
1999-2000	1634	2290	1401	Std	498.08	425.09	237.10
2000-01	1759	2732	1553	CV	29.59	19.30	17.44
2001-02	1647	2375	1442	LOGEST	0.975	0.987	1.012
2002-03	1415	1316	930	CAGR (%)	-2.471**	-1.278**	1.224**
2003-04	1666	1966	1180	R^2	0.950	0.500	0.622
2004-05	1553	2432	1567	Instability	6.616	13.644	10.724

Source: Ministry of Agriculture & Farmers Welfare, Govt. of India
Note: Std: Standard deviation CV: Coefficient of variation CAGR: Compound annual growth rate
R^2: Coefficient of multiple determination
** Significant at 1 percentage Significant at 5 percentage

Table 2: Growth rate of area under ragi in different states

Year	Andhra Pradesh	Bihar	Gujarat	Karnataka	Maharashtra	Orissa	Tamil Nadu	West Bengal	Other state
1981-82	258.9	168.8	47.4	1148.3	225.2	288.9	245.5	16.8	210.6
1982-83	242.0	138.2	47.8	1030.3	225.8	298.5	206.1	14.3	208.7
1983-84	255.3	150.9	45.0	1124.6	228.1	297.5	232.5	13.6	210.7
1984-85	226.1	131.0	44.6	1081.2	227.4	257.3	202.9	14.6	201.8
1985-86	212.7	125.5	44.8	1109.2	221.7	285.8	195.1	13.9	191.9
1986-87	182.6	117.6	40.7	1174.9	220.6	276.7	176.4	16.1	199.1
1987-88	173.4	103.4	35.2	1116.2	213.8	224.2	198.5	15.3	182
1988-89	168.1	106.7	33.2	1150.4	205.0	260.6	193.0	14.9	185.4
1989-90	171.0	104.3	33.0	1167.3	206.6	245.5	201.5	13.6	200.2
1990-91	164.1	97.6	29.9	1054.4	207.5	256.8	169.7	13.1	178.2
1991-92	145.8	91.1	28.6	1066.1	204.7	246.5	158.4	12.8	175.9
1992-93	144.7	87.4	24.8	1038.4	193.9	79.9	150.5	12.5	173.2
1993-94	140.3	94.2	25.8	1028.5	165.6	85.2	158.0	12.4	174.3
1994-95	129.9	91.3	20.0	944.2	163.0	80.5	144.7	12.4	177.6
1995-96	126.8	82.5	18.9	1019.9	152.9	71.5	121.6	12.9	166.7
1996-97	120.0	80.1	20.2	1035.2	150.6	81.3	111.4	12.5	172.9
1997-98	97.8	74.3	18.9	938.5	156.6	79.9	107.0	12.6	171
1998-99	103.0	72.0	19.7	1030.7	157.0	81.1	120.0	12.9	161.8
1999-2000	96.7	65.7	19.4	916.3	156.4	82.0	122.7	12.5	162.7
2000-01	99.2	22.5	19.6	1021.0	154.9	84.0	127.0	12.7	15.6
2001-02	81.7	19.6	21.0	953.5	150.7	76.3	125.0	12.7	13.2
2002-03	71.0	20.7	24.6	767.1	146.0	77.1	104.3	13.5	12.1
2003-04	78.0	15.2	21.0	998.3	147.0	70.5	145.3	13.6	11.9
2004-05	69.0	15.6	24.3	893.0	145.0	78.0	108.9	12.4	11.2
2005-06	66.0	14.5	24.0	938.0	136.0	65.5	99.6	12.6	11.2
2006-07	59.0	14.3	17.0	606.0	136.0	65.0	95.5	13.1	10.6
2007-08	55.0	14.5	22.0	833.0	128.0	67.6	93.7	13.1	9.7
2008-09	50.0	11.4	19.0	841.0	126.0	65.7	90.1	12.7	10
2009-10	45.0	10.4	14.0	765.0	120.0	59.0	82.3	11.8	9.805
2010-11	42.0	9.0	20.0	788.0	120.0	66.2	75.7	11.7	7.512
2011-12	42.0	7.7	16.0	680.0	130.0	55.0	82.8	8.4	8.82

2012-13	39.0	7.9	14.0	645.0	125.0	57.2	70.3	10.0	7.389
2013-14	41.9	7.0	14.0	671.0	126.0	56.6	118.7	10.1	7.182
2014-15	33.0	6.7	20.0	708.0	112.0	51.5	104.4	10.1	17.8
2015-16	32.0	6.9	19.0	705.0	92.0	45.7	90.0	11.0	6.6463
2016-17	32.0	4.8	19.0	598.0	92.7	47.0	61.4	9.9	5.769
2017-18	35.0	4.2	12.0	778.0	93.0	42.6	86.5	12.0	2.7985
2018-19	32.0	2.9	12.0	527.3	80.3	36.7	78.6	3.3	2.9057
2019-20	34.0	2.8	11.6	641.0	82.2	35.9	84.5	2.9	2.929
2020-21	33.0	2.8	10.5	785.0	81.6	41.3	82.9	6.0	1.703
Total	4229	2204	972	36317	6207	4824	5223	483	3691
Mean	106	55	24	908	155	121	131	12	92
Std	69.59	51.29	10.56	185.21	45.86	93.12	48.92	2.86	89.53
CV	65.82	93.09	43.42	20.40	29.55	77.21	37.46	23.66	97.01
LOGEST	0.943	0.895	0.969	0.984	0.975	0.947	0.972	0.980	0.876
CAGR (%)	-5.716**	-10.544**	-3.102**	-1.634**	-2.549**	-5.289**	-2.839*	-2.003**	-12.402**
R^2	0.918	0.897	0.763	0.815	0.955	0.730	0.832	0.597	0.821
Instability	18.858	29.895	21.152	8.776	6.239	40.093	15.369	15.015	41.098

Source: Ministry of Agriculture & Farmers Welfare, Govt. of India
Note: ** Significant at 1 percentage * Significant at 5 percentage

Table 3: Growth rate of production under ragi in different states

Year	Andhra Pradesh	Bihar	Gujarat	Karnataka	Maharashtra	Orissa	Tamil Nadu	West Bengal	Other state
1981-82	286.9	93.6	48.7	1427.8	228.0	238.1	448.5	9.7	179.2
1982-83	233.4	74.9	43.2	944.5	215.0	244.0	273.0	8.3	186.8
1983-84	262.6	104.4	49.1	1434.1	240.9	270.9	250.9	9.0	209.1
1984-85	216.2	107.0	44.2	1267.0	261.9	191.0	227.5	10.1	205.2
1985-86	205.9	94.9	33.4	1200.1	261.1	211.9	300.8	9.6	200.4
1986-87	182.3	75.5	22.2	1552.4	148.6	201.4	315.3	12.0	198.6
1987-88	169.3	52.2	13.9	1203.8	209.2	206.4	329.1	10.9	124.2
1988-89	171.0	67.1	29.8	1178.0	227.3	253.2	273.4	12.9	197
1989-90	207.8	80.2	26.9	1399.4	217.0	241.2	356.0	12.1	225.9
1990-91	191.3	88.2	25.4	1043.0	213.8	253.6	316.2	10.9	197.6
1991-92	152.2	71.7	19.9	1443.7	188.2	189.8	310.6	11.8	193.9
1992-93	159.3	63.8	20.1	1536.1	207.5	41.8	291.0	11.7	199.8
1993-94	163.3	65.6	27.5	1566.6	173.8	54.7	331.0	11.7	203
1994-95	171.4	69.8	16.0	1352.7	176.6	47.4	285.0	13.2	209.9
1995-96	148.0	74.7	17.9	1618.2	160.6	43.7	221.0	13.6	203.7
1996-97	148.0	75.7	19.1	1488.1	152.5	49.0	190.5	14.0	203.2
1997-98	90.0	65.3	17.9	1283.0	146.8	47.1	217.9	15.3	203.5
1998-99	122.0	61.3	20.4	1734.1	159.1	51.9	240.6	15.6	203.1
1999-2000	110.6	64.7	21.5	1402.2	168.1	53.0	245.9	15.1	208.4
2000-01	120.2	24.7	14.0	1887.0	128.6	46.5	259.5	15.2	14.9
2001-02	102.8	16.7	21.5	1539.4	181.6	45.1	235.0	14.8	13.3
2002-03	78.0	14.2	15.9	714.5	124.0	35.5	140.2	15.6	12.8
2003-04	101.0	10.4	24.1	1125.1	170.0	44.6	271.1	15.6	12.7
2004-05	87.0	10.5	25.8	1733.0	147.0	44.9	154.1	15.1	11.3
2005-06	79.0	11.3	22.0	1724.0	132.0	40.3	132.7	15.3	11.5
2006-07	64.0	12.5	11.0	816.0	123.0	43.1	148.2	15.0	10.9
2007-08	69.0	8.7	18.0	1497.0	124.0	46.8	175.9	15.0	10.3
2008-09	52.0	9.3	20.0	1394.0	125.0	41.0	170.0	14.7	10.1
2009-10	53.0	8.4	11.0	1312.0	109.0	37.7	162.6	13.9	9.975
2010-11	50.0	7.2	14.0	1588.0	117.0	46.9	171.1	13.8	7.571
2011-12	40.0	9.4	13.0	1272.0	138.0	30.9	224.9	8.2	8.73
2012-13	42.0	9.4	14.0	975.0	139.0	44.0	138.3	12.0	7.311
2013-14	43.0	7.1	14.0	1180.3	142.0	45.8	362.3	11.1	6.89
2014-15	34.0	9.8	16.0	1298.0	119.0	38.0	349.6	11.1	9.7
2015-16	34.0	9.9	15.0	1188.0	93.0	28.3	271.2	12.5	7.6
2016-17	35.0	3.5	27.0	859.0	111.1	33.1	114.4	11.0	4.6
2017-18	44.7	4.2	10.8	1286.0	106.5	32.7	321.3	13.6	3.6
2018-19	43.1	3.1	9.6	677.5	93.5	25.3	256.0	2.9	3.5
2019-20	44.9	2.2	10.0	1164.1	87.2	26.2	274.5	4.2	3.9
2020-21	39.5	2.6	12.6	1369.8	93.9	32.9	288.6	6.5	2.3
Total	4648	1646	856	52674	6360	3700	10046	485	3936
Mean	116	41	21	1317	159	92	251	12	98
Std	71.17	35.60	10.21	279.95	48.22	85.61	75.43	3.09	96.47

CV	61.25	86.52	47.67	21.26	30.33	92.56	30.03	25.50	98.04
logest	0.946	0.906	0.973	0.995	0.977	0.943	0.990	0.994	0.877
CAGR(%)	-5.391**	-9.447**	-2.719**	-0.464	-2.330**	-5.687**	-1.010*	-0.580**	-12.264**
R^2	0.015	0.018	0.528	0.045	0.808	0.643	0.129	0.008	0.726
Instability	60.782	85.732	32.762	20.773	13.292	55.341	28.025	25.399	51.331

Note: Std: Standard deviation CV: Coefficient of variation CAGR: Compound annual growth rate
R2: Coefficient of multiple determination
** Significant at 1 percentage Significant at 5 percentage

Table 4: Growth rate of productivity under ragi in different states

Year	Andhra Pradesh	Bihar	Gujarat	Karnataka	Maharashtra	Orissa	Tamil Nadu	West Bengal	Other state
1981-82	1108	555	1027	1243	1012	824	1827	577	1285
1982-83	964	542	904	917	952	817	1325	580	1180
1983-84	1029	692	1091	1275	1056	911	1079	662	1128
1984-85	956	817	991	1172	1152	742	1121	692	1298
1985-86	968	756	746	1082	1178	741	1542	691	1210
1986-87	998	642	545	1321	674	728	1787	745	878
1987-88	976	505	395	1078	978	921	1658	712	869
1988-89	1017	629	898	1024	1109	972	1417	866	1112
1989-90	1215	769	815	1199	1050	982	1767	890	1096
1990-91	1166	904	849	989	1030	988	1863	832	1107
1991-92	1044	787	696	1354	919	770	1961	922	1061
1992-93	1101	730	810	1479	1070	523	1934	936	1187
1993-94	1164	696	1066	1523	1050	642	2095	944	1098
1994-95	1319	765	800	1433	1083	589	1970	1065	1019
1995-96	1167	905	947	1587	1050	611	1817	1054	1008
1996-97	1233	945	946	1438	1013	603	1710	1120	1109
1997-98	920	879	947	1367	937	589	2036	1214	1156
1998-99	1184	851	1036	1682	1013	640	2005	1209	1209
1999-2000	1144	985	1108	1530	1075	646	2004	1208	1343
2000-01	1212	1098	714	1848	830	554	2043	1197	1123
2001-02	1258	852	1024	1614	1205	591	1880	1165	1122
2002-03	1099	686	646	931	849	460	1344	1156	1034
2003-04	1295	684	1148	1127	1156	633	1866	1147	1144
2004-05	1261	673	1062	1941	1014	576	1415	1218	946
2005-06	1197	779	917	1838	971	615	1332	1214	1170
2006-07	1085	874	647	1347	904	663	1552	1145	1101
2007-08	1255	600	818	1797	969	692	1877	1145	1088
2008-09	1040	816	1053	1658	992	624	1887	1157	773
2009-10	1178	808	786	1715	908	638	1976	1180	709
2010-11	1190	800	700	2015	975	709	2260	1179	1023
2011-12	952	1213	813	1871	1062	562	2715	979	1203
2012-13	1077	1180	1000	1512	1112	770	1967	1200	1002
2013-14	1027	1016	1000	1759	1127	809	3053	1095	728
2014-15	1030	1473	800	1833	1063	739	3348	1095	714
2015-16	1063	1429	789	1685	1011	620	3013	1136	439
2016-17	1094	723	1421	1436	1198	705	1865	1108	478
2017-18	1277	994	896	1653	1145	767	3714	1130	575
2018-19	1348	1071	804	1285	1164.1	690	3257	895	505
2019-20	1320	796	862	1816	1061	731	3247	1464	574
2020-21	1197	934	1205	1745	1151	796	3481	1073	550
Total	45129	33852	35721	59120	41270	28184	82011	40998	39356
Mean	1128	846	893	1478	1032	705	2050	1025	984
Std	117.26	216.33	189.67	301.05	109.08	127.85	664.55	207.73	247.83
CV	10.39	25.56	21.24	20.37	10.57	18.15	32.41	20.27	25.19
LOGEST	1.003	1.012	1.004	1.012	1.002	0.996	1.019	1.015	0.982
CAGR(%)	0.345	1.226*	0.395	1.189**	0.225	-0.420	1.882**	1.452**	-1.810
R^2	0.148	0.327	0.038	0.423	0.054	0.097	0.529	0.545	0.502
Instability	9.591	20.966	20.834	15.471	10.282	17.241	22.253	13.665	17.782

Note: Std: Standard deviation CV: Coefficient of variation CAGR: Compound annual growth rate
R2: Coefficient of multiple determination
** Significant at 1 percentage Significant at 5 percentage

Conclusion

This study has analysed the trend in area, production and productivity of finger millet and the instability by Cuddy Della Valle index. The growth rate of area of finger millet in India showed significant at 1 percent but negative trend which is due to diversification of crops and production showed significant at 5 percent but negative trend and productivity showed insignificant negative trend which is due adoption of traditional varieties. The growth rate of area and production of finger millet of Karnataka showed significant negative trend and productivity showed insignificant negative trend. Thus there is a need to take up productivity enhancing measures in finger millet like varietal improvement, improved cultural practices and irrigation facilities. The instability indices for area, production and productivity for finger millet is positive which indicates less risk in growing finger millet in future. Government intervention needs to focus on spreading finger millet as a wonder grain for dry lands and infant nutrition.

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