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RESEARCH PAPER

A study on trend in area and production of major millets in India

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Abstract: Millets are ancient super grains and are the reservoirs of nutrition for a better health. Millets particularly pearl millet, finger millet and small millets are the important food and fodder crops in semi - arid regions and are predominantly gaininig importance in the world. Among them roughly one million plant spieces that inhabit our plants, approximately 30 are essential for meeting the demands for food, fodder and fuel. Nonetheless, numerous plant species remain inadequately harnessed or undiscovered.

Key words: Area, Growth rate, Instability index, Millets, Production

Introduction

Millet is a collective term referring to a number of small-seeded annual grasses that are cultivated as grain crops, primarily on marginal lands in dry areas in temperate, sub-tropical and tropical regions. Among the estimated one million plant species existing on earth, about 30 plants meet the food, fodder and fuel requirements. However, many of the plant species still remain under-utilized or unexplored crops. Millets are the important crops in the semi-arid tropics of Asia and African countries (especially in India and Nigeria), with 97 per cent of millet production in developing countries. The crop is favored due to its productivity and short growing season under dry, high-temperature conditions. Small millets like finger millet, proso millet, and foxtail millet and other small millets are also important crop species. In the developed world, millets are less important, while millets are indigenous and staple food to many parts of the world, it is believed that they had an evolutionary origin in tropical western Africa, as that is where the greatest number of both the wild and cultivated forms exist. Millets have been important food staples in human history, particularly in Asia and African subcontinent.

Millets have been cultivated for 10,000 years in East Asia. For generations, sorghum and millets have been significant mainstays in Asia and Africa's semi-arid tropics. These crops remain the primary sources of energy, protein, vitamins, and minerals for millions of the region's poorest residents.

Sorghum and millets are grown in hard environments where other crops fail to grow or yield. In many countries, they are farmed with limited water resources and without the use of fertilizers or other inputs by a large number of small-holder farmers. As a result, they are largely consumed by disadvantaged communities; they are also known as "coarse grain" or "poor people's crops." They are rarely traded on international or even domestic market places in many nations.

India is the world leader in the production of millets with share of around 41 per cent of total world production in 2021. India produces around 10.08 Metric Tonnes of millets annually, according to Ministry of Agriculture and Farmers Welfare data. In India, millets are cultivated in about 21 States. There is a major impetus in Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Telangana, Uttarakhand, Jharkhand, Madhya Pradesh and Haryana. In India, millets are cultivated in an area of 12.45 million hectares, producing 14.08 Metric Tonnes with a yield of 1247 kg/ha during 2021-22. Sorghum is the fourth most important food grain in India after rice, wheat, and maize in terms of area (3.84 million hectares) and production (3.90 Metric Tonnes). Bajra (7.05 million hectares) is contributing more than 50 per cent of the country's area under millets with nearly equal percentage of production.

India is the leader in production of Barnyard (99.90%), Finger (53.30%), Kodo (100%), Little millet (100%) and pearl millet (44.50%), producing about 12.08 Metric Tonnes from an area of 8.87 million ha. Though, area under millets has gone down significantly but the production & productivity has increased by 32 and 159 per cent, respectively. This significant increase in the production of millets will contribute in doubling farmers income by the year 2023-24. Rajasthan has the highest area under millets cultivation (31.30%) followed by Maharashtra (18.90%), Karnataka (13.30%), Uttar Pradesh (8.90%), Tamil Nadu (4.20%) and Madhya Pradesh (3.90%). However, the highest yields were recorded in Tamil Nadu (2137.60 kg/ha), Delhi (1579.50 kg/ha) and Madhya Pradesh (1420.50 kg/ha).

Understanding the importance of millets, the Government of India declared 2018 the Year of Millets to stimulate and promote millet cultivation. The Government of India spear headed the United Nations General Assembly (UNGA) resolution establishing 2023 as the International Year of Millets in order to generate local and global demand and offer nutritious food to the people. The Indian proposal was endorsed by 72 countries, and the United Nations General Assembly declared 2023 to be the International Year of Millets in March 2021(PIB.gov.in.2023)

Hence, it is important to know the trends in the scenario of area and production of these millets in India from the last decades. The study has been undertaken with an objective to estimate the trends in area and production of selected millets.

Material and methods

The data required for the study is exclusively from the secondary sources and hence**,** secondary data related to the details of information pertaining to area and production for the period 1990-91 to 2021-22 was collected from the website of www.Indiastat.com. Further, on the basis of area and production, the major millet crops like sorghum, bajra, and ragi and rest of the millet's crops were grouped as other small millets

Analysis of data

Growth model

To examine the compound growth rate in Area and production of millets for the period of twenty years from 1992 to 2022, Compound growth rates were estimated with the help of exponential function.

$Y = a\, b^t$ ——————————————————(1)

Where,

Y = Dependent variable for which growth rate is estimated (export volume Mt.)

a = Constant

b = Regression coefficient

t = Time variable in year (1991 to 2022)

In the logarithmic form of the above equation estimated the compound growth rate

$\log Y = \log a + t \log b$

The value of antilog of 'b' was estimated by using LOGEST function in MS- Excel give below

Antilog of $\log b$ = LOGEST (Y_1: Y_n)

The per cent compound growth rate (r) was derived using relationship

'r' (per cent) = [antilog of log (b) – 1] x 100

The compound growth rate was tested for their significance by using the following formula:

$$t = \frac{r}{S.E\ (r)}$$

Cuddy-Della Valle index

Cuddy Della Valle Instability index (Cuddy and Della Valle 1978) is a modification of coefficient of variation to accommodate trend present in the data, which is commonly present in economic time series data. This method is superior over the scale dependent measures such as standard deviation. The Cuddy Della Valle index (CDVI) is calculated as follows:

$CDVI = CV\sqrt{X}$

Where, X = 1 - R^2,CV is coefficient of variation, and R^2 is adjusted coefficient of determination. The ranges of CDVI are given as follows:

Low instability = between 0 and 15

Medium instability = greater than 15 and lower than 30

High instability = greater than 30

Results and discussion

Trends in area and production of selected millets.

The growth in area of selected millets in India for the period 1990-91 to 2021-22 is analyzed by dividing the data into decadal periods, that is from 1990-91 to 2000-01 is decadal period-I, from 2000-01 to 2010-11 is decadal period II, 2010-11 to 2020-21 was considered decadal period III and finally the overall period 1990-91 to 2020-21 is also analysed using growth rate analysis method and the results are presented in the Table.1

It is observed from the table that growth in the area of sorghum for the first decadal period was at the growth rate -3.53, second decadal period (-3.1), third decadal period (- 4.68) and overall period (-3.61). CAGR of bajra observed the growth rate of -1.52, -0.46, -1.70 and -1.19 CAGR for first, second, third decadal period and overall period, respectively. Ragi exhibited growth rate of -2.82, -3.18, -1.83 and -2.40 for the first, second, third decadal period and overall period respectively. In terms of small millets, the growth rate in area observed that, -5.40, -5.13, -6.23 and -5.16 for the first, second, third decadal period and overall period respectively. The observations are in same line with observations of the study conducted by Gyawali (2021) and Sekhara and Devarajulu *et al.*(2019).

Table1. Decadal change in area of millets in India

	Period -I (1990-91 to 2000-01			Period-II (2000-01 to 2010-11)			Period-III (2010-11 to 2020-21)			Overall period (1990-91 to 2020-21)		
Crops	CAGR	Instability Index	R^2	CAGR	Instability Index	R^2	CAGR	Instability Index	R^2	CAGR	Instability Index	R^2
Sorghum	-3.53	0.04	0.88	-3.10	0.02	0.94	-4.68***	0.07	0.82	-3.62	0.06	0.96
Bajra	-1.53***	0.03	0.69	-0.47*	0.09	0.03	-1.71**	0.07	0.38	-1.20***	0.07	0.70
Ragi	-2.83***	0.04	0.84	-3.18***	0.08	0.59	-1.84*	0.08	0.34	-2.40	0.07	0.90
Small Millets	-5.40	0.04	0.96	-5.13	0.03	0.96	-6.24	0.06	0.93	-5.17	0.05	0.99
Total millets	-2.85	0.02	0.93	-2.05	0.04	0.69	-2.98	0.05	0.80	-2.51	0.05	0.96

(Source: Author's calculation)

* Significant at 10 per cent level of significance

** Significant at 5 per cent level of significance

*** Significant at 1 per cent level of significance

Table 2. Decadal change in Production of millets in India

Crops	Period -I (1990-91 to 2000-01)			Period-II (2000-01 to 2010-11)			Period-III (2010-11 to 2020-21)			Overall period (1990-91 to 2020-21)		
	CAGR	Instability Index	R^2	CAGR	Instability Index	R^2	CAGR	Instability Index	R^2	CAGR	Instability Index	R^2
Sorghum	-3.10	0.15	0.28	-0.29*	0.05	0.02	-4.00***	0.12	0.54	-3.10	0.12	0.84
Bajra	-0.52*	0.16	0.01	1.65	0.23	0.04	0.26	0.09	0.01	1.55***	0.17	0.38
Ragi	-0.81	0.07	0.12	-1.74	0.21	0.05	-1.76	0.16	0.11	-1.46***	0.15	0.40
Small Millets	-5.89	0.07	0.88	-3.14	0.10	0.50	-2.36***	0.07	0.54	-3.27***	0.13	0.99
Total millets	-2.10	0.10	0.30	0.17	0.12	0.00	-1.31	0.04	0.17	-0.83	0.11	0.32

(Source: Author's calculation)

* Significant at 10 per cent level of significance

** Significant at 5 per cent level of significance

*** Significant at 1 per cent level of significance

The negative growth in area of all the millets was majorly may be because of change in cropping pattern of farmers, as the millets are less importance in the consumption practices. The low productivity nature if these millets were also may be an important reason for decreased cropping area

Similarly the growth in production of selected millets was analysed using growth rate analysis method for the decadal period I,II,III and overall period and the results are presented in the Table 2.

In terms of production all the selected millets growth rate of sorghum was -3.10, 0-.28, -4.00 and -3.10 CAGR for first, second, third decadal period and overall period respectively. The growth rate of bajra recorded -0.51, 1.65, 0.26 and 1.55 CAGR first, second, third decadal period and overall period, respectively. Growth rate of ragi observed that -0.80, -1.73, -1.76 and -1.45 CAGR for first, second, third decadal period and overall period respectively. Small millets recorded the growth rate of -5.89 for first decadal period, -3.14 during second decadal period, -2.36 during third decaled period and -3.26 at overall period. It is found that the research conducted by Goverdan *et al*. (2014), Babu *et al.*(2019) and Parthiban *et al.* (2019) were also had recorded similar results.

The growth rate of production of sleeted millets was negative, as the area under millets reduced the production was also parallelly reduced. The production of bajra was shown positive growth as the crop is consumed more in the northern parts of Karnataka and many other states. The productivity of millets is low and there are less high yielding varieties available for these millets in the market.

The Cuddy & Della Valle instability index was used to compute the degree of variation around the trend. The Cuddy & Della Valle instability index was calculated for both area and production of selected millets for the period 1990-91 to 2021-22. Jainuddin *et al.* (2019) were also employed the same tool in their study. With respect to Cuddy & Della Valle instability index the area of millets during the period 1, bajra was more stable with 0.03 per cent, in period 2 sorghum were more stable with 0.02 percent of index value, during the period 3, small millets were more stable with 0.05 percentage of instability index. In the overall period area of small millets was more stable with 0.05 per cent followed by overall millets (0.05%), sorghum (0.06%), and ragi (0.07%) during the study period. Similarly, Cuddy & Della Valle instability index of the production of millets during the period 1, small millets were more stable with 0.07 per cent, in period 2

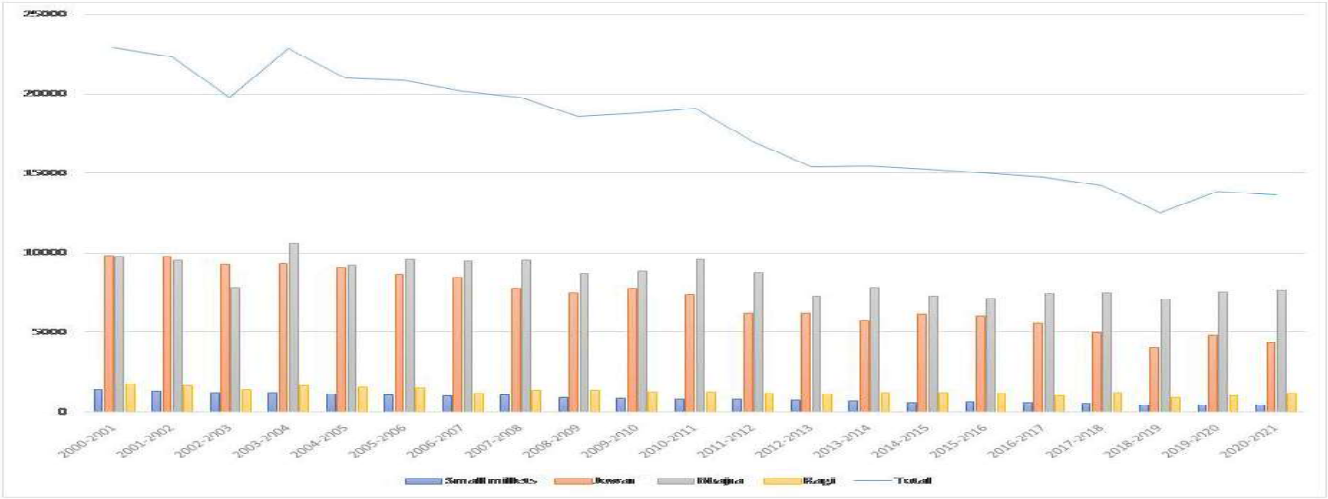

Fig.1 Area under millets in India from 2000-01 to 2020-21 (In ' 000 Hectare)

Table 3. Dynamics of area under millets (TE 1990 to TE 2021)

	TE1990-91 (In '000 Hectare)	TE2020-21 (In '000 Hectare)	Absolute change	% Change
Sorghum	14598.00	4431.67	-10166.33	-69.64
Bajra	11140.67	7433.33	-3707.33	-33.28
Ragi	2277.00	1018.00	-1259.00	-55.29
Small Millets	2631.00	350.33	-2280.67	-86.68
Total millets	30646.67	13335.00	-17311.67	-56.49

(Source: Author's calculation)

Table 4. Dynamics of millets production in India (TE1990 to TE 2021)

	TE 1990-91 (In '000Tonne)	TE 2020-21 (In '000Tonne)	Absolute change	% Change
Sorghum	11583.00	4353.00	-7230.00	-62.42
Bajra	8152.00	9963.33	1811.33	22.22
Ragi	2505.67	1664.00	-841.67	-33.59
Small Millets	1220.00	452.00	-768.00	-62.95
Total millets	23460.67	16330.67	-7130.00	-30.39

(Source: Author's calculation)

sorghum were more stable with 0.05 percent of index value, during the period 3, small millets were more stable with 0.07 percentage of instability index. The total millets were more stable in production with index value of 0.11per cent which was followed by sorghum (0.12), small millets (0.13%) ragi (0.15%) and bajra (0.17%) (0.11) during the same period. The results are in similar line with the research conducted by Dudhat *et al.* (2017).

The result of this index showed that the area as well as production of the millets was fluctuated variably. It's may be due to change in cropping pattern and low yielding capacity of these millets.

Dynamics of area under millets is calculated for triennium year 1990 to triennium year 2021 and presented in the Table 3 and 4, respectively. As Umagowri *et al*. (2020) and Panwar *et al.* (2019) observed in their study, the results shows that both the area and production of millets has been decreased in a remarkable rate. Area under small millets is reduced the most with -86.68 percentage followed by sorghum (-69.64%), total millets (-56.49%), ragi (-55.29%) and bajra (-33.28%). similarly, bajra shown increase in production with 22.22 followed by ragi (-33.59%), total millets (-30.39%), sorghum (-62.42%) and small millets (-62.95%).

The area and production both had been changed negatively for all the millets, it's due to mainly reduction of cropping area under millets, because of replacement of millets by other crops. The production of all the millets was shown negative except bajra,

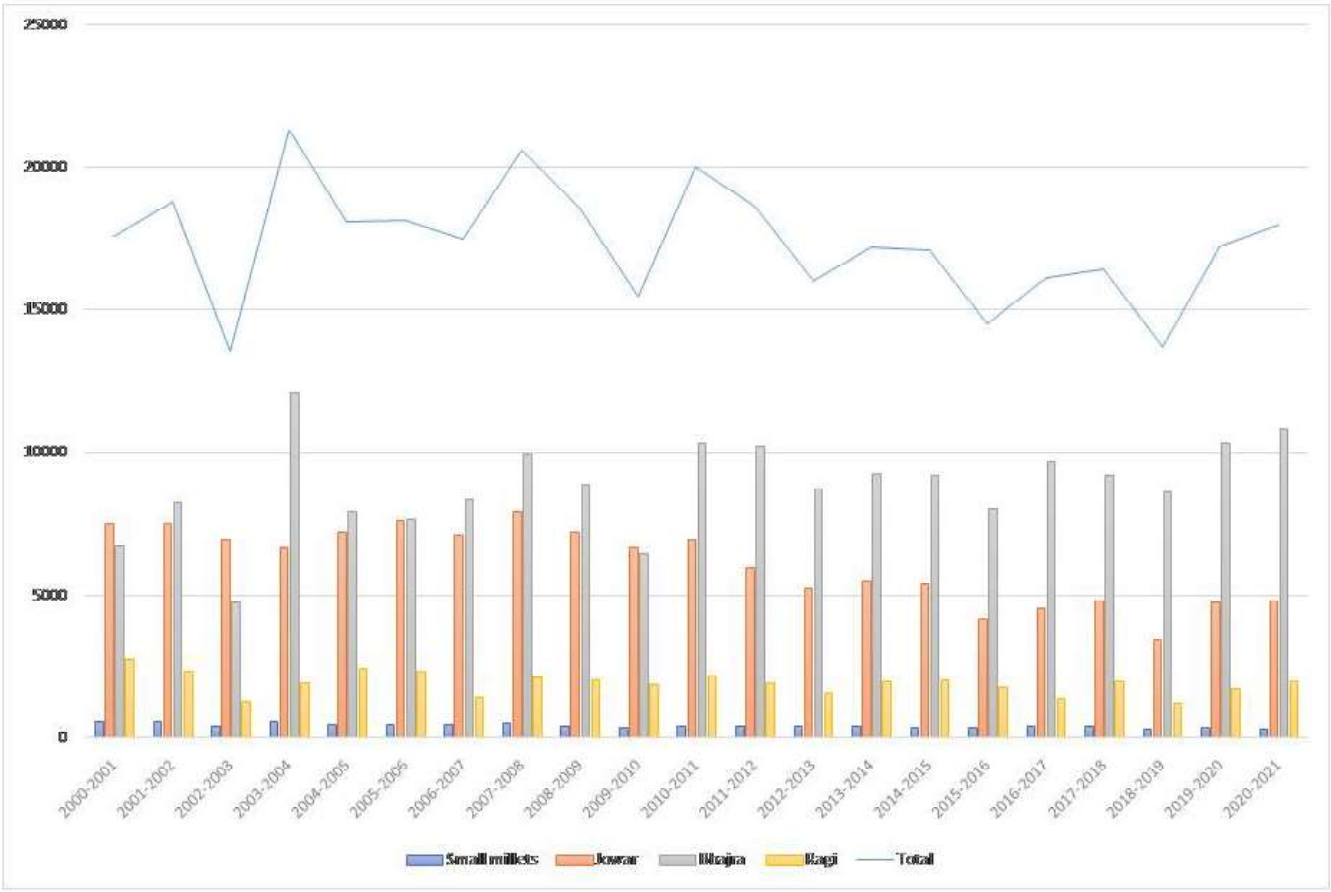

Fig 2: Production of millets in India from 2000-01 to 2020-21 (In ' 000 Tonne)

here bajra have got good yielding varieties and its staple food for northern parts of Karnataka. It's observed that Udaykumar *et al.* (2021) observed the similar results in their study.

Conclusion

There was negative growth in area and production of selected millets in India. Hence, farmers need to be educated by imparting training for gain of knowledge on good agricultural practices in cultivation of millets. The value addition of millets is an important area to save the millets from depletion in area and production. The millets need to be popularized among the consumers regarding their nutrition values which creates demand in the market. Agricultural universities must develop and introduce high yielding verities for these millets to get the attention of farmers. As sorghum and bajra other small millets must include under the minimum support price to secure the price loss by the farmers in the market.

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