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Growth pattern of millets in India

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ABSTRACT

The present study was carried out to estimate the growth rate of area, production and yield and to measure the contribution of different components to the growth rate of millets in India during the last six decades i.e. from 1950-51 to 2011-12. Area under sorghum, pearl millet, finger millet and total millets registered positive growth during 1950-51 to 1980-81 and negative growth subsequently. The production of total millets registered significant growth during overall study period due to increase in yield. Increase in production of sorghum, pearl millet, finger millet and total millets were contributed by their yields, whereas area and its interaction with yield have adversely affected the production. Decline in production of small millets was due to area effect and interaction effect. The main source of growth in production of millets has been the growth in yield per hectare during the period from 1950-51 to 2011-12.

Key words: Millets, Compound growth rate, Decomposition analysis.

INTRODUCTION

Millets are important cereals which play a significant role in the food and nutrition security of developing countries in the semi-arid tropics of Asia and Africa, especially in India, Nigeria and Niger. They are grown on soils which typically are too poor to support any other crop. They have a higher tolerance for drought, low nutrient application, and fluctuations in temperature than other cereal crops and also unique due to their short growing season. Millets are all-season crops cultivated round the year and produces multiple securities (food, fodder, health, nutrition, livelihood and ecological) making them the crops of agricultural security available at affordable prices.

Important millet crops grown in India are Sorghum (Great millet), Bajra (Pearl millet), Ragi (Finger millet) and small millets *viz*., Korra (Foxtail millet), Little millet, Kodo millet, Proso millet and Barnyard millet. These are often referred to as coarse cereals, but realizing the nutrient richness of the grains they are now considered as nutri-cereals. Millets are rich in minerals like iron, magnesium, phosphorous and potassium. Finger millet is the richest in calcium content, about 10 times that of rice or wheat. In this fashion, nutrient to nutrient, every single millet is extraordinarily superior to rice and wheat and therefore is the solution for the malnutrition that affects a vast majority of the Indian population.

Global millet production was estimated at 27.83 million tons (FAO, 2014). India is the largest producer (41.04%) in the world followed by Niger (11.94%). In the last two decades their importance as food staples, 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 (Rao and Basavaraj, 2015). 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 India, millets are cultivated in an area of 15.48 million hectare producing 17.2 million tonnes with a yield of 1111 kg/ha (Directorate of Economics and Statistics, 2015). Maharashtra, Rajasthan and Karnataka are the top most states of millets cultivation in India. Contribution of millets in total foodgrain production of India reduced from 22.17 % to 6.94 % over the last six decades from 1950-51 to 2011-12. In spite of all the extraordinary qualities and capacities of millet farming systems, the area under millet production has been shrinking over the last five decades and rapidly, since the Green Revolution period due to relentless promotion of other crops such as rice and wheat for intensive farming in select few resource rich areas under irrigated conditions (MINI). Another major threat that millets facing in the country in the form of an unnatural promotion of maize, which is resulting in maize invasion in various parts of the country owing to the corporate-induced demand for bio-fuels and poultry feed (Michaelraj and Shanmugam, 2013).

In this paper an attempt has been made with a specific objective to estimate the growth pattern of area, production and yield of millets and the relative contribution of area and yield in the deviation in production. It is hoped that the results of the study will assist the policy makers in

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formulating necessary strategies and policies to increase the production of millets to meet their demand during the changing times with the increasing health consciousness of people.

MATERIALS AND METHODS

The study uses secondary data pertaining to area, production and yield of millets in India during the last six decades i.e. from 1950-51 to 2011-12 collected primarily from Directorate of Economics and Statistics, Ministry of Agriculture, Government of India. The data was analyzed through percentages and averages to examine the change in area, production and yield of major millet crops viz., sorghum, pearl millet, finger millet, small millets and total millets.

Measurement of growth rate: The growth rates for area, production and yield of millet crops were calculated for three time periods *viz.*, period-I (1950-51 to 1980-81), period-II (1980-81 to 2011-12) and overall period (1950-51 to 2011-12). Compound growth rate (CGR) of area, production and yield of millets were estimated using the following exponential model (Goswami, 2006).

$Y=ab^t$

Where, b= (1+r)
i.e. log a + t log b
t log b = log Y – log a
log b = (log Y – log a)/t
Substituting (1+r) for 'b',

Log (1+r) = (log Y – log a)/t

Say, (log Y – log a)/t = some quantity of 'X'

Therefore, (1+r) = anti log 'X'-1
The compound annual rate of growth = (anti log 'X'-1) x 100
Since 'X' = log b,
The equation becomes
r = (anti log 'b'–1) x 100
The significance of the estimated compound growth rates was estimated with the help of student's 't' test.

Decomposition of growth components: Any change in the production of a crop depends basically on the changes in area under the crops and its average yield. Singh and Chandra (2001) analysed the relative contribution of area, productivity and their interaction in increasing the food grain production in Madhya Pradesh during 1950-51 to 2000-01 and observed higher productivity effect compared to area effect and interaction effect in increasing the food grain production. Vatta and Aggarwal (2000) found that area and yield collectively contributed to changes in the production of major agricultural crops in Punjab. To examine the contribution of area, yield and the interaction of area and yield towards change in the production of millet crops in the country, a decomposition analysis was performed (Mudinamani et al., 1995, Kumar and Devraj, 2010) and is expressed as

$\Delta P = A_o \Delta Y + Y_o \Delta A + \Delta A \Delta Y$

Change in production = Yield effect +
Area effect + Interaction effect
Production in the base year is given by
$P_o = A_o \times Y_o$
similarly, production in the n^{th} year is given by
$P_n = A_n \times Y_n$
Also $P_n = P_o + \Delta P$, $A_n = A_o + \Delta A$ and
$Y_n = Y_o + \Delta Y$
Therefore, $P_n = A_n \times Y_n$
$= (A_o + \Delta A)(Y_o + \Delta Y)$
$= A_o Y_o + A_o \Delta Y + \Delta A Y_o + \Delta A \Delta Y$
$= P_o + A_o \Delta Y + \Delta A Y_o + \Delta A \Delta Y$ Or
$\Delta P = P_n - P_o = A_o \Delta Y + Y_o \Delta A + \Delta A \Delta Y$
Where,
$A_o \Delta Y$ = Yield effect
$Y_o \Delta A$ = Area effect
$\Delta A \Delta Y$ = Interaction effect
A_o = area in the base year
A_n = area in the n^{th} year
P_o = production in the base year
P_n = production in the n^{th} year
Y_o = yield in the base year
Y_n = yield in the n^{th} year
ΔA = Change in area ($A_n - A_o$)
ΔP = Change in production ($P_n - P_o$)
ΔY = Change in yield ($Y_n - Y_o$)

RESULTS AND DISCUSSION

Change in area, production and yield: The analysis of average area, production and yield indicated decline in area and increase in yield under all the millet crops from TE ending 1951-52 to TE ending 2011-12 (Table 1). The total area under millets reduced from 31966 thousand ha to 18376.17 thousand ha (42.51 %) and the decline in area was highest in case of small millets (82.36 %) which contributes more to the reduction in the area under total millets. The production of almost all the millets crops increased over the study period due to the increase in yield despite of reduction in area under the crop, except in case of small millets. Although, the yield of small millets increased by 58.48 %, the decline in area under these crops (82.36 %) resulted in the reduction of total production by 72.04 %. The fluctuations in production are due to their cultivation in marginal and sub marginal dry lands by poor farmers, non adoption of improved varieties and timely agricultural operations, low genetic potential and cultivation of some of these crops in the hilly areas under shifting cultivation. Shrinkage of area under small millets in India is due to crop diversification towards commercial crops. With decline in area, impressive growth in production of total millets was mainly contributed by growth in yield (Kannan and Sundaram, 2011).

Sorghum and finger millet recorded 12.89 % and 47.41 % increase in production with an increased yield of 147.97 % and 145.71 % respectively over the study period. Pearl millet production was increased highly by 247.48 %,

Table 1: Average Area, Production and Yield of Millets in India 1950-51 to 2011- 12

Crop	Average Area ('000 ha)				Average Production ('000 tonnes)				Average Yield (Kg/ha)			
	TE ending 1951-52	TE ending 2011-12	Net change	Per cent change	TE ending 1951-52	TE ending 2011-12	Net change	Per cent change	TE ending 1951-52	TE ending 2011-12	Net change	Per cent change
Sorghum	15670	7133.87	-8536.13	-54.47	5826.67	6577.7	751.03	12.89	372	922	550	147.97
Pearl Millet	9280	9068	-212	-2.28	2583.33	8976.67	6393.34	247.48	278	990	712	255.61
Finger Millet	2211.7	1326.87	-884.83	-40.01	1359.3	2003.73	644.43	47.41	615	1510	896	145.71
Small Millets	4804.3	847.43	-3956.87	-82.36	1863.7	521	-1342.7	-72.04	388	615	227	58.48
Total Millets	31966	18376.17	-13589.83	-42.51	11633	18079.1	6446.1	55.41	364	984	620	170.35

which is largely attributed to the highest increase in yield (255.61 %) and minimal reduction in area under the crop (2.28 %) among the millet crops under study. Pearl millet is an important, dual purpose crop to meet the food, feed and fodder demand in western India (Rao *et al.* 2007). There is an increased demand for pearl millet grain as ingredient in preparation of beer and starch in breweries industry, use as ingredient in poultry and cattle feed industry since the last decade needs to be effectively met through increased supply of grain at competitive prices through innovative value chain models that link farmer with industry (Yadav *et al.* 2011) and the current high yield levels need to be maintained and sustained since increase in production through area expansion is limited.

Growth performance of area, production and yield: Annual compound growth rates were calculated for the millet crops during 1950-51 to 1980-81 (period-I), 1980-81 to 2011-12 (period-II) and 1950-51 to 2011-12 (overall period) and the results are presented in Table 2. Sorghum registered significant increase in area, production and yield during period-I (1950-51 to 1980-81) with an annual compound growth rate (CAGR) of 0.18 %, 2.16 % and 1.97 % respectively. Production of sorghum reduced significantly (1.7 %) during period-II even though there is a significant increase in yield due to high and significant negative growth in area (2.98 %), and also recorded significant increase in production with a growth rate of 0.15 % per annum during the overall study period (1950-51 to 2011-12). The major reasons for productivity improvement were use of high yielding varieties and increased utilization of input for sorghum cultivation (Hile *et al*. 2013). Even though there is an increase in yield with the use of improved/ hybrid seeds, there is not much increase in production as farmers shift to other, more remunerative crops (Basavaraj and Rao, 2012).

Significant positive growth in production (2 and 2.2 % CAGR) was observed in pearl millet during period-II and overall period due to relatively higher increase in yield (2.94 % and 2.39 % CAGR) and less decline in area (0.91 % and 0.18 % CAGR). Area under finger millet increased significantly during period-I with an annual growth rate of 0.35 % but reduced significantly during overall study period with negative growth rate of 0.87 % per annum. Although there was an increase in the yield of small millets, higher decline in area resulted in reduction of total production by 0.36 %, 3.83 % and 2.17 % respectively during all the three periods. All the millet crops registered significant decline in area during overall period (1950-51 to 2011-12) which started during eighties, due to increase in cultivated area of major cereal crops, oilseeds, pulses and other cash crops. Production increased significantly in almost all the millet crops during overall study period except in case of small millets. Area and production of small millets registered negative growth during all the periods because the increased growth in per hectare yield is less than reduction in area.

Table 2: Compound growth rates of millets in India 1950-51 to 2011-12

Crops	Area			Production			Yield		
	Period-I (1950-51 to 1980-81)	Period-II (1980-81 to 2011-12)	Overall Period (1950-51 to 2011-12)	Period-I (1950-51 to 1980-81)	Period-II (1980-81 to 2011-12)	Overall Period (1950-51 to 2011-12)	Period-I (1950-51 to 1980-81)	Period-II (1980-81 to 2011-12)	Overall Period (1950-51to 2011-12)
Sorghum	0.18*	-2.98*	-1.46*	2.16*	-1.7*	0.15*	1.97*	1.32**	1.64
	(0.64)	(0.6)	(0.77)	(1.85)	(1.28)	(1.38)	(1.27)	(0.84)	(0.78)
Pearl Millet	0.6	-0.91	-0.18	2.43	2*	2.2*	1.82*	2.94*	2.39*
	(0.81)	(0.05)	(0.51)	(3.15)	(0.88)	(1.64)	(2.49)	(0.92)	(1.34)
Finger Millet	0.35**	-2.01	-0.87	1.77	-0.7	0.48	1.41*	1.33*	1.37
	(0.25)	(0.22)	(0.50)	(0.34)	(1.04)	(0.72)	(0.16)	(0.96)	(0.48)
Small Millets	-0.49	-4.82	-2.75	-0.36*	-3.83*	-2.17*	0.13*	1.04*	0.6**
	(0.61)	(0.18)	(0.94)	(0.82)	(1.17)	(1.02)	(0.30)	(1.05)	(0.57)
Total Millets	0.24	-2.18	-1.02	1.89**	-0.21*	0.8*	1.64*	2.01*	1.83
	(0.55)	(0.25)	(0.58)	(1.03)	(0.84)	(0.79)	(0.47)	(0.69)	(0.42)

Figures in parenthesis are standard errors
* Significant at 1 % level and ** Significant at 5 % level

Decomposition of growth components: The total change in the production of millet crops was decomposed in to three effects i.e. area effect, yield effect and interaction effect (Table 3). The relative contribution of area, yield and their interaction in increasing the total production of millets was -76.72 %, 307.41 % and -130.69 % respectively. The increase in production of sorghum, pearl millet and finger millet was mostly due to yield effect (1147.98 %, 103.28 % and 307.35 % respectively), where the area and interaction effect contributed negatively. The reduction in small millets production was due to area effect and interaction effect by 114.32 % and 66.86 % respectively. The results of the decomposition analysis clearly indicates that per hectare yield contributed majorly in increasing the total production of millet crops in the country over the study period from 1950-51 to 2011-12.

Table 3: Effect of Area, Yield and Interaction of Area and Yield in changing the Production of Millets in India (1950-51 to 2011-12)

Crop	Area Effect	Yield Effect	Interaction Effect
Sorghum	-422.63	1147.98	-625.35
Pearl Millet	-0.92	103.28	-2.36
Finger Millet	-84.39	307.35	-122.96
Small Millets	114.32	-81.18	66.86
Total Millets	-76.72	307.41	-130.69

CONCLUSION

From the results of the study it is clear that area under millets has been declining over the years. It was mainly due to increase in area under cultivation of major cereals like rice and wheat after green revolution, increased cultivation of commercial crops like oilseeds, cotton, spices, fruits and vegetables during recent years due to globalization of agriculture. Even though there is a decline in area, the production of millets increased significantly during the last sixty years. It can be concluded that yield plays a major role in increased production and the yield effect remained greater than area effect and interaction effect.

During recent years people are recognizing the nutrient superiority and health benefits of millets compared to fine cereals. Increased use of small millets in various ready-to-eat food products should be encouraged as it enhances their value and market price. There may be an increase in demand for millets due to recent inclusion of millets in public distribution system with the implementation of food security bill coupled with increased awareness of people about inclusion of millets in daily meals for healthy living. And also millets are ideal solution for climate change. So, there is a need to increase the millet production with the increasing demand and to recognize them as climate change compliant crops to promote their cultivation and consumption which makes them India's food and farming future.

REFERENCES

Basavaraj, G. and Rao, P. P. (2012). Regional analysis of household consumption of sorghum in major sorghum – producing and sorghum consuming states in India. *Food Security*. **4:** 209-217.

DACNET: (2015) http://eands.dacnet.nic.in/. Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Govt. of India.

FAOSTAT: (2014) http://faostat3.fao.org/home/E. Food and Agriculture Organization, Rome.

Goswami, S. N. and Challa, O. (2006). Land use scenario in Meghalaya – An exploratory analysis. *Indian Journal of Soil Conservation.* **34:** 140-144.

Hile, R. B., Gulave, C. M. and Namdas, S. C. (2013). Economics of production and marketing of rabi Sorghum in Western Maharashtra. *Agricultural Situation in India.* **70:** 21-28.

Kannan, E. and Sundaram, S. (2011). Analysis of trends in India's agricultural growth. Working paper, 276. The Institute of Social and Economic Change, Bangalore.

Kumar, H. and Devraj. (2010). Growth rates of field pea in India – A Decomposition Analysis. *Agricultural Situation in India.* **67:** 127-129.

Michaelraj, P. S. J. and Shanmugam, A. (2013). A study on millets based cultivation and consumption in India. *International Journal of Marketing, Financial Services & Management Research.* **2:** 49-58.

MINI: Millets Future of food and farming. Millet Network of India - Deccan Development Society, FIAN, India.

Mudinamani, S. M., Sastry, K. N. R. and Murthy, T. N. V. (1995). Growth performance of oilseeds in Karnataka. *Agricultural Situation in India.* **50:** 451-456.

Rao, B.D., Reddy, S. and Seetharama, N. (2007). Reorientation of investment in R&D of millets for food security: The case of sorghum in India. *Agricultural Situation in India*. **64:** 303–305.

Rao, P. P. and Basavaraj, G. (2015). Status and prospects of millet utilization in India and global scenario. Millets : Promotion for Food, Feed, Fodder, Nutritional and Environment Security, Proceedings of Global Consultation on Millets Promotion for Health & Nutritional Security. Society for Millets Research, ICAR, Indian Institute of Millets Research, Hyderabad, Pp. 197-209.

Singh, G. and Chandra, H. (2001). Growth trends in area and productivity affecting total foodgrains production in Madhya Pradesh. *Agricultural Situation in India.* **58:** 597-602.

Vatta, K. and Aggarwal, M. (2000). Pattern of growth of major agricultural crops in Punjab. *Agricultural Situation in India.* **57:** 81-84.

Yadav, O.P., Rai, K.N., Khairwal, I.S., Rajpurohit, B.S. and Mahala, R.S. (2011). Breeding pearl millet for arid zone of north-western India: Constraints, Opportunities and approaches. All India Coordinated Pearl Millet Improvement Project, Jodhpur, India. Pp. 28.