

Production and consumption of minor millets in India- A structural break analysis

P. Anbukkani*, S. J. Balaji, M.L. Nithyashree and Prakash¹

Division of Agricultural Economics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
e-mail: anbueconomic@gmail.com

Received : May 2016 ; Revised Accepted: October 2017

ABSTRACT

Millets play an important role in rainfed region of the country which contributes 60 percent of the total area. Especially minor millets are very rich nutrients and are minerals and resistant to drought and stress in rainfed farming. Consumption pattern of small millets and finger millet was examined by using NSSO unit level data. Assam (18.82 kg/hsh/m) and Bihar (18.69 kg/hsh/m) states have highest consumption of small millets found in all India and rural areas. Madhya Pradesh has highest area of small millets (32.4%) followed by Chhattisgarh (19.5%), Uttarakhand (8%), Maharashtra (7.8%), Gujarat (5.3%) and Tamil Nadu (3.9%). Uttarakhand has highest productivity of 1174 Kg/ha followed by Tamil Nadu (1067 Kg/ha) and Gujarat (1056 Kg/ha). Structural breaks estimated based on bai-peron method for both finger millet and minor millet. In case of area under minor millets structural break was observed in the year 1998 and between 2000 and 2002. In comparison to sorghum, pearl millet and finger millet limited varieties of small millet have been developed.

Key words: Minor millets, Structural Break, Varietal Development, Cost Benefit Analysis.

Millets play important role in rainfed region of the country which contributes to 60 percent of the total area. The minor millets are rich source of nutrients and minerals and resistant to drought and stress in rainfed farming. Millets are adapted to a wide range of ecological conditions and are often grown on skeletal soils that are less than 15 cm deep. It does not demand rich soils for their survival and growth. All these qualities of millet farming system make the climate change portends less rain, more heat, reduced water availability and reduced malnutrition (Millet network of India). Worst part in minor millet is that area under millet production is shrinking over the last decades. Between 1966 and 2006, 44% of millet cultivation areas were occupied by other crops indicated loss to India's food and farming systems (Dhan foundation). Therefore,

*Corresponding Author :

¹ Scientist, Division of Agricultural Extension, ICAR-Indian Agricultural Research Institute, New Delhi-12

there is an urgent need for Indian policy makers to refocus their attention towards millet farming systems and enact policies that create an enabling environment for millet farmers. So scientist and researcher should focus more on high yielding varieties of millets which should give more yield and income for the farmer like other crops rice and wheat so that consumer can benefit from the nutrient rich millets. Because it has all the nutrients and minerals even better than other cereal like rice and wheat. In recent year consumer are very conscious about what they are consuming especially like sugar and obesity people are moving towards the small millets. So it is now important to know the status and different constraints of production and consumption of minor millets through in depth analysis of trend yield growth, instability and consumption pattern. In this context, the present study has been carried out with following specific objectives.

1. To study consumption pattern of small millets for the major states
2. To study spatial and temporal analysis of small millets of area, production and yield
3. Structural break of minor millet and finger millet in last two decade

DATA AND METHODOLOGY

The secondary data was compiled on various aspects like, area, production and yield of ragi and minor millets for major producing states. To calculate gross return and net return the cost of cultivation data was used. The data on area, production and yield were compiled from the Directorate of Economics and Statistics, Ministry of Agriculture. consumption pattern of small millets extracted from unit level NSSO data on "Household Consumer Expenditure and Employment and Unemployment" was used. Structural break analysis of area and yield of minor millet bai-peron (bai-peron, 2004) method has been used. R software was used to analyse structural break in minor millets.

RESULTS AND DISCUSSIONS

Nutritional status of millets

The millet has substantially high amount of protein, fiber and minerals in comparison to fine cereals like wheat and rice. The protein content in millets like Jowar (10.4), Bajra (11.6), Proso

millet (12.5), foxtail millet (12.3) and barnyard millet (11.6) is comparable with wheat (11.8) and much higher than rice (6.8). Though the finger millet contains lesser protein (7.3), but it is rich in mineral matter and calcium in comparison to wheat and rice. All the millets contain more fibre than fine cereals (Table 1). Particularly, the small millets namely barnyard millet (14.7), Kodo millet (9) little millet (8.6) and foxtail millet (8.0) are the richest in fibre in comparison to wheat (1.2) and rice (0.2). Therefore, millets are now being pronounced as "Miracle grains/ Adbhut Anaj and nutria-cereals".

Consumption pattern

Consumption pattern of small millets compiled from unit level NSSO data extracted from the 68th round on 'Household Consumer Expenditure' and 'Employment and Unemployment' for urban, rural and all India has been given in the table 3. Assam (18.82 kg/hsh/m) and Bihar (18.69 kg/hsh/m) states were highest consumption of small millets was found in all India and rural areas. Other state are consuming less than the 10 kg/household/month which is lower than that of Assam and Bihar.

Consumption pattern of finger millet was also analyzed for rural, urban and all India. Bihar consumed 12.02 kg/hsh/m of finger millet followed by Karnataka (even though area and production of finger millet highest in Karnataka).

Table 1. Nutritive value of coarse and fine cereals (Per 100 g).

Crop	Protein (g)	Carbohydrate (g)	Fat (g)	Crude fibre (g)	Mineral Matter (g)	Calcium (mg)	Phosphorous (mg)
Sorghum	10.4	72.6	1.9	1.6	1.6	25	222
Pearl millet	11.6	67.5	5.0	1.2	2.3	42	296
Finger millet	7.3	72.0	1.3	3.6	2.7	344	283
Proso millet	12.5	70.4	1.1	2.2	1.9	14	206
Foxtail millet	12.3	60.9	4.3	8.0	3.3	31	290
Kodo millet	8.3	65.9	1.4	9.0	2.6	27	188
Little millet	8.7	75.7	5.3	8.6	1.7	17	220
Barnyard millet	11.6	74.3	5.8	14.7	4.7	14	121
Barley	11.5	69.6	1.3	3.9	1.2	26	215
Maize	11.5	66.2	3.6	2.7	1.5	20	348
Wheat	11.8	71.2	1.5	1.2	1.5	41	306
Rice	6.8	78.2	0.5	0.2	0.6	10	160

Source: National Institute of Nutrition (NIN), Hyderabad.

Table 2. Consumption pattern of small millets.

States	All India		Rural		Urban	
	kg/hsh/m	Rs/hsh/m	kg/hsh/m	Rs/hsh/m	kg/hsh/m	Rs/hsh/m
Andhra Pradesh	6.52	80.39	7.06	84.68	1.11	37.86
Assam	18.82	381.96	18.82	381.96	-	-
Bihar	18.69	354.04	18.69	354.04	-	-
Chhattisgarh	4.18	55.14	4.22	55.41	1.97	40.71
Gujarat	0.39	17.82	0.48	19.81	0.36	16.96
Himachal Pradesh	2.00	50.00	2.00	50.00	3.80	47.03
Karnataka	7.12	87.45	8.41	103.37	1.05	119.96
Madhya Pradesh	1.71	96.48	1.88	90.08	0.86	44.89
Maharashtra	1.06	44.31	1.13	44.11	-	-
Orissa	4.06	48.69	4.06	48.69	-	-
Punjab	3.00	60.00	-	-	3.00	60.00
Rajasthan	0.75	30.00	-	-	0.75	30.00
Tamil Nadu	1.77	33.77	2.60	44.12	0.99	24.05
Uttarakhand	4.15	41.02	4.15	41.02	-	-
Uttar Pradesh	4.78	50.01	4.78	50.01	-	-
West Bengal	2.00	160.00	-	-	2.00	160.00

Source: NSSO, MOSPI, GoI

Table 3. Consumption pattern of finger millet.

States	All India		Rural		Urban	
	kg/hsh/m	Rs/hsh/m	kg/hsh/m	Rs/hsh/m	kg/hsh/m	Rs/hsh/m
Andhra Pradesh	2.40	38.24	2.68	40.11	1.64	32.83
Bihar	12.02	692.00	12.02	692.00	-	-
Chhattisgarh	3.18	41.09	3.18	41.09	-	-
Gujarat	8.39	136.72	8.39	136.72	-	-
HP	0.50	18.75	0.50	20.00	0.50	15.00
Karnataka	10.03	119.11	11.98	135.78	7.00	93.17
Kerala	0.96	23.86	1.02	23.69	0.81	24.36
Maharashtra	9.48	132.59	10.56	145.72	3.32	59.46
Orissa	3.51	46.70	3.62	46.98	2.29	43.07
Rajasthan	0.56	20.00	0.56	20.00	-	-
Tamil Nadu	2.35	38.33	2.71	40.96	1.63	32.96
Uttarakhand	4.61	52.00	4.65	52.23	2.17	28.26
West Bengal	0.80	38.00	-	-	0.80	38.00

Source: NSSO, MOSPI, GoI

Maharashtra and Gujarat also consumed significant amount of finger millet in 2011-12.

Production pattern

Over the last five decades area under minor millet and finger millet have decreased drastically from 1955-56 to 2013-14 (table no 4). In case of minor millet almost eight fold reduction

in area decreased from 53.35 lakh ha in 1955-56 to 6.82 lakh ha in 2013-14. Further the production of minor millet recorded four fold decreases during these periods. However the marginal increase in yield of minor millets was seen but this is very minimal as compared to other crops. Major reason for the reduction of area and production were the tradeoff between rice and

Table 4. Area, production and yield of small millets and finger millet from 1950-2014.

	1955-56	1965-66	1975-76	1985-86	1995-96	2005-06	2013-14
Small millets							
Area (Lakh ha)	53.35	45.64	46.72	31.55	16.62	10.64	6.82
Production (Lakh tones)	20.7	15.55	19.24	12.17	7.79	4.72	4.29
Yield (q/ha)	388	341	412	386	469	443	633
Finger millet							
Area (Lakh ha)	23.07	26.96	26.3	24.01	17.74	15.34	11.93
Production (Lakh tones)	18.46	13.27	27.97	25.18	25.01	23.54	19.92
Yield (kg/ha)	800	492	1064	1049	1410	1534	1661

Source: DES, MoA, GoI

wheat with minor millet. Whereas finger millet, one fold decrease in area and there is not as much as decrease in production due to yield almost doubled in these period i.e from 800 kg/ha to 1661 in 2013-14. Poor policy support for coarse cereals on the one hand favorable policies for the cultivation of oilseeds such as sunflower and soybeans and cash crops such as cotton on the other hand became more profitable, driven by yield increases and higher prices spurred by growing consumer demand (Status paper on coarse cereals, Directorate of Millets Development, Department of Agriculture and Cooperation). Easy availability of rice and wheat on subsidized rate through PDS, social status attached to fine cereals, the penetration of diversified value-added products from rice and

wheat and the ease of preparation and short cooking time for them have resulted in their increased consumption

Madhya Pradesh has highest area under small millets (32.4%) followed by Chhattisgarh (19.5%), Uttarakhand (8%), Maharashtra (7.8%), Gujarat (5.3%) and Tamil Nadu (3.9%). Uttarakhand has highest productivity of 1174 Kg/ha followed by Tamil Nadu (1067 Kg/ha) and Gujarat (1056 Kg/ha). State-wise average area, production and yield estimates of small millets are given in table 5. Karnataka has the highest area and production of finger millet followed by Tamil Nadu. Karnataka itself occupied around 66 per cent of total production and other states are very minimal production in India. But Tamil

Table 5. Major state-wise area, production and yield of small millets (Average of 2009-14).

State/ UT	Area (⁰⁰⁰ ha)	Production (⁰⁰⁰ Tonnes)	Yield (Kg/ha)	Compound growth rate (%)		
				Area	production	Yield
Andhra Pradesh	30.00 (3.88)	26.00 (6.07)	866.67	-6.01	-1.95	4.31
Arunachal Pradesh	22.09 (2.86)	21.54 (5.03)	975.03	0.67	1.43	0.76
Gujarat	49.00 (6.34)	48.60 (11.35)	991.84	-6.55	-5.82	0.79
Jharkhand	24.95 (3.23)	11.95 (2.79)	478.96	13.58	29.07	13.64
Karnataka	24.21 (3.13)	11.85 (2.77)	489.61	-9.79	-11.10	-1.46
Madhya Pradesh	246.22 (31.85)	88.66 (20.71)	360.09	-5.83	-0.86	5.27
Maharashtra	63.00 (8.15)	28.72 (6.71)	455.87	-5.37	-6.89	-1.61
Tamil Nadu	30.84 (3.99)	32.58 (7.61)	1056.62	-7.16	-4.71	2.65
Uttarakhand	71.83 (9.29)	84.38 (19.71)	1174.77	-0.48	-0.20	0.29
All India	773.13 (100)	428.20 (100)	553.85	-5.13	-2.21	3.08

Figure in parenthesis are percentage to all India

Source: DES, MoA, GoI

Table 6. Major state-wise area, production and yield of finger millet (Average of 2009-14).

State/ UT	Area (⁰⁰⁰ ha)	Production (⁰⁰⁰ Tonnes)	Yield (Kg/ha)	Compound growth rate (%)		
				Area	production	Yield
Andhra Pradesh	42.80 (3.53)	46.80 (2.45)	1093.46	-6.43	-7.64	-1.29
Gujarat	15.60 (1.29)	13.20 (0.69)	846.15	-3.51	-3.11	0.41
Karnataka	709.80 (58.62)	1265.46 (66.13)	1782.84	-2.88	-1.08	1.85
Odisha	58.80 (4.86)	41.07 (2.15)	698.35	-1.84	-1.08	0.77
Tamil Nadu	85.96 (7.10)	211.85 (11.07)	2464.40	-2.84	-0.46	2.46
Uttarakhand	124.37 (10.27)	166.98 (8.73)	1342.56	-3.36	0.16	3.65
West Bengal	10.40 (0.27)	11.80 (0.62)	1134.69	-1.97	-0.58	1.41
All India	1210.94 (100)	1913.70 (100)	1580.34	-2.99	-1.26	1.78

Figure in parenthesis are percentage to all India

Nadu state has recorded highest productivity (2464 Kg/ha) of finger millet followed by Karnataka (1782 Kg/ha) which is above the national average yield (1580 Kg/ha). As far as compound growth rate is concern negative growth in all states including Karnataka and Tamil Nadu. Area under finger millet and minor millets are losing its area to cereal crops and commercial crops even though they have higher nutritive value and are resistant to pest and disease and drought.

Structural break analysis

The change in area and productivity trend was analyzed by employing bai-peron method of structural break analysis for both finger millet and minor millet shows that, the break point fortrend in area under minor millets during the period 1998 and between 2000 and 2002. The possible reasons for observed changes could be occurrence of drought during these years further the area under finger millet occurrence of structural break during the years 1998, 2001 and

Table 7. Structural breaks of Minor millet and finger millet- 1990-2013.

S. No.	State	Minor millet		Finger millet	
		Area	Yield	Area	Yield
1	Andhra Pradesh	1998	2006	2002	2003
	Arunachal Pradesh	2002	1998		
2	Gujarat	2005	2005	2001	2006
3	Karnataka	1998	2000	2006	2002
4	Madhya Pradesh	2000	2000		
5	Maharashtra	2001	2015	1998	2006
6	Odisha	1998	-	-	2003
7	Tamil Nadu	1998	-	1998	2004
	All India	1998	2000	1998	2002

2002. However, the yield trend of minor millet and finger millet did not reveal structural breaks during study period.

Cost benefit analysis

The feasibility of finger millet cultivation was assessed by using secondary data of cost of production compiled from Directorate of Economics and Statistics. It is revealed that, except Tamil Nadu all other states could get negative net return from the cultivation of finger millets economic term it loss almost Rs. 16000 in Andhra Pradesh to Rs. 6614 in Karnataka. The cultivation of finger millet lost its profit during 2012-13 as compare to other cereal crops (Table 7). Farmers are moving from minor millets to other cereal and cash crops mainly to earn more income even though minor millets are drought resistant and are rich in nutrients. Like new technology and new variety may breakthrough the increase the area under finger millet and can increase the production. Varietal development and yield gap are major concern for increase in production of minor millet.

Varietal development and yield gap of finger millet

The improved varieties developed and released as Central/State variety during last 15 years (1995- 2010) are Bhairabi, Bharti, Birsa Marua-2, Champavathi, Chilka, Co (Ra)-14, KM-65, L-5, Maruthi, MR-1, MR-2, MR-6, ML-365, GPU-26, GPU-28, GPU-45, GPU-48, GPU-67, Paiyur (Ra)-2, Saura, KMR-301 and VL Finger millet-146. Potential varieties like GPU-28, GPU-67, RAU-8, CO (Ra)-14, and Paiyur-2 for development of finger millet hybrids. Karnataka

is the major finger millet growing State. About a dozen new varieties have been released for Karnataka during last 15 years. The yield performance of FLD indicates largest yield gap over State Average Yield in Chhattisgarh (641%) followed by Jharkhand (325%), Odisha (223%), Gujarat (104%), Maharashtra (73%), Andhra Pradesh (61%), Karnataka (28%) and Tamil Nadu (0.3%).

In comparison to sorghum, pearl millet and finger millet only a few varieties of small millet have been developed. During last 15 years only 34 varieties of 6 crops namely kodo millet (9), little millet (6), foxtail millet (5), barnyard millet (6) and proso millet (8) have been released for different states. Out of these 34 new varieties only 11 have become popular in the states of Gujarat, Karnataka, Tamil Nadu and Uttarakhand, whereas, in Chhattisgarh and Madhya Pradesh none of the new variety could reach to the farmers. Kodo millet: Largest yield gap has been recorded in Madhya Pradesh (101%) followed by Chhattisgarh (87%), Karnataka (70%) with least yield gap in Tamil Nadu (36%) over control plot. Foxtail millet: Yield gap of 62% and 40% has been recorded in Karnataka and Andhra Pradesh over control plot. Little millet: The largest yield gap has been recorded in Madhya Pradesh (115%) followed by Maharashtra (95%), Odisha (91%), Tamil Nadu (55%), and Karnataka (49%). Barnyard millet: Yield gap of 52% and 27% has been recorded in Uttarakhand and Tamil Nadu over control plot. Proso (Common) millet: Yield gap of 60% and 27% has been recorded in Karnataka and Tamil Nadu over control plot (Status paper on coarse cereals, directorate of millets development, MoA, GoI, 2014).

Table 8. Cost of cultivation parameters for finger millet -2012-13.

	Andhra Pradesh	Karnataka	Maharashtra	Tamil Nadu	Uttarakhand
Cost/ ha	35543	35938	32901	44123	39426
Gross Returns/haa	18994	29324	21619.	86206	29546
Net returns/ha	-16549	-6614	-11282	42082	-9879
Variable cost (cost A2)	16354	19572	16120	17550	17156
Return over a variable cost	2639	9751	5498	68655	12390
Cost/q (Rs.)	2469	2634	1521	1137	1861
price/q (Rs.)	1426	2049	1000	1984	1310

Source: Cost of cultivation, Directorate of Economics & Statistics

Table 9. Varietal development of finger millet and yield gap.

State/ UT	Varieties popular in the State
Andhra Pradesh	Padmawathi, Maruti, Kalyani, Godawari, AKP-2, SURAJ, Simhadri, Ratnagiri, Gouthami, Saphthagiri.
Gujarat	Gujarat Nagali-2 & Gujarat Nagali-3.
Karnataka	Indaf-8, Indaf-9, HR-911, PR-202, MR-1, MR-6, L-5, GPU-26, GPU- 28, GPU-66, GPU-45, VR-708 & OEB-10.
Odisha	Subra, Chilika & Saura
Tamil Nadu	GPU-28, CO-7, CO-10, CO-11, CO- 12, CO-13, CO-14, Paiyur (Ra)-2, K-567, Indaf-5, Indaf-7, Indaf-9, Paiyur-1, PR-202 and TRY-1.
Uttarakhand	VL-146, VL-149, VL-315, VL-324, PRM-1 & PRM-2.

Source: status paper on coarse cereals, Directorate of millets development, MoA, GoI, 2014.

Institution and programmes for millet development

The government has recognized the importance of the crop in meeting nutritional requirement of people. To promote area under millets government has initiated two programmes (i) NFSM and (ii) INSIMP (Appendix Table 1). The development of millet through AICRIP (1986) and Directorate of millet Development (1971). All India Coordinated Research Project on Small Millets (ICAR) Established in 1986 located at UAS, Bangalore, 14 AICRP centers and 16 voluntary centers located all over India. Target crops are finger millet, foxtail millet, barnyard millet, proso millet, little millet and kodo millet. They have focused on developing appropriate production technologies to meet regional needs work is multidisciplinary and applied in nature and value addition- limited extent.

Initiative for Nutritional Security through Intensive Millets Promotion (INSIMP): Government has announced an allocation of Rs. 300 crores in 2011-12 under Rashtriya Krishi Vikas Yojana for promotion of millets as Nutri-cereals. Scheme on Initiative for Nutrition Security through Intensive Millets Promotion has been formulated to operationalize the announcement. The scheme aims to demonstrate the improved production and post-harvest technologies in an integrated manner with visible impact to catalyze increased production of millets in the country. Besides increasing production of millets, the Scheme through processing and value

addition techniques is expected to generate consumer demand for millet based food products.

National Food Security Mission: Area Coverage under NFSM coarse cereals is being implemented in 28 States including North Eastern and Hill States. Priority is given to districts that have yields lower than State average. According to NFSM Coarse cereals is implemented in 265 districts of 28 States. Crops covered under NFSM Coarse Cereals are Maize, Sorghum, Barley, Pearl Millet, Finger Millet and Small millets (Kodos, Barnyard, Foxtail, Proso, & Little millet).

National Food Security Bill (NFSB): The recently passed NFSB has included millets in the basket of food grains to be given at subsidized rate. Concern has been expressed about inadequacy of production to meet this new demand.

CONCLUSION

Area under millets are cultivated have shown a steep decline between 1956 and 2006. During the same period, wheat and rice which were cultivated in less area than millets in 1955-56, have steadily climbed to overtake millets. Millets play important role in rainfed region of the country which contributes 60 percent of the total area. Especially minor millets has very rich nutrients and minerals and resistant to drought and stress in rainfed farming. Consumption pattern of small millets and finger millet are examined by using NSSO unit level data. Assam (18.82 kg/hsh/m) and Bihar (18.69 kg/hsh/m)

states were highest consumption of small millets found in all India and rural areas. Madhya Pradesh has highest area of small millets (32.4%) followed by Chhattisgarh (19.5%), Uttarakhand (8%), Maharashtra (7.8%), Gujarat (5.3%) and Tamil Nadu (3.9%). Uttarakhand has highest productivity of 1174 Kg/ha followed by Tamil Nadu (1067 Kg/ha) and Gujarat (1056 Kg/ha). Structural breaks estimated based on bai-peron method of structural break analysis for both finger millet and minor millet. In case of minor

millet area of structural break observed in the year 1998 and between 2000 and 2002. In comparison to sorghum, pearl millet and finger millet limited varieties of small millet have been developed. Investment of minor millets should be increased to improve the varietal development. Consumers are aware that, minor millets are significant to their diet and recent fast food habits. So it may be promoted by different extension activities.

REFERENCES

- GoI (various issue). Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, New Delhi
<http://www.dhan.org/smallmillets/report.php>
<http://www.milletindia.org/> Millets Net in India (MINI).
 Millets Future of Food & Farming Millet Network of India - Deccan Development Society - FIAN, India
 GoI. 2011. Agricultural statistics at a glance, Department of Economics and Statistics, Government of India, ([http:// www.dacnet.in/eands](http://www.dacnet.in/eands), Accessed on 15 Feb, 2016)
 NSSO. 2012. Household Consumer Expenditure' 68th round, Ministry of Statistics and Programme Implementation, GoI.
 NAAS. 2013. Role of Millets in Nutritional Security of India, National Academy of Agricultural Sciences, New Delhi policy paper 66
 Karthikeyan, M. 2014. Small Millets, Big Potential: Diverse, Nutritious and Climate Smart, Policy Briefing
 GoI. 2014. Status paper on coarse cereals, Directorate of Millets Development, Department of Agriculture and Cooperation, Ministry of Agriculture, GoI.
 Bai, J and P. Perron. 2004. Multiple structural break models: A simulation analysis