

## Availability and utilization of pearl millet in India

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Citation: Basavaraj G, Parthasarathy Rao P, Bhagavatula S and Ahmed W. 2010. Availability and utilization of pearl millet in India. Journal of SAT Agricultural Research 8.

### Introduction

Pearl millet (*Pennisetum glaucum*) is the most widely grown type of millet. Because of its tolerance to difficult growing conditions such as drought, low soil fertility and high temperature, it can be grown in areas where other cereal crops, such as maize (*Zea mays*) or wheat (*Triticum aestivum*), would not survive. Pearl millet production is concentrated in the developing countries which account for over 95% of the production and acreage. India continues to be the single largest producer of pearl millet in the world, although the area has been declining in the traditional growing states of Gujarat, Rajasthan and Haryana. Pearl millet is usually grown as a dryland dual-purpose grain and fodder crop although it is sometimes irrigated in India, particularly the summer crop grown mainly as a forage crop.

Pearl millet grain is the staple diet for farm households in the world's poorest countries and among the poorest people. In the Sahelian region of Africa and rural regions of northwestern India, pearl millet is an important cereal for consumption. Pearl millet stover is a valuable livestock feed in the growing regions in India and Africa. Exports and imports of pearl millet grain are negligible suggesting low demand, and/or unreliable availability of marketable surpluses for this commodity in world markets.

Pearl millet production in India was characterized by subsistence cultivation during 1970s with a small marketable surplus. But in recent years, it is being geared to a more market oriented crop owing to the change in utilization from mainly food use to many other alternative uses such as animal feed, potable alcohol, processed food, etc. However, data on utilization of pearl millet for food and other uses are not readily available. To fill this lacuna, an attempt has been made in this paper to compile data on utilization of pearl millet for food use and its trends over the years using consumer expenditure survey data published by National Sample Survey Organization (NSSO) (Ministry of Planning and Programme Implementation, Government of India, New Delhi). Such an analysis juxtaposed with pearl millet production/availability data would provide estimates of pearl millet utilized as food and with suitable assumptions for uses

like seed, wastage, etc and the residual available for other alternative uses including processed food.

The key research questions that this paper tries to address are:

- Trends in area and production of pearl millet;
- Trends in per capita consumption of pearl millet for food use (country and state level); and
- Estimation of utilization of pearl millet for alternative uses.

The estimates thus obtained on utilization of pearl millet for food and alternative uses (including processing) and their trends would help to understand the magnitude of the changes in utilization patterns over the years that would provide valuable information to researchers (crop scientists) and policy makers to concentrate their efforts on prioritizing the needs for the pearl millet growing sector as a whole.

### Data source and methodology

The main data source for this study is the quinquennial survey on household consumer expenditure for rural and urban consumers published by NSSO. The data considered for the present study includes seven NSSO quinquennial rounds, namely, the 27<sup>th</sup> round (October 1972–September 1973), 32<sup>nd</sup> (July 1977–June 1978), 38<sup>th</sup> (January–December 1983), 43<sup>rd</sup> (July 1987–June 1988), 50<sup>th</sup> (July 1993–June 1994), 55<sup>th</sup> (July 1999–June 2000) round and 61<sup>st</sup> round (July 2004–June 2005).

Data on trade of millets (exports and imports) for the period of study is obtained from Food and Agriculture Organization of the United Nations (FAO). Since separate data on pearl millet trade are not available from FAO it is assumed that pearl millet constitutes 90% of the trade in millets in India. Three-year average of imports and exports is considered in order to even out year-to-year fluctuations.

Data on pearl millet production in India is obtained from publications of Directorate of Economics and Statistics, Ministry of Agriculture, Government of India,

New Delhi, which provides data on area, production and yield of principal crops in Indian on annual basis. Three-year average of area and production of pearl millet is considered to even out any sharp fluctuations.

Seed consumption demand is estimated after consultation with breeders and researchers on seed rate used for pearl millet for the past three decades. The seed rate is multiplied with the area under pearl millet during the period of study to estimate seed demand. Wastage is assumed to be 0.1% of the total supply for the reference period.

Data on population for urban and rural areas in India for the period 1971, 1981, 1991 and 2001 are obtained from publications of Census of India (Registrar General and Census Commission of India, Government of India, New Delhi). Population is projected for the respective reference period under study based on the census population and growth rates. The population so estimated is bifurcated into rural and urban population based on the percentage of rural and urban population prevailing during respective census period.

In order to calculate the annual consumption demand of pearl millet in India for the reference period, the monthly per capita consumption of pearl millet in rural and urban areas is multiplied with total rural and urban population respectively. The rural and urban per capita monthly consumption is then multiplied by 12 to get annual consumption of pearl millet. After accounting for utilization of pearl millet for food consumption, seed demand, wastage and export, the residual quantity is the estimate of pearl millet utilization for other uses (Fig. 1).

## Results and discussion

**Pearl millet production and area trends.** Pearl millet in India is grown as a single season crop. Cultivation predominantly takes place on marginal lands and unirrigated lands. It is also grown in a small area as summer crop under irrigation particularly in the

northwestern states of India mainly as a fodder crop. Area trends of pearl millet in India are constantly declining. Between 1972–73 and 2004–05, nearly 3 million ha has been diverted from pearl millet cultivation to other crops, such as wheat, rapeseed mustard, cotton, chickpea and groundnut (Fig. 2). Reduction in area under cultivation of pearl millet is highest in Gujarat with 48% decline from 1971–72 to 2004–05 (Table 1). The shift in area is also most prominent in Haryana where increased irrigation facilities have made the cultivation of fine cereals like rice (*Oryza sativa*) and wheat a more profitable venture.

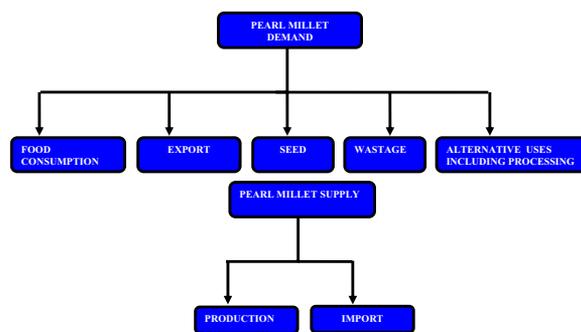


Figure 1. Flow chart of pearl millet utilization and supply.

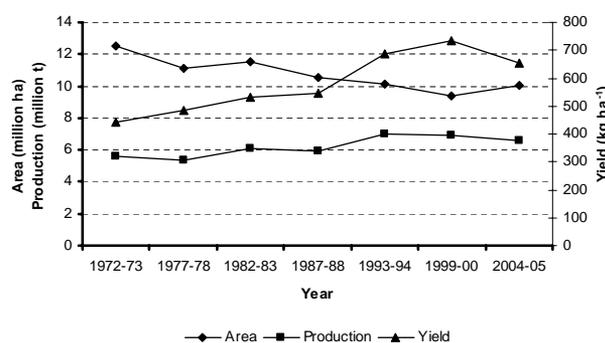


Figure 2. Trends in area, production and yield of pearl millet in India during 1972 to 2005.

Table 1. Area, production and yield of pearl millet in major growing states of India, 1972 to 2005<sup>1</sup>.

Year	Rajasthan			Gujarat			Haryana		
	Area ('000 ha)	Production ('000 tons)	Yield (kg ha <sup>-1</sup> )	Area ('000 ha)	Production ('000 tons)	Yield (kg ha <sup>-1</sup> )	Area ('000 ha)	Production ('000 tons)	Yield (kg ha <sup>-1</sup> )
1972–73	5355	1471	271	1842	1330	716	914	594	649
1977–78	4070	1092	272	1464	1279	872	901	405	447
1982–83	4916	1548	314	1421	1419	997	825	518	629
1987–88	4732	1662	324	1202	1053	811	626	500	715
1993–94	4767	2135	439	1228	1231	997	575	603	1030
1999–2000	4571	2389	505	952	979	1031	593	690	1164
2004–05	5128	4140	783	971	1252	1278	596	811	1357

1. Source: Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

Pearl millet production is concentrated in Gujarat, Maharashtra and Rajasthan which account for 70% of production in India. These states also have the highest concentration of pearl millet consumers since bulk of the consumption for food use takes place in the growing areas. Haryana used to be an important growing state, but since the 1980s, rice and wheat have replaced pearl millet, and now it accounts for only 9% of pearl millet production in the country. By and large, production levels have remained relatively stable in the early part of the study period at around 5 million tons and with the introduction of high-yielding hybrids in the late 1980s, production started increasing steadily (Bidinger and Parthasarathy Rao 1990).

**Consumption demand trends in India.** Pearl millet is consumed primarily as food in most of the developing countries. Pearl millet grain is also used as bird feed, but this use is largely restricted to the developed countries. But its utilization pattern is changing even in developing countries where its use is growing as feed, alcohol, beer making and food processing industry. Pearl millet fodder is an important feed resource in the crop–livestock systems where the crop is grown. In India, pearl millet is usually pounded to flour and then used to make a range of dishes for consumption. It is consumed mainly in the rural areas of western and central India. However, with the introduction of cheaper rice and wheat through Public Distribution System (PDS), consumers of pearl millet in rural areas have shifted away from pearl millet to consumption of wheat and rice.

This decline in per capita consumption of pearl millet both in rural and urban areas at all-India level is due to several factors but the most important ones are increase in per capita income, growing urbanization, changing tastes and preferences (Radhakrishnan 2005). This stagnation in consumption trend is seen for the cereal group as a whole in general and coarse cereals like sorghum (*Sorghum bicolor*) and pearl millet in particular. While the decline in pearl millet consumption is universal, ie, affecting pearl millet consumption as food in all growing countries, an important factor aiding its decline particularly in India is the government policy related to subsidy on rice and wheat consumption.

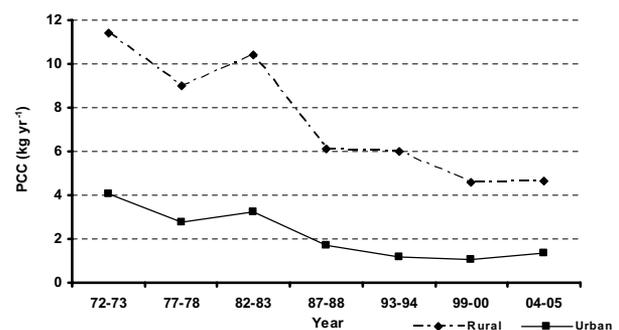
While rice and wheat consumption trends have remained stable, pearl millet consumption reduced sharply both in rural and urban India (Fig. 3). Consumption in urban India was always low because of the low shelf life of processed flour and hence grain has to be milled just before consumption. However, higher opportunity cost of women in urban areas makes them to spend less time in processing of pearl millet for consumption (FAO-ICRISAT 1996). As already mentioned, consumption in both rural and urban India decreased owing to

availability of rice and wheat through PDS. The lower preparation time for the fine cereals, and the perception of pearl millet as inferior grains contributed to the shift to rice and wheat. It is pertinent to observe that though the consumption trends of pearl millet in India have declined in the past two decades, both rural and urban trends are seen to plateau since the late 1990s at the present lower levels.

Across income classes, pearl millet is consumed mainly by the low and middle income groups. The higher income group accounts for less than 10% of total pearl millet consumed as food in rural areas and less than 5% in urban areas. About 46% of pearl millet in urban India is consumed by low income consumers (Table 2). Thus pearl millet continues to be an important staple for the poor despite an overall decline in its consumption.

**State-level trends of consumption.** Pearl millet is consumed predominantly in western and central states of India. However, the consumption of pearl millet as a staple is mainly in Gujarat and Rajasthan. Within the states the pattern of consumption is the same as it is in the rest of India, with rural per capita consumption being higher than in the urban areas (Figs. 4 and 5). Haryana, which was a significant consumer of pearl millet in the rural area, is now not a significant consumer with consumption decreasing by over 85% in both urban and rural areas (Table 3). This change can be attributed to the introduction of Green Revolution technologies in the state which diverted land to rice and wheat. It is important to note however, that the per capita consumption is relatively stable since the early 1990s both in the rural and urban areas. This reduction in pearl millet consumption is offset by the increase in rice and wheat consumption (Table 4).

**Shift in consumption of pearl millet between 1972–73 and 2004–05.** The decline in consumption of pearl millet



**Figure 3.** Annual per capita consumption (PCC) of pearl millet in rural and urban India during 1972 to 2005.

**Table 2. Annual consumption of pearl millet in India by income class, 2004–05<sup>1</sup>.**

Expenditure category	Consumption		Per capita consumption (kg yr <sup>-1</sup> )	Population (%)
	('000 t)	(%)		
<b>Rural average consumption</b>				
Low (less than ₹ 365 per month)	891.2	24.4	3.82	30.2
Medium (₹ 365–890 per month)	2,444.0	67.0	5.30	59.8
High (greater than ₹ 890 per month)	314.3	8.6	4.08	10.0
<b>Urban average consumption</b>				
Low (less than ₹ 580 per month)	197.4	46.5	2.12	30.2
Medium (₹ 580–1880 per month)	211.2	49.7	1.14	59.8
High (greater than ₹ 1880 per month)	16.4	3.9	0.53	10.0

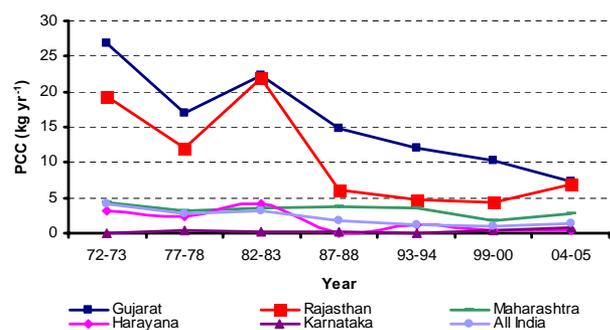
1. Source: Compiled from NSSO Report No. 508, Level and pattern of consumer expenditure, 2004–05.

**Table 3. Shift in consumption (kg yr<sup>-1</sup>) of pearl millet between 1972–73 and 2004–05 across major pearl millet consuming states in rural and urban India.**

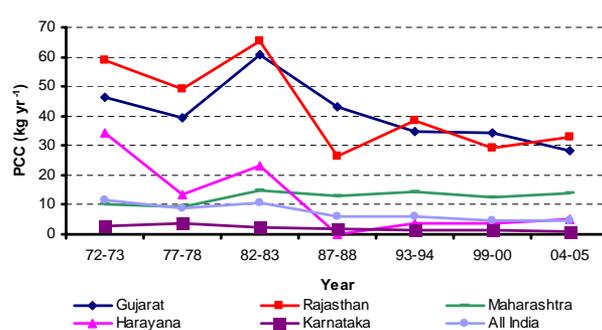
State	Urban			Rural		
	1972–73	2004–05	% change	1972–73	2004–05	% change
Gujarat	26.9	7.3	-73	46.4	28.1	-39
Rajasthan	19.3	6.9	-65	58.7	33.0	-44
Maharashtra	4.3	2.8	-35	10.3	13.8	33
Haryana	3.2	0.4	-86	34.1	5.0	-85
Karnataka	0	0.7	0	85.7	1.0	-99
India	4.1	1.4	-67	11.4	4.7	-59

**Table 4. Share (%) of pearl millet in total cereal consumption between 1972–73 and 2004–05 in Gujarat and Rajasthan.**

Crop	Rural				Urban			
	Gujarat		Rajasthan		Gujarat		Rajasthan	
	1972–73	2004–05	1972–73	2004–05	1972–73	2004–05	1972–73	2004–05
Pearl millet	29	23	27	22	21	7	–	5
Rice	12	20	1	1	15	25	4	5
Wheat	28	36	30	67	56	65	76	89



**Figure 4.** Annual urban per capita consumption (PCC) of pearl millet across states in India during 1972 to 2005.



**Figure 5.** Annual rural per capita consumption (PCC) of pearl millet across states in India during 1972 to 2005.

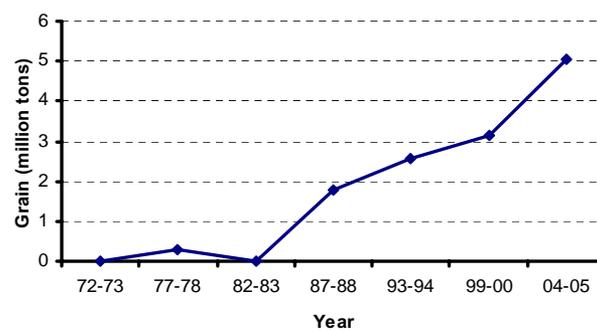
by 86% in urban Haryana is the maximum across major urban pearl millet consuming states followed by Gujarat with 76% decline between 1972–73 and 2004–05 (Table 3). Similarly in rural areas the maximum decline of 85% is seen in Haryana followed by Rajasthan with 44%. Growth in per capita income, changes in relative prices of food commodities, changes in lifestyle, taste and preferences (urbanization) are some of the major factors that have contributed to shift in consumption of coarse cereals.

**Export demand.** Pearl millet is very thinly traded in the world market. In the early 1970s and into the 1980s, pearl millet cultivation in India was primarily subsistence in nature with very little being marketed. A combination of low yields and fluctuating production in those years made trade infeasible. In 1987–88 close to 60,000 tons of pearl millet were exported to compensate shortfall in production due to severe drought in the main growing regions of the world (FAO-ICRISAT 1996). Since then exports of pearl millet have been increasing mainly to meet the growing demand for bird feed from developed countries.

**Seed demand.** Seed consumption demand for cultivation of pearl millet has shown a continuous declining trend (Table 5). The seed demand has been estimated after consultation with breeders on the trend in seed rate for pearl millet cultivation over the years. Seed rate is assumed to be 4 kg per ha during 1970s and 1980s and 3 kg per ha during the recent years. One of the factors that has contributed to the decline in seed demand is the introduction of hybrids in the 1980s, which are more vigorous than the local varieties and consequently require lower seed quantities per ha than the traditional saved seeds. The wide adoption of pearl millet hybrids was

largely due to subsidies provided by various state governments for the purchase of these seeds and more importantly they are high yielding.

**Estimation of other uses.** Based on the above data on household food use, seed demand and exports of pearl millet, its alternative use is estimated. We find that the non-food utilization of pearl millet has seen rapid increases over the years. The proportion of pearl millet that is being utilized in non-food uses has increased from 0% in the early 1970s to over 50% in 2004–05 (Table 5 and Fig. 6). Pearl millet is increasingly being diverted to other uses such as feed use, alcohol production, food processing and other industrial uses. Some information on these uses was obtained through field surveys in Rajasthan and Haryana and discussion with industry experts. But the exact utilization of pearl millet in each of these sectors has to be estimated through an extensive study on industrial uses of pearl millet. Identifying the precise channels in which pearl millet is being utilized would be a necessary second step in tailoring research needs to cater to changing preferences.



**Figure 6.** Trend in other uses of pearl millet in India during 1972 to 2005.

**Table 5. Availability and utilization of pearl millet in India between 1972–73 and 2004–05.**

Year	Total availability <sup>1</sup> (million t)	Food consumption (million t)	Percent food consumption	Seed demand (million t)	Wastage (million t)	Percent seed demand	Alternative uses (million t)	Percent alternative uses
1972–73	5.59	5.83	100 <sup>2</sup>	0.1	0.01	1.8	0	0
1977–78	5.38	4.98	93	0.08	0.01	1.6	0.31	7
1982–83	6.13	6.30	100 <sup>2</sup>	0.06	0.01	1.1	0	0
1987–88	5.91	4.06	69	0.06	0.01	1.1	1.78	30
1993–94	6.96	4.29	62	0.06	0.01	0.9	2.57	37
1999–2000	6.93	3.72	54	0.04	0.01	0.7	3.15	46
2004–05	9.19	4.05	44	0.04	0.01	0.5	5.04	55

1. Production + Imports – Exports.

2. The availability of pearl millet was less than the demand of pearl millet due to data discrepancy in consumption.

## Conclusion

The findings of the study show that while food use of pearl millet has declined sharply at the country level, its use as food though declining is still important in the major producing states. The decline in per capita consumption has plateaued between 2000 and 2004 with consumption increasing in a few states. Despite the overall decline in consumption a large share of pearl millet is consumed by the rural and urban poor while it only forms a small share in the basket of high income consumers. The increase in pearl millet production juxtaposed with its declining food use implies that its use in alternative uses has been increasing as indicated by the data from less than 5% to 55% in 2004–05. Alternative uses largely comprise demand for animal feed which includes mainly dairy (in rural parts of western Rajasthan) and to some extent in poultry, alcohol industry, starch industry, processed food industry and export demand. The potential demand for food processing, though at a nascent stage, presents encouraging prospects for value addition.

In addition to targeting increased yields, superior quality should be an overriding goal to continue its usage as a staple in growing area and also other regions. Incentives should be provided to food industry to use pearl millet for new processed food products and traditional processed products (bread, biscuits, etc). Capitalizing on the niche markets that are developing in urban India would also benefit the pearl millet farmer and

consumer simultaneously. Thus, research in understanding consumer preferences and profiling utilization needs of pearl millet will help in targeting the segments for better penetration. Hence, keeping in view the potential demand for pearl millet from these sectors, the prospects of pearl millet usage and production are encouraging.

**Acknowledgments.** This research work was carried out under "HOPE" project. The funding support from Bill & Melinda Gates Foundation (BMGF) is greatly acknowledged.

## References

- Bidinger FR and Parthasarathy Rao P.** 1990. Genetic and cultural improvement in the production of pearl millet. A comparative assessment for India and Sahelian/Sudanian Africa. Pages 194–206 *in* Proceedings of the International Congress of Plant Physiology, Vol. 1, June 1988, New Delhi, India. New Delhi, India: Society for Plant Physiology and Biochemistry.
- FAO-ICRISAT.** 1996. The world sorghum and millet economies: Facts, trends, and outlook. Rome, Italy: Food and Agriculture Organization of the United Nations; and Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 72 pp.
- Radhakrishan R.** 2005. Food and nutrition security of the poor. *Economic and Political Weekly* 18:1817–1821.