

Status and prospects of millet utilization in India and global scenario

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Introduction

Sorghum and millets are important cereals that play a significant role in the food and nutrition security of developing countries. Together, they account for 10% of Asia's coarse grain production. India is the largest producer of sorghum and millets, accounting for over 80% of Asia's production. However, the yield levels in India are relatively low despite the adoption of improved cultivars and hybrids

The pattern of utilization for both sorghum and millets varies across countries/regions. In countries of Africa these crops are used primarily as food grain and form the staple particularly for the poor. In recent years the use of sorghum and millet grain for beer manufacturing is gaining in importance in Africa. In Asia 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) and alcohol. For both the crops more than 50% of the production is now finding its way to alternative uses as opposed to its consumption only as a staple. The demand for Value added / processed food products (being promoted as health foods) from sorghum and

millets from urban consumers is also increasing albeit from a very low base.

In the developed countries sorghum is used largely as a feed grain and millets are used as bird feed. Here too the demand for sorghum is closely linked to maize prices. Globally, sorghum prices generally track maize prices and are 15-20% lower than maize prices historically.

This paper highlights the utilization patterns of sorghum and millets globally with special emphasis on their use in India and future prospects to sustain their utilization particularly in Asia. The first section highlights the utilization pattern of sorghum followed by millets in section 2. Conclusions and way forward are discussed in section 3.

Sorghum

Sorghum (*Sorghum bicolor* (L.) Moench) is the fifth largest produced cereal crop in the world and one of the staples of the world's poorest, particularly in the developing countries of Africa and South Asia.

The developing countries, account for 92% of global area under the crop. Africa, in particular, accounts for 61% of the global sorghum area and 41% of global production. The bulk of the crop in Africa is grown on marginal lands under low

input conditions and, consequently, yield levels are relatively low. Asian countries are the second most important block of sorghum producers, accounting for 22% of the global sorghum area and 18% of the global production. Yields are closer to the global average in Asia as improved seeds and fertilizers are used, though production has been falling as farmers shift to other, more remunerative crops. Furthermore, there is a large disparity in yield levels within Asia in the major sorghum-growing countries with yields in China nearly four times those in India and Pakistan. Developed countries account for only 8% of global sorghum area but 22% of global production since the yield levels in these countries is about three times higher than the global average. Intensive cultivation of sorghum with high input usage distinguishes sorghum production in North America, Oceania and Europe.

Sorghum grain and stover are of economic value – the grain is used as food, cattle and poultry feed and in alcohol manufacture while its stover is an important dry fodder resource for large ruminants. In India, for example, the stover value accounts for nearly 30-40% of the total value of the crop (Parthasarathy Rao *et al.* 2003). The world market for sorghum currently represents only about three percent of global cereal trade as most sorghum continues to be consumed in the countries where it is produced. On an average about 15% of sorghum is traded relative to its production. Global trade in sorghum grain is mainly to meet demand for livestock feed, primarily in the developed countries where it is an important ingredient of cattle feed. Consequently, traded volumes are very sensitive to sorghum-maize price differentials in the developed world.

In India sorghum is grown in two seasons rainy and post rainy season. Rainy season sorghum is predominantly grown in the Semi-Arid Tropics (SAT) (82% of rainy season sorghum area) with 13% of the area falling in the semi-arid temperate zones. The area under rainy season sorghum has been declining in both the zones due to the

declining competitiveness of sorghum with the emergence of irrigation and shift to irrigated crops like rice, wheat, and sugarcane in the semi-arid temperate zone and cotton oilseeds in the SAT.

Post rainy season sorghum which is grown under residual soil moisture is primarily concentrated almost exclusively in the SAT, accounting for 98% of total post rainy season area. Maharashtra (68%) and Karnataka (25%) account for bulk of the area. Unlike rainy season sorghum area under post rainy season has remained somewhat stable and thus over time the share of post rainy season sorghum in total sorghum area in India increased from 36% in 1980 to 58% in 2010. The production share of post rainy sorghum also increased from 28% to 50%.

Utilization

Sorghum is a rich source of protein, vitamin B1, B2, niacin, iron and zinc. A study on sorghum consumption in India (Parthasarathy Rao *et al.* 2006) found that sorghum is one of the cheapest sources of iron and zinc, second only to pearl millet. Globally, the utilization of sorghum varies by regions. In Africa and Asia, it is grown mainly for food use, although industrial use of sorghum grain has been increasing in Asia, particularly in Southeast Asia and in India in the last two decades. In North America (which is the third largest sorghum-growing region), Europe, Australia and Latin America, the grain is used primarily as feed. Furthermore, sorghum fodder is an important livestock feed source in the developing countries, particularly in the dry months when other sources of feed are scarce.

Food use

Sorghum continues to be an important staple in Africa and in regions of India where it is traditionally consumed. Food consumption of sorghum in Africa doubled between 1980-82 and 2007-09 from 8 million t to 17 million t (Table 1). Per capita food consumption of sorghum is the highest in Africa, where despite an increase in the population between 1980 and 2009, per

Table 1: Trends in sorghum utilization ('000 t)

Region/ Country	1980-82				2007-09			
	Total availability	Feed	Food	Other Uses	Total Availability	Feed	Food	Other uses
World	63,908	35,318	23,584	5,007	60,266	27,591	25,452	7,744
Europe	4,573	4,273	0	299	2,830	2,809	1	21
North America	10,729	10,452	110	166	5,493	4,195	308	1,520
Oceania	379	258	0	121	2,794	2,731	0	63
Africa	11,845	1,336	8,248	2,262	24,377	2,636	16,935	4,807
Latin America	12,410	11,654	248	507	13,364	12,736	181	436
Asia	23,973	7,345	14,977	1,652	11,603	2,483	8,195	925

Table 2: Per capita consumption trends of sorghum (kg capita-1 yr -1)

Region/ Country	1980-82	1993-95	2007-09
World	5.3	4.5	3.8
Europe	0.0	0.0	0.0
North America	0.4	1.2	0.9
Oceania	NA	NA	NA
Africa	16.8	18.0	18.6
Central America	1.6	1.3	0.9
Asia	5.8	3.6	2.1

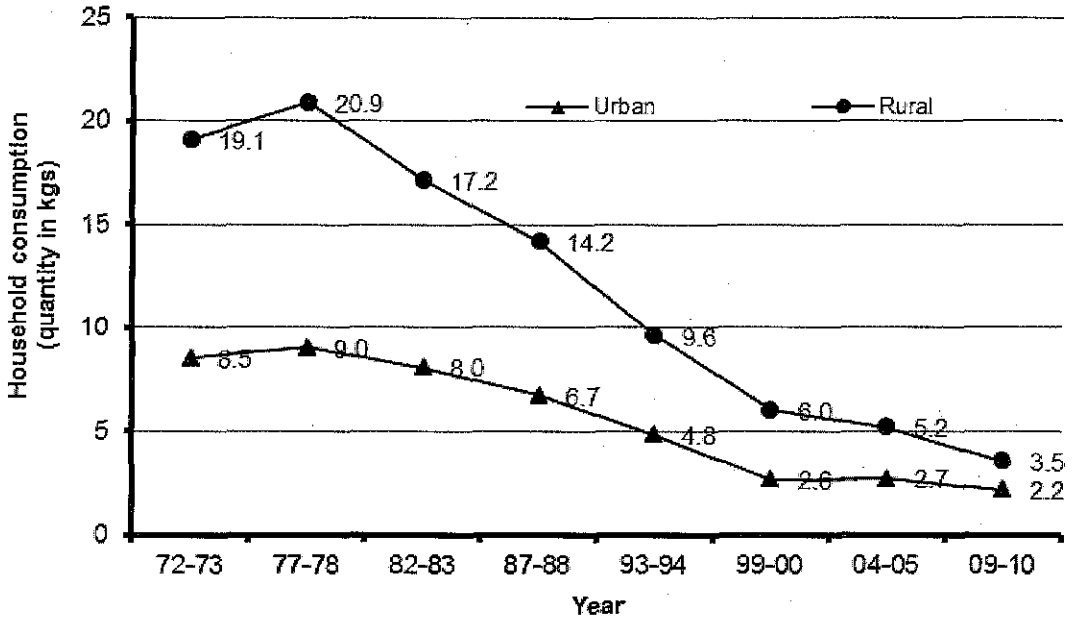
capita consumption increased from 17 kg capita/year in 1980-82 to 19 kg capita/year (Table 2). In Asia, rising incomes, urbanization, and changing consumer preferences has led to a sharp decline in food consumption of sorghum from 15 million t to 8 million t in 2007-09. Per capita consumption too declined sharply from 5.8 to 2.1 kg / capita / annum.

In India sorghum is a traditional cereal staple but has been declining in popularity and importance over time, particularly in urban areas. An in-depth analysis of the consumer survey data for India conducted by the National Sample Survey Organization reveals that between 1980 and 2010 both for rural and urban consumers, the annual

per capita consumption of sorghum declined sharply (Fig.1). This decline is largely attributable to the fact that as incomes increase, fine cereals are substituted for sorghum. Government policies providing subsidized fine cereals like rice and wheat have further exacerbated this situation. However, since the mid-1990s, per capita sorghum consumption while continuing to decline has slowed down compared to the sharp declines in the 1970s and 1980s.

The largest decline in consumption has been in the states of Andhra Pradesh and Madhya Pradesh where the availability of subsidized staples such as rice in Andhra Pradesh and wheat in Madhya Pradesh has contributed to the

Figure 1: Annual per capita consumption of sorghum in urban and rural India (kg)



Source: Compiled from Level and Pattern of Consumer Expenditure, NSSO 62nd Round, 2009-10

increased substitution of sorghum. In the major growing regions of the states of Maharashtra and Karnataka, where sorghum had a major share in the consumption basket in the 1970s, it is still able to compete in the cereal consumption basket because of existence of strong preference for sorghum in the daily food requirement (Basavaraj and Parthasarathy Rao 2012).

There are, however, differences in the utilization of rainy and post rainy season sorghum in India. The decline in per capita food consumption of sorghum at the all-India level is mainly due to decline in consumption of rainy season sorghum while the availability of post rainy season sorghum has more or less remained constant (Figure 2). Bulk of the post rainy season sorghum grain is used for food since it is of superior quality with a bold grain, lustrous white color and sweeter taste. Post rainy season sorghum grain prices are higher by 20- 40% compared to rainy season sorghum, thus making it uneconomical for alternative uses like

poultry feed and alcohol manufacture compared to other close substitutes. Besides its use as a staple at household level, small quantities of post rainy season sorghum are used in the processed food industry. On an average, 3-5% of post rainy season sorghum is used in the processed food industry while another 5% is used to prepare *rotis* sold at restaurants (Basavaraj and Parthasarathy Rao 2012).

Further disaggregation of NSSO consumption data by expenditure classes reveals that sorghum is an important crop for the nutritional security of the poor in India. The low income consumers (about 50% of the population in rural and urban areas each) account for 52% and 67% of sorghum consumption in rural and urban areas of India respectively (Table 3). Their per capita consumption is also the highest among the three income groups.

Small quantities of sorghum are also being

Figure 2: Availability of Kharif and Rabi sorghum for Food use in India

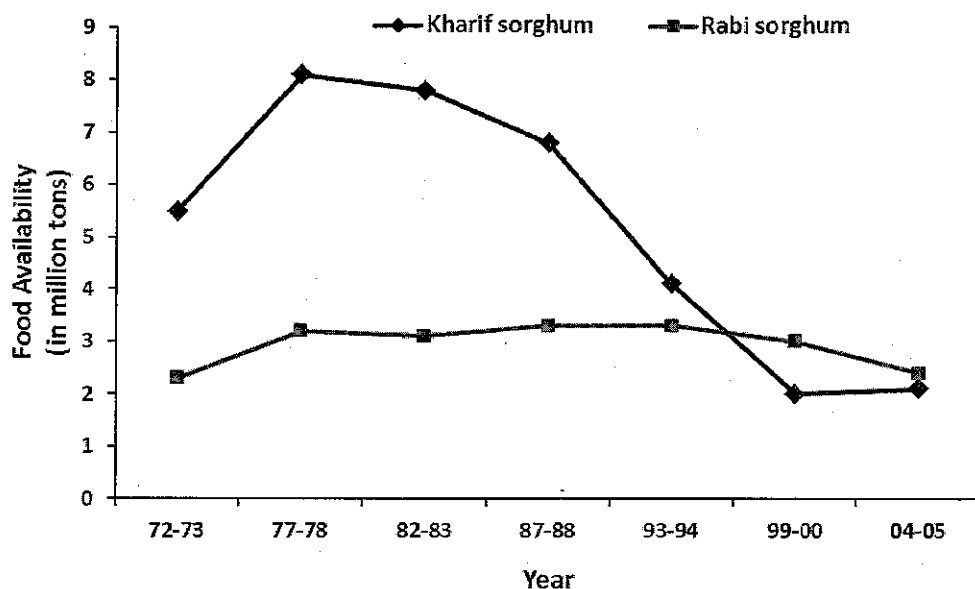


Table 3: Consumption of sorghum by income class, 2009-10

Expenditure category	Consumption		Per capita consumption (Kg yr ⁻¹)	Population (%)
	('000 t)	(%)		
Rural average consumption by expenditure category				
Low (Less than Rs. 765 (\$14.98) per month)	1,447.6	52.2	4.75	50
Medium (Rs. 765- 1477 (\$14.98- 28.93 per month)	1,106.9	39.9	3.64	40
High (Greater than Rs. 1477 (\$28.93) per month)	221.1	8.0	1.45	10
Urban average consumption by expenditure category				
Low (Less than Rs. 1307 (\$25.60) per month)	414.5	67.3	3.67	50
Medium (Rs. 1307-3166 (\$25.60- 62.02) per month)	172.0	27.9	1.52	40
High (Greater than Rs. 3166 (\$62.02) per month)	29.1	4.7	0.52	10

Source: Compiled from Level and Pattern of Consumer Expenditure, NSSO 62nd Round, 2009-10

used by the food manufacturing industry for making biscuits, breads, noodles and cakes. With increasing awareness about the nutritional properties of sorghum, the demand for such products is increasing from a low base.

Feed and other uses

In the early 1980s 55% of sorghum grain was used as feed globally (Table 1). The demand for sorghum grain as feed is concentrated in the developed countries and the middle income

countries of Latin America and Asia where the demand for livestock products is relatively high. However, the demand for sorghum from this sector is very sensitive to change in the maize market, as maize is a close substitute. The yield improvements in maize and the policy changes in USA (the main driver in sorghum feed markets) favoring maize over sorghum has lowered the competitiveness of sorghum vis-à-vis maize. Also, consumer preferences for meat color have contributed to sorghum being discounted for feed use (poultry meat from maize-fed birds tend to have a golden yellow shank color compared to the white color of sorghum-fed birds).

Thus, overall, the utilization of sorghum as feed has declined in the world, largely due to decreases in North America and Europe where maize has taken over as the primary feed source. In Australia, sorghum is almost entirely used for feed and plays a key role in providing feed grains to the beef, dairy, pig and poultry industries in the country. Sorghum feed usage in Latin America is the highest in the world, accounting for 46% of the total in 2007-09, with Mexico, Argentina and Brazil being the largest consumers. These trends are expected to continue owing to increased livestock demand in the region and the domestic policies in various Latin American countries that restrict maize imports.

In Asia, Japan and China are the main consumers of sorghum grain feed. In 2005-07 together they accounted for 90% of Asia's sorghum feed consumption. In Japan, where there is a preference for white meat, sorghum is an important ingredient in compound feed rations for poultry, pork and some beef cattle. However, historical trends in both countries indicate that the popularity of sorghum feed is declining (Table 1).

In India, sorghum grain is used as poultry feed. Its popularity in this use pattern has been increasing, with the poultry farms substituting sorghum for maize depending on the relative price of the two crops. Sorghum is generally substituted to the

extent of 25-50% of maize ration if its price is 10-15% lower than maize price. The poultry industry in India is growing at 5% per annum and the associated demand for sorghum feed is expected to increase in the near future.

An increasing proportion of sorghum grain is being used in industrial alcohol and beer production. In Africa sorghum beer is an important cottage industry. In Asia, the use of sorghum in alcohol production is most popular in China to make beverages such as kaoliang and maotai. In India, the use of sorghum grain in making commercial grade alcohol is increasing in popularity. With the lifting of the ban on the use of food grains for the manufacture of alcohol, the demand for sorghum from this sector is expected to increase.

It is expected that sorghum non-food uses will increase in the future, largely owing to renewable energy legislation in most countries that mandates the mixing of biofuels to meet emission reduction cut offs, and which has resulted in a diversion of maize to ethanol production lowering its availability for feed use.

Fodder

The use of sorghum as a dual-purpose crop is restricted largely to the developing countries of Africa and Asia, where besides grain, the straw/stalk is an important component of livestock feed. Sorghum stover is also considered to be more nutritious with a higher digestibility coefficient compared to rice and wheat stover. In India, sorghum stover is stored and constitutes an important feed for livestock in the dry months of the year when other feed sources are scarce.

In India, the increased demand for livestock products due to increasing incomes and urbanization is driving the derived demand for fodder and feed from different sources. For sorghum, this is reflected in the faster increase in sorghum straw prices compared to grain. The grain to fodder price ratio fell from 6:1 in 1980 to 3:1 by 2005. Consequently, the value of fodder in total

value of sorghum crop production also increased from 20% to 40% by mid-2000 (Kelley *et al.* 1993, Parthasarathy and Hall 2004). In Rajasthan, the value from sorghum fodder was nearly equal to the value from sorghum grain in 2009-10. This trend is expected to continue in the near future with feed demand estimated to increase to 855 million t in India by 2020 driven by the livestock revolution (Dikshit and Birthal 2010).

MILLET

Millets are a group of small-seeded annual grasses grown mainly in Asia and Africa and account for less than 1% of global cereal production and 3% of coarse cereal production. 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. African countries account for 59% of the global area under millets and 55% of global production. Yields in this region are relatively low. Asian countries are the second most important block of millet producers, accounting for 38% of the global area and 42% of the global production. Yields are somewhat higher here compared to Africa, as improved/hybrid seeds are widely used, though the total production in these countries has been falling as farmers shift to other, more remunerative crops. They are thinly traded with less than 1% of total millet production being exported. However, they are significant contributors to the food security of the people living in Africa and Asia. The most important millets by area cultivated and production quantities are pearl millet, finger millet, proso millet and foxtail millet.

Since FAO does not separate millet data by type, we have used national statistics on pearl millet published by the Government of India to analyze pearl millet trends in India. Pearl millet is the main millet that is grown in India, accounting for nearly 75% of total area under millets. The cultivation of pearl millet is largely concentrated in Rajasthan, north and central Maharashtra, dry areas of

Gujarat and northern Karnataka.

Utilization

Globally the availability of millets grew from 26 million t in 1980-82 to 32 million t in 2007-09 (Table 14). Millets are consumed primarily as food in most of the developing countries. It is highly nutritious, high energy food and in recent years an important component of processed baby foods. The form in which millets are consumed varies across regions – as a thick porridge or as flat breads (*rotis*) etc. Millets are also used as bird feed, but this use is largely restricted to the developed countries. However, their utilization pattern is changing even in developing countries where its use in alcohol manufacture and as livestock and poultry feed is growing. Millet fodder is an important feed resource in the dryland systems of Africa and Asia, particularly in the post-monsoon seasons when other feed resources are not available.

Food use

The utilization of millets as food is restricted to countries in Africa and Asia. Overall, the food demand for millets increased from 21 million t in 1980-82 to 24 million t in 2007-09 (Table 4). However, the per capita consumption of millets fell marginally from 4.6 kg in 1980-82 to 3.6 kg in 2007-09 (Table 5). Most of the increase can be attributed to the increase in demand from Africa, where food demand increased from 5 million t to 13 million t over the past twenty five years. In Asia, the food demand has decreased over the past twenty five years. The per capita consumption trends show a halving of per capita food demand in Asia (Table 5). Much of the decrease in millet food demand is due to the sharp reduction in China, from 4.6 million t in 1980-82 to 0.5 million t in 2007-09. The reasons for this shift away from millet consumption can be attributed to the changing policy environment in the country which led to millets losing their competitive advantage in production.

Food demand in India increased from 8 million t in

Table 4: Trends in millet utilization ('000 t)

Regions	1980-82				2007-09			
	Total availability	Feed	Food	Other uses	Total availability	Feed	Food	Other uses
World	25,896	2,513	20,517	2,867	31,663	4,012	23,876	3,782
Europe	2,052	294	1,522	235	731	429	250	52
North America	76	70	0	6	279	258	0	15
Oceania	15	15	0	0	22	31	0	0
Africa	7,474	727	5,399	1,347	17,377	2,116	12,595	2,667
LAC	119	106	0	13	22	21	0	1
Asia	16,161	1,300	13,596	1,265	13,230	1,158	11,032	1,046
East Asia	6,155	997	4,726	432	1,433	733	609	91
South Asia	9,775	264	8,696	815	11,404	332	10,142	930
Southeast Asia	86	10	67	8	207	32	167	14
West Asia	145	29	106	10	151	35	108	8

Table 5: Per capita consumption trends of millet (kg capita⁻¹ yr⁻¹)

Region/ Country	1980-82	1993-95	2007-09
World	4.6	3.7	3.6
Europe	2.0	0.9	0.3
North America	0.0	0.0	0.0
Oceania	0.0	0.0	0.0
Africa	11.0	12.1	13.8
LAC	0.0	0.0	0.0
Asia	5.3	3.3	2.8
Eastern Asia	4.0	1.7	0.4
South Asia	9.1	6.6	6.3
Southeast Asia	0.2	0.3	0.3
Western Asia	1.2	0.5	0.6

1980-82 to 10 million t in 2007-09. However, the per capita consumption decreased from nearly 12 kg in 1980-82 to 8 kg in 2007-09 owing to the availability of subsidized rice and wheat through Public Distribution System (PDS). The increase in

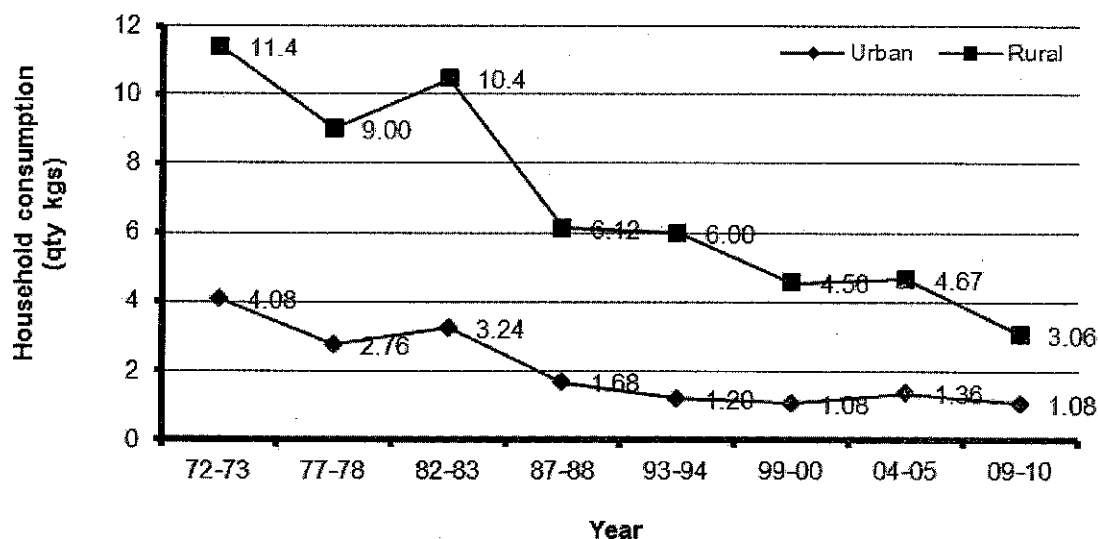
per capita income in India, growing urbanization, and changing tastes and preferences have contributed to the decline in the consumption trend of coarse cereals in general.

Pearl millet consumption trends in India

The consumption trends of pearl millet in India in the past two decades, both in rural and urban area depict a sharp decline in consumption (Fig. 3). However the trends in both rural and urban areas are seen to plateau since the late 1990s

at the current lower levels. There is a significant difference in the levels of pearl millet consumption along the rural and urban divide. Pearl millet consumption in urban India was always low because of the low shelf life of processed flour which entails processing the grain before using it.

Figure 3: Annual per capita consumption of pearl millet in urban and rural India (kg)



Source: Compiled from Level and Pattern of Consumer Expenditure, NSSO 62nd Round, 2009-10

Table 6: Annual consumption of pearl millet by income class, 2009-10

Expenditure category	Consumption		Per capita consumption (kg yr ⁻¹)	Population (%)
	('000 t)	(%)		
Rural average consumption by expenditure category				
Low (Less than Rs. 765 (\$14.98) per month)	826.6	35.6	2.72	50
Medium (Rs. 765- 1477 (\$14.98- 28.93) per month)	1,221.2	52.6	4.01	40
High (Greater than Rs. 1477 (\$28.93) per month)	274.0	11.8	1.80	10
Urban average consumption by expenditure category				
Low (Less than Rs. 1307 (\$25.60) per month)	145.9	49.8	1.29	50
Medium (Rs. 1307-3166 (\$25.60- 62.02) per month)	119.2	40.6	1.06	40
High (Greater than Rs. 3166 (\$62.02) per month)	28.1	9.6	0.50	10

Source: Compiled from Level and Pattern of Consumer Expenditure, NSSO 62nd Round, 2009-10

Pearl millet is consumed predominantly in the western and central states of India. However, it is consumed as a staple mainly in Gujarat and Rajasthan. Haryana, which was a significant consumer of pearl millet in the 1970s, saw consumption decreasing by over 85% in both urban and rural areas. 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 6). Thus, pearl millet continues to be an important staple for the poor despite an overall decline in its consumption.

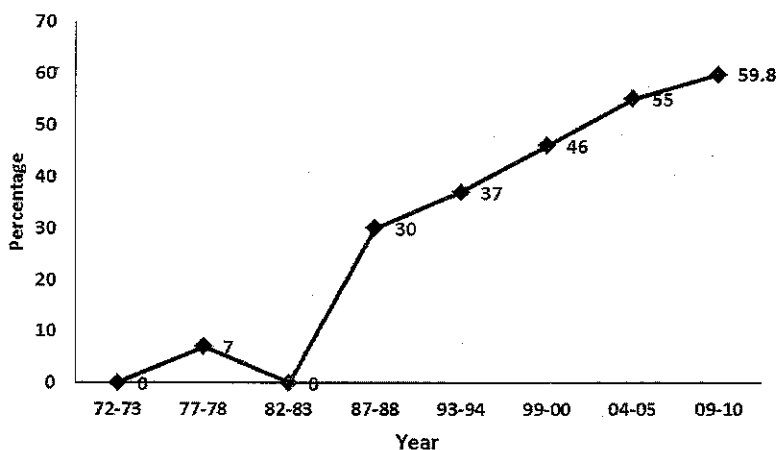
Feed and other uses

The demand for millet grain as feed increased from 2.5 million t in 1980-82 to 4.0 million t in 2007-09. However, among the coarse cereals, the use of millets as feed is very small. Only 13% of total availability is used as animal feed compared to 45% of total sorghum availability and 62% of total maize availability. The developed countries, particularly Japan, the USA and Europe use

millets as bird feed. Utilization of millets for feed is concentrated in Africa and Asia Nutritionally, millets compare well with sorghum and maize as feed for livestock. However, they are not an important feed source globally. The main reason for this could be that the yield levels of millets do not compare favourably with those of maize and other coarse cereals. Furthermore, millet cultivation continues to be by smallholder subsistence dominated systems which are characterized by low marketable surpluses. In these regions, millets are grown primarily for household consumption and therefore marketing and trade are restricted.

In India, the importance of pearl millet as cattle feed is increasing in recent years in northern states like Haryana and Punjab and the main growing state of Rajasthan. In Tamil Nadu, farmers growing improved cultivars of pearl millet are able to market their surplus to the animal feed sector, mainly poultry and cattle feed manufacturing units. Pearl millet grain is also finding increasing use as poultry feed in Haryana, where it used to be a food staple two to three decades ago. Also in India, since 2000, large quantities of pearl millet

Figure 4: Share of non-food uses of Pearl Millet in total production: All India



Source: Compiled from various rounds of NSSO survey on "Level and pattern of consumer expenditure" and production data from Directorate of Economics and Statistics, GOI

are being used in the alcohol industry based in Rajasthan, Punjab and Haryana. Among the cereals, broken rice is most preferred by the alcohol industry, followed by pearl millet and sorghum. Pearl millet varieties with high starch content are preferred. The relative prices of different cereal crops also determine their usage (Market surveys HOPE project 2010-11). This is reflected in the rising share of pearl millet in alternative / non-food uses with close to 60% pearl millet production going for alternative uses (Figure 4).

Fodder

Pearl millet straw is an important feed resource, particularly in India and parts of Sub-Saharan Africa. In India, particularly in the arid zone, pearl millet straw is stored and used throughout the year, particularly in the summer months when other feed resources are scarce. There is also a growing market for pearl millet straw in urban areas close to the growing centers to meet the increasing demand from urban and peri-urban dairies. Chopped pearl millet straw is commonly traded in urban markets due to its transportability and ease of consumption by animals. Pearl millet dry stover is often traded from Haryana, Punjab and UP to Rajasthan whenever pearl millet stover is in short supply due to drought. Pearl millet is also exclusively grown as a fodder crop under irrigation in Punjab, Haryana and western Uttar Pradesh.

Markets, Institutions and Policies

The prevailing trends in production, consumption and consequently trade of sorghum and millet have been the result of the domestic policies and institutional support in the major growing countries. By and large, both crops have been neglected on this front with policies favouring rice, wheat and maize. Furthermore, in the developing countries, both are primarily grown as subsistence crops and consequently variable marketed surpluses arrive to the markets. However, these crops are now also grown for the market with an increase in their utilization in alternative uses.

In many of the major sorghum and millet growing countries of the developed world, there are no explicit producer support policies. Sorghum in particular is affected by the policies that are in place for maize, since it is considered a close substitute. In India, sorghum and millets are offered a common Minimum Support Price (MSP) by the government of India. Although the MSP has been increasing over the past few years in line with market prices by and large it is lower than the prices ruling in the market and the off take of sorghum and millet under the scheme is low and erratic.

Marketing system

The marketing system for sorghum and millet grain varies considerably between the developing and developed countries. In developed countries where sorghum and millets are grown for feed use, the marketing system is a highly developed one with stringent quality standards for both domestic use and export. The volumes reaching the market are large. Domestic markets for sorghum and millets in Africa and Asia are characterized by low and variable volumes, high transaction costs and long distances to better markets. There is no organized marketing infrastructure for these crops in most countries, particularly the African countries, because of irregular and unpredictable supplies. Furthermore, compared to other cereal grains, sorghum and millets are not widely traded internationally for food use and there are very few quality standards that are met.

In India, although sorghum and pearl millet are primarily grown for domestic consumption, a significant portion of production is traded. This is particularly true for rainy season sorghum and pearl millet which are increasingly being used in the poultry and cattle feed industry and in the manufacture of fine grain alcohol. However, the markets are dominated by a plethora of middlemen reducing the farmers share in consumer rupee. There is a need for innovative models linking farmers to end users that would reduce transaction and marketing costs for both the farmers and the buyers (Marshland and Parthasarathy Rao 1999).

Fodder markets in India for both sorghum and pearl millet are informal and there is no regulation on the sales and purchases. The transactions are generally carried out by middlemen who play an important role in determining the price. Although the demand for processed (chopped) fodder for both crops is increasing, there are no policies or incentives for private fodder processing.

Conclusion

While sorghum and millets are primarily used for feed in developed countries, they are an important staple for the poor in the developing countries of Africa and South Asia. The outlook in the short to medium term indicates that the demand for and prices of sorghum and millets will register an increase, largely owing to spillover effects from the changes in the world maize markets and the general increase in feed demand owing to increased incomes, particularly in the emerging developing economies. The demand for sorghum for feed use in developed countries is slated to improve with large quantities of maize being diverted to biofuel industry (Walsh 2011).

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 favoring 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, alcohol and processed food industry (being promoted as health foods).

For example in India, sorghum and pearl millet in India are witnessing resurgence as the alternative utilization patterns unfold. For both the crops more than 50% of the production is now finding its way to alternative uses as opposed to its consumption only as a staple. The one exception, however is the post rainy season sorghum grown in India on residual soil moisture that continues to be a staple because of its superior grain quality. It is, however, also finding small niches in the

food processing sector. With growing health consciousness the demand for sorghum and millet based value added products (flour, flakes, rawa etc) is rising albeit from a very low base in urban centers of major growing states of India. Additionally, the demand for clean, graded and branded sorghum grain is finding niches in urban supermarkets.

To harness the potential of sorghum and millets in emerging uses supply-side constraints should be overcome through generation and diffusion of appropriate technologies for different production environments. While yield improvement and yield stability should receive high priority in crop improvement programs to make sorghum and millets competitive both at the farm and end use levels developing varieties with traits suitable for different uses should also be an important priority of crop improvement programs to meet end user requirement. With the recent increasing demand for coarse grains in niche markets such as health foods and gluten-free substitutes, identifying and developing processing technologies that increase the shelf-life of sorghum and pearl millet flour will result in their increased use in processed products particularly in the urban centers. There is a need to establish a link between health and consumption of millets (Nagaraj *et al* 2012).

Since dual purpose cultivars are preferred, the focus should be both on grain and stover. Both sorghum and pearl millet stover are important sources of livestock feed and stover with high digestibility coefficients are preferred for higher milk yield.

Even as there is a need to correct policy bias against sorghum and pearl millet in particular and rainfed agriculture in general, there is a need to put in place institutions and policies linking small-scale farmers to the new sources of demand, through innovative institutional arrangements to ensure that produce of a given quality and price is delivered to end users.

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