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Nutricereals Role in Indian Agriculture, Food and Nutritional Security : A Review

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Abstract

Millets are very important plant genetic resources for agriculture sector that extends food security to poor farmers having arid, marginal and poor lands especially in Asia and Africa. Millets are a group of small grain cereal food crops which are highly nutritious and are grown under marginal/low fertile soils with very low inputs such as fertilizers and pesticides. Indian agriculture is highly dependent on monsoon. Millets are also gaining popularity among farmers as climate-friendly, drought-resistant crops which can thrive even on barren soil. These crops are preferable choice of farmers for cultivation under various adverse environments - prone to climatic extremes. Millets are gluten-free and have a low glycemic index, making them a balanced and healthy diet for people suffering from diabetes. An intensive attempt to include millet crops in cropping systems, especially in vulnerable environments, is a positive step towards long-term sustainability. An effort has been made to expand global and regional scope and target for millet production, usage and in this regard, India's proposal to observe an International Year of Millets in 2023 was approved by the Food and Agriculture Organization (FAO) during 2018 and the United Nations General Assembly has declared the year 2023 as the International Year of Millets. In this esteem, the status of millets and their importance is compiled in this paper.

Keywords : Nutricereals, Nutrition, Areas, Production or Millet, Cultivation, Duration, Marketing

Millets are being referred as Nutri-cereals are important crops in the country with higher area coverage as compared to wheat and rice before green revolution period. After launching green revolution, the area of nutri-cereals drastically reduced due to shifting of irrigated area from nutri-cereals to more remunerative crops like rice, wheat and sugarcane. At present, Nutri-cereals are grown in resource poor agro-climatic regions, hilly & tribal areas of the country in rainfed conditions. Nutri-cereals are known for nutri-rich content (Gupta *et al*., 2017) and having characteristics like drought tolerance, photo-insensitivity and resilient to climate change etc. The millets role can never be overlooked for attaining justifiable means for nutritional safety (Kumar *et al*., 2018). Nutri-cereals are grown in arid

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and semi-arid tracts under low rainfall (300-600 mm) conditions, where cereals like wheat and rice cannot be grown profitably. The abiotic stresses such as drought, salinity and nutrient deficiencies (N, P, K, B and Zn) seems to have lesser impact on the performance of finger millet (Maharajan *et al*., 2018; Ramakrishnan *et al*., 2017; Yamunarani *et al*., 2016). Millets are grown from mean sea level to 2300 m above mean sea level showing their ability under diverse soil and climatic conditions. However, these ignored crops are important by virtue of their role in biodiversity and the means of livelihood of the poor in various parts of the world (Belton & Taylor, 2004). In India, they are seen from Tamil Nadu in the south to Uttarakhand in the North and Gujarat in the West to Arunachal Pradesh in the Northeast (Sukanya *et al*., 2022). Millets are a group of relatively small cereal grasses that are classed as major millets and minor millets based on grain size. Millets have excellent nutritional value and grow well under diverse situations, but they aren't utilized to their full potential. Sorghum and pearl millet are regarded as major millets while, finger millet, foxtail millet, kodo millet, proso millet, barnyard millet, little millet and browntop millet are named as minor millets. Millets are richer in minerals and vitamins than rice and wheat and have a significant potential to supply food, nutrition, fodder, fiber, health, livelihood and environmental security. Millets have been the first cereal grain to be cultivated for domestic use. Millets are hardy and grow well in rain-fed situation under marginal soil fertility and low moisture. Millets are versatile, climate-resilient crops and can be grown under diverse soil and climatic situations. India is the world's largest producer of millets. In India, millets are cultivated over a total area of 35.71 million hectares, yielding 62.49 million tonnes in 2020 (Anonymous 2020). They are significant in densely populated countries like India and millets can be kept in good condition for many years and hence they are called as famine reserves. Millets are also being used in the animal feed industry and distilleries.

Global Scenario of Millets

India is one of the important consumers and producers of Nutri-cereals in the world. Group of crops comprising sorghum (Jowar), pearl millet (Bajra) and small millets *viz.,* finger millet (Ragi/ Mandua), little millet (Kutki), kodo millet (Kodo), barnyard millet (Sawa/Jhangora), foxtail millet (Kangni/Kakun), proso millet (Cheena), browntop millet (Makra/murath) all together comes under Millets which are now called as 'Nutri-Cereals' due to their higher nutritive value. The spatial distribution of millets either as a primary crop or as allied crops, is generally determined by the growing habitat and the amount of rainfall received in the region. Small millets are produced in 31.01 million tonnes around the world, according to the FAO, from an area of 33.56 million hectares (Anonymous 2018). The most common millet crops are sorghum and pearl millet, which account for more than 90 per cent of global millets production, followed by finger millet. foxtail millet, proso millet, barnyard, little millet, kodo millet and browntop millet which account for less than 10 per cent of all millets (Anonymous 2020a). In terms of productivity, foxtail millet outstands all the other millets by accounting 2166 kg/ha followed by finger millet (1623 kg ha^{-1}), proso millet (1535 kg ha^{-1}), sorghum (1426 kg ha^{-1}), barnyard millet (1034 kg ha^{-1}), pearl millet (850 kg ha^{-1}) and little millet (469 kg ha^{-1}) (Assocham, 2021).

Status of Millets in India

India is the world's largest producer of millets. Millets are grown in almost 21 states across the country. Maharashtra, Karnataka and Rajasthan in Jowar; Rajasthan, Uttar Pradesh and Gujarat in Pearl millet; Karnataka, Uttarakhand and Maharashtra in Finger millet; Madhya Pradesh, Chhattisgarh and Uttarakhand in other small millets are three major states where these nutricereals are grown and the area is showing declining trend from previous years although the productivity is towards promising inclination (Anonymous 2020).

In India, Finger millet and other small millets are cultivated in an area of 10.48 and 5.45 lakh hectares (2016-20) with a production of 16.37 and 3.95 lakh tonnes, respectively. In spite of drastic decline in the area in the last six decades, the total production is maintained same to some extent due to the enhanced productivity of millets over the years (Fig.1).

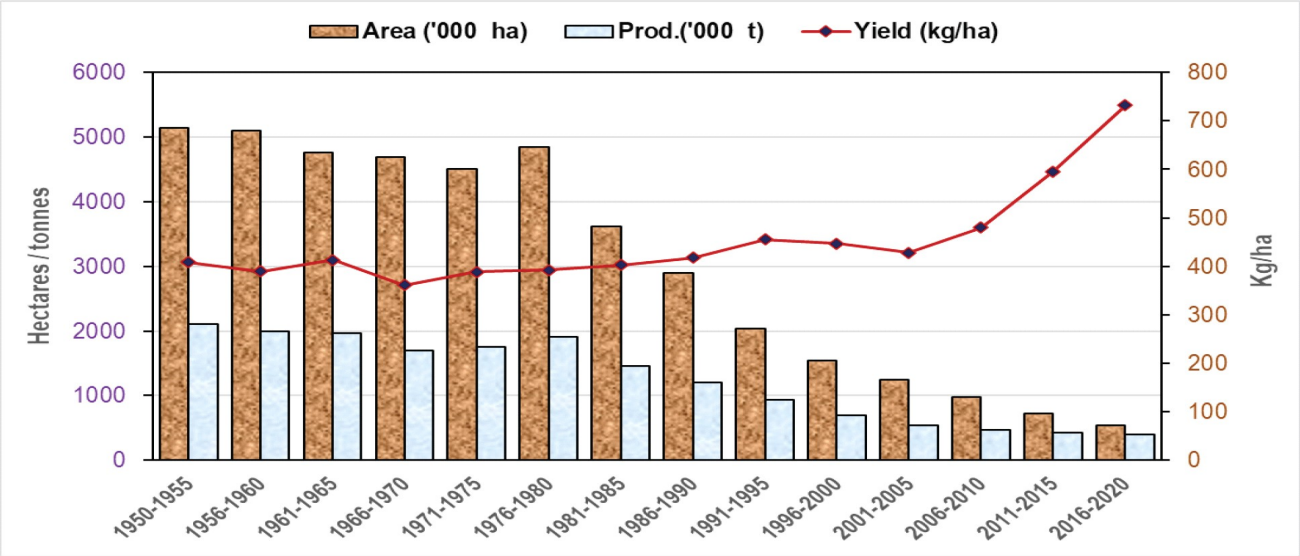

Fig.1 Area, production and yield of Small milletsin India (1950-2020)
(Source:Ministry of Agriculture and Farmers Welfare, Govt. of India, 2020)

Nutritional Benefits

Millets are vital in Africa, Asia, China and are extremely nutritious and in some ways, they outperform rice and wheat in terms of presence of key nutrients like phosphorus, potassium, magnesium, manganese, iron and niacin. Protein, fibre, important amino acids like methionine, lecithin and vitamin E are also found in them. Millets have a low glycemic index, suiting them ideal for diabetics (Dayakar Rao *et al*., 2017). The calcium content of finger millet is nearly ten times that of rice or wheat and proso millet contains about 12 per cent protein. Every millet is far superior to rice and wheat in terms of nutrients and so is the answer to the malnutrition that is affecting bulk of the Indian population. Small seeded grains are produced by these grasses, which are commonly used as cereals. Millets are being demonstrated in recent exploration to provide therapeutic effects, such as controlling asthma, migraine, blood pressure, diabetic heart disease, atherosclerosis and heart attacks, due to their high level of these nutrients. Gallstones are prevented by the fibre in millet. Whole grains of millets, contain health-promoting properties comparable to, if not superior to, fruits. To overcome malnutrition, systematic eating can help to solve the major issue which is prevalent in our Indian population. Millets provide more calcium, iron, beta-carotene and other nutrients than rice and wheat. Jowar has eight times the fibre of rice, ragi has forty times the calcium of rice and bajra has eight times the iron and five times the riboflavin and folic acid of rice

Agronomic Advantages

The agronomic practices are critical for accomp lishing an assured harvest (Hegde and Krishne Gowda, 2003). Millets are probably the best alternative for farmers who would like to achieve the triple objectives of farming versatility, sustainability and profitability. The advantages of millets-based farming techniques are many as millets are awfully resistant to harsh temperatures, drought and floods. Millets can be grown successfully in dry zones/rain-fed locations with limited soil fertility and moisture. Because of their excellent root system, water requirement of these crops is less in comparison to other crops and have climate resilient traits (Table 1 & 2). Millets need lesser moisture for production and cultivated under rainfed situations or under regimes of lesser rainfall (200-500 mm) (Sukanya *et al*., 2022; Laxmi Rawat *et al*., 2022 and Vinod Kumar Singh, 2022). The storage life of grains is relatively long (two years or beyond). Millets growing is a low-cost practice. The majority of the added ingredients are organic and respond very well to integrated nutrient management

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TABLE 1
The climate resilient traits of small millets

Crop	Duration (days)	Climate resilient traits
Finger millet	90-130	Adapted to wide altitude range, moderately resistant to drought, heat stress and humidity
Foxtail millet	70-120	Adapted to high altitude and low rainfall conditions
Proso millet	60-90	Short duration crops, adapted to high altitude and low rainfall conditions
Little millet	70-110	Famine food, adapted to poor soils, low rainfall and can also with stand water logging to some extent
Kodo millet	100-140	Very hard crop with long duration, adapted to low rainfall, poor soils and shows good response to improved agronomic practices
Barnyard millet	75-90	Short duration crop, well adapted to high altitudes and low rainfall conditions

(Source: Assocham, 2021)

TABLE 2
List of improved varieties released for cultivation in India

State	Varieties
Finger millet	
Andhra Pradesh	VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), VR 847, PR 202, VR 708, VR 762, VR 900, VR 936, Vakula (PPR2700), VR 929, PPR 1012, PR 10-45
Bihar	VL Mandua 379 (VL 379), Arjuna (OEB-526), VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), RAU 8, VL379, OEB 526, OEB 532
Chattisgarh	Chhattisgarh Ragi-2 (BR-36), Arjuna (OEB-526), VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), VL 324, VL 315, VL 149, Indira Ragi1, Chhattisgarh 2, BR7, GPU 28, PR 202, VR 708 and OEB-526, OEB-532
Gujarat	VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), GNN7, GNN 6, GN 5, GN 4
Jharkhand	VL Mandua 379 (VL 379), VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), A 404, BM 2
Karnataka	DHFM-78-3, Vakula (PPR 2700), Arjuna (OEB-526), VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), GPU 67, GPU 66, GPU 48, GPU 45, GPU 28, PR 202, MR 1, MR 6, Indaf 7, ML365, KMR 340, KMR 301, KMR 204, KMR 360
Madhya Pradesh	VL Mandua 379 (VL 379), VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), GPU 28, PR 202
Maharashtra	VL Mandua 376 (VL 376), Phule Nachani 1 (KOPN 235), KOPLM 83, Dapoli 1, Dapoli 2
Orissa	VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), Arjuna (OEB-526), OEB 10, OUAT 2, BM 9-1, OEB 526, OEB532
Tamil Nadu	VL Mandua 376 (VL 376), Arjuna (OEB-526), GPU 28, CO 15, TNAU 946 (CO 14), CO 13, CO 12, CO 9
Uttarakhand	VL 379, VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), VL 348, VL 324, VL 315, VL 149, VL 146, PES 400, PRM 1, PRM 2, VL 382
Finger millet	
Andhra Pradesh	VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), VR 847, PR 202, VR 708, VR 762, VR 900, VR 936, Vakula (PPR2700), VR 929, PPR 1012, PR 10-45

Table 1 Contiuned....

State	Varieties
Bihar	VL Mandua 379 (VL 379), Arjuna (OEB-526), VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), RAU 8, VL379, OEB 526, OEB 532
Chattisgarh	Chhattisgarh Ragi-2 (BR-36), Arjuna (OEB-526), VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), VL 324, VL 315, VL 149, Indira Ragi1, Chhattisgarh 2, BR7, GPU 28, PR 202, VR 708 and OEB-526, OEB-532
Gujarat	VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), GNN7, GNN 6, GN 5, GN 4
Jharkhand	VL Mandua 379 (VL 379), VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), A 404, BM 2
Karnataka	DHFM-78-3, Vakula (PPR 2700), Arjuna (OEB-526), VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), GPU 67, GPU 66, GPU 48, GPU 45, GPU 28, PR 202, MR 1, MR 6, Indaf 7, ML365, KMR 340, KMR 301, KMR 204, KMR 360
Madhya Pradesh	VL Mandua 379 (VL 379), VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), GPU 28, PR 202
Maharashtra	VL Mandua 376 (VL 376), Phule Nachani 1 (KOPN 235), KOPLM 83, Dapoli 1, Dapoli 2
Orissa	VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), Arjuna (OEB-526), OEB 10, OUAT 2, BM 9-1, OEB 526, OEB532
Tamil Nadu	VL Mandua 376 (VL 376), Arjuna (OEB-526), GPU 28, CO 15, TNAU 946 (CO 14), CO 13, CO 12, CO 9
Uttarakhand	VL 379, VL Mandua 376 (VL 376), VL Mandua 352 (VL 352), VL 348, VL 324, VL 315, VL 149, VL 146, PES 400, PRM 1, PRM 2, VL 382
Foxtail millet	
Andhra Pradesh & Telangana	SiA 3088, SiA3156, SiA 3085, Lepakshi, SiA 326, Narasimharaya, Krishnadevaraya, PS 4, SiA 3223
Bihar	RAU-2, SiA 3088, SiA 3156, SiA 3085, PS 4
Karnataka	DHFt 109-3, HMT 100-1, SiA 3156, SiA 3088, SiA 3085, SiA 326, PS 4, Narasimharaya, HN-46
Uttar Pradesh	PRK 1, PS 4, SiA 3088, SiA 3085, Sreelaxmi, Narasimharaya, SiA 326, S-114
Uttarakhand	PS 4, PRK 1, Sreelaxmi, SiA 326, SiA 3156, SiA 3085
Tamilnadu	TNAU 43, TNAU-186, TNAU 196, CO 1, CO 2, CO 4, CO 5, CO (Ten) 7, K2, K3, SiA 3088, SiA 3156, SiA 3085, PS 4, ATL-1
Rajasthan	Prathap Kangani-1 (SR 51), SR 11, SR 16 (Meera), SiA 3085, SiA 3156, PS 4
Little millet	
Andhra Pradesh & Telangana	Chhattisgarh Kutki 1 (BL-6), DHLM 36-3, OLM 203, JK 8, LMV518
Chhattisgarh	Chhattisgarh Kutki 1 (BL-6), Chhattisgarh Kutki 2 (BL-4), JK 8, JK 137, JK 36, DHLM 36-3
Gujarat	GNV-3, Chhattisgarh Kutki 1 (BL-6) GV 2, GV 1, OLM 203, JK 8, DHLM 36-3, DHLM 14-1, LMV 518
Jharkhand	Chhattisgarh Kutki 1 (BL-6), DHLM 36-3, LMV 518
Karnataka	DHLM 36-3, DHLM 14-1, Chhattisgarh Kutki 1 (BL-6), OLM 203, JK 8, LMV 518, BL-41-3
MadhyaPradesh	Chhattisgarh Kutki 1 (BL-6), Jawahar Kutki 4 (JK 4), JK 8, JK 36, JK 137, DHLM 36-3, LMV 518
Maharashtra	Chhattisgarh Kutki 1 (BL-6), Phule Ekadashi (KOPLM 83), JK 8, OLM 203, DHLM 36-3, DHLM 14-1, LMV 518

Table 1 Contiuned....

State	Varieties
Orissa	Chhattisgarh Kutki 1 (BL-6), OLM 203, OLM 208, OLM 217, DHLM 36-3, DHLM 14-1, LMV 518, OLM 217
Tamil Nadu	Chhattisgarh Kutki 1 (BL-6), DHLM 14-1, DHLM 36-3, Paiyur 2, TNAU 63, CO 3, CO 4, K1, OLM 203, OLM 20, TNPSu177, LMV 518
Proso millet	
Andhra Pradesh & Telangana	TNAU 202, TNAU 164, TNAU 151, Sagar, Nagarjuna, CO 4, CO 3, ATL 1(TNPm 230), GPUP 25
Bihar	ATL 1(TNPm 230), BR 7, TNAU 164, 145, PR 18, TNAU 202, GPUP 25
Chhattisgarh	TNAU 202, GPUP 25
Gujarat	TNAU 202, GPUP 25
Karnataka	ATL 1 (TNPm 230), DHPM-2769, GPUP 8, GPUP 21, TNAU 145, TNAU 151, TNAU 164, TNAU 202
Madhya Pradesh	TNAU 202, GPUP 25
Tamil Nadu	ATL 1 (TNPm 230), Co 5, TNAU 151, TNAU 164, TNAU 145, TNAU 202, CO 4, K 2, CO 3, CO 2, GPUP 21, GPUP 8, GPUP 25
Uttarakhand	PRC 1, TNAU 145, TNAU 164, TNAU 151, GPUP 25
Uttar Pradesh	Bhawna, PRC 1, TNAU 145, TNAU 164, TNAU 151, GPUP 25
Kodo millet	
Andhra Pradesh & Telangana	RK 390-25, TNAU 86, ATL-2, BK-36
Chhattisgarh	Chhattisgarh Kodo-2, Jawahar Kodo 137, RBK 155, Indira Kodo 48, Indira Kodo 1, GPUK 3, JK 439, JK 98, JK 65, Chhattisgarh-2, RK 390-25, TNAU 86, ATL-2, BK36
Gujarat	GK 2, GK 1, GPUK 3, JK 65, JK 13, RK 390-25, GAK-3, ATL-2, BK-36
Karnataka	GPUK 3, RBK 155, RK 390-25, TNAU 86, ATL-2, BK-36
Madhya Pradesh	JK 439, JK 137, JK 106, JK 98, JK 65, JK 48, JK 13, RBK 155, RK 390-25, GPUK 3, DSP 9-1, TNAU 86, ATL-2, BK-36
Tamil Nadu	KMV 20 (Bamban), CO 3, TNAU 86, GPUK 3, RK 390-25, ATL-1, ATL-2, BK-36
Kodo millet	
Andhra Pradesh & Telangana	RK 390-25, TNAU 86, ATL-2, BK-36
Chhattisgarh	Chhattisgarh Kodo-2, Jawahar Kodo 137, RBK 155, Indira Kodo 48, Indira Kodo 1, GPUK 3, JK 439, JK 98, JK 65, Chhattisgarh-2, RK 390-25, TNAU 86, ATL-2, B36
Gujarat	GK 2, GK 1, GPUK 3, JK 65, JK 13, RK 390-25, GAK-3, ATL-2, BK-36
Karnataka	GPUK 3, RBK 155, RK 390-25, TNAU 86, ATL-2, BK-36
Madhya Pradesh	JK 439, JK 137, JK 106, JK 98, JK 65, JK 48, JK 13, RBK 155, RK 390-25, GPUK 3, DSP 9-1, TNAU 86, ATL-2, BK-36
Tamil Nadu	KMV 20 (Bamban), CO 3, TNAU 86, GPUK 3, RK 390-25, ATL-1, ATL-2, BK-36

(*Source*: Anonymous, 1986 - 2020)

practices (Basavaraja Patil *et al*., 2022), (Deepti *et al*., 2022 and Kumar *et al*., 2003). Millets have a higher number of tillers than other crops. They serve as both food and forage for the animals.

These millets have agronomic advantages *viz*., highly adapted to low rainfall conditions, able to withstand fairly long dry spells, recover fast after delayed rain, make them good contingent crops. Millets are highly resilient in adapting to different ecological conditions; ideal crops for climate change and contingency planting. Being C4 plants these are more environment friendly with high water use efficiency and low input

requirement, but equally responsive to high input management

As Ecofriendly Crops

These have lower requirement of water, chemicals and management interventions for raising. Besides, millets can come up in marginal lands and harsh weather conditions where no other crop can be grown. In India, finger millet farmers realize good yields even with reduced rains and minimum inputs. As these crops are resilient to climate change and provide yield assurance despite environmental risks, they have sustained the onslaught of rice and wheat all these years, despite drastic reduction in cultivation. Another important byproduct of millet cultivation is fodder which is a main source of roughage for cattle in dryland ecosystem. In times of climate change millets are often the last crop standing and thus, are a good risk management strategy for resource-poor marginal farmers. Relatively these crops are less affected by pests and this is a characteristic that comes in very handy when planning a mixed crop cultivated using non-pesticide management techniques. A few rows of millets separating rows of more susceptible leguminous crops are a common practice in farms in different parts of the world.

Nutricereals as Fodder

Millet crops are critical to the country's overall agricultural development. Because majority of the produce is eaten at the farm/village level, the true worth of their crops and their importance have been overlooked. Food, feed, fodder and nutritional security for a substantial portion of the rural community have not been recognized so far. Around 33.5 million hectares of nutricereals are cultivated. For finger millet, the dry weight ratio of grain crop residue is about 30:70, while for other small millets, it's about 25:75. Other small millets (Other than Finger millet) contribute 1.2 million tonnes grain and 3.5 million tonnes straw while finger millet only contributes 2.5 million tonnes grain and 5.9 million tonnes straw. The fodder or stover of nutricereals is the most valued fodder source in crop or livestock system where millets are cultivated, regardless of the fact that millet grain is not usually used as animal feed. Millets are appropriate for fragile and vulnerable agro ecosystems despite of environmental friendly nature and are the crops for sustainable and green agriculture. The promotion of millets can lead to much more efficient natural resource management and as a result, to a more holistic approach in preserving precious agro-biodiversity.

Cultivation of Millets

The millets are often rain-fed crops grown in dryland farming conditions even though they respond well to irrigation. Because they grow well in warm weather and are dependent on rain, cropping is often associated with summer moisture systems like the South Asian monsoons. Fertilizers will increase yield, yet this is often not practiced (Deepthi *et al*., 2022). Field pests and diseases are not of much concern when compared to other cereal crops but there is a need for weeding. Yet grain yield can be significant with minimal energy relative to more traditional crops (Table 3). Maximum millet cultivation happens in the *kharif* period, *i.e*., during the monsoon season. In areas that receive more

TABLE 3

The yield potential of small millets under optimum management practices

Small millet	Harvesting and Yield
Finger millet (*Eleusine coracana* L.)	25-35 q/ha of grain and 60-70 q/ha of fodder
Foxtail millet (*Setaria italica* L.)	20-25 q/ha of grain and 30-40 q/ha of straw is expected
Little millet (*Panicum sumatrense* L.)	18 - 20 q/ha of grain and 25-30 q/ha of straw is expected under well managed agronomic practices

Table 3 Contiuned....

Small millet	Harvesting and Yield
Proso millet *(Panicum miliaceum L.)*	Crop comes to harvest in 65-80 days of sowing in most of the varieties. Harvesting is to be done at physiological maturity and with the adoption of improved package of practices, it ispossible to harvest 18-20 q/ha grain and 25-30 q/ha straw under rainfed situation Under irrigated situation, 20-25 q/ha grain and 50-60 q/ha straw is expected.
Kodo Millet (*Paspalum scrobiculatum* L.)	With the adoption of package of practices, kodo millet can yield upto 20-25 q/ha grain and 30-40 q/ha straw
Barnyard millet	The crop should be harvested when it attains the physiological maturity. Generally, it is cut from the ground level with the help of sickles and stacked in the field for about a week before threshing is done by trampling under the feet of bullocks. 15-20 q/ha grain and 25-30 q/ha can be realized by following the improved production practices
Browntop millet (*Brachiaria ramosa* L.)	The crop should be harvested as soon as it attains the physiological maturity. 15-20 q/ha grain and 20-25 q/ha straw can be harvested by following the improved production practices.

(*Source*: Anonymous, 1986 - 2020)

than 800 mm of rains, many of the millets can be cultivated in the second season, *i.e.,* as a *rabi* crop (during the post monsoon, early winter months). And in some places with the right soil and geography, a few millets can even be grown in the third season, during the dark days of winter, utilizing residual moisture in the soil and the dew that precipitates (Sukanya *et al.,* 2022).

Constraints in Millet Production

Beside its numerous advantages, there are a few drawbacks in millet production that must be addressed. Low productivity of millets, non-availability of good quality seeds, lesser shelf life of millet value-added products, lack of technologies and machinery for primary and secondary processing, dearth of continued demand, lack of awareness on the nutritive value of millets, lesser established market linkages and lack of uniform standards and grades for exporting are the major problems. Further, the expansion of area under millets in non-traditional millet cultivating markets, more value-added products, lack of more ready to cook products are also the issues to be addressed.

Way Forward and Scope for Small Millets in the Coming Years

Due to growing nutritional awareness and processing technology, millets can be consumed more often as a food. People are becoming more cognizant of their healthy living habits in order to combat metabolic illnesses and lifestyle diseases, which have resulted in increased demand for various millets. Despite the fact that millet food products are known for their nutritional value, public awareness of their nutritional and therapeutic benefits is gaining. In spite of the fact that millets are recognized to have a rich composition of nutrients and minerals, health branding has not been used effectively to promote millet foods.

Millets have been gaining huge popularity due to their nutritional advantages and these are gluten free. These crops are also eco-friendly, low cost and input consuming crops and found with lower incidence of pests and diseases. More importantly these are crops of dryland where uncertain rainfall, shorter length of growing period (LGP), limited soil moisture, low soil fertility and poor socio-economic conditions are exceedingly observed.

Rich diversity of millet crops has made them well suited for contingency crop planning and also to address the issues of climate change. The farmers who had shifted from millets to other crops are keen to go back to millets in view of the stable harvests ensured, easy crop production, drought resistance and eco-friendly production, provided the assured market is in place.

To develop a millet-based climate smart cropping system, the role of researchers, farmers, policy makers, and rural agro-service providers are essential to achieve success.

Farmers can be motivated through the supply of high-yielding varieties, range of tools such as hand-held crop sensors, rain gauges, decision support tools, leaf color charts, zero-till machinery and improved production options in order to study the crop status in field.

To boost millet production and productivity, expanding the area under millets in non-traditional millet cultivating regions, using good quality seeds, cultivating high yielding varieties of millets, implementing good agricultural practices and encouraging millet cultivation are all important.

To bring consumer-specific millet value-added goods of export grade, extensive research is required. Millets must be mainstreamed in public-sector programmes such as Mid-Day Meals and Integrated Child Development Services to reach the general population and address issues such as lifestyle diseases and malnutrition. Millet promotion must be spread across several states and districts with policy support.

They are also the potential feed stalks for biofuel, a source of renewable and environment friendly raw material for fuel, circumventing the food versus fuel debate. This new demand for millets, leading to higher prices, can make their cultivation profitable, ensuring the legitimate place for millets in the national food basket.

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