Original Article

Millets-The Nutritious Forgotten Crops

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DOI:10.47750/pnr.2023.14.S01.106

Abstract

Millets are used both as food and fodder. Various studies show that consumption of millets has reduced with time. Millets are healthy and nutritious for human consumption. In the current situation when health issues and diseases like obesity, diabetes and cardiovascular are high, the decrease in production and consumption of millets is not a good sign. If the demand for any commodity decreases, eventually its production reduces. Millets are climate resistance crop, suitable tool against fight with climate change and can easily undertake the climate and abiotic stress. They are rightly called as the crop of future as it also provides the additional food security. The people who are aware of the millets benefits purchase millets at high cost. Present paper reviews the benefits of millets and reviews the reasons behind low production-consumption of millet in Indian scenario.

Keywords: Commodity, Consumption, Millets, Nutritious, Production

INTRODUCTION

Cultivation of millets is being done in India since pre-historic era. Millets were the first crop domesticated by humans during prehistoric times. Millets are considered as miracle crops rich in nutrient and can be easily grown under biotic and abiotic stress. Being a rainfed crop, it can be grown in the areas recieving low rainfall, low moisture and infertile/less fertile soil [1]. Most of the millets which are grown in India are of short duration i.e. ready to harvest within 3-6 months. Table 1 shows the common millets grown in India and their benefits.

Table 1. Common Millets grown in India and their benefits.

S. No.	Crop	Botanical Name	Local Name	Family	Benefits
1	Finger millet	*Eleusine coracana*	Madua/Koda/Ragi	Poaceae	Proper cardiac functioning, Alzheimer's disease, Memory enhancement, Excellent Antioxidant, heals weakness of muscle
2	Sorghum	*Sorghum bicolor*	Jowar	Poaceae	Source of protein, fibres and acts as good antioxidant, rich in vitamins and minerals like magnesium, phosphorous, Zinc and Iron
3	Barnyard millet	*Echinochloa frumentacea*	Maadira/Jhangora/ Sawa	Poaceae	Good source of protein and fibres, glycemic index is lower, non glutinous , rich in Iron, effective in reduction of weight
4	Proso millet	*Panicum miliaceum*	Cheena	Poaceae	Enriched with vitamin B-complex, folic acid, essential amino-acid, P,Ca, Zn, lower in glycemic index, reduction in type-2 diabetes
5	Foxtail millet	*Setaria italic*	Kauni	Poaceae	Rich in Vitamin B_{12}, reduce insulin, cholesterol and fasting glucose level

Millets production and consumption scenario- World's Perspective

According to a report 0.9% decline in the global consumotion of millets has been administered. But the five year term i.e. 2019-2024, some positive results are expected in global millets market [2]. Although largest millets producers in the world are India, Niger and China respectively but the cultivated area has been decreased in these countries while an increasing trend in millet production has been observed in Africa. The estimated global millets production is 27.8 millions tons. African countries particularly Nigeria, Sudan, Niger, Burkina, Mali are the highest millets consuming nations. They accounts for more than 40% of the consumption of millets [3].

In Asia, however the millets are considered as the staple food but its importance is declining because of various factors like increase in income, unchecked urbanisation and the policies of the Government which favours the production as well as consumption of wheat and rice crops [4]. Although the world's leading producer of millets in the world is India with a share of 41.04%, but the U.S.A dominates the world export market. In 2015, millets export was of USD 16,341 was while in 2016 it millets exported were USD 12,802 [5].

Millets production and consumption scenario- India's Perspective

Agriculture is an important sector which enhances the economy of any country. India is an agricultural country. "*Serving farmers saving farming"* the title of first report by National Commission for farmers gives the insight on the distress condition of farmers and farming.[6] A report published in online portal of The Hindu newspaper suggests that the total number of farmers according to Government of India is approximately 145 Million but only 90 Million of families have been identified. In India at every five years the Agriculture Census is conducted. The latest Census was conducted in the year 2015-16. The difference in the number of farmers in India can be due to the migration of farmer families. [7]

According to Union Ministry of Agriculture and Farmers Welfare as in March, 2020 about 2.78 Million hectare of land was under the practice of organic cultivation. 2.78 million hectares is about 2% of the total 140.1 million hectare of total cultivated area. According to a report, the states of Madhya Pradesh, Rajasthan and Maharashtra have half of their cultivation as organic. Till date Sikkim is only state in India which is termed as fully organic. Other states like Meghalaya, Mizoram, Uttarakhand, Goa accounts for 10% or more than 10% of area under organic cultivation. [8]

Health Benefits of Millets

For the diabetic patient's sweets known as barnyard millet burfi (BMb), burfi made up of foxtail millet (FMb) and burfi made up of control Bengal gram flour (CBGFb) have been prepared for consumption. It has low glycemic index and do not harm the diabetic patients [9]. A study was undertaken in Karnataka where the mid day meal of students which was rice based and was replaced with the millets based mid-day meal. The results revealed that the students who were given millets based mid-day meal had notable enhancement in body mass index and stunting. The same results were not found in the students used as control for the study. [10]

Table 2: Nutrient composition of millet and cereals (per 100 g of edible portion)

Parameter	Protein (g)	Fat (g)	Minerals (g)	Total Dietary fiber (g)	Insoluble Dietary fiber (g)	Soluble Dietary fiber (g)	CHO (g)
Rice milled	7.94	0.52	0.6	2.81	1.99	0.82	78.2
Whole Wheat	10.6	1.5	1.4	11.2	9.6	1.6	64.0
Finger	7.2	1.9	2.0	11.2	9.5	1.7	66.8
***Proso**	12.5	1.1	1.9	-	-	-	70.4
***Foxtail**	12.3	4.3	3.3				60.9
***Little**	10.4	3.9	1.3	7.7	5.5	2.3	65.6
***Kodo**	8.9	2.6	1.7	6.4	4.3	2.1	66.2
***Barnyard**	6.2	4.4	2.2		-	-	65.5
pearl	11.0	5.4	1.4	11.5	9.1	2.3	61.8
***Sorghum**	10.0	1.7	1.4	10.2	8.5	1.7	67.7

**No clue whether polished/unpolished*

Source: IFCT 2017, Nutritive value of Indian Foods, 2009

According to recent study Barnyard millets (genus *Echinochloa*) is comprised of major two species i.e. *Echinochloa esculenta* and *Echinochloa frumentacea* which had been cultivated by the man from time immemorial. Both the species have good quantity of protein, fibre, carbohydrates, micronutrients (Fe & Zn) more than other available major cereals. Besides having agronomic and nutritional benefits, still barnyard millet remains an underutilized crop [11].

According to a study undertaken by Rao *et al*., (2019), unbalanced dietary fibres have raised many health issues like metabolic syndrome which ultimately leads to cardiovascular malfunctioning. They studied the effect of millets based diet to 69 patients in comparison to the non-millets based diet in 73 patients and found significant results in the millet based diet patients. Lower body mass index, systolic BP, total serum cholesterol, serum low density lipoproteins, serum triglyceride levels were noticed [12].

Finger millet (*Eleusine coracana*) is another species of millets which is filled with high concentration of carbohydrates, essential amino acids, essential minerals, dietary fibre and is proved to be gluten-free. Consumption of Finger millet contributes to reduced gastro-intestinal tract disorders, reduced risk of diabetes and blood pressure [13].
One of the study compared the mineral content of minor/small millets with rice and wheat. The findings suggested the mineral content higher in millets than wheat and rice. Alone Finger millet contains about 30 times more Calcium in comparison to rice and wheat. Higher amount of iron was found in little millet and foxtail millet. Non-glutinous quality makes the millets suiFigure for therapeutic use. The minor millets are rich in lysine, methionine and cysteine and provide energy [14].

Significance of millets farming- Indian context

Commercial agriculture is practised in the plains while hill areas practice the subsistence farming. Major crops cultivated in most of the states in India are rice, wheat, sugarcane, maize, soybeans, pulses, millets, oilseeds etc. Bestowed with fifteen major agricultural zones, there is a huge potential of agriculture in this India. The traditional farming of millets is quite common in hills and is well known for its health benefits.

Farmers practicing farming in some arid zones of Karnataka, India have came across the ill effects of climate change and had now shifted from water intensive crops like maize and rice to drought resistant crops like millets. The role of millets is well known in combating climate change as it is a drought resistant crop[15]. For combating climate change, greater resilience crops are needed which do not need lot of natural resources. Millets are adaptative to different moisture regimes and temperature changes [16]. They do not require power or irrigation and can be called future smart crops [17]. Climate change has direct influence on quantity and quality of natural resources and can directly affect the productivity of the crops. Mobilization of Crop diversity can reduce the consequences of climate change[18]. The outcome of climate change on crop productivity during a study concluded that major cereals have higher contribution to global warming. Therefore the use of millets can be considered for fighting against climate change and global food insecurity [19].

Millets cultivation can achieve the nutritional balance and food security in India. Modernisation and expansion of agriculture are known to produce green house gas emissions and increased utilization of natural resources as compared to traditional agriculture practices of nutri-cereals mainly millets. The shift from traditional farming to modern farming has produced increased burden of malnutrition which ultimately causes nutrient deficient diseases and undernourishment [20]. India is the leading supplier of the millets in the world.

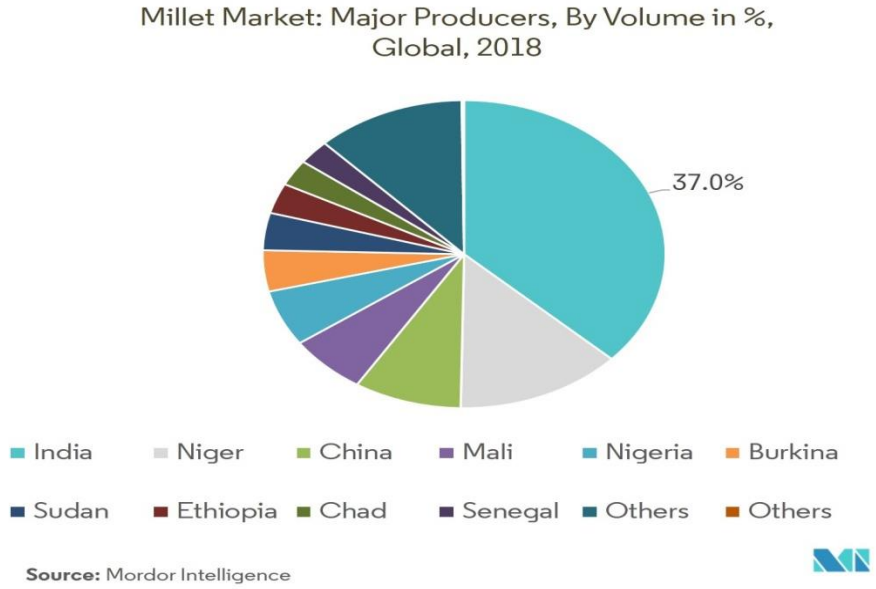

Figure 1 Major producers of millets in the world

According to the study carried by Uttarakhand Organic Commodity Board a rise in demand of consumers for healthy and safe food is increasing. The concern over chemical contaminated food, health hazards and various bacterial infections has risen in recent times. Sustainable and organic products are back with huge demand. The Figure given below shows the popular millet which is grown in hills [21].

Millets farming is considered to be successful in rain-fed regions of our country. It is well –known that millets are nutritive in nature and are drought resistant. The productivity of millets is highest in Uttarakhand i.e. 1174 kg/ha, followed by Tamil Nadu with 1067 Kg/ha and Gujarat at third place with 1056Kg/ha [22]. The millets are adaptive to a

vast range of ecological conditions and can easily grow on less fertile or skeletal soil. This is the reason that millets can grow in stress conditions also.

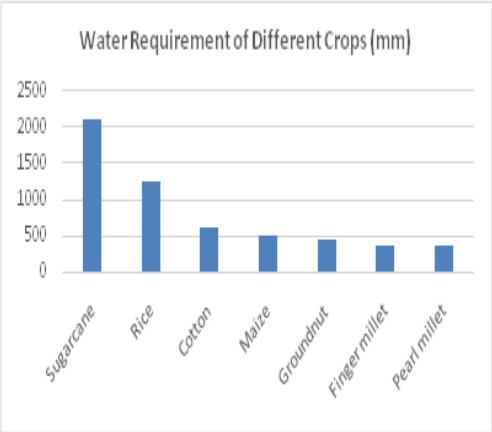

Figure 2- Water Requirement of Different Crops. (*Source-Behera 2017*)

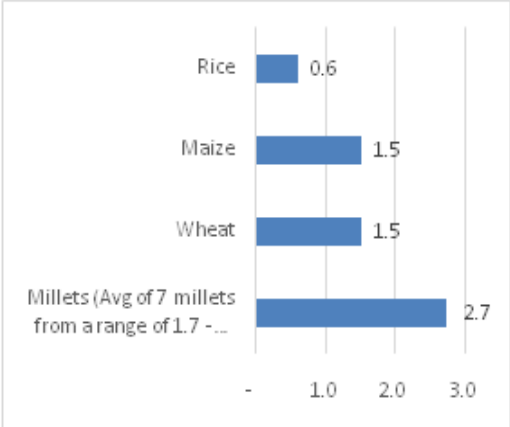

Figure 3- Mineral Content in 100 gm of cereals. (*Source-Behera, 2017*)

A study undertaken by Bahera, 2017, shows that in rain-fed conditions millets prove to be a boon for farmers. The water requirement is highest in sugarcane followed by rice, cotton, maize, groundnut and least is required by millets (Figure 2). Similarly, mineral content was found highest in millets in comparison to wheat, maize and lowest in rice (Figure 3). Protein content was found highest in wheat followed by maize, millets and lowest in rice (Figure 4) [23].

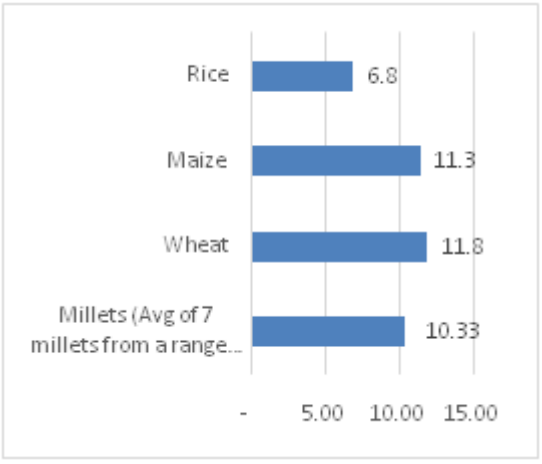

Figure 4- Protein content in 100 gm of cereals *(Source-Bahera M (2017)*

But, the current scenario of millet farming is not favourable. According to a published report, the area under millet farming is reducing with the time passing by. 44% of the area which was under the millet farming has now turned up to other crops meaning that the area under millet farming is reducing. This observation came after the analysis of data between the periods of 1966-2006. Therefore, an urgent need is required by the policy makers of our country on reduced farming of millets [24].

According to another study, the farmers in Nepal of villages Aiddhungra, Budechaur and Bagargot are so scared of crop raiding by the animals that they have abandoned the farming of maize and millets. Agro-ecological conditions are suitable for growing maize and millets but farmers are abandoning the cultivation of these crops [25].

An interesting study claims that, Uttarakhand always had a hold on millets farming. *Manduway ki roti* (made from finger millet) and *jhangore ki kheer* (made from barnyard millet) had always been favourite of older generation but the if the status of millet farming remains as such or the situation becomes worse than these dishes of Uttarakhand cuisine prepared from millets will soon become legacy for young generation. [26]. According to a report of Indian Institute of Millets Research, India needs to increase its production of millets by 40%. [27]

A study was carried out in Central Himalaya and surveyed 150 villages and found that the traditional crops cultivated area in past two decades have declined significantly. The agriculture trend is shifting from subsistence farming to cash economy which is eliminating the traditional crops from the ongoing cropping pattern. States like Kashmir and Himachal Pradesh also follows the same trend [28]. Food habits of the people belonging to Himalayan region are also experiencing the shift from coarse grains (barley, millets, pseudo-cereals, maize) to rice and wheat. The original staple crops of Himalayas such as millets are now replaced with other staple crops like rice and wheat. As the food of rural people is becoming urban in respect to nutrition and diet, the diseases such as high blood pressure, diabetes, heart diseases have make their way to the people living in rural areas.

Issues related to millets farming in India

Migration is the burning issue today. According to a report published by Department of Planning, Government of Uttarakhand in 2018 many villages in Uttarakhand have been specified as "*Bhutia Gaon*" means the ghost villages. The condition is so worse that around 1700 villages have been emptied or very less population mainly the elderly person are present. The people who migrated from rural areas to urban areas, not all of them are doing well. Leaving their farmland barren, moving to urban areas and working as daily wages labourers is the story of many farmers who have migrated. A report suggests that around 3900 villages are under the reeling pressure of migration Agriculture is the main occupation of the state, although the production of millets is high but the potential of the land is not being used. According to 2001-2011 census, approximately 2, 26,949 farmer families have migrated from Uttarakhand. As a result around 20% of the agricultural land is being farmed in Uttarakhand and 80% land is lying as fallow land. [29]
Migration trend in Uttarakhand has been depicted by the map below. Most of the migration is from Rudraprayag, Chamoli, Pithoragarh, Champawat, Almora and Bageshwar. [30]

Source: Department of Planning, Govt. Of India Report by Institute of Human Development

Uttarakhand farmers have more reason for giving up the farming of millets. Wild animals like wild boar and monkeys destroys the standing crop in the fields. Huge loss which is unbearable for the farmers occurs due to the attack of wild animals. In Uttarakhand Sambhar (*Rusa unicolor*), Wild Pig (*Sus scrofa*), Nilgai (*Boselaphus tragocamelus*), Elephant (*Elephas maximus*) and Cheetal (*Axis axis*) are other animals which enter the fields and destroys the crops [31].
While studying the crop damage by wild animals a study concluded that Wild Boar is proving to be more disastrous to the crops. With the increase in population of wild boar the crop damage has also increased. Their findings revealed that 21.67% of barley crop had been damaged during their study period in Himachal Pradesh [32].
Gujarat suffered a loss of 48,600 kg of Sorghum due to attack of Blackbuck. The financial loss was worth of Rs. 29,000 which is around 558 U.S. Dollars [33]. Murthy et al., (2013) undertook a study on crop damage by wildlife in Karnataka.

Millets, Paddy and some fruits are grown by the villagers that get damaged by mainly elephants and wild boars. The farmers suffered a loss of Rs. 3,45,100.00. [34]
Global Hunger Index (GHI) is a scale which measures and tracks hunger at regional, national and global level. GHI severity scale is shown below:

S.No.	Measure	Score
1	Low	≤ 9.9
2	Moderate	10.0-19.9
3	Serious	20.0-34.9
4	Alarming	35.0-49.9
5	Extremely Alarming	≥ 50.0

Source: globalhungerindex.org

India ranks at 94th position in Global Hunger Index, out of 107 countries and measure being Alarming and extremely alarming. The situation of India can be assessed with the data [35]. India is an agricultural country where most of the people are engaged in agriculture but still India ranks far behind in Global Hunger Index. A report published in Down to Earth magazine the key reasons for high GHI agricultural output from small and marginal farmers are stagnant or declining. The reason can be reduced soil fertility, fragmentation of land and fluctuating price in the market. After having surplus food also, small and marginal farmers do not have enough food to last year long [36]. Millets are very important for providing food security all the year round. It can overcome all the abiotic stress. Millets can be an answer to India's food security and nutrition [37] [38].
Small millets can be the new staple crops to fight with hunger and malnutrition, especially in hotspots of hunger and also in the times of pandemic [39]. Food and Agriculture Organization on the call of India had set forth the year 2023 as the International Year of Millets. Indian Government had set an agenda for malnutrition free India and doubling the income of the farmers. Hence promotion, production and consumption of millets (nutri-cereals) seems the best way possible [40].

Issues related to millets farming in India

According to Directorate of Economics and Statistics, Department of Agriculture & Cooperation, Government of India, the decreasing trend has been noticed in the production and consumption of millets. There may be several reasons about abandoning the millets farming. The foremost reason comes up from the time of Indian green revolution when farmers were provided with the high yielding variety crops [41].
The reasons for decreasing trend can be attributed to the following points:

Demand and Supply Factor: A significant gap has been administered in demand and supply of millets. A wrong perception of millets being the food of the poor becomes one of the factors for the decreasing demand no matter it has proven health benefits, thereby decreasing the consumption of millets. Limited supply can also owe to the reason of limited processing centres near the villages. Mainly the hill farming is subsistence farming and do not grow crops for supply sake.
Low remuneration of Millets: Major reason for low production according to the potential of the land can owe to the low remuneration as in comparison to the other cash crops. Farmers are considered to be the financially deprived community. Lack of subsidies, incentives and latest agricultural technology also yields to the low remuneration of the millets.

Change in food habits: The change in food habit of the people may be the other reasons for the less consumption of millets. The easy availability of other food items, packaged items and ready to eat food items has even worsened the scenario. The change in taste and easy preparation of food can owe the reason of less production and consumption.

Labour Intensive: The plantation, harvest and post harvest work is labour intensive. Cleaning and processing of millets after the harvest period needs lot of hard work. It can be one of the reasons of the farmers shifting from millets plantation to market oriented agricultural crops.

Absence of quality seeds: The absence of quality seeds is another factor for low production of millets. Lower production of millets can be attributed to lack of high yielding seeds, availability of poor quality seeds and unimproved and traditional cultivating practices [42]. Ragi millet and Sorghum millet are widely used and have easy availability of seeds, while the other small millets quality seeds are not available [43].

Inadequate Branding: In today's fast changing world, advertising has its own impact on the consumers. Branding and advertising of millets is required on the large-scale. Presently, due to inadequate branding and advertisement, the production and consumption of millets is lagging behind.

CONCLUSION

Millets are the underutilized assets. They can solve the nutrition and food security issues mainly in those countries which are utmost affected by climate change. India as a pioneer country wishes to seek the attention of the world towards the benefits of millets. Sustainable Development Goals (SDG) which is set for Agenda for Sustainable Development, 2030 marks millets as the important crops.[44] The step for marking the Year 2023 as International Year of Millets on suggestion of India is the step towards this direction. India is quite convinced that production of millets will surely rise with the raised awareness among consumers about the health and nutrition benefits of millets. Efforts are required to support the farmers cultivating the millets with financial aids, good quality seeds, supply chain and market for millets. This is an urgent need to advocate for national public programmes and consumer awareness week for awareness of the benefits of millets. Encouragement for research and development in the millets farming, increase in production, efficient processing and consumption, subsidies will help India to become food basket for the world and this will also be the step for "*Atmanirbhar Bharat*" which means self-dependent and sustainably developed.

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