

Millets- the Climate Resilient Crops

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Abstract

Millets are an important staple cereal crop for millions of smallholder dryland farmers across Asia and sub-Saharan Africa. These have a wide capacity for adaptation because they can grow from coastal regions of Andhra Pradesh to moderately high altitudes of North-eastern states and hilly regions of Uttarakhand. Millets can withstand variations in moisture, temperature and the type of soils ranging from heavy to sandy infertile lands. These can endure extremely high temperatures to drought to salinity making it a climate resilient crop. The higher water use efficiency and lesser input requirements of millets for its cultivation make them a wonderful crop for ecological balance and sustainability as compared to other cereals. The health benefits of millets are one of the reasons for increasing demand of millets in today's scenario.

Keywords: Celiac disorder, climate resilient, glycemic index, millets, nutri-cereals.

Introduction



Millets were domesticated and cultivated as early as 10,000 years ago in Northern China (Yang et al, 2005). The millets cultivation is taken up usually in degraded and marginal lands that receive scanty rainfall and are poor in soil nutrient content. Seven important millets cultivated globally are finger millet, pearl millet, foxtail millet, barnyard millet, proso millet, kodo millet, and little millet. Overdependence on cereals after the green revolution and the present-day sedentary lifestyle of people has proliferated health-related disorders like obesity, diabetes, coronary diseases, gastrointestinal disorders and risk of colon, breast, and oesophageal cancer. The only way to sail through is through the introduction of nutritionally rich millets in our daily diets. Millets are unique for their richness in dietary fibers, antioxidants, minerals, phytochemicals, polyphenols, and proteins; that act as elixir to fight against health-related disorders. Recent global phenomenon of climate change has led to a decrease in the yield of major staple cereals and has paved path for introduction of millets into agriculture production system to formulate climate resilient cropping systems because millets are C4 plants with very superior photosynthetic efficiency, short duration, higher dry matter production capacity, and a high degree of tolerance to heat and drought.



Tolerant to drought and high temperature, and other climate change vagaries, millets are mostly cultivated on low-fertile land, mountainous, tribal and rain-fed areas. India is the leading producer of millets in the world followed by Niger and China (Weber,1998 ; Takei,2013). In India, Rajasthan is leading among millet-producing states followed by Maharashtra and Gujarat, and others like Andhra Pradesh, Chhattisgarh, Haryana, Madhya Pradesh, Odisha, Karnataka, Uttar Pradesh, Tamil Nadu and Telangana. According to the Ministry of Agriculture & Farmers Welfare, in 2016-17, the area under the cultivation of millet declined with approx. 60% less coverage area due to change in consumption pattern, conversion of irrigated area for wheat and rice cultivation, unavailability of millets, low yield, dietary habits, less demand. This resulted in fall in the level of nutrients like vitamin-A, protein, iron and iodine in women and children leading to malnutrition. Several Indian and international organizations have been working towards enhancing crop productivity by using multi-disciplinary approaches (Baltensperger,2002; D'Andrea,2002; Collett,2013). For instance, the Pearl Millet Genome Sequencing Consortium, comprising 30 institutions, decoded the genome of pearl millet and identified genes for drought and heat tolerance that may be useful not only for millets but also for other major cereals.

Millets are important crop in relation to health/nutritional security and climate change and are well adopted in the farming system of most of farmers with small land holdings (McDonough et al, 2000). Nearly 40% of the food produced in India is wasted every year. Millets do not get destroyed easily, and some of the millets are good for consumption even after 10-12 years of growing, thus providing food security, and playing an important role in keeping a check on food wastage.

What are millets

Millet is a cereal grain that belongs to the Poaceae family, commonly known as the grass family. Millet is a C4 plant, which means that it has good water-use efficiency and utilizes high temperature and is therefore a summer crop. It is widely consumed in developing countries throughout Africa and Asia. Millet's nutritional profile is similar to that of sorghum and other cereals. Being good sources of proteins, carbohydrates, dietary fibre and essential amino acids, millets are considered to be superfoods or smartfoods. Millets have 65% carbohydrates, 9% proteins, 3% fat, and 2-7% crude fibre. They are rich in various vitamins such as vitamin A, C and B-complex vitamins and minerals such as magnesium, manganese, phosphorus and also iron.

Types of millets

There are two broad categories of millets, namely major and minor millets (Table1)

- Major millets : Pearl millet, Sorghum, Finger millet, Foxtail millet
- Minor millets : Proso millet, Kodo millet, Barnyard, Little millet etc.

Other minor millets include Buckwheat, Amaranth, Browntop, Guinea, Burgu etc. Many of the minor millets are endangered, as they are getting depleted, and some of them have even totally been eliminated. However, each millet has an importance of its own. While some millets, such as finger millet, are full of calcium, some like jowar have potassium and phosphorus, and foxtail is fibrous while kodo is rich in iron. Therefore, it is advisable to keep rotating the kind of millets we are eating. One should not mix millets and should only eat one grain in a meal as each grain has its own requirement as the medium for digestion and mixing them can create imbalances in body.

Table 1: Important millets and their botanical names

Common name	Botanical name
Pearl millet (Bajra)	<i>Pennisetum glaucum</i>
Sorghum (Jowar)	<i>Sorghum bicolor</i>
Finger millet (Ragi)	<i>Eleusine coracana</i>
Foxtail millet (Kangni)	<i>Setaria italica</i>
Little millet (Sama)	<i>Panicum sumatrense</i>
Barnyard millet (Sanwa)	<i>Echinochloa frumentacea</i>
Kodo millet (Kodon)	<i>Paspalum scrobiculatum</i>
Proso millet (Chena)	<i>Panicum miliaceum</i>

Millets can possess either naked grains or husked grains. Millets such as Ragi, Jowar, and Bajra have naked grains i.e. without the hard, indigestible husk (Manning et al, 2011). These millets don't demand processing after harvest and can directly be utilized after being washed. These are extensively cultivated and popular due to the availability and easy procedure as compared to the other millet and their long processes. On the other hand, millets such as Kodo, Foxtail and Little millets have an indigestible seed coat and the husk on them needs to be separated prior to consumption. They take time to digest, which doesn't cause the blood sugar spike associated with easily digestible food, thus helping in controlling diabetes.

Advantages of millet production

Millets have often been called the coarse grains, however, because of their nutritional contributions they are now being referred to as ‘nutri-cereals’.

Advantages of production of millets in India are:

- (i) Millets are termed as the ‘miracle grains’ or ‘crops of the future’ as they can not only grow under harsh circumstances but are drought-resistant crops that require fewer external inputs.
- (ii) Millets are dual-purpose crops and cultivated both as food & fodder, thus providing food as well as livelihood security to millions of households and contributing to remunerative farming.
- (iii) Being a C4 group of cereals, millets convert more carbon dioxide to oxygen, contributing in mitigating climate change. On the contrary, wheat and paddy being thermally sensitive crops, are the major contributor to climate changes through methane emission.
- (iv) The maturation time for certain millets is 45-70 days, half to that of rice (120-140 days).
- (v) Being short duration crops, millets also act as a contingent crop in the situation of natural calamities like drought and flood and are also one of the important climate resilient crops. Production of millets does not depend on the use of chemical fertilisers.
- (vi) The millet crops do not attract pests and are not affected by storage.
- (vii) Millets are remarkable in their nutritive value be it vitamins, minerals, dietary fibre and phytochemicals like tannins, phytosterols, polyphenols and antioxidants. These are nearly 3 to 5 times nutritionally superior to wheat and rice. Sorghum (Jowar) is an important source of polyphenols, antioxidants, and cholesterol-lowering waxes. Millets are rich in dietary fiber, both soluble and insoluble. The insoluble fiber in millet is known as a “prebiotic,” which means it supports good bacteria in your digestive system. This type of fiber is also important for adding bulk to stools, which helps keep one regular and reduces one’s risk of colon cancer.
- (viii) Being rich in polyunsaturated fatty acids and omega-3 fatty acids, these help lower cholesterol.
- (ix) Millets help in curbing obesity, lower the risk of hypertension, cancers as well as help in preventing constipation due to their high dietary fibre content coupled with low glycemic index. Being gluten-free, these are ideal for people suffering from diabetes and celiac disorders.
- (x) Millets are rich sources of minerals like calcium, iron, zinc, phosphorus, magnesium, and potassium. They also contain appreciable amounts of dietary fibre and vitamins such as folic acid, vitamin B₆, β-carotene, and niacin. The availability of high amounts of lecithin is useful for strengthening the nervous system. Therefore, regular consumption of millets can help to overcome malnutrition.
- (xi) They play a role in body immune system, a solution to tackle childhood under nutrition and iron deficiency anaemia.

However, millets do contain some anti-nutritional factors which can be reduced by certain processing treatments (Mulder et al,2013 ; Rai et al,2014 ; Saturni et al,2010)

Health benefits of millets

- Anti acidic
- Gluten-free
- Detoxify body
- Help lower cholesterol
- Prevents breast cancer and many other diseases
- Prevent type 2 diabetes
- Reduce blood pressure
- Protection against heart diseases
- Helps in treating respiratory conditions like asthma
- Optimize kidney, liver and immune system health
- Reduces risk of gastrointestinal conditions

- Helps in avoiding issues like constipation, excess gas, bloating

Millets are multipurpose

- They consume 70% less water than rice
- Grow in half the time of wheat
- Require 40% less energy in processing
- Being rain-fed crops, use minimal amount of fertilisers
- Do not require pesticides as they are less vulnerable to insect attack
- Seeds of millet can be stored for years making it advantageous in drought-prone areas.
- Have better forage value
- Have better tillering capacity than maize and sorghum

Multidimensional benefits associated with millets can address the issues related to nutrition security, food security, economic security and farmers' welfare. Many unique features linked with millets make them resilient to India's varied agro-climatic conditions. As Millets are resistant to climatic stress, pests and diseases, this makes them a sustainable food source for combating hunger in changing world climate. Further, millets are not water or input-intensive, making them a sustainable strategy for addressing climate change and building resilient agri-food systems. Therefore millets are regarded as the climate-resilient crops.

Millets contribute a lot towards nation's nutritional and economic security. Nutri-cereals are a powerhouse of nutrients including iron, folate, calcium, zinc, magnesium, phosphorus, copper, vitamins and antioxidants in addition to dietary fibre. They are not only important for the healthy growth and development of children but have also been shown to reduce the risk of heart disease and diabetes in adults. Millets, being gluten free and low glycemic index food are good for diabetic persons and can help to combat cardiovascular diseases and nutritional deficiency. Millets can be grown on dry, low-fertile, mountainous, tribal and rain-fed areas. Moreover, millets are good for the soil, have shorter cultivation cycles and require less cost-intensive cultivation. Given these features, low investment will be needed for production of millets and thus can prove to be a sustainable income source for farmers.

Currently efforts are being done to collect, conserve, and utilize germplasm of millets in breeding programs. Of late, several private and government agencies have ventured into value addition of millets to manufacture food and non-food products. But, the governments have a key role in formulating policies to promote cultivation and consumption of millets.

Conclusion

Millets are one-stop solution in the wake of climate change, water scarcity, and drought conditions along with high nutritive value to provide sustainable food security. There is ample evidence on nutritive value of millets being a good source of energy, carbohydrates, fats, proteins, soluble and insoluble fiber, antioxidants, iron, zinc, and vitamins and can help eliminate micronutrient deficiency for India and other developing nations.

However, in spite of acknowledging their significance as a super-food, they possess long appreciated tag of "poor man's food grain" due to its fine affordability. Therefore, it is necessary to rebrand coarse cereals/millets as nutri-cereals and promote their production and consumption. Millets can also contribute to addressing some of the largest global issues in unison such as poor diet (malnutrition to obesity), environmental issues (climate change, water scarcity and environmental degradation), and rural poverty. They have a low carbon footprint and have the ability to survive and grow in warm climate with very little water. They are climate-smart and hence constitute a good risk management strategy for farmers as compared to rice and wheat crops, which require higher quantities of water and fertilisers supplements.

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