

## SHORT ARTICLE

## Power of Millets- Critical for addressing Ecological, Agrarian, and Emerging health crisis in Punjab

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### Abstract

The state of Punjab is facing a major threat of ecological, agrarian as well as emerging health crisis. Continuously depleting water tables due to unregulated use of irrigation water and increased cultivation of water-thirsty, varieties of rice are posing major threat to water availability in the state. Indiscriminate use of chemicals in farming leading to soil infertility, polluted surface waters and air pollution are contributing to ecological catastrophe and eventually leading to many health problems in the population. Hence there is need to focus on environmentally friendly, economically viable and health benefitting solutions. Millets as climate change compliant crops score highly over other grains in terms of marginal growing conditions and high nutritional value are proposed as a solution for emerging challenges in Punjab.

### Keywords

Millets; Ecology; Agriculture; Health; Environment

### Introduction

Punjab, which is also known as “the bread basket of India”, with its only 1.5 %country’s geographical area, has made unprecedented progress in the history of global agriculture. In mid-sixties, with the adoption of new technologies in agriculture backed with suitable agricultural policies, Punjab which was food deficit at the time of independence became surplus in food grains and presents India’s successful model of green revolution.(1) However, this is not the complete picture. Over the years the unchecked use of ‘green revolution’ has become an expanding ecological catastrophe.(2) The depleting water levels is a serious issue in the state because the net withdrawal of ground water is in excess than its recharge.(3) The alarmingly decline in the water table in Punjab, is due to excessiveness as well as unmonitored use of pumps for irrigation and increased use of water-thirsty, high-yielding rice varieties. In the districts south-eastern region, the water table has dropped to an extent that it has become unreachable by the hand-pumps and

by older tubewells. About 79% Blocks in the state are found to be under ‘over-exploited’ category, which means that they are fast reaching to the threshold limit of 300 metres. As per the data available from month January 2021, deep water levels upto 20-40 m bgl are observed majorly in Jalandhar, Fatehgarh Sahib, Nawanshahr, Kapurthala, Ludhiana, Moga, Patiala, Sangrur and Barnala districts. While in small patches of Sangrur, Patiala and Barnala districts, very deep water levels i.e upto >40 m bgl, are also seen. (4) The surface water is also polluted, mainly by the unregulated release of industrial effluent that contains poisons, heavy metals and carcinogenic agents. In the fields, the excessive use of fertilizers and insecticides is polluting it. The groundwater has also become undrinkable everywhere in the state.(2) Rice is the most detrimental part of the wheat-rice rotation, especially the distinctive pattern of growing it by Punjab’s farmers. The farming area under the cultivation of rice has increased from 4.8% to 47.6% from 1966–1967 to 49% by 2010–2011. The highest annual marginal return

per unit of land is provided by wheat-rice rotation to the farmers for many reasons as follows:

1. Quick maturity of rice makes it fit in the kharif growing season.
2. Rice displaces cotton and maize due to its more reliability and better price.
3. The rice being major diet in most of Indian states.
4. The government being the major buyer of rice and its price reliability
5. The availability of free of cost canal water and electricity for farmers to pump the water.(2)

In Punjab, the rate of increase in agriculture yield has declined sharply since 1990 and is lagging behind India as a whole, even though the state is still producing higher average agricultural yields as compared to all other states in the country.(2) The farmers of Punjab are in the state of economic crisis because farming is becoming increasingly capital-intensive due to continually rising prices of chemical inputs and machinery. Furthermore, the soil fertility is being depleted by intensive cropping patterns, including increased use of fertilisers to attain the same yields, also the pests are developing resistance to the pesticides hence requiring higher applications. As the money spent by the farmers is more than their earnings, it is leading to gradual decrease in their income. (5) There are reports of high suicide rate among cultivators.

The high concentrations of agrochemicals in surface water channels and in the aquifer is resulting in adverse health impacts. Along with significantly higher systemic and general health morbidities, genotoxic effect has also been linked to contamination of water bodies by heavy metals and pesticides.(6) Air pollution linked with stubble burning by the farmers and release of harmful gases from the industries has also been highlighted. Besides, causing environmental damage, evidence also supports an increase in cancers rates and diseases of reproductive system in Punjab.(7,8) The people in Punjab state are also facing the threat of rise in NCDs. The prevalence of hypertension and diabetes is 40% and 14.3% respectively, while 40% population of Punjab is overweight with BMI > 25.(with Asian cut off BMI > 23 it is 58%).(9)

The crop diversification has been suggested as a viable solution to this problem of ecological, agrarian and health crisis.(10) Keeping in view of current situation in Punjab, we have established a Centre for Sustainable Development, Health and Wellness under the smart village project initiative at Village Gurah in Tehsil Majri and District Mohali of Punjab state, which acts as demonstration centre with active participation of stakeholders and community. The main focus areas of this centre are Sustainable Agriculture, One Health and Wellness, Cancer Prevention, Sustainable Development Goals and Rural Development. "Operation Millets" has been initiated for promoting sustainable agriculture, environment and health. The centre is committed to provide comprehensive development model by

convergence and integration of diverse medicinal systems, addressing social determinants of health and multisectoral participation. The centre is working on planetary health model focusing on SDGs, especially on linkage of human health with the soil health. (11) As part of sustainable agriculture initiative we are involved in promoting organic farming and propose that the crop diversification to millets can be considered as a solution to Punjab's ecological, agrarian as well as rising health problems. Millets are a group of cereals rich in fibres, minerals & proteins and has been part of staple diet in the developing world. Millets nutritional content is higher as compared to traditional foods i.e wheat and rice being consumed by the Indian people. The different types of millets and their health benefits are given in [Table 1](#).

Millets are best suited cropping system to the current situations in Punjab, because millets cultivation do not require synthetic fertilizers and pesticides. Furthermore, millets can grow on the most marginalized soils, without irrigation and in even drought like conditions. Millets are considered as climate change compliant crops.

Millets are not a new introduction to the Punjabi culture. Their historical evidence can be traced back to the times of the first sikh guru Baba Nanak who ate Kothra roti. Even various idioms, phrases and folk orations of Punjab also reflect the use of millets in the past times.

In the modern times where burden of NCDs prevalence is high in which diet plays a major role, there is need to promote the consumption of these power packed grains. Usefulness of millets in celiac disease, gluten sensitivity, diabetes, cardiovascular diseases, arthritis, obesity and autoimmune diseases has been reported in the literature.(12)

Many steps are being taken at government level to promote the consumption of millets. These have been made part of poshan mission abhiyan by Ministry of Women & Child Development. For promotion of the global acceptance of millets, recipes, value added products from India, Government of India decided to make it peoples' movement, and hence proposed United Nations for declaration of year 2023 as International Year of Millets (IYOM), which was supported by United Nation's General Assembly (UNGA) along with 72 countries across the globe on 5th March, 2021. (13)

Although, efforts are being made, still only a few organic farmers are involved in growing different types of Millets and the area under cultivation is very low. At policy level also, in order to attract more farmers to grow millets the Government should provide reliable ecosystem, processing and marketing support. Also, there is need to promote the consumption of millets as mass level by organizing millets festivals, through lectures/talks and provision of millet based foods/snacks in canteens and cafeterias. The millets should be given space in various

government schemes and should be made the part of the Public Distribution System (PDS) in the country.

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**Tables**

**TABLE 1 DIFFERENT TYPES OF MILLETS AND THEIR HEALTH BENEFITS (12)**

Sr. No	Type of Millet	Nutritional composition and health benefits
<b>Major millets</b>		
1	Finger millet or Ragi (Eleusine coracana)	Finger millets contains high quantities of calcium, proteins, high fiber content, Vitamin A, Vitamin B and phosphorus. Finger millet are found to be rich in lysine, threonine, and valine. Tryptophan amino acid present in it is known for reducing the appetite and helps in keeping the check on weight. Being rich in natural calcium, finger millet helps in strengthening bones and is very useful for growing children and aging people. The phytochemicals in finger millets helps in slowing the digestion and hence helps to control the levels of blood sugar in diabetics. Finger millet is also useful in lowering the blood cholesterol levels due to presence of amino acids like Lecithin and Threonine which acts on liver to reduce the cholesterol. It is also beneficial in treating anemia, muscle repair and natural relaxation of the body. Finger millet is also useful for lactating mothers, facing problems in milk production. arabinose and xylose present in finger millets are potent prebiotics and also have potential to be used as wound dressing potential. Finger millet also have anti-ulcerative properties and finger millet diets are found to have nephron-protective and anti-cataractogenic properties in animal models <b>Caution</b> -Higher intake can lead to increased levels of oxalic acid in the body, hence, use of finger millets should be avoided in patients with kidney stones (Urinary Calculi).
2	Sorghum or Jowar (Sorghum bicolor)	Apart from being good source of protein and fibres, sorghum contains potassium, phosphorus, calcium along with iron and zinc in sufficient quantities. Practically it is devoid of sodium. High fibre content reduces the risk of inflammatory bowel disease. It is beneficial for pregnant women to meet their daily requirements of minerals and vitamins. Except for vitamin B12, sorghum is a rich source of B vitamins. As it is gluten free so it is good for people suffering from celiac disease. Due to its high fibre content, it aids to satisfy the hunger, resulting in feeling of satiety, hence resulting in reduced risk of obesity development. Sorghum being a low Glycemic Index food results in reduced levels of postprandial blood glucose and glycosilated hemoglobin. It is also found to reduce to risk of coronary heart disease. Presence of polyphenols, flavonoids and condensed tannins contribute to its antioxidant properties. Anti-carcinogenic properties of these millets have been well studied through In Vivo and In Vitro studies.
3	Pearl millet or Bajra (Pennisetum glaucum (L.) R. Br)	The highest protein content is contained in the Pearl Millets. Many essential minerals like magnesium, calcium, phosphorus, iron and zinc along with essential amino acids and vitamins can be obtained from these millets. Pearl millets are considered as a treasure trove of useful properties. It is considered useful in preventing gall stones, curing stomach ulcers and is suitable for patients with celiac disease. The antioxidants in the form of lignin and phytonutrients in millet are beneficial in preventing heart diseases. Also presence of magnesium in high quantities helps in controlling the blood pressure, relieving the heart stress, reducing the severity of respiratory problems for asthma patients and migraine attacks. The large amount of phosphorus contained in pearl millets is good for bone growth and development as well as for ATPs development. As all other millets, pearl millet is also helpful in reducing the risk of cancer. It also controls diabetes and lowers cholesterol levels. Being a rich source of iron, pearl millets are beneficial in meeting the iron requirements of anaemic pregnant women.
<b>Minor millets</b>		
1.	Foxtail millet or Italian millet or Kangani (Setaria italica)	Foxtail millet contains high content of fibre, protein, calcium and vitamins, manganese, phosphorus, copper and iron. It is amongst most digestible and non-allergic grains having antioxidant properties. The aqueous extract of foxtail millet has excellent anti-hyperglycemic and anti-lipidemic activities. For pregnant and nursing mothers, soup of foxtail millets is used for nourishment. It is also used in the treatment of dyspepsia, indigestion and constipation. White seeds of foxtail millet are useful in the treatment of cholera and fever while the green seeds are used as diuretics and for strengthening the virility.
2.	Kodo millet or Kodon (Paspalum scrobiculatum)	Kodo millets contains high proteins, low fats and very high fibres content. It is good for strengthening the nervous system due to its lecithin content. Kodo millets are rich source of vitamins and minerals, especially niacin, B6, folic acid, calcium, iron, magnesium potassium, and zinc. Kodo millets are gluten free, hence are good for gluten intolerant people.

Sr. No	Type of Millet	Nutritional composition and health benefits
		For postmenopausal women suffering from high blood pressure and high cholesterol levels, consumption of kodo millets regularly has been found to be beneficial. It improves resistance power and is useful in anemia, diabetes and cancers. It also reduces swellings
3.	Proso millet or Chena or Barri (Panicum miliaceum (L.)) -	Proso millet contains high fibre and protein content, rich in calcium, entirely gluten-free and is a good source of manganese. Proso millets are rich in vitamin-B6 and folic acid. Proso millets can be useful in preventing diabetes and heart ailments as improved plasma adiponectin levels, high density lipoprotein (HDL) cholesterol, glycemic responses and insulin were observed in genetically obese type 2 diabetic mice under high fat feeding conditions. Proso millet also has antioxidant properties.
4.	Barnyard millet or Sanwa (Echinochloa esculenta)	Nutritionally, it is a good source of proteins and dietary fibers. Barnyard millet being Gluten free, low in carbohydrate content and slowly digestible, is a nature's gift for the sedentary lifestyle of modern mankind. It is also rich in linoleic acid, palmitic and oleic acid. It also shows a high degree of retrogradation of amylase, facilitating the formation of resistant starches, hence, is effective in reducing the levels of blood sugars and lipids. Barnyard millet is also found to be effective in patients of celiac disease and many cancers. Barnyard millet is also good for thyroid, liver and pancreatic glands functioning. Barnyard millets are the rich source of iron hence are useful for anaemic pregnant women.
5.	Little millet or Kutki (Panicum sumatrense)	Little millet is rich in proteins and is also good source of vitamin B <sub>1</sub> , B <sub>2</sub> & B <sub>3</sub> , calcium, iron, zinc, potassium and many other minerals. The highest dietary fibre content has been reported to be in little millet. Due to its high total carotenoid and tocopherol content, antioxidant capacity of little millet is higher. Little millet is useful for patients suffering from CVDs, Cancers, joint problems, gastrointestinal problems and in relieving migraine symptoms. Little millet is also helpful in curing diseases of reproductive system in both males and females.
6.	Browntop millet or Makra (Urochloa ramosa)	Brown top millet is rich in fibre, proteins, minerals like calcium, phosphorus, iron, magnesium and vitamins like niacin, riboflavin and thiamine. Being gluten free, it is useful in allergy related digestive disorders. It is also beneficial in hypertension, arthritis and cancers.