# MILLETS AS CLIMATE RESILIENT CROPS

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## INTRODUCTION

One of the most common cereal grains consumed worldwide, particularly in arid and semi-arid regions is millets. Due to their nutritional content and lower glycemic index value than other major cereals, millets are known as wonder foods or Nutri-cereals. With the aim to create awareness and increase the production & consumption of millets, Government of India had proposed to United Nations for declaring 2023 as International Year of Millets (IYOM). The proposal of India was supported by 72 countries and United Nation's General Assembly (UNGA) declared 2023 as International Year of Millets on 5th March, 2021.Now, Government of India has decided to celebrate IYOM, 2023 to make it's peoples' movement so that the Indian millets, recipes, value added products are accepted globally. Millets are an integral part of the basic diet for a majority of the population in India. However, their consumption and production grew less in the past few decades. We now are realizing the importance of millets in fulfilling nutritional requirements and in fighting many diseases.

### Millets

Millets are group of small grained cereal food crops which are highly nutritious and are grown under marginal/low fertile soils with very low inputs such as fertilizers and pesticides Most of millet crops are native of India and are popularly known as Nutri-cereals as they provide most of the nutrients required for normal functioning of human body. Millets are rain fed crops and are grown in regions with low rainfall and thus resume greater importance for sustained agriculture and food security. Based on area grown and its grain size the millets are classified as major millet and minor millets. The major millets include pearl millet (bajra) and sorghum (jowar). The finger millet (ragi/mandua), foxtail millet (kangni/Italian millet), little millet (kutki), kodo millet, barnyard millet (sawan/jhangora) and proso millet (cheena/common millet) are categorized under small/minor millets. Millet crops also yield good amount of fodder. Grain and fodder yielding 'dual purpose' millets are grown basically to ensure food and fodder security in the rainfed agriculture system. All these millets are nutritionally rich, complete their life cycle in 2 to 4 months, adapting to the shorter cropping windows that facilitated wider adaption, shifting cultivation and withstanding nature's unforeseen vagaries. All millets are essentially kharif season crops that complete their life cycle in the monsoon period. However, most of them give satisfactory to excellent yields in other warmer seasons as well. Millets are especially drought tolerant and can perform well in areas receiving less than 450 mm rainfall.

**Pearl Millet**
***Pennisetum glaucum***
**(Bajra, Bajri)**

**Kodo Millet**
***Paspalum scobiculatum***
**(Kodo, Kodon, Kodra)**

**Sorghum**
***Sorghum bicolor***
**(Jowar, Juar, Chari)**

**Little Millet**
***Panicum miliaceum***
**(Cheena, Cheeno, Barri)**

**Finger Millet**
***Elusine coracana***
**(Ragi, Mandua, Mandika)**

**Barnyard Millet**
***Panicum miliare***
**(Kutki, Shavan, Samai)**

**FoxtailMillet**
***Setaria italica***
**(Kakum, Kang, Kangani)**

**Proso Millet**
***Echinochloa frumentacea***
**(Sanwa, Banti, Swank)**

**Millets as Climate Resilient Crops:**

Millets are one of the oldest foods known to humans and possibly the first cereal grain to be used for domestic purposes. Millets are termed as "yesterday's coarse grains and today's nutri-cereals". Millets are considered to be "future crops" as they are resistant to most of the pests and diseases and adapt well to the harsh environment of the arid and semi-arid regions of Asia and Africa.

- Millets are generally Photo-insensitive and resilient to climate change.
- Millets can grow on poor soils with little or no external inputs.
- Millets are less water consuming and are capable of growing under drought conditions, under non-irrigated conditions even in very low rainfall regimes.
- Millets have low carbon and water footprint (rice plant needs at least 3 times more water to grow in comparison to millets).
- Millets can withstand high temperature. 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.
- Climate resilience is defined as the capacity of social, economic and ecosystems to cope with a hazardous event or trend or disturbance. The changing climate is leading to an increase in global average temperature which is directly influences agricultural production.
- In the present-changing climate scenario, abiotic stresses entail a huge risk for plant growth and development leading to an over 50% decrease in the yield among the popular cereal crops. Almost 90% of the cultivable land is affected by various abiotic stresses globally, while only 10% of the agricultural land is free from these abiotic stresses.
- Drought and heat are the two most significant production constraints existing among the different environmental stresses. In this context, a crop species like Millets, which is resilient to high temperatures and lower rainfall and show better tolerance to environmental stresses than major cereals which can play a crucial role in fulfilling the increasing food demands of the growing population of the world.
- Primarily, the short life cycle of millets assists in escaping from stress as they require 12-14 weeks to complete their life cycle (seed to seed) whereas rice and wheat requires a maximum of 20-24 weeks.
- Millets are mainly cultivated on marginal lands under rainfed conditions and can sustain and produce a significant amount of grain even in drought-prone areas that receive an average annual precipitation of <250 mm.
- Millets are **C4 plants** having high photosynthetic efficiency, more dry matter production capability, and survival under adverse agro-climatic conditions with lesser inputs and more economic returns.
- Millets have **more ability** to fix inorganic carbon dioxide and more efficient in water utilization in comparison to C3 plants. Thus, being a C4 plant, millets can account for

30% of global terrestrial carbon fixation along with other C4 plants such as Maize and Sorghum.

- Millets have an **advantage of** early maturity, drought tolerance, the requirement of minimal inputs, and usually free from biotic and abiotic stresses.
- Millet's inherent ability to **endure high temperature** up to $42^0$C during the reproductive phase makes it suitable for growth in extremely hot summers under irrigations in northern Gujarat and eastern Uttar Pradesh of India, thus making it a climate resilient crop.
- Millets have **enhanced photosynthetic rates** at warm conditions and confers immediate water use efficiency (WUE) and nutrient use efficiency (NUE). For instance, foxtail millet requires just 257 g of water to produce a dry biomass of 1 g. whereas maize and wheat require 470 and 510 g. respectively.
- Therefore, **realization of stress tolerance** potential of millets is imperative for expedited progress in developing climate-resilient crop species.

**Why Millets:**

Here are six key reasons why millets deserve our attention and a place on our tables:

**Millets are there when others are not:**

There is an ever-growing global population that needs sufficient and healthy food amidst climate emergencies and depleting natural resources. Millets can be part of the solution. These grains can survive harsh climate conditions, offering solutions to food scarcity. Because they are often the only crops that can be harvested in dry seasons, millets can be a vital food source for populations vulnerable to food insecurity.

**Millets can contribute to a healthy diet:**

Millets provide antioxidants, minerals and protein. As whole grains, each millet variety also offers different types and amounts of fibre, which play a role in regulating bowel function, blood sugar and lipids.

Furthermore, millets are gluten-free with a low-glycaemic index making them a great food option for those with celiac disease or gluten intolerance, high-blood sugar or diabetes. They can also be a cost-effective source of iron. Incorporating millets in our diets can provide us with nutritious and healthy alternatives to the usual refined grains in the global market.

**Millets are Climate-Resilient:**

Millets are resistant to drought and tolerant to crop diseases and pests, allowing them to survive in adverse climatic conditions. Because millets can be grown with minimal inputs and maintenance and can adapt to climate shocks, expanding production of millets can transform local agrifood systems to be more efficient, resilient and inclusive. The ability of millets to grow in poor, degraded soils can also provide land cover in arid areas, reducing soil degradation and supporting biodiversity.

**Millets offer promising livelihood opportunities for small-scale farmers:**

As other cereals have become widespread, dietary preferences have shifted and led to a decline in the production and demand for millets. By encouraging the consumption and production of these underutilized crops, we can help millets regain market share and create additional opportunities for small-scale farmers.

**Millets' trade can improve the diversity of the global food system:**

Currently, millets account for less than three percent of the global grains trade. When sudden shocks affect the foodgrain market, millets can provide a valuable alternative to typically traded grains. This added diversity can improve the resilience of the global trade markets and mitigate our reliance on other grains.

**Millets can be used in many innovative ways:**

The genetic diversity of millets lends itself to many diverse and innovate applications of millets in areas such as therapeutics and pharmaceuticals. Used innovatively, millets offer even greater market opportunities for regional and international trade.

vaccine during this pandemic and the burgeoning pharmaceutical industry has the potential to impact the horseshoe crab populations. Therefore, the farming techniques of the horseshoe crabs are prerequisites to conserving them and for blood extraction.