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## Millets: Production and utilization

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### Abstract

The millets have been of key interest in the recent times due to its emergence in the limelight as the functional food. The small seeded group of grains cites its existence in the extremities, with little water and high temperatures and still possess an appreciable nutritional and functional value for consumption. This review digs the history of the orphan cereals, their production and chemical composition.

**Keywords:** Millets, nutrition, functional, health

### Introduction

Millets also recognised as the small-seeded orphan cereals also known as pseudo-cereals have a well-established trace of being a major part of Indian and Asian cuisine. The nutritionally stuffed underutilized group of eleven seeds namely, Pearl Millet, Little Millet, Sorghum Millet, Amaranth Millet, Proso Millet, Kudu Millet, Foxtail Millet, Finger Millet, Browntop Millet, Barnyard Millet and Buckwheat Millet, are the least demanding crops with great potential, having the capability of differentiating themselves in terms of excellent phytochemical and antioxidant properties. The so well defined functional food is most popular in the Asian and African continent and holds sixth rank in cereal production. The production and utilization of the underutilized cereal has witnessed a roller coaster ride over the decades.

The enormous diversity of plant species offered by nature includes many underutilised and neglected crops that have been forgotten in favour of the 'major' grains. Millets and pseudo-cereals are under this group since they have a variety of adaptation and nutritive characteristics. Due to the resilience of these crops to climate change, sustainable development can only be possible if we manage and enhance them in a way that is scientifically planned, protects and solidifies livelihoods, and ensures adequate nutrition and health (Joshi *et al.*, 2021) <sup>[9]</sup>.

### History of millets

India's history dates back in the second millennium of the Neolithic period (about 2500 BCE), in which Ragi, or finger millet (*Eleusine coracana*), is said to have gone from East Africa to the Western Ghats area of India. This millet initially appeared in South India at the same time as the first permanent human settlements and the start of cultivation (HAZAREESINGH, 2021) <sup>[20]</sup>. According to the earliest archaeo-botanical macro remains discovered there, foxtail millet, one of the world's oldest crops, emerged in the Yellow River Valley in the northern province of China between 7,400 and 7,900 years ago (Singh *et al.*, 2017) <sup>[17]</sup>.

Pearl millet has a record of being domesticated around 4,000 years ago in the West African Sahel which eventually moved to East Africa and India (Satyavathi *et al.*, 2021) <sup>[15]</sup>. The traces of its domestication have also been found for the second and first millennia cal BC in West Africa, wherein, the Nok people used pearl millet as their main crop (Champion *et al.*, 2023) <sup>[21]</sup>. The wild varieties, which were the ancestors of Indian millets, developed in moist environments or habitats like the banks of rivers and ponds. They also attacked fields of rice. Numerous Poaceae grass species are found in paddy fields and on wetlands in Pakistan, Nepal, and India. These weeds eventually developed a sympatric habitat in rice paddies and/or upland fields where they coexisted and became companion weeds (Kimata, 2015) <sup>[22]</sup>.

### Millet production trends

The last half century, portrays a decline in sorghum harvesting at a linear rate of 154 thousand ha/year. The top players like China, India and the United States witnessed a decline in the land area harvested when compared to the 1970 baseline, in the order of 89%, 56% and 59%. Most area loss was observed in China (89%), followed by the US (59%) and India (56%) as compared to the 1970 baseline. Up until 1984, India's hectare loss was rather minimal, and after that the

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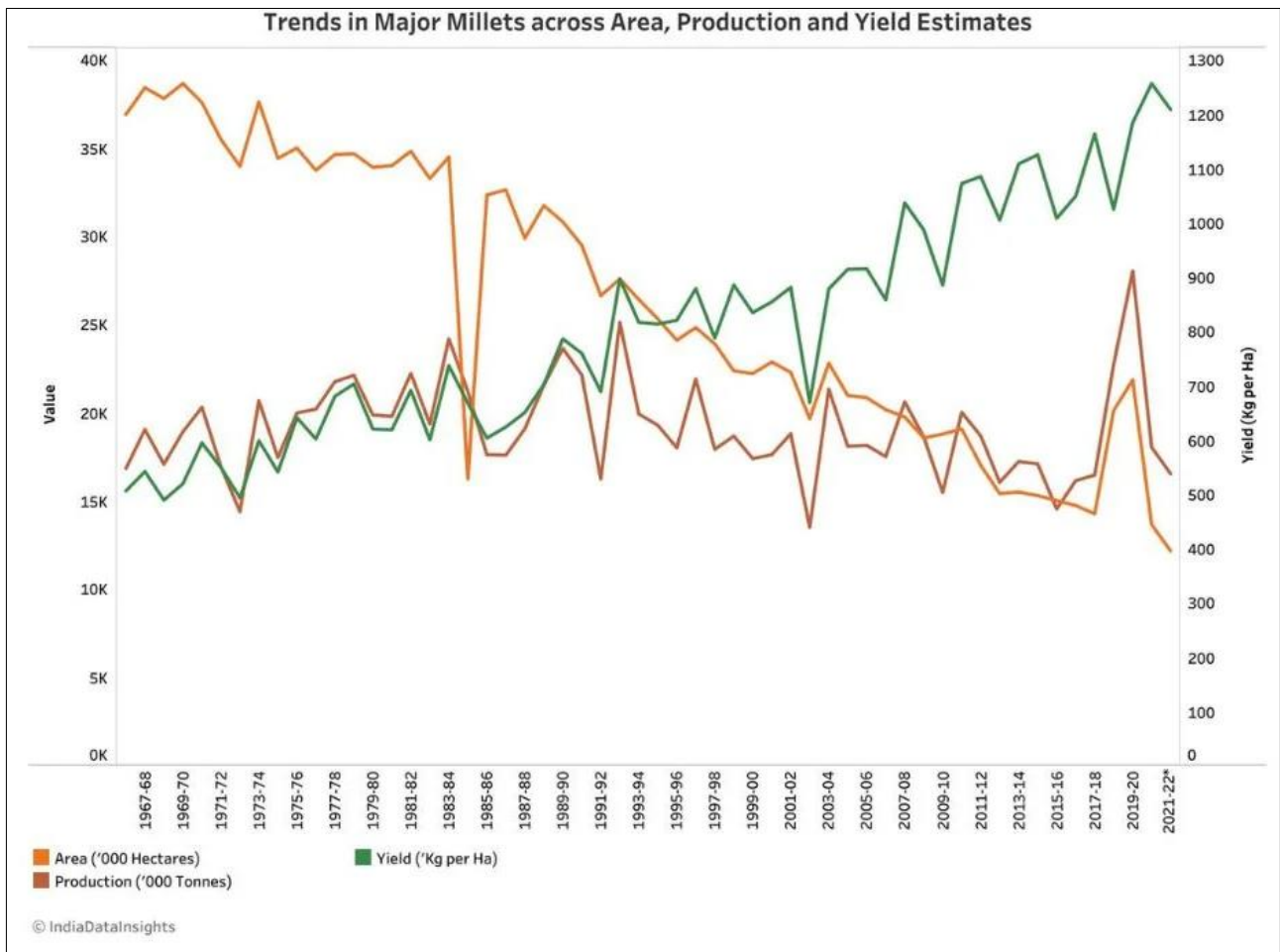
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area quickly shrunk (Rakshit *et al.*, 2014)<sup>[13]</sup>. The study of Sharma, S., & Singh, I. (2016)<sup>[16]</sup>, highlights the state of Rajasthan as the largest millet producer in the nation with a cultivation area of about 80% of 4.38 million hectares for the Pearl Millet. Foxtail millet is currently grown throughout much of China, some regions of India, the United States, Canada, the Korean Peninsula, Japan, Indonesia, Australia, and northern Africa. The Great Plains' northern and western regions, as well as the Midwest, are where foxtail millet is largely grown in the United States. (Ganapathy, 2017)<sup>[6]</sup>

In the Indian context, according to Ganapathy, (2017)<sup>[6]</sup> Karnataka, accounts for 60% of the crop in India, is followed in importance by Uttarakhand, Orissa, Maharashtra, Andhra Pradesh, and Tamil Nadu. Around 4.5 million tonnes of finger millet are produced annually on an estimated 4-4.5 million hectares of land worldwide (Antony Cesar *et al.*, 2018)<sup>[3]</sup>. Together, India and Africa produce 70–80% of the world's finger millet. The crop is grown in a variety of environments in India, from the ocean to the mountainous Himalayan foothills,

but it does best in loamy, well-drained soils. Das, n.d. (2019)<sup>[4]</sup> states that Proso millet is commonly grown in the Middle East, Turkey, Romania, India, China, Nepal, Africa, Russia, Ukraine, and Belarus. German-Russian immigrants planted along the eastern Atlantic coast brought it to North America in 1875. One of the greatest crops for a rainfed agricultural system with an annual rainfall of less than 100 mm is this one. It is the perfect dryland crop due to its shallow root system (90–120 cm) and short growing season (60–90 days).

The area and output of millet both saw negative growth, with annual rates of decline for the two variables being 16.31% and 13.58%, respectively. Productivity had been dropping up until 2005, but after that, it began to increase (3.23 percent). Also, when examining the economics of crops, it was found that the cost of cultivating millet crops, such as sorghum and maize, was cheaper than that of other significant crops. In a similar vein, millet farmers' gross income was likewise meagre, with the exception of maize crop. (Gowri, 2020)<sup>[7]</sup>.



(Ref: Millet cultivation in India: History and trends)

Treads in Major Millets across Area, production and yield Estimates

Renganathan *et al.*, (2020)<sup>[14]</sup> in their study concludes that the ancient millet crop known as barnyard millet (*Echinochloa* species) is farmed around the world in warm, temperate climates. It is very popular in Asia, particularly in India, China, Japan, and Korea. It is the fourth most produced minor millet and provides many hungry people with food security all around the world. In terms of area (0.146 m ha<sup>-1</sup>) and production (0.147 mt), India is the world's largest producer of barnyard millet, with an average productivity of 1034 kg/ha during the previous

three years (IIMR, 2018). Bunkar, (2021)<sup>[3]</sup> states, Kodo millet is believed to have originated in India which is extensively grown in arid and semi-arid regions of India and African countries on subpar soils. It is a modest grain crop in India, but it is quite important on the Deccan plateau. Typically, Gujarat, Karnataka, Chhattisgarh, Eastern Madhya Pradesh, and portions of Tamil Nadu are the only states in India where it is grown. Most of the world's kodo millet is grown in India, and Madhya Pradesh leads the world

in production. It contributes over 50% of the area and 35% of the nation's millet production.

The majority of India's millet is produced in just a handful of districts across a select few states, with Rajasthan and Uttar Pradesh accounting for the majority of the country's area (about 70%) and generate (around 62%) of pearl millet. Gujarat, on the other hand, ranks first in regard to yield (2.29 t/ha), followed by Tamil Nadu (2.28 t/ha), and the state of Madhya Pradesh (2.26 t/ha). The state with the largest area and highest output of tiny millets is Madhya Pradesh. For tiny millets, the area under cultivation is more evenly dispersed, but for ragi, it is heavily concentrated. With few exceptions, the area and output are dropping in the top states. (Sukumaran Sreekala *et al.*, 2023)<sup>[18]</sup>

### Chemical Composition of millets

A typical millet protein has high amounts of amino acids that are essential, particularly the amino acids that contain sulphur (methionine and cysteine). They are also a source of antioxidants such as phenolic acids and glycosylated flavonoids & are considered a potential prebiotic that could enhance the viability or effectiveness of probiotics, with substantial health benefits (Amadoubr & Le, 2013)<sup>[2]</sup>.

The study of Odusola *et al.*, (2013)<sup>[12]</sup> evaluated methanol extract made of millet sample analysed for antioxidant properties during the research the results of which indicate that pearl millet has a significant phenolic content with moderate reducing capacity and a significant free radical scavenging ability and thus can be used as an antioxidant within our daily diets.

The products formulated with foxtail millet as well as the barnyard millet are superior to Rice as they have a high nutritive value and are a possibility for its use in traditional food products. (Verma *et al.*, 2014)<sup>[19]</sup>. Each millet whether tiny or whole is 3 to 5 times more nutritionally superior over the highly promoted wheat and rice in the sense of vitamins, minerals, and proteins. The genotypes of the two shows a significant effect on variations for all nutritional parameters, *viz.* the moisture, protein fat carbohydrates, crude fibre Total minerals and total energy. A wide range of variations was evident between the protein content of the genotypes range between 8.98 and up 14.37 percent with a mean that is 12.63 percent (M. Y. Kamatar *et al.*, 2015)<sup>[11]</sup>.

The pearl millet is a mine of micronutrients as it contains 2.05-2.72% Ash, 5.14-5.96% fats, 10.97-11.65% protein, 2.07-2.63 crude fibre and 66.49-68.85 percent carbohydrates. The mineral content of pearl millet varied between 40.07-42.67 mg/100 g calcium 255.67-327.82 mg/100 g of phosphorus, as well as 5.08-8.12 mg per 100 g of iron (Kulthe *et al.*, 2016)<sup>[10]</sup>. The chemical structure of finger millet has revealed the total carbohydrate content between 72 - 79.5 percent. It is a source of almost 7% protein, however huge variations in protein content between 5.6 to 12.70 percent have been documented through various research studies. Ash content in total is higher in finger millet than generally eaten cereal grain. The amount of ash has been determined to be between 1.7 to 4.13 percentage in the finger millet. The calcium content of the 36 varieties of finger millet varied from 162 to 487 mg % (Pragya Singh, 2012).

Along with possessing the nutritional properties, the cereal grains have excellent functional properties in terms of bulk density, absorption capacity for oil capacity, capacity for water absorption minimum gelatinization temperature, and numerous other factors alongwith the possibilities of the grain with regard

to their characteristics of pasting (Abah *et al.*, 2020)<sup>[1]</sup>.

The nutrients found in millets, such as minerals, vitamins, and essential fatty acids, have benefits in the field of preventive diseases, in addition to their recognized functions of preventing nutrition deficiency-related illnesses. Since they are non-glutinous, millets can be safe for people with celiac disease and gluten allergy. They are not acid-forming easy to digest and do not trigger allergies. Millets can provide protection against the onset of degenerative illnesses that are common to age. Millets consumption reduces the heart disease risk as well as diabetes. They also improves digestion, reduces the risk of developing cancer, detoxifies the body, improves the immune system in respiratory health boosts energy levels, and boosts neural and muscular systems. They also protect against degenerative diseases like Parkinson's disease and metabolic syndrome (Dayakar Rao *et al.*, 2017)<sup>[5]</sup>.

Himanshu, *et al.*, (2018)<sup>[8]</sup> stated that the strongest evidence regarding the millet's health benefits is derived from animal studies. A few epidemiological studies have proven the regular intake of millet grain as well as their products can be linked to decreased chance of developing chronic illnesses like cardiovascular disease, diabetes cancer, all-cause death. So, diet modification through the increase in consumption of a variety of fruits, vegetables and millet grains every day is an effective way for people to enhance their health and lower the risk of developing chronic illnesses. The importance of nutrition for millets calls for an analysis of the nutritional properties and functional properties of various millet cultivars, as well as making value-added products from millets (Amadoubr & Le, 2013)<sup>[2]</sup>.

### Conclusion

The small seeded orphan cereals have been known to the mankind since the Neolithic period as the wild grass. Most of the production area of the wild grass belongs to US, China and India which has witnessed a linear decline over the years. In India, the Rajasthan belt and the southern belt occupies the largest area of millet production. The nutritional value of millets has been a goldmine in terms of phytochemicals, antioxidants, and micronutrients such as iron, calcium, and zinc. They also play a significant role in reducing chronic diseases such as cancer, diabetes, and cardiovascular disorders. Hence they are an apt choice to be incorporated in the today's conventional foods.

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