Innovations

A Geographical Study of Millets Production in India (Special Reference to Achieving Sustainable Development Goals)

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Abstract: *Millet cultivation plays a crucial role in enhancing food security and promoting sustainable agriculture through its climate-resilient nature and nutrient-rich composition, contributing to both environmental and human well-being. The declaration of 2023 as the 'International Year of Millets' by the 'United Nations' has sparked renewed global interest in millets. India has played a leading role in promoting millets, highlighting their potential benefits and guiding the world in recognizing their importance. It is also called a 'Poor Man Food'. India is the largest producer of millet as of 2021, with a total share of 41 %, followed by Niger (~12 %) and China (~ 8 %). The major millets producing states in India are Rajasthan, Karnataka, Maharashtra, Uttar Pradesh, Haryana, Gujarat, Madhya Pradesh, Tamil Nadu, Andhra Pradesh and Uttarakhand. The key objectives of this paper are to analyze the millets production in India with special reference to achieving sustainable development goals. This paper is based on secondary data which is collected from various secondary sources. The main findings is that millets are a highly nutritious, climate-resilient and environmentally sustainable food source that can play a vital role in achieving 'sustainable development goals'. Millets are found to be very helpful with the reduction of weight, BMI (Body Mass Index) and high blood pressure. Millets are low-cost, highly nutritious food that can help reduce poverty and improve food security, especially in developing countries.*

Keywords: *Geographical Study, Millets, Production in India, Achieving Sustainable Development Goals & highly nutritious food.*

- **Introduction:**

The declaration of 2023 as the **International Year of Millets** by the United Nations has sparked renewed global interest in millets. India has played a leading role in promoting millets, highlighting their potential benefits and guiding the world in recognizing their importance (Govt. of India, 2019-20). Research on millets in India has demonstrated their positive impact and utility in tackling malnutrition, managing diseases like diabetes, heart ailments, and anemia, as well as their resilience to climate impacts and contribution to nutritional security (Singh, 2024). Innovative and useful millet-based products have strengthened India's robust startup ecosystem. Millets have been an integral part of India's staple diet for centuries, deeply embedded in its food systems, culture and traditions (Singh et al., 2010). They are mentioned in religious scriptures and form a significant part of many traditional Indian practices. Before the Green Revolution, millets were a primary food crop in most Indian households. An analysis of Indian agricultural statistics reveals that before 1960–61, millets were grown and consumed in approximately 60-70 % of the country's regions (Bhat et al., 2023).

The United Nations, **Food and Agriculture Organization** (**FAO**) steers international efforts to achieve food security for all and ensure that people have regular access to enough high-quality food. The Committee on Agriculture is one of FAO's governing bodies providing overall policy and regulatory guidance on agricultural issues. It also provides advice and recommendations to the FAO conference on global agricultural policy and regulatory matters, and to the FAO council on matters relating to the organization's priorities, Programmes and budgets. India is the leading producer and consumer of millet crops and their products (FAO, 2019). The people in arid and semi-arid regions of the country grow and consume millets as a staple food. Millets provide food and fodder security to the dry land agricultural communities. They are also being recognized as food grains for nutrition and health, and nearly organic in cultivation (Chaudhary et al., 2023). Millets are the most secure crops to small farmers as they are the hardiest, resilient and climate adaptable crops in harsh, hot (up to 50°C) and drought environments. They are often the last standing crops in drought seasons and will be the sustainable future food source amidst of worsening climatic conditions (Sinha, 2021).

- **Study Area:**

At present, the people are very conscious with their health. Millets are one of the best solution to found highly nutritious and health benefits in pandemic era. Under the cereals crops, as a Kharif crop the millets are traditional 6th crop and cultivated in past 50 years ago use as fodder and human meal. It is also called a '**Poor Man Food**'. India is the largest producer of millet as of 2021, with a total share

of 41 %, followed by Niger (~12 %) and China (~ 8 %). India also ranks 12th among those countries that produce high yields of millets. The major millets producing states in India are Rajasthan, Karnataka, Maharashtra, Uttar Pradesh, Haryana, Gujarat, Madhya Pradesh, Tamil Nadu, Andhra Pradesh and Uttarakhand. The Indian Government is promoting millets as part of its **National Food Security Mission (NFSM)**. Millets are found to be helpful with the reduction of weight, BMI (Body Mass Index) and high blood pressure. In India, millets is generally consumed with legumes, which creates mutual supplementation of protein, increases the amino acid content and enhances the overall digestibility of protein. Millets are rich in nutrients and plant compounds. Not only, millets are good source of minerals like iron, zinc and calcium. Millets is an important source of food and fodder for millions of resource -poor farmers and play a vital role in ecological and economic security of India.

- **Objectives:**

  The key objectives of this research paper are as follows –

1. To analyze the millets production in India with special reference to achieving sustainable development goals.
2. To analysis the variation in international scenarios of millets production.
3. To make the citizens of India aware of the health and nutritional benefits of millets.

- **Sources of Data, Data Collection and Research Methodology:**

This research paper has been based on secondary data. Secondary data has been collected from the various sources like - **(i)** ICAR- Indian Institute of Millets Research, Rajendranagar, Hyderabad. **(ii)** FAO, Statistics (2019). **(iii)** Annual Report, Govt. of India (2019-20), Ministry of Statistics and Programme Implementation. **(iv)** Agricultural Statistics - at a glance, Govt. of India (2019), Ministry of Agriculture and Farmer Welfare, Dept. of Agriculture, New Delhi. **(v)** Estimations of Dept. of Economics & Statistics, DAC & FW, Govt. of India, New Delhi. The collected secondary data have been processed and analysis through the computer as well as the processed data are analyzed with the help of quantitative techniques and systematically represented through the maps and diagrams to make a significant interpretation of different aspects as well as to bring out the reaching conclusion.

- **Results & Discussions:**

International Scenario of Millets Production:

Global production of millet is about 97.75 million tons from 78.43 million hectares area. Sorghum and pearl millet comprise more than 90% of the area and production. The rest of the production includes finger millet, proso millet, foxtail millet and other non-segregated millets.

Table no. - 01

World - Area, Production and Yield of Millets Crops (Average of 2015 – 19)

Types of Millets	Area (Million Hectares)	Production (Million Tons)	Yield (Kg. / Hectares)
Sorghum	**41.91 (high)**	**61.18 (high)**	1460
Pearl Millet	28.38	23.68	834
Proso Millet	**0.77 (low)**	1.19	1535
Finger Millet	2.31	3.33	1442
Foxtail Millet	0.79	2.11	**2688 (high)**
Teff	3.35	5.56	1660
Fonio	0.92	**0.70 (low)**	**790 (low)**
Total	**78.43**	**97.75**	**1247**

Source: Indian Institute of Millets Research, Rajendranagar, Hyderabad.

Sorghum is most widespread in terms of the total area covered by the countries, which is spread all over the world. The top 5 countries comprise Sudan, Nigeria, India, Niger and the USA possess 57% of the global area under sorghum with about 45% of global sorghum production. While Sudan has a maximum area of 7.141 million ha, the USA contributes the maximum production of 10.9 million tones. Average yield of sorghum in India is 1064 kg/ha which is much less than that of the world average of 1460 kg/ha.

Pearl millet is cultivated in 36 countries in Africa, though India is the single largest country in terms of area (31.5%) and production (46.7%). Niger comes second with 24.3% area and 15.3% of production. The yield levels of India (1237 kg/ha) are much higher than the world average of 834 kg/ha. Finger millet is cultivated in 14 countries; the top 5 countries, viz. India, Ethiopia, Nepal, Uganda and Malawi in terms of area (99.4%) produce 99.6% of finger millet globally. Ethiopia

has the highest yield level (2301 kg/ha). The yield in India is slightly higher than the global yield. A large proportion (89.7%) of the area under proso millet is located in 5 countries, viz. Russian Federation, USA, Ukraine, North Korea and Kazakhstan that produce86.4% of global proso millet. The bottom 25 countries of the total 35 countries consist 5.9% of proso millet area, producing 7.2% of global production.

Foxtail millet is a predominant crop of China with a production of 2.1 million tons from 0.79 million ha area. Foxtail millet is mainly cultivated in China, India and Myanmar. Other Millets that are known and grown in Africa such as teff are majorly grown in Ethiopia and Eritrea which contribute more than 90% of world's production. Amhara and Orimia regions together contribute more than 85% of Ethiopia's production. It is cultivated over3.35 million ha land and producing 5.56 million tons at an average yield of 1660 kg/ha.

Fonio is majorly grown in Guinea and Nigeria, which account for 88% of total production. It is cultivated over 0.92 million ha and producing 0.7 million tons at an average yield of 790kg/ha. Millet crops utilization varies across countries and continents depending on the use and climate of production, and cultivars. In the USA and Europe, sorghum and other millets are grown for feed purpose with lesser concern for quality and associated traits.

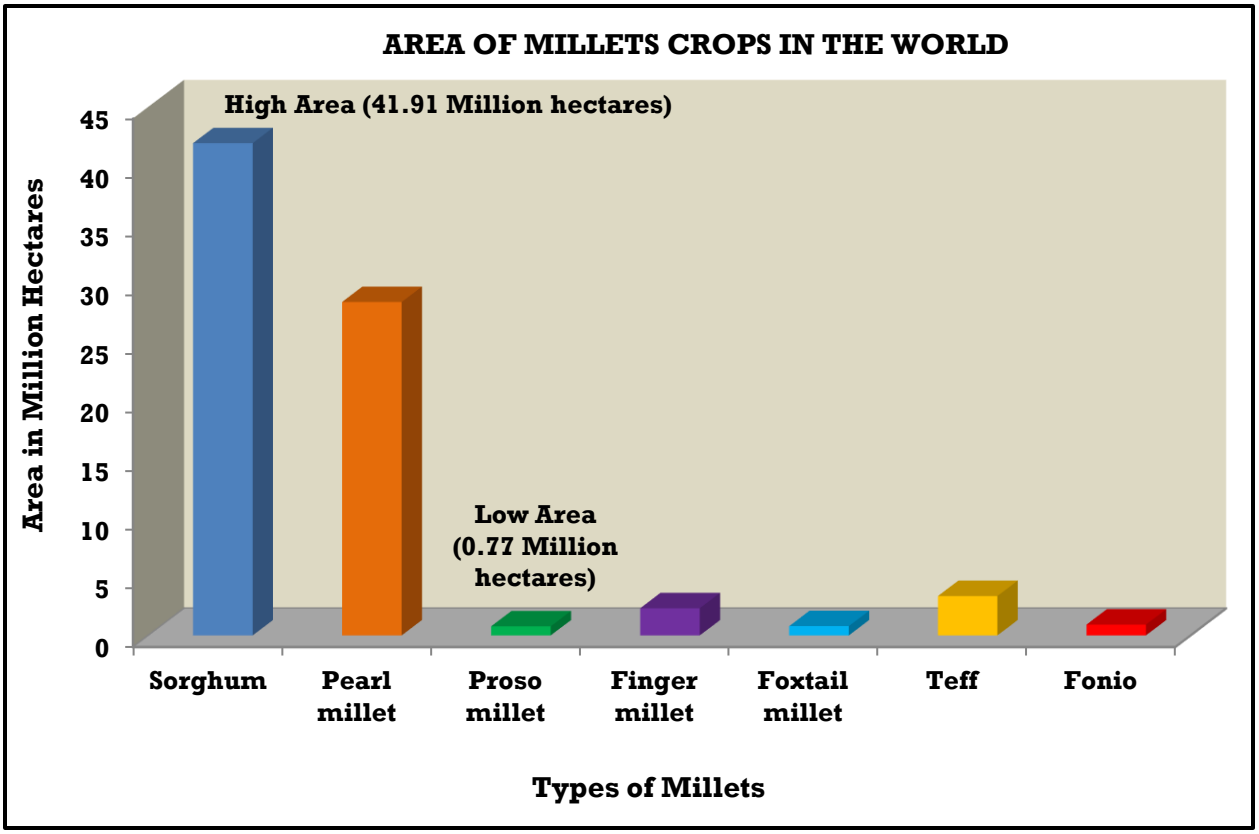


Fig. no. 01: World - Area of millets crops in million hectares.

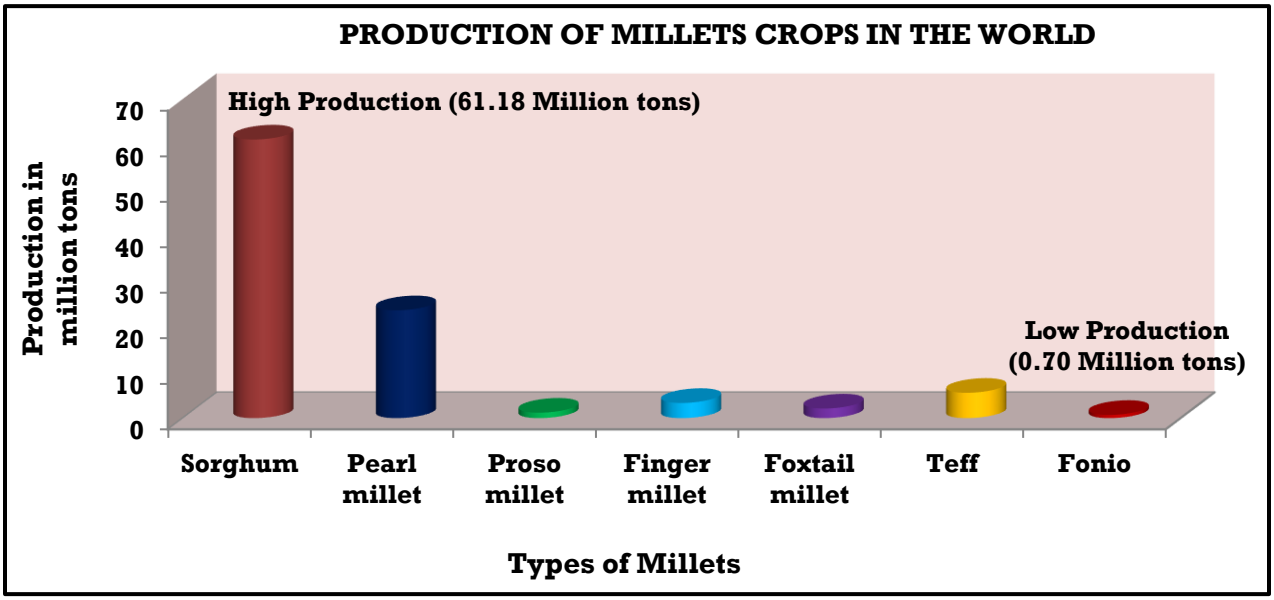


Fig. no. 02: World - Production of Millets Crops in million tons.

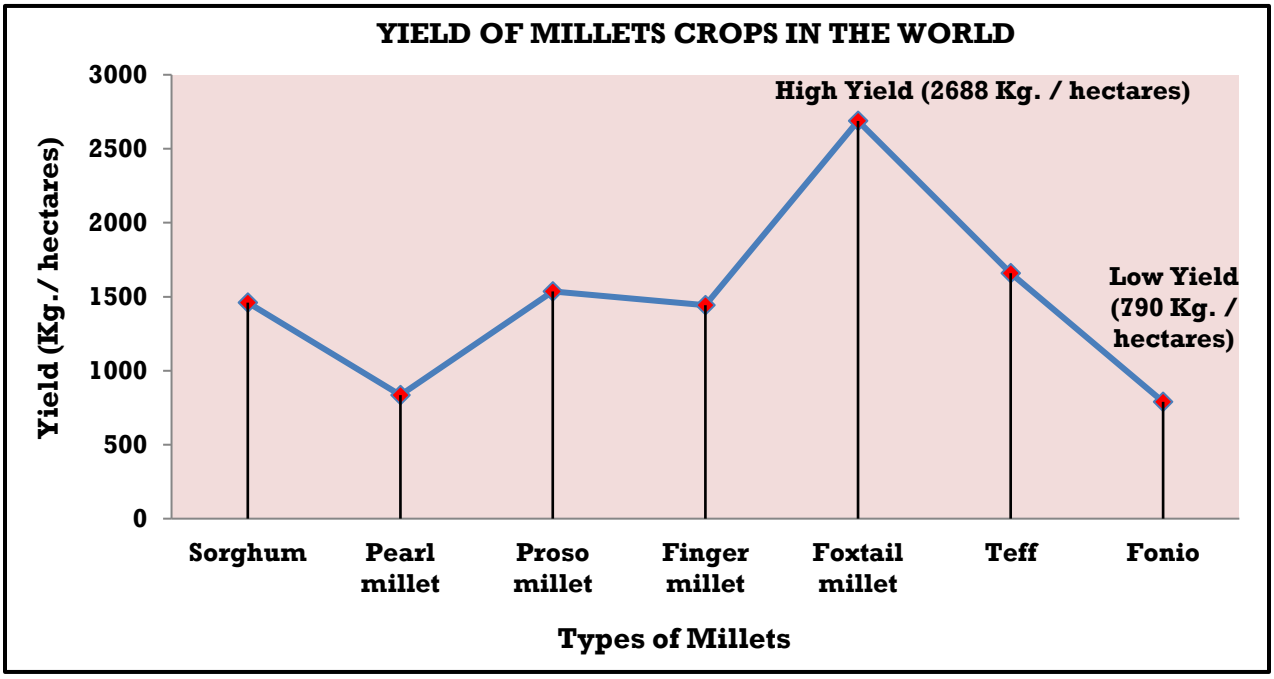


Fig. no. 03: World – Yield of Millets Crops in Kg. / hectares.

Importance of Millets in India:

Millets are significant in India for several reasons, including their nutritional benefits and role in sustainable agriculture and food security. Millets are high in nutrients, including protein, fiber, vitamins, and minerals (Husain, 2017). They contain critical nutrients that help to maintain a healthy diet. Millets are more drought-tolerant than many other cereal crops, making them ideal for cultivation in arid and semiarid locations. Millets contribute to climate-resilient agriculture

because they can survive in various agro-climatic situations, including low soil fertility.

Millets have been integral to traditional Indian diets for centuries, particularly in Karnataka, Andhra Pradesh, and Tamil Nadu. Millets help provide food security by providing a source of income and nutrition for smallholder farmers, particularly those in rain fed and marginal agricultural areas. Because of their nutrient richness and affordability, millets are crucial in combating malnutrition, particularly among vulnerable communities. Cultivating diverse millet varieties contributes to agricultural biodiversity, helping maintain a resilient and sustainable food system (Rasika et al., 2024).

Millets offer nutritional security and there is a need for promoting millets as they are highly nutritious. These have been important food staples in human history, particularly in Asia and Africa. Sorghum and other millets consumption usage as direct food have significantly declined over the past three decades (Chaudhary et al., 2023). The decline in demand has led to the decline in millets production considerably in India. These tiny, versatile grains, technically seeds, have been part of global diets for centuries, offering a remarkable array of essential nutrients. In this comprehensive guide, we'll explore the nutritional value of various millets, unveiling their potential health benefits.

Table no. - 02

Nutritional composition of millets v/s food grains

(Per 100 grams)

Millets Grain	Carbo - hydrates (gm.)	Protein (gm.)	Fat (gm.)	Energy (Kcal.)	Dietary fiber (gm.)	Ca (mg.)	P (mg.)	Mg (mg.)	Zn (mg.)	Fe (mg.)
Sorghum	67.7	09.97	1.73	334	10.22	28	274	133	2.96	3.95
Pearl Millet	61.8	10.96	5.43	348	11.49	27	289	124	2.76	6.42
Finger Millet	66.8	07.16	1.92	321	11.18	364	210	146	2.53	4.62
Kodo Millet	66.2	08.92	2.55	332	6.39	15	101	122	1.65	2.34
Little Millet	65.6	10.13	3.89	346	7.72	16	130	91	1.82	1.26
Proso Millet	70.4	12.50	1.10	341	2.20	14	206	153	1.40	0.80

Foxtail Millet	60.1	12.30	4.30	331	8.00	31	188	81	2.40	2.80
Barnyard Millet	65.6	06.20	2.20	307	9.80	20	280	82	3.00	5.00
Compared with - Wheat	**64.7**	**10.59**	**1.47**	**322**	**11.23**	**39**	**315**	**125**	**2.85**	**3.97**
Compared with - Rice	**78.2**	**07.94**	**0.52**	**356**	**2.81**	**7**	**96**	**19**	**1.21**	**0.65**

Source: Indian Institute of Millets Research, Rajendranagar, Hyderabad.

Small millets are having a potential to serve as an important source of nutraceuticals. They can be used to treat diabetes, tumour, obesity, pre-mature aging and serve as an important source of calcium, essential amino acids and vitamins (Banerjee & Maitra, 2020). A variety of value added product can be derived from small millets and thus there is always a huge scope of research to evaluate the nutritional property of these value added products. The nutraceutical field of research always looks for natural source which are rich in nutrients. Small millets are cheap, easy to grow, environment friendly and excellent source of nutrition which supports sustainable agriculture.

Millets Production in India:

India is the leading producer of millets. Most of the states of India grow one or more millet crop species. A total of about 16.9 million tones of millets food grains are produced in India from nearly 12.7 million ha area, which constitutes about 6 % of the national food grain basket (Govt. of India, 2019). Pearl millet is grown in about 7.4 million hectares yielding 10.1 million tones, followed by sorghum (4.35 million ha., yielding 4.63 million tons), finger millet (1.1 million ha., yielding 1.58 million tons) another millets (0.44 m ha., yielding 0.35 million tons). Pearl millet, sorghum and finger millet account for more than 95 % of the area under millets, while small millets comprising of barnyard millet, foxtail millet, little millet, kodo millet and proso millet constitute less than 5 % of the area. In India, Rajasthan, Maharashtra and Karnataka are the topmost states in millets cultivation with a share of 35 %, 23 % and 14 % to total millets area (Singh et al., 2024). Maharashtra and Karnataka have the maximum area under sorghum while Rajasthan, Gujarat, Uttar Pradesh and Maharashtra have more area under pearl millet. Ragihas the maximum area in Karnataka, Tamil Nadu and Uttarakhand. Small millets area is maximum in Madhya Pradesh, Uttarakhand and Chhattisgarh.

Despite the surrender of almost 56% area during last 50 years in the country, the millet production has increased from 11.3 to 16.9 million tons due to an increased productivity that went up by more than two-times overall while it's more than tripling in pearl millet. Development and adoption of improved varieties / hybrids have played a significant role in the productivity improvement of these crops (Singh & Singh, 2024).

Table no. - 03

Millet Crops area, Production and Yield in India During 2009 - 22.

Types of Millet	Area ('000' ha.)			Production ('000' tones)			Yield (kg / ha.)		
	2009-13	2014-18	2019-22	2009-13	2014-18	2019-22	2009-13	2014-18	2019-22
Sorghum	6684	4910	4355	4290	4404	4632	913	897	1064
Bajra	8480	7142	7415	7030	8738	10149	1065	1223	1369
Ragi	1211	1104	1097	985	1710	1807	1580	1549	1647
Small Millets	773	570	436	435	403	349	554	707	800
Total Millets	**17149**	**13726**	**12680**	**12740**	**15255**	**16937**	**1019**	**1111**	**1273**

Source*:* Estimations of Dept .of Economics & Statistics, DAC & FW, Govt. of India, New Delhi.

The Analysis of Climatic conditions and their utility of millets produced in India are as fallows -

(i) Sorghum:

Sorghum is known as Jawar in India. Sorghum fits very well in a sustainable agricultural model with its ability to survive in water limiting conditions and provides an option for marginal farmers. It requires warm conditions but it can be grown under a wide range of climate. It is also widely grown in temperate regions and at altitudes of up to 2300 m in the tropics. It can tolerate high temperature throughout its life cycle better than another crop. Sorghum requires about 26-30^0 C temperature for good growth. Grain sorghum can be grown on many different soils. Sorghum will yield best in deep, fertile, well drained loamy soils. Nevertheless it performs well in shallow soils and drought conditions. It is grown to meet the need of fodder and feed for animals and poultry in dry land rain-fed areas besides food grain. It is also used for industrial purposes such as bio-fuel, potable alcohol, starch,

alternate food products, etc. It is a major source of nutrition and provides nutritional and livelihood security to the resource poor population in dry land agricultural areas.

It is the most produced millet in India and is typically grown in arid climates because high temperatures are necessary for a healthy harvest. It is cultivated in Maharashtra, Karnataka, Telangana, Andhra Pradesh, Tamil Nadu, Madhya Pradesh and is a traditional food of dry land regions. Other grains are not suitable for production in these areas unless irrigation is available, where these crops are mainly grown. Sorghum has a strong stem and grows to a height of 2 to 8 feet, sometimes reaching as high as 15 feet. It has a drought-tolerant nature and can be grown under a wide range of environmental conditions. Regarding production and planted areas, sorghum is the fifth most significant cereal globally. Over 90% of the world's sorghum and 95% of its millet are found in developing nations, primarily in Asia and Africa. These crops provide millions of people with a significant source of protein and calories. This crop makes up over 60% of the millets produced worldwide. About 300 million people worldwide rely primarily on sorghum as a food source. It is beneficial to health as it helps improve blood circulation, aids in weight loss, and aids in cell regeneration. It can be used to make dishes such as dosa, upma, cookies, rice, roti, and salads.

(ii) Pearl Millet:

It is a major millet type. It is the sixth major cereal in terms of area and production and one of the most widely consumed millets, this greenish grain is cultivated in Rajasthan, Haryana, Gujarat, Maharashtra, Uttar Pradesh, and Punjab. Pearl millet is critically essential for food and nutritional security as the crop is suitable for cultivation as it is drought tolerant and requires low soil fertility and high temperatures. When hybrids of 80–85 days maturity are grown in summer crops under irrigated and high fertility conditions, pearl millet can easily provide an economical grain yield (600-700 kg/ha) under marginal and low management conditions. It can also produce a grain yield of 4-5 t / ha. It has high protein content, phyto chemicals, and minerals like zinc, copper, and magnesium. Additionally, it has unsaturated fatty acids, which are considered healthy fats. Millet has many health benefits, as it reduces cholesterol, promotes bone health, promotes heart health, and aids in weight loss. It can be used in making khichdi, roti, upma, idli, khakhra, and parathas.

(iii) Finger Millet:

Finger millet comes up well in tropical and sub-tropical climate and can be cultivated up to an altitude of 2100 m. The minimum temperature required is 8-10°C. A mean temperature range of 26 - 30°C during the growth is the best for proper

development and good crop yield. The crop is widely adaptable from mean sea level to foot hills of Himalaya and can be grown in range of soils. The crop can tolerate a certain degree of alkalinity. The best soil is alluvial, loamy and sandy soil with good drainage. Finger Millet is a major millet type. It is a staple food for the rural populations of Southern India and East and Central Africa and is widely grown in dry regions of India, particularly in the south. It is mainly cultivated in Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, and Kerala.

This reddish grain is a protein-rich, incredibly filling alternative to wheat and rice. It has high fiber content and is rich in phosphorus, vitamins A and B, and amino acids. People with constipation, high blood pressure, and cardiovascular illnesses are known to benefit from it. Although finger millet, also known as ragi, can be grown anywhere from sea level to the hilly regions of the Himalayas, it prefers well-drained, loamy soils. Karnataka produces about 60% of the world's finger millet, or about 34% of the total. The grains contain high levels of tryptophan, cytokine, and methionine in addition to 10-15% dietary fiber, photochemical, calcium, and other minerals. The crop has a deep but shallow root system and is acclimated to consistent rainfall conditions. Of all the millets in India, finger millet has the highest productivity (1640 kg. / ha.).

Table no. - 04

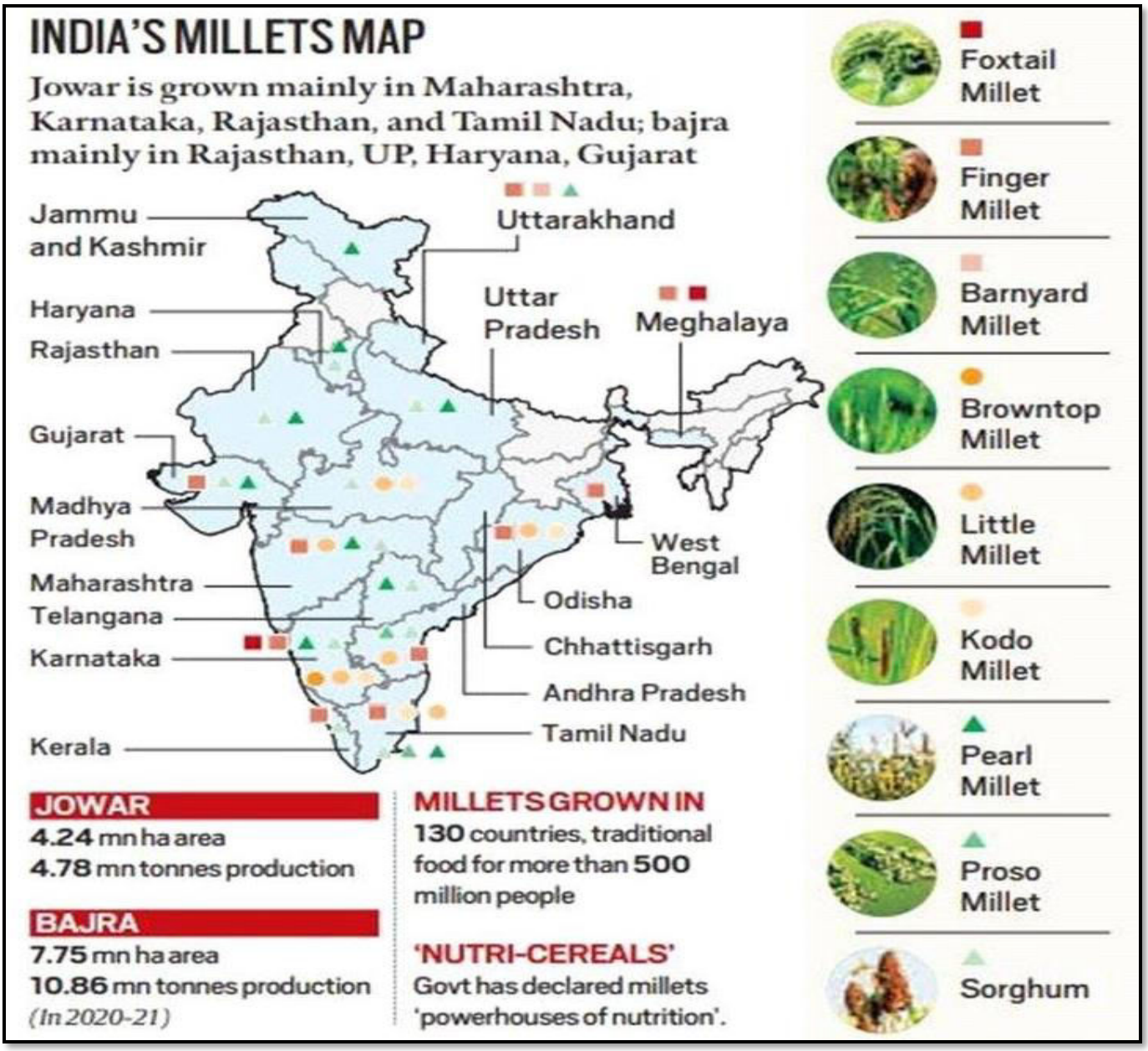
Area, production and yield of millets in important millet growing states of India (States with area of more than 10000 ha.)

Area ('000' hectares), Production ('000' tons), Yield (kg. / Hectares)

Name of the States	Sorghum			Pearl Millet			Finger Millet			Small Millets			Total		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Andhra Pradesh	134	306	2289	34	63	1881	33	41	1248	22	17	798	223	427	1926
Arunachal Pradesh	-	-	-	-	-	-	-	-	-	22	27	1217	22	27	1217

Bihar	01	01	1066	04	04	1134	03	03	892	04	03	784	12	11	943
Chhattisgarh	03	04	1268	-	-	-	06	01	248	83	23	281	92	28	314
Gujarat	72	99	1369	423	942	2227	13	14	1076	09	12	1291	517	1067	2062
Haryana	42	22	527	483	986	2043	-	-	-	-	-	-	525	1008	1921
Jammu &Kashmir	00	00	635	15	08	563	02	01	347	07	02	294	24	11	463
Karnataka	911	954	1047	240	272	1133	666	1071	1609	30	21	721	1847	2318	1255
Madhya Pradesh	157	299	1905	308	692	2246	01	00	277	117	92	788	583	1083	1860
Maharashtra	2257	1641	727	719	594	826	86	98	1145	50	25	501	3112	2358	758
Nagaland	-	-	-	01	01	1014	-	-	-	09	11	1122	10	12	1106
Odisha	06	04	632	02	01	619	41	30	738	31	16	513	80	51	639
Punjab	-	-	-	01	01	616	-	-	-	-	-	-	-	-	-
Rajasthan	572	433	757	4240	4193	989	-	-	-	10	08	722	4822	4634	961
Tamil Nadu	379	399	1053	59	142	2404	79	251	3186	24	31	1280	541	823	1521
Telangana	78	102	1296	11	10	910	01	02	1270	01	01	1084	91	115	1249
Uttar Pradesh	168	216	1287	907	1853	2044	-	-	-	09	06	691	1084	2075	1915
Uttarakhand	-	-	-	-	-	-	95	132	1391	56	75	1332	151	207	1369

Source: Dept. of Economics &Statistics, DAC & FW, Govt. of India.



Source: Indian Express.

Fig. no. 04: Geographical distribution of Different millets production in India during 2020-21.

(vi) Foxtail Millet (Kakun):

Can be grown in tropics as well as sub-tropical regions both under low and moderate rainfall. The crop can be grown in altitude up to 2000 m with 50-75 cm annual rainfall. Foxtail millet grows well on well-drained loamy soils. They will not tolerate water-logged soils or extreme drought. Foxtail Millet is a minor millet type. The third-largest crop among millets, foxtail millet is grown for food in Asia's semi-arid tropical regions and as fodder in North Africa, Europe, Australia, and North

America. It is cultivated in Tamil Nadu, Andhra Pradesh, Karnataka, Odisha, Maharashtra, Madhya Pradesh. It has a high protein content (12%), which makes it a nutritional powerhouse. In addition to having a distinct flavor, foxtail millet is well-known for being hypoallergenic. Because it is so full of minerals (calcium, iron, and copper), it is a good choice for pregnant women and malnourished kids who need strength and immunity. It can withstand drought, thrive at higher elevations (up to 600 feet), and is commonly planted on black cotton soils as a backup crop to sorghum in times of insufficient rainfall. It thrives in clayey, alluvial, or loamy soils as well. Foxtail millet has a low water requirement and matures in 65-70 days. It has double the quantity of protein content compared to rice. It has some health benefits, such as proper nervous system, functioning, helping maintain muscle health, being suitable for cardiac health and improving immunity. It can be used in making dosas, cheelas, chapatis, kheer pudding, and pancakes.

(v) Little Millet (Kutki):

It is originated in south-east Asia and is grown throughout India. Important states are Madhya Pradesh, Orissa, Jharkhand, Uttar Pradesh, Chhattisgarh, Tamilnadu and Karnataka. It can withstand both under drought and water logging. It can be cultivated up to 2000 m above mean sea level. Little millet is a minor millet type and cultivated in Karnataka, Tamil Nadu, Maharashtra, Madhya Pradesh, Uttar Pradesh, Uttarakhand. It has High Dietary fiber and antioxidant activities along with high iron content. Although little millet and proso appear related, little millet is typically shorter, has smaller panicles and seeds, and is grown on poorer lands on a limited voluntary basis or with little care. Little millet is drought- and flood-tolerant, maturing rapidly. It has some health benefits, such as being rich in antioxidants, helping decrease blood cholesterol levels, regulating blood sugar levels, weight loss, and improving respiratory ailments. It cures all stomach issues and aids in the prevention of constipation. A small amount of millet adds nutrition to rice. Little millet can be used to prepare any recipe calling for regular rice. It cooks more quickly than other millets because its grains are the smallest. Little millet has a significant role in providing nutraceutical components such as phenols, tannins, phytates, and other nutrients.

(vi) Proso Millet (Chena or Barri):

It is cultivated during kharif and summer in India. It is highly drought resistant and can be grown in areas where there is scanty rainfall. It can withstand water stagnation also to some extent. It is a hardy crop which completes its life cycle in a short span of time. Proso millet can be grown both in rich and poor soils, having variable texture, ranging between sandy loam to clays of black cotton soils. Coarse sands are not suited for proso millet cultivation. Well drained loam or sandy loam

soils free from *stones* and gravels, better water holding capacity with high organic matter are ideal for proso millet cultivation.

Proso Millet is a minor millet type. It is cultivated in Uttarakhand, Uttar Pradesh, Rajasthan, Haryana, Gujarat, Maharashtra, Karnataka, and Tamil Nadu and is a short season crop that grows in low rainfall areas. Proso Millet is a rich source of vitamins and minerals such as iron, potassium, phosphorus, zinc, magnesium, vitamin B-complex, niacin, and folic acid. Proso millet grows well in a wide range of climates and soil types. Proso millet is particularly resistant to drought, which makes it a valuable crop in areas with limited water resources and extended dry spells. Unlike all other millets, it is a short-season crop, maturing 60–75 days after planting. The most common way to grow it is as a late-seeded summer crop. Proso millet has a height of three to four feet. In the past, this millet was cultivated in Russia, China, the Balkan nations, and Northern India; however, rice and other cereals eventually took their place in most of these regions. This millet helps in the smooth functioning of the nervous system, strengthens bones, reduces cholesterol, and is suitable for the skin. It is also used in making idli, khaja, burfi, and samosa

(vii) Kodo Millet:

It is grown mostly in warm and dry climate in India. It is highly drought tolerant and therefore, can be grown in areas where rainfall is scanty and erratic. It thrives well in areas receiving only 40 to 50 cm annual rainfall. Kodo millet is grown from gravelly and stony upland poor soils to loam soils. Deep, loamy, fertile soils, rich in organic matter, are ideal cultivation condition for higher profit. Well-drained soils with adequate moisture supply are required for uninterrupted growth of the crop. Kodo Millet is a minor millet type and is cultivated in areas such as Maharashtra, Odisha, Uttar Pradesh, Tamil Nadu, Andhra Pradesh, Telangana. It is native to tropical and subtropical parts of South America; Kodo millet was domesticated some 3,000 years ago in India. In India, kodo millet is widely planted on the worst soils, but it's unlikely that it's grown in any other location. It takes four to six months to mature, which is longer than the two to four months needed for the other millets. Since Kodo Millet is naturally gluten-free, people with celiac disease or gluten sensitivity can use this grain. It can be relished upon as a substitute for grains made of wheat. It releases glucose into the bloodstream more slowly because it has a low glycemic index. For those with diabetes or those trying to control their blood sugar, this aids in preserving steady blood sugar levels. It helps in weight management and digestive health and benefits for postmenopausal women suffering from metabolic diseases. Kodo millet is high in magnesium and selenium and is a source of thiamine, riboflavin, copper, and zinc. This annual tufted grass can reach a height of 90 cm. The color of the grain can range from pale red to dark grey.

(viii) Barnyard (Sawan) Millet:

It is quite popular in northern hills up India especially in the foot hills up Himalayas. It is important component of hill and tribal agriculture. It is also grown on a lesser scale in Bihar, Tamilnadu, Maharashtra and Madhya Pradesh. Plant of barnyard millet is tall, erect up to 50-95 cm in height. Its leaves are flat, glabrous or slightly hairy without ligule. The grain is caryopsis and white or yellow in colour. Barnyard Millet is a minor millet type and is cultivated in Uttar Pradesh, Rajasthan, Madhya Pradesh, Gujarat, Karnataka, Tamil Nadu. They grow well at higher elevations and in several of seasons but take three to four months to mature. It is grown on marginal land unsuitable for growing rice or other crops. It is the fourth most produced minor millet, providing food security to many poor people across the world. Globally, India is the biggest producer of barnyard millet. Barnyard millet grows upright to 60 to 130 cm, with brownish to purple spikelet. It is a good source of dietary fiber, soluble and insoluble, rich in protein and highly digestible, iron, zinc, calcium, protein, magnesium, fat, vitamins, and some essential amino acids. It is a short-duration crop that can tolerate a various biotic and abiotic stresses and grow in unfavorable environmental conditions with little input.

(ix) Brown-top Millet:

It is grown in rocky, shallow soils from sea level up to 2500 mabs. It is adaptable to almost all upland soil, but does not grow well in water-restricted, drought conditions. It will not survive in temperature less than 11°C. This millet seed is grown in a variety of soils and climates. Like other millets, it is a hardy crop and well suited for dry land. Brown - top Millet is a minor millet type and is a native to India, this millet has largely restricted cultivation to regions of Karnataka and Andhra Pradesh. However, it is known to occur as a weed throughout the country. In India, it is mainly grown for food. In the late prehistoric era of the Deccan peninsula of India, it seems to have been a significant staple crop. Brown-top grows to heights of 2-3 feet and grows well in rich, moist, dark soils. It is the most affordable crop, requires no weeding, and has no serious pests or diseases. It can even be grown in less fertile sandy loam soils and matures in 60 to 80 days. In some parts of southern India, this millet is still a minor for human and animal consumption cereal. It promotes digestion, helps in maintaining blood glucose levels, strengthens bones and muscles, and optimizes heart health. Brown-top millet contains serotonin, which aids in nervous system relaxation and is very helpful in bronchitis and Asthma.

(x) Buckwheat Millet:

It is a pseudo millet type and cultivated in Jammu & Kashmir, Uttarakhand, Himachal Pradesh and Chhattisgarh states of India. It can grow well in infertile, poorly drained soil and is adapted to rugged terrain. Buckwheat is a minor crop

worldwide, and it is frequently grown as a crop cover to protect land from erosion between planting seasons. Its short growth period allows for late-season planting, and its deep root system helps to minimize erosion. Buckwheat also helps farmers by covering weeds and bringing beneficial insects to their fields. This millet is beneficial in health and may help in weight loss. It also enables blood pressure reduction and the improvement of cardiovascular. It helps improve the blood sugar control due to its low glycemic index. Buckwheat is commonly used to make foods like khichdi, dosas, sandwich, halwa, cutlets, cheela and laddoo.

(xi) Amaranth Millet:

It is a pseudo millet type and cultivated in Kerala, Tamil Nadu, Karnataka and Maharashtra states of India. Amaranth is an ancient plant with considerable potential for combating under nutrition and malnutrition. Amaranth is an edible plant that grows well in tropical and subtropical regions; its culture has beneficial properties such as rapid growth and cultivation in drought conditions. Amaranth leaves and grains are high in nutrients. They are beneficial for good health as they lower blood cholesterol levels and activate the immune system. It also aids in the prevention of osteoporosis. One of the best plant sources of protein is amaranth. All of the amino acids, including lysine, frequently absent from cereal grains, are present in the protein, which the body can easily absorb. tikkis, salads, cupcakes, cookies, chikki, and laddoo are some foods made using amaranth.

Fig. no. 05: Different types of Millets.

Role of Millets in Achieving Sustainable Development Goals:

Millets, a family of small-seeded grasses widely cultivated worldwide, has the potential to play a critical role in achieving the Sustainable Development Goals (SDGs). Promoting millets can be part of a more comprehensive approach to achieving the broader aim of sustainable development. International Year of Millets 2023 aims to contribute to the UN 2030. Agenda for Sustainable Development, particularly Zero Hunger, Good health and well-being, Decent work and economic growth, Responsible consumption and production Climate action and Life on land. The following are a few ways in which millets might contribute to the Sustainable Development Goals with particular reference to India -

(i) End Hunger: - Millets can be produced sustainably, which can reduce hunger and improve nutrition and food security. Millets are an essential component of the household food basket and are frequently the only crops harvested during the dry season in arid regions. Millets prevent further soil degradation, promote biodiversity, and aid in sustainable land restoration by supplying land cover in arid areas.

(ii) Good Health and Well-being:- Millets are an excellent source of protein, dietary fiber, antioxidants, and minerals, which can be a part of a healthy lifestyle. For those who have high blood sugar, they are a good option because of their low glycogenic index and are gluten-free. Innovative agro-processing has the potential to reach both traditional and non-traditional markets, including young people, urban consumers, tourists, and the production of nutrient-dense foods. Increased food and nutrition security, market expansion, and smallholder farmers' incomes could all result from this value addition.

(iii) Economic Growth: - More millet consumption can offer opportunities for smallholder farmers to improve their livelihood. Economic growth can be bolstered by creating additional revenue streams for smallholders and the food sector by promoting millet and regaining market opportunities. Millets are a strategic crop to ensure food security in areas where they are culturally relevant. Millets were among the first plants to be domesticated and have been a part of Indigenous Peoples' culture and traditions for centuries.

(iv) Sustainable Consumption and Production: - It is imperative that market structure and transparency be upheld to ensure stability and sustainability in millet prices and volumes. Ensuring that millet traders have access to the same resources as other grain traders-such as digitalization-is critical because doing so could raise the added value of millet across the grain's value chain and increase the opportunities for producers to profit.

(v) Climate Action: - Through their ability to counteract the adverse effects of climate change and global warming, millets may contribute to increased food production. Another way that millet-based agriculture could lessen harmful environmental effects is by reducing the production of synthetic fertilizers and pesticides. Its goal is to "promote mechanisms for raising capacity for effective planning and management related to climate change in small island developing states and least developed countries." Millets are crops grown on dry, rain-fed soils that adapt to changing climates. They are resistant to pests and diseases and require little upkeep and inputs. Millets promote biodiversity and sustainable land restoration by slowing down soil deterioration.

(vi) Life on land: - Sustainable millet production can fight against hunger and contribute to food security and nutrition. Including millets and increasing their production in national agricultural systems can help facilitate the transition to agri-food systems that are more resilient, inclusive, efficient, and sustainable, resulting in improved nutrition, output, environment, and quality of life.

- **Conclusion:**

Overall, Millets are a highly nutritious, climate-resilient, and environmentally sustainable food source that can play a vital role in achieving sustainable development goals. They are low-cost, highly nutritious food that can help reduce poverty and improve food security, especially in developing countries. They are a good source of essential vitamins and minerals that can help prevent chronic diseases and promote good health and well-being. Finally, because millets require fewer resources to grow than other crops, they can help reduce greenhouse gas emissions and combat climate change. By promoting the incorporation of millets in daily diets, the strengthening of sustainable food systems is being done by the Govt. of India. However, multiple constructive initiatives and innovations in the world of millets still wait to help achieve the sustainable development goals efficiently and create a healthy, sustainable and inclusive future for everyone.

- **Acknowledgement:**

We are sincerely our heartfelt gratitude to the members of Government and Non-government institutions for their kind helping hand and to provide the relevant information related to this research paper. We are also expressing our deep sense of thankfulness to the members of Indian Institute of Millets Research, Rajendranagar, Hyderabad for their co-operation during research paper writing.

- **Conflict Of Interest:**

There is no conflict of interest in this present research paper. This research work is not a part of any other studies and it is our original work.

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