

## Millets : A Powerhouse of Nutrients - Prospects and Global Scenario

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### ABSTRACT

Rice and wheat are the staple food crops of India. Before green revolution, this scenario was completely different. Almost 80% of people's diets were composed of different types of millets. Millets are rich in variety of nutrients such as calcium, phosphorus, iron, potassium, vitamins A, B, B12 and various antioxidants (Health and diet medical reference, WebMD). Today, there is an urgent need to improve the millet cultivation to achieve food security as we need to overcome the harsh climatic conditions which affects the productivity of many food crops. Today, India is the top producer of millets followed by Niger, Sudan, Nigeria and USA. India is the fifth largest exporter of millets. 2023, being the "international year of millets", this is the right time to study the importance, characteristics, benefits and the global scenario of millet productions.

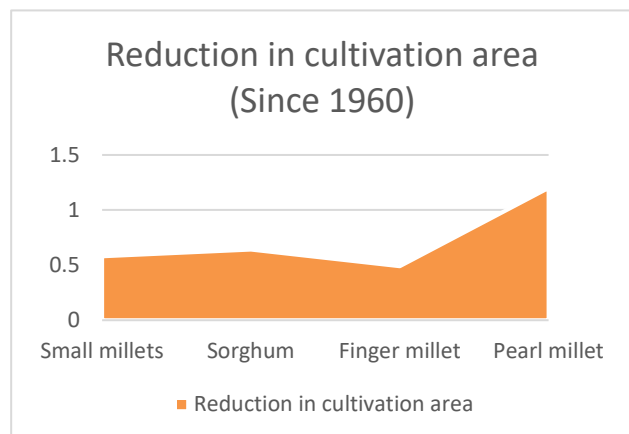
**Keywords :** Rice, Wheat, Green revolution, food scarcity, nutrients, harsh climatic conditions and exporter.

### I. INTRODUCTION

For the past one century, millets played a vital role in fulfilling the diet need of people all over the world. But now, their consumption as well as their cultivation is getting reduced day by day, even though, these crops can withstand many physical stress factors such as rise in temperature and climate change. Recently, the Food and Agricultural Organisation (FAO) of United Nations has declared 2023, as the "international year of millets" based on the proposal

given by India as the leading producer of millets. With this, we should understand their importance, as it will play a vital role for the developing and most of the underdeveloped countries to overcome the food scarcity, malnutrition and famine. Today, India is the leading producer of millets and it has a great export potential. By announcing 2023 as the "international year of millets", FAO has given the opportunity to all the countries to understand the importance of millets and encourage them to give importance for their cultivation by announcing various schemes and

measures for the farmers who involve in millet cultivation.



## II. Types of millets and their global scenario:

millets are classified into three major categories such as: 1) Major millets, 2) Minor millets and 3) Pseudo millets. Pearl millet, sorghum and finger millets are classified under major millets. Proso millet, foxtail millet, barnyard millet, little millet, kodo millet and browntop millet are classified under minor millets. Buckwheat millets and amaranth millets are classified under pseudo millets. All of these millets are rich in nutrients and their health benefits are given below (Figure 1). Various types of millets, millet producing countries and their benefits are given in (Table 1).

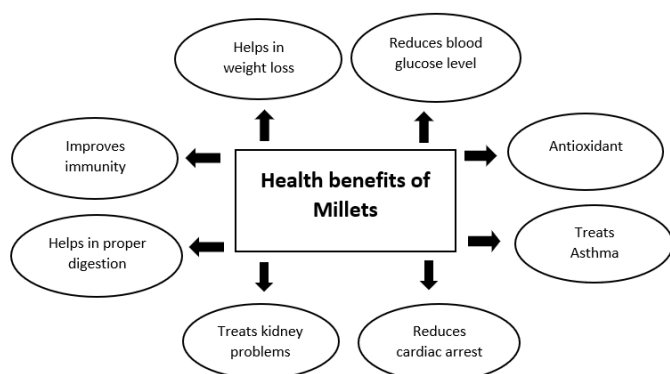
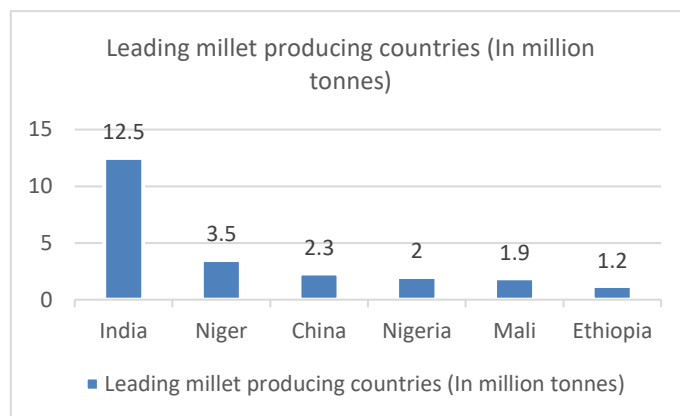


Figure 1: Major health benefits of millets (According to Food and Agricultural Organisation – FAO)



Graph 1 : Leading millet producing countries according United states department of Agriculture

Table 1: Important millets, leading producers and their health benefits

| S.N o. | Millets      | Major producers                                                                                              | Important health benefits                                                              | References          |
|--------|--------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|---------------------|
| 1.     | Pearl millet | Parts of Eastern Africa, Western Africa and Southern Africa, Arabian Peninsula , India, Pakistan and Namibia | Treatment of Anaemia, Cancer and Diabetes, Reduces Cholesterol and removes gall stones | Malik et al., 2015  |
| 2.     | Sorghum      | Nigeria, USA, Sudan, Mexico, Ethiopia and India                                                              | Antioxidant and Anticancer properties                                                  | Ambati et al., 2019 |
|        | Proso millet | Australia, USA, Argentina , Russia, Ukraine and Kazakhsta                                                    | Treats cancer, diabetes and cardiovascular diseases                                    | Das et al., 2019    |

|     |                      |                                                                                                    |                                                                                    |                          |     |                     |                                          |                                                                                                            |                                  |
|-----|----------------------|----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------|-----|---------------------|------------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------|
|     |                      | n                                                                                                  |                                                                                    |                          | 11. | Amarant<br>h Millet | United<br>states,<br>Mexico<br>and India | Anti-<br>inflammator<br>y, Anti-<br>oxidant,<br>Anti-<br>diabetic and<br>Anti-<br>hypertensive<br>property | Balakrishn<br>an et al.,<br>2022 |
| 5.  | Foxtail<br>Millet    | Ethiopia,<br>South<br>Korea,<br>China,<br>Guinea,<br>Nigeria,<br>Europe,<br>India and<br>Indonesia | Reduces<br>cholesterol,<br>Blood<br>glucose level<br>and cancer<br>risk            | Sharma et<br>al., 2018   |     |                     |                                          |                                                                                                            |                                  |
| 6.  | Barnyard<br>Millet   | India                                                                                              | Reduces the<br>risk of type-<br>2 diabetes                                         | Ugare at<br>al., 2017    |     |                     |                                          |                                                                                                            |                                  |
| 7.  | Little<br>Millet     | Indonesia<br>, Sri<br>Lanka,<br>Myanmar<br>, India,<br>Nepal and<br>Pakistan                       | Reduces the<br>risk of type-<br>2 diabetes,<br>Cancer and<br>obesity               | Srilekha et<br>al., 2019 |     |                     |                                          |                                                                                                            |                                  |
| 8.  | Kodo<br>Millet       | Western<br>Africa<br>and India                                                                     | Cardiovascul<br>ar diseases,<br>treat high<br>cholesterol<br>and blood<br>pressure | Dayakar et<br>al., 2017  |     |                     |                                          |                                                                                                            |                                  |
| 9.  | Brownto<br>p Millet  | India                                                                                              | Antioxidant<br>property                                                            | Sirisha et<br>al., 2022  |     |                     |                                          |                                                                                                            |                                  |
| 10. | Buckwhe<br>at Millet | Russia,<br>India                                                                                   | Antioxidant<br>property,<br>treats<br>diabetes and<br>obesity                      | Nepali et<br>al., 2019   |     |                     |                                          |                                                                                                            |                                  |

## 2.1 Pearl millet:

Pearl millet is one of the major food crops grown in different regions of Africa and parts of India. They can grow well under stress factors such as heat, unfertile land as well as drought condition. They are mainly grown as fodder crop for cattle and the secondary products derived from them can be used as biofuel (Andrews et al., 1992). It is a majorly grown millet crop as it accounts for 50% overall millet production. Over 2,60,000 sq. kms of land all over the world is cultivated with pearl millet (Yadav et al., 2017). India is the largest producer of pearl millet followed by Africa, Sahel and Namibia. In various countries, they are grown as intercrop along with other crops (Parthasarathy et al., 2015). Around 55% of world pearl millet cultivation is concentrated on African regions especially Sudan, Senegal, Mali, Nigeria, Niger, Faso and Chad (Jinu et al., 2023). Because of its stress tolerant ability, it is preferred as a sustainable crop all over the world.



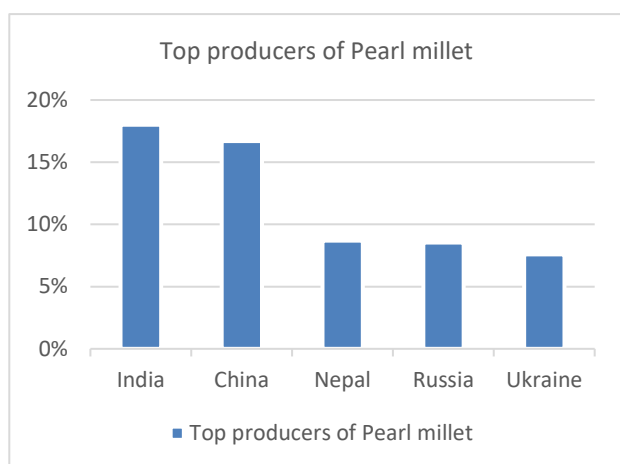


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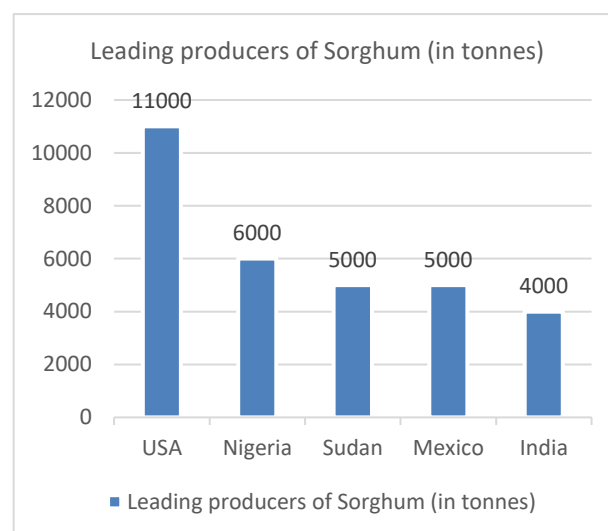


Image Courtesy: Encyclopaedia Britannica

## 2.2 Sorghum:

Sorghum is one of the majorly grown grains in Asia and African regions. It has been used as fodder crop and staple food in different regions of African and Asian continents (Ratnavathi et al., 2014). It is very versatile and has high genetic diversity. They are rich in antioxidants and known to reduce body weight along with controlling diabetes (Awika et al., 2003). Today, there are around 100 sorghum producing countries, and around eight countries have more than 1 million ha under sorghum cultivation. And these eight countries contribute around 60% production of sorghum. In the past four decades, sorghum production is steadily decreasing by 13-15%. Their consumption by humans also decreasing day by day, as the result, they are used as fodder for livestock (Hariprasanna et al., 2016). Top producers of sorghum are Nigeria, USA, Sudan, Mexico, Ethiopia and India (Belton et al., 2004).



## 2.3 Finger millet:

East African region is known for their finger millet production. But, because of labour constraints, their cultivation in these regions is rapidly declining. But in Asian region, their production is not affected. The main producers of finger millets are Zimbabwe, Kenya, Uganda and other East African regions along with India and Nepal. Finger millets are drought resistant, heat tolerant and need moderate rainfall. They can be intercropped with various legumes such as cowpea. It can also grow at the altitude of 2000 m above mean sea level. They are rich in dietary fibres and other nutrients. They can be utilized as the source to overcome the malnutrition and food scarcity in many underdeveloped countries (Adhikari et al., 2018).



Leading finger millet producing Countries:

- 1)India
- 2)Niger
- 3)Zimbabwe
- 4)Kenya
- 5)Uganda

Image courtesy: Food and Agricultural organisation (FAO)

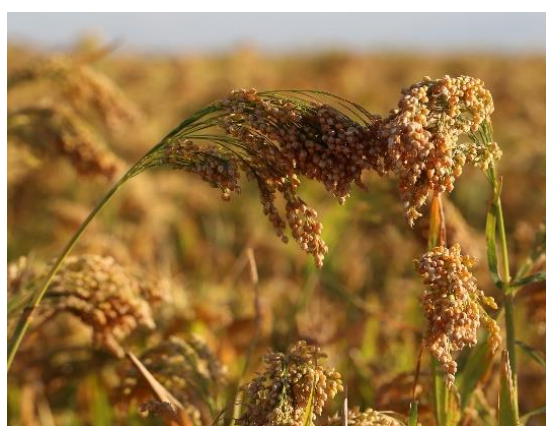
Leading proso millet producing Countries:

- 1)United States
- 2)India
- 3)China
- 4)Russia
- 5)Middle-East

Image courtesy: Wikipedia

## 2.4 Proso millet:

Proso millet is also called as hog millet. It has been widely used as feed for birds. But they are rich in various nutrients such as vitamins, dietary fibres and minerals. This is the right time to think proso millet for human consumption beyond bird feed. These millets can with many stressors and they are not affected by any pests or diseases. The leading producers of proso millet are United States, India, China, Nepal, Turkey, Russia, Ukraine and Middle East (Das et al., 2019). They require very less water and they need very short time to grow (Baltensperger et al., 2002). Recently, scientists had suggested the farmers to go for no-tillage method, as it improves the production of proso millet (Nielson et al., 2017).



## 2.5 Foxtail millet

Foxtail millet are concentrated in dry regions of Africa and Asia. Like proso millet, foxtail millet also used as bird feed. They possess various properties and health benefits like antioxidant, less sugar content and less fat content in addition to variety of fibres, proteins, minerals and phytochemicals. But they have certain antinutrients like tannins and phytic acid. Certain processing methods can be used to remove these antinutrients. Even though they have many health benefits, they are not utilized properly. But we need to understand their role in achieving food security (Sharma et al., 2018). It is a most important millet and is widely cultivated after pearl millet. They are majorly grown in Asian countries such as India and China.



Leading foxtail millet producing Countries:

- 1)India
- 2)China
- 3)Japan
- 4)Kenya
- 5)Uganda

Image courtesy: Wikipedia

## 2.6 Barnyard millet

There are certain species of barnyard millet which acts as a weed. Most of the farmers treat barnyard millet as weed and create nuisance when they grow in between various crops. They are mostly grown as fodder crop. They are rich in iron, calcium, vitamins and dietary fibres. Barnyard millet has tremendous antioxidant potential and known to improve the haemoglobin content in humans (Ranganathan et al., 2020). Leading producers of barnyard millets are India, China and Japan. Their cultivation has been gradually decreasing over the past five decades. But due to their survival ability in harsh climatic conditions it is still grown in many parts of Asian countries. Various species of barnyard millets are grown in different parts of Africa, Europe and Australia. They have high protein content of around 11-14%. Even though they have all these health benefits, it has certain antinutrients which needs to be addressed soon (Sood et al., 2015).



Leading barnyard millet producing Countries:

- 1)India
- 2)China
- 3)Japan
- 4)Korea
- 5)Nigeria

Image courtesy: Wikipedia

## 2.7 Little millet

Little millet cultivation takes less time for harvesting. Another extraordinary characteristic of little millet is they can tolerate drought as well as overwaterlogging. Like some other millets, little millet also has certain antinutrients. They have certain dietary tannins which might cause oesophageal cancer in humans (Dey et al., 2022). Unlike other millets, little millet can grow well in temperate regions like China, Asia and tropical countries like India and Malaysia. India is the largest producer of little millets densely concentrated in central India. They are rich in protein around 8% (Maitra et al., 2019).



Leading little millet producing Countries:

- 1)India
- 2)Mali
- 3)Nigeria
- 4)Niger
- 5)Malaysia

Image courtesy: Crop science society of America

## 2.8 Kodo millet

Kodo millet is one of the ancient millet varieties, widely distributed to central parts of India. Tribal people use kodo millet as one of their staple foods. But people mostly don't consume kodo millet regularly. This is because of kodo poisoning. Poisoning is due to fungal infection (*Paspalum ergot*) which might cause muscle spasm, nausea, vomiting and unconsciousness. In animals, they may cause death also (Deshpande et al., 2015). They are widely cultivated in parts of India, Nepal, Western Africa, Indonesia, Thailand,

Philippines and Vietnam. Mostly they are used as fodder for cattle (Johnson et al., 2019). There are certain disadvantages in growing kodo millets for farmers. It is very difficult to de-husk the kodo millet. Their grasses grow very well, lead to lodging. It causes significant loss in their production. When compared to other millets, kodo millet is not widely dispersed and farmers don't show interest in cultivating them (Neelam et al., 2013).



Leading kodo millet producing Countries:

- 1)Nepal
- 2)India
- 3)Philippines
- 4)Indonesia
- 5)Vietnam

Image courtesy: Wikipedia

## 2.9 Browntop millet:

Browntop millet is very sustainable for small and marginal farmers as they can grow well even in unfertile soil and ecologically sensitive and fragile landscape (Maitra et al., 2020). This millet grows as weed along with other major millets. Apart from some parts of Southern India, they are also grown in USA as a feed for livestock and birds. They can withstand drought and extreme environmental conditions. They are still in existence, just because of their ritual uses (Banham et al., 2014). They are rich in nutrients such as dietary fibres, protein, iron, calcium and certain minerals (Ashoka et al., 2020).



Leading browntop millet producing Countries:

- 1)India
- 2)Mali
- 3)Nigeria
- 4)Kenya
- 5)Niger

Image courtesy: Wikipedia

## 2.10 Buckwheat millet

Buckwheat, also called as common buckwheat is native to Asia. Leading producers of buckwheat are Russia followed by China, Ukraine, USA, Brazil and Japan (Rustagi et al., 2022). They are rich in nutrients such as proteins, minerals like calcium, copper, iron, magnesium, manganese and phosphorus, vitamins like B complex and C. They possess certain phototoxic compounds which might trigger allergic reactions to consumers. Hulls of buckwheat millet can be used as filling for various products such as pillows as they are durable. Buckwheat is classified as pseudo-millet. They are known to have certain bioflavonoid, which might help patients to come out of blood pressure, cancer and certain allergic inflammatory conditions. In spite of all these benefits, their cultivation is concentrated to very less region and their cultivation is declining day by day. Russia is the top producer of buckwheat millet.



### Leading Buckwheat millet producing Countries:

- 1)Russia
- 2)China
- 3)Ukraine
- 4)USA
- 5)Brazil

Image courtesy: Wikipedia

### 2.11 Amaranth millet

Amaranthus is a pseudo-millet grown majorly in India, United States and Mexico. They are rich in proteins, minerals such as phosphorus, potassium, magnesium and calcium, vitamins like B-complex. They require very less water and fertilizers. They can grow well even in unfertile soil. They provide certain health benefits such as anticancer, antioxidant and antidiabetic properties (Balakrishnan et al., 2022). Revived in 1970, now amaranth cultivation is widespread all over the world. India and USA are the leading producers of amaranth millet.

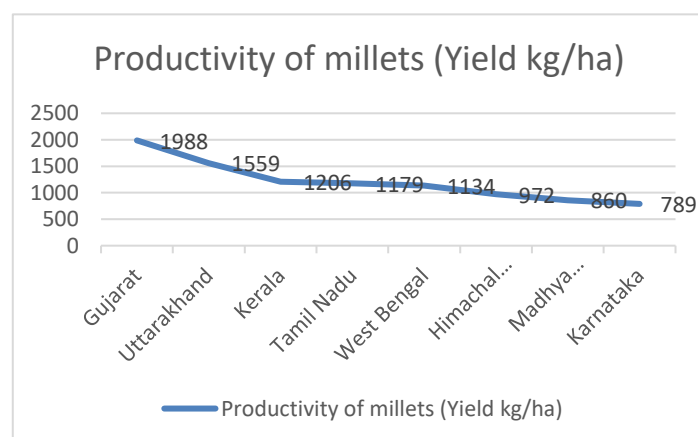
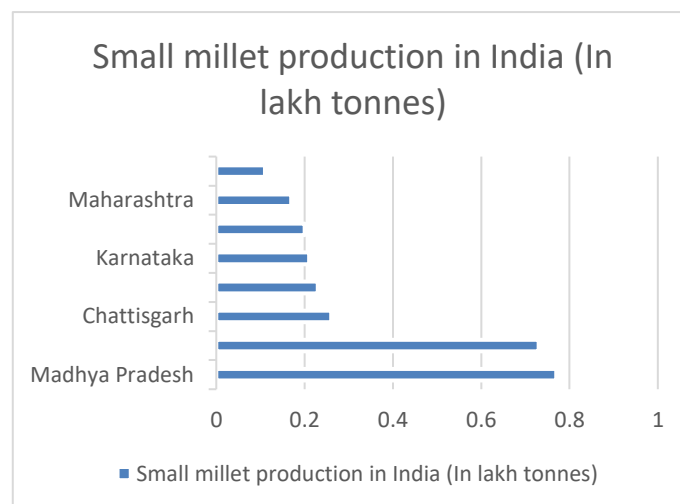
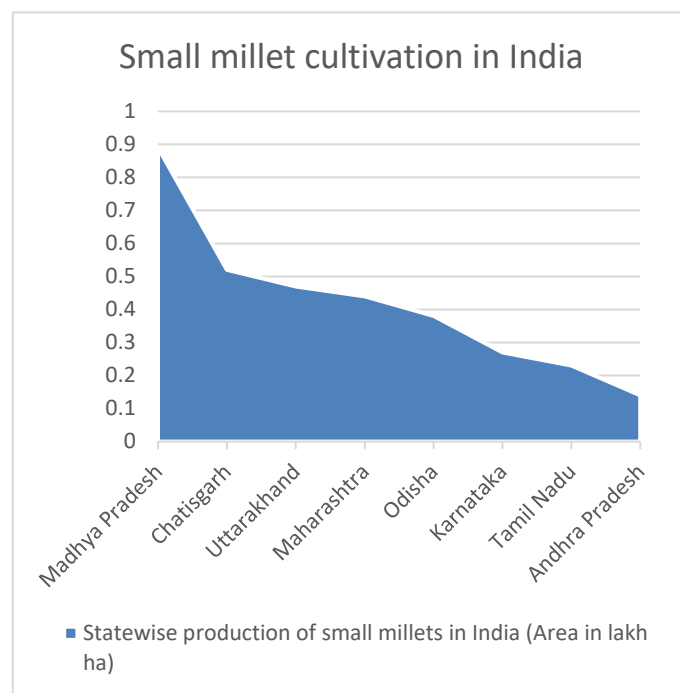


Image courtesy: Wikipedia

### III. Small millet cultivation in India

Almost every state in India involves in millet cultivation. Based on the physiography, demography and climatic conditions, the production of small millets varies from state to state. The following graphs clearly explains various data on small millets production in India according to the data published

by “Agricultural and Process Food Export Development Authority (APEDA)”.



#### IV. Conclusion

Millets are the powerhouse of various essential nutrients. Another advantage of millets is they can grow well in any extreme conditions. India's efforts in declaring 2023 as "international year of millets" needs to be appreciated as it will encourage the governments of various countries to give importance to millet cultivation. It is a golden opportunity for the mankind to revive the millet cultivation and to achieve the food security. Many underdeveloped African countries are under severe famine; therefore, the revival of millet cultivation will recover them from malnutrition and famine. India, being the largest producer of millets, they must ensure their dispersal and promote them in the global market and help the poor, underdeveloped countries affected from drastic climate change.

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