



# Climate Change, Food Security and Farming Millets in India: The Need to Change Cropping Pattern

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**Abstract.** At the recently held Conference of Parties (COP-28) UN Climate Summit in Dubai, India remained non-committal on reducing fossil fuel use or making any firm commitment to reducing carbon emissions, although under tremendous pressure from the developed countries. This is due to India's concerns regarding the possible impact on its energy, security, trade, economic and agricultural sectors. However, India is one of the countries poised to achieve its net zero goals, and India's new climate mission is focused on a sustainable lifestyle (LIFE). India has adopted manifold strategies to reduce its carbon footprint. One of the most important initiatives taken in the agricultural sector is to promote millet, which has numerous benefits, making it a much healthier choice than other staples. On the behest of India, The Food Agriculture Organization and UN recognized 2023 as the International Year of Millets. In this paper, the researchers will use doctrinal methods to highlight the various millet production techniques and how millet can contribute to achieving India's carbon emission goals and a healthier population. Researchers have mentioned government initiatives, lifestyle for the environment, issues, challenges, and opportunities and reflected on solutions.

**Keywords:** Millets, LiFE, carbon footprint, climate change, carbon resilience, India, food security.

## 1 Introduction

Millet, a variety of small-seeded grains with high nutritional value, have been significant in India's agricultural domain for years (Devi, 2017). These crops, including sorghum, pearl millet, finger millet, and foxtail millet, have been grown in many agroecological zones, working as essential food sources and generating money for small-scale farmers. Millets provide a high content of dietary fibre, vitamins, and vital minerals, rendering them a significant constituent of the diet for communities with limited availability of varied food options (Saleh et al., 2019). Millets have a

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strong presence in India's agricultural practices, especially in dry and semi-dry areas, where they surpass other grains in terms of productivity and nutritional value (Hegde et al., 2005). These crops have been a dependable source of nourishment for diverse cultures, ensuring food security in areas with limited water supply. Furthermore, millets are devoid of gluten, making them a viable choice for persons with gluten sensitivities and promoting a varied diet.

Nevertheless, India is experiencing significant climatic variations characterized by escalating temperatures, modified rainfall patterns, and heightened extreme weather phenomena (IPCC, 2021). These alterations have significant ramifications for agriculture, impacting the productivity of crops, the accessibility of water, and the overall viability of farming methods. The cultivation of millet, which is already susceptible to damage due to its dependence on rain-fed agriculture, is further confronted with extra obstacles caused by these climate fluctuations. Hence, it is necessary to adopt a policy given climate variability and adopt a multi-faceted approach to improve millet cultivation and productivity in response to the effects of climate change and environmental variations. India's strong push towards cultivation, production, distribution for access and food security of millets highlights how important the government considers millets to be (Sadhukhan & Debangshi, 2023).

## 2 Government initiatives

In this paper, the authors have highlighted government initiatives, lifestyle for the environment, issues, challenges, and opportunities and reflected on solutions. In the period between 1966 to 2022, millet production in India increased by 7% in India (IDR, 2023). The Food and Agriculture Organisation (FAO) 2017 issued a call to change the future of migration by investing in food and income security for rural families, especially in drylands (ICRISAT, 2023). In response, India forwarded a proposal highlighting the importance of millets as a climate-resilient crop and their critical role in augmenting rural income. It called for a declaration of an 'International Year of Millets'. India's proposal received overwhelming support from the FAO Council and the UN General Assembly, who, at its 75th Session, declared the year 2023 as the International Year of Millets (FAO, 2023).

At the national level, the Indian government has continuously taken several initiatives to popularise millets. In 2011-12, the Government of India announced the Initiative for Nutritional Security through Intensive Millet Promotion (INSIMP), a scheme that sought to promote millets as 'nutri-cereals' and increase production. The Initiative was part of the Rashtriya Krishi Vikas Yojana. An outlay of 300 crores was made towards the initiative for the said financial year. The Operational Guidelines of the scheme focus on aspects like organising production programmes, awareness campaigns, provision of zero-cost input kits to the farmers, incentivising new/hybrid varieties of seed production, setting up of millet excellence centres & demonstration cum training centres for post-harvest technologies and monitoring and record management (INSIMP, nd.).

### 3 Section National Food Security Act and Nutritious Millets

The National Food Security Act 2013 entitles a large section of rural and urban households, identified as ‘priority households’, to five kilograms of subsidised food grains annually through a Targeted Public Distribution System (PDS). Though no specific mention of millets is found in Schedule I of the Act, millets come under ‘coarse grains’ and are provided a subsidised price (NFSA, 2013).

NITI Aayog, in 2017, in its National Nutrition Strategy (NNS), recommended the production and diversification of production of cereals, including coarse cereals like millet. In 2018, millets were officially recognised as ‘nutri-cereals’, and India celebrated 2018 as the National Year of Millets (ORF, 2024). Millets were also integrated into the National Food Security Mission, aiming to increase millets' productivity, strengthen the supply chains and enhance post-harvest value addition for better prices to farmers (Operational Guidelines, 2018). The initial outlay for the mission was 300 crores.

In 2021, the Government revised its Guidelines for procurement, allocation, distribution and disposal of coarse grains. Earlier, the State Governments at MSP could procure the coarse grains under the Public Distribution System, but they had to be distributed within three months. This period was extended to nine months for jowar and bajra and ten months, respectively, for ragi. The guidelines also established provisions for the inter-state transport of surplus coarse grains through the Food Corporation of India (PIB, 2021; ORF, 2024). Also, to develop a market for ready-to-cook/eat millet products, the government launched the Production Linked Incentive Scheme for Millet-Based Products in 2021 (PLISMBP), with an initial outlay of 800 crores (Economic Times, 2023). The scheme, which the Ministry of Food Processing Industries is administering, has been renewed for the second round in 2023 with an increased outlay of 1000 crores (Business Standard, 2023).

Besides this, several State governments have taken initiatives to popularise and mainstream millet production and consumption. Andhra Pradesh, the largest producer of millets in the country as per the data for the year 2023 (Times of India, 2023) runs its Comprehensive Revival of Millets Cultivation by Tribals scheme to develop tribal and rain-fed areas into millet-hubs. Millets are also an essential limb of the state's Drought Mitigation Project, which seeks to popularise millet cultivation and promote its consumption by local households. States like Orissa, Chhattisgarh, and Tamil Nadu run their own Millet Missions. Tamil Nadu's Sustainable Dry Land Agriculture Mission focuses on improving the production of millets. Many states like Chhattisgarh, Madhya Pradesh, and Orissa have integrated millet into the Supplementary Nutrition Programme under the Integrated Child Development Services (ICDS) scheme (NITI Aayog, 2023).

Figure 01 represents the Area harvested for millet across India from 2012 to 2021. The data shows that between the mentioned years there were fewer changes in the proportion of farming of all kinds of millet in India.

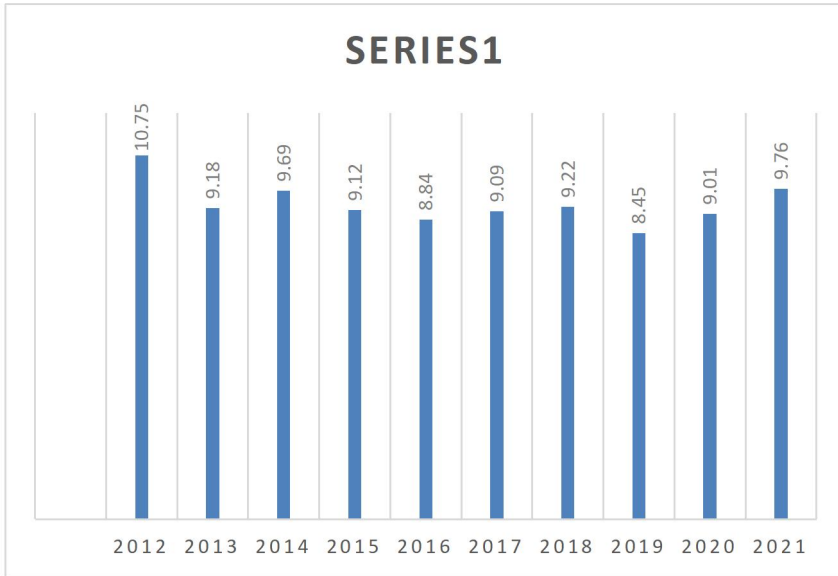


Fig 01- Millets harvested in India (in million hectares).

<https://www.statista.com/statistics/874901/india-area-harvested-for-millet-production/>

Eating food is not enough for a person if that food does not contain nutrients. Adding millet to the Public Distribution System (PDS) is essential to add nutritious food. PDS mainly supplies rice and wheat, which provide calories but not many other kinds of nutrition. Millets are much richer in nutrients than in the PDS guarantees. Under the food security law, millet prices are set lowest at a token one rupee per kg as an incentive (Rajsekhar & Raju, 2017). Some states like Odisha have already commenced doing this. Given that various millets and production and consumption are spread across the country and considering issues of shelf life, local preference, etc., decentralised procurement linking local farmers to the state institutional feeding programmes is the way to go. Print and electronic media can be effectively harnessed to communicate messages in local languages about millet cultivation targeting farmers and the benefits of millet consumption targeting consumers.

#### 4 Lifestyle for the Environment (LiFE)

In the context of food security and climate change, Prime Minister Narendra Modi introduced the term LiFE ‘Lifestyle for the Environment (LiFE) at COP26. It was called to the global community because India believes in Vasudhev Kutumbakam, which means the world is one family. The global community of individuals and institutions to drive LiFE as an international mass movement towards “mindful and deliberate utilisation, instead of mindless and destructive consumption” to protect and preserve the environment. Life puts an individual and collective duty on everyone to

live a life that is in tune with Earth and does not harm it. Those who practice such a lifestyle are recognised as Pro Planet People under LiFE. Changing our lifestyle, however, takes work. Our habits are deeply ingrained in our daily lives and are continually reinforced through several elements of our environment. Translating our intention to do good for the environment into action can be challenging. However, it is not impossible to take one action at a time and make one change daily. We can change our lifestyle and inculcate long-term environment-friendly habits. Studies suggest that practising an action for at least 21 days helps make it a habit. In that context, the LiFE 21-Day Challenge was launched to enable Indians to take one simple environment-friendly action per day for 21 days and eventually develop an environment-friendly lifestyle. It is a challenge to change one small thing in your life daily and become Pro Planet People. The cultivation, production and consumption of millet mitigate the effect of climate change and reduce greenhouse climate resistance, improving soil nutrition and health, therefore supporting Life.

## **5 Issues, Challenges and Opportunities:**

### **5.1 Reduction of the demand, production, consumption and low yields**

There has been a decline in the production and consumption of millets in India except for Bajara. The decline is a concern, especially for crops like Jawar and Ragi (The Hindu, 2023). Jawar and Ragi are major millets cultivated in India and highly nutritious millets containing fibre, phosphorous, calcium and rich protein. The lack of consumption resulted in a lack of demand for three reasons: lack of awareness about nutrition with cost efficacy, lack of efficient policy, and lack of implementation of existing policies at the grassroots level. Millet needs to revive the advancement of processing technology and awareness. Labour is limited to households and rural and faces challenges. Regarding research in development services, there is a need to invest more in research and innovation.

Millets gradually increased due to a reduced cultivated area, government initiatives such as serial development programme macro management of agriculture and national food security mission state government. Figure 02 elaborates on the distribution of area under millet cultivation in India in the financial year 2020 by state. The data shows that in semi-arid areas like Rajasthan, Maharashtra, and some parts of Gujarat, Karnataka, Uttar Pradesh and Madhya Pradesh cultivation of millets has been increased.

## 6 Inadequate use to increase millet cultivation

Inadequate use to increase millet cultivation:

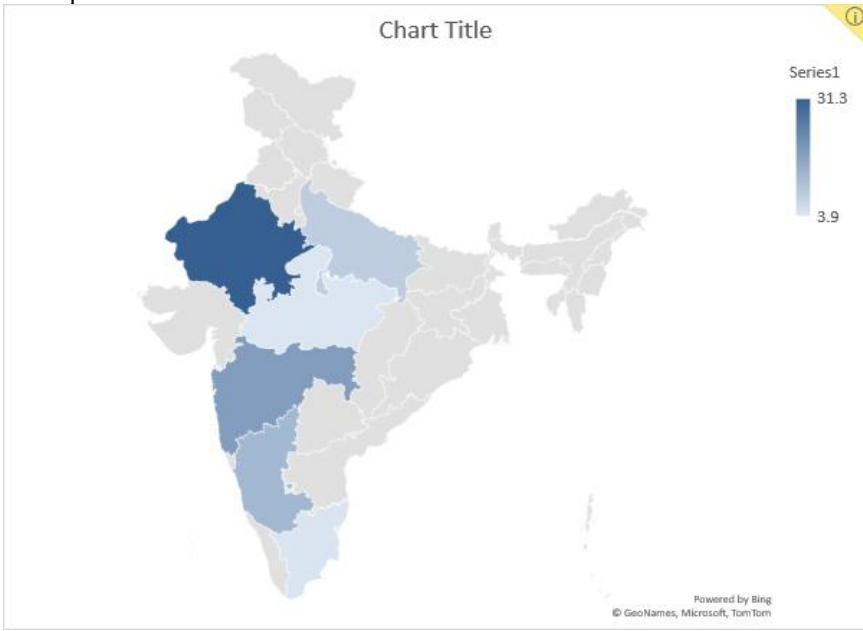


Fig 02- Distribution of area under millet cultivation in India in financial year 2020, by state (data generated by Microsoft, Bing).

In the above figure, high serial points denote the scope of millet farming in India. Rajasthan is a semi-arid state. Millet farmers in draught-prone regions like Rajasthan use specific adaptive strategies to cope with water scarcity caused by climate change. By using crop-diverse application forms, implement adaptive measures such as shifting planting dates, reducing clay, cultivating areas and planting out resistant varieties to mitigate the effects of drought on millet production (Muroyiwa et al., 2022). Farmers utilise water conservation and irrigation Technology, including mulching and irrigating to adapt to changing climate conditions. By using access to information farmers who receive seasonal forecast information are more likely to integrate drought-tolerant crops into their cropping system, especially when there are private grain wires in the village (Maggio & Sitko, 2019). These strategies help millet farmers in drought-prone regions leave water scarcity caused by climate change. By diversifying crops, and managing water. It effectively uses relevant information on the impact of drought and inserting sustainable agriculture production (Li et al., 2015). However, specific adaptive strategies and technology used in Rajasthan are not extended to other drought-prone region (Prasad & Babu, 2016). Therefore, no increase in protection has been seen in others.

## **7 Inadequate government initiatives**

Government initiative to promote millet farming in India demand generation and conjunction. The government aims to contribute to creating a domestic market for millets and strengthen the value chain policies. The focus will be growth and area expansion which are being divided into value chain development. The government is working on post-production value addition and market linkage to extension. The value chain will benefit both farmers' income and the nutritional security of consumers. Nonetheless, existing government initiatives are inadequate cultivation of millet. There is a need for increased investment in research and development extension services and infrastructure to improve millet productivity and promote sustainable intensification. Millet farming contributes to sustainable agriculture practices in India as climate resilience and security. Millets are ready with carbon emission lower carbon footprint, and improve natural resource management production.

## **8 Carbon footprint, food security and cultivation of millets**

Millets have lower carbon footprints, contribute to sustainable agriculture and reduce carbon emissions. Millets promote biodiversity conservation, are genetically diverse and adapted to marginal growing conditions. Millets can be grown on marginal lands reducing the pressure on a tile agricultural land. Millet farming can be profitable with improved varieties and agro-economic practices leading to higher profit. Millets have the potential to increase production through the popularization of new varieties and improve crop management practices. Millets also provide food security, so, millets are nutritional superior to most other cereals and can address malnutrition (Orr et al., 2001). Millets contribute to food security by providing energy and training for poor people in low and middle-income countries. Millets are included in the public distribution system to ensure availability and accessibility. Even the Jharkhand State government has provided millet in the midday meal scheme included in the mid-day meal scheme.

## **9 Rainwater harvesting to mitigate draught-prone climate change**

The benefits of rainwater harvesting for millet farmers in draught-prone regions are improved crop yields. Rainwater harvesting techniques such as in situ moisture conservation and ex situ water management, have significantly encouraged millet crop yields. Lifesaving irrigation through harvested water can result in higher yield. Adopting low-cost interventions like rainwater harvesting can improve crop productivity and provide better economic returns for millet farmers in dryland regions. rainwater harvesting is a crucial adaptive strategy for millet farmers in drought-prone regions to ensure food security and alleviate poverty (Balderama,

2015). It helps farmers cope with weather aberrations and the impacts of climate change. Millet farmers face challenges in draught-prone regions when implementing rainwater harvesting for irrigation. Small farmers are reluctant to invest in water harvesting due to limited returns on investment, especially in regions with low agricultural productivity. Some rainwater harvesting techniques require technical expertise and labour intensive which can be a challenge for millet farmers. Technological and socio-economic constraints and poor adoption and upscaling can hinder the implementation of harvesting at the individual farm level (Tomar & Singh, 2022).

Millet farmers use many techniques in draught-prone regions for rainwater harvesting. In situ, moisture conservation techniques like summer plugging, sowing across the slope, and ridge sowing have resulted in additional millet yields compared to farmers' practices. Ex-situ water management, such as harvesting and storing rainwater through farm ponds and other water storage systems, can provide supplementary irrigation for millet crops. Micro catchment rain-water harvesting techniques collect runoff from small catchment areas such as rooftops and small runoff basins for agriculture. Rainwater harvesting has many impacts on millet crop yield in draught-prone regions. Water harvesting has significantly improved crop yields, especially in the low rainfall years. Using rainwater harvesting techniques can improve efficiency and increase water productivity (Gaddikeri, et al, 2023). Rainwater harvesting offers under-exploited opportunities for rainfed farming systems in dry lands, simultaneously reducing hunger, elevating poverty and improving environmental resilience. Rainwater harvesting provides several benefits for millet farmers in draught-prone regions to mitigate climate change and food security policies, including improved crop yield, economic returns, and climate change adaptation. Techniques like in-situ moisture conservation and ex-situ water management are commonly used in millet farming for rainwater harvesting. The impact of rainwater harvesting on millet crop yield is significant, leading to increased water use efficiency and sustainable agriculture (Yazar, & Ali, 2017).

## 10 Conclusion

Millet farming in India offers benefits such as water efficiency, nutritional value and climate resilience. However, it faces challenges such as a decline in production, lack of awareness and policies and low yields. The Government has initiated various programmes to promote millet farming including demand generation, value chain development and research and extension services. However, the existing government policies are inadequate and inefficiently implemented. Millets promote biodiversity conservation as they are genetically diverse and adapted to marginalised growing conditions.

Millet can be grown on marginalised lands, reducing the pressure on fertile agricultural land. Millets cultivation can also be encouraged in other parts of India because it requires less water than rice and sugarcane. Millet farming can be profitable, with improved varieties and agronomic practices leading to higher grain



yields and profits. Millets are nutritionally superior to most other cereals and can address malnutrition. Millets can contribute to the National Food Security Act by being part of the Public distribution system to ensure availability and accessibility.

India has laws governing plant varieties, such as the Protection of Plant Varieties and Farmers' Rights Act, 2001 which encourages the protection of new plant varieties, including those developed through advanced breeding techniques, upholding principles of biodiversity conservation and farmers' rights.

## 10.1 Recommendations

**Need to develop climate-resilient varieties:** Developing climate-resilient millet varieties is crucial in addressing the challenges climate change poses in global agriculture. The policy involves integrating advanced breeding techniques, such as marker-assisted selection and genomic selection, to enhance the resilience of millet crops to varying climatic conditions. Researchers focus on identifying genetic traits that confer tolerance to heat, drought, and pests, ensuring that the resulting varieties can thrive in adverse environmental conditions.

**Need for collaborative efforts:** Additionally, the development process considers nutritional content and yield potential to meet the demands of a growing population. Collaborative efforts between agricultural scientists, local farmers, and policymakers are essential for successful implementation, ensuring the widespread adoption of these climate-resilient millet varieties. The ultimate goal is to secure food security, promote sustainable farming practices, and bolster the resilience of agriculture in the face of a changing climate.

In the context of developing climate-resilient millet varieties, both Indian and international legal frameworks play significant roles. At the national level, India has laws governing plant varieties, such as the Protection of Plant Varieties and Farmers' Rights Act, 2001 which encourages the protection of new plant varieties, including those developed through advanced breeding techniques. This legislation ensures that farmers have fair access to improved varieties and receive just compensation.

**Need to have multi-country collaborations:** On the international front, agreements like the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and the Convention on Biological Diversity (CBD) emphasize the importance of conservation and sustainable use of plant genetic resources. Collaborative initiatives involving multiple countries require adherence to these agreements, ensuring equitable sharing of benefits arising from developing and using climate-resilient millet varieties while upholding principles of biodiversity conservation and farmers' rights. Compliance with these legal frameworks is essential for the ethical and lawful progression of research and implementation in this field.

**Need to have awareness initiatives and an effective Public distribution system-** The government has to raise awareness about the millet climate resilient benefits, nutritious and make public distribution system more effective. The government need to provide more subsidies for tech-related harvesting machine.

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