YOJANA

JANUARY 2023 | A DEVELOPMENT MONTHLY | ₹ 22

MILLETS

International Year of Millets 2023

Ancient Grains for a Healthy Future
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Cultivation in North-East India
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PRELIMS TEST SERIES

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Test No.	Date	Day	Subject
1.	04 Dec. 2022	Sunday	Ancient + Medieval History
2.	10 Dec. 2022	Saturday	Modern History
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7.	25 Dec. 2022	Sunday	Current Affairs (Jan to May)
8.	07 Jan. 2023	Saturday	Current Affairs (June to Dec)
9.	08 Jan. 2023	Sunday	Full Mock Test 1
10.	14 Jan. 2023	Saturday	Full Mock Test 2
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YE-2142/2023

JANUARY 2023

Volume-67
No. 01

YOJANA
Since 1957 A DEVELOPMENT MONTHLY

Yojana (English): Room No. 647, Soochna Bhawan, CGO Complex, Lodhi Road, New Delhi-110 003.
E-mail (Editorial): sec-yojanaeng-moib@gov.in

YOJANA, a development monthly published since 1957, is a theme-based journal providing in-depth analyses and views on socio-economic issues in the broader framework of government policies. Although published by the Ministry of Information and Broadcasting, YOJANA is not restricted to expressing the official point of view.

SUBSCRIPTION/GRIEVANCES

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(Monday-Friday, 9:30 am- 6:00 pm)

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Let noble thoughts come to us from all sides.
Rig Veda

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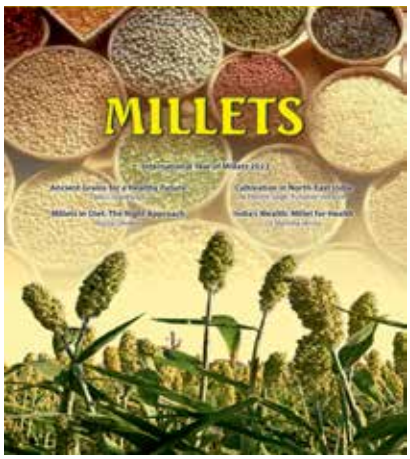
YOJANA is published in Assamese, Bengali, English, Gujarati, Hindi, Kannada, Malayalam, Marathi, Odia, Punjabi, Tamil, Telugu, and Urdu.

Reviving India's 'Nutri Cereals'



India has a rich tradition of consumption of millets. There have been innumerable sources of literature and documents that suggest how millets were an intrinsic part of our food habits, culinary, rituals, and society at large.

Kalidasa, in his legendary literary masterpiece 'Abhijnana Shakuntalam', has sage Kanva pouring foxtail millet while bidding farewell to Shakuntala in Dushyant's court, which indicates the auspicious nature attributed to this millet. There is mention of millets in Yajur Veda's verses. Sushruta in his Samhita classified cereals as dhanya varga, khudhanya varga and samidhanya varga where khudhanya varga included various millets.

'Ragi thandheera', a composition in Kannada, written by Purandara Dasa highlights the importance of finger millet (ragi) during his times. Another Kannada poet Kanakdasa personified ragi as the weaker sections of society through his metaphoric creation 'Ramadhanya Charithre', which showed its conflict with the 'mighty' rice and gave a powerful social message.

Kautilya's Arthashastra has a mention of various millets and their various properties when soaked or boiled. Ain-i-Akbari, written by Abul Fazl, records millets and their cultivating regions. It is said that Mughal King Jahangir was fond of 'laziza', a form of bajra khichri, mixed with peas, which has its roots in Gujarat.

With such a diverse roots of millets in India and even diverse ways of culinary preparations, where are millets in our kitchen these days? How much millet do we consume in our staple diet? What are their benefits and why millets should reclaim their place on our plates is where this issue of Yojana comes from.

This year marks the celebration of the International Year of Millets (IYM 2023) which has been spearheaded by the sustained efforts of India. Recognising the enormous potential of millets, which also aligns with several UN Sustainable Development Goals in terms of being climate-resilient, nutritious, and water-efficient crops, the Government of India has been prioritising millets. Millets are important by the virtue of their great potential to generate livelihood, increase farmers' income and ensure food & nutritional security all over the world. A sub-mission on National Food Security Mission– Nutri Cereals was implemented considering the high-nutritive value, potential for economic empowerment of small & marginal farmers, and contribution to maintaining the earth's biodiversity; in April 2018, Millets were rebranded as "Nutri Cereals", and the year 2018 was declared as the National Year of Millets, aiming at larger promotion and demand generation. These efforts of cultivation and consumption of millet in India have been brought to the forefront of the international arena through the declaration of IYM 2023.

A new year is also a moment for new resolve. This is an opportune moment for us to review our lifestyle, and food habits, and make corrections wherever needed. We are hopeful that this issue of Yojana will help you explore the bountiful benefits of millets thus making them a part of your lives. ❑

International Year of Millets 2023

"There is a need for diversity on the land and on our tables. If agriculture becomes monoculture, it impacts our health and the health of our lands. Millets are a good way to increase agricultural and dietary diversity. Raising awareness to create 'Millet Mindfulness' is an important part of this movement. Both institutions and individuals can make a tremendous impact. While institutional mechanisms can encourage production of millets and make it profitable via policy initiatives, individuals can make health-conscious and planet-friendly choices by making millets a part of their diet. I am positive that the International Year of Millets 2023 will start a mass movement towards a secure, sustainable and healthy future."

– PM Narendra Modi's message during the opening ceremony of the International Year of Millets at FAO Headquarters in Rome, Italy

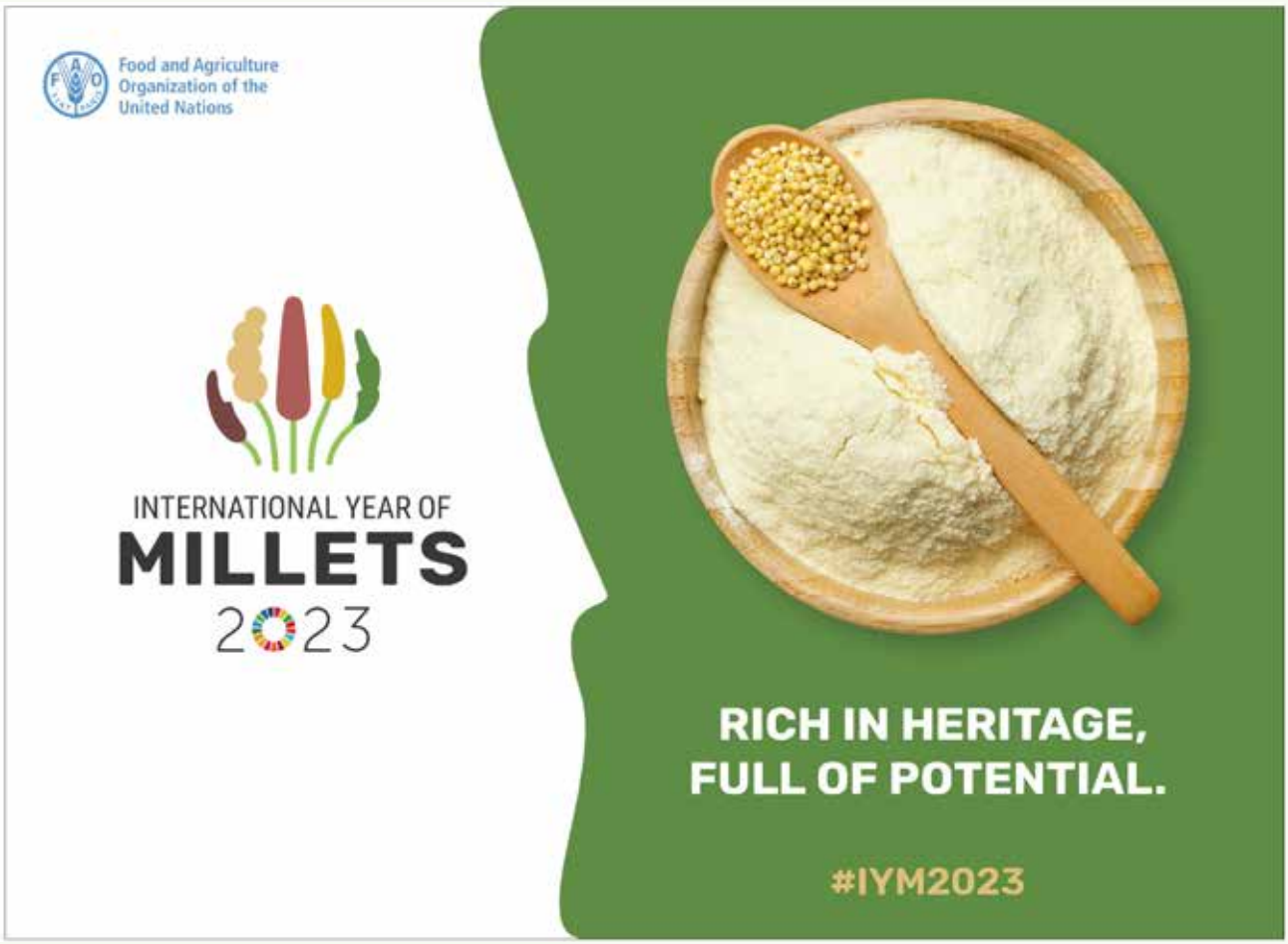
The United Nations General Assembly has declared the year 2023 'International Year of Millets'. It is the Prime Minister's vision and initiative that led to this United Nations Resolution being adopted with support from more than 70 nations across the globe. It will help in creating awareness throughout the world about the significant role of millets in sustainable agriculture and its benefits as a smart and superfood. India is poised to become the global hub for millets with a production of more than 170 lakh tonnes which makes for more than 80% of the millets produced in Asia. The earliest evidence for these grains has been found in the Indus Valley civilisation and was one of the first plants to be domesticated for food. It is grown in about 131 countries and is the traditional food for around 60 crore people in Asia & Africa.

The Government of India has declared to celebrate the International Year of Millets, 2023 to make it a people's movement so that Indian millets, recipes, and value-added products are accepted globally. The 'International Year of Millets' stands to provide a unique opportunity to increase global production, ensure efficient processing and consumption, promote better utilisation of crop rotations, and encourage better connectivity throughout food systems to promote millets as a key component of the food basket.

The Food and Agriculture Organisation (FAO) in a brief message said that the opening ceremony of the International Year of Millets (IYM) 2023 hosted by the FAO aims to raise awareness and create momentum for the IYM 2023 by engaging FAO Members and other relevant stakeholders and highlighting the benefits of promoting the sustainable cultivation and consumption of millets.

The Prime Minister of India said, I would like to congratulate the United Nations and the Food and Agriculture Organisation for the launch of the International Year of Millets 2023. I also express my appreciation to the different member nations who supported our proposal to mark the International Year of Millets. Millets have a glorious history of being among the earliest crops grown by humans. They have been an important food source in the past. But the need of the hour is to make them a food choice for the future!

A once-in-a-century pandemic followed by a conflict situation has shown that food security is still a concern for the planet. Climate change can also impact food



availability. At such a time, a global movement related to millets is an important step, since they are easy to grow, climate resilient, and drought resistant. Millets are good for the consumer, cultivator and climate. They are a rich source of balanced nutrition for consumers. They benefit cultivators and our environment since they need lesser water and are compatible with natural ways of farming.

The United Nations General Assembly at its 75th session in March 2021 declared 2023 the International Year of Millets (IYM). The IYM 2023 is an opportunity to raise awareness of, and direct policy attention to the nutritional and health benefits of millets and their suitability for cultivation under adverse and changing climatic conditions. It is an occasion to promote the sustainable production of millets while also highlighting their potential to create sustainable market opportunities for producers and consumers.

IYM 2023 aims to contribute to the UN 2030 Agenda for Sustainable Development, particularly SDG 2 (Zero Hunger), SDG 3 (Good health and well-being), SDG 8 (Decent work and economic growth), SDG 12 (Responsible consumption and production), SDG 13 (Climate action) and SDG 15 (Life on land).

1. The sustainable cultivation of millets can support climate-resilient agriculture

SDG 13 (Climate Action) and SDG 15 (Life on Land)

- Millets are often referred to as climate-resilient crops because they can grow on arid lands with minimal inputs and maintenance, are tolerant or resistant to diseases and pests and are more resilient to climate shocks than other cereals.
- Including and/or expanding the production of millets in national agricultural systems can support the transformation to more efficient, inclusive, resilient and sustainable agrifood systems for better production, better nutrition, a better environment and a better life.

2. The sustainable production of millets can fight hunger and contribute to food security and nutrition

SDG 2 (End Hunger)

- In arid areas, millets are very often the only crops that can be harvested in the dry season and are a crucial part of the household food basket. Millets can help to overcome food scarcity in difficult periods, therefore contributing to the food security and nutrition of vulnerable populations.
- Millets can grow in very poor and fertile soils in dryland conditions and do not heavily deplete soil nutrients. By providing land cover in arid areas, they reduce further soil degradation and help support biodiversity and sustainable land restoration.

3. Millets can be an important part of a healthy diet

SDG 3 (Good Health and Well-Being)

- Millets are good sources of minerals, dietary fibre, antioxidants and protein. With a low glycaemic index, they are a good option for people with high-blood sugar. Millets are also gluten-free and an excellent and cost-effective source of iron for iron-deficient diets.
- As whole grains, each variety of millets provide different amounts and types of fibre. Dietary fibre has a role in regulating bowel function, blood sugar and lipids, and satiation.

4. Greater consumption of millets can offer opportunities to smallholder farmers to improve their livelihoods

SDG 8 (Decent Work and Economic Growth)

- The production of millets and the demand for them has declined as other cereals such as wheat, maize or rice became a dietary preference. By promoting millets and regaining market opportunities, additional sources of revenue can be created for smallholders and in the food sector, boosting economic growth.
- Millets were among the first plants to be domesticated and for centuries, they have been an important food for hundreds of millions of people in sub-Saharan Africa and Asia. They are deeply rooted in Indigenous Peoples' culture and traditions and therefore a strategic crop to guarantee food security in areas where they are culturally relevant.

5. Proper handling of millets is key to maintaining their high quality and nutritional benefits

SDG 2 (End Hunger) and SDG 3 (Good Health and Well-Being)

- Timely harvesting ensures good grain quality followed by threshing to remove grains from the stalks. Controlled mechanised processes for the dehusking of millets, at any scale, are more efficient than manual dehusking, as they reduce losses from spillage and provide clean intact grains that are ready for market. Smallholders and supply chain holders benefit accordingly from better incomes and reduced drudgery.
- Innovative agro-processing, especially in the production of nutritious foods, could target both traditional and non-traditional markets such as youth, urban consumers, tourists, etc. This value addition could lead to market expansion, and increased food and nutrition security and incomes for smallholder farmers.

6. Greater trade in millets can improve the diversity of the global food system

SDG 8 (Decent Work and Economic Growth) and SDG 12 (Sustainable Consumption and Production)

- Millets, including sorghum, account for less than 3% of the global grains trade. With the need to improve the resilience of global trade and its ability to respond to sudden changes in the foodgrain market, millets are a valuable option to increase output diversity and mitigate risks related to production shocks.
- Market structure and transparency, in relation to volumes and prices of millets, are key elements to ensure stability and sustainability. It is important to ensure that millet traders benefit from the same tools as other grain traders, such as digitalisation, which could boost the added value of millet along the grains value chain and consequently provide more revenue opportunities for producers. ❑

Source : PIB and FAO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YE-2152/2023

Millets: Ancient Grains for a Healthy Future

Pallavi Upadhyaya

Millets have been a part of the Indian food basket for hundreds of years. They are deeply ingrained in our food systems, culture, and traditions. They find mention in religious texts and are a part of many traditional Indian practices. Interactions with elders in the family and farmers throw light on their consumption in older times. In the Indian subcontinent, millets were used as a staple in most households prior to the Green Revolution.

With 2023 being observed as United Nations International Year of Millets, there is a renewed interest in millets around the globe. Nations, institutions, businesses, and individuals are coming together to promote these miracle grains and give them a rightful place in the food basket. India has been a leader in the millet movement and is showing the way to the rest of the world in promoting and showcasing the potential of millets. Research and work done on millets in India have also shown the positive impact and usefulness of millets in dealing with malnutrition, management of diseases like diabetes, heart conditions, anemia as well as their climate resilience and contribution to nutrition security.

The vibrant millet startup ecosystem in India has come up with innovative and functional products with millets. This is extremely useful if we are to make them as popular as wheat and rice. Although significant strides have been made by many stakeholders in the promotion of millets there are still several aspects that need to be strengthened from both the demand as well as supply aspects.

Consumer Awareness: A retrospective and forward view

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The author is the Co-founder and Managing Director of a social enterprise working for the revival of millets.
Email: md@milletsforhealth.com

practices. Interactions with elders in the family and farmers throw light on their usage in older times. In the Indian subcontinent, millets were used as staple in most households prior to the Green Revolution.

There are many old Indian sayings that highlight the climate resilience of millets. One such saying is,

> सांवा साठी साठ दिन, बरखा बरसे रात दिन।
>
> Even if it rains day and night, Sanwa (Barnyard Millet) and Saathi (a variety of rice) will grow in sixty days.

Millets also find mention in the Krishna–Sudama meeting in Srimad Bhagwat, a religious text, where on return from Dwarka, Sudama is surprised to find his home resplendent.

He reflects that,

> कै जुरतो नहीं कोदो सवाँ, प्रभु के परताप तें दाख न भवत।
>
> Earlier it was difficult for him to even afford grains like Kodo and Sanwa (Barnyard millet) but now they have all kinds of delicacies.

Another folk saying tells us about the ways of consumption of different types of millets.

> मड़ुआ मीन, चीन संग दही, अ कोदो के भात, दूध संग सही।
>
> Finger Millet with fish, Proso millet with curd and Kodo millet rice will best be digested with milk.

Apart from the above references, cultural customs also reflect the prevalence and usage of millets. Millets are used for fasting purposes, songs sung by women during sowing and harvest times mention millets and in many communities, they were also used to bless the bride and groom during marriage ceremonies.

Innovative Millet Products

Although these miracle grains were traditionally a part of our food platter across the length and breadth of the country, their presence in our food plates reduced significantly over the years due to a multitude of factors. Socio-economic dynamics resulting from the hardy nature of the crop, relegated them to be the grain of the poor. They could grow without much input and even in the worst of lands. As a result, they were looked down upon. With the growing support for wheat and rice and easy availability, people moved easily to them due to a desire for upward mobility. In fact, in many places millets have been systematically discouraged from cultivation. *Kodo Kutki Hatao Soyabean Lagao* (Remove Kodo and Little millet and grow Soyabean) was a famous slogan in unified Madhya Pradesh until the early 2000s directed towards millet farmers and encouraging them to move towards oilseeds. All of these factors led to the steady decline of millets from our diverse food plates.

In the post-Covid era, there has been a renewed interest in eating healthy and millets are increasingly finding favour amongst many. The last two years have seen an upswing in the interest and conversation around millets.

The Prime Minister of India in his recent address during the opening ceremony of the International Year of Millets 2023, highlighted how the availability of food is being impacted by climate change. He also spoke about the pandemic and stressed the importance of making millet a future food option due to its health benefits, climate resilience, and potential for food security.

Despite this, there is a significant need to work on awareness and consumption of millets, both within and outside the country. A study assessing Millets and Sorghum Consumption Behavior in Urban India in 2021[1] found that the major reason the respondents did not eat more millets was that it was not eaten at home (40%), followed by reactions such as not liking the taste (22%).

Myths and misconceptions about millets still continue to be widespread. The same study found that there was a significant gap between people who were health conscious (91%) and those who were sure millets were healthy (40%). In rural India, the challenge continues to be the socio-economic view on consuming millets which discourages widespread consumption.

The incidence of gluten intolerance and celiac disease (CD) is on the rise in the European and American markets. In Europe, the incidence of CD is seen to be increasing by 7.5% per year over the past several decades.[2] Millets being naturally gluten-free and nutritious are a perfect alternative and the availability of millets on the shelves is slowly increasing. However, the consumption is limited amongst people with CD, gluten intolerances, or also possibly the Indian diaspora.

To increase demand and make them a regular food option, mission mode campaigning is required which not only encourages people to move towards millets but also counters the myths and misconceptions as well as demystifies their cooking.

Production & Processing of millets

Government, startups, hotels, chefs, and even home chefs have been instrumental in reviving the interest in millets. With the advent of the International Year of Millets, many more people are joining the movement.

To keep this momentum going another aspect that needs attention is the production side of millets. At present, production is limited because millets are being grown only in certain pockets. In addition to this, the processing facilities are also limited and largely present in the southern part of the country.

While major millets like Finger millet, Pearl millet and Sorghum are still easily available due to the ease of post-harvest processing, minor millets like Foxtail millet and Little millet need to be de-hulled before consumption. The prices of these millets become higher due to logistical and transportation issues to the rest of the country. Due to these factors, the supply of millets, especially the minor millets is erratic thereby discouraging further value addition and consumption.

To address this, production as well as processing needs to be supported and encouraged in different states. This will uniformly increase supplies to match the demands and also keep a check on the prices. Unless the cost of production and processing can be brought down, it will be difficult to increase the mass consumption of millets.

We can encourage farmers to grow millets by linking them to markets. Traditional farming across the Gangetic plains used to see millets being grown as the first crop of the Kharif season as it was ready to harvest in 60 days and still leave time for another crop. Systems like the *Barahnaja* (Twelve Seeds)

Millets on the shelf at a market in Slovenia

from Uttarakhand and other mixed cropping practices in different states not only contributed to food security & soil fertility but also to diet and nutrition diversity by including millets, legumes, and other nutritious crops in the basket.

Through the revival of traditional methods and increased facilities available for post-harvest processing and the creation of primary processing clusters at the farm level, we can increase the production and supply of millets in all parts of the country.

India has made many leaps in the processing of millets. While traditionally, the minor millets were hand-pounded, we now have specialised machines that can de-hull millets with ease thereby bringing down the drudgery and cost associated with it and also improving the quality. De-hulling machines are available for multiple scales of operations, ranging from large-scale de-hullers to tabletop ones, and can be deployed accordingly.

Gluten-free value-added products made from millet can be developed for the export market. However, startups & industries will need to ensure they meet the stringent regulations in North American & European markets towards labelling of gluten-free food. Millets are also the right fit for consumers who

Minor millets like Foxtail millet and Little millet need to be de-hulled before consumption. The prices of these millets become higher due to logistical and transportation issues to the rest of the country. Due to these factors, the supply of millets, especially the minor millets is erratic thereby discouraging further value addition and consumption.

Delicious and diverse food made with Millets

are on a vegan, vegetarian, and gluten-free diet due to their high-nutritional value.

A number of studies over the last few years have also substantiated claims made regarding the healing powers of millets. Doctors, nutritionists, and the medical community can be made more aware of these. A study published in August 2021 concludes that consumption of millets reduces hyperlipidemia and hence hypertension, and raises the levels of HDL-C (good cholesterol), which can be beneficial for managing the associated risk of developing hypertension and atherosclerotic cardiovascular diseases in the future.[3]

Another study published in October 2021 showed that millets can reduce Anemia caused due to iron deficiency.[4]

Way Forward

In order to make this sustainable and truly manifest the spirit of the International Year of Millets, it needs to become a mass movement. IYM 2023 places the agenda of millet promotion on an international stage. Millets will now re-enter the food platters both nationally and internationally. However behavioural change takes time. It has taken us many years to forget eating millets and we need to make sure that they are not just seen as a fad. To give them their rightful & continued place in the food basket, concerted & sincere efforts need to be made by all actors in the ecosystem.

Supporting farmers, creating an enabling environment for industry and startups, and increasing awareness among consumers are key to the future of millets. A number of steps have already been taken toward this through India's visionary leadership and the international agenda set for this year. With this momentum, the 'International Year of Millets' is all set to provide a unique opportunity to increase global production, improve processing and promote the consumption of these Indian superfoods. ❑

Endnotes

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Millets in Diet: The Right Approach

Rujuta Diwekar

Millets are back in focus and rightly so. For centuries, they have been cultivated across India and have been an integral part of our food system and festivals. Saints have used millets as metaphors to spread their social messages; our cuisines have developed to incorporate millets as a central food and our agricultural practices, soil and weather are perfectly suited to grow millets. Thus, millets have been an integral part of our culture and are the original Indian superfoods, which are native to the land, can be eaten in multiple ways, have therapeutic benefits and are a part of the folklore.

Millets are good for people and good for the planet. Millets made a comeback due to climate change and the associated food insecurity. Similarly, concerns over deteriorating soil health and the need to provide adequate nutrition to the growing population also became important factors. The resilience and ability to grow in all kinds of soil and weather conditions while requiring minimum inputs, and still providing the right nutrients for sustenance and growth, make millets an invaluable food.

Without delving into why they lost favor in the first place, as that is a topic more suited for economists, this article will focus on how to bring millets back into our diet. But before we get to that, there is something I want to warn you against. Every time a type of food comes into focus, there is always a risk of it being appropriated by the food industry. You can already see that with millets; packaged and processed as pops, chips, cakes, and more. But the trends of the food industry are short-lived and unsustainable, mostly because they try to introduce foods into our lives in ways that are incompatible with our cuisine and time-tested food wisdom. So, if you want to make a serious effort to include millets in your diet, and you must do so, you should do it the right way. Here are five guidelines that will help you with that–

Eat millets as per the season

Our traditional eating practices put a lot of focus on eating food as per the season. It not only ensures easy availability of nutrients at just the time they are needed, but it also ties in beautifully with farming practices and crop cycles. Here is a quick guide about which millets work best for which season:

- **Bajra and Makai** are for the **winter**: eat them with jaggery and ghee
- **Jowar** is better for **summer**: eat it with chutney
- **Ragi/Nachni** is eaten **year-round**, but especially during rains, and can even be turned into a dosa, laddoo, porridge, etc.
- The lesser-known millets are usually linked to change of season, mostly tied to festivals. A few examples of such millets are raajgira, samo, kuttu, and mandua.

Eat millets with the right food combination

Another critical learning from indigenous food wisdom is the food combinations that are inherent to our cuisines. These food combinations ensure that the right ingredients come together and make digestion and nutrient assimilation easier. Combining millets with pulses, spices, fats, etc., also ensures that limiting amino acids are compensated for, protein quality/digestibility is improved and the effect of anti-nutrients like phytates, tannins, trypsin, etc., is reduced. Millets that are particularly hard to digest, like Bajra should preferably be taken with a dollop of makhan (white butter) or a tsp extra of ghee, and never without jaggery. One can't but marvel at *dadis and nanis ke gharelu nuskhe* of turning every meal into a joy, long after it's been consumed.

The author is India's leading nutrition and exercises science expert. Email: mitahar@gmail.com. Website: www.rujutadiwekar.com

Nutrition from millets

Apart from being inexpensive and easier to grow, they are a rich source of many vitamins, minerals, and fibre.

Some of these are–

- *Niacin, a type of Vitamin B found in millets is useful in energy production, and nerve health and keeps the digestive tract healthy. If you have food intolerances, this is very helpful.*
- *The magnesium, Zinc, and fibre found in millets make it an excellent food for blood sugar regulation, especially for PCOD and Diabetes.*
- *Folic acid helps with iron assimilation and improves skin, health, and fertility.*

Making a millet bhakri

Is there a way for us to eat millets where we can access all of their nutrients and create no ecological waste? Yes, there is. And it is a well-known one. Just use your millets and convert them into a bhakri/rotla. Eat them with a sabzi, dal, or chutney.

I know that it's tough to make the rotlas and that they break but I am going to share a kitchen secret on how to roll them without breaking - Add warm water while kneading the atta and then hand press them before you put them on your iron tava.

Eat millets in all forms

The diversity in the ways in which we can consume millets is staggering and a testament to the brilliance of our grandmothers. The germination and fermentation for satva, kheer or porridge, as the soaking and heating for khichdis, bhakris, and laddoos, not just helped in dealing with the antinutrients (naturally occurring substances that come in the way of assimilation of minerals, amino acids, etc.) but also ensured that there is no taste fatigue while eating nutritious and healthy food.

Don't eat multigrain

If one is good, many are not necessarily better. Mixing grains might sound better on paper but that's not how it works in reality. There is ease and wisdom in keeping things simple and not being greedy for nutrients, antioxidants, fibre, etc., every time we discover the benefits or goodness of our foods. Remember, food is medicine but not in form of a pill, powder, potion, or multigrain atta.

Don't replace all grains with millets

Lastly, know that millets are not a replacement for rice and wheat, atleast not a complete replacement. Again, it comes to sustainability and common sense. So, continue with the rice and/or wheat for normal consumption but don't forget the weekly bhakri, the seasonal laddoos, and the daily porridge.

Moving away from traditional foods reduces farming of traditional foods, which in turn has an adverse effect on soil health and ecology, putting not just our health but our entire future at risk. Bring back the millets on your plate. ❑

Millet Cultivation in North-East India

M Premjit Singh
Punabati Heisnam

In Arunachal Pradesh, millets such as foxtail millet, proso millet, finger millet, and pearl millet are the most frequently grown crops among millets under jhum cultivation. They provide a variety of seasonal native foods for traditional uses including ceremonies, occasions, and festivities. Additionally, the permanent kind of settled agriculture or terrace cultivation was not very effective in this area due to the undulating mountainous terrain, heavy rainfall, inadequate irrigation systems, and lack of plain land. Jhum cultivation was the sole viable source for providing food.

Millets are often grown in tropical and subtropical regions at an altitude of 2,100 m. Being a heat-loving plant, 8-10° C is the required minimum temperature for germination. These crops can tolerate a certain level of soil alkalinity and adapt well to a variety of soil types, from extremely poor to very fertile. Sandy, loamy, and alluvial soils with good drainage are the best types of soil for them. At the onset of monsoon, land should be ploughed deeply with a soil-turning plough. For effective germination and crop establishment, fine tilth is crucial. Its cultivation in Jhum field is ideal during the months of April and May. The ideal growth temperature range for millets is between 26-29° C for optimum production and good crop yield. It is grown in regions with rainfall between 500 and 900 millimetres.

Calcium, iron, protein, fibre, and other minerals are abundant in millets. The cereal primarily contains unsaturated fat, which has a low-fat content. The absence of gluten makes it simple to digest. Given its lower glycemic response or reduced capacity to spike blood sugar levels, it helps diabetics maintain blood sugar levels. Millets are one of the most nutrient-dense cereals and also aid in maintaining bone health, decreasing blood cholesterol, regulating anemia, and keeping weight under control.

Importance of Organic Agriculture in Millets

India's agricultural industry entered a new phase with the Green Revolution in the 1960s. By adopting high-yielding wheat and rice varieties and contemporary agricultural techniques, which required the substantial use

Foxtail millet cultivation in Upper Siang District of Arunachal Pradesh

M Premjit Singh is former Vice Chancellor, Central Agricultural University, Imphal, Manipur. Email: mpremjit55@gmail.com
Punabati Heisnam is Assistant Professor in the same University.

Table –1 Mean Area, Production and Yield of Millets in Millet-growing Districts of Arunachal Pradesh during the past 20 years (1997-2016)

District	Small Millets			Total Millets		
	Area (ha)	Production (ton)	Yield (kg/ha)	Area (ha)	Production (ton)	Yield (kg/ha)
Anjaw	1106	1046	945	1106	1046	945
Changlang	1830	1446	790	1830	1446	790
Dibang Valley	779	695	892	779	695	892
East Kameng	624	638	1022	624	638	1022
East Siang	2214	2645	1195	2214	2645	1195
Kurung Kumey	488	471	965	488	471	965
Lower Dibang Valley	1466	1130	771	1466	1130	771
Lower Subansiri	1710	1826	1068	1710	1826	1068
Papum Pare	651	809	1243	651	809	1243
Tawang	948	1082	1142	948	1082	1142
Tirap	3895	2985	766	3895	2985	766
Upper Siang	1170	980	838	1170	980	838
Upper Subansiri	1319	1549	1174	1319	1549	1174
West Kameng	1148	1113	970	1148	1113	970
West Siang	2524	2161	856	2524	2161	856

Source: Bhat *et al., (2019)*[1]

of chemical fertilisers and pesticides, the requirement for large-scale food production was addressed. Although this movement had brought a significant increase in the total production of food crops, it also had a significantly worsening effect on the environment. Water bodies were poisoned and agricultural land was extensively destroyed as a result of the use of pesticides and the quick succession of crops without giving the soil enough time to restore its nutrient quality.

The country's rivers and waterways have been devastated by the relentless cultivation of cereals and other crops with extensive use of chemical fertilisers to boost crop yields. A number of these rivers have become so contaminated that their water cannot be used for any purpose. The once-fertile soils are now unsuited for growing any crop and the same issues can be experienced in Arunachal Pradesh if not addressed in time. In recent years, this issue has gotten worse as the impact of climate change has been more widespread. Agricultural communities all over India have been hit by the abrupt rise in temperature and the ensuing water constraint. In Madhya Pradesh, known as India's "Wheat Bowl," repeated heat waves have negatively harmed wheat production. However, the recent monsoon failure in India's North Eastern States, where most farmers depend on rain-fed agriculture to raise their crops, has had a catastrophic impact on the local farmers in the area. Similarly, Kaveri river's water deficit caused almost 70% of the crops being grown in Tamil Nadu's agricultural belt to fail.

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The negative consequences of climate change are not limited to India; many nations throughout the world are experiencing crop failures as a result of unpredictable seasonal changes. Due to the increasing frequency of droughts in some of India's most productive agricultural regions, farmers must adopt farming techniques that have the least negative environmental effects while still yielding an adequate amount of crops to support both their livelihood and the nation's food demand. This is where sustainable organic farming and millet cultivation comes into play.

Nutrient management in organic millet cultivation

Millets do not require chemical fertilisers. In fact, they grow better

in dry conditions without chemical fertilisers. Therefore, most farmers grow it with farmyard manure in purely ecological conditions. In recent years, farmers have also started using organic fertilisers like vermicompost found in their backyard. Growth promoters like *Panchagavya, Amritpani* are also used. These practices not only make millet production environmentally friendly but also make them remain under the farmer's control.

Proso millet cultivation in East Siang District of Arunachal Pradesh

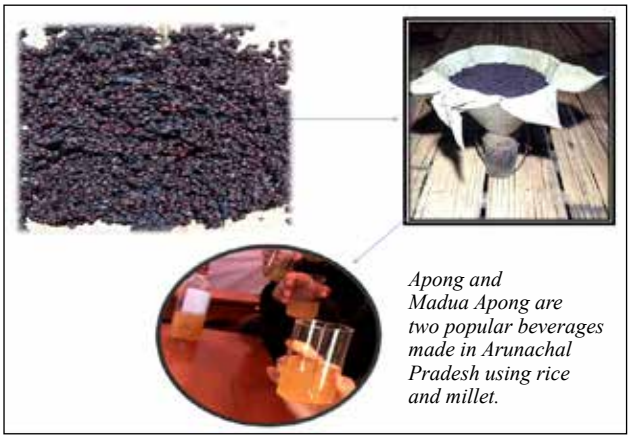
In organic millet farms, nutrient management should efficiently supply crop's nutrient needs, prevent nutrient depletion, and maintain or increase soil productivity without disproportionate nutrient losses. The various chemical, physical, and biological factors of the soil influence availability of nutrients in the soil and their interaction with the crop growth. Crop performance is a yardstick for several soil parameters and is regarded as the best indicator for a measure of soil productivity.

Millet farmers frequently succeed in enhancing the physical and chemical characteristics of the soil for sustained productivity by using techniques like:

1. Using organic material, such as compost, vermicompost, farm yard manure, and bio-fertilisers, to preserve soil organic matter and deliver nutrients.
2. Using cover crops to recycle soil nutrients and biologically fix nitrogen from the atmosphere.
3. Planting green manure legumes in situ or using green leaf manuring and incorporating them into the soil.
4. Intercropping or growing multiple crops simultaneously.
5. Rotation of crops.
6. Management of crop residues.

Shifting cultivation of millets in hill/tribal areas

Shifting cultivation, also known as "Slash and burn" or "Swidden," is a type of farming used by tribal groups in Arunachal Pradesh. This farming approach permits the production of two or three annual crops before abandoning the field until the trees have recovered enough to permit a second filling. This cycle continues until there is no more chance for forest growth since the land is so stripped of its soil. The majority of the crops planted on lands under shifting agriculture are millets, specifically finger millet, small millet, foxtail millet, proso, kodo millet, pearl millet, and sorghum. In addition to millets, valuable commercial crops are grown, including red gram, horse gram, castor, plantain, and turmeric.



Apong and Madua Apong are two popular beverages made in Arunachal Pradesh using rice and millet.

A variety of millet varieties, including finger millet, foxtail millet, pearl millet, barnyard millet, little millet, and sorghum, are broadcast on hill slopes during the summer, and paddy seeds are typically sown as the monsoon season approaches. Vegetables and other crops are also grown at the same time.

Since they don't use any chemical pesticides or fertilisers, tribal farmers don't need to take any action to control pests and diseases. By default, all aspects of jhum production fall under organic farming. Slash-and-burn techniques are frequently used to clear the land; trees, bushes, and forests are cut down by slashing, and the leftover flora is burned, adding potash to the soil as it burns. Hill soils are more susceptible to soil erosion and other natural processes because of the slope and topography, which lowers soil fertility. Additionally, in hilly places, animal dung is a crucial source for repairing and sustaining the fertility of these soils. By virtue of a symbolic connection, animal have continued to be a crucial component of diverse farming systems in the hills.

Application of organic matter to the soil

Manures: In organic farming, applying manure to the millet crop is frequently a beneficial source of nutrients. However, because millet crops extract more nitrogen and potassium than phosphorus, using manures to fulfil all of the crop's nutritional requirements could result in an excess of some nutrients, such as phosphorus. Although it is unlikely that crops will be harmed by the excessive soil phosphorus added through organic manures, it does contribute to phosphorus loss in runoff and erosion. As a result, organic systems or biological nitrogen fixation must be used to supplement manure nitrogen.

Due to the increasing frequency of droughts in some of India's most productive agricultural regions, farmers must adopt farming techniques that have the least negative environmental effects while still yielding an adequate amount of crops to support both their livelihood and the nation's food demand. This is where sustainable organic farming and millet cultivation comes into play.

Compost: By using biological processes in under-regulated settings, composting is a technique that transforms organic wastes into organic fertilisers with increased nutrient concentrations while also reducing the bulk of organic materials through the loss of water and carbohydrates during decomposition. Composting also often kills some diseases and weed seedlings, making it easier to handle than bulk organic material.

Cover crops: Cover crops can enhance the microbial activities, nitrogen cycling, and physical characteristics of the soil. In addition, cover crops can recover leftover nitrogen mineralised from soil and organic amendments before it is lost by volatilisation, runoff, or leaching. The nitrogen available in biomass from cover crops, like found in other sources of organic nitrogen, is not fully available to the following crops. In organic farming, cover crops can be a sustainable and affordable source of nutrients by supplying plants' needs for micronutrients, phosphorus, and potassium.

Green Manures: Green manure is the term for uncomposted, green plant matter used as manure. There are two ways to get it: either by planting green manure crops or by gathering green leaves and twigs from plants growing in wastelands, field bunds, and forests. Leguminous plants, which make up the majority of green manures grown in fields, are often integrated into the soil once they have grown sufficiently. Sunhemp, dhaincha, *pillipesara,* cluster beans, *and Sesbania rostrana* are the most significant crops for producing green manure.

Crop rotation: Crop productivity, nutrient availability, insect control, nutrient usage efficiency, and soil physical qualities can all be improved through crop rotation. Legumes

grown as crop rotation might result in adding nitrogen for succeeding crops because of biological nitrogen fixation and less nitrogen immobilisation than growing non-legume as the preceding crop.

Consumption habits of millets in the region

Zan: The most favoured porridge recipe among the monpa tribes of Arunachal Pradesh. The dish is made using millet flour. They eat this for breakfast in the morning. It is nourishing and filling. They typically season it with salt and eat it alone or with some vegetables, meat, fermented soy beans and fermented cheese.

Apong: Apong and Madua Apong are two popular beverages made in Arunachal Pradesh using rice and millet, respectively, through an unrestrained fermentation process. Among the tribes, Mirung (Millet) is used to make Madua Apong, a dark red organic wine. The Adi and Nyishi Tribes frequently brew this. For the Adi tribe, it represents more than just brewed wine, it is an integral part of their culture and religion. It is important to the traditional Adi tribal culture since it relates to shamanic practices, ritualistic principles, and folklore. The Adi tribe holds its annual Solung Festival in the month of September. Apong is served as a staple and distributed to everyone throughout the festival.

How is Apong made?

After millet is harvested from the fields, it is dried in the sun or in some circumstances above a traditional kitchen hearth. Then, in a sizable wok, it is dry-roasted until it turns a dark shade of black while being constantly stirred to prevent burning. A bamboo mat (Epuh) is used to spread the roasted millet out to cool. The local yeast made by grinding rice (siye) is blended with the cooled millets when it has cooled, and then the mixture is transferred to an airtight container to start the fermentation process. After 15-20 days or so the fermented stock gives off a strong aroma to show it is ready. The container is kept in a cool, dry location during this period. After that, the mixture is distilled to extract Apong. Various tribes in Arunachal Pradesh have their own unique ways for making alcoholic beverages.

Millets are said to be the forerunner of the evergreen revolution and therefore, also can be referred to as Miracle Grains and a boon to the region. ❑

The other contributing author is Abhinash Moirangthen who is an Assistant Professor in Agriculture University in Imphal, Manipur.

Endnote

1. Bhat, B.V., Arunachalam, A., Kumar, D., Tonapi, V.A. and Mohapatra, T. (2019). Millets in the Indian Himalaya, Indian Council of Agricultural Research, New Delhi, 84p.

India's Wealth: Millet for Health

Dr Manisha Verma

The Government of India has initiated the revival of millets in the past few years and declared 2018 as the "National Year of Millets" to raise awareness about its health benefits and boost millet production. They are labelled as "Nutri-cereals" due to their high nutrition quotient. Millets were included under Prime Minister's overarching scheme for holistic nutrition, POSHAN Abhiyan in the same year.

Under the leadership of the Prime Minister, the Government of India proposed at the United Nations for declaring 2023 as the International Year of Millets. India's proposal was supported by 72 countries and United Nations General Assembly declared 2023 as the International Year of Millets (IYM 2023) on 5th March 2021.

As India celebrated its glorious 76th Independence Day on 15th August 2022, in his speech from the ramparts of Red Fort, Prime Minister said that millets have been an integral part of India's legacy.

The celebration of 2023 as the International Year of Millets is a matter of immense pride for India and in particular for the farmer community. To take forward this declaration, the Government of India has decided to celebrate IYM 2023 by making it a peoples' movement or "Jan Andolan" to enhance awareness regarding millets as a healthy option for the food basket. Activities are also being taken up to propel demand creation of millets at both global and local levels, for better remuneration to the farmers for its production, to provide protection of sources (soil and water), and creation of direct and indirect employment. India produces more than 170 lakh tonnes of millets per year and is the largest producer of millets in the world; accounting for 20% of global production and 80% of Asia's production. India's average yield of millets (1239 kg/hectare) is also higher than global-average yield of 1229 kg/hectare. Major millet crops

The author is Additional Director-General (Media and Communication), PIB, Ministry of Health & Family Welfare, Government of India. Email: pibhealth@gmail.com

grown in India and their percentage share of production are Pearl Millet (Bajra) – 61% share, Jowar (Sorghum) – 27%, and Finger Millet (Mandua/Ragi) – 10%.

In his addresses on various national and international forums, the Prime Minister has highlighted how India is honoured to be at the forefront of popularising millets that further nutrition, food security, and welfare of farmers. This also offers research and innovation opportunities for indigenous agriculture scientists and startup communities. Recently, in the popular talk show "Mann ki Baat", he mentioned that millets have been a part of our tradition, culture, and ancient civilisation, their relevance being cited in sacred texts such as Vedas, Puranas, and Tolkappiyam. From time to time, his addresses on millets have created an enthusiastic wave for the celebration of IYM 2023 in India.

What are Millets?

Millets, popularly called "Mota Anaj" in Hindi, are a collective group of small-seeded annual grasses that are grown as grain crops, primarily on marginal land in dry areas of temperate, sub-tropical, and tropical regions. They are one of the ancient foods dating back to the Indus Valley Civilisation, around 3000 BC. They are grown in almost 131 countries today. Currently, millets constitute the traditional food for 59 crore people across Asia and Africa.[1]

In India, millets can be clubbed into major, minor, and pseudo categories.

1. **Major Millets:** Sorghum (Jowar), Pearl Millet (Bajra), Finger Millet (Ragi/Mandua)
2. **Minor Millets:** Foxtail Millet (Kangani/Kakun), Proso Millet (Cheena), Kodo Millet, Barnyard Millet (Sawa/Sanwa/ Jhangora), Little Millet (Kutki)
3. **Pseudo Millets:** Buck-wheat (Kuttu) and Amaranth (Chaulai)

The top five states producing Millets are Rajasthan, Karnataka, Maharashtra, Uttar Pradesh, and Haryana.

Millets, popularly called "Mota Anaj" in Hindi, are a collective group of small-seeded annual grasses that are grown as grain crops, primarily on marginal land in dry areas of temperate, sub-tropical, and tropical regions. They are one of the ancient foods dating back to the Indus Valley Civilisation, around 3000 BC.

What is the importance of Millets?

Climate-friendly crop:

Apart from its health benefits, millets are resilient to climate change as they are pest free, adapted to a wide range of temperatures and moisture regimes, and demand less input of chemical fertilisers to grow; thus making them bio-diverse and climate-smart crops. These crops have low carbon and water footprints. Requiring minimum rainfall for their growth, they can even sustain in drought-prone areas.

Popularising millets in Telangana

Kumaram Bheem Asifabad is a predominantly tribal and one of the most backward districts in Telangana. The district had a significant number of children, women, and adolescent girls with multiple malnutrition indicators like being underweight, wasting, and anemia. The district under the Project Sampoorna focused on ensuring the availability of traditional and local food like millets. Towards this objective, various activities were undertaken in a span of 3 months that included 33 food festivals and 10 millet recipe trainings which were conducted covering 225 Anganwadis. In addition, millet cooking videos were shared through social media among beneficiaries. Further, 10 millet cooking training sessions within 10 days in 225 Anganwadis were conducted for targeted women. In addition to the above, millets were made available for local purchase. Home visits were undertaken and the monitoring of the same was carried out by supervisors and district officers on day-to-day basis. To promote millet cultivation, Agriculture Officers trained 2500 farmers covering more than 1000 acres of land, and subsidised seeds were distributed. SHG Women were trained in production, processing, and marketing through which 973 Shops were established covering all Anganwadis where millets were made available at subsidised prices. Under decentralised Millet Village Circular Economic Model, millets are grown, procured, processed, packaged, and sold locally to villagers at cheaper prices. Following the initiative, behavioural change has been observed in the community and it has been seen that 80% of beneficiaries have acceptance for millets and are now consuming millets and nutritional vegetables in other two meals, other than supplementary nutrition provided at Anganwadis.

Source: Ministry of Women and Child Development

Viable options for small farmers:

Due to the low investment needed for the production of millets, they millets prove to be a sustainable and viable income source for small and marginal farmers.

Millets as a part of the welcome kit given to the Sherpas of G20 during their recent visit to India

High in nutrition and health benefits:

Millets are known to be a storehouse of nutrition as they are good sources of calcium, zinc, magnesium, phosphorous, copper, vitamin, iron, folate, carbohydrates, micronutrients, antioxidants and phytochemicals with nutraceutical properties.

They are gluten-free and are also considered good for celiac patients. The promotion of millets is now being seen as an effective strategy for tackling malnutrition in the country. The nutrition and health-packed millets hold special significance in today's times when people are gravitating to healthier options.

Economic and food security:

Once known as the 'poor man's food grain', millet have been cheaper in price in comparison to other food grains. Under India's National Food Security Mission the area, production of millets have increased. Over the years, the production of millets has increased from 14.52 million tonnes (2015-16) to 17.96 million tonnes in 2020-21 (Department of Agriculture and Farmers Welfare). Its exports are increasing exponentially as the demand for millets is increasing at a fast rate worldwide. With the growing demand for millets, it is creating more business opportunities for all stakeholders.

Millet as a part of the Food basket

The Government of India has initiated the revival of millets in the past few years and declared 2018 as the "National Year of Millets" to raise awareness about its health benefits and boost millet production. They are labelled as "Nutri-cereals" due to their high nutrition quotient. Millets were included under Prime Minister's

overarching scheme for holistic nutrition, POSHAN Abhiyan in the same year.

The Government of India also launched Mission POSHAN 2.0 in 2021 to tackle malnutrition and leverage traditional knowledge systems and popularise the incorporation of millets in local recipes in order to enhance the quality of supplementary nutrition.

Under the POSHAN Abhiyan every year, September is celebrated as Rashtriya Poshan Maah or National Nutrition Month across the country. The Ministry of Women and Child Development has further encouraged all states and union territories to incorporate millets in the recipes to enhance the nutritional quality of the meal provided under the Supplementary Nutrition Programme of Anganwadi Services. Millets are being mandatorily supplied at least once a week.

Various creative campaigns on several forums such as radio, print, social media, offline events, and activities are being taken up to break the stigma of millet being the "food of the poor", showcasing it as a superfood, combating misinformation, reviving lost recipes, thus making it as an essential part of the mainstream food basket.

Balanced diets based on locally available low-cost nutritious foods and benefits of consuming millets are being shared with mothers' groups through the Anganwadis. Millets are being incorporated in supplementary nutrition in several States and Union Territories such Odisha, Telangana, Chandigarh, etc.

Initiatives towords making IYM 2023 a success

The Government has embarked on a nationwide Jan Andolan to enhance awareness and highlight the nutritional benefits of millets, positioning it as a modern-day healthy food that is easy to cook and quick to prepare. Various creative campaigns on several forums such as radio, print, social media, offline events, and activities are being taken up to break the stigma of millet being the "food of the poor", showcasing it as a superfood, combating misinformation, reviving lost recipes, thus making it as an essential part of the mainstream food basket. Millets have been showcased in various reputed events like India International Trade Fair, Dubai Expo and Surajkund Mela, etc.

Over 500 startups are working in millet value chain while the Indian Institute on Millet Research has incubated 250 startups under RKVY-RAFTAAR. More than Rs. 6.2 crores has been disbursed to over 66 startups while about 25 startups have been approved for further funding.

Food Safety and Standards Authority of India (FSSAI) is actively spreading awareness of the health benefits of the miracle crop by celebrating "Recipe Ravivar" every Sunday on social media platforms where each month is dedicated to a specific variety of millet. Over 100 Walkathons and Eat Right Melas have been organised in various cities across the country.

Besides this, under directions of the Union Minister of Health & Family Welfare, with a view to introducing healthier food options to people, Union Health Ministry has done away with fried food such as samosa, bread pakoras, and the like from its canteen menu in favour of healthier options such millet roti, cheelas, etc.

The Government of India has launched a set of seven sutras in the run-up to IYM 2023 and has allocated different government departments for the same. The seven sutras outline areas in the enhancement of production/productivity, nutrition and health benefits, value addition, processing, and recipe development, entrepreneurship/startup/collective development, awareness creation-branding, labelling and promotion, international outreach, and policy interventions for mainstreaming.

Of the seven sutras, nutrition and health benefits will focus on generating awareness regarding health and nutrition benefits by developing mass campaigns such as Eat Right Campaigns, enhancing steps to avail technology support for Indian Agricultural Research Institute (ICAR), SAUs and others like Indian Council of Medical Research (ICMR), National Institute of Nutrition (NIN), AYUSH, Indian Institute of Millets Research (IIMR), Central Food Technological Research Institute (CFTRI) and International Crops Research Institute for Semi-arid Tropics (ICRISAT) to research and collate evidence, promoting biofortification of millets, giving more focus on the digital publication of papers on millets, encouraging commissioning of studies by National/International reputed organisations, spreading awareness among mothers through Anganwadis. The Government also plans to establish Centres of Excellence on millets across the length and breadth of the country and link industries with these centres.

Conclusion

Due to various activities and efforts of different Departments and Ministries of Government of India and the states and UTs, momentum has kickstarted for popularising millets and turning it into a revolutionary movement. In line with Prime Minister's vision for a healthier India, at a time when the country is entering "Azadi ka Amrit Kaal", there is a strong focus on *Jan Bhagidari* or people's movement to bring the spotlight on this superfood and for bringing this ancient food to the centrestage. ❑

Endnote

1. FAO; http://www.fao.org/3/w1808e/w1808e0c.htm

Health Benefits for Lifestyle Diseases

Dr Sundeep Mishra
Dr Priyanka Chandolia

Millets are native grains of many countries including India and can be an alternate staple food. Furthermore, because of their low carbohydrate-fibre ratio, they can also be useful in many lifestyle diseases. Millets are also 'nutritional supplements' that have phytochemicals and anti-nutrients that are essential for preserving good health and having a significant impact on the treatment of chronic illnesses.

Millets are considered wonder foods. With their high levels of fibre content, vitamins, minerals, phytochemicals, and antioxidants, they can help fight many modern-day, lifestyle diseases. Important amino acids enhance millets' nutritional value. However, the nutritive and medicinal potentials of bioactive chemicals found in millets are largely unexplored, and a thorough evaluation of existing evidence in the literature is lacking. Millets include many bioactive principles that have been shown to reduce cardiovascular risk, diabetes, aging, and even cancer. This article illustrates recent improvements in nutritional characteristics, processing methods, and their impact on lowering anti-nutritional factors and increasing nutrient bioavailability, as well as the possible health advantages of millets. This review also discusses the consumption of various traditional and modern millet-based foods, as well as the bioavailability of minerals after ingesting millet-based foods.

Millets are native grains of many countries including India and can be an alternate staple food, able to overcome issues such as water scarcity, desertification, global warming, and managing carbon footprints. Furthermore, because of their low carbohydrate-fibre ratio they can also be useful in many lifestyle diseases like cardiac, diabetes mellitus, and some kinds of cancer (Table 1). Consumption of dietary fibre lowers the absorption of glucose maintaining blood glucose levels and is thus useful in Non-Insulin Dependent Diabetes (NIDDM). Moreover, fibre also binds cholesterol, thus protecting from heart disease. Millet fibre owing to its incomplete/slow fermentation by microflora in the large intestine allows normal gut functioning. Dietary fibre contributes to fecal bulk and along with it increased fecal mobility and fermentation of contents all contribute to the prevention of colon cancer.

Millets are also 'nutritional supplements' that have phytochemicals such as flavonoids, saponins, tannins such phenols, tannins, flavonoids, alkaloids, and terpenoids and anti-nutrients that are essential for preserving good health and having a significant impact on the treatment of chronic illnesses. They include vital amino acids, carbs, lipids, fibres, folic acid, vitamins like thiamine, niacin, and riboflavin, as well as minerals like iron, calcium, and potassium. The dietary items made from millet products feed the body and guard against several illnesses including diabetes, cardiovascular disease, cancer, inflammation,

Table 1: Carbohydrate-to-fibre ratio of common millets compared with rice

Cereal	Common Name	Dietary Fiber Content (g/100g)
Finger Millet	Ragi	11.2
Foxtail Millet	Kangani	11.2
Pearl Millet	Bajra	11
Sorgham	Jowar	9.7
Proso Millet	Cheena	9.1
Little Millet	Sama	7
Rice	Chawal	3.2

Dr Sundeep Mishra is VC, NIMS University, Rajasthan, Jaipur and former Professor, AIIMS.
Dr Priyanka Chandolia is associated with Institute of Pharmacy, NIMS University, Rajasthan, Jaipur.
Email: drsundeepmishranic@gmail.com

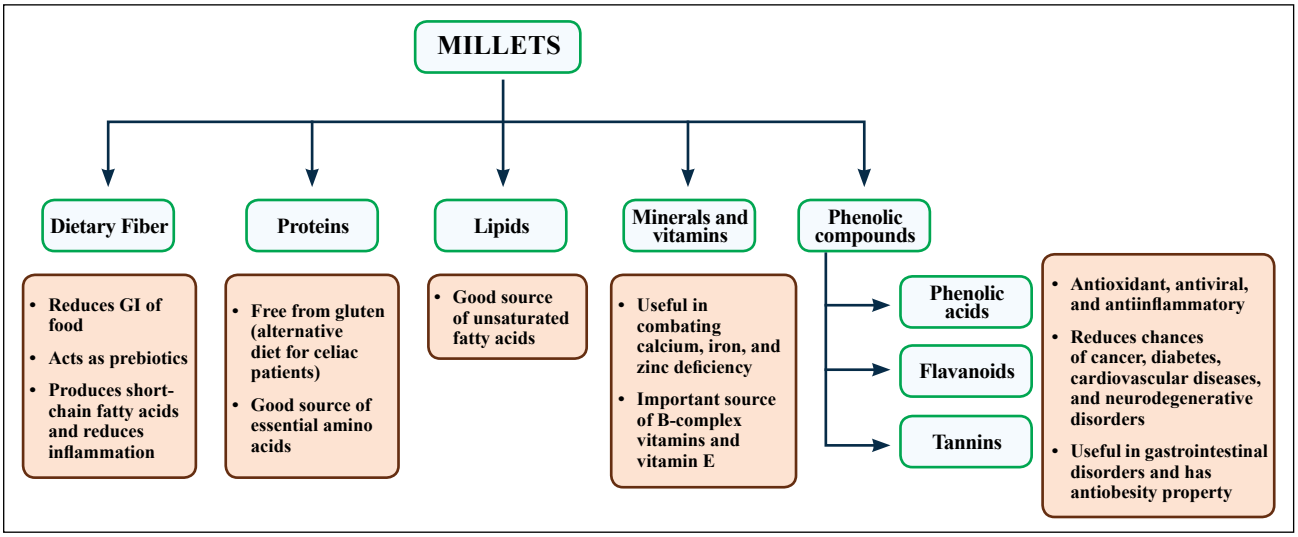


Figure 1: Phytochemicals present in Millets

gastrointestinal problems, and others. Despite the fact that millets are frequently farmed in dry and semiarid environments, their nutritional value and possible health advantages have received little attention. The nutritional content and other bioactive phytochemicals as shown in (Fig 1) of major and minor millets vary greatly. The current review is an attempt to assemble firsthand evidence on nutritional content and its role as a strong phytotherapeutic against a variety of diseases.

India's consumption pattern has been considerably impacted by modernisation, leading to decreased consumption of some grains like millets and increased consumption of foods derived from animals, such as oil, refined sugar, fat, and alcohol. Around 71% of all fatalities worldwide are now attributed to non-communicable illnesses, a burden that has escalated as a result of this consumption pattern. Additionally, the current pattern of intake is crucial in causing oxidative stress. The imbalance between the production and accumulation of reactive oxygen species (ROS) in cells and tissues often leads to oxidative stress. Furthermore, ROS have a role in the development of NIDDM, mutagenesis, carcinogenesis, and DNA damage. Cancer is one of several illnesses caused by damaged DNA. Increase in oxidative stress can significantly contribute to inflammatory diseases like arthritis, vasculitis, adult respiratory disease syndrome, and muscular dystrophy, as well as to AIDS and other conditions.

The human body has numerous indigenous antioxidants (naturally produced or given externally through diet) to combat oxidative stress. These antioxidants work as free radical scavengers in preventing and repairing the damages caused by ROS, improving immunological defense, and reducing the risk of degenerative illnesses. Antioxidants are naturally present in millets. Additionally, millets' free radical scavenging ability can help to prevent and treat diseases that are caused by free radicals as well as lower ROS. Consuming millet will thereby reduce the risk of the mentioned degenerative illnesses by inhibiting oxidative stress.

Benefits of Millets

A. Impact of Millets on Diabetes Mellitus & Heart Disorders

Hyperglycemia and altered protein, carbohydrate, and lipid metabolism are hallmarks of NIDDM, a long-term metabolic illness. Dietary glycaemic load is directly linked to a higher risk of developing NIDDM. Dietary fibre is crucial for glucose regulation. Millet is an excellent source of leucine, slowly digesting carbohydrate (and minerals), blunting the otherwise sudden increase in post-prandial glucose level, thus making it a nutritious food for diabetes. In-vitro studies have revealed effectiveness of millets in controlling postprandial hyperglycemia. Additionally, in-vivo studies have also demonstrated the hypoglycemic effects of millet-based foods following intervention.

Increasing the risk of NIDDM significantly increases the risk of heart disorders. Low-density lipoprotein (LDL) and high-density lipoprotein (HDL) have opposing effects on the chance of developing heart disease. Accordingly, every 1 mg/dL rise in LDL raises heart disorders risk by 2%, and every 1 mg/dL increase in HDL lowers heart diseases risk by 2-3%. Another factor contributing to the risk of heart disorders is triglyceride, since there has been a long-standing correlation between an elevated triglyceride level and the chance of developing heart diseases. Lowering LDL cholesterol has proven to be the most effective heart diseases prevention strategy out of all others. Therefore, to reduce the risk of heart disorders, a diet that decreases LDL should be chosen. Millets enriched in niacin reduce LDL and triglyceride levels and correct lipoprotein abnormalities. Furthermore, millets retard the

absorption of dietary cholesterol. Thus, millets-rich foods are suggested as one of the means to reduce the risk of heart disorders. In-vivo studies show that millet-based meals reduce LDL and increase HDL while decreasing triglycerides (without enhancing LDL level). An in-vivo investigation, on the other hand, discovered a substantial drop in blood glucose and cholesterol levels without affecting HDL.

B. Impact of Millets on Cancer

Millet grains include phenolic components such as phenolic acids, flavonoids, and tannins, making them anti-nutrients that lower the incidence of colon and breast cancer in animals. An in-vivo study demonstrated that a novel 35kD protein called Fibroin-modulator-binding protein (FMBP) extracted from foxtail millet suppresses the growth of colon cancer cells by inducing G1 phase arrest and the loss of mitochondrial transmembrane potential, which results in apoptosis (programmed cell death) in colon cancer cells via caspase activation.

Another in-vivo study found that adding foxtail millet to one's diet promotes the activation of the gut receptor, which in turn aids in the treatment of colon cancer linked to colitis. As a result of the study, it was discovered that millet-based diets aided in suppressing the STAT-3 signaling pathway. In cancer cells, unregulated cell proliferation, angiogenesis, and apoptosis evasion are all crucially influenced by the STAT transcription factor family.

C. Impact of Millets on Brain Disorders

Several studies have shown that excessive fat consumption in the human diet can not only increase risk of heart diseases but recent epidemiological research has revealed that dementia risk is also increased by a high-fat, high-calorie diet. Due to the fact that an HFD has been shown to generate oxidative brain dysfunction may result from stress in the brain. Additionally, oxidative stress is reportedly a catalyst and aggravating factor for neurodegenerative conditions like Addison's disease (AD). Increased oxidative stress also stimulates pro-inflammatory factor production, which results in inflammation in the brain, which can cause dementia. The cerebral cortex and hippocampus often exhibit tau tangles and amyloid plaques, which are hallmark pathology features of AD. Reducing oxidative stress is proposed to either prevent or lessen the degree of brain dysfunction. In northwest China, millet has long been a staple diet and a venerable traditional grain. High quantities of polyphenols in millet demonstrated remarkable oxidation resistance. However, there aren't many researches that discuss millet polyphenols in-vivo antioxidant activity. A research indicates that polyphenols and their metabolites are crucial in controlling the amount of oxidative stress in the brain. Either by directly crossing the blood-brain barrier into the brain or by being transformed into tiny metabolic derivates with increased biological activity through the metabolism of intestinal microbiota, dietary polyphenols may have antioxidant and neuroprotective effects.

Millets due to their low carbohydrate:fibre ratio, high antioxidants, and other effects are useful in lifestyle diseases like cancer, diabetes, and cardiovascular problems. In terms of production and climatic sensitivity, millets may be even more important than staple grains and health-wise they may be preferable to other cereals because they contain vital amino acids (such as leucine, isoleucine, valine, and phenylalanine), minerals (calcium, iron, and zinc), vitamins, phytochemicals, antioxidant qualities but most importantly fibre. ❑

Other contributing author is Dr Hemant Bareth who is associated with Institute of Pharmacy, NIMS University, Rajasthan, Jaipur.

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Millets for Pregnant and Lactating Women

Ravindra Kumar

Millet-based foods have a positive impact on the nutritional status of pregnant women. It is recommended that millets may be incorporated into the diet of pregnant women in the form of supplementary food. The millet-based complementary food products are very nutritious for pregnant women and lactating mothers. Nutrition wise, millets are free from gluten and rich in polyphenols, antioxidants, vitamins, minerals, and dietary fibres that are important for the functioning of a healthy body.

Pregnancy is a physiological condition with an increased demand for nutrients to promote the growth and development of foetus with changes in weight, plasma and blood volume. Anaemia caused by iron deficiency is one of the major health problems in pregnant women due to inadequate intake of iron-rich foods. Similarly, lactating mothers also suffer from iron deficiency anemia due to blood loss in the post-natal period. It is important to provide complete nutrition among pregnant women and lactating mothers to fulfill recommended calories, proteins, iron and calcium. A study indicated that taking millet-based foods in diet during pre-natal and post-natal period play an important role in improving the nutritional status of pregnant women and lactating mothers.[1]

Millets are a group of cereal food grain crops that are small-seeded, can be grown to on-farm resources and minimise off-farm resources such as chemical fertilisers, pesticides, insecticides, etc., which are expensive and harmful to the human being and environment. The various millet species can be divided into two categories. Major millet crops include Jowar or Sorghum, Bajra or Pearl millet, Mandua/Ragi or Finger millet and small millets comprising Kangani/Tangoon or Foxtail millet, Sama/Kutti or Little millet, Kodo millet, Jhangora/Sanwa or Barnyard millet and Cheena or Proso millet.

Millets are highly nutritious and provide food and livelihood security. Millets are cultivated as dual-purpose crops providing both food grains for human consumption and straw for animals. They are the staple foods in some rainfed areas. The rich crop and varietal diversity of millet-based cropping system foster and enrich the Agrobiodiversity of their ecosystems. Millets are C4 Carbon sequestrating crops contributing to the reduction

The author is a Nutrition Expert who has served on the Food and Nutrition Board, Ministry of Women and Child Development, Government of India. Email: ravindrakumar151960@gmail.com

Table 1: Millet cultivation in India

Millet crop	Local names	States in term of cultivation
Pear millet	Bajra, Bajri, Sajja, Sajje, Cumbu	Rajasthan, Uttar Pradesh, Haryana, Gujarat, Maharashtra and Tamil Nadu
Sorghum	Jowar, Jhandla, Jola, Jonna, Cholam, Juara, Rotla	Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh and Tamil Nadu
Finger millet	Ragi, Mandua, Keppayi, Kaelbaragu, Nagli, Nachni, Mandiya, Marwa	Karnataka, Uttarakhand, Tamil Nadu, Maharashtra, Andhra Pradesh
Barnyard millet	Konidhan, Shyama, Bantisanwa, Oodalu, Kheera, Swank, Kutdiravali	Uttarakhand, Arunachal Pradesh, Nagaland, Madhya Pradesh, Uttar Pradesh, Tamil Nadu
Little millet	Gajroo, Kurikutki, Sava, Same, Save, Sama, Suan, Samalu, Swank	Madhya Pradesh, Tamil Nadu, Karnataka, Chhattisgarh, Jharkhand
Kodo millet	Kodra, Kodon, Harika, Varaku, Kodua, Arika, Varagu	Madhya Pradesh, Chhattisgarh, Tamil Nadu, Maharashtra, Uttar Pradesh
Fox millet	Kaon, Kang, Kakun, Kangni, Navane, Thera, Rala, Kangam, Kangani, Korra	Andhra Pradesh, Karnataka, Arunachal Pradesh, Maharashtra, Rajasthan, Tamil Nadu
Proso millet	Cheena, Cheno, Bari, Baragu, Vari, Bachari, Panivaragu	Maharashtra, Bihar, Odisha, Rajasthan, Tamil Nadu

of CO_2 in the atmosphere besides being water efficient. Millets contain several bio-active phytochemicals including feraxans, lignans, beta-glucans, insulin, resistant starch, sterols and phenolic compounds (eg., ferulic acid, caffeic acid and quercetin). Studies have supported the role of polyphenols in antioxidants, anti-carcinogenic, anti-inflammatory, anti-viral and neuroprotective activities which have beneficial against diseases like cancer, cardiovascular diseases, diabetes, high blood pressure, high cholesterol, inflammatory diseases, metabolic syndrome and Parkinson's diseases.[2] Millets also have antimicrobial and DNA damage protection activities. Millets are an excellent source of slow digestive starch and fibres. The non-starch polysaccharides found in millets form a major part of dietary fibre which produce short chain fatty acids by fermentation of resistant starch and serve as excellent pre-biotics. Fermentation of millets using various cultures promotes the growth of gram-negative bacteria that makes millets an effective probiotic food in the gut.

The millet-based supplementary food products are very nutritious for pregnant women and lactating mothers. Millet milk malt is prepared from the flour of various millets, jaggery and milk powder. Ragi cutlets are prepared from Ragi (Finger millets) flour which is a rich source of protein, iron, calcium, phosphorus, and dietary fibres.

One of the many nutrient-rich grains for pregnant women is Pearl millets known as Bajra. It is an excellent source of iron which helps in improving haemoglobin levels in pregnant and lactating mothers. It is also rich in dietary fibres, antioxidants, zinc, magnesium, copper and Vitamin B-Complex.

Studies show that millet-based foods contribute to improving the Body Mass Index (BMI) in pregnant women and lactating mothers.[3] Millet-based foods such as mixed millet malt, Ragi biscuits, Ragi cutlets, mixed millet energy foods and millet bars developed with Ragi, Jowar and Bajra can contribute to the improvement of the nutritional status of pregnant and lactating mothers. Lactating mothers are also advised to consume Ragi to increase the production of breast milk.

Kodo millets are highly nutritious. They are gluten-free, easy to digest, and rich in phytochemical constituents, antioxidants and dietary fibre. Kodo millet is used in the spot of grain in the preparation of Pulao, Khichdi, Upma, Paranthas, Dosas and Chapatis. Various products are made from millets such as multigrain pasta, multigrain sweet mix, muffins, nutritious millet flours, Ragi flakes, Ragi papad, bread, cookies, Ragi snacks, flaked jowar, ready-to-eat foods, germinated Ragi drink mix, Ragi Vermicelli, Semolina, millet flours, etc..

Based on the nutritional composition in Table 2, given nutritive value millets are compared with rice and wheat.

- **Fat-** pearl millet (5.43 g)
- **Calcium-** finger millet or ragi (364 mg)
- **Protein-** proso millet (12.50 g)
- **Dietary fibres-** pearl millet (11.49 g)
- **Zinc-** barnyard millet (3 mg)
- **Iron-** pearl millet (6.42 mg) and barnyard millet (5.0 mg)
- **Folic acid-** kodo millet (39.49 mg) and sorghum (39.24 mg)

Malted Ragi flour

Enzyme rich/Amylase-rich foods may also be prepared from finger millet. Puffed whole grain proso millet is produced as breakfast cereal for pregnant women and lactating mothers. Many pre-processing techniques are applied in coarse cereal grains/millets. The two most important techniques are germination and pro-biotic fermentation. Germination is a method to improve the nutritional value of millets and soften the structure of the kernel and decrease anti-nutritional factors. Germination is also known as one of the most effective methods for lowering the anti-nutritional factors of millets. When the seed undergoes germination, it leads to the activation of enzyme phytase which further reduces phytate and leads to reduced phytic acid level. Germination generally affects the physical structure, nutritional composition and biochemical activities of food grains. Germination results in lowering the concentration of anti-nutritional factors such as tannin and phytic acid and which directly increases the bio-availability of various minerals in the body and results in the improved nutritional value of millets.

Fermentation is a method that not only enhances the nutritive value of millet but also improves the digestibility of raw products. There are two types of fermentation i.e., single culture-based fermentation and sequential culture-based fermentation. Both types of fermentation techniques significantly decrease the phytic acid, trypsin inhibitor activity and tannic acid content while enhancing the digestibility of starch as well as protein.

I. Millet-based probiotic Yoghurt

Probiotic yoghurt has been developed by using a pure culture of Lactobacillus Rhamnosus GR-I and Streptococcus thermophilus C106. This probiotic yoghurt developed contains a fiti sachet. Fermentation improves the bioavailability of nutrients.

II. Cereal mix-based probiotic functional food

A cereal mix contains pearl millet. Probiotic yeast is used for enhancing the organoleptic taste and functional properties of the cereal-based mixture during the fermentation process.

III. Pearl millet-based food blend

This type of food blend is prepared by mixing germinated pearl millet flour, whey powder and tomato pulp not only improve the nutritional content of the food mixture but also provides a perfect medium for the growth of probiotic L. acidophilus. Probiotic fermentation in pearl millet also enhances the bio-availability of calcium, zinc and iron.

IV. Finger millet and oats-based symbiotic drinks

A symbiotic drink is developed using finger millet, oats and double-toned milk, malt drink with the ratio of 60:40 (finger millets: oats) with three times water. Malt drink and double-toned milk are mixed in a ratio of 47:53 and rose

Table 2: Nutritional composition of Millets in comparison with Rice and Wheat

Millets	Carbohy-drates (g)	Protein (g)	Fat (g)	Energy (Kcal)	Dietary Fibre (g)	Ca (mg)	P (mg)	Mg (mg)	Zn (mg)	Fe (mg)	Thia-mine (mg)	Ribo-flavin (mg)	Nia-cin (mg)	Folic Acid (mg)
Sorghum	67 . 68	9. 97	1. 73	334	10.2	27.6	274	133	1.9	3.9	0.35	0.14	2.1	39.4
Pearl millet	61 .8	10 . 96	5.43	347	11.49	27.4	289	124	2.76	6.42	0.25	0.2	0.86	36.11
Finger millet	66 . 82	7 . 2	1. 92	320.73	11.18	364	210	146	2.5	4.6	0.37	0.17	1.3	34.7
Kodo millet	66 . 19	8. 92	2. 55	331	6.39	15.27	101	122	1.65	2.34	0.29	0.2	1.49	39.99
Proso millet	70 .4	12.5	1 . 1	341	-	14	206	153	1.4	0.8	0.41	0.28	4.5	-
Foxtail millet	60.1	12.3	4.3	331	-	31	188	81	2.4	2.8	0.59	0.11	3.2	15
Little millet	65 . 55	10 . 13	3. 89	346	7.72	16.1	130	91.41	1.82	1.26	0.26	0.05	1.29	36.2
Barnyard millet	65.5	6 .2	2.2	307	-	20	280	82	3	5	0.33	0.1	4.2	
Wheat	64 .7	10 .6	1. 47	321	11.23	39.36	315	125	2.85	3.97	0.46	0.15	2.68	30.1
Rice	78 . 24	7. 94	0. 52	356	2.81	7.49	96	190.3	1.21	0.65	0.05	0.05	1.69	9.32

Sources: 1. Indian Food Composition Table 2017- National Institute of Nutrition
2. Nutritive Value of Indian Food, 2004 - National Institute of Nutrition

Finger Millet

Foxtail Millet

Kodo Millet

Little Millet

Proso Millet

Sorghum Millet

syrup can be added for flavour. The prepared drink is highly nutritious as the energy drink is mineral rich and low in lactose, cholesterol and fat in comparison with dairy milk. The composite drink is rich in healthy components such as anthocyanins, beta-glucan and soluble dietary fibre, these components are otherwise absent in dairy milk. This drink is a good probiotic due to the presence of dietary fibre.

Shelf life of millet-based products

The shelf life of any raw millet flour is about 1-2 months and it is only 5-7 days for pearl millet because they are easily prone to oxidative rancidity due to the free fats and sugars. The techniques like parboiling, irradiation and germination can enhance the shelf life of millet. Consistent research and development programmes for enhancing the shelf life of processed millets and their products with the aid of inactivating lipases, use of permitted antioxidants and suitable packaging are being explored. ❑

Endnotes

1. Krishnendu M. Devaki G. KAP towards breastfeeding among Lactating Mothers in rural areas of Kerala.
2. Dayakar et al., 2018.
3. International Journal of Nutrition, Pharmacology, Neurological diseases.

Little Millet Khichdi

INGREDIENTS

- Little millet: 500 g
- Green gram: 200 g
- Onion: 25 g
- Green chillies: As required
- Oil/ghee: 50 g
- Vegetables (beans, cauliflower, potato, carrot, etc.): 400 g
- Tomato: 100 g
- Curry leaves: few
- Coriander leaf: 50 g
- Mustard seeds: 5 g
- Cumin seeds: 5 g
- Ginger garlic paste: 5 g
- Salt: As per taste

PROCESS

- Wash green gram and soak it in a bowl for 30 min.
- Wash the little millet and keep aside in a bowl.
- Chop onions, green chillies and vegetables.
- Take a medium-sized pan and heat the oil/ghee.
- Add the mustard seeds, cumin seeds, curry leaves, chopped onions, green chillies, and stir fry at a low flame for 2 to 3 min.
- Add ginger garlic paste and stir fry for 2 min on low flame.
- Add all the vegetables, turmeric powder, tomato, and stir fry for 5-10 min on low flame.
- Add green gram, water, and heat it on medium flame till water boils.
- Once water starts boiling, pour the little millet into the pan. Add salt as per taste.
- Cover the pan and cook for 20-25 min.
- Keep stirring at regular intervals and check if the little millet is cooked or not.
- Turn off the heat after completion of cooking. Serve with a garnishing of chopped coriander leaves. ❑

(Excerpts from Mann ki Baat booklet brought out every month by Publications Division, Ministry of Information & Broadcasting)

Startups Making Millets Popular

Madan Jaira

Several startups are making the road ahead for coarse grains smoother, quite literally. They are bringing innovative products and popularising millets across the country. Growing health awareness, the easy availability of these products online, and their consumer-friendly preparation have increased their popularity and consumption. Also, big reputed companies engaged in making food products are offering more nutritious options by mixing coarse grains in their food products.

Till some years ago, coarse grains like Jowar, Bajra, and Ragi were often looked down upon. There was a time when only poor people used to consume coarse grains. Economic prosperity further led to a decline in the consumption of coarse grains. But recent scientific researches suggest that coarse grains are far more nutritious. They have more protein, fibre, vitamins, calcium, iron, etc. Secondly, they are also gluten-free. Gluten is a type of protein that is believed to be responsible for weight gain. Thanks to such information, awareness about the consumption of coarse grains has increased again.

According to the Indian Council of Agricultural Research (ICAR), more than a thousand startups are working on coarse grains in the country. Some of these have become fully functional, and some are in the process of launching their products in the market. ICAR's Hyderabad-based Indian Institute of Millet Research (IIMR) aims to make these entrepreneurs successful by introducing their brands in the market keeping in mind the International Year of Millets. IIMR has set up a technology incubator NutriHub with the help of the Department of Science and Technology (DST) to promote millets. Here, people are trained for startups. Along with this, startups are also provided with the facility to develop their products and assess their quality. Dozens of startups have successfully launched their millet-based food products in the market under the guidance of IIMR.

Startups are provided grants of upto Rs 25 lakh under the Government's Rashtriya Krishi Vikas Yojana (RKVY-RAFTAAR). However, they many examples when such millet-based startups have also attracted huge investments from the market. The Central Government started a Millet Startup Innovation Challenge aims to last year. This initiative encourage young minds to find technical and business solutions to the existing problems in the millet ecosystem. This innovation challenge is open till 31st January 2023. The three best startup solutions will be awarded seed money of Rs 1 crore each.

On India's initiative, the United Nations General Assembly has declared the year 2023 as the International Year of Millets. It was adopted by a UN resolution led by India and supported by over 70 countries. It will

The author is a senior journalist who covers health and related issues. Email: m_jaira@hotmail.com

help spread worldwide awareness about the importance of millet, its role in sustainable agriculture and its benefits as a superfood. India is poised to become a global hub of coarse cereals with a production of over 17 million tonnes, accounting for more than 80 per cent of the coarse cereals produced in Asia. Millets are grown in about 131 countries and are still the traditional food of about 600 million people in Asia and Africa.

The Central Government started a Millet Startup Innovation Challenge last year. This initiative will encourage young minds to find technical and business solutions to the existing problems in the millet ecosystem.

Many states have included Millet in the National Nutrition Mission and Mid-Day Meal Scheme. Many startups are contributing towards the millets.

The Government is also enabling startups for the export promotion of value-added products like noodles, pasta, breakfast-cereal mix, biscuits, cookies, snacks, and sweets in the Ready to Eat (RTE) and Ready to Serve (RTS) categories. For this, the Ministry of Commerce has made necessary policy amendments.

Most of these startups procure coarse grains directly from farmers. After processing them, they prepare products and sell them online and offline. The advantage of this initiative is that the farmers have started increasing the production of coarse grains. These startups have established their units in rural areas only.

An Agri startup from Tamil Nadu has launched many products, including South Indian dishes using millets, such as *dosa, pongal*, and *rava dosa*. Usually, *dosa* is prepared from rice. But millets are more nutritious than rice and wheat. The company has launched products like millet *dosa* mix, millet *pongal* mix, millet *adai*, *pearl* millet *khichdi*, millet *rava dosa*, millet *pakora*, millet *biryani*, millet *chapati*, millet porridge. The startup manufactures ready-to-cook and ready-to-eat food products from coarse grains. They are directly procuring produce from 13000 farmers in 10 states. Their mission is to promote natural food grains. The company's theme is Farm to Fork, i.e., from the farm to the dining table. The company sells its products in India and abroad.

Another startup in Hyderabad has prepared snacks by adding fruits and vegetables to coarse cereals. These snacks are ready to eat and are very nutritious. Whole grains are healthy, but adding fruits and vegetables

A conversation with Dr B. Dayakar Rao, CEO, Nutri Hub, Indian Institute of Millet Research, Hyderabad (IIMR)

Essential for nutritional security

According to Dr Dayakar Rao, from 1955-65, nine types of coarse cereals were grown in an area of 35 million hectares in the country. However, the focus of the Green Revolution was on food security only, due to which more emphasis was placed on wheat and rice production. As a result, their production and consumption increased while coarse grains took a back seat. In recent years though, attention has been shifted to them, but despite this, millets are still being grown in only a 1.5 crore hectare area. It is less than half of what it was in earlier times.

In the opinion of Dr Rao, the issue today is not food security. Instead, the focus today is on nutritional security. Therefore, emphasis is being laid on increasing the production of millet. A few years ago, the National Agriculture Innovation Project of the World Bank formulated a strategy to increase millet production. Since then, continuous efforts have been made for this. IIMR has so far developed more than 500 millet recipes, and their technology is transferred to startups and industries. Apart from this, various facilities are being provided in NutriHub, from training to financing, product development, packaging, market access, quality checking, etc. The result is that today around 500 startups are working on millet, while 200 startups are making organic food products.

He said that under the Rashtriya Krishi Vikas Yojana, more than 70 startups had been provided funding ranging from Rs 5-25 lakh. The target is to provide funding to 100 startups this year. A total of one thousand startups are expected to be operative in this sector by next year.

According to Dr Rao, as per rough estimates, the startups currently working on millets are doing a business of Rs 1,000 crore annually. Millet products are available to people nowadays. Only a few years ago, people in the cities learned about coarse grains, but today there is hardly any house that is unaware of it or whose one member has never used coarse grains.

He said that the demand for coarse grains is on the rise. Presently 1.7 to 20 million tonnes of coarse grains are being produced annually. But it needs to be increased. Farmers are also being encouraged to increase it at various levels. ❑

MSP of Millet

The Minimum Support Price (MSP) for various kinds of cereal in the country is fixed by the government. The Government also procures food grains on MSP. It motivates farmers to grow that crop as it fetches a reasonably good price. Till some time back, the MSP for coarse cereals was very low. But today, it is more than wheat and rice. Today, MSP is fixed for 22 cereals, pulses, and oilseeds, of which three major coarse cereals are Jowar, Bajra, and Ragi.

In the Budget of 2018-19, the Central Government announced fixing MSP for other cereals and coarse cereals with a minimum profit of 50 per cent. That is, 50 per cent of the cost of the crop will be kept as profit for the farmers. The Commission for Agricultural Costs and Prices (CACP) makes this assessment. Following this, a record MSP was fixed in 2018-19 for Jowar, Bajra, and Ragi, the three coarse cereals grown in abundance in the country.

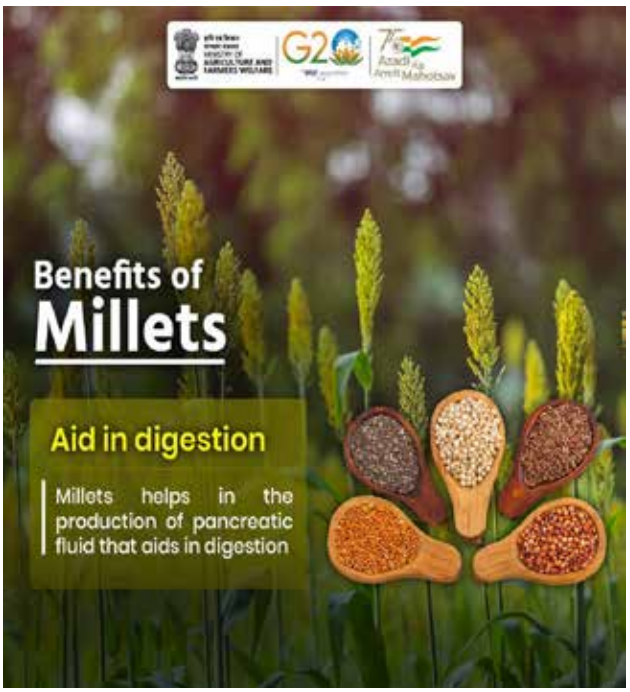
For 2018-19, the MSP of the Jowar Hybrid has been kept at Rs 2430 per quintal. Its production cost was then estimated at Rs 1619. Similarly, an MSP of Rs 2450 was fixed for Jowar Maldandi. Since then, the MSP of Jowar has been fixed every year before harvest. For the year 2022-23, the MSP of the Jowar Hybrid has been kept at Rs 2970 and Jowar Maldandi at Rs 2990 per quintal. In this, a margin of more than 50 per cent has been kept for the farmers.

Similarly, the support price of Bajra was fixed at Rs 1950 per quintal in 2018-19. Its production cost was estimated at Rs 990 per quintal at that time. This way, it kept 97 per cent benefit to the farmers. The MSP of Bajra has been fixed at Rs 2350 per quintal for the year 2022-23.

Ragi is the third major crop. The support price of Ragi was fixed at Rs 2897 per quintal in 2018-19. Its production cost was recorded at Rs 1931 per quintal at that time. In this, 50 per cent profit was kept for the farmers. The MSP of Ragi for 2022-23 has been fixed at Rs 3578 per quintal. It is much more than the MSP of wheat, which is Rs 2125 per quintal.

Many central and state government agencies also procure millets on MSP. It fetches a fair deal to the farmers. Due to this initiative, farmers also show interest in growing these neglected crops. ❑

makes them more nutritious and tastier. This snack has 13 grams of protein, while 250 grams of milk contains ten grams. One of the products of the startup combines coarse grains, ginger, honey and pulses. Beetroot, lime and pulses have been mixed with coarse grains in another product, whereas coarse grains, carrots, mint and pulses are combined to bring another variety of products.



A Bengaluru-based startup has developed several ready-to-cook products from millets. More than 50 products have been launched, and many more are still being introduced. These include millet *idli* mix, millet *khichdi*, millet *rawa upma*, millet pizza, etc. One of their products is *bajra methi khakhra*. Similarly, other products include Ragi and Bajra flour products viz. Ragi *dosa, bhakra,* etc.

A Jaipur-based startup has launched starters, breakfast, millet nut, *desi masala* millet, different types of millet-based porridge and *khichdi* like tomato and cheese millet *khichdi* using coarse grains. These are ready-to-eat products that take just six minutes to prepare.

A startup based in the Nandyal district of Andhra Pradesh has worked among the farmers. It has prepared *laddoos*, biscuits, cookies and all kinds of food products using Jowar, Bajra and Ragi. The startup motivates farmers in rural areas to grow coarse grains and processes them there. Millet and Kodo have also been used to make *chivda*. A multi-millet *laddoo* has also been developed using a variety of coarse grains.

A startup in Tamil Nadu has launched 36 millet-based products. Kodo millet rice, white jowar *chapati*, Jowar *idli rava* etc., are different from conventional

products and are more nutritious. This startup has converted most of the South Indian food into ready-to-eat products by replacing wheat, rice and pulses with millet.

Most coarse grain-based startups have also developed their products keeping in mind the food habits of the people. Another Hyderabad-based startup has come out with multi-millet noodles. Nowadays, noodles are consumed on a large scale in urban and rural areas. But this food made of white flour is not considered sufficiently nutritious, but multi-millet noodles are considered healthy. Apart from this, it has also launched toffees, biscuits, cookies and many ready-to-cook products using millet. Ragi cookies and multi-millet *dosa* figure prominently among its products.

Pani poori is also a very popular product in almost every region of the country. *Pani poori* is prepared from wheat flour. But a startup from Vijayawada, Andhra Pradesh, has come up with a multi-millet *pani poori* by combining several millets, which is becoming quite popular. This startup is introducing several local dishes popular in the state using coarse grains.

Another Bengaluru-based startup has developed a variety of multigrain flour from millets and has introduced products like *papad* and chips. Apart from this, Kodo grain has been introduced as an alternative to rice and is available online.

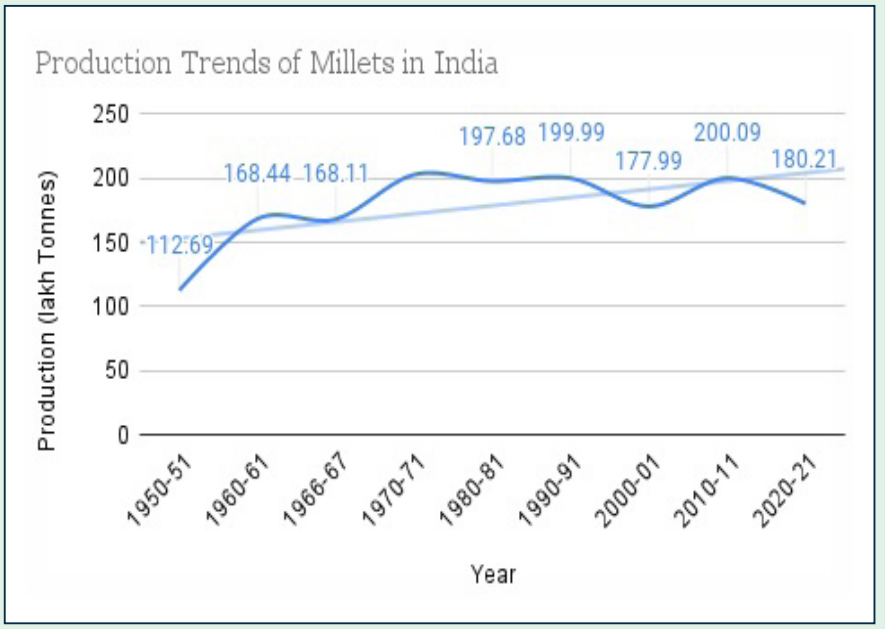
A startup from Prayagraj, Uttar Pradesh, has developed a wide range of Bajra biscuits. They have been prepared using butter and *desi ghee* which make them nutritious. Similarly, biscuits and cookies using Ragi have been made. Many of these products are also sugar-free, which can be consumed by diabetic patients.

A Hyderabad-based startup has started selling coarse grains online. They include naturally grown millets like Kodo, Ragi, Kangni, Barnyard Bajra, Murat Bajra, etc. This startup sells them without polishing in packs of one, two, or four kg so that people can consume them as per their requirements.

The theme of a Chennai-based startup is ancient grains and modern taste. It has prepared many ready-to-eat food products by mixing fruits with coarse cereals. The startup has developed many snacks from Jowar, Bajra and other coarse grains and prepared them according to modern tastes.

A Bengaluru-based startup has developed millet-based nutrition bars from coarse grains. Ginger and fruit flavours have also been added to these to make them more nutritious and tastier. ❑

Millet Production in India



According to the World Food Programme, there are an estimated 1.2 billion people who consume millet as a part of their diet. Millet production has remained relatively stable over the past few years, with an estimated production of 28 million metric tons in 2020. The majority of millet is produced in Africa, followed by Asia. India is the largest producer of millet, followed by Niger and China. Other major millet-producing countries include Burkina Faso, Mali, and Senegal. While millet is not a major food crop in the developed world, it plays a vital role in the diets of many people in developing countries. Millet is a drought-tolerant crop that can be grown in dry, arid climates where other crops would fail. It is also a nutritious grain that is high in fibre and essential minerals. For these reasons, millet will continue to be an important food crop in the years to come.

In India, millet production has been on the rise in recent years. India is one of the largest producers of millets and Indian farmers have been increasingly planting millet as a drought-resistant crop. The Indian government has also been promoting millet production as part of its National Food Security Mission. As a result of these factors, millet production in India is expected to continue to grow in the coming years. The graph depicts the production trends of millets in India. ❑

Source: APEDA

Processing Technology in Millets

The common element in all sectors of food processing is the conversion of raw material into a product of higher value. In some situations, the processing is a one-step conversion of raw material to a consumer product. The history of food processing emphasises the role of establishing and maintaining microbial safety in foods, as well as the desire to establish and maintain economic shelf-life. All developments in food processing have similar and common origins. One common aspect is achieving and maintaining microbial safety in the product. These processing methods are used worldwide as they improve the digestibility and nutritional quality of the grains.

Overview of Millet Processing

Millet processing involves the partial separation and modification of the three major constituents of the millet grain– the germ, the starch-containing endosperm, and the protective pericarp. Various traditional methods of processing are still widely used, particularly in those parts of the semi–arid tropics where millet is grown primarily for human consumption.

Most traditional processing techniques are laborious, monotonous, and manual. To some extent, the methods that are used have been developed to make traditional foods to suit local tastes and are appropriate for these purposes. Traditional techniques that are commonly used include decortication (usually by pounding followed by winnowing or sometimes sifting), malting, fermentation, roasting, flaking, and pounding. These methods are mostly labor-intensive and give a poor-quality product.

Processing methods have been either fine-tuned or developed by the Indian Institute of Millets Research (IIMR) using modern equipment to prepare quality processed products like dehulled millet, semolina or *suji*, flakes, extruded products (vermicelli and pasta), biscuits, millet-rich multigrain *roti,* and millet-rich multigrain flour to improve the nutritional quality. Food processing operations are undertaken to add value to food commodities after production. The main purpose of processing is to minimise the qualitative and quantitative deterioration of the material during post-harvest. The millet processing operations mainly involve:

Primary Processing

Purification of raw materials by removing foreign matter, and immature grain and making it into a suitable form for secondary processing through grading, destining, and dehulling. The bulk operations of these processes can be done mechanically. Primary processing of the grain is the removal of impurities, foreign contaminants, and glumes from the grain that are necessary to improve the storage capacity and consumer acceptability for usage.

Secondary Processing

Processing of primary processed raw material into a product which is suitable for food uses or consumption such as Ready-To-Eat (RTE) and Ready-To-Cook (RTC) products, which minimises the cooking time and makes it a convenient food.

Importance of Processing Intervention

Lesser-availability of RTE and RTS millet products in market hinders consumption. This scenario was found to be proportional to the increase in production expenditure. Increased income is accompanied by increased consumption of wheat and rice, as products made from these cereals are easy to prepare and have better keeping quality. At the same time, people have increased their tendency to eat a greater variety of foods. The prospects of technological change could perhaps change the scenario for improved production and utilisation of millet.

One of the major constraints identified in developing a variety of millet products is the drudgery in processing millet. The traditional processing method of hand pounding is not an efficient method because a part of the husk remains in the grain. Improperly dehusked grain cannot be ground to fine-quality flour. Therefore, the use of millets has been limited to traditional preparations like *roti* and *khichdi.* The absence of appropriate processing technologies to

yield shelf stable products is a major limitation in utilisation of millet grain for the development of value-added products.

At IIMR, an attempt has been made to create demand for millet through processing interventions by diversifying its food uses; integrating all functions from on-farm production to consumption in a 'production to consumption' value chain. For this particular reason, IIMR took up the challenge to increase millets consumption, with special preference given to sorghum millets vis–a–vis its production.

Processing and Value-Added Products from Millets

Value addition in food processing has a high degree of interdependence with forward and backward linkages and hence can play an important role in accelerating economic development. Value addition has many consumer benefits such as simple, low-cost processing and packaging technologies which can improve the shelf life and storage quality of food and preserve many of the health-promoting compounds.

For example, in India, sorghum is mainly grown in the *rabi* or dry season, which produces white bold grain, which is free from blemishes. The grain is highly prized for processing. Sorghum grown in the *kharif* (wet season) has staining and molds that deteriorates the quality of food. In this context, IIMR had screened around 430 genotypes (germ-plasm lines, elite lines and released hybrids/varieties) for various physical and chemical parameters.

Processing of Millet Grains

Processing involves cleaning, grading, partial separation and/or modification of the three major constituents of the millet grain– the germ, the starch-containing endosperm, and the protective pericarp. Various traditional methods of processing are still widely used, particularly in those parts of the semi-arid tropics where millet is grown primarily for human consumption. Most of the traditional processing techniques are laborious, monotonous, and manual.

At IIMR, processing interventions in millet are attempted to remove the inconveniences in recipe making by developing and standardising millet product technologies. Primary and secondary processing methods have been developed and fine-tuned using specialised equipment to prepare good quality millet. Processing interventions are continuing to include all millets to target niche markets as well as for mass marketing at the national level. Improved packing material is used for all millet products. IIMR has developed & commercialised millet products to widen the commercialisation of millet in the country. ❑

Source: nutricereals.dac.gov.in

India as a Climate Leader and its G20 Presidency

Rising from the ashes of the 1997 Asian financial crisis, G20 has become a legitimate voice of the 19 emerging economies (and EU) that can steer the world amidst the geopolitical wranglings of G7 and the deadlock in UNSC. As a diverse forum, G20 can further augment its reputational capital by ensuring robust institutional mechanisms and collaborations with other governance structures.[1]

India's multifarious initiatives with partners to strengthen socio-economic linkages are testimony to its commitment to rule-based international order. Its year-long presidency of a grouping that represents 80% of global GDP, 75% of global exports and 75% of world trade is a shot in the arm for multilateral and plurilateral cooperation. The motto for its presidency "One Earth One Family One Future" signals the intent to build endurable partnerships.

The G20 mandate of ensuring global financial stability and sustainable growth resonated after Covid-19 pandemic and Russian-Ukrainian war disrupted global economic networks and created domestic economic crises across the globe. The need for building responsive, equitable and diverse supply chains and securing access to critical resources like rare earth minerals for future-proofing has been made clear.

Setting the Global Climate Goalpost- India as a Trailblazer

The International Institute for Sustainable Development (IISD) research on G20 found that the Government support towards fossil fuel consumption declined by 3% between 2014-16. Tax on coal production saw an increase of 3 times in the 2010-16 period.[2] Despite being heavily reliant on coal, India has walked the talk by already reducing the carbon intensity of its GDP by 24% during 2005-2016. Panchamrit strategy as illustrated by the Prime Minister in COP 26 lays special mention on the shift to renewable energy. India fended off efforts by historical emitters to categorise certain non-renewable energy sources as "green" and ensured that the discourse on coal usage considers its phasing down.

By ignoring the developmental needs of the developing world and whitewashing over their common but differentiated responsibilities, the developed world continues with its luxury emissions. With insistence on equity, India's leadership of LMDCs ensured that their survival emissions are not compromised over mitigation and adaptation efforts. One cannot understate the need of ensuring global, national and regional public financial support and cooperation for building a just transition. India's pioneering global environmental leadership has culminated in the International Solar Alliance, Coalition of Disaster Resilient Infrastructure and LiFe movement among others. It is one of the few countries that have upped the ante by upgrading its Paris commitments.

The Intersection of the G20 Agenda and Addressing Climate Change

MEA has specified that the Indian focus shall be on energy security, climate finance and the development of green hydrogen during the G20 presidency.[3] Industry 4.0's support in the mega transition to a climate-friendly future is a must. PLI schemes for lithium-ion production and semiconductor manufacturing indicate that India is mindful of emerging geopolitical trends as well. The domestic quest of becoming a green hydrogen hub alone calls for investment potential worth billions of dollars in which other G20 members can participate.

G20's workstreams Energy Transition Working Group (ETWG) like the Sustainable Finance Working Group (SFWG) and engagement groups including the Think 20 (T20) signal its commitment to securing green finance for emerging economies. India would do well to drive momentum in agenda-setting with access to cutting-edge climate technologies and resources. It must strive to pivot discussions on securing energy sustainability and transition. The performance of key tracks like Green

Finance Study Group (GFSG) operationalised under the G20 Finance Track to identify market and institutional barriers to green finance can be assessed.

A Roadmap for Indian Presidency

G20, in the past, has established several dialogues and frameworks for broadening the knowledge base and sharing best practices of climate-friendly resource use. To meet the climate change challenges, G20 countries are utilising regulatory, market, education and information-based instruments throughout value chains. A case in point is the successful implementation of the Extended Producer Responsibility (EPR) based polluter pays principle by G20 members. A 2021 OECD report[4] on the role of G20 in assuring a global resource-efficient and circular economy elaborates on national and subnational roadmaps and strategies. It suggests four pathways:

- Promote resource efficiency throughout the full lifecycle of products
- Align sectoral policies and Covid-19 recovery packages with resource efficiency objectives
- Strengthen policy development through better data and indicators
- Enhance international cooperation

As climate change impinges on lifestyles and the survival of all, G20 can be an effectual forum for representing different regions and charting out global response to loss and damage suffered due to extreme climatic events, climate financing, upgrading crucial sectors like agriculture, marine economy, mining, manufacturing and augmenting adaptation efforts. With respect to Environmental, Social and Governance (ESG) norms, development of clean and climate-resilient infrastructure and green growth, G20 can become a standard setter and rule maker. As a 2021 UNDP survey[5] illustrated that millennials and Gen Z are concerned about the climate emergency and demand urgent behavioural change, it would augur well to heed immediately. ❑

Endnotes

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The author, **Rishya Dharmani**, is a postgraduate in political science and an independent researcher in developmental policy. Email: rishya.dharmani@gmail.com

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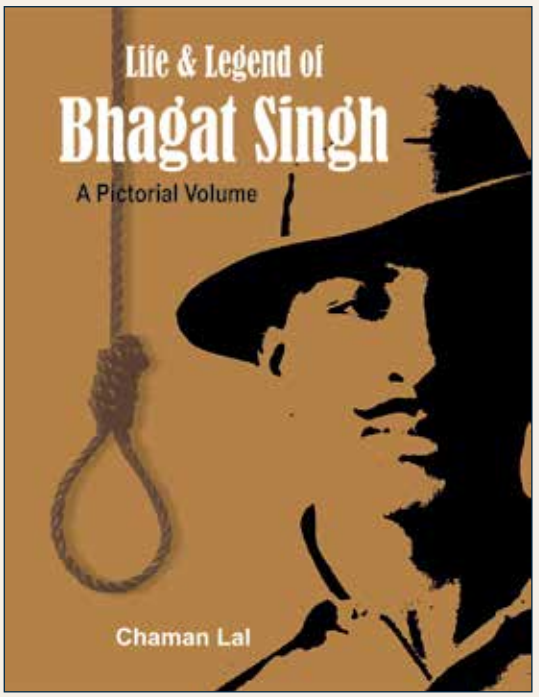


"They may kill me, but they cannot kill my ideas. They can crush my body, but they will not be able to crush my spirit" ~ these words of Bhagat Singh spoken many years ago still reverberate. A whole generation was inspired by them.

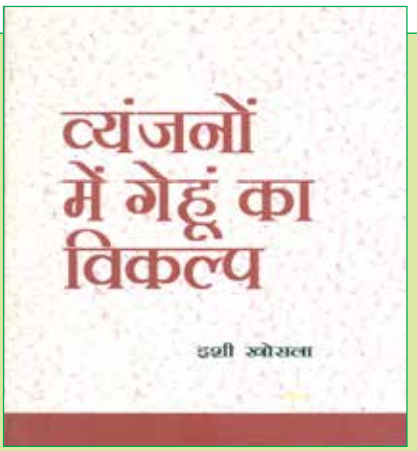
Hailing from a family well-known for its revolutionary prowess and witnessing the injustice meted out against his fellow countrymen, Sardar Bhagat Singh was shaped as a patriot due to the politically charged era of his time. In his short life, he has left behind a legacy of organised agitation, unbelievable courage, and exemplary defiance against all forms of oppression. This pictorial volume consists of some rare photographs, letters, documents, and personal belongings of Bhagat Singh and those associated with him. Apart from his influential role in India's independence, this book sheds light on Bhagat Singh's persona as well. His life journey, early influences, his association with the freedom movement, and lesser-known instances from his trial, have been chronicled in this book.

About the author

The author has been a Professor and Dean in prestigious Universities and is presently an honorary advisor to the Bhagat Singh Archives and Resource Centre, New Delhi. A known authority on Bhagat Singh, Chaman Lal has researched the lesser-known aspects of his life, ideology, and personality. He has written around sixty books and has been honoured by many literary associations throughout the country and abroad. ❑

Vyanjano Mein Gehu ka Vikalp

Author: Ishi Khosla
Price: Rs 175, Language: Hindi



This book is a handy guide for non-wheat substitutes for food. Focusing on those who are gluten-resistant or suffering from Celiac disease, this book has a case-study-based approach to deal with food requirements for persons suffering from different conditions. Over 200 recipes included in the book are specially curated by the author who is a leading nutritionist. ❑

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ISSN-0971-8400
Total pages - 56
Published on 23 December, 2022
Posted on 25 & 26 December, 2022

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Printed & Published by Anupama Bhatnagar, Director General, Publications Division, Soochna Bhawan, C.G.O. Complex, Lodhi Road, New Delhi-110003. Printed at J.K. Offset, B-278, Okhla Indl. Area, Phase-I, New Delhi. Editor: Shuchita Chaturvedi