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MILLETS
SPECIAL

ODISHA REVIEW



International
Convention on
Millets
BHUBANESWAR, ODISHA | 9TH & 10TH NOV 2023



Hon'ble Chief Minister Shri Naveen Patnaik inaugurating the Millet Shakti Cafe in the premises of Lok Seva Bhawan, Bhubaneswar.



Hon'ble Chief Minister Shri Naveen Patnaik inaugurating the Millet Shakti Outlet at Kalinga Stadium during the Hockey World Cup 2023 in Bhubaneswar.



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Odisha receives the prestigious 'Best Millet Promoting State' Award under 'Poshak Anaj Awards' instituted by the Indian Council of Agricultural Research (ICAR), Indian Institute of Millets Research (IIMR) and Food and Agriculture Organisation of the United Nations (FAO) from the Union Minister.

GLORIOUS MOMENT

The Department of Agriculture & Farmers' Empowerment congratulates the tribal farmers, Women self-help groups of Mission Shakti, FPOs, Line Departments, NCDS, NGO partners and WASSAN for their contribution in achieving this milestone for Odisha.





*Hon'ble Chief Minister
Shri Naveen Patnaik with
WSHG members and women
farmers during the Krushi
Odisha 2023 at Biju Patnaik
Playground, Baramunda,
Bhubaneswar.*

Inspiration and Acclamation



*Shri Prem Chandra
Chaudhary, Director of
Agriculture and Food
Production, Government of
Odisha, receiving the
Poshak Anaaj Award 2022
for the "Best State for
Scaling Up Millet Mission"
on behalf of the State
Government in Hyderabad.*



Message of
Shri Naveen Patnaik,
Hon'ble Chief Minister of Odisha
on the occasion of
International Convention on Millets - 2023



Millets have formed a substantial part of our dietary patterns since ages. In Odisha, they've primarily been grown by our tribal communities, who have made sure that these precious grains are around even today.

Back in 2017, my Government started the Odisha Millets Mission, to promote the production and consumption of Millets. With this Mission, we're aiming at a large scale revival of these indigenous supergrains, by promoting them as an essential part of today's diets. These humble grains bring quite a few exceptional health advantages to us. Being truly climate resilient, they can grow across all climates and terrains, which greatly helps the small and marginalised farmers. Due to their low Water and Carbon footprint, they're planet friendly as well.

By declaring Year 2023 as the International Year of Millets, the United Nations and FAO have successfully brought these coarse grains into global limelight, and sent out a strong message to the world that these ancient grains can become excellent answers to modern day challenges. For the same, I thank them from the bottom of my heart! Taking to next level, Odisha is about to complete its journey from first Millet Divas (10th November 2022) to International Convention on Millets (9th & 10th November 2023) with



active involvement of farmers, millet mothers, school children, teachers, sportspersons, women SHGs, FPOs, entrepreneurs, doctors, hotels, and many others from urban and rural areas. Odisha has adopted whole of government and whole of society approach to revive and mainstream millets. With these significant efforts, our State will leave no stone unturned to ensure these super foods reach plates of common people. Empowering tribal communities through promotion of millets and millets based entrepreneurship is our mission.

Through the Odisha Millets Mission, we're relentlessly working towards positively impacting the State's health index, by spreading awareness and creating a positive outlook amongst the citizenry. I truly hope these exceptional grains win back their deserved recognition in today's society, and help us all in leading a healthier life!

Jay Jagannath.

Chief Minister, Odisha



Editor's Note



It is a matter of pride for Odisha that a two-day International Convention on Millets is going to be held in Bhubaneswar on November 9 and 10, 2023. Odisha is the first state in the country to organise such a convention on the theme '**Millets – Ancient Grains for Modern Challenges**'. The convention will showcase the tribal heritage of millets, the success stories of the millet entrepreneurship, and the emerging technologies and innovations in the field of millet production and consumption.

It will be attended by eminent personalities from UN agencies, countries, states and millet-related fields.

The year 2023 is being celebrated as the International Year of Millets as announced by the United Nations. The Odisha government is the first state in India to observe November 10 as "Mandia Dibas" in the state to promote millets and other millet crops globally. Odisha is also the first state to celebrate this day across the country to highlight the importance of nutritious crops.

The visionary Chief Minister of Odisha, Shri Naveen Patnaik opines that prosperity is associated with nutrition. Ragi is a storehouse of nutrition. It is providing nutrition to everyone from young children to adults. The Odisha Millet Mission was launched in the state in 2017 with a focus on improving the condition of small ragi farmers, poor tribal farmers and providing nutrition to the people.

The ICAR-IIMR and FAO have been roped in for all these efforts. Odisha has been ranked as the 'Best Millet Promoter State' for two consecutive years.

Today, the Millet Mission has managed to attract the attention of the whole world. The Odisha Millet Mission is nationally and internationally acclaimed and awarded. The United Nations World Food Programme has signed a Memorandum of Understanding (MoU) with the Odisha Millet Mission to study and follow this model in Africa and other countries. NITI Aayog and the World Food Programme have also praised it, with Odisha being honoured with the "Poshak Anaj Award" by the Union Ministry of Agriculture & Farmers' Welfare. The Odisha Millet Mission is working to include millets in the daily diet list. Farmers and women of Mission Shakti are taking an active part in the programme.



On the occasion of the International Convention on Millets 2023, the November issues of Utkal Prasanga and the Odisha Review are focused on millets. The Department of Agriculture and Farmers' Empowerment has given an opportunity to be a part of such a flagship programme.

On behalf of the Utkal Prasang and Odisha Review, I&PR Department, we extend our appreciation to the authors for shaping their millet related research articles for a general as well as technically inclined reader. We are grateful for the cooperation, guidance and suggestions of the Principal Secretary, Department of Agriculture and Farmers' Empowerment, Government of Odisha in improving the standard of the publication. I thank the Director of the Information & Public Relations Department for his full cooperation in carrying out this responsibility. Above all, I extend my sincere thanks to the officials of the Department of Agriculture and Farmers' Empowerment for their active support and cooperation. I thank my colleagues for their tireless hard work and support without which it would have been impossible to complete the publication of the magazines. I thank the officials and staff of the Odisha Government Press, Cuttack for their unflinching cooperation.

We are grateful to the Government that Utkal Prasanga and Odisha Review have got the opportunity to present its specialty and benefits to the public on this occasion. I firmly believe that this publication will be appreciated by general readers and help in knowledge enhancement and practical change.

On this momentous occasion, let us all know about these nutrients and benefits by incorporating this quality of useful nutrition in our daily diet. We should help keep ourselves healthy and build a healthy and prosperous society.

Editor, Odisha Review



The changing dynamics of millets addressing Sustainability, Climate Change, Food and Nutrition Security and Sustainable Development Goals: Need for Actions and plans for Zero hunger world beyond International Year of Millets 2023

Dr. Vilas A. Tonapi and Dr. Venkatesh Bhat

Introduction

Millets are the ancient food grains known to humans, first domesticated for food around 8000 BC, and played a key role in household food security and dietary diversity before rice replaced millets as a staple grain in India, and also across the globe with expansion of rice and wheat in the food plates. The country has rich millet diversity with 59,434 millet accessions in National Gene bank and region specific traditional and high yielding varieties. Sustainable livelihood requirements of smallholder farmers in drylands in the climate change scenario needs positioning of sustainable millet production, nutrition and enhancing farmers' income on the list of priorities to be addressed during International Year of Millets 2023 and beyond to create demand-led millet market economy. Millets are important staple food for 760 million people in 131 countries across semi-arid regions. Thus, millets are key for the sustenance of human and livestock populations. It is time's demand to enhance production of nutri-cereals which are predominantly grown in rainfed areas and farmers' income, and profitability in our country to enhance profitability and ensure nutrition security in the

climate change scenario. It is also important to recognise the key role of millets for achieving the goal of Zero Hunger and realising the targets under SDG 2. Millets are often the only cereal crops that can grow in arid lands, needing only 350-400 mm annual rain with tolerance to heat and in fact pearl millet survives at temperatures up to 46° C. Besides they require minimal inputs and are naturally organic crops. But their USP is the nutritional profile as they provide varied health benefits. Despite all the virtues, their consumption and cultivation in India has been gradually declining over the past six decades, some minor millets were on the verge of becoming museum crops before the millet momentum started in 2016 with great efforts of ICAR-Indian Institute of Millets Research with its SAU-AICRP network and further taken up by government of India after recognising their importance as climate resilient nutritious crops. Hence, millets were rechristened as "nutri-cereals" by the Government of India in 2018, while declaring 2018 as National Year of Millets, owing to their nutritional merits for carbohydrate and energy, and good source of protein, high dietary fibre, vitamins, minerals, antioxidants and micronutrients. To position



Indian Millets to global platform, the United Nations accepted Government of India proposal to celebrate the year 2023 as International Year of Millets. India being the largest producer and consumer of millets should be ready with the integration of forward and backward linkages, sufficient production, strong value chain, diverse value-added products, standards and guidelines, policy support to give nutri-rich millets their legitimate place in global food basket.

Millet Production: Historical Perspective

Millets are among the staple food crops that are grown in diverse agro-ecological zones of India, particularly suited for drylands and hilly

Kodro/Kodo millet (*Paspalum scrobiculatum*), Jhangora or Sawan or Barnyard millet (*Echinochloa frumentacea*), Cheena or Proso millet (*Panicum miliaceum*), and Korale or Browntop millet (*Brachiaria ramosum*). Other minor millets grown elsewhere are Teff (*Eragrostis tef* (Zucc.) Trotter) and Fonio (*Digitaria exilis* Stapf and *Digitaria iburua*) and Job's tears (*Coix lachryma-jobi*). In fact climate Resilient Millets are grown in 131 countries and are traditional food for 760 million people in Asia & Africa. Earliest evidence of millet cultivation in India dates back to Indus valley civilisation around 3000 BC.



areas under rainfed agriculture are climate resilient, hardy and dryland crops, also termed as nutri-cereals which contribute substantially for food and nutritional security. Millet crops cultivated in India include Jowar or sorghum (*Sorghum bicolor*), Bajra or pearl millet (*Pennisetum typhoides*), Mandua/Ragi or Finger millet (*Eleusine coracana*), and small millets comprising of - Kangni or Foxtail millet (*Setaria italica*), Kutki or Sama or Little millet (*Panicum miliare*),

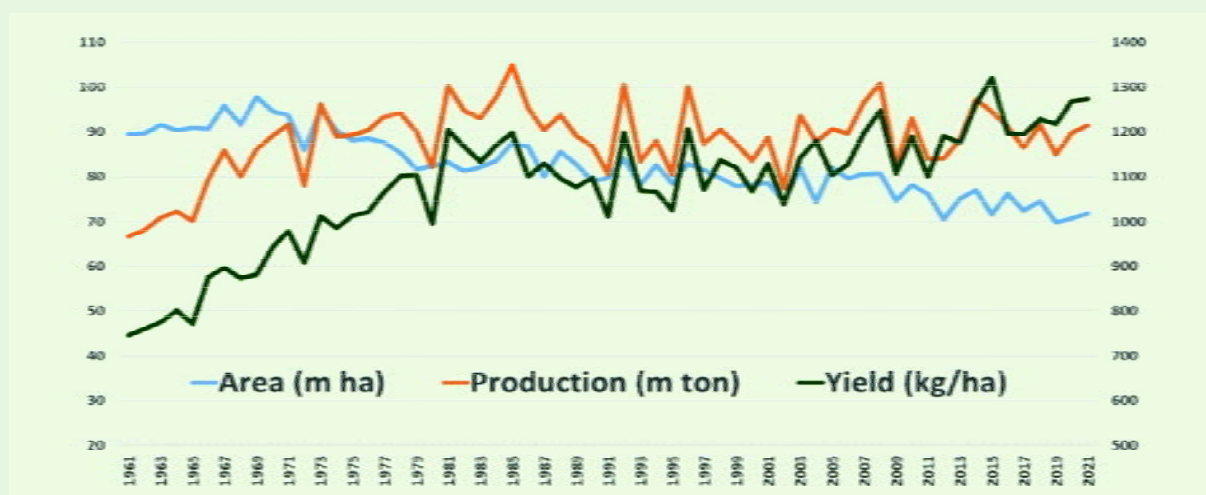
Global landscape of millets

Millet crops are mainly grown in tropical, sub-tropical and slightly temperate regions of the world, with Asia and Africa accounting for major production and consumption centres. These crops also originated in either of these continents and domesticated in other continents as well. Sorghum and Proso millet (common millet) are most widespread being cultivated in 112 and 35



countries respectively during 2019 (FAOSTAT database, <http://www.fao.org/faostat/en/>). The global production of millet crops is about 91.48 million tonnes from 74.15 million hectares. Sorghum and pearl millet comprise more than 90% of the area and production. The rest of the production includes finger millet, proso millet, foxtail millet and other non-segregated millets. Sorghum is most widespread in terms of the total area covered by the countries, which are spread all over the globe. The top five countries comprise Sudan, Nigeria, India, Niger and the USA, which possess 57% of the global area under sorghum

Millet crops' utilisation varies across countries and continents and thus depending on the use and climate of production, cultivars and the yield levels vary. In the USA and Europe, sorghum and other millets are grown for feed purpose, with lesser concern for quality and associated traits. Hence, yields are very high. Similarly, in some countries of Africa and Asia where sorghum is used for making alcohol-based beverages, the quality is not important. In the African and Asian countries where millet grains are consumed as a staple food, quality is important and mostly the local varieties of specific adaptation and culinary niceties are predominantly grown,



Global millet scenario in the last 60 years

with about 45% of global sorghum production. The yield in India is slightly higher than the global yield. Foxtail millet is a predominant crop of China with a production of 2.1 million tonnes from 0.79 million ha. A large proportion, 89.7% of the area under proso millet, is located in 5 countries - Russian Federation, USA, Ukraine, North Korea and Kazakhstan - that produce 86.4% of global proso millet.

which do not necessarily possess appreciable yield potential.

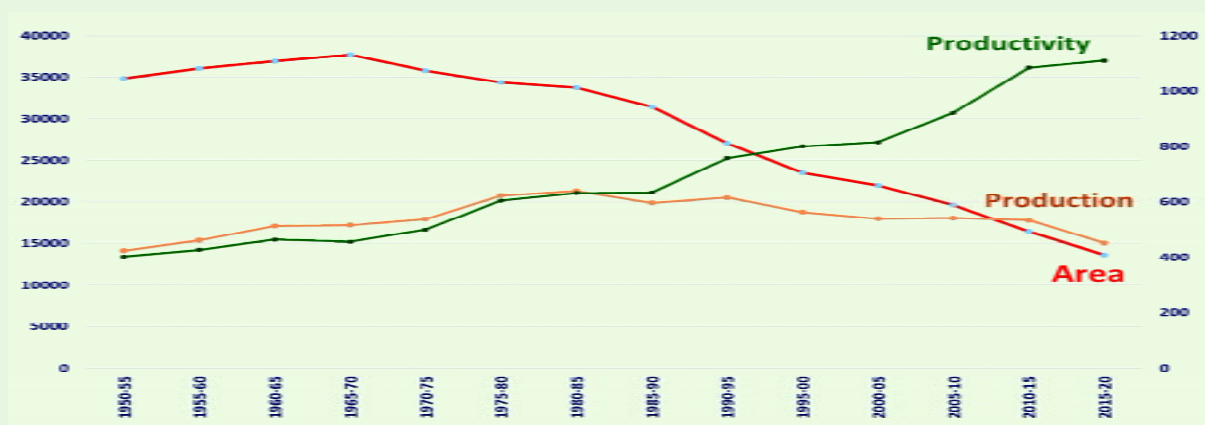
Economic Significance of Millets in India: Availability and Demand

A total of about 15.3 m tonnes of millets food grains are produced in India from nearly 12.7 million ha area, which constitutes about 6 % of the national food grain basket. Pearl millet is



grown in about 6.77 million hectares yielding 8.9 million tonnes, followed by sorghum (4.48 million ha, yielding 4.38 million tonnes) and finger millet (0.97 million ha, yielding 1.68 million tonnes) and other millets (0.46 m ha yielding 0.34 million tonnes). Despite the surrender of almost 56% area, the millet production has increased from 11.3 to 17.6 million tonnes during the last 50 years due to an increased productivity that went up by more than two times overall while it's more than tripling in pearl millet. Development and adoption of improved varieties/hybrids have played a

has seen a 3.85 times reduction (22.17 to 5.76%). This reduction in share has been ascribed to loss of millets acreage to other food (rice, maize), commercial (sugarcane, cotton) and remunerative crops (soybean) rather than their ability to produce high. This is evident from the fact that despite huge losses in acreage, total millet production was maintained. Whatever, the reasons, millets have been finally relegated to areas where other crops can't replace them. Thus, millets with near exclusive reliance on rainfall (green water) are playing an important role in



Indian millet scenario in the last 70 years

significant role in the productivity improvement of these crops. Production increase of millets from 164 lakh tonnes (2017-18) to 176 lakh tonnes (2020-21) and productivity increase from 1163 kg/ha (2017-18) to 1239 kg/ha (2020-21). India is the leading producer of millets. Most of the states of India grow one or more millet crop species. India is also the country where most of the millets, nine of them, except fonio and teff and being cultivated. Development and adoption of improved varieties/hybrids have played a significant role in the productivity improvement of these crops. In the past seven decades (1950-21), share of millets in total food grain production

conserving the blue water resources of country for use by irrigated crops. The ICAR-Indian Institute of Millets Research based on the production and economic activity around millets has estimated economic value of millet production in India as follows:

- Total Value of Exports - Rs 2280 Crore
- Total Value of Domestic Consumption - Rs 88140 Crore
- Total Value of Value addition of Millets - Rs 3966.3 Crore
- Total Value of Millets - Rs 127826 Crores.



Cultivation of different millets in India and other countries in the world

World production of millet grains was about 91.48 million tonnes produced from 74.15 million hectares during 2019, with sorghum and pearl millet comprise more than 90% of the area and production. The rest of the production includes finger millet, proso millet, foxtail millet and other millets. Millets are also being recognised as food grains for nutrition and health and nearly organic in cultivation.

Area, production and yield of different millets in major countries

Millet crops are mainly grown in tropical, sub-tropical and slightly temperate regions of the world, with Asia and Africa accounting for major production and consumption centres. These crops also originated in either of these continents and were domesticated in other continents as well. Sorghum and proso millet (common millet) are most widespread being cultivated in 112 and 35 countries respectively during 2019 (FAOSTAT) database, <http://www.fao.org/faostat/en/>).

Sorghum is most widespread in terms of the total area covered by the countries, which are spread all over the globe. The top five countries comprise Sudan, Nigeria, India, Niger and the USA, which possess 57% of the global area under sorghum with about 45% of global sorghum production. While Sudan has a maximum area of 7.141 million ha, the USA contributes the maximum production of 10.9 million tonnes. The countries- Italy, France, Egypt, China and the USA have the highest sorghum yield levels of 4655 kg/ha (USA) to 6819 (Italy) kg/ha while India produces 840 kg/ha which is much less than that of the world average of 1460 kg/ha.

Millets production scenario in India

Though millets are one of the earliest grains to be cultivated and consumed, in the last 5-6 decades India has witnessed significant decrease in the area under the millets crops. However, the productivity (yield in kg/ha) of these crops has gradually gone up due to development and adoption of high yielding varieties and improved production technologies.

World area, production and yield of important millet crops (Mean of 2015-2019)

Millet Crop	Area (million ha)	Production (million tons)	Yield (kg/ha)
Sorghum	41.91	61.18	1460
Pearl millet	28.38	23.68	834
Proso millet	0.77	1.19	1535
Finger millet	2.31	3.33	1442
Foxtail millet	0.79	2.11	2688
Teff	3.35	5.56	1660
Fonio	0.92	0.70	790
Total	78.43	97.75	1247

(IIMR estimates based on FAOSTAT)



**Millet crops area, production and yield during
2009-13, 2014-19, 2019-2020, 2021-2022 and 2022-2023**

Millets	Area (000 ha)					Production (000 ton)					Yield (kg/ha)				
	2009-2013	2014-2019	2019-2020	2021-2022	2022-2023	2009-2013	2014-2019	2019-2020	2021-2022	2022-2023	2009-2013	2014-2019	2019-2020	2021-2022	2022-2023
Sorghum	6684	4910	4480	3800	3721	6101	4404	4380	4151	4075	913	897	1051	1092	1095
Bajra	8480	7142	6770	6841	7033	9029	8738	8900	9781	9785	1065	1223	1265	1430	1391
Ragi	1211	1104	970	1218	1115	1914	1710	1680	1701	1669	1580	1549	1662	1396	1497
Small millets	773	570	460	429	474	428	403	340	367	380	554	707	804	857	800
Total millets	17149	13726	12680	12288	12343	17472	15255	15300	16000	15909	1028	1094	1195	1194	1028

Source: Agricultural Statistics Division, Department of Agriculture & Farmers Welfare, New Delhi

Most of the states of India grow one or more millet crop species. A total of about 16.9 m tonnes of millets food grains are produced in India from nearly 12.7 million ha area, which constitutes about 6 % of the national food grain basket. Pearl

millet, foxtail millet, little millet, kodo millet and proso millet constitute less than 5% of the area (Directorate of Economics and Statistics, DA&FW, 2021). Rajasthan, Maharashtra and

Area, production and yield of millet crops in India (2015-16 to 2020-21)

Year	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Area (million hectares)	15397	15480	15277	14994	14718	14247	12543	13829	13633	12288	12342
Production (Million ton)	16034	17205	17076	14517	16125	16438	13711	17261	18021	15999	15909
Yield (Kg/ha)	1041	1111	1118	968	1096	1154	1093	1248	1322	1302	1289

(Based on estimations of Dept. of Economics & Statistics, DAC&FW, GoI, New Delhi)

millet is grown in about 7.42 million hectares yielding 10.1 million tonnes, followed by sorghum (4.4 million ha, yielding 4.6 million tonnes) and finger millet (0.99 million ha, yielding 1.8 million tonnes) and other millets (0.4 m ha yielding 0.35 million tonnes). Pearl millet, sorghum and finger millet account for more than 95% of the area under millets, while small millets comprising of barnyard

Karnataka are the top most states of millets cultivation in the country with a share of 38%, 19% and 13% to total millets area. Maharashtra and Karnataka have the maximum area under sorghum while Rajasthan, Gujarat, Uttar Pradesh and Maharashtra have more area under pearl millet. Ragi has the maximum area in Karnataka, Tamil Nadu, and Uttarakhand, besides



Maharashtra. Small millets area maximum in Madhya Pradesh, Odisha, Uttarakhand and Chhattisgarh.

associated traits. Hence, yields are very high. Similarly, in some countries of Africa and Asia where sorghum is used for making alcohol-based beverages, the quality is not important. In the

**Per cent change in area, production and yield of millets during last six years
(2015 to 2021) in India**

Crop	Area	Production	Yield
Jowar	-17.8	3.3	35.1
Bajra	-7.5	-3.1	0.9
Ragi	-19.8	-18.4	-2.4
Small millets	-22.0	-11.9	22.9
Total millets	-13.0	-3.6	13.5

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

Global production of millets

The global production of millet crops is about 91.48 million tonnes from 74.15 million hectares. Sorghum and pearl millet comprise more than 90% of the area and production. The rest of the production includes finger millet, proso millet, foxtail millet and other non-segregated millets.

Millet crops' utilisation varies across countries and continents and thus depending on the use and climate of production, cultivars and the yield levels vary. In the USA and Europe, sorghum and other millets are grown for feed purpose with lesser concern for quality and

African and Asian countries where millet grains are consumed as a staple food, the quality is important and mostly the local varieties of specific adaptation and culinary niceties are predominantly grown, which not necessarily possess appreciable yield potential.

Cultivation of millets in India - Mapping of states

India is the leading producer of millets. Most of the states of India grow one or more millet crop species. India is also the country where most of the millets, nine of them, except fonio and teff, are being cultivated. Pearl millet, sorghum and finger millet account for more than 95% of the area under millets, while small millets comprising of barnyard millet, foxtail millet, little millet, kodo millet and proso millet constitute less than 5% of the area (Directorate of Economics and Statistics, DAC&FW, 2021, <https://eands.dacnet.nic.in>) for all estimations hereafter.

In sorghum, Maharashtra holds nearly 50% area of the country contributing 36% of



production, with a yield level of 606 kg/ha, compared national average of 835 kg/ha. Conversely, the remaining 50% area under other states contribute 64% of production, with a mean yield of 1064 kg/ha. The states with the highest yield levels, i.e., Andhra Pradesh and Madhya Pradesh, together possess 6.3% area of sorghum and contribute 14.5% of the production of the country. Karnataka with 19% area contributes 22% of produce, with yield levels slightly more (17%) than the national average.

In Pearl millet, Rajasthan, Uttar Pradesh and Maharashtra hold about 80% of the nation's area with 57%, 13% and 11% area respectively. They contribute about 70% of nation's production with 44%, 20% and 6% share respectively. Gujarat, with less than 6% area, produces nearly 10% of production. The highest yields are realised by farmers in the states of Tamil Nadu, Madhya Pradesh, Gujarat and Uttar Pradesh. Maharashtra, with nearly 7.8 lakh ha under pearl millet, has very poor yield levels (677 kg/ha), nearly 45% lesser than that of national yield (1229 kg/ha).

Finger millet is a millet crop with the highest national yield levels amongst millet crops, despite the absence of hybrids. However, this crop needs a moderate temperature regime with protective moisture and milder climate to yield adequately. This crop also recovers well from intermittent drought. This is one of the longer duration (100-120 days) millet crops. Much of the area (60.8%) and production (62.4%) of finger millet is from the state of Karnataka with yield levels similar to that of the country. The states of Uttarakhand, Maharashtra and Tamil Nadu possess 25.9% of the area under finger millet yielding 30% of national production. The highest

yield levels are from the states of Tamil Nadu and Karnataka. States like Odisha and Chhattisgarh have potential of tremendous improvement.

The small millets produced by different districts vary in the type of millet(s) grown, especially across the states. The states of Madhya Pradesh, Chhattisgarh, Uttarakhand and Maharashtra offer 63.8% of the country's area under small millets, contributing 53.4% of production. Among these, except Uttarakhand, other states have yield levels below the national mean. Uttarakhand has 10.4% of the national area under small millets and produces 19.4% of the production, with the highest productivity as well. Madhya Pradesh and Chhattisgarh are having 30% lower yields than the national mean (692 kg/ha).

Despite the surrender of almost 56% area, the millet production has increased from 11.3 to 15.3 million tonnes during the last 50 years due to an increased productivity that went up by more than two times overall while it's more than tripling in pearl millet. Development and adoption of improved varieties/hybrids have played a significant role in the productivity improvement of these crops.

Causes for decline of area in India

The main reasons for decline of the millet crops in India are low remuneration as compared to other competing crops, lack of input subsidies and price incentives, subsidised supply of fine cereals through PDS, and change in the consumer preferences. These factors led to shift from production of millets (jowar in particular) to other competing crops such as soybean, maize, cotton, sugarcane and sunflower in the country as a whole. In the context of present Indian agricultural



scenario the production and income increase of the farmers through area expansion is of major limitation, since supply of area is inelastic in nature. To achieve the target of doubling the farmers' income by 2021-22, the policy makers also need to address issues other than area expansion. Generation of demand for the millets-based products along with productivity enhancement would help the farmers in realising better prices for their produce. Since the processing of millets involve significant hardships as compared to the rice and other food grains, proper processing and value addition will be effective in creating more demand among the consumers.

ADVANTAGE OF GROWING MILLETS

Built-in adaptation to stress environments with drought, heat and low soil fertility

Millets, being C4 crops, are efficient users of water and nutrients for growth. They are highly tolerant to warmer temperatures and to some extent to flooding. Their tolerance to salinity results in germination and seedling stages results in very good plant stand. As millets possess physiological mechanisms for rapid recovery from abiotic stresses like drought and heat, they are most promising sources for food during climate change. In times of climate change they are often the last crop standing and, thus, are a good risk management strategy for resource-poor marginal farmers. As millets are short duration crops, make good contingent crops to manage failure of monsoon rains.

Climate-change ready crops

Millets are diverse and adapted to different climatic conditions and cropping systems, provide a strong case to enrich biodiversity as well as diversify the food grain basket. Under the

climate change scenario, millets are the most dependable food crops the mankind, especially for the resource poor dryland farmers of the world as they are resilient to climate change and assure sustainable grain production with minimum inputs. The plasticity exhibited has made them flexible for apparent early as well as delayed planting, very low and high rainfall areas, across various elevations and different soil regimes. These positive features have not been duly recognised and exploited in the country.

Bio-fortified food crops

Millets are gluten-free and possess unique nutritional characteristics specifically have complex carbohydrates, rich in dietary fibre as well as unique in phenolic compounds and phytochemicals having medicinal properties. Millets are natural source of iron, zinc, calcium and other nutrients that are essential for curbing the problem of malnutrition in India. They have higher content of niacin, B6, and folic acid, and calcium, iron, potassium, magnesium and zinc. Finger millet is the richest source of calcium (300-350 mg/100 g) and other small millets are good source of phosphorous and iron. Millets are easy to digest, contain a high amount of lecithin and are excellent for strengthening the nervous system. Millets contribute to antioxidant activity with phytates, polyphenols, tannins, anthocyanins, phytosterols and pinacosanols present in it having important role in aging and metabolic diseases. Biofortified cultivars with higher iron and zinc content have been developed in pearl millet, finger millet and little millet.

Organic/natural food

Millets are extremely resistant to pest attacks. This is a characteristic that comes in very handy when planning a mixed crop farm cultivated



using non pesticide management techniques. A few rows of millets separating rows of more susceptible leguminous crops are a common practice in farms in different parts of the world. These are called eco-friendly crops due to their lower requirement of water, chemicals and management interventions for raising the crops. The global market share of organic millets grown naturally without any chemical is US\$ 2644 Mn in 2018 i.e. 28.1% of total millets market, and expected to grow to US\$ 4160 Mn by 2027 at a CAGR of 5.2% compared to 4.3% that of regular millets.

Millets are amenable for preparing modern foods

Use of 100% millet in ready-to-eat breakfast cereals would be feasible. Puffs can also be made from all millet grains and readily used as breakfast cereals. Sorghum seeds can be popped in the same manner as popcorn, although the popped kernels are smaller than popcorn. Since several years sorghum has come into increasing use in homemade and commercial breads and cereals made specifically for the gluten-free diet in USA. Sorghum blended with wheat flour has been used over the last two decades to produce baked products, including yeast-leavened pan, hearth and flatbreads, cakes, cookies, and flour tortillas. Millet based malt drinks and malt cocoa-based weaning food and baby foods are popular in Nigeria. Hard endosperm sorghum is used extensively in south-east Asia for noodles. Modern processing technologies provide more options to develop value added modern foods from millets. Because millets are gluten free it does not make good leavened bread when used alone; however, it can be milled and combined with other flours to make delicious breads. To increase the functional aspects of millets, processing such as parboiling,

malting, flaking, popping, boiling, extrusion (hot and cold) are done, thus resulting in the diversification and shift towards more convenient/processed products of fine cereals like rice and wheat from the millets. These processing interventions are easily achieved by retrofitting of the processing machinery. Absence of gluten makes millets unsuitable for the preparation of easy-to-handle pure-millet solid food products, particularly bakery or noodle products. Therefore, there is a need for innovative processing technologies to convert millet grains into liquid foods such as drinks of high nutritional quality and safety that can be consumed by large populations in rural and urban areas.

Millets for green forage

Millets are grown for green forage in USA, India, South America, Middle East and Egypt. In India, in regions with assured irrigation, exclusive forage producing sorghum and pearl millet forage varieties and hybrids are grown which produce superior quality fodder for the feeding livestock. Many multi-cut type hybrids are available in these crops which ensure continuous supply of green fodder during kharif and summer seasons. The interspecific Pearl millet × Napier grass hybrids (popular as Napier bajra hybrid in India) is a perennial forage crop and is popular in dairy farms throughout the country. Pearl millet uses less water per unit of forage production, tolerates both lower and higher soil pH and higher aluminium concentration, and is rich in minerals as compared to sorghum. However, sorghum has a wider range of adaptability and is more widely grown. Sorghum forage quality is better than that of other millets and next only to maize. Per day biomass production potential is the highest in pearl millet x Napier hybrids followed by forage sorghum cultivars. They are also more water



efficient compared to forage maize. Green fodder from most of these millets can also be made into silage and used during off-season feeding.

Stover from millet crops

The farm communities in the semi-arid and arid regions of the country are dependent on crop residues as a major form of roughages for cattle since they neither have the luxuries of green fodder from irrigated forage crop nor can afford to sacrifice the farm area for dedicated one-time green forage. As the millets are the major cereals of dryland crops in arid and semi-arid regions, they form an important source of stover (millet plants left after harvesting the ear head) for the livestock of these regions. Annually, millets account for 11% of the 30 million tonnes crop residues produced in India. The decision of the farmers to select the crop and variety are greatly influenced by the ability of the crop/variety to meet their fodder requirements from stover, although stovers are poor in nutrition compared to green fodder.

Promoting millet production and enhancing productivity of millet crops:

New cultivars with high production potential

Enormous progress has been made in post-independent India to improve productivity of sorghum, pearl millet and small millets by developing high-yielding cultivars and hybrids. In fact, Sorghum and Pearl Millet hybrids established the seed industry in the country. Hybrids were successfully developed in Sorghum (often cross-pollinated crop) and Pearl millet (cross-pollinated crop) due to the availability of the male sterility system for hybrid seed production. Private entrepreneurs and companies have also contributed significantly to the development of

superior hybrids and their commercialisation in pearl millet, forage sorghum and grain sorghum.

Millets are pioneer as far as utilisation of hybrid technology is concerned. CSH-1 in sorghum and HB-1 in pearl millet were the first hybrids released during 1964 and 1965. Production technologies have been developed for all small millets. The productivity of finger millet, pearl millet, sorghum and foxtail millet doubled during the past 40 years. Varieties with high yield potential have also been developed in barnyard millet, kodo millet, little millet and proso millet at national and state levels.

Crop improvement programmes at IIMR and centres of AICRPs on millet crops have been working on the enhancement of productivity of these crops in view of the decreasing area, high nutritional value and the importance of sustenance of millets-based rural communities. Varieties for different needs such as short duration varieties, bio fortified varieties, dual purpose types, varieties adapted to specific seasons and soil types, varieties tolerant to pests and diseases, varieties suitable for mechanical harvesting, etc. have been developed.

Crop production technologies for efficient conservation and utilisation of moisture, integrated pest and nutrient management, cultivation in rice fallows, summer production, etc. have been developed.

The yield potential of the newer varieties has been increasing over decades. New cultivars have been developed in all eight millets- 31 high yielding varieties and hybrids developed by ICAR and SAUs have been notified during last two years. Public sector cultivars notified at national level (recommended for multiple states) are available in all millet crops.

**Numbers of cultivars of millet crops notified during 2010-21**

Millet Crop	No. of cultivars	National releases	Private sector cultivars	Public sector cultivars
Sorghum	54	21	6	8
Pearl millet	87	60	41	21
Finger millet	38	9	--	--
Foxtail millet	6	3	--	--
Barnyard millet	6	2	--	--
Little millet	13	4	--	--
Kodo millet	11	4	--	--
Proso millet	6	3	--	--
Total	221	106	47	29

Release of > 80 hybrids of sorghum (26) and pearl millet (70) and > 100 HYVs of millet crops during last 15 years indicates availability of good genetic variability. High yield potential up to 5950 Kg/ha in pearl millet, 7000 Kg/ha in sorghum, 5000 kg in finger millet and 2648 Kg/ha in small millets have been recorded in farmers' production by the adoption of improved technologies. Value-added products of millets have started entering the mainstream urban food chain due to demand created by health conscious consumers.

Among the 8 millet crops where crop improvement programmes have been undertaken by ICAR institutes and SAUs, substantial improvements have been made in sorghum and pearl millet where in more than 100 cultivars have been developed under the AICRP system. In these two crops, a large number of hybrids that possess 30-50% more yield potential than varieties have been released. Hybrids have been successfully developed in Sorghum (often cross-pollinated crop) and Pearl millet (cross pollinated crop) due to the availability of male sterility system for hybrid seed production. Hybrids have enhanced the yield potential in these crops as realised by yield levels of 5-7 tonnes/ha in summer cultivation under

irrigated conditions. Hybrids developed for low input production regions (Sorghum rabi situation of Maharashtra, Karnataka and Telangana; Pearl millet in the arid kharif situation of western Rajasthan -A1 zone) have not been popular due to their lower adaptation and non-preference.

Varieties have been largely successful in sorghum, an often-cross-pollinated crop due to higher seed and grain potential. Kharif sorghum dual purpose (grain + stover) varieties have become popular due to high grain and stover yield potential. However, productivity gains in rabi sorghum varieties have been limited due to the resource-limiting conditions of their cultivation-receding soil moisture and cool climate (less dry matter accumulation).

In finger millet, similar to varieties of sorghum and pearl millet, genetic diversification and introgression of elite genes through recombination breeding has led to release of varieties with substantial genetic gain over the local landraces. In other five small millets, genetic improvement has been limited due to lack of genetic diversity, difficulty in recombination breeding and lack of serious crop improvement



programmes with requisite funding support. These small millets have received relatively less priority for research. Though varieties have been developed, no male sterility/other systems are available for producing hybrids. Most of the varieties are selections.

Enhancing adoption of high yielding cultivars

A major input for enhancing farm productivity in terms of production of millets is the adoption of high yielding and climate change resilient varieties to both replace older varieties/landraces and area expansion. Current availability of quality seed of improved varieties is limited in all millets except in bajra where private hybrids form bulk of the seeds planted. In order to improve the availability of quality seeds of all millet crops across the states where they are grown, 24 state-centric seed hubs have been sanctioned under National Food Security Mission (NFSM)-Sub-Mission on nutri-cereals, to cater to 10% increase in availability of quality seeds each year. These seed hubs would source the quality breeder seed from breeder seed production centres, which are being supported under this mission.

Strengthening seed supply chain

The hybrids developed in sorghum and pearl millet in 1960s and onwards led to the birth and expansion of private seed industry in India. In the present hybrid seed market, 90% of the grain and forage pearl millet, 40-60% of grain sorghum and 70-80% forage sorghum are catered by private hybrids and the rest by public sector hybrids.

The varietal seed requirement (excluding the farmer-saved seed), is almost fully catered by public varieties produced by ICAR institutes

and SAUs. This constitutes of about 40-60% of sorghum seed market, 10-15% of pearl millet varieties/composites and 100% of all other millets. As per the seed demand estimates of DA&FW, the required quantity of millet seeds is fully met by quality seed production. Seed production in millet crops by public agencies including state and national seed corporations is about 70 to 85 thousand quintals each year.

Recently, the provision of additional quality seeds - breeder seeds and certified seeds for the production of the latest high-yielding millet varieties has been initiated to enhance the seed replacement ratio. This initiative includes the establishment and operation of 18 EBSP centres under the DA&FW-sponsored NFSM Sub-mission on nutri cereals. During the years 2018-19, 2019-20, and 2020-21, an additional 7,51,852, and 1,140 quintals of breeder seeds were produced in various millet crops. This can provide quality seeds for additional 10% area. The quality seed to farmers is provided at subsidy to farmers, reducing the cost of production and increasing productivity. Except pearl millet where private hybrids are predominantly cultivated, in all other millets recently released (up to 10 years old) cultivars are brought in seed production chain, thus trying to augment productivity in farmer's cultivation. However, some golden varieties are also in seed chain due to their unique traits such as adaptation, culinary properties and broader resistance to pests and diseases, etc.

In small millets, state-specific varieties dominate the scenario, since the area under these millets has shrunk to a few pockets. Moreover, most of the improved varieties are not in seed chain as there is no significant demand for quality seeds from states. Therefore, the national



average yields of small millets have not increased in commensurate with release of new varieties.

Identifying suitable cultivars for large-scale product manufacturing

Specific interventions were made through cultivar-level and product-oriented cultivars were developed for a better yield during production. ICAR-IIMR identified suitable cultivars for specific-end products in collaboration with M/s Britannia Pvt. Ltd, for large-scale biscuit production. CSH 13 R was ideal for biscuit manufacture while CSV 15 and CSV 20 suited vermicelli and pasta making. Rabi sorghum varieties CSV 18, CSV 216R were suitable for popping, Phule Yashoda and C-43 were good for flaking. These cultivars have special features compared to market available bulk grains. Similar efforts for identifying varieties in other millets are in progress at ICAR-IIMR.

Expanding area under millet crops

Being a world's leading millet producer, India can augment higher production of millets from better endowed non-traditional regions of Punjab, Uttar Pradesh, Bihar and other regions where ICAR has initiated efforts to diversify agriculture by mainstreaming short duration millets in the Wheat-Rice cropping systems. Improved technologies for cultivation of millets in terms of improved cultivars, cost-saving and yield enhancing production practices are available owing to crop improvement and production technology research over years.

Bringing the fallow and waste lands under cultivation

Production of millets in India can be significantly increased through inclusion of fallow

and waste lands in the country. The total waste and fallow lands in India has seen slow decline in the last decade and stands to be more than 36 million hectares during 2015-16. It has been estimated that an additional amount of 28 million tonnes of millets could be produced in the next three decades, if the waste and fallow lands are brought under cultivation of millets at above mentioned rates. This significant increase in the millets production can increase the income of dryland farmers in the coming years. Millets can be successfully cultivated in water-stressed conditions. Thus, in the states like Tamil Nadu, Madhya Pradesh, Odisha, Maharashtra and Gujarat among others there is a huge scope of increasing the production of millets by bringing fallow lands under cultivation. In recent times, states like Tamil Nadu already incentivising millet cultivation in identified waste/ fallow lands.

Rice fallows

In addition, in the past decade there has been gradual increase in area under sorghum along with maize cultivation in Guntur district of Andhra Pradesh state in paddy fallows due to low inflows of water discouraging second paddy crop. This is spreading to other locations in states such as Odisha. Thus, there is a growing scope to enhance millet cultivation in the country.

Increasing the cropping intensity in dryland agriculture

Most of the farmers in dryland parts of the country go for single crop in a year due to unavailability of water to irrigate the crops. This significantly reduces the national cropping intensity which stands to be 145%. This calls for proper crop planning to utilise all three seasons of *khari*, *rabi* and *summer* in the dryland conditions.



Millets are the most viable solution in maintaining the all year cropping system in the dryland agriculture. Most of the millets are short duration in nature (generally 65-80 days) and can be successfully grown in the post-*kharif* fallows. Given the minimum requirements for water, small millets like *kodo*, *little* and *barnyard* millets can be successfully grown in the post-*kharif* fallows with the residual moisture content in the drylands on country. This will significantly increase the cropping intensity in dryland agriculture and yield in throughout year income generation for the farmers. For instance; sorghum can be successfully grown throughout the year. Many parts of the country cultivate sorghum both in *kharif* and *rabi* seasons.

Consumption of millets and its promotion

Generation of demand for millets is most important point to absorb the enhanced output generated with improved production technologies already available. Generation of demand through value addition and millets sub-sector development will generate remunerative prices for the farmers and enhance the millets farmers' income. Hence, there has been a focus to generate demand for millets through value addition of processed foods, feed and industrial products, by various projects led by ICAR-Indian Institute of Millets Research (IIMR).

The demand for millets has dominantly been for the household consumption for decades, but it's gradually declining due to the lack of awareness about health benefits, and easy availability of fine cereals. As per the studies, the per capita consumption of millets in rural area has decreased from 3.2 kg during 1977 to 0.53 in 2011 i.e., 83% drop, and in urban clusters it has

decreased from 1.15 kg to 0.27 kg during the same period i.e. 77% drop. As per a recent study by ICAR-IIMR, less than 42% of the produce is available as marketable surplus and the remaining is dominantly consumed for household purpose, followed by feed and seed purposes.

Value addition

Value addition is the key to the diversified utilisation of millets. While traditionally millets are consumed in the form of rice (boiled grains), roti, porridge, bread, sweets, etc., advances in food processing have made convenience food consumption possible. Technologies are now available for making ready-to-cook (RTC) and ready-to-eat (RTE) foods from millets which are not only easy to prepare, but also palatable and acceptable across regions that have diverse food habits. Millets-based bakery products, including snacks, cookies, noodles, pasta and more, have made inroads in the urban markets of India and are becoming popular with the health-conscious citizens.

The rapidly growing market for value-added products has created enhanced demand for millets which in turn is also benefitting the millet farmers. Federating millets farmers as Farmer Producer Organisations (FPOs) for better supply chain management would be helpful to ensure profitability. FPOs organise and enhance productivity through efficient, cost-effective and sustainable resource use and fetch higher returns. Supply of location specific inputs, providing timely training programmes and direct procurement of the produce can be effectively managed through these organisations.

Research priorities in millets for supporting value addition include



(i) Identification and development of product specific cultivars of millets, (ii) development of standards and grades for millet products and (iii) fabrication of primary processing machinery which are being pursued in a fast track. Market infrastructure development and technology upgradation and dissemination are equally important. Capacity building for value addition to farmers and farmer groups in terms of training is being offered by Indian Institute for Millets Research. Entrepreneurs are also given commercially potential technologies on licensing basis to promote commercialisation of millet products.

Enhancing shelf life

Shelf life is one of the major problems in millet grains and flours. The shelf life of any raw millet flour is about 1-2 months. In some grains like pearl millet, it is 5 to 7 days only because they are easily prone to oxidative rancidity due to their free fats and sugars. If the millets are expanded into different value-added products, the technologies like parboiling, irradiation and germination can enhance the shelf life to 6-12 months. Consistent R&D programs for enhancing the processed millets and their food products with the aid of inactivating lipases, use of natural and permitted antioxidants, and also suitable packaging approaches are being standardised at IIMR, CFTRI, etc.

CREATING ADDITIONAL DEMAND FOR MILLETS

Using grain as poultry feed

In USA and Japan, millets, especially, sorghum grain is being fed to poultry and swine. The grains in the form of ground, dry rolled,

soaked, pelleted, steam rolled, extruded, flaked, popped, etc. are being used as poultry feed. Replacing the maize with sorghum or other millets in broiler ration will improve the body weight gaining because of high feed conversion ratio. In India, it is used as an alternative to maize grain when the prices are 80% of maize.

Use in bioethanol production

Sweet sorghum varieties have a potential uses as complementary crop to sugarcane and the sugars and starches in it could be fermented to ethanol and lignocellulose could be gasified to methanol. The high energy sorghums are capable to provide 75-100% more energy than sweet sorghum also. The distilled ethanol finds purposes for various applications such as cooking, lighting, gas engines, boilers, etc. The bioethanol can be sourced from stalks of sweet sorghum and is now being propagated through technology partners IIMR and ICRISAT with some industries who are involved in piloting use of sweet sorghum stalks as feedstock for ethanol production to supplement sugarcane molasses-based ethanol for bioethanol to be used for blending bioethanol with petrol up to 15%.

Potable alcohol

Ethanol is the most important fermentation product of grain sorghum, while beverage alcohol is feasible with procedural changes. Other possible fermented products include citric acid, lactic acid, riboflavin, antibiotics and microbial polysaccharides. There are number of distillation units in India that are into potable alcohol from sorghum and bajra grain especially when it is mould-infested. States like Maharashtra has given policy support to grain-based distilleries.



Policy support for regional foods through PDS

The current procurement and distribution system of the country which is dominated by fine cereals like rice and wheat has caused havoc in the production and consumption of nutritious millets. Local procurement at designated spots and use of the grains in PDS, Mid-Day meals, etc. would increase production and consumption of millets and nutritional security of the masses. Some state governments such as Maharashtra, Madhya Pradesh, Odisha and Karnataka have initiated distribution of millets through PDS.

EXPLORING EXPORT POTENTIAL OF MILLETS

India traditionally export millets in commodity form and not significantly. World over sorghum and other millets are used for feed purposes except in India, SE Asia, and Africa. However, in the changed context, the millets exports are emerging in terms of diversified food uses. India is the world's leader in the production of millets with a share of around 15% of the world total production that is around 15 million tonnes annually. India is the second-largest exporter of millets. India has exported millets of worth 28.5 million USD during 2019-20- top 10 country destinations include -Nepal, Saudi Arabia, Pakistan, UAE, Tunisia, Sri Lanka, Yemen, Libya, Namibia and Morocco.

There are potential emerging trends globally for gluten-free, weight management, health and wellness foods, etc. and to capture those opportunities, export markets can be mapped in relevance to those food trends and a strategic export promotion can be undertaken to develop and direct the relevant products and start-

ups towards them. India is the seventh largest exporter of millets. The millets' market is projected to grow from its current value of more than \$9 billion to over \$12 billion by 2025, based on current trends and extrapolation.

China has remained the top most importer of sorghum in past decade with 70.27 % of world imports in 2020. It imports majorly from USA, Argentina and Australia. Other major importers globally are Japan, South Sudan, Philippines, Uganda, Bangladesh, UAE, Pakistan, Spain and Italy. India majorly had exported sorghum to UAE (USD 5.48 million), Saudi Arabia (USD 1.66 million), Bangladesh (USD 1.66 million), Iran (USD 966 k) and Egypt (USD 608 k). UAE, Nepal, Iran and Bangladesh are the fastest growing markets for Indian sorghum between 2019 and 2020.

ICAR-IIMR and APEDA have been organising sensitisation events to educated millet start-ups on value addition, emerging trends and potential export markets. Thus, a framework is put in place to work on the refinement of the value chain for export markets, with the involvement of several other stakeholders such as ICRISAT, NIN, IIFPT, DFRL, CFTRI, Private companies, FPOs, etc.

- Asia Pacific Markets (APAC): India is dominating the regional market, followed by other countries such as China, Japan, Vietnam, Korea, Thailand, Malaysia, and Indonesia. The rising awareness about the health benefits and disposable income of the population may increase millets usage in foodstuff in the region. Millets market is expected to grow from US\$ 3851 Mn in 2018 to US\$ 5653 Mn by 2027 at a CAGR of 4.4%, while organic market (CAGR of 3.9%)



is expected to grow faster than the regular market (CAGR 3.0%).

- India is the dominant market with 41.0% market share in Asia Pacific Markets, and holding the biggest market share with 16% of total world market. In APAC, China 21.1%, Japan 11.0%, South Korea 6.9%, Australia 5.9% and others 14% are following India.
- Middle East and Africa Markets: After India, Niger is the second largest consuming country of millets. Middle East countries such as Kuwait, Saudi Arabia, and the UAE have experienced a shift in the socio-economic condition, food eating habits, lifestyle and economic status, and health patterns in the past four decades. Millets market is expected to grow from US\$ 3015 Mn in 2018 to US\$ 4559 Mn by 2027 at a CAGR of 4.7% while, the organic foods market is expected to grow at a CAGR of 5.3% and regular market at 4.5%. Niger is the single most dominant market with 45.1% market share followed by UAE 14.0%, Saudi Arabia 9.9% and others 31.1%. Unlike APCA markets, other parts of MEA are also expected to grow at higher CAGR.
- Europe Markets: The western part of Europe is known for its better standards of living, with people displaying a higher income level, growing urbanisation, and rising demand for health beneficiary products. Millets market is expected to grow from US\$ 1323 Mn in 2018 to US\$ 2132 Mn by 2027 at a CAGR of 5.4%. In the Europe markets, the organic food are expected to grow at a CAGR of 6.1% which is higher than other markets, while the regular market also expected to grow at 5.2%.
- Alike APAC market, Europe market is well distributed over 5 countries such as Russia

(26.1%), Germany (18.2%), France (14.9%), UK (11.0%), Italy (8.8%) and others (21%0.). Europe markets have shown strong growth projections compared to both APAC and MEA markets. Unlike APCA markets, all other parts of Europe are also expected to grow at higher CAGR

- North American Markets: Several domestic and multinational companies already have a strong foothold in the North American countries like the U.S. and Canada. Millets market is expected to grow from US\$ 842 Mn in 2018 to US\$ 1192 Mn by 2027 at a CAGR of 4.0%. USA is the single most dominant market with 81.0% followed by Mexico (12.1%) and Canada (7.0%). Markets have shown strong growth projections, while the bakery, breakfast and infant food markets are expected to grow at a higher CAGR.
- South and Central American Region Markets: Millets market is expected to grow from US\$ 371 Mn in 2018 to US\$ 491 Mn by 2027 at a CAGR of 3.2%. In this market, the organic food are expected to grow at a CAGR of 3.8% which is lower than APAC, MEA, Europe and North America markets, while the regular market also expected to grow at 2.9%. Argentina is dominant market with 19.1% followed by Brazil (8.9%) and others (71.9%). Markets have shown poor growth projections compared other markets.

Issues constraining the millet exports

- **Unstable production** – The production of millet crops has decreased in most countries due to changing environmental conditions and low crop yield. The low crop productivity, difficult post-harvest operations, high labour intensity, and lack of attractive farm gate prices, etc. are the other major factors leading local farmers shifting



towards the high yield crops such as what that offers high returns and profits as compared to millets.

- **Farm-gate processing technologies** – The current processing at the farm level is very limited and inefficient. This is posing challenges in terms of the consistent quality of grain for food processors.

- **Unorganised supply chain** – Millets are produced by marginal farmers and need grouping, pooling and procurement for consistent supply of grain.

- **Grades and standards** – Lack of grades and standards of quality for procurement and marketing and HS codes for exporting are hindering the possibilities for small millets to be adopted by entrepreneurs.

- **Lack of HS codes for export** – Small millets do not have the HS codes required for exporting millets and their products.

- **Minimum portion of millets** – Currently, private brands are claiming their products as multi-grain, multi millet etc. irrespective of the actual content within the product, which lead to wrong branding, claims and consumer learning.

- **Labelling information** – Nutritional profiling and clinical data is required for proper labelling and claims resolving.

- **Awareness** – Many parts of the world is not familiar with the millets and their nutritional merits, which needs to be taken up globally. Inter-departmental convergence for awareness creation and popularisation efforts is vital.

- **Limited diversification of technologies** – Products with appropriate packaging standards for export markets based on their food habits and interests.

- **Policy interventions** – The current policies are focused on fine cereals, however, MoFPI is bringing some incentives to promote exports of selected millet products by linking with the PLI scheme, which incentivises the export by private food processors. Some targeted policies for encouraging the processing and export of a wide range of millet products are to be rolled out to promote processing by new and existing processors.

The technological interventions required in millets and allied farming for enhancing productivity and farmers' income and profitability are given below:

1. Bridging the yield gaps to upgrade yield levels:

This implies comparison of existing yields vis-à-vis the yield levels under Front Line Demonstrations (FLDs). Generally, there is a steep drop at the farmer's field level when compared to the FLD achievement due to poor agronomic practices. It is possible to bridge this gap to some extent, if not fully in case of pearl millet which is grown under much harsher environment.

2. Increasing the crop intensity under rainfed agriculture:

Millets and pearl millet in particular are amenable for incorporation into the cropping system for enhancing the cropping intensity, as these can adapt to a range of climatic variations including poor endowment conditions of water stress and high temperature. In India, an estimated extent of 12 million hectares of post-kharif paddy land is available, mostly in central India with good residual moisture. This area can be used to grow pulses, oilseeds and millets including pearl millet.



3. Improvement in Total Factor Productivity (TFP):

There should be due emphasis on attaining resource use efficiency to improve returns on investment, with a view to helping millet farmers gain higher income. ICAR-IIMR has estimated the Malmquist TFP mean of major millet-producing states of the country for the period 2004-05 to 2013-14, and reports the TFP growth rates to be positive. This indicates the scope that exists for increasing farmers' income.

4. Seed and soil management:

Seeds play a critical role in enhancing the yield levels, as a good seed can contribute to a positive change in yield by around 25 per cent and a healthy soil can support good growth resulting in good productivity. The strategy should be to identify location-specific, short duration and high yielding varieties; building a robust seed production chain; ensuring easy access and at affordable prices to the farmers and enriching soil health with organic carbon.

5. Use of high yielding cultivars

Among the millets, the use of HYVs is more pronounced in case of sorghum and bajra. In small millets it needs to increase. To enhance access of farmers to these, promoting a healthy seed village programme would help. Latest cultivars introduced in millet growing states across the rainfed regions of the country under frontline demonstrations (FLDs) have yielded 78% more grain and 60% more stover than the local cultivars, which have resulted into 51 per cent more net returns than the local cultivars.

6. Improved practices and timely management

Impact of the demonstrated technologies under FLDs showed that adoption after FLD

period significantly increased by more than 48%, especially in practicing seed treatment (85%), use of high yielding varieties (70%), use of nitrogen fertiliser (57%), following time of sowing (49%) and maintaining plant spacing (48%). It has resulted into increased in higher net returns (170%), followed by grain yield (58%) with better quality (78%) and fodder yield (26%).

7. Water conservation and millets-based intercropping

In-situ moisture conservation practices such as compartmental bunding, ridges, and furrows, along with the adoption of soil-based improved cultivars, nutrient management, and irrigation scheduling based on water availability, enhance production. To achieve appropriate land use, efficient inter- and sequence-crop systems were recommended based-on soil type, rainfall and length of growing seasons. Intercropping sorghum with legumes not only produces higher yields per unit area and time, but also provides nutritional security, economic benefits and improves soil health. Many millets-based intercrop and sequence cropping are found to be more profitable.

8. New niches of millets cultivation in rice fallows and non-traditional areas

Although millets are known to be climate resilient crops, shifting their cultivation to non-traditional areas enhances productivity, income and profitability. New niches of cultivation like rice fallows for sorghum or millets play significant role in economic security of the farmers. Sorghum yields are to the tune of 6.5 tonnes/ha, and that of pearl millet and small millets are to the tune 6 tons/ha and 3.5 tonnes/ha. Such success story can be replicated in the areas where there is scope in to introduce sorghum and other millets in rice fallows, which assures additional income to the farmers.



9. Value-addition and post-harvest processing

There is lot of scope for value-addition and processing to earn more than the routine business. Creation of demand for millets and millets value-added products as healthy food will boost the production and consumption scenario of millets which will have a long-term impact on the sector. Increase in demand for the millets and value-added products will boost the farmers' morale towards millets cultivation and will also help in realising better prices for their produce.

10. Mechanisation

The millets cultivation especially, sorghum and pearl millet is more labour-intensive and more than 55% cost goes towards labourer. Harvesting operations needs more labourer and takes major share. Hence, suitable harvesting-cum-threshing like combine machine is much essential. Moreover, proper tillage and precise placement of seed and fertilisers in the moist zone are most critical to for successful crop establishment in drylands, thus mechanisation can help to reduce cost and labour requirements which will encourage millets farmers.

11. Sustainable millets production and value chain through group approach

Good agricultural practices and high yielding varieties enhance export competitiveness of Indian millets in the international as well as targeted domestic markets will help the farmers to fetch good returns for their produces in the long term. For this and in view of small and marginal farmers' background, their collectivisation into Farmer Producer Organisations (FPOs) may be an effective pathway to harness collective synergy.

Role of millets in combating the problem of malnutrition and hunger

Until now national agricultural policies have tended to focus on increasing production and, in general, not addressed negative externalities on nutritional health, natural capital, and the protection of biodiversity. Though there has been rapid growth in agriculture with its focus on food production, more than 820 million people in the world today are still hungry, underscoring the immense challenge of achieving the 'Zero Hunger' as targeted under SDG 2030. It is almost all sub-regions of Africa and, to a lesser extent, Latin America and Western Asia that are experiencing growing hunger. It is also highly disturbing that about 2 billion people in the world are vulnerable to moderate or severe food insecurity. This is apart from the hidden hunger that many suffer from, due to poor nutrition intake. The lack of regular access to nutritious and sufficient food is what is resulting in risk of malnutrition and poor health. Though this is a problem mostly in low- and middle-income countries, around 8 per cent of the population in Northern America and Europe also suffers from moderate or severe food insecurity. In this scenario, millets can play a greater role in providing nutrition security and also address malnutrition and zero hunger.

Strategies and Action Plans for Building Millet Ecosystem

The discussions till date from 2016 with policy makers, researchers, traders, farmers, financial institutions, and other stakeholders have stressed on the need for continuing governmental support to develop enabled ecosystem of millets through following strategic action plans based on following pathways were evolved and recommended for consideration by the



Government of India. Key interventions for implementation and expected outcomes for stakeholders are as follows:

a. Policy Efforts

Policy Intervention	Description	Expected Outcomes
Production Incentives	Providing incentives for millets cultivation through subsidised farming inputs, equipment, minor infrastructure, etc.	• Increase in Area and Production
Minimum Support Price (MSP)	The Minimum Support Prices for all the major and minor millets of both regular and bio fortified cultivars to be declared all over India.	• Increase in Area and Production
Procurement of Grains	Procuring Millets under the State Govt. departments at the MSP, and extending the procurement period beyond 3 months for states. a) Development of steady of integrated market support for millets. b) Linking the local trades with National and International market through various ICT based initiative i.e., online marketing plat forms (e-NAM). c) Creation of marketing of millets products by tagging them and nutritional smart foods. d) Entrepreneurship development by creation of direct linkages between the millets growers and building start-ups entrepreneur.	• Increase in Area and Production
Development of FPOs	A policy for encouraging the millet FPOs in developing infrastructure, value addition, marketing, etc.	• Stepped up production for improved remuneration to farmers • Improved human and soil health
Inclusion of Millets in ICDS, MDM, PDS, etc. programs	Guidelines for all the state govt. to include millets in ICDS, MDM, PDS programs.	• Increased procurement • Improved nutrition especially of women and children
State Millet Missions	Guidelines for All State Govt. to design and implement the Millet Mission covering the farming aspects such as FPOs, infrastructure, seed hubs, farming incentives, farm-gate Value addition, capacity building, etc. towards increasing the cultivation area under millets.	• Increase in Millets cultivation area and production
Promotion of Processing Units	Policy for encouraging the millet processing units	Increased entrepreneurship, marketing efforts and thus promotion
Promotion of Exports	Supportive policies such as RODTEP, PLI, etc. schemes for incentivising the export of wide range of millet products and encouraging expanding export markets.	Increased Exports



b. Research and Development Efforts

Intervention	Description	Expected Outcomes
Yield Enhancement	Fast tracking the funding for R & D projects for developing the varieties and hybrids with high yield and nutritional parameters	• Remunerative Cropping • Drop in prices
Bio fortification	Fast tracking the funding for R & D projects for developing the fortified varieties and hybrids with multiplied nutritional parameters	• Diversified use of millets in foods, medicine etc.
End-Product Specific cultivars	R & D on analysis of cultivars from major growing areas and identification of cultivars for end products based on physical and nutritional properties.	• Improved Product diversification and quality • Increased processing units
Primary Processing Machinery	Development of primary processing machinery with high efficient, scaled up capacities, range of capacities (micro, small, medium, big, etc.) and capability of processing different grains.	• Drop in product prices • Increased processing units
Scaling up of Secondary Processing machinery	Development of high capacity value addition machinery on par with fine cereals.	• Drop in product prices • Increased processing units
Diversification of Value Addition	R & D on developing diverse range of products and recipes in specific to the - Local food habits of Indian states, - Export segments, and - Emerging trends such as plant-based protein, nutraceuticals, biofuel, etc.	• Improved Product diversification and uses • Increased processing units
Shelf life improvement	R&D for increasing the shelf life on par with rice and wheat, using various processing technologies, packaging standards, etc.	• Higher Marketability • Higher Export demand
Clinical Studies	R&D on conducting the studies for generating the authentic data for - Nutritional profiling, - Bioavailability of nutrients - In-vitro digestibility and glycemic index - Functional and therapeutic characteristics of various millet products	• Consumer Safety and awareness • Transparent Marketing efforts • Increased Exports



c. Regulatory Measures

Intervention	Description	Expected Outcomes
Standards and Grades	Establishing the Standards and Grades for small millets, and also for degree of polishing, for transparent marketing	• Consumer safety • Increased processing units
HS Codes	Establishing separate HS Codes for all millets and millet products for exporting	• Increased Exports
Minimum Portion of Millets	Regulation on minimum portion of millets for various product forms to be eligible to claim the millet branding, benefits, etc.	• Transparent claims • Consumer Safety

d. Exports Related

Intervention	Description	Expected Outcomes
Export Demand Mapping	Identifying Export market trends and potential for various millet value added products	• Clear positioning Strategies
Positioning Strategies	Framing the USPs for various product segments of domestic and international markets	• Better penetration of products
Export Promotion Forum	Creation of a Millet Export Promotion Forum with all concerned stakeholders for integrated export promotion nationally	• Strong Sourcing linkages • Increased export traders, startups

e. Entrepreneurship Development

Intervention	Description	Expected Outcomes
Millet Incubation Centres	Replication of Millets specific incubation centres across the country for generating the adequate number of start-ups for meeting the domestic and export demand	• More Start-ups • More processing and exports
Grant-in-aid	Allocation of larger fund for supporting the millets start-ups with grant-in-aid	• More Start-ups • More processing and exports
Sensitisation Events	Organising the sensitisation of aspiring entrepreneurs through physical and online events	• More Start-ups

f. Outreach and Promotional Strategies

Intervention	Description	Expected Outcomes
Millets for Nutrition	Identification of most important champion millets and positioning them for particular nutrient (iron, calcium, zinc, fibre etc.)	• Positioning India as a health food destination – boost Export • Road shows by APEDA
	Developing standard material with top parity comparison of millets' nutrition with other grains	• Informed choice for public
	Highlight culinary heritage of India	• Focus on low cost, local source of nutrition
	• Mass communication programs relating the benefits to existing health issues, the importance of nutrients, etc. • Multi lingual IEC material	• Nutrition Literacy



Conclusion and Recommendations

A targeted focus on increasing the demand for millets is key to reviving their production and supply. The government also has to step in to promote millet consumption in rural areas, especially among the most food vulnerable communities, that are not the typical focus areas for private enterprises. This effort has to be complimented by creating awareness among urban consumers on the benefits of millets consumption. A balanced rural-urban approach will change to minimise disparities in value creation opportunities and simultaneously re-position millets as the 'nutri cereal of choice'. The role envisaged is similar to what the National Egg Coordination Committee (NECC) and National Dairy Development Board (NDDB) did for creating widespread demand for egg and milk respectively. Focused efforts to increase demand led the way and helped create, nurture and sustain other ecosystem players in both industries. Increased demand has spawned several new businesses in the private, public and cooperative sectors. While support from existing institutions and departments can be drawn, a millet-focused institution is needed to work in an integrated manner on multiple fronts. Market creation should be treated as a public good and the government needs to invest in that. In addition, the farmers have limited resources and diversified needs under several socio-economic and farming constraints which had become their primary concern in motivational perspectives before they decided for any changes and adoption of the new practices. As millets are less remunerative which require the following necessary supports as drivers in value chain mode to make them more profitable in order to enhance farmers' income. There is a lot of scope for value-addition and processing to earn

more than the routine business. It can be promoted through entrepreneurship development in collective action mode through SHGs and FPOs. These apart, policy support for farm-gate processing, buy-back assurance; implementation MSP for all millets, their inclusion in MDM and PDS system will boost-up the economy of millets farmers in this region. Farmers should be covered under insurance schemes to avoid any loss due to crop failure and other natural calamities. Building the linkages between the captive markets such as publicly funded programs and the start-ups/processors will result in a solid supply-demand chain. Further, the start-ups are to be linked with the backward linkages such as FPOs or SHGs for creating solid supply chain linkages. Building an ecosystem where start-ups can process the products for big private FMCG player on contract manufacturing will result in efficient use of capacity while the big players can concentrate on penetrating the nutrient-rich products into domestic and export markets to create a sustainable millet ecosystem for future to usher in food and nutrition security in the climate change scenario.

Millets are our own superfoods as more and more research findings are revealing now. Millets are looked upon as offering greater comparative advantages compared to other food crops owing to their rich nutritional profiles, income augmenting opportunities, and resilience to climate change. The beneficial effects of millets are also understood by the fewer diseases and longer lives that our millet-consuming elders had just a couple of generations ago. Higher calcium and potassium content in finger millet, higher iron and beta carotene in pearl millet, greater energy content in pearl millet and little millet are some of the goodness in the millets besides their ability to



provide wholesome nutrition as staple foods. Millets, similar to grain amaranth, are the superfoods of our country. A diet consisting of finger millet and pearl millet would provide richer nutrition than quinoa. Due to lack of awareness and availability these millets have not found their place in the modern food basket. Now, we are seeing increase in awareness and demand for millets in urban and semi-urban societies. Also, besides the conventional staple foods, “ready to cook” and “ready to eat” processed foods made from millets are entering the market in a big way. Revitalising millets into mainstream dryland agriculture and diversifying the food basket is important for sustaining the food, nutritional security of consumers and livelihood security of the rural households. For achieving this, the major challenges are to deliver millet-based technologies which are sustainable and market oriented. This can be achieved through reconsideration of millets research in terms of present and future demand, resolving specific production constraints thereby improving productivity, improved agronomic practices, development of value addition and processing technologies, marketing strategies and policy measures that would generate more income and employment generation to the farmers without sacrificing overall goal of attaining sustainable food and nutritional security. Scientific and technological interventions involving convergence of efforts of agricultural and food scientists, policy makers and media is needed to revalorize millets for attaining food and nutritional security.

Millets are diverse and adapted to different climatic conditions and cropping systems,

provide a strong case to enrich biodiversity as well as diversify the food grain basket. Under the climate change scenario, millets are the most dependable food crops the mankind, especially for the resource poor dryland farmers of the world as they are resilient to climate change and assure sustainable grain production with minimum inputs. The plasticity exhibited has made them flexible for apparent early as well as delayed planting, very low and high rainfall areas, various elevations and different soil regimes. These positive features have not been duly recognised and exploited in the country. The farmers who had shifted from millets to other crops are keen to go back to millets in view of the stable harvests ensured, easy crop production, drought resistance, and eco-friendly production, provided the assured market is in place. Policy and incentive support for creating farmer producer organisations, farm gate warehouse and processing in village clusters, linking farmers to the value chains of both nutri-grains and nutri-fodder and the platform of e-NAM can enable better price and incentivise farmers to produce more of millets adopting improved and sustainable technologies. That would enable the nation to produce surplus of nutri-cereals to confer cost efficient and environment friendly food and nutritional security, once all the policy initiatives are fulfilled and comprehensive millets policy is in place.

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Women farmers engaged in harvesting finger millet crop in Nuapada District.



Odisha Millets Mission Paving the Way for Women Empowerment: Members of Trishakti SHG at their Millets Processing Unit in Bhubaneswar.



Momentous Event: Millets based Food Stall at Dot Fest, Janata Maidan, Bhubaneswar.



A Successful Journey Ensuring Nutritional Value: "Mandia Rath" creating awareness on Millets.



The Successful Journey of Odisha Millets Mission

Prem Chandra Chaudhary

This flagship programme of the Government of Odisha is a pioneering initiative to mainstream nutritious and climate-resilient millets across farms, plates and market in the State.

Millet holds significant importance in Odisha and its cultivation has been an integral part of the agricultural practices in the State for centuries. The State's diverse agro-climatic conditions make it suitable for growing a variety of millet crops and among them finger millet (mandia) is the prominent one. But there has been a noticeable decline in millet cultivation due to changing dietary preferences, shift towards cash crops, and the introduction of high-yielding varieties of other cereals.

Under the guidance of the Honourable Chief Minister Shri Naveen Patnaik, the Government of Odisha developed a strategy for the revival of millets in the State. In this context, a multi-stakeholder consultation was organised by the Planning & Convergence Department, Government of Odisha, with the Nabakrushna Choudhury Centre for Development Studies (NCDS), the Revitalizing Rainfed Agriculture (RRA) Network and the Alliance for Sustainable and Holistic Agriculture (ASHA) in 2016. This led to the launching of Special Programme for Promotion of Millets in Odisha named as Odisha Millets Mission (OMM) in 2017 which became

a flagship programme of the Government of Odisha under the Department of Agriculture and Farmers' Empowerment (DA&FE). The programme focuses on improved production of nutri-cereals, local consumption, procurement under MSP and distribution through PDS. In the initial year of 2017-18, the Odisha Millets Mission was successfully implemented in 30 Blocks of 7 Districts. Subsequently, in the year 2022-23, OMM was extended to 143 Blocks in 19 Districts for implementation of the programme. Currently the programme is being implemented in 177 Blocks in all 30 Districts of Odisha.

Programme Objectives

The objectives of the programme aim to significantly improve various aspects of millet production and consumption in Odisha. A key goal is to increase household consumption of millets by 25% from baseline levels by revalorising millet food cultures in both urban and rural communities. Another focus is on conservation and promotion of landraces through community-based seed systems to preserve millet diversity. The objectives also include promotion of post-harvest



and primary processing enterprises involving millets to improve productivity of millet-based cropping systems. The objectives seek to encourage millet value-addition businesses in rural and urban areas alike. An additional target is facilitating inclusion of millets in public distribution systems, nutrition programmes, mid-day meals, welfare hostels and other schemes. Also, the programme aims to facilitate millet markets and exports of millet-based products from Odisha to expand opportunities for farmers and entrepreneurs. This programme has an additional objective of promoting equity alongside its central goal. This objective aims to provide substantial incentives to farmers in tribal areas, as many other schemes lack this component in supporting tribal communities. The incentives aim to help address the inequality often faced by tribal area farmers.

Multi-Pronged Strategy

The success of the Odisha Millets Mission can be attributed to its comprehensive and multi-pronged strategy. Instead of just promoting production, it incorporated interventions across the value chain with a focus on consumption, marketing, processing and community engagement.



Transplantation of finger millet saplings in progress.

Boosting Production

The Odisha Millets Mission has been promoting improved agronomic techniques to enhance millet seed quality and diversity, as well as boost productivity and farmer incomes. As part of this, monetary incentives are electronically transferred to farmers' accounts upon completing specified practices. These include applying adequate farm yard manure and compost to improve soil health, treating seeds to prevent diseases and pests while improving purity and yields, and adopting methods like System of Millet Intensification (SMI), Line Transplanting (LT), and Line Sowing (LS). The use of organic preparations for pest and disease management is also encouraged. Local Community Resource Persons (CRPs) provide hands-on support at the village level to promote these practices, while facilitating NGOs monitor progress. For successfully completing all activities under SMI and LT/LS, farmers are provided financial support via Direct Benefit Transfer (DBT). Farmers are eligible for incentives for five years.

The Odisha Millets Mission has ensured that farmers have access to all the necessary inputs and equipment required to boost millet productivity. Improved, high-yielding millet seed varieties are distributed among farmers. Training on preparation of bio-fertilizers and other organic inputs for seed treatment and plant nutrition has been imparted to them. This has enabled farmers to enhance the productivity potential of traditional millet crops using sustainable methods. Additionally, recognizing the small landholdings of marginal farmers, custom hiring centres have been established across districts to provide critical farm machinery and implements on a rental basis. Equipment like weeders, threshers, etc. can be sourced by farmers as per need instead of making



capital investments. This has helped overcome financial constraints and made farm mechanization affordable and convenient for smallholder millet cultivators, especially in tribal regions.

In 2017-18, a total of 8,030 farmers engaged in the cultivation of millets in 3,333 hectares spanning 30 Blocks in seven Districts. By 2022-23, the number of farmers involved in millet cultivation rose significantly to 1,72,367, covering an area of 79,556 hectares in 143 Blocks in 19 Districts. The ambitious target is to involve 3,50,000 farmers cultivating millets in 177 Blocks across 30 Districts by the end of 2023-24.



A farmer using a cycle weeder in his finger millet field at G. Khatipadu village in Kalyansinghpur Block in Rayagada District.

Conserving indigenous landraces

The Odisha Millets Mission has undertaken systematic efforts to identify and promote the cultivation of indigenous ragi landraces. Extensive participatory varietal trials have been conducted across tribal districts to evaluate diverse landraces. Further purification and multi-location trials have helped identify climate resilient landraces like Kundra Bati, Laxmipur Kalia, Malyabant Mami and Gupteswar Bharati suited to local conditions. These landraces have been released for cultivation in Koraput and

Malkangiri, marking a historic first in India. Meticulous documentation, community participation and scientific validation have enabled conservation of precious millet diversity. Mainstreaming landraces enhances farmers' access to resilient traditional varieties while preserving agrobiodiversity.



Women farmers spraying bio-inputs in their finger millet field in a village in Mayurbhanj District.

Ragi procurement under OMM

Direct procurement centres or millets mandis have been established where farmers could sell their produce directly to government agencies at fair Minimum Support Prices without dependence on exploitative middlemen. The process of procuring ragi under the Odisha Millets Mission begins with farmers producers organisations (FPOs) and self-help group (SHG) federations conducting village-level awareness campaigns to inform farmers about the Minimum Support Price and Fair Average Quality standards for ragi. The District Level Purchase Committee (DLPC) chaired by the Collector and District Magistrate then decides on the procurement start date, the number and names of Primary Agricultural Cooperative Societies (PACS),



Large-sized Adivasi Multipurpose Cooperative Societies (LAMPCS), FPOs and SHG Federations who will serve as procurement agencies, the location of the mandis, and the number of procurement days. The FPOs/SHG Federations consult with the Tribal Development Co-operative Corporation of Odisha Ltd (TDCCOL) to propose suitable mandi locations and dates to the Chief District Agriculture Officer (CDAO) based on farmer convenience. The TDCCOL then makes arrangements for mandis on the dates and locations approved by the DLPC.



Ragi procurement is in progress under Odisha Millets Mission at Budaguda in Rayagada District.

Farmers must fill out a registration form with ID proof, Bank passbook details, and land records and submit this to the FPO/SHG Federation/LAMPCS/PACS for registration on the MPAS portal. The FPO/SHG Federation/LAMPCS/PACS then digitizes the farmer registration forms on the M-PAS portal. TDCCOL district officials generate reports on a per Agricultural Assistant Officer (AAO)/Bank Agricultural Officer (BAO) and bank-wise basis

for verification of land records and bank accounts. The land and bank verifications are done by AAOs/BAOs and bank managers respectively, based on records. Any corrections and changes based on the verification are updated by TDCCOL district officials on the portal. Land records are further authenticated using the Bhulekh database and by respective AAOs/BAOs.

Once land and bank verification is complete, surplus generation happens on the portal against the approved surplus quantities per farmer. Farmers then receive a token for the approved surplus quantity to sell at the mandi. At the mandi, farmers present their produce and token to sell their ragi at the designated procurement centre. Payment is transferred to the farmers' bank account within 72 hours from the sale date at the mandi.

The procurement of Ragi has witnessed a substantial increase, surging from 0.179 lakh quintals in 2018-19 to 6.03 lakh quintals in 2022-23 in Odisha.

Millet in PDS, ICDS and Welfare Hostels

The programme on introduction of Ragi Ladoo in ICDS morning snacks is an integral part of the Odisha Millets Mission's initiative to promote the consumption of millets, with a specific focus on millet-based servings for children at Anganwadi centres, as a nutritious and wholesome dietary option for children in the Keonjhar and Sundargarh districts. The objective is to improve the nutritional quality of the diet served under ICDS through additional serving of ragi Ladoos in the ICDS morning snacks for pre-school children, promote livelihood opportunities to WSHG members, pilot modalities and define one model implementation plan for scale up. The programme covers 6077 Anganwadi centres in 13 blocks of Keonjhar and 17 Blocks of



Sundargarh Districts, serving to 1.5 lakh pre-school children. The programme was initially piloted in Sadar Block of Keonjhar and Hemgiri Block of Sundargarh District during July and August of 2020. The programme is implemented through the existing ICDS centres across Keonjhar and Sundargarh district in the state of Odisha. The programme was introduced as an collaboration of departments with financial support from the District Mineral Foundation. The Ragi is procured at Minimum Support Price by the State Marketing Agency, named TDCCOL (Tribal Development Co-operative Corporation of Odisha Limited). And the existing channel of distribution is followed through Civil Supply Department. All the quality protocols with the ICDS Supplementary Nutrition programme are followed here in the implementation of the programme. Women SHGs and Federations are involved as processing and value addition enterprises for transporting, cleaning, processing and preparation of Ragi Ladoo mix, and supplying to the doorsteps of Anganwadi centres monthly. The Helpers at Anganwadi centre are responsible for preparation of Ragi ladoo out of the Ladoo mix and serve fresh to pre-school children, for weekly 4 days. The programme is a well coordinated programme in partnership of Agriculture and Farmers' Empowerment Department, Mission Shakti Department, Women and Child Development Department, Odisha State Civil Supply Department and District Mineral Foundation with technical support from CSIR-CFTRI (Central Food Technological Research Institute), NCDS (Nabakrushna Choudhury Centre for Development Studies) and WASSAN (Watershed Support Services and Activities Network). The successful implementation of the ICDS Ragi Ladoo programme paved way for piloting inclusion of millets in other welfare schemes of the government. The successful implementation

of the programme opened ways for the following interventions in state: Introduction of millets-based food in welfare hostels, Introduction of millets in MDM, introduction of millet-based take-home-ration in ICDS for pregnant women, lactating mother and adolescents, Scale up of the programme in all districts of Odisha. With holistic objective of diversifying the food basket for school boarders in SC ST Development Department supported welfare hostels in Odisha the programme first piloted in tribal-dominated Keonjhar District with budget support from District Mineral Foundation.



*Keonjhar Collector & District Magistrate
Mr. Ashish Thakare speaking during the
introduction of Ragi Ladoo into ICDS in the district.*

With holistic objective of diversifying the food basket for school boarders in SC ST Development Department-supported welfare hostels in Odisha, the programme first piloted in tribal-dominated Keonjhar district of Odisha with budget support from District Mineral Foundation. The programme first piloted in one Block of Keonjhar started from the month of November 2022. Now the programme covers 39,000 boarders in 340 welfare hostels in Keonjhar. The Ragi ladoo of 20gm each is being served to the boarders everyday as an additional supplementation in addition to the existing menu. The pilot programme paved its way for



implementation of the same programme in other DMF districts, and the proposal got approved in Sundargarh for implementation soon. Through the programme, 19 women SHGs and 2 FPCs were involved in processing and value addition, and supported for service provided, leading to their livelihood. Department of SC ST and Backward Class Development, Department of Agriculture and Department of Mission Shakti were part of the programme for implementation, with financial support from DMF Keonjhar and with technical support from Programme Secretariat under Odisha Millets Mission.

Partnership with Mission Shakti

The Odisha Millets Mission and the Mission Shakti Department have partnered to promote millet cultivation and empower women's self-help groups (SHGs) in Odisha. The Mission Shakti Department works to organise women into SHGs and federations to foster socio-economic development. Under the collaboration, SHG members are being encouraged to take up millet cultivation, as many women traditionally engage in this farming activity. The Odisha Millets Mission is providing training to SHG members on improved practices for millet farming through demonstrations and workshops. This covers sowing methods, intercropping, using biofertilisers, plant protection and mechanised harvesting. SHG federations are involved in activities like supplying quality seeds to women farmers, organising millet procurement through mandis, and linking SHGs to government nutrition programmes as suppliers of millet products. SHG women are also being trained to operate small millet processing units and millet-based enterprises like millet restaurants. To enable women cultivators to benefit from the Minimum Support Price for millets, SHGs carry out

registrations of women farmers on the government procurement portal. Bank account details are also collected to facilitate direct payment on millet procurement. SHG federations act as procurement agencies at the village level.

By promoting millet cultivation and value-addition activities among SHG women, the partnership aims to increase women's income, ensure nutrition security, and revive India's traditional millet crops. It exemplifies how government departments can collaborate meaningfully for agriculture development and women's empowerment. The model can potentially be scaled to benefit millions of small and marginal women farmers engaged in millet farming across India. Apart from this, the collaboration has created Millet Shakti brand to promote millet-based food enterprises among members of women self-help groups (WSHGs).



Members of Dibyajyoti Self-Help Group who run a tiffin centre in Bisra block of Sundargarh District with the support of Mission Shakti Department and Odisha Millets Mission.

Enterprises promoted

There are different types of enterprises which have been promoted and a few are in the pipeline under the Odisha Millets Mission. These



include bio-inputs centres, custom hiring centres (CHCs), community-managed seed centres (CMSCs), millet tiffin centres, millets-on-wheels, millet outlets, pulverising units, dehulling units, threshing units, cleaning-destoning-grading units, millet cafés, self-help groups (SHGs) as start-ups and farmers producers organisations (FPOs) as start-ups. These enterprises have provided new opportunities for SHGs and FPOs to engage in business activities and foster growth. The detailed descriptions of the different enterprises as follows:



Members of Maa Sarada Self-Help Group preparing bio-inputs at Budabahal village in Rangiamunda Block in Sundargarh District with the support of Odisha Millets Mission.

Bio-inputs centres: The bio-inputs centres are promoted in order to boost the production of organic inputs and to encourage its use at the block and GP levels. Reducing the use of chemical fertilizers and pesticides in the management of nutrient and pest problems in millet cultivation is one of the goals of the preparation of bio-inputs. Another goal is to relatively reduce input costs in agriculture by encouraging the use of locally accessible raw materials for the preparation of organic inputs. Although there is incentive assistance for farmers to use farm yard manures (FYM) and for seed treatment through bio-inputs, it has become a motivating element for FPOs and

WSHG members to pursue bio-input as a business. This can be used by FPOs/WSHGs as a source of income and to lower production costs in agriculture. Through farmers producers organisations and women self-help groups (WSHG), these centres have been set up across the 30 districts. WSHGs are in charge of production, while FPOs are in charge of marketing the bio-inputs in the local market. Jeevamrutha, Ghanajibamruta, Handikhata, Nimastra, Agniastara, and Bijamruta are the six major products on which these centers initially concentrated their efforts in terms of production and marketing. Apart from these, they also produce and market Fish tonic, Egg tonic, Dashaparni arka and Vermicompost etc. WSHGs have been instrumental in advancing the bio-input effort, which has aided in their economic empowerment.

Custom Hiring Centres (CHCs): custom hiring centres function as service centres at the village level, providing support for agriculture. Various necessary agricultural implements such as pump sets or spray machines are stocked within these centres. Farmers have the option to rent these implements at a highly reasonable cost, in comparison to other alternatives. These centres are managed by members of self-help groups or farmers producers groups.

Community-Managed Seed Centre (CMSC): Community-managed seed centres (CMSC), run by SHGs or FPOs, collect and conserve seeds through established package of practices. Seed centres preserve a portion of the seeds and cultivate the rest, storing new seeds after selling to farmers. They follow the cultivation practices outlined for seed conservation, and this cycle continues annually, resulting in seed preservation sustainably. Seed centres identify locally available seeds, collect and analyse



sources and details, then cultivate the best available 10 varieties. After harvest, one or two top-performing seeds are chosen. This process takes three years for centres to obtain the best seed for local cultivation. In the first year, participatory varietal trials are conducted, followed by mass selection in the second year to find the best-performing seeds. In the third year, seed multiplication is done. For seed multiplication, the centres select 10-20 farmers to cultivate the best-performing seeds. These farmers receive training in seed cultivation practices. After harvest, seed centres purchase the seeds from these selected farmers and later supply them to other farmers. Seed centres operate as business entities. Research is conducted in the first two years, and seed multiplication begins in the third year when their business actually starts. The government provides necessary support to these centres in starting their business.



A farmer after purchasing Ragi seeds from the community-based millet seed centre run by Saraswati Self-Help Group at Siletpani in Nuapada District.

Millet thresher unit: The Odisha Millets Mission has successfully promoted the establishment of millet thresher units across the state. Threshing is a crucial step in millet farming, aiding in separating the grains from the stalks. This initiative has significantly contributed to creating livelihood opportunities for many farmers across the state.

The initiative has also eased and helped to increase the production of millets in the state, which has become the frontrunner in millet production in the country.

Millet cleaning-cum-grading-cum-destoning unit:

A number of millet cleaning-cum-grading-cum-destoning units have been established in Odisha, benefiting hundreds of farmers for whom they have become an alternative source of income. These units have helped to improve the quality of millets, making them more marketable. They have also helped to reduce the drudgery of manual cleaning and destoning, freeing up farmers to focus on other tasks. In addition, the units have created employment opportunities for local people, helping to boost the local economy.

Millet dehuller unit: Millet dehuller units are another livelihood activity promoted by the Odisha Millets Mission for members of women self-help groups (WSHGs) across different districts. These units are playing a crucial role in enabling WSHG members to secure a livelihood and enhance their economic well-being. Millet dehulling involves the process of removing the outer husk from millet grains, making them easier to cook, digest and extending their shelf life. Equipped with efficient machines, millet dehuller units swiftly remove the husks from millet grains. Women working in these units are trained in machine operation and quality control of the dehulled grains. By providing a means of self-employment, these units are empowering women and positively impacting their financial circumstances.

Millet pulveriser unit: As a means of earning, millet pulverisers have been provided to members of women's self-help groups (WSHGs) to support their livelihoods across the state. These individuals offer their services to farmers for a nominal fee, creating a mutually beneficial



arrangement. This initiative not only helps individuals within WSHGs generate income but also aids farmers in their agricultural pursuits.

Millet tiffin centre: Tiffin centres are operated by SHGs in rural areas with the support of the Odisha Millets Mission. Their primary aim is to reach out the rural population. These centres create affordable and popular local snack items such as vada, samosa, pakoda, breadchop, nimki, mixture and more.

Millets-on-Wheel: The “Millets-on-Wheel” is like a moving food stall that travels around rural and some urban areas. Every day, these special vehicles follow specific routes and stop at chosen places where they can do good business. The Odisha Millets Mission wants self-help groups (SHGs) to run these food vehicles. They help the selected SHGs start this business. The food sold from these moving stalls includes popular snacks items like vada, samosa, idli, puri and more. These special food stalls not only offer more food options locally but also help SHGs start their own businesses. The millets-on-wheel idea shows how the mission wants to encourage new and creative ways of using millets for cooking and help local economies grow.



A millets-on-wheel being run by Swastik SHG at Rajgangpur in Sundargarh district with the support of Mission Shakti Department and Odisha Millets Mission.

Millet outlet: Members of self-help groups (SHGs) are running millet outlets with the support of the Odisha Millets Mission programme in urban areas. These outlets offer various kinds of cakes, biscuits, and snack items. Take-home rations are also provided at these millet outlets.



The Millet Shakti Cafe being run by members of Maa Mangala Self-Help Group at Lok Seva Bhawan in Bhubaneswar.

Millet cafe: Under the Odisha Millets Mission (OMM), millet cafes have been set up in urban areas across the state through women self-help groups (WSHGs). These cafes are located in various places such as Lok Seva Bhawan in Bhubaneswar, Puri, Barabati in Cuttack, and Balangir. In these cafes, a range of millet-based snacks and meals are on offer, including biscuits, cakes, soups, and freshly prepared snacks. These cafes are found in Bhubaneswar, the capital city, as well as district headquarters. The main aim of these millet cafes is to encourage the consumption of millets, which are both nutritious and cost-effective sources of food. These cafes provide an accessible and reasonably priced way for people to try out dishes made from millets. Apart from this, these cafes have been empowering women economically.



Apart from these, a few enterprises which are in the pipeline include a millet service centre and a mini millet factory.

Millet Service Centre: The Government is planning a Millet Service Centre for providing support to farmers producers organisations (FPOs) and self-help groups (SHGs). This initiative aims to facilitate substantial investments, amounting to crores of rupees in FPOs and SHGs to develop comprehensive and fully operational setups. This will be a good opportunity for FPOs and SHGs, enabling them to initiate new businesses. The establishment of the Millet Service Centre will lead to promotion of entrepreneurship and economic growth in the state.

Mini Millet Factory: A mini millet factory is in the process of being established in Bhubaneswar. The factory is envisioned as a comprehensive setup, encompassing all stages of production, and it will be run by a Farmers Producers Organisation (FPO) or a Self-Help Group (SHG). This initiative aims to streamline the entire millet processing process, from the initial stages to the final products.

Promoting millet consumption

The government has launched various initiatives to re-popularise millets and increase their consumption. These efforts include holding awareness campaigns, promotional events, food fairs, seminars and social media outreach. To encourage millet consumption nationwide, the government has organised millet promotion activities at the block, district and state levels. These initiatives aim to reintroduce millets into farms and diets by educating the public about the benefits of these nutritious grains. Celebrity endorsements and food tasting events have also been used to showcase delicious millet recipes.

During the Hockey World Cup, millet was extensively promoted through various initiatives across the state. The promotion included setting up millet stalls, cafes, and outlets at the Hockey World Cup venue, as well as during the Hockey World Cup district tour. The capital city and other urban areas also witnessed the opening of millet cafes and outlets to increase awareness. Numerous promotional events were organised to reach a wider audience. Festivals like Sisira Sarasa Mela, BhuFest, City Fest, Adivasi Mela, Toshali Mela and District Food Melas in Bhubaneswar featured millet promotion stalls. Schools and educational institutions were not left out, as events such as millet tasting sessions, quiz competitions, and awareness programmes were organised there. The efforts extended beyond the sports and festival arenas. For instance, millet was added to the menu of Odisha Bhawan in New Delhi. Collaboration with Hotels and Restaurants Association led to millets finding their way into restaurant menus, with various IEC activities, tasting events, and more. Moreover, exhibitions and stalls were organised at significant events, including the National Climate Conclave in Lucknow and the celebration of “Akshya Trutiya” in Bhubaneswar. Housing societies and medical institutions like AIIMS, Bhubaneswar, also hosted millet tasting events and awareness campaigns. These multifaceted approaches aimed to create awareness about the benefits of millets, promoting their consumption as a healthy and sustainable dietary option. The concerted efforts of various organisations and institutions played a crucial role in spreading the message about the significance of millets in Odisha.

Food festivals, cooking competitions and recipes shared online and through social media have popularised delicious millet preparations.



State and district-level food festivals have celebrated local millet-based cuisine and culture. Collaborations with leading food brands have introduced millet-based products into the mainstream. By generating consumer awareness and making millets “aspirational” while ensuring availability, OMM has succeeded in boosting millet consumption across urban and rural Odisha.

Harnessing Partnerships

The Odisha Millets Mission (OMM) has partnered with a wide range of institutions to tap into the potential of millets, aiming to enhance nutrition and food security. Working alongside the Indian Institute of Millet Research (IIMR), OMM is committed to developing innovative millet varieties and promoting their utilisation in food and feed applications. Additionally, in collaboration with the Central Food Technological Research Institute (CFTRI), OMM seeks to advance millet processing technologies to boost their nutritional value. OMM is also conducting joint research with Cambridge University to explore the various health benefits of millets. Moreover, teaming up with the World Food Programme (WFP), OMM aims to integrate millets into food assistance programmes to combat malnutrition. The primary goal of these collective endeavours is to fully unleash the potential of millets and address crucial challenges related to nutrition and food security.

Working in association with the Food and Agriculture Organisation (FAO), OMM has initiated impactful projects, including the Seed System Landraces (SSLR), policy support for the International Year of Millets, and active participation in the International Convention on Millets. Additionally, OMM has collaborated with the World Food Programme (WFP) to strengthen policy advocacy, knowledge exchange programmes, and the publication of millet-related

materials. These collaborations have significantly magnified the mission’s impact and have elevated Odisha’s millet movement on the global stage. Furthermore, OMM’s collaboration with research institutions like the M.S. Swaminathan Research Foundation (MSSRF) has laid the groundwork for extensive research on millets, exploring their nutritional potential and establishing sustainable seed systems. Similarly, the mission has partnered with SCSTRTI to conduct a comprehensive change detection study on the millet-based food habits of tribal people in Odisha.

The Odisha Millets Mission has successfully engaged in productive partnerships with a wide range of stakeholders, including various associations and government departments. Notably, the Restaurant Association of Odisha (RAO) and the Hotel & Restaurant Association of Odisha (HRAO) are playing a crucial role in integrating millet-based dishes into menus, thereby increasing awareness among urban dwellers. The OMM collaborated with the Institute of Hotel Management in Bhubaneswar to provide training on millet recipes. Members of self-help groups and chefs from reputed hotels across the state participated in these training sessions. The goal was to build capacity among local communities and food professionals to prepare delicious and nutritious dishes using millets. By partnering with IHM Bhubaneswar, the government leveraged culinary expertise to promote innovative millet meal options. Esteemed educational institutions like OUAT and XIMB have become valuable partners in organising millet tasting events and effective branding activities, demonstrating the versatility of millets. Collaboration with the Sports and Youth Services Department has resulted in millet tasting events



with the Indian hockey team and the inclusion of millet items in sports hostel menus. The Bhubaneswar Development Authority (BDA) has also collaborated with the mission to promote millet awareness in parks and festivals, while the Bhubaneswar Municipal Corporation (BMC) has contributed by spreading awareness through captivating wall paintings and hoardings. Furthermore, the All India Institute of Medical Sciences, Bhubaneswar, has taken a step towards enhancing the nutritional value of patients' diets by incorporating millets. The Department of Agriculture and Farmers' Empowerment has partnered with FICCI to celebrate the International Year of Millets 2023, showcasing the widespread dedication of the mission to reach all segments of society and promote millets among diverse populations.

The Odisha Millet Mission relies on the facilitating agencies to carry out crucial tasks in the district. These agencies have a three-fold responsibility. First, they actively promote millet cultivation through extensive awareness campaigns, farmer training programmes, and the provision of essential resources like seeds, fertilizer, and pesticides. By educating farmers about millet benefits and imparting cultivation know-how, they strive to foster millet adoption. Secondly, these agencies facilitate millet marketing by bridging the gap between farmers and buyers, especially government procurement Mandi. They offer support for value addition, guiding farmers in how to sell at Mandi and keeping them informed about prevailing market prices. Furthermore, they aid in transforming millets into processed products like flour, snacks, and porridge, boosting their marketability. Lastly, the facilitating agencies take charge of monitoring mission implementation and conducting millet-related research. They diligently

track mission progress, collect comprehensive data on millet cultivation and marketing, and delve into research to unveil the nutritional significance of millets. Working in close collaboration with the government, farmers, and stakeholders, these agencies bear the weight of the mission's overall success. By ensuring effective execution and dissemination of millet-related benefits, they prove instrumental in fulfilling the mission's objectives, benefiting both farmers and consumers alike.



Chefs of reputed hotels from different parts of Odisha attended a training on millet-based recipes held at Institute of Hotel Management, Bhubaneswar.

IYoM: Mandia Dibasa to International Convention on Millets

In the past few years, Odisha has emerged as a frontrunner in promoting millets through the Odisha Millets Mission (OMM), in line with the International Year of Millets (IYoM) 2023. OMM has encouraged tribal communities, women and farmers while promoting equity and empowerment. Through collaboration between Government, NGOs and research institutes, OMM has taken a holistic approach, making it a model for millet promotion globally. The hugely successful inaugural *Mandia Dibasa* on November 10, 2022 led the CM to declare it an



Author speaking on Odisha Millets Mission and health benefits of millets at SAI International School in Bhubaneswar.

annual event. To mark the International Year of Millets, an International Convention on Millets is being organised on November 9th and 10th, 2023. OMM partnered with industry at the “Make in Odisha” conclave. Mission Shakti and the Indian Hockey Team collaborated for opening a Millet Shakti outlet, highlighting nutrition.



Members of Indian Hockey team enjoying millet-based recipes during Hockey World Cup 2023 held at Kalinga Stadium, Bhubaneswar.

Bhubaneswar Development Authority, Bhubaneswar Municipal Corporation and DA&FE created millet artworks across Bhubaneswar. Agricultural and Processed Food Products Export Development Authority

(APEDA), Mission Shakti and DA&FE facilitated the first millet export to UAE. The state released high-yielding, nutritious ragi landraces to conserve local varieties. DA&FE and Odisha University of Agriculture & Technology (OUAT) are benchmarking prices of Non-Ragi minor millets. Odisha’s IYoM framework connects millets with sports, tribes, gender, SDGs and events, highlighting tribal communities and empowering women and farmers. OMM is documenting tribal food cultures with Scheduled Castes and Scheduled Tribes Research and Training Institute (SCSTRTI). With the World Food Programme (WFP), OMM is exchanging knowledge to empower women and farmers. Indian Institute of Millet Research (IIMR) is helping develop an SOP for seed systems. Through the celebration of IYoM, Odisha is also bringing millets to the forefront, from cities to villages, while empowering tribal communities, women and farmers.

Policy milestones

The Odisha Millets Mission has achieved several policy milestones since its inception. Odisha has been recognised as the best performing millet promotion state at the National Convention on Nutri Cereals by the Ministry of Agriculture & FW and UN-FAO. The Ministry of Agriculture & Farmers’ Welfare, Government of India and Niti Aayog has identified OMM as one of the best models and asked other state governments to adopt the OMM approach for promotion of millets. The World Food Programme has also identified OMM as one of the best practices that can be replicated in the other states and other countries in Africa as part of South Collaboration. Apart from this, OMM has developed an alternate seed system for landraces for the first time in the world. Odisha became the first state to declare direct incentive to farmers for five years through Direct Benefit Transfer (DBT). It has also



become the first state to develop standard specifications for the minor millet machinery through a recognised panel of experts from different scientific institutions. Odisha is the third state to distribute millets in PDS in the country. Moreover, Odisha has become the first state to include Ragi Ladoo in ICDS through District Mineral Fund (DMF) support under OMM.

Recognition & impact

The Odisha Millets Mission has received significant recognition for its work and impact. Government of India has asked all states to adopt the Odisha Millets Mission model for the promotion of millets, pulses and oilseeds. Niti Aayog has chosen Odisha and Karnataka as two progressive models and will facilitate the learnings of these states for other states. The State Planning Commission of Chhattisgarh has asked Government of Chhattisgarh to start a millet mission on the lines of “Odisha Millets Mission”. Similarly, the Governor of Maharashtra has asked the state government to explore initiating a project on millets considering the Odisha Millets Mission. Government of India has also set up a task force

to understand the framework of Odisha Millets Mission and to revise the National submission on millets based on the learnings of the OMM. Cambridge University partnered with Odisha Millets Mission to explore the possibility of designing OMM as an alternative to the Green Revolution framework. International agencies like UN-IFAD and UN-FAO have supported the framework of Odisha Millets Mission as suitable for taking up agroecological initiatives.

The Odisha Millets Mission has shown how government support and strategic interventions can help revive traditional nutritional crops at scale. It has been a story of reclaiming forgotten grains, empowering tribal communities, restoring sustainable farming practices, and ushering food system reforms. With millets regaining their rightful place in Odisha’s fields and food habits, there is now an opportunity to replicate this success nationally.

*Director, Agriculture and Food Production,
Government of Odisha.*



Kids enjoying Ragi ladoos at an Anganwadi Centre at Bargaon village in Bargaon Block of Sundargarh District.



Bringing Happiness: Members of Triranga Self-Help Group managing Millet Shakti Outlet at Gandhi Nagar in Balangir.



Ensuring Livelihood and Nutritional Value: Members of Maa Sata Bhauni Self-Help Group managing a Millet Shakti Tiffin Centre at Kashipur in Rayagada District.



Delicious and Nutri-foods: Display on Millet Food Products at Toshali Mela, Bhubaneswar.



Exploring the Benefits of Registration of Farmers' Varieties through PPV&FR Act, 2001

Pritesh Sundar Roy

Farmers, the familiar name; who are they literally? The answer is they are the lifelines of the world population. The (any) food/fodder crop that we are familiar with must have been identified and the seeds have been sown by a farmer at some point of time since the existence of human life. They are the ones who painstakingly brought the edible food crops to the limelight of the world.

In the present scenario of existing and being developed hybrids/high yielding varieties in the agricultural system throughout the whole world, the native varieties are fading from the limelight and are in the verge of extinction. The native varieties which are being cultivated by farmers in small pockets possess tremendous untapped traits. The treasures available in many of these are still unexplored potentially. Lots of articles have been published showcasing the important and excellent characters available in these native heritages that can be explored to meet the present climate change scenario for feeding the millions. However, these valuable pearls of nature in the form of local landraces are often neglected.

Keeping this in view to safeguard the available genetic resources with farmers and new varieties developed by plant breeders the 'Protection of Plant Varieties and Farmers' Rights Act' (PPV&FRA) was implemented in the year

2001, framed in 2003, and the Authority was established on November 11, 2005. The Act extends to whole India under the 'Protection of Plant Varieties and Farmers' Rights Authority', New Delhi. Through the PPV&FR Act the plant varieties developed by plant breeders and the native varieties available and cultivated by farmers of the country are registered for their protection.

The act highlights (link-<https://plantaauthority.gov.in/sites/default/files/ppvfract2001.pdf>):

An Act to provide for the establishment of an effective system for protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants.

WHEREAS it is considered necessary to recognize and protect the rights of the farmers in respect of their contribution made at any time in conserving, improving and making available plant genetic resources for the development of new plant varieties;

AND WHEREAS for accelerated agricultural development in the country, it is necessary to protect plant breeders' rights to stimulate investment for research and development, both in the public and private



sector, for the development of new plant varieties;

AND WHEREAS such protection will facilitate the growth of the seed industry in the country which will ensure the availability of high quality seeds and planting material to the farmers; AND WHEREAS, to give effect to the aforesaid objectives, it is necessary to undertake measures for the protection of the rights of farmers and plant breeders;

AND WHEREAS India, having ratified the Agreement on Trade Related Aspects of Intellectual Property Rights should inter alia make provision for giving effect to subparagraph (b) of paragraph 3 of article 27 in Part II of the said Agreement relating to protection of plant varieties.

According to the PPV&FR Act farmers' variety means a variety which:

- (i) *has been traditionally cultivated and evolved by the farmers in their fields; or*
- (ii) *is a wild relative or landrace or a variety about which the farmers possess the common knowledge;*

The complete details on "farmers' rights" are mentioned in the chapter VI of the act. According to the act application for farmers' variety by farmers or community of farmers or group of farmers as contained in the Protection of Plant Varieties and Farmers' Rights Act, 2001 shall be submitted only with an endorsement in Annexure 1 (link- <https://plantauthority.gov.in/registration-farmers-variety>) either by the concerned Panchayat Biodiversity Management Committee, or District Agricultural Officer, or Director of Research of concerned State

Agricultural University or District Tribal Development Officer.

For registration of varieties under farmers' variety category, which varieties qualify ?

According to the PPV&FR Act, 2001: Varieties which are traditionally cultivated and evolved by the farmers in their fields by way of selection of variants naturally evolved in the field or varieties which are wild relatives or land race about which the farmers concerned possess common knowledge. In the case of traditional varieties or landraces being maintained by the community or village, the rights will be that of the entire community without restricting it to its being under cultivation for a period of 15 or 18 years in cultivation, as the case may be. However, in the case of selection of evolved variant in such traditional or land races, the period of common knowledge of existence of the variant selection with the individual farmer shall be acknowledged by restricting it to no more than 15 or 18 years, as the case may be for the purposes of registration under extant variety in common knowledge. *(The complete details are available in the PPV&FRA website.* Moreover, the variety must fulfill the criteria of Distinctiveness, Uniformity and Stability (DUS) test conducted over different locations throughout the country and should also have a single and distinct denomination. The major steps in registration of plant varieties under the Act includes filing of application, examination of application and conduct of suitable DUS test, evaluation of DUS test results, publication of passport data in the Plant Variety Journal of India (PVJI) for calling objections, if any, within a specified time frame and issuance of registration certificate to the applicant / breeder.

A total of 5377 certificates have been issued (as on 18.10.2023) towards registration



ANNEXURE 1

Endorsement of application for registration of farmers' variety under Protection of Plant Varieties and Farmers' Rights Act, 2001

1. Name(s) of applicant farmer/ Group of farmers/Community of farmers

Serial Number	Name with surname/Name of Group/ Name of Community	Permanent Address

2. Denomination of the variety:

2a. (Applicable to individual farmer applicant)
I hereby declare that I have been a permanent cultivator since last many years in the village falling under the local body/ Panchayat in the District of State and that I and my family are the initial and exclusive developers and conservers of the candidate variety denominated as under the kind (Common name of crop) to the botanical species

2b. (Applicable to group/community of farmers applicant)
We hereby declare that we have been the permanent cultivators since last many years in the village(s) falling under the local body/ Panchayat(s) in the District(s) of State(s) and that we are the initial and exclusive developers and continuous conservers of the candidate variety denominated as under the kind (Common name of crop) belonging to the botanical species We on behalf of our group/community hereby authorize s/o (Name), who is a member of our group/community and permanent resident of (Complete postal address) to do the needful and be the signatory on our behalf for the limited purpose of securing registration of the candidate variety in our favour under Protection of Plant Varieties & Farmers' Rights Act, 2001.

Date:
Place:

Signature and Name of the Farmer or
Authorized person of Group/Community
(To be signed before the endorsing official)

It is hereby certified that the above said candidate variety is bred / developed and continuously conserved and cultivated only by the applicant farmer / group of farmers / community of farmers who is / are permanent residents of above said village(s) and I am fully conversant with the applicant farmer / group or community of farmers and that the candidate variety is due to their efforts (strike out unwanted words given as options).

Signature:
Name:

Date:
Place:

(Chairperson / Secretary of the Concerned
Panchayat, Biodiversity Management
Committee OR Concerned District
Agricultural Officer OR Director of
Research/Director of Extension of concerned State Agricultural
Universities OR Concerned District Tribal
Development Office / Zonal Project Director (ICAR).
(With Official Rubber Stamp)

of plant varieties with PPV&FR Authority, of which 2211 are farmers' varieties of different crops. For example the farmers' variety (Umakanta Mohapatra, Kusudiha, Block Sadar, District Balasore, Odisha) of rice i.e. Kathia having specific character of straw colour of lemma and palea was registered (Acknowledge no: REG/2011/219). Similarly, farmers' variety of rice i.e. Karakoili having specific character of high weight of 1000 fully developed grains was registered (Acknowledge no: REG/2011/277) in the name of Balaram Nayak, Dumra Guda, Block-Jeypore, Dist- Koraput, Odisha. Another aromatic farmers' variety (Dhanurjaya Behera, Dhanshli, Block-Jaipatna, Dist- Kalahandi, Odisha) of rice i.e. Mohan Bhog having specific character of

green basal leaf sheath, anthocyanin absent in lemma apex, white colour of stigma, anthocyanin absent in stem node, white lemma tip and aromatic decorticated grains was registered (Acknowledge no: REG/2011/829).

Keeping this in view ragi/finger millet exploration was conducted by Odisha Millets Mission for collecting the seeds of finger millets available with the farmers of different districts of Odisha. Field level data on the collected farmers' varieties have been generated in experimental trials conducted by Odisha Millets Mission. Presently, initiatives have been taken for registration of these farmers' varieties at PPV&FRA, New Delhi. The PPV&FRA forms (19 numbers) for farmers' varieties collected from different blocks of Koraput with all the necessary formalities have been completed recently and those will be submitted to PPV&FRA, New Delhi along with requisite information regenerated for these varieties.

The registration of farmers' varieties with PPV&FR Authority certainly paves the way for safeguarding the Intellectual Property Rights of the farmer on the plant variety. Therefore, generation of awareness and encouragement among the farmers and farmers' communities is the utmost thrust for protection of their own varieties. Further, registration of farmers' varieties will certainly help in continuous cultivation and preservation of these heritages.

WASSAN (Odisha Millets Mission).



Millets for Human Health and Climate Resilience

Prof. Pravat Kumar Roul

Millets are among the oldest known cultivated crops grown since pre-historic ages. Millets are a group of annual grassy plants producing small grains used for human food and animal consumption. These crops are extensively cultivated in various countries of the world. The nutritious values of the grains and their health benefits have made millets a preferred diet both in urban and rural areas. In the recent time, millets are gaining increasing importance due to numerous benefits in terms of human health and environmental aspects. These crops can be suitably grown under rainfed situation in arid and semi-arid ecosystems. Millet crops being highly adaptable to different ecological conditions, are ideal for climate change and contingency crop planting. Millets are tolerant to extreme weather events like drought and can be grown with low external inputs such as fertilizer & pesticide. These crops are considered as a major source of nutrients such as carbohydrate, protein, fibre, vitamin, minerals, etc. fulfilling food and nutrient requirement for millions of poor people across the world. These crops are usually grown with limited water and without application of fertilizer. Millets are otherwise known as ‘smart foods’ and

‘nutri-cereals’ due to their contribution for food, health and feed. Millets can help to support livelihood, enhance income of farmers and ensure nutrition security.

Major areas of production of millets are tropical and subtropical areas of Asia and Africa. The area under millet crops in Asia is 162 lakh hectares and the production is 215 lakh tonnes. Similarly in Africa, the area under millet cultivation is 489 lakh hectares with production of 423 lakh tonnes. In India, the area under millets cultivation is increasing over last couple of years. The area has been increased from 12.29 million hectares during 2013-14 to 15.48 million hectares during 2021-22 in the country. Major millet crops grown in India include sorghum, pearl millet, finger millet, proso millet, kodo millet, foxtail millet, little millet and barnyard millet. These are traditional crops with high nutritional value and health benefits.

Health benefits of Millets

Millets offer a wide range of health benefits because of high nutrient content and unique characteristics. Millets contain high quantity of nutrients and dietary fibre. The protein of millet



grain contains better quality of essential amino acids as compared with other cereals. Small millets are good source of phosphorous and iron. Presence of phytates, polyphenols, tannins, anthocyanins, phytosterols and pinacosanols in millets contributes to antioxidant activity. The magnesium and potassium content in millets can help regulate blood pressure, reduce the risk of hypertension, and promote overall heart health. Higher quantity of fibre available in millets play a vital role in reducing the cholesterol level.

Millets are low-glycemic index food and help to reduce the blood sugar level. Millets contain adequate quantity of calcium and phosphorus, which are essential for maintaining healthy bones and teeth. The vitamins and minerals in millets can contribute to healthy skin and hair. Presence of fibre in millets eliminates several gastro-intestinal disorders like gastric ulcer. As millets are gluten free, those can be suitable for persons suffering from celiac disease. Millet consumption is advantageous for weight loss and overall health.

Millets for climate resilience

Millets are considered climate-resilient crops due to their ability to thrive in diverse and challenging environmental conditions including drought, heat stress and flood. There is increase in temperature and heat stress due to ill effects of climate change, which has substantial effect on agricultural production. Drought and heat are the two most significant production related constraints affecting crop yield. In this context, millets show better tolerance to aberrant weather events when compared with other crops. Cultivation of millets, due to their tolerance to adverse weather events, can play a pivotal role in fulfilling the food demand of burgeoning population.

The short lifecycle of millets supports in escaping from stress condition. Many millet varieties have a short growing season, which allows farmers to adapt to changing climate conditions and uncertainties. As the roots of millet crops go deep into the soil, those get access to soil moisture from a wider area. Hence, the crops are not substantially affected by short-term drought like other crops. It enables millets to thrive and produce considerable yield even in areas with low rainfall or limited access to irrigation. Millets are also resistant to extreme heat, making them well-suited for growing in hot and arid regions. The plants have tolerance for high temperatures, allowing them to grow and produce grain even during hot spells. In addition to the ability to withstand drought, millets has also resistance for flood. The plants have tolerance for standing water, which allow those to survive in areas prone to flooding. Generally, millets are grown in areas having poor soil fertility and without irrigation facility. However, these crops produce even under drought-prone situations. The photosynthetic efficiency of these crops is quite high, which helps in higher dry matter production.

OUAT Initiatives

Odisha University of Agriculture and Technology (OUAT) has taken proactive steps for promotion of millets production and increasing the yield. The University has so far developed eight varieties of finger millet and six varieties of little millet for cultivation in various agro-climatic zones of Odisha. Some of the prominent ragi varieties are Chilika, Arjuna, Kalua, Shreeratna, etc. Important little millet varieties are Sabara, Saura, Kalinga Suan 217, Kalinga Suan 18, etc. Several farm machineries have been developed for the benefit of farmers. Some of those are



OUAT ragi thresher--cum--pearler, OUAT little millet thresher, OUAT sorghum thresher-cum-cleaner, OUAT pearl millet thresher, OUAT barnyard millet thresher, OUAT bullock drawn 4 row seed drill for millets, etc. Among these, OUAT ragi thresher-cum-pearler has become popular among the farmers. Besides, capacity building training, on-farm testing and frontline demonstrations on innovative technology of millets are conducted by the Krishi Vigyan Kendras of the University.



Little millet variety Kalinga Suan 217



Finger millet variety Shreeratna



OUAT ragi thresher-cum-pearler

It is necessary to take appropriate steps for enhancing millets production. Some of the initiatives may include development of post-harvest equipment & protocol for processing of different millets; bringing millet farmers under the umbrella of Farmers Producers Organisations to resolve various issues; developing systematic linkage between production points and marketing outlets; capacity-building initiatives to motivate farmers for millet production; promotion of primary processing facilities such as cleaning & grading; technology for wide range of value added production for higher market price and many more.

Vice Chancellor, Odisha University of Agriculture and Technology, Bhubaneswar.



A member of Maa Bastarani Self-Help Group operating Thresher-cum-Pearler to separate Ragi grains at Belagaon village in Komna Block of Nuapada District.



Members of Maa Shitalama Self-Help Group operating a Pulverizer Unit at Kusumashila in Rayagada District.



Research Priorities on Millets for India

Dr. C. Tara Satyavathi

In India, millets were traditionally consumed as staple food but for fine cereals like rice & wheat due to Green Revolution technology adopted in the 1960s, millets were relegated to back seat because of the policy push given to rice and wheat crops by way of creating both demand and supply. Before Green Revolution, millets made up around 40% of food basket, which was dropped to less than 6% now, over the years compromising both nutritional and environmental security. On the basis of their production level, they have been classified into major millets viz., Pearl Millet (Bajra), Sorghum (Jowar) & Finger Millet (Ragi), and minor millet like Barnyard Millet (Sawan), Foxtail Millet (Kangni), Proso Millet (Cheena), Kodo Millet (Kodra), Browntop Millet (Hari Kangani), and Little Millet (Kutki). The tiny millet seeds are structurally different, so specific techniques and machines are required for their processing. Because of insufficient processing equipment and facilities millets were replaced by commercial crops like cotton, soybean, maize etc. This has resulted in changes of dietary patterns with preferential consumption towards fine, calorie-rich cereals. During the thrust to food security,

nutrition security took a back seat. Against the backdrop of rising malnutrition and Non-Communicable Diseases (NCDs), it becomes imperative to discuss the merit of millets and need for their promotion among both poor and urban populations.

India is the world's leader in millets production, with a share of around 40% of the world's total production. India produces around 16 Million MT of Millets annually (Source: DAC& FW). India is the second largest exporter of Millets. Millets exports from India have continuously increased at 12% CAGR in the last 3 years. The millets market is set to grow from its current market value of more than \$9 billion to over \$12 billion by 2025. The Government of India has realized the importance of millets in building Nutritional Security in the country and made several efforts such as gazetting millets as Nutri-Cereals, the celebration of the National Year of Millets, 2018 and International Year of Millets (IYM 2023) for creating awareness on millets and popularizing them as the future foods in changing climatic conditions which was reemphasized in the recent G20 meetings. The IYM 2023 is offering



the mandate to scale up the interventions for increasing the millets area and production, and diversifying the processing machinery and technologies, and to cater various segments in domestic and export markets.

ICAR-Indian Institute of Millets Research, is the country's premier National Institute on Millets under the Indian Council of Agricultural Research, has pioneered research on developing technologies for millets improvement, production, processing, value chain modelling, capacity building, and entrepreneurship development and has admirably supported the Government of India's Plan through DAC&FW in designing and implementation of the sub-Mission on Nutri-cereals under NFSM. Keeping in view the efforts of ICAR-Indian Institute of Millets Research in creating an ecosystem to create global demand for millets Govt. of India upgraded ICAR-IIMR as "Global Centre of Excellence on Millets" and named Millets as "Shree Anna".

Research Priorities in Millets:

The awareness on millets and their role in changing climatic conditions and their importance in food, fodder, nutritional and environmental security made us to prioritize millets as crops for the future. With this backdrop, the present topic is discussed under the following heads.

1. Strategies to revive and enhance area, production and consumption in the country.
2. Strategies to improve productivity through modern research tools.
3. Strategies to build capacities on value chain and marketing.

4. Strategies to mainstream millets through policy interventions.

1. Strategies to Revive and Enhance Area, Production and Consumption in the Country

- The major challenges in millet cultivation and consumption that needs to be addressed are:
 - a. low productivity of small millets,
 - b. lack of data on nutritional profiling of various cultivars across all major millet growing areas,
 - c. non-availability of end-product specific cultivars,
 - d. lack of improved primary and secondary processing facilities,
 - e. less shelf-life of millet food products etc.
- To overcome these challenges research outcomes needs to be deployed at the earliest on priority, to achieve food and nutrition security. There should also be procurement from farmers by government agencies to create more demand for production,
- These research outcomes collectively aim to promote millets as a sustainable, nutritious, and climate-resilient crops globally.

Strategies to Improve Productivity Through Modern Research Tools

- Development of best practices and SoPs for millets technologies for breeding, genotyping and phenotyping especially in small millets is the need of the hour.



- This will lead to the development of high yielding cultivars in all millets.
- New cultivars thus developed will break the yield barriers and thus significantly high yielding besides having good quality parameters.
- To broaden the genetic base, continuous exploration of millet germplasm, use of wild relatives and improvement through molecular approaches such as developing genomic resources, identification of gene of interest, SNPs, QTLs, gene edition for target traits etc are to be carried out.
- Seed production techniques and SoPs are to be developed for these newly developed cultivars for enhanced millet seed production activities.
- Timely availability of quality seeds of the recommended varieties to the farmers will help in scientific crop production and thus production enhancement.

Strategies for Capacity Building on Value Chain and Marketing

- Conducting field demonstrations for the speedy delivery of improved production technologies, including varieties available for the benefit of the Indian millet community.
- Development and promotion of millet specific FPOs, strengthening them with technological backstopping, extensive extension linkages etc.
- Value chain interventions are to be piloted through various initiatives engaging all the stakeholders.
- Entrepreneurs are to be nurtured and promoted across the country by handholding

them, vetting their ideas especially of the early-stage entrepreneurs and backstopping them with millet technologies.

- Incubation centres are to be created which offers 360° handholding to entrepreneurs and start-ups offering technologies, mentoring, offering R&D support, Training, infrastructure for large scale production of value-added products, market facilitation and industry and government market connectivity.
- There is a need for establishing such millet incubators in at least all major millet growing states.
- ICAR-IIMR being pioneers in the development of the value chain on millets can bring all the stakeholders such as R&D institutes, farmers, FPOs, private food processors, state, and central government departments on board in delivering the outputs that are needed for envisioned millets promotion in the domestic market by capturing the consumer preferences in terms of emerging food trends.

Strategies to Mainstream Millets Through Policy Interventions

- To enhance millet production in the country, Government should provide incentives for millets cultivation through subsidized farming inputs, equipment, minor infrastructure, etc.
- The Minimum Support Prices for all minor millets to be declared.
- Government schemes are required for procurement of millets from the farmers, PDS, make value addition and marketing. This will not only increase the profitability of



the farmers but also make quality and nutrient rich millet products available for the consumers.

- Millet missions of the state governments should cover farming aspects such as FPOs, infrastructure, seed hubs, farming incentives, farm-gate value addition, capacity building, etc., towards increasing the cultivation area under millets.
- Government policy to encourage small and medium entrepreneurs in setting up millet processing units is also required.
- Owing to the nutritional superiority of millets, now it is time to shift our focus from food security to nutritional security to have a healthy Indian population.
- Government of India should devise many schemes through policies involving ministries of health, women and child development, social welfare and public distribution system to enhance millet consumption.
- As a major policy intervention by state Governments to bring millets to the mainstream by introducing millet and millet products in public distribution system, ICDS,

Anganwadis and mid-day meal schemes to school children.

- Industrial uses of millets, especially using them as feed, biofuel, ethanol, brewery etc., to be promoted.

With India being on the forefront in celebrating IYoM and G20 presidency, the world is looking towards India's traditional foods transforming into nutria rich/ neutra cereal foods from millets. This gives an impetus to Government of India to scale up interventions for increasing the millets area, production, diversifying the processing machinery and technologies, expanding the private food processing ecosystem and thus to cater to the various segments in domestic and export markets. As millets are climate smart/resilient future super foods which can address the climate change concerns, provide nutrition security, efforts towards upscaling the millet cultivation in expanded areas, enhanced production, productivity through proper Govt. policies will pave way for food and nutritional security to India and to the world which is the core "**Vasudhaiva Kutumbakam**".

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A PVT field in Malkangiri, Odisha.



Millets: Nutri-food for All

Dr. Ashutosh Biswas and Dr. Ashok Kumar Jena

Millets are one of the oldest foods known to humans. Millets are consumed primarily as food by the poor segment of the population. In developed countries, millets are considered as ‘poor man’s food’. The nutritional content of millets is 3 to 5 times more compared to the nutritional content of widely used rice and wheat. Wheat and rice provide the security of food, while millets provide many guarantees like food, health, nutrition, and livelihood. Millets are rich sources of various nutrients and phytochemicals due to which they are commonly known as ‘functional food’.

Millets have many health benefits and help in the management of various acute as well as chronic diseases. The health benefits associated with the consumption of millets have been neglected for many decades. However, in recent years, millets are an important component of many modern foods.



There are about 6000 varieties of millets grown throughout the world. Based on the grain size of millets, they are broadly divided into major and minor millets. However, a few small grained cereals are nutritionally similar to millets, and they are known as pseudo millets. Sorghum (Jowar), Pearl (Bajra) and Finger (Ragi) millets are considered as major millets. Foxtail (Kakum), Kodo (Kodon), Barnyard (Sanwa), Little (Kukti/Sama) and Proso (Barre) millets are called as minor millet. Amarnath and Buckwheat millet are popularly called as pseudo millets.

The millets are referred to as “Nutri-cereal” as the nutritional values of millets are way ahead of wheat and rice. Overall, millets contain about 65-75% carbohydrates, 7-12% proteins, 2-5% fat, and 15-20% crude fibre, vitamins, and minerals. The total energy in different millets is comparable to most widely used cereals like rice and wheat.



Millets are rich in proteins like albumins, globulins, glutelin, glutelin-like, and cross-linked prolamin, etc. The protein content in Pearl millet is the highest among all millets. The fat content of the millet ranges from 1-5%. Of all fats, about 18-22% is saturated fatty acids and 78-82% unsaturated fatty acids. Millets contain plenty of essential fatty acids like linoleic, oleic, and palmitic acids. The fibre content of millet is very high compared to rice and wheat. Barnyard millet has the maximum crude fibre content, which is several times higher than wheat and rice. Both soluble and insoluble fibres are present in the millets. The dietary fibres work as energy diluents, reduce the risk of inflammatory bowel disease, help in the management of diabetes, decrease the risk of cardiovascular diseases and act as detoxifying agent. Millets are good source of various micronutrients like vitamins and minerals compared to rice and wheat. Millets are rich source of vitamin B like niacin, folic acid, riboflavin, and thiamine, various minerals like magnesium, calcium, manganese, phosphorus, and iron. The calcium content of Finger millet is very high and it can be used as a rice replacement to overcome the deficiency of calcium. The magnesium present in millets can help in blood vessel relaxation, blood pressure maintenance, blood flow improvement, and protection of the cardiovascular system. Magnesium also increases insulin sensitivity and decreases the levels of triglycerides in the blood.

In addition to various macro- and micro-nutritional benefits, millets have many nutraceutical benefits. Various nutraceuticals in the millets provides extra health benefits for the prevention and treatment of various diseases, in addition to the fundamental nutritional value. The nutraceutical benefits are provided by various

phenolic compounds, carotenoids, tocopherols, phytosterols and arabinoxylans etc. Phenolic compounds work in many ways to prevent diseases associated with oxidative stress, such as cancer and cardiovascular diseases. Carotenoids are well known for their provitamin A activity. They act as antioxidants and protect against various diseases. Tocopherols have antioxidant, and anti-inflammatory activities. Phytosterols reduce serum cholesterol levels and minimize the risk of heart disease. Arabinoxylans are non-digestible and regarded as dietary fibres. They not only provide bulk to the diet but also have a prebiotic effect in the colon of humans through selective stimulation of beneficial intestinal microbiota. These dietary fibres also have positive effects on chronic diseases such as diabetes mellitus, cardiovascular diseases, and gastrointestinal cancer.

The rapid urbanization in India has affected the pattern of food consumption. There is a significant decline in the consumption of cereals and vegetables, and increase in the consumption of animal-based products, refined sugar and fat. This food pattern has resulted the development of various inflammatory and cardiovascular diseases, cancer, peptic ulcer and neurological disorders like Alzheimer's disease, Parkinson's disease and muscular atrophy. Millets are a good source of antioxidants which helps in the prevention and treatment of various degenerative diseases. Because of being an excellent source of proteins, millets are mostly utilized by vegans or vegetarians. Millets have excellent plant protein, which is better than animal protein. The health benefits of millets are primarily due to its high dietary fibre content, gluten-free and presence of phytochemicals and nutraceuticals. Presence of high dietary fibres in millets help in prevention of constipation and



intestinal cancer. The high fibre content results slow release of sugar and help in the diabetes management. Presence of high fibres in millets also reduce the serum cholesterol level and inhibit atherosclerosis. The phytochemicals and nutraceuticals have antioxidant properties and help overall health management and prevention of disease risks etc.

Although millets have many health benefits but they can be used for the prevention and treatment of many specific disease like obesity, diabetes, cardiovascular diseases and celiac disease. *Obesity* is an emerging health problem in India. Obesity often results from intake of more calories than are burned by normal daily activities and exercise. Obesity is associated with several non-communicable diseases like diabetes, high blood pressure, and cardiac problems etc., which are largely preventable. Millets are very rich in dietary fibres. High content of dietary fibres improves bowel function and slow the process of digestion and absorption, thereby reducing the risk of obesity. Millets also satisfy hunger quickly and prevent excessive intake of foods. *Diabetes* is characterized by hyperglycaemia with alteration of protein, carbohydrate, and lipid metabolism. Diabetes leads to many serious complications like heart diseases, high blood pressure, high cholesterol, atherosclerosis, nerve damage, kidney damage, eye damage, cataracts, skin infection and gum problems etc. Fibre content in the diet plays a significant role in the control of blood sugar level. Millets also contain high amount of slowly digestible starches. The glycemic index of millet-based food is low, and reduces the postprandial blood sugar level. Millets also contain a high amount of magnesium that increases the efficiency of insulin and glucose receptors, and thereby helping in the reduction of blood glucose

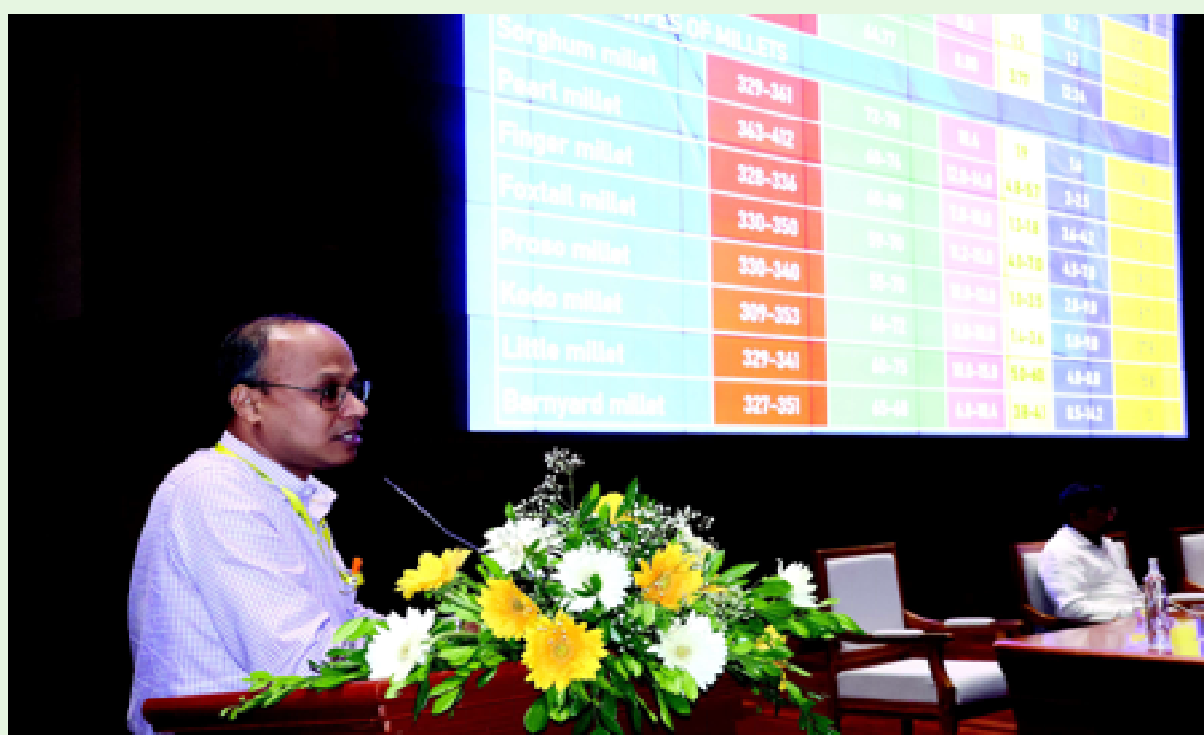
level. *Cardiovascular diseases* are a group of disorders of the heart and blood vessels. The risk of cardiovascular diseases depends on the proportion of low-density lipoprotein (LDL) and high-density lipoprotein (HDL) in the blood. High level of triglyceride is also a well-known risk factor for cardiovascular diseases. Most cardiovascular diseases can be prevented by addressing behavioural risk factors such as tobacco use, unhealthy diet and obesity, physical inactivity and use of alcohol. Of various strategies to prevent cardiovascular diseases, lowering the level of LDL in the blood is very important. Millets are rich in niacin which decreases the levels of LDL and triglyceride in blood, and are one of the best possible cardio-protective grains. Millets are also a good source of magnesium which help in reducing blood pressure and the risk of heart attack among subjects with atherosclerosis. The phytochemicals in millets help in lowering the blood concentration of cholesterol and preventing cardiovascular disease by reducing plasma triglycerides. Few millets are also a great source of potassium, which keeps blood pressure low by acting as a vasodilator. In *celiac disease*, gluten triggers an immune response in the small intestine, and over time this reaction leads to damage of linings of small intestine. Further, the damage prevents absorption of some nutrients (malabsorption). Millets are gluten-free and help in reducing celiac disease by reducing the irritation in the small intestine. Millets do not form acid in the digestive tract and are hence easy to digest. Also, millet does not produce any allergenic reaction. Millets are rich in phenolic acids, phytates, and tannins. These nutraceuticals have antitumor activities and help in reducing the risk of various *cancers*. Antioxidants and beta-carotene present in the millets are also helpful for the overall maintenance of health of an individual and thus slow the process of *aging*.



The nutritive potential of millet in terms of protein, carbohydrates, and energy values is comparable to popular cereals such as rice, wheat, and barley. Most of the health benefits associated with millets are generally due to the presence of phytochemicals such as polyphenols, tocopherols, phytosterols, and dietary fibre. Millets also contain abundant quantities of minerals, vitamins, and trace elements. Regular consumption of millet grains and their products can reduce the risk of

developing chronic diseases like diabetes, cardiovascular disease, cancers, and all-cause mortality. Therefore, dietary modification by increasing the consumption of millet grains daily is a practical strategy to optimize health and reduce the risk of chronic diseases.

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Author Dr. Jena speaking on health and nutritional benefits of millets during a workshop organised by Odisha Millets Mission at Lok Seva Bhawan in Bhubaneswar.



Underutilized Species and Climate Change

Susanta Sekhar Choudhury

Neglected and underutilized species (NUS) are considered 'minor' in terms of global trade and the research attention that they have received. They are often, however, far from minor in the lives of the rural poor. As well as playing significant, if not crucial roles in household food security and income generation, many are important in local food cultures. Such as, *taro*, *small millets* and *buckwheat* in Asia, *fonio* and *bambara groundnut* in Sub-Saharan Africa, or *quinoa*, *oca* and *ulluco* in the Andes. Underutilized crops are found in numerous agricultural ecosystems and often adapted to marginal farming systems. These minor crops have received little attention, yet almost all of these neglected species are essential to local people as food and a source of income. Research and development in general are lacking in underutilized crops. In recent decades, a number of scientific and economic interests have emerged with focus on lesser-known cultivated species.

NUS, which include crop wild relatives (CWR), are an important germplasm resource for future crop improvements for beneficial traits such as nutritional value and abiotic and biotic stress tolerances. Among the NUS, millets are one of the oldest foods known to humans and possibly first among cereal grains to be cultivated for

consumption. At that time millets are called birds food, poor man food, Orphan crops and so on. But millets are small seeded crops from grass family that are hardy and grow well in arid and semi-arid ecosystem mostly as rainfed crops under low soil fertility and moisture condition on marginal lands. These are resilient to high temperatures and drought prone environments; require only 350 mm water as compared to 1200 mm for rice. Millets being highly adaptable to different ecological conditions are ideal crops for climate change and contingency planting.

India is the leading producer and consumer of millet crops and their products. The people in arid and semi-arid regions of the country grow and consume millets as a staple food. Millets provide food and fodder security to the dryland agricultural communities. They are also being recognized as food grains for nutrition and health, and nearly organic in cultivation. Millets are the most secure crops to small farmers as they are the hardest, resilient and climate adaptable crops in harsh, hot (up to 50°C) and drought environments. They are often the last standing crops in drought seasons and will be the sustainable future food source amidst of worsening climatic conditions.



Some of the Underutilized species utilized by farmers:

Crops that were identified included bambara groundnut (*Vigna subterranea* (L.), amaranth (*Amaranthus* sp.), bottle gourd (*Lagenaria siceraria*), maize landraces (*Zea mays*), cowpea (*Vigna unguiculata* (L.) Walp), sweet potato (*Ipomoea batatas*), taro (*Colocasia esculenta*), sword bean (*Canavalia gladiata*), black jack (*Bidens pilosa*), marama bean (*Tylosema esculentum*) jews mallow

(*Corchorus olitorius*), spider plant (*Cleome gynandra*), Finger millet (*Eleusine coracana*), nightshade (*Solanum nigrum*), chinese cabbage (*Brassica chinensis*), cocoyam (*Xanthosoma* spp.), sunberry (*Solanum nigrum*), wild water melon (*Citrullus lanatus*), wild mustard (*Sinapis arvensis*), sorghum (*Sorghum bicolor*), Pearl millet (*Pennisetum glaucum*), Kodo millet (*Paspalum scrobiculatum*), Foxtail millet (*Setaria italica*), sesame (*Sesamum indicum* L.), and tef (*Eragrostis tef*).

List of underutilized and wild crop species of Odisha grown by tribal farming Communities

Crops	Underutilized species	Properties
Rice landraces	<i>Machhakanta, Haladichudi, Paradhan, Muktabali, Sapuri, Unuriachudi</i>	Popular nutritious, non-sticky cooked rice, slender grain best for pulao and biriyani
	<i>Kalajeera, Dubaraj, Lactimachi, Dudhmani, Basubhoga, Deulabhoga, Dudhmani, Nadiarasa</i>	Popular non-basmati aromatic rice
	<i>Meher, Kalachudi, Bodikaburi, Kandulakathi</i>	Pigmented, medicinal and rice value addition
Millets	<i>Finger millet, foxtail millet, proso millet, little millet and sorghum</i>	Nutritional, high fibre and minerals, vitamins
Wild edible tubers	<i>Dioscorea oppositifolia, D. hispida, D. hamiltoni, D. bulbifera, D. pubra, D. pentaphyla, D. wallichii and D. glabra</i>	Nutritional, mineral antioxidant content
Wild edible leaves	<i>Butea monosperma, Bauhinia purpurea, Paederia foetida, Andrographis paniculata, Sterculia foetida, Cassioides, Meyma spinosa</i>	Nutritional and medicinal



Wild edible fruits	<i>Buchanania lanzan</i> , <i>Carissa opaca</i> , <i>Careya arborea</i> , <i>Dipsyros melanoxyton</i> , <i>Syzygium cumini</i> , <i>Ziziphus mauritiana</i> , <i>Mangifera indica</i> , <i>Artocarpus</i> <i>heterophyllus</i> , <i>Phoenix sylvestris</i> , <i>Schleichera oleosa</i> , <i>Madhuca indica</i> , <i>Annona squamata</i>	Nutritional and health benefits
Wild flowers	<i>Indigofera pulchella</i> , <i>Cordia oblique</i> , <i>Sesbania grandiflora</i> , <i>Woodfordia fruticosa</i> , <i>Tamarindus indica</i> and <i>Azadirachta indica</i>	Nutritional and health benefits

Importance of Underutilized crops:

- Providing genetic traits for adaptation and second by strengthening the resilience of agroecosystems through crop diversification.
- Underutilized species help agriculture to adapt to climate change is through their contribution in enhancing the diversification and resilience of agroecosystems in order to withstand the impacts of climate change scenarios.
- Underutilized crops known for their drought tolerance are the minor millets, a category of several “coarse” cereals used particularly in South Asia whose drought-resistant traits coupled with an excellent nutritious profile.
- Underutilized annual species are mostly used by Indian farmers for mixed cropping, Intercropping, “*Akdi*” and “*Barhanaja*” systems to better cope with erratic rainfall.
- Millets are C4 plants having better photosynthesis efficiency, water use efficiency, better yield and more productive at building sugar molecules

under hot dry conditions, temperate, tropical and subtropical conditions with less rainfall and drought prone conditions than C3 species, such as wheat and rice.

Strategies for promotion of NUS crops:

- Increasing yield of some of the priorities NUS crops through different agronomic trial and biotechnological method. It will support and encourage farmers to grow and cultivate for better return.
- Research institutions like CFTRI, IIMR, NIN etc will take nutritional analysis of these NUS crops and awareness creation through Government and Non-Government Organizations for health benefits.
- Research should focus on assessing climate change impacts on their production for selected bio-climatic regions, with a focus on fitting them into semi-arid and arid areas.
- Government should take a step to document the Traditional Knowledge associated with NUS from the custodian farmers, forest dwellers, Traditional healthcare Practitioner, Traditional birth attendant etc for safeguarding their Intellectual Property Rights (IPR).



Finger millet



Foxtail millet



Sorghum



Kodo millet



Bambara Groundnut (*Vigna subterranea*)



***Azadirachta indica* (Neem)**



***Woodfordia fruticosa* (Dhatuki)**



Dioscorea alata



Custard apple



Blackberry

Conclusion:

The NUS have enormous nutritional, medicinal, and economic values and when promoted, could highly contribute to poverty reduction mainly in rural areas, and to the improvement of both nutritional and health status of the local populations. Un-fortunately they have never been the priority of the national agricultural research system mainly because of lack of political will and financial supports. It will be important to put in place a national and special research and development programme under the joint umbrella of the ministries of agriculture and scientific research sponsored by the government involving all the possible actors including researchers, developers, and producers.

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WASSAN (Odisha Millets Mission).



The Marvelous Millet

Chef Sekh Sahajan

Introduction

Millet, often referred to as the “forgotten grain,” has been a staple food for millions of people around the world for centuries. While it may not have gained the same level of global popularity as rice, wheat, or maize, millet offers a plethora of nutritional benefits, is environmentally sustainable, and is making a resurgence in modern diets due to its versatility and health advantages. In this article, we will explore the various types of millet, their nutritional value, health benefits, and their role in promoting sustainable agriculture.

Types of Millet

Millet is a collective term that encompasses several different species of small-seeded grasses, each with its unique characteristics. Some of the most common types of millet include:

Pearl Millet : Widely consumed in Africa and the Indian subcontinent, pearl millet is known for its drought-resistant qualities.

Foxtail Millet: Common in East Asia, foxtail millet is rich in minerals like iron and copper.

Proso Millet: Popular in Europe and Asia, proso millet is known for its quick cooking time.



Finger Millet (*Eleusine coracana*): Also known as ragi, finger millet is a staple in parts of Africa and Asia and is rich in calcium.

Barnyard Millet: Consumed in parts of India, barnyard millet is high in fiber and has a nutty flavor.

Nutritional Benefits

1. Rich in Nutrients

Millet is a powerhouse of nutrients, including:

Protein: Millet is a good source of plant-based protein, making it an excellent choice for vegetarians and vegans.

Fiber: With a high fiber content, millet supports digestive health and helps in maintaining a feeling of fullness.



Vitamins and Minerals: Millet contains essential vitamins and minerals such as B vitamins, iron, magnesium, and phosphorus.

2. Gluten-Free

For individuals with gluten sensitivity or celiac disease, millet is a safe alternative to wheat and other gluten-containing grains.

3. Antioxidant Properties

Millet contains antioxidants that help in neutralizing harmful free radicals in the body, contributing to overall health and well-being.

Culinary Uses

Millet's versatility in the kitchen makes it a popular choice for a variety of dishes:

Grains and Pilafs: Millet can be cooked and served as a side dish similar to rice or quinoa.

Baking: Millet flour can be used in baking, adding a unique flavor and nutritional boost to bread, muffins, and pancakes.

Porridge: Millet porridge is a wholesome and comforting breakfast option.

Sustainability

Millet is an environmentally friendly crop with several sustainable advantages:

Drought Resistance: Millet is well-suited for regions with limited water resources, making it a vital crop in the face of climate change and water scarcity.

Low Input Requirements: Millet requires minimal use of pesticides and fertilizers compared to other grains, reducing environmental impacts.

Crop Rotation: Millet is often used in crop rotation systems, which can improve soil health and reduce the risk of pests and diseases.

Conclusion

Millet, often overlooked in favor of more well-known grains, is a nutritional powerhouse with numerous health benefits. Its sustainability and adaptability make it an essential crop for the future, especially in a world where environmental concerns are growing. Whether you use millet as a base for a savory dish or incorporate it into baked goods, this versatile and nutritious grain is worth adding to your diet. So, embrace the marvel of millet and enjoy its delicious and wholesome benefits.

FOXTAIL MILLET UPMA

Ingredients:

- 1 cup foxtail millet
- 1 onion chopped finely
- 2 tomatoes chopped finely
- 1-2 green chillies slit in halves optional
- 1 cup vegetables Medium chopped beans, carrots, and Green Peas
- ¼ Cup Red Yellow Green Capsicum
- 1 tbsp. ginger-garlic Chop
- 1 tsp. garam masala powder
- Himalayan Salt To taste
- finely chopped coriander leaves
- 1 tbsp. ghee
- 1 tsp. mustard seeds
- ½ tsp. cumin seeds
- A sprig of curry leaves
- 1 tsp. urad dal
- a pinch of asafoetida



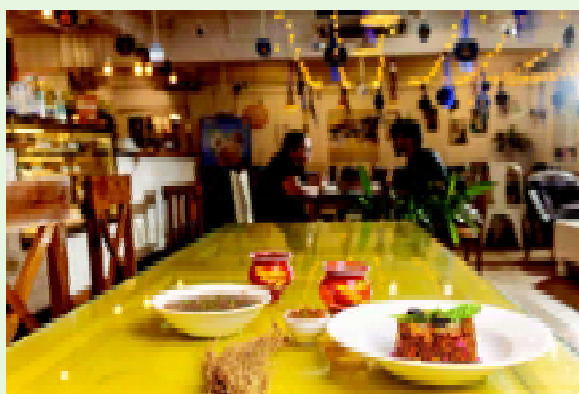
Method-

- Soak the Foxtail Millet for Six an hour.
- After 6 Hours Heat ghee in a deep thick bottomed pot or pan.
- Add mustard seeds, allow to sputter. Add cumin seeds, urad dal, asafoetida, and curry leaves. Fry for few seconds.
- Add in the chopped Ginger Garlic Green Chilli & Capsicum, Stay Few minutes.
- Add the onions and fry till translucent, add tomato and Cut Vegetables. Let it cook down for a couple of minutes.
- Now add the soaked and drained Foxtail Millet and fry in the mixture for 1-2 minutes.
- Pour 2 cups of water into the pan. Depending on the quality of Foxtail Millet you have used, you can add less or more water. You can replace water with vegetable stock.
- Season with salt. Mix very well. To figure out if you have added the right amount of

salt, check the taste of the water. You should feel some saltiness in the water. This means the amount of salt added is right. If the water does not feel salty, then you need to add some more salt.

- Stir and tightly cover the pot or pan with its lid.
- Cover and cook the Foxtail Millet until all the water is absorbed. Cook on a low to medium flame. Usually, in the beginning, I cook on a medium-low or medium flame and then halfway through, I lower the flame. Check a few times during cooking to ensure there is enough water. Depending on the quality, you may need to add more water.
- Once the foxtail Millet are cooked, 5 minutes covered with the lid, serve with your Favourite Curry or chutney Garnished with coriander Leaves.

Executive Chef, Naad Wellness, Delhi (NCR).



Curated millet recipes in hotels and restaurants in Bhubaneswar drawing interest from consumers.



Nayagarh's Kondh Tribal Women Reclaiming their Respect with Bihan Mela

Rakhi Ghosh

It was a winter day. Nirola Jani, Sita Pradhan, Rashmita Jani and Kanchan Behera – the Kondh tribal women were overwhelmed to participate in the annual seeds festival, locally known as *Bihan Mela* in their village Bidapaju of Daspalla block in Nayagarh district. The seeds

festival or the festival of biodiversity was last held in December 2019 in Daspalla, so this time the enthusiasm is much bigger. Since morning the women of Bidapaju and other adjacent villages are decorating their

earthen pots in red and white motifs to carry seeds of maize, sorghum, corn, paddy, millet and other seeds to the festival, where they will exhibit and while returning they will bring other varieties of seeds for cultivation in next season. “This year I am carrying 4 different types of paddy and millet seeds which I and my husband Duryodhan Jani grew in our 2 acres land”, said 38 year old Nirola,



while preparing to attend the seeds festival. She wore a clean colourful saree, put vermilion on her forehead, wore ornaments and finally in a bamboo-weaved basket adjusted 4 decorated earthen pots filled with different types of seeds. Carrying that basket for few yards she joined the

group where hundreds of other women from adjacent villages were carrying their seeds on earthen pots singing and dancing to the festival. The male members were beating drums and other traditional instruments not only to encourage women groups but also happily accepting that organic farming and traditional seed conservation had returned.

The seeds festival which was being held 47 km away from Nayagarh town and 146 km far from capital city Bhubaneswar was surrounded by hills and forests. On the foothill where the



exhibition was organised, the women members who were carrying the earthen pots filled with seeds, after singing and dancing, kept pots on the



floor decorated with white *alpana* (designs) to attract others. “We have kept our seeds so that others can take these indigenous seeds and we will carry of our choice of seeds when we return home,” said Rashmita Jani, a kondh woman. When asked what seed she would like to take back her reply was “a new variety of finger millet”.

There was a time when the indigenous community people were preserving seeds for cultivation, but with the advent of green revolution they were lured to sow high yielding variety seeds in their fields, use fertiliser and pesticides for better yield, for which they lost their traditional knowledge of seeds conservation. This forced them to depend on market and the women who were playing a significant role in conservation, preservation and taking decision in sowing seeds,

lost their control. Their role was confined to weeding, sowing and planting of paddy than taking decisions in which seeds to be planted in which season. Besides, over use of fertiliser and pesticides has started impacting on soil fertility and food intake of tribal communities. Keeping that in mind, Nirman, a non-profit organisation working in the field of forest rights and agro-ecological farming has been sensitising tribal people of 18 villages in Dasapalla Block to practice organic farming, mixed crop farming by using indigenous seeds. Prashant Mohanty, Executive Director of Nirman, says, “Indigenous seeds conservation is important in the present context of climate change.”

Convincing villagers a tedious task

Just few years back when Duryodhan Jani, a Kondh tribal farmer noticed that a major patch of his standing crop was infected with a typical disease, locally named Mahisa or *Patrapoda*, he couldn't realise that it was the impact of climate change and high use of chemicals (fertiliser and pesticide). When the field staff of Nirman interacted with the villagers of Bidapaju, he shared his ordeal. “When I explained about the disease and crop loss, the field staff said it might be the impact of climate change and high use of chemicals in my agriculture field,” said Jani, which surprised him and other farmers of his village as well. “The field staff explained that due to erratic rainfall and regular use of fertiliser and



pesticide, it has deteriorated soil fertility making crops prone to diseases,” said Duryodhan, who is now practicing agro-ecological farming in his 2 acres of a total 4 acres of farm land.

But transition of villagers from chemical to organic farming was not an easy task. “Whenever we had come for discussion they were reluctant to listen. Most of them turned their heads when we started discussing about agro-ecological farming or mixed crop farming. Some of them also said when the government is providing high yield variety seeds why do they need to practice organic farming. It was a tedious task to convince them,” said Kailash Sahoo, Programme Coordinator, Nirman.

He added, most of the tribal farmers are poor and marginalised, they suffer with the impact of climate change. The paddy seeds they used to procure from government for sowing were not drought resilient seeds thus, if there was no rainfall for 90 days there would be no yield and they will suffer from crop loss. In dongar (hill top) also tribals used to do mixed crop farming which was helping to provide them variety of foods. But later lured by middle men they started planting cashew and other cash crop plantation, this also impacted their food habits and soil fertility.

After a few rounds of discussions with villagers of Bidapaju, they accepted and agreed to use organic manure in their agriculture fields and dongar. “Initially we 4-5 families agreed to follow mixed crop farming in 1 acre of our total farm land (each farmer has 3-4 acres of land both in plain and hill top). We cultivated corn, *kandula*, millet, black gram, sorghum and *janha* by using organic manure,” said Nirola. She expressed in the beginning though her husband was little skeptical about shifting to organic farming but

today he is convinced. “I remember, our father and grandfather used to put cow-dung manure or liquid manure to make lands fertile but since we shifted to fertilizer-based farming for high yield that culture has changed,” said Duryodhan.

Setting up of Seed Bank

When villagers decided to shift to mixed crop farming there were few indigenous seeds available in their villages. Because they had completely shifted to paddy and not cultivating other crops there was a scarcity of indigenous crops too.

“For the past two decades, the Kondhs have shifted to high-yield variety of seeds so the traditional culture of seed conservation has vanished with time,” said Anita Jena, who is the cluster in-charge of Nirman. Later, it was decided to set up a Seed Bank in the village with the women farmers owning it.

The seed bank was set up with an aim to provide indigenous seeds to the farmers. Indigenous seeds are climate resilient and it can grow in less water. The villagers follow the same transaction process like banks but use seeds instead of money. “After borrowing seeds, they have to return double the quantity of seeds as interest or separate seeds they borrowed in the first year for cultivation. We maintain a register of seeds procured, borrowed and returned,” said Kanchan Behera, in charge of Seed Bank.

The seed bank which had initially only 12 varieties of paddy has now 62 varieties; four new varieties of millet; five kinds of pulses and eight kinds of vegetables. Behera said, “Women have been the decision makers for generations. They used to decide the kinds of seeds to be sown in



fields but after the green revolution when our husbands brought high-yield seeds from the market, we lost control. We are happy that indigenous seeds have empowered us again.”

The seeds festival which was first started with tribal people from 18 villages now extended to inhabitants of 27 villages in four panchayats of Daspalla Block to encourage them to exchange seeds. Women not only own the Seed Bank, they also play a significant role in exchange of seeds in the festival. “There are nearly 750 beneficiaries of the Seed Bank,” said Sita Pradhan (28), a member of the Seed Bank.

Food Diversity Increased

Sabitri Jani of Gambharikhol village says that there was a time when villagers were suffering from hunger. They were digging tubers from hills and having it for months. But now they have variety of food in their plates. After practicing mixed crop farming in donger and paddy in plain fields, they get variety of crops. Sabitri had brought 20 types

of spinach, tuber fries, pitha and sweet dishes to display at the tribal food festival organised at Gambharikhol village. The villagers had displayed nearly 200 varieties of dishes at the tribal food festival. “All these recipes I had learned from my grandmother, but with time it was lost. This food festival has given me a scope to live it,” said Sabitri.

Dulana Jani, while displaying her food items in the festival, said, “Tribals have their own variety of food prepared from roots, tubers, greens, grains and fruits from forests. But for various reasons we lost, resulting our children have nothing in their plates.” When asked do their young children love eating these, the Kondh women replied in unison, “they love traditional food”.

Journalist, Bhubaneswar.



A Seed Centre managed by Mahalaxmi SHG with the support of Odisha Millets Mission at Ranjitpur in Paikmal Block of Bargarh District.



Millet Business Opportunities for Entrepreneurs

Tapas Chandra Roy

Millets are a group of highly variable small-seeded grasses, widely grown around the world for food and fodder. Millets are ancient super grains the reservoirs of nutrition for better health. Millets (sorghum, pearl millet, and small millets) are important food and fodder crops in semi-arid regions and are predominantly gaining more importance in the world and in India.

Millets are the only crop that will address the important issues in the future:

1. Food, Feed, and Fuel
2. Malnutrition
3. Health
4. Climate Change

Millets require less water and inputs to grow as compared to wheat and rice. The days are changing and the crisis in agriculture is increasing due to climate change. There is a frequent occurrence of drought and millets are the only crop to sustain this water starvation.

Types of Millets:

There are nine types of millets grown in India. It is broadly categorised basing upon the area and the size of the millet grains.

- Sorghum (Jowar)
- Pearl Millet (Bajra)
- Finger Millet (Ragi)
- Foxtail Millet
- Little Millet
- Kodo Millet
- Barnyard Millet
- Proso Millet
- Browntop Millet

In India, major millets are sorghum, pearl millet and finger millet and rest comes under minor millets.

Nutritional Value of Millets:

Millets are far ahead of nutrients content as compared to wheat and rice. Finger millet contain the highest amount of Calcium, 364 mg per 100 gram of grains. Pearl Millets contain 6.4 mg of iron that can address the iron deficiency in the body. From the above table (Source: Indian Food Composition Tables, 2017, National Institute of Nutrition) it can be marked that Millets are rich in nutrients.

Health Benefits of Millets:

In this busy world, we sometimes forget the good things, which matters a lot for our life



Good for YOU - Nutritional Value of Millets													
Grain (Millet /Cereal)	Carbo- hydrates (g)	Protein (g)	Fat (g)	Energy (Kcal)	Dietary Fibre (g)	Ca (mg)	Mg (mg)	Zn (mg)	Fe (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Folic acid (mg)
Sorghum	67.7	10.0	1.7	334.1	10.2	27.6	133.0	2.0	4.0	0.4	0.1	2.1	39.4
Pearl Millet	61.8	11.0	5.4	348.0	11.5	27.4	124.0	2.8	6.4	0.3	0.2	0.9	36.1
Finger millet	66.8	7.2	1.9	320.7	11.2	364.0	146.0	2.5	4.6	0.4	0.2	1.3	34.7
Kodo millet	66.2	8.9	2.6	331.7	6.4	15.3	122.0	1.7	2.3	0.3	0.2	1.5	38.5
Proso millet*	70.4	12.5	1.1	341.1	-	14.0	153.0	1.4	0.8	0.4	0.3	4.5	-
Foxtail millet*	60.1	12.3	4.3	331.0	-	31.0	81.0	2.4	2.8	0.6	0.1	3.2	15.0
Little millet	65.6	10.1	3.9	346.3	7.7	16.1	91.4	1.8	1.3	0.3	0.1	1.3	36.2
Barryard millet*	65.6	6.2	2.2	307.1	-	20.0	82.0	3.0	5.0	0.3	0.1	4.2	-
Wheat	64.7	10.6	1.5	321.9	11.2	39.4	125.0	2.9	4.0	0.5	0.2	2.7	30.1
Rice	78.2	7.9	0.5	356.4	2.8	7.5	19.3	1.2	0.7	0.1	0.1	1.7	9.3

Source: Indian Food Composition Tables, 2017, National Institute of Nutrition

and healthy living. We do not care unless until we do not need it again. The same thing happened with millets. It was the time in India when millets were part of people's diet during the 1960s.

1. All millets are gluten-free and recommended for celiac patients

Celiac disease is a digestive disorder that damages the small intestine, triggered by eating food containing gluten. Gluten is a protein found in wheat, rice, and many more grains. Gluten makes the dough elastic.

When someone with celiac disease eats gluten food, their body overreacts to the protein and damages the villi of the small intestine.

Celiac disease is found in 1 out of 100 people worldwide. So, millets are becoming a part of the diet of celiac patients.

2. Due to a low glycemic index, millets control diabetes

Many of us might be heard from our forefathers that, they had no diabetes during their

time. But now, it is increasing at a fast rate in India and abroad. Now you could rightly point out what is going wrong now. It is all about the diet we consume, the lifestyles we are following with no exercise. It must be coming to mind, why we should consider millets.

Millets have a low glycemic index, that means it raises the blood sugar slowly in the body instead of rising quickly as in case of rice.

Due to the presence of high fibre, it takes more time for digestion. Millets contain complex carbohydrates which digest slowly in the body.

If you are diabetic, want to add millets to your diet, it is the right time.

3. Health Benefits of Millets - Millets help in decreasing obesity/weight loss

Due to less fibre in our diet, there is an increase in obesity in India mostly in urban areas. We prefer more refined cereals based which contain less fibre. Dietary fibre helps in the



retardation of carbohydrates absorption and impaired glucose tolerance.

It helps in increasing the transit time of food in the gut. Tryptophan is found in millet (Foxtail Millet), which helps in managing weight. The presence of policosanols (Sorghum) favours weight loss.

4. Millets help in reducing the risk of cardiovascular disease

Millets contain essential fats, just the right amount to give our body natural fat. This helps prevent fat from depositing over muscles and avoid high cholesterol, heart strokes and heart-related diseases.

5. Health benefits of millets in preventing cancer

Millets are effective in the prevention of cancer initiation and progression. Millets contain fibres and phytonutrients, the combination of which is believed to reduce the risk of developing colon cancer.

6. Millets help to slow the ageing in our body

Everyone likes to look and remain young always. Millets are a good source of antioxidants. The high amount of anti-oxidants present in millets fights with the free radicals present in the body which slows down the ageing process.

7. Millets help in better sleep

Are you worried about getting better sleep ? Tryptophan in millets raises the serotonin level in the body, which helps in reducing stress.

8. Millets help in reducing hypertension

Millets help in preventing oxidation of low-density lipoprotein thus reducing hypertension.

9. Health benefits of millets in preventing anaemia

In India, anaemia is prevalent and it is mostly found in children, pregnant and non-pregnant women. Millets are the best source of iron. Iron is beneficial in preventing anaemia. Pearl millet (Bajra) contains the highest iron content (11 mg per 100gm grains). Consumption of Pearl millet prevents iron deficiency in the body.

10. Millets improve skin elasticity

Millets are rich in amino acids called L-Lysine and P-Proline. Millets help to create collagen in the body, a substance that gives structure to the skin and tissue. Thus eating millet fortifies the collagen level to improve skin elasticity and makes it less prone to wrinkles.

Consumption Trends of Millets:

India is the largest producer of millets in the world and its market share is about 41%. Millets were the main staple food in the rural areas during 1960's but slowly its area and consumption of millets decreased drastically.

In the last decade, lots of initiatives have been taken to revive millets in the field and on the plates of the consumers. Now the demand for millets is increasing in the urban areas. It has turned into poor man's food to rich man food because it has the ability to control many lifestyle diseases like diabetes and cardio vascular diseases.

The recent, meta-analysis has given us much evidence of millets controlling diabetes and cardio vascular diseases.

Now a days lots of millets products has come to the market and people have accepted millets in their regular diets.

State like, Odisha, Telangana, Andhra Pradesh and Karnataka have introduced millets



in their Public Distribution System & Mid-Day meals and hence addressing the nutritional security.

Millet Business Plan:

1. *Millet Primary Processing Unit:*

Sorghum, Pearl Millet, and Finger Millet do not contain husks and they are called naked grains. The rest 6 millets (Little Millet, Foxtail Millet, Barnyard Millet, Proso Millet, Kodo Millet, and Browntop Millet) require removing of the husk to make it suitable for human consumption. It starts with cleaning, grading, and finally removing the husk layer.

For establishing a millet processing unit, we require space as per the machines to be installed. To start with we require at least three machines.

1. Grader-cum-Aspirator
2. Destoner-cum-Aspirator
3. Dehuller-cum-Aspirator (Single and Double Stage dehuller)

Grader-cum-Aspirator:

Primary cleaning is done using a grader-cum-aspirator with the support of different sieve sizes for different millet grains. The grader separates the millet grains from sand particles, stones, sticks, mud balls, sticks, straws, etc. So selecting the right kind of sieve is an important factor to get good quality millet grains.

Before putting the millet grains into the machine, the moisture of the grains should be checked. It should be around 11-12% moisture level. Otherwise, we need to dry the grains in sunlight for 2-3 days for desired moisture level. Even solar dryers can be used for drying.

Proper care should be taken to prevent the millet grains from clogging. The machine operator can use a brush to remove the grains which are clogged into the sieve. For small millet processing, we generally use a triple deck grader with three sieves.

The top sieve will separate big stones, sticks, straws, etc. which are bigger than the millet grain. The middle sieve will separate the good-quality grains and the last sieve will separate the fine and coarse sand particles.

The aspirator attached to the grader will send the fine dust particles to the rear end.

Destoner:

The material coming from the grader is sent to the Destoner for removing the small stones and mud balls that are identical to the size of the grains. Destoner works on the principle of gravity. A Destoner has two sieves under the hopper which grade the material coming from the hopper. The graded material falls on the destoner bed where the lighter material moves towards the front and the heavier material moves towards the rear end. The air adjustment slot has to be adjusted carefully depending on the material.

Dehuller-cum-Aspirator:

The raw materials after proper cleaning are sent for husk removal into the huller. Dehullers can be classified into two types under the millet processing machinery.

Centrifugal Dehullers:

A Centrifugal Dehuller has an impeller that is responsible for the husk removal. The material is sent to the hopper which then enters the impeller, where it gets thrown with a great centrifugal force onto the impeller casing. Due to the heavy impact, the husk gets separated from



the millet rice and is sent to the aspirator where the lighter husk is collected at the back and the rice is collected at the front.

The quality of the dehuller is measured depending on the retention of the bran layer on the millet rice after dehulling.

Abrasive Dehuller:

Abrasive dehuller is classified into two types, one is the Emery type and the other one is Rubber roller type. In Emery type dehuller two grinding stones are used for husk removal, where one stone is stationary and the other rotates at a constant speed. The raw material passes through these two grinding stones and the husk gets sheared or abraded off.

In the Rubber roller type, rubber rollers are used instead of stones.

Let us see what are the millet processing machines and infrastructure required to establish a Millet Processing unit at different levels with different capacities.

1. Village/Community Level: You require a space of 200 square feet floor area. Destoner-cum-Grader with Aspirator and a Dehuller is sufficient. It may cost around 2 lakhs. Tabletop dehuller which costs around Rs.75,000/- will fit into this project. Its capacity is around 50kg/hr and two-person can easily operate it. It can work in a single phase.

2. Small Scale Level: It requires a minimum of 1200 square feet of floor area to operate the machines. Destoner, Grader, and Dehuller two numbers each are required. Its capacity is around 100 kg/hour. It may cost around 4-5 lakhs.

3. Medium Scale Level: The capacity of this enterprise may be around 500-1000 kg/hour.

5000 to 10,000 square feet is required with godowns to stock raw materials up to 10-20 tonnes. In this enterprise, we can keep Destoner and Grader of four to eight numbers, Two to four dehuller machines. For value addition, we can keep Pulveriser, Semolina Machine, Flakes Making Machine. The cost maybe around 20-30 lakhs.

4. Large Scale Level: Most of the large-scale Enterprises are found in Nashik. It may cost around Rs.60-70 lakh to Rs.1 Crore.

The cost of establishing this unit varies from 3-5 lakhs to 60-70 lakhs depending upon the capacity of the machines.

If you want to start with small dehuller, it will cost about Rs.75,000/-. This is the first table top dehuller in India developed by DHAN Foundation.

Now, due to problem of electricity in the rural areas, solar millet processing units are being installed and drudgery of women are reduced to a great extent.

2. Millets Value Addition:

Value-Addition is the process of taking a raw commodity and changes its form to produce a high-quality end product.

Why Value Addition of Millets is required?

1. To meet the taste/preferences of the consumers.
2. Reducing the post-harvest losses.
3. Nutrient enhancement.
4. Ready to eat (RTE), ready to Cook (RTC) – Reduces the cooking time.
5. Enhance shelf life and make the product available for a long time.



6. Diversified Millet products can solve our food needs as climate changes.
7. Improve the consumption of millet products and can help to overcome malnutrition.
8. Millet farmers will have more post-harvest technologies thus enhance the economic value of millet as well as improve the status of farmers.

MILLET PUFFS:

Millet puffs are the product that is a result of explosive puffing where the millet grains are expanded to maximum expansion consistent with grain identity.

Before going to the millet puffs, let us understand the difference between popping and puffing.

Popping is a simultaneous starch gelatinization and expansion process, during which grains are exposed to high temperatures for a short time. During this process, the superheated vapor produced inside the grains by instantaneous heating cooks the grain and expands the endosperm suddenly, breaking out the outer skin.

You might have noticed that most people like to have popcorn while watching a movie and it is based on popping technology. It is an easy, simple, and low-cost technology as compared to puffing.

Puffing is a similar process to popping in which controlled expansion of the kernel is carried out, while the vapor pressure escapes through the micropores of the grain structure due to high pressure.

Popping and puffing impart acceptable taste and desirable aroma to the snacks.

Though a wide range of cereals and millets such as rice, wheat, corn, sorghum, ragi, and foxtail millet are used for popping/puffing; only a few of them pop well. The reason behind this may be the factors that influence the popping qualities of cereals, such as season, varietal difference, grain characteristics such as moisture content, the composition of grain, and physical characteristics.

Gun puffing is a process in which the milled grains are introduced into the gun or high-pressure chamber after preheating, and then superheated steam is introduced to the closed rotating chamber (Luh, 1991).

The steam pressure is critical to the final texture of the puffed product, as too low pressure would result in the product lacking crispiness and too high pressure would shatter the rice. Sufficient time is allowed for the superheated steam to cook the grain in a semi-plastic state and at the end, the pressure is suddenly released for obtaining the crispy puffed grain. Keesenberg (1978) developed a puffing gun, which was composed of a rotating horizontal cylinder having a length of 1.2 m and an inner diameter of 200 mm.

Millet puffs are ready-to-eat snacks that are developed using a puff gun machine. For making millet puffs, the millet grains are properly cleaned and graded using a grader-cum-cleaner. Then the grains are put into the dehuller for dehulling. Then the conditioning of dehulled grains is done using water and it is loaded in the puff gun machine rotating barrel under proper heat and pressure. The mixture is roasted and fried resulting in millet puffs.

Millet puffs are crispy and tasty. It has a shelf life of 2-4 months depending upon the type of millet and the packing materials used. Many ranges of millet products can be made by frying



and coating with a different variant of masala. It can be served as premium products under the category of snacks.

MILLET RAVA/KHICHDI/ IDLI RAVA:

Millet Rava/Semolina is ready to cook food. It is made through milling technology where the bran and germ are separated from the starchy endosperm so that the endosperm can be ground into medium size Rava in a hammer mill.

The process starts with cleaning the grains and putting them into the feed. The grains are milled by the hammer crusher where the endosperm, germ, and bran get separated.

In this machine, we can get 3 variants of Millet Rava.

1. Fine Semolina (Idli Rava)
2. Medium Semolina (Upma Rava)
3. Coarse Semolina (Khichdi Rava)

Millet semolina has a shelf life of 3 months if packed properly and kept at ambient temperature. These millet products are an excellent source of complex carbohydrates, fiber, protein, calcium, iron, zinc, and magnesium.

MILLET PASTA AND VERMICELLI:

Pasta and Vermicelli are nowadays getting more demand in most households in India. But when it is made with millets, it's a healthier option. As it is a very quick and easy breakfast, we can make lots of recipes with the available vegetables at home.

To make pasta and vermicelli with machines, you need to follow some processes. It starts with mixing ingredients, extruding, drying/roasting, length sizing, and packing vermicelli. The machine which is used is called a single screw

extruder. It has three main parts- Die, Main Screw, and Mixing Screw.

Depending upon the output you have to change the die. For vermicelli, you need one die and for making pasta you need to change the die. The cost of the machine is Rs.11,00,000/-. The capacity of the machine is 12 kgs per hour.

The products are made with millet/sorghum flour or a combination of millet flour and semolina.

MILLET EXTRUDED SNACKS:

Extruded snacks can be made by using a twin-screw hot extruder. Most of the extruded snacks are prepared using corn. But taking millet as the main ingredient improves the nutritional value of the product. It can be done by mixing all the ingredients and proper conditioning followed by mixing water and passing through the twin screw extruder and it results in expanded snacks that are ready to eat. The output snacks can be coated with special spices to give them a better flavor and taste.

MILLET FLAKES:

Most of us are familiar with cornflakes, but few know about millet flakes. Millet flakes can be made from most millets. For making flakes, the millets are cleaned properly and soaked in water overnight. Then it is roasted in a grain roaster. Then it is flattened to flakes using the edge-runner machine.

Millet flakes can be used for making breakfast items. It reduces the time of preparation.

MILLET ENERGY BARS:

Millet Energy Bars are one of the most demanded products in the market. It's very simple and easy to make. It can be made by mixing millet



bran powder, millet flakes, or with millet puffs. The ingredients are mixed properly and the binding agents are added and put into shaping and finally cooling and packing the product.

MILLET LADDUS/ INSTANT LADDU MIX:

Laddus is one of the most popular sweets across India. It is mostly taken or made during festivals and special occasions. The main ingredients for making ladoos are millet flour, jaggery, some nuts, ghee, and cardamom for flavor.

Many variations of laddus can be made with millet. I do remember when I made Ragi Ladoos without ghee and jaggery. It was superb and tasty and all the family members enjoyed it. Making millet laddus and packing it up in beautiful boxes will become gifting boxes during festivals.

MILLET MUESLI:

Muesli is traditionally made with rolled whole grains by adding nuts, seeds, fresh and dried fruits, and often sweetener is added such as honey. Likewise, Millet muesli can be made by mixing millet flakes, dry fruits, roasted cashew nuts, almonds, pista, and raisins. After mixing it properly, it can be packed in beautiful packets.

Millet muesli can be used for breakfast, dessert, tasty snacks, and many more.

Indian Institute of Food Processing Technology, Tamil Nadu has developed some amazing innovative millet-based products..

- Edible Millet Film – It is flexible, transparent, eco-friendly having good anti-oxidants and antimicrobial properties. It can be cooked by steaming, baking, and frying.

- Non-dairy millet ice cream
- Millet Milk Powder
- Millet Moringa Pasta

3. Millet Business Plan for Millet Seed Entrepreneurs:

As the demand for millets is increasing and there is also demand from the farmers' side for good quality millet seeds. In India, we have a good presence of quality seeds of Sorghum and Pearl Millet. But there is ample scope for the minor millets.

Good quality minor millets seeds will definitely increase the production and productivity of millets. Farmers can also join in Government Seed Production Programme for producing quality seeds. There is a huge potential business in the seed sector.

4. Millets Aggregators:

Aggregating millets in the warehouse for supermarkets and the food industry is another millet business plan. Large quantity millets can be purchased and kept in the warehouse and can fulfill the needs of the food industry when needed. The specialty of millet grains is that they can be stored for years together with husk by following the storage safety principles.

There is always a problem at the farmers' level for proper storage of millets grains. Farmers prefer to sell their produces just after harvesting. This opportunity can be captured by procuring the millets from the farmers and can be kept in big warehouses.

5. Millets packaging for Supermarkets and Retail Industry:

Processed millets can be packed and can be supplied to retail and supermarkets. This is



the millet business plan for B2B. Nowadays retailers are dedicating separate aisle and shelf for millet-based products. Putting products on display is generating more sales and ultimately more revenue.

The millet products can be packed as per the requirement of the clients.

6. Millet Business Plan for Bakery Industry (Biscuits and Cakes):

Today, when we see biscuits in the market are mostly made of refined cereals (maida) but when are made with millets, will be a healthy choice. For establishing a millet bakery unit, you require these three machines:

- Planetary Mixer
- Cookies cutting machines
- Rotary Convection Oven

People are becoming health conscious and when it's time for a birthday celebration, they are preferring cakes made of Millets. You might have heard of Mumbai-based Chef Natasha Gandhi, founder of House of Millets, she makes beautiful cakes with Millets that are healthy, gluten-free, vegan, and free from refined sugar. She delivers all over Mumbai.

7. Millet Business Plan for Millet based Hotel Industry:

Its very happy moment to see Hotels and Restaurants planning Millet based tiffins and meals in most of the cities in India like Bangalore, Hyderabad, Visakhapatnam, Chennai and many more. One such inspiring story of Chittem Sudheer of Visakhapatnam started his startup with only Rs.50,000/-. He makes healthy and yummy idlis wrapped in Vistharaku leaves. This has created food sensation in Visakhapatnam.

8. Millet Business Plan for Export Industry:

India is the largest producer of millets and there is ample demand for millets in the international markets. The potential export markets for Indian Millets in 2020 were Indonesia, Austria, Netherlands, Phillippines, and New Zealand.

India's export of Millets was 24.5 million dollar in 2017-18, 25.76 million dollar in 2018-19 and 21.05 million dollar in 2019-20(April to December).

According to a report- The North America Millets Market was valued at US\$ 841.87 million in 2018 and expected to grow at a CAGR of 4.0% during 2019-2027 to reach US\$ 1,192.24 million by 2027.

APEDA is taking initiative for export of millets from our country. Recently, Ragi and Barnyard Millet from Uttarakhand was exported to Denmark and this has created export opportunities in European countries.

9. Millet Business Plan for Farmer Producer Organisation(FPO):

Creating FPOs will successfully deal with the constraints and challenges faced by the farmers. It will give strength and bargaining power to access financial and non-financial inputs, services, and technologies. This will help farmers in generating more revenue from the collective sale of millet grains.

Under Odisha Millet Mission, FPOs are created at the block level and are involved in the procurement of Ragi for PDS and ICDS.

For this you can get lot of support from Government.



10. Creating e-Commerce Online platform on Millet Products:

Now, people prefer online platforms to buy their household items including groceries. Online sales are increasing at a faster rate in India. Creating an e-Commerce platform for millet products will create more business as it will reach large customers.

You just need to build a good website and add all ranges of millet products.

11. Millet Cutlery:

You must have seen sign boards in airports claiming "Single-use plastic free airport". "Indira Gandhi International Airport" of Delhi is declared India's first single-use plastic-free airport and it has been certified by the CII-ITC Centre of Excellence for Sustainable Development.

Most plastics are not recycled globally and millions of tons of plastic pollute the world's oceans, impact wildlife and affect drinking water. Risk is associated with the tiny bits of broken-down plastics. According to the Federal pollution watchdog, in 2020, over 4.1 million metric tons of plastic waste was generated in India. You can imagine how severely it is impacting the environment.

So, to mitigate the pollution arising from plastics, spoons, and cutlery is being made with millets and you will be astonished to know that this millet cutlery is edible. This innovation has a better impact on society and also on the environment.

The main ingredients for making the cutlery are millet. As you know millets require fewer inputs and water, and a short period to grow, and thus helps farmers to sustain their livelihood through farming.

The innovation of millet cutlery was brought forward by Narayan Peesapathy, based in Hyderabad. He started his manufacturing business Bakeys Foods Private Limited in 2010. It was his day-night efforts experimenting with different ingredients that resulted in the final product. He has made a fully automatic edible cutlery manufacturing machine.

Points to remember before starting a Millet Business:

1. *Do a survey and research of the market potential before taking up the project.*
2. *Visit some successful enterprises and study the difficulties faced in the initial stage.*
3. *Buy the machines only after checking the performance.*
4. *New Entrepreneurs should take training before starting the project.*
5. *Better understanding of the sieve size and the size of the millet grains.*
6. *Shelf life of millets to be taken into consideration.*

Millet businesses offer an array of opportunities for entrepreneurs, driven by the rising interest in healthier dietary choices, growing awareness of millets' nutritional value, and their environmental benefits. By venturing into the millet industry, entrepreneurs can contribute to their own success while promoting better health, sustainable agriculture, and environmental responsibility.

Block Agriculture Officer, Kundra, Koraput.



Millet Landraces : Harbinger of a Climate-Resilient Food System

Dr. Arabinda Kumar Padhee

“The Seed Systems for Landraces by Odisha Millets Mission to conserve and mainstream landraces is a landmark intervention which will leave a lasting impact on the lives of farmers and scaling up of sustainable agriculture in Odisha.”

Emerging weather and climate patterns indicate serious impacts on agricultural productivity, shifts in cropping patterns, and changes in the types of crops that can be grown due to the lack of timely availability of agricultural inputs such as water and sunlight, as well as the emergence of new pests and diseases. These changes could affect food security, trade policy, livelihood activities and water conservation, and impact large sections of the population. Agricultural biodiversity or agro-biodiversity focuses on that part of the biodiversity, which has undergone selection and modification over millennia by human civilization to better serve the human needs¹.

In the agriculture landscape, rainfed agriculture plays an important role. Rainfed agriculture contributes 40% of India's total food grains and over 50 crops are grown in rainfed areas by farmers through their farm saved seeds. Farm saved seeds or landraces play important

role in the rainfed ecosystem. Seed demand of 86 million hectares of rainfed areas, the largest agro-ecosystem, is met 40-60% through farm-saved seeds with little formal sector support. Millets occupy a significant position in the rainfed landscape of the country.

Out of 6100 high-yielding varieties/hybrids of field crops developed from 1969s to 2022 by ICAR², 2858 varieties belong to cereals alone² and more than 1200 belong to rice³. The formal seed system is characterized by an institutionally organized production and distribution of improved varieties using officially defined quality assurance mechanisms. Scientifically supported plant breeding and the aligned commercialization of the seed market contributed to a formal seed system that focuses on a few homogeneous crop varieties. Of these enormous diversities, fewer than 40 varieties often occupy huge areas under cultivation (about 44 million ha of rice under cultivation) in India⁴.

1. <https://www.fao.org/3/x2775e/X2775E03.htm>

2. <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1845109>

3. <https://icar-nrri.in/released-varieties/>

4. <https://nfsm.gov.in/StatusPaper/Rice2016.pdf>



It is estimated that India has over 40,000 rice landraces and potentially over 1,00,000 developed by farmers over thousands of years. ICAR has collected 3,96,189 accessions of 1,584 crop species mostly from farmers' fields⁵. Only about 6100 varieties of field crops were made available to farmers through institutions compared to hundreds of thousands developed by communities. The enormous genetic diversity is being lost mainly due to genetic erosion, genetic vulnerability and genetic wipe-out.

Odisha at Glance

Odisha is administratively divided into 30 districts with 6.2 million hectares of cultivable land distributed across 10 distinct agroclimatic zones. With an average annual rainfall of 1451.22 mm, paddy cultivation covers more than half of this cultivable area. The State's population includes a significant tribal segment, comprising 22% of its total population. Over 55% of the area is rainfed, predominantly in tribal regions.

These rainfed areas in Odisha are characterised by diverse topographies, undulating terrains and varying agroclimatic conditions. Marginal soils and susceptibility to dry spells further underscore their challenges of rainfed regions. Due to high rainfall and steep slopes, fertilizer efficiency is often lower compared to flatlands. Therefore, suitable seeds must withstand these varying conditions.

Landraces represent crop varieties that have naturally evolved to adapt to the specific conditions of a local area. They are genetically diverse and well-adapted to their surroundings, distinct from cultivars that have been selectively bred to meet certain standardised characteristics. Landraces play a crucial role in sustainable

agriculture, aiding crop adaptation to climate change and forming an integral part of the traditions and cultures of rural communities in Odisha, as in many other places worldwide. This is why landraces are indispensable.

In the traditional agricultural landscape of Odisha, farmers have heavily relied on an informal seed sector for their needs. In spite of adaptability to local conditions and pests, lack of standard protocols and procedures is the reason for no government investments in the informal seed systems.

Process of Evolution of Seed Systems for Landraces

In 2017, Odisha's Department of Agriculture and Farmers Empowerment (DA&FE) launched a flagship initiative titled "Special Programme for Promotion of millets in tribal areas of Odisha" popularly known as Odisha Millets Mission (OMM) to revive millets in farms and on plate. Odisha is home to 62 ethnic tribal groups and has a priceless legacy of thousands of crops that have adapted naturally or through human selection. These tribal areas are rich in diverse foods like various types of paddy, millets, tubers, pulses, oilseeds, wild edible flowers and ethnobotanical plants. Tribal farmers are custodians of diversity as they continue to conserve and preserve the traditional varieties of different crops. As millet is a tribal crop, one of the objectives of OMM is to focus on conservation and promotion of landraces through a seed system for landraces.

Participatory Varietal Trial

Efforts for mainstreaming landraces started with participatory varietal trials in 2018.

5. http://www.nbpg.ernet.in/Divisions_and_Units/Conservation.aspx



Participatory Varietal Trial (PVT) a scientifically designed trial in farmers' fields for selecting preferred varieties from collected landraces. Each OMM block conducted a PVT using a Randomised Block Design (RBD) with three replications. Each variety had a minimum plot size of 25 sq.m, with 100cm spacing between replications and 60cm between varieties within each replication. Seedlings aged 15 to 22 days were uprooted and planted in rows 20 x 10 cm apart. Required organic nutrients were applied both in basal doses and vegetative stages. Farmers and grassroots workers regularly visited the PVT plots for monitoring. During physiological maturity, a field day was organised, inviting male and female farmers aged 20 to 60 from nearby villages. Varieties were decoded, and the purpose of the visit was explained. Farmers were divided into groups by gender and age, each led by a Community Resource Person (CRP). They discussed and tagged varieties as very good, good, or average, with CRPs recording the reasons. Visual and measurement data on the varieties

were collected during the vegetative stage. Agronomic data of 10 randomly selected plants from each variety were collected. Crop Cutting Experiments (CCE) data for each variety from each replication (1 x 1 sq.m) were collected, including fresh and dry grain weights. The data from both farmers and researchers were compared to determine the top two varieties for the block or the micro-agroecological area.

This process was conducted meticulously, ensuring farmers' preferences and experiences were valued and integrated into decision-making. The PVT was executed systematically and scientifically, which allowed for a comprehensive evaluation of the landraces and their potential to thrive in Odisha's unique agro-ecological conditions. The Government of Odisha formed a technical Working Group on Seeds under OMM with representatives from ICAR-IIMR, OUAT, Scientists, Custodian farmers, Seed Savers and other eminent people for standardizing the efforts to mainstream the informal seed systems in 2019.

After an exhaustive evaluation process with technical guidance from the Working Group on Seeds under OMM, four Ragi landraces, namely, Mami, Kalia, Bati and Bharati, emerged as superior among the shortlisted 14 landraces for a larger set of 163 landraces. These varieties were handpicked by agricultural experts, and from these, six true-to-plant types were selected for further cultivation.

Number of PVTs conducted in Ragi from 2018 – 2022

Season	Districts (n)	Blocks (n)	Farmers (n)	Ragi landraces (n)	Govt. Check varieties (n)	Final selected LRs (n)	Final Selected Govt. varieties (n)
Kharif–2018-19	5	12	12	79	14	18	6
Rabi–2018-19	2	4	4	26	3	2	4
Kharif–2019-20	12	39	39	185	41	71	8
Kharif–2020-21	3	12	12	104	15	23	1
Kharif–2021-22	2	12	12	107	12	23	1
		79	79	501	85	137	20

Note: The ragi landraces and Government Check varieties were repeated in the blocks

Source: PVT reports of Odisha Millets Mission



Author with custodian farmers in a millet field of Koraput.

Products Certification Agency (OSSOPCA) guides seed production and certification through these groups and organisations.

A Landmark Achievement

Following two years of varietal purification, the results were presented to the Working Group on Seeds. The group suggested conducting multi-location trials of the four chosen landraces, which took place in various districts, including Koraput, Malkangiri, Rayagada and Mayurbhanj. The trial design followed the Random Block Design (RBD) method, and agronomic studies adhered to the AICRP format, with expert inputs from institutions like the Indian Institute of Millets Research (IIMR) and Odisha University of Agriculture and Technology (OUAT).

The first-ever Landraces Varietal Release Committee (LVRC) meeting was held on

July 21, 2023. The primary objective of this meeting was to recommend the release of four finger millet landraces for general cultivation in suitable regions.

The Ragi landraces proposed for notification were aptly renamed as Kundra Bati, Laxmipur Kalia, Malyabant Mami and Gupteswar Bharati, reflecting their association with significant places in Koraput and Malkangiri and the custodian farmers' habitation. The unanimous approval from the LVRC to release these four landraces for Koraput and Malkangiri districts marks a historic first in the agriculture sector in India. **The release of Ragi landraces is not just a historic first for Odisha, it serves as an example for the country.** On August 10, 2023, Odisha officially notified the release of these four landraces for Koraput and Malkangiri districts, marking an extraordinary historic first in India.



**DEPARTMENT OF AGRICULTURE & FARMERS' EMPOWERMENT
GOVERNMENT OF ODISHA**

NOTIFICATION

Number 29866^{10th} Bhubaneswar, the August, 2023

In exercise of the powers conferred by Government of Odisha in the Standard Operating Procedures (SOP) for Seed Systems for Landraces (SSLR) and as per the recommendation of Landrace Varietal Release Committee (LVRC), which was constituted vide Notification No- 1M (04) 07/2019- 20340 dated 30.05.2023, Govt in Department of Agriculture & Farmers' Empowerment (DA&FE) finds it expedient to regulate and promote the quality of the seeds of the landraces/farmer varieties, specified under column (4) of the kinds specified in the corresponding entries under column (2) and types specified under column (3) of the below mentioned Table.

The Department hereby declares that the said landraces/farmer varieties shall be notified varieties for the districts mentioned in column (5) for seed production, and shall be sold for the purpose of agriculture in the districts mentioned in column (5) of the said Table. Custodian farmers/Women Self Help Groups/Farmer Producer Organizations/NGOs will be supported by ICAR and OUAT for maintaining the purity and quality of the released landraces/farmer varieties and their production shall be undertaken as per the process laid out in the SOP for SSLR.

TABLE

Sl	Kind	Type	Name of the Landrace/Farmer Varieties	Recommended Districts
(1)	(2)	(3)	(4)	(5)
1	Ragi	Open Pollinated Variety	KUNDRA BATI	Koraput, Malkangiri
2	Ragi	Open Pollinated Variety	LAXMIPUR KALIA	Koraput, Malkangiri
3	Ragi	Open Pollinated Variety	MALYABANTA MAMI	Koraput, Malkangiri
4	Ragi	Open Pollinated Variety	GUPTESWAR BHARATI	Koraput, Malkangiri

By the Order of the Governor

(Dr. Arabinda Kumar Padhee)

10.08.2023
Principal Secretary to Government



Timeline of Process of Landrace Release

2018-19	Initiated the Participatory varietal process leading to the primary screening of 14 landraces.
2019-20	Varietal purification trial with 2 replications and further shortlisting of 4 landraces out of 14 screened from different PVTs. Formation of a working group on seeds under OMM.
2020-21 and 2021-22	Purification of 4 landraces along with check on panicle to row method Multilocation trials of 4 landraces with state, national & local checks.
2022-23	Largest screening trials with national checks and preparation of preliminary landrace proposals.
2023-24	Constitution of LVRC and release of 4 finger millet landraces.

Conclusion

The release of Ragi landraces in Odisha marks a historic and commendable achievement in the agriculture sector, with implications for the State's farming communities. This initiative by the Odisha Millets Mission showcases the power of collaboration between local communities, government authorities and scientific experts in preserving agricultural heritage and promoting sustainability. By supporting the cultivation of traditional landraces, the initiative not only

promotes local agro-biodiversity but also enhances the resilience of agriculture in a changing climate. As these unique Ragi landraces take root in Odisha, they symbolize a brighter, more diverse, and more sustainable future for the State's agriculture, setting a precedent that shall be expanded to other crops.

Principal Secretary, Department of Agriculture and Farmers' Empowerment, Government of Odisha.



Women SHG members managing the Millet Shakti Cafe at Lok Seva Bhawan in Bhubaneswar.

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