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Millets Primary Processing for income and nutritional security:

Custom Hiring Models for Farmer

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Abstract:

This booklet is a compilation success stories of primary processing facilities which were developed by ICAR-IIMR with the help of AICRPs, and NGOs services provided at farm gate to millets farmers in different socio-agroecological conditions across the country through custom hiring models. These infrastructures also support to promote secondary processing technologies for the benefit of the users. This book highlights the potential of primary millet processing on a custom hiring basis at village level to enhance farmer income and nutritional security. It proves innovative models that reduce post-harvest losses, improve quality of produce, and promote millets consumption. It will serve as a reference manual to create suitable primary processing technologies for millet growers, processing industries, extension functionaries, entrepreneurs and policy makers to enhance millets farming and profits.

Disclaimer:

The information in this book was collected and synthesized from different agro-ecological local situations and perception of the millets farmers regarding effectiveness of primary processing facilities availed includes different version of machinaries through custom hiring models. Since, the informations generated from the highly location-specific agro-ecologies and millets farmers, these models may not perform the same way under other agro-climatic conditions. Any damage or loss resulting from the use of this book's information is entirely the responsibility of the users, not the authors or the institute.

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ICAR-IIMR, Hyd.

Foreword

Millets (*Shree Anna*) are most important crops for improving nutrition and human health around the world. In the face of growing global challenges such as climate change, food insecurity, and economic disparities, it has become imperative to rethink our strategies for agricultural practices and crop systems. Millets stand out as a resilient, nutrient-rich, and sustainable crop, particularly suited to the diverse agro-climatic conditions and provide livelihood security particularly in dryland and rainfed agriculture of the country.

Recognising the importance of millets in world agriculture, the UNO declared 2023 as the International Year of Millets on the request of Government of India and several other countries. The celebration of which brought in sharp focus importance of millets, awareness of their nutritional advantages, and role ensuring nutritional and food security besides, bringing economic benefits to millions of millet growers. Government of India during the celebration declared ICAR-IIMR as the Global Centre of Excellence on Millets (*Shree Anna*) as the institute is pioneer in millets research and development activities. The institute scientists in collaboration with scientists of AICRP centers of Small millets, Pearl millet and Sorghum are developing new high yielding varieties and technologies for high production. This has led to higher productivity. However, despite increase in productivity, the area of small millets has been on decline due to low income of the millet growers. The demand for millets is increasing due to efforts by several state and central government. One of the major challenge is also that farmers not get fair price in market due to poor quality of grains because of lack of processing. Dr. Chapke and his colleagues made innovative efforts in establishing and popularising small scale village level post-harvest primary processing facilities as custom hiring centres. I had visited one of the most successful models that created primary processing facilities at farm gate at Gangapur village in Sangareddy district of Telangana State which was run by a local farmer on custom hiring basis. Using these facilities, millets farmers could enhance their income up to 3-4 times than their existing practices and raise millets consumption of their households. Therefore, the primary processing facilities including cleaning, destoning, and grading at village level was one of the most effective way to enhance millets profitability and consumption.

By focusing on the custom hiring model, the authors have opened new avenues for farmers, particularly for smallholders to access modern processing equipment at an affordable cost. These facilities have the potential to revolutionize this space, offering a practical solution to the challenges faced by the farmers in rural areas. This also highlights how modern processing techniques can reduce yield losses, improve storage, and provide market-ready products, thus boosting farmer's income.

This book will serve as a resource for policymakers, researchers, extension workers, and farmers to take up promotion of millets. The authors have skilfully woven together the economic and nutritional dimensions of millet processing, providing a roadmap for harnessing the full potential of this ancient grain. I compliment Dr. Rajendra R. Chapke and all the contributing authors for their efforts to bring out this book timely. I am confident that this work will make a significant contribution to the ongoing efforts of enhancing the farmers' income and motivation for millets production and consumption.

(S.L. Mehta)

ACKNOWLEDGMENTS

Encouraging support and inspiration received from Dr. V.A. Tonapi and Dr. J.V. Patil, Former-Directors, ICAR-IIMR for creation of these facilities under STSP, SCSP, FFP and NASF-funded extension projects is gratefully acknowledged. Special thank are due to Dr. S.L. Mehta, Former-DDG (Education), ICAR, Former-Chairman RAC & QRT of the institute for his personal visit to one of the successful models at Gangapur, Sangareddy district of Telangana, and his appreciation and guidance for further improvements. Also visit of Dr. R.K. Samanta, former-VC, BCKV, Mohonpur, Kolkatta and Chairman, Advisory Committee, NASF funded-Extension project to the models established at Koraput, Odisha and his appreciation for keeping functional in long term. Cooperation from scientists of All India Coordinated Project on Sorghum, and Small Millets to develop these facilities and implementation of these modules, and providing the useful information on their performance is thankfully acknowledged. Thanks are due to scientists of the institute namely, Drs. B. Venkatesh Bhat, Dayakar, Sooganna, A. Srinivas, Swarna Ronanki, and Sangappa for assistance in developing these facilities. The support received from the project staff of Farmers FIRST project on Millets namely, Ms. V. Priyanka, SRF, Mr. M. Bhagath Reddy, Ms. M. Soujanya, Field Assistant and Mrs. Laxmi Prasanna, SRF for data compilation and typing support to publish this book is also sincerely acknowledged.

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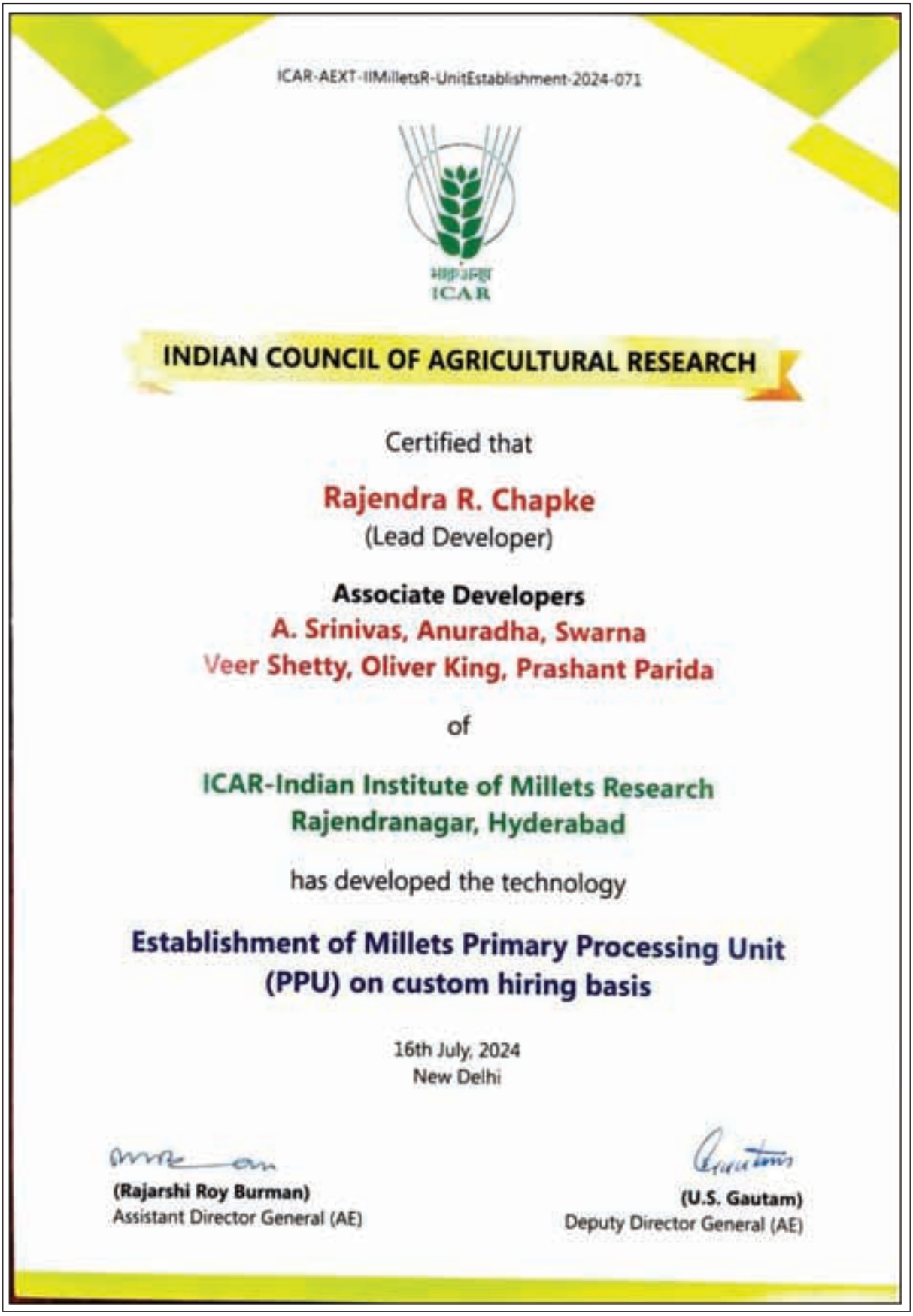

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Rajendra R. Chapke
(Lead Developer)

Associate Developers
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Veer Shetty, Oliver King, Prashant Parida

of

ICAR-Indian Institute of Millets Research
Rajendranagar, Hyderabad

has developed the technology

Establishment of Millets Primary Processing Unit (PPU) on custom hiring basis

16th July, 2024
New Delhi

(Rajarshi Roy Burman)
Assistant Director General (AE)

(U.S. Gautam)
Deputy Director General (AE)

Millets Primary Processing for income and nutritional security:
Custom Hiring Models for Farmer

Introduction

Importance of millets for consumption

Millets are known as climate flexible crops grown by resource-poor farmers. These crops primarily constitute a diverse group of small grains, categorized under coarse cereals and recently renamed as Sri Anna in India. These are classified into; major millets and minor or small millets. These are important crops for dryland farmers, highly nutritious and are acclimate compliant crop. The millets production is labor-intensive that requires more labour especially in harvesting and post-harvest operations. Due to drudgery in production and preparation of traditional food items, overall millet consumption in India has declined over the years and area under cultivation on as well. In addition there is a lack of attractive traditional recipes for improving value in people's diet menu, lack of awareness of the nutritional value of millets, poorly organized integration with markets for availability and generally, unfavorable environmental policy, were the reasons to lead in reduction in cultivation area and consumption. Inadequate post-harvest technologies for value-addition, and lack of awareness, knowledge and skill for processing among the farming community, millets were looked down as inferior or as a poor man's food. The nutrients composition and technological properties of small millet grains offer a number of opportunities for processing and value-addition to use as next generation foods to meet out the consumers' choice of different culture, location-specific, choice and society. By virtue of special properties of millets among food grains, the year 2023 was celebrated as "International Year of Millets".

After harvesting, grains of cereals or coarse cereals are not eaten as unprocessed and uncooked whole seeds in any human society. Millets are good sources of calorie and nutrients. There is raising demand for millets, is leading to higher prices and requirement of quality grains, can make their production profitable and sustainable. The focus on utilization of millets is on an upward swing given the proven understanding that they are good source of phytochemicals, dietary fiber and nutritional components. It is therefore, imperative to address constraints in harvest and processing of millets, and what are suitable options that are available.

Problems in existing post-harvesting operation

- Mostly, harvesting of the millet crops is coinciding with heavy rains and lack of sunny days leading to problems like lodging, shattering of grains, blackening of grains and straw, increased duration of heaping before threshing resulting in deterioration of grain quality and sometimes germination of seeds starts in the fields due to continuous rain.
- Drying for two to three days is a pre-requisite for easy grain separation during threshing, but this may not be achieved due to cold and humid weather conditions.
- Low wind velocity during the winnowing increases the labour requirement to as much as three times of the labour requirement compared to there is good wind velocity.
- The labour requirement for harvesting and threshing operations is high and given the increase in wages, harvesting is becoming a costly activity.

- Trampling the dried panicles by women results in rashes in the feet and beating with stick results in swollen patches on the palm of women. Further, winnowing results into itching and respiratory problems of many labourer.
- Threshing on roads leads to grain damage contamination and huge loss.
- Threshing and drying on a mud floor is less efficient than on the cement floor, and access to cemented threshing yards is very limited in rural areas.
- In case of small millets, small stones, dirt and other varieties of small millets get mixed with the grains during threshing and drying operation and thereby, leading to detoriation in quality.
- Rodent damage is a significant problem in millets production for small millets and insect pests of store grains are a major problem with the associated crops.
- Lack of adequate processing facilities at village level for all small millets except finger millet at a very few places.
- Dehusking is a tedious and time consuming operation undertaken by the women.

Drudgeries in traditional post-harvest operations and remedies

Traditional post-harvest activities in agriculture are mostly done by women. These are most drudgerious. A study was done by Chapke et al., 2024 on identifying post-harvest operations of millets and determine level of drudgery of women farmers while doing by traditional methods and improved practices. The results revealed that the level of drudgery realized in performing the five identified operations with improved practices was considerably reduced by 35 to 87% than the traditional practices. The identified five most drudgery-involved post-harvest operations of millets (Table 1 and 2) includes; flatbread making that was found to be a most drudgerious (DI=78.97) with indigenous method which was made easier (35%) by using flatbread (*roti*) maker machine (DI=58.51). Second most drugerious operation was found to be winnowing with traditional method (DI=72.52). It was also made easier by reducing drudgery (61%) using power-operated winnower (DI=45.00). Threshing was the major operation after harvesting of the crops which was found to be more drudgerious task (DI=72.16). Whereas, it was reduced to large extent (61%) using power-operated thresher (DI=44.84). The flour making were also found to be a most tiresome task (DI=70.41) doing with sitting for long time in same posture under traditional method which was made more convenient (84%) by using most common power-operated flour mill (DI=38.16).

Drying of grains was not found to be much tedious compared to the above operations. Wherein, the farm women need to spread grains in open sunlight and watch for entire day time that was mostly done by aged-women and they felt bit drudgerious (DI=69.40) which was also reduced by 87% using power operated dryer (DI=37.01) under improved practices, introduced among the millet farmers.

Thus, the farm women got rescue from their drudgery in addition to saving their working hours. The women's ages and their degrees of drudgery were significantly correlated while performing all the five post-harvest operations (p=0.01). Whereas, their experience with age was playing a key role in reducing their drudgery in flatbread making and flour making under traditional methods. It was realized that the drudgery of the women could be reduced by using the appropriate technologies include suitable machineries which made them comfortable and reduced their physical strain followed by, leading them towards good health and enable to boost up consumption of millets. Post-harvest operations of millets are tedious and the drudgery index of the operations with both traditional and mechanical methods are shown in the Tables below:

Table 1. Drudgery index (DI) of the post-harvest operations of millets performed by traditional method

Post-harvest operation	Traditional practice	DI (Traditional method)	Drudgery level
Threshing	Using bullocks or tractor and hand pounding with a wooden stick in mud yard or on tar road	72.16	Maximum (70 and above)
Winnowing	Removing dust manually by pouring from height and using bamboo fans	72.52	Maximum (70 and above)
Drying	Spreading grains by hand on floor under sunlight	69.40	Moderate (50 to 70)
Flour making	Pounding and grinding manually in stone crusher	70.41	Maximum (70 and above)
Flatbread (*roti*) making	Making by hands	78.97	Maximum (70 and above)

Table 2. Drudgery index (DI) of the post-harvest operations of millets performed by mechanical method

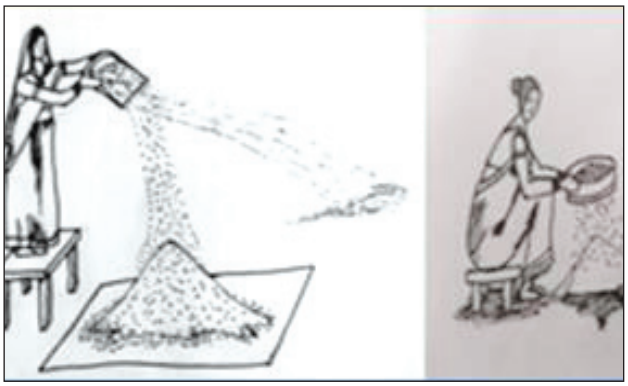
Post-harvest operation	Improved practice (mechanical method)	DI (Mechanical method)	Drudgery level
Threshing	Thresher (Power 2 HP, single phase electric motor, 80-150 kg/h (depending on millet types)	44.84	Minimum (50 and below)
Winnowing	Winnower (DAM grain cleaner machine with 0.4 HP motor, Capacity : 400-600 kg/hr)	45.00	Minimum (50 and below)
Drying	Dryer (power-operated)	37.01	Minimum (50 and below)
Flour making	Flour mill (Commercial flour mill Motor power: 2 HP Capacity: 8 to 40 kg/hr)	38.16	Minimum (50 and below)
Flatbread (*roti*) making	Flatbread (*roti*) maker (Power: 150 W, Single-phase high torque motor Capacity : 40-45 *rotis*/hr)	58.51	Moderate (50 to 70)

Source: Chapke et al, 2024. Traditional post-harvest operations of millets and drudgery of women. *Indian Journal of Traditional Knowledge.* 23(8), pp 805-811.

Traditional Processing of millets

Threshing

Cleaning and Drying



De-stoning

Pulverising

Flatbread making

Traditional cleaning, de-stoning of millets

Traditional pulverising/milling of millets

Need for processing of millets

Millets have good grain qualities for processing. Primary processing mainly involves destoning, cleaning, dehusking, dehulling, grading and pulverizing operations. Millets can be used for traditional as well as novel value-added foods. Unprocessed or processed grain can be cooked as whole or decorticated and if necessary, ground to flour by traditional or mechanized methods. However, there is a need to look into the possibilities of alternative uses for easy processing.

In general, primary operation in processing of cereal or coarse cereal, are usually the separation of dirt material, pericarp and sometimes the germ from the edible portion. The outer tough seed coat of millets, characteristic flavour, cultural attachments and non-availability of processed millet products, are limiting factors unlike rice or wheat. These are the prime reasons for low acceptability and popularity of millet foods among rice and wheat eaters. The farmers are getting very less price (Rs.25-30/kg) to their un-processed produce compared to quality processed one (Rs.80-100/kg). Unfortunately, there is no well-proven industrial process available for making white products from coloured small millets. Satisfactorily, the nutrients composition and technological properties of small millet grains offer a number of opportunities for primary processing and value-addition to use as next generation foods to meet out the consumers' needs of different culture, location, choice and society. It is therefore, compulsory to process the raw millet produce which has the following advantages (Table 3).

Table 3. Merits of millets processing

1	Maximize market price	Quality grains after primary processing has 3-5 times more price than the raw produce of farmer's field
2	Digestibility	Processing is required to make dried grains edible and digestible
3	Food safety	Cooking inactivates natural toxins and heat prevents bacterial and food spoilage
4	Organoleptic properties	Processing optimizes the appearance, taste and texture of foods to meet the needs of consumers
5	Ready to eat (RTE) and convenience	To meet consumer demand for quick and easy meal solutions and also nutritional supplement
6	Maximize nutritional availability	Processing can make it easier for nutrients from grains to be digested. Nutrients lacking in the diet can be added to staple grain-based foods (food fortification) (e.g. thiamin added to flour)

Effect of processing on antioxidant activity of millets

Antioxidants are substances that scavenge free radicals that may cells in our body. They are found in many foods, including millets, fruits and vegetables. They help to neutralize free radicals in our body, and this is enabled to boost overall health. Different processing methods of small millets especially, foxtail millet made an effect on the total phenolic content (TPC), and the six kinds of phenolic acids. Compared with whole millet, the TPC of dehulled millet decreased and TFC of dehulled millet increased. Compared with dehulled millet, the TPC and total flavonoid contents (TFC) of cooked and steamed millet decreased. However, the total phenolic content and cinnamic acid content were rich in cooked millets. In addition, cooked millets demonstrated remarkable radical scavenging capacity, which was associated with its high contents of natural antioxidants found in the samples, such as phenolic compounds, cinnamic acid, and phytic acid. Correlations between the antioxidant activity and cinnamic acid ranged from 0.75 to 0.89, while the antioxidant

activity and total phenolic content ranged from 0.83 to 0.91. Therefore, cooked millet was a good choice for human consumption.

Need of processing facility

Generally, women take utmost part in post-harvest activities and they work for long hours, on average of 10-11 hours in agriculture and allied operations including four hours in domestic activities. In millets cultivation, women contribution is higher than the men as these are labour intensive. One of the important issues faced by the rural communities is drudgery while performing post-harvest operations of the millets. Difficult processing is the key challenge that hinders consumer demand and up-scaling potential for minor millets. Women farmers complained about various health related problems like backache, hand injury and respiratory problems, associated with traditional methods of harvest and post-harvest operation of millets. The physical stress of them seems to be too high as of heavy exertion tasks of various activities done by them. Traditional post-harvest and processing methods condemn the women who prepare millets food to considerable daily drudgery.

The introduction of small scale aspirators and de-stoners or machineries for post-harvest operation are much essential in the area, having potential to improve the hygiene and quality millet products. As per the feedback of farmer, "Processing of millets is very difficult and women often feel the burden of this onerous task. Several interventions can be made to facilitate access by value chain actors to processing plants on the one end and by consumers to processed millet products on the other. The lack of suitable processing units near to millet fields, forces local producers to take their produce to distant places. This causes price increases across the value chain, including for consumers, who have to pay higher amounts for millet foods as compared with paddy and wheat products. In this regard, it is essential to establish at least one small - scale processing units at village or block level.

Labour requirement for harvest and post-harvest operations of millets seems to be relatively higher than other cereal crops when it is seen in the background of low productivity and low value. Given its value as a nutritious crop, labour efficient practices need to be evolved to address this issue. Pursuing this feedback, threshing, destoning, grading, dehulling, separating hulled and unhulled grains can have significant benefits for farm labour, who bear the major burden of post-harvest operations. By any nutritional parameter, millets are miles ahead of rice and wheat in terms of their mineral content, as much as fifty times that of rice. While most of us seek a micronutrient such as Beta Carotene in pharmaceutical pills and capsules, millets offer it in abundant quantities at affordable price. In this way, every single millet is extraordinarily superior to rice and wheat, and therefore, processed millets are the solution for the malnutrition that affects a vast majority of the tribal population. Processing unit will be helpful to realizing the economic and potential value of the minor millets to the farmers of tribal area. Keeping this in mind, there is an essential need of developing Millets Primary Processing facilities (PPUs) at village level especially, in tribal and rural areas.

I. Primary processing methods

Good remuneration from millets production is one of the major dominating factor in millets cultivation and its expansion. The farmers are getting very low price for their raw produce (Rs.2500 to 3000/q) because it contains dirt and unwanted materials in it. However, good quality materials derived from the same raw materials after simple primary processing operation that has high price in the market (Rs.80-100/kg). It depicted that only primary processing can enhance price of the farmers' produce up to 4- 5 times higher. For this, the following different primary processing operations needs to be done in order at village level.

1. **Cleaning:** To remove plant husk, dirt or other light material from the grains
2. **Destoning:** To remove sand, stones, metal contaminants or other impurities from grain
3. **Grading and packaging:** To grade the de-stoned grains based-on suitable size by removing broken grains and pack them for sale or transport purpose.
4. **Pulverizing:** To pulverize the millets into fine flour which is shifted, blended or roasted and make it suitable for packaging

De-cortication

De-cortication is partial removal of outer layer of the millet grain. It is accomplished by hand pounding and using traditional de-hulling or other suitable mechanized abrasive de-hullers.

Pounding

Traditionally, dry, moistened or wet grain is pounded with a wooden pestle in a wooden or stone mortar. Moistening the grain by adding about 10% of water facilitates not only the removal of fibrous bran but also the separation of germ and endosperm, if desired. However, this practice produces slightly moist flour. Parboiling increases the de-hulling efficiency of kodo millet and also eliminates stickiness in cooked finger millet porridge.

In hand pounding, grain which should be fairly dry, is crushed and pulverized by the backward and forward movement of the hand-held stone on the lower stone. Generally, women do these unpleasant and laborious work. It has been reported that women working hard with a pestle and mortar can decorticate 1.5 kg per hour providing a non-uniform poor keeping quality product. Consequently, the women faced lots of drudgeries in these operations and get demotivated to use millets for consumption purpose.

De-hulling

In this process, husk of the grains is removed and pericarp is also sometimes removed for preparation of special food items. De-hulling is accomplished by using rice de-hullers or other power-operated de-hullers. Millets would probably be more widely used if processing is improved. In market, many machines are available for processing of cereals.

Destoner-cum-Grader-cum-Aspirator

Millet mill dehuller

Double stage centrifugal dehuller

Major millet dehuller

Millet pulverizer

Small millets polisher

Benefits of de-hulling in millets

Wheat has the unique property of forming an extensible, elastic and cohesive mass when mixed with water as it contains glutamine. Millet flours lack these properties when used alone. Hence, fortification brings many innovative 'Ready-to-eat and Ready-to-cook' millet-based processed products. Processing makes possible to fortify malted finger millet (70%) weaning food with green gram (30%) having low cooked paste viscosity and high energy density.

The de-cortication reduces total protein and lysine by 9 and 21%, respectively, but improves the remaining protein utilization. The loss of minerals is minimal. Decortication improves the biological availability of nutrients and consumer acceptability. The anti-nutritional element phytate content of proso millet varieties ranged from 170 to 470 mg/100 g of whole grain, and dehulling resulted in a 27 to 53% reduction in phytate content.

On de-hulling, phytin phosphorus decreased by 12% in proso millet, 39% in little millet, 25% in kodo millet and 23% in barnyard millet. De-hulling of sorghum can remove 40 to 50% of both phytate and total phosphorus. Bio-availability of iron in sorghum in human subjects was found to reduce more by phytin phosphorus and thereby, tannin content of the grains (Table 4). On pearling of sorghum grain, a significant increase in ionizable iron and soluble zinc content showed improved bioavailability of these two micronutrients, which was attributed partially to the removal of phytate, fibre and tannin along with the bran portion during pearling (Table 5).

Table 4. Nutrient composition of whole sorghum grain (per 100g)

S. No	Parameters	Whole grain
1.	Moisture (%)	11.90
2.	Ash (%)	1.60
3.	Protein (%)	10.40
4.	Fat (%)	1.90
5.	Carbohydrates (%)	72.60
6.	Iron (mg)	4.10
7.	Calcium (mg)	25.00
8.	Zinc (mg)	1.60
9.	Riboflavin (mg)	0.13
10.	Energy (KCal)	349

Source: Dayakar et al, 2018. Nutritional and health benefits of nutri-cereals. ICAR-IIMR Hyderabad. pp 96.

Table 5. Proximate composition of different sorghum value-added products compared to flour

Name of product	Moisture (g)	Protein (g)	Fat (g)	Total fiber (g)	Insoluble dietary fiber(g)	Soluble dietary fiber (g)	Carbo-hydrates (g)	Energy (K. Cal)
Sorghum flour	13.80	6.20	2.80	9.69	8.10	1.59	76.15	355
Sorghum soya blend	7.89	11.92	2.62	12.71	9.77	2.94	63.22	330
Sorghum Rawa	8.97	7.15	1.20	9.23	7.92	1.31	77.74	350
Sorghum Pasta	11.47	8.39	1.38	5.56	4.82	0.74	76.21	355
Sorghum flakes	13.80	5.09	2.40	5.97	5.43	0.54	74.90	342
Sorghum Biscuit	5.67	4.59	24.50	5.27	3.54	1.73	60.29	481

Source: Dayakar et al, 2018. Nutritional and health benefits of nutria-cereals. ICAR-IIMR Hyderabad, India. pp 96.

Parboiling

Parboiling is basically the process of partial cooking of grain along with husk or bran. The raw grain is briefly steamed. The resulted product is dried, de-husked and decorticated.

Milling

Milling is the process of separating bran and germ from the starchy endosperm so that the endosperm can be grinded into flour and *rawa* using different types of sieves in a hammer mill. Milling is to separate the seed coat or decortication reduces protein, dietary fiber, vitamins and mineral contents of the grains to some extent but, this compensates better consumer acceptability, improved bio-availability of the nutrients and enhanced product making qualities. The bran fraction from the millets is a very good source of dietary fiber and edible oil.

The de-oiled millet bran may be used as source of dietary fiber in formulating high-fiber foods as it contains negligible or less of silica compared to de-oiled rice bran. The changes in nutritional parameters upon milling and other processing interventions in sorghum are given in Table 6. Biological value and digestibility of processed millets are given in Table 7.

Table 6. Chemical, mineral and vitamin composition of upon milling process of sorghum (per 100g)

Parameters	Whole grain	Flour	Fine Semolina (*idli rawa*)	Medium Semolina (*Upma* semolina)
Moisture	11.90	13.80	10.17	8.97
Ash (%)	1.60	1.60	0.73	2.03
Protein	10.40	6.20	6.65	7.15
Fat (%)	1.90	2.80	1.70	1.20
Carbohydrates (%)	72.60	76.15	77.75	77.74
Iron (mg)	4.10	8.40	10.57	5.10
Calcium (mg)	25.00	10.03	7.55	5.75
Chromium (mg)	0.008	0.008	1.27	1.48
Zinc (mg)	1.60	1.30	1.21	1.38
Riboflavin (mg)	0.13	0.38	0.11	1.09
Energy (Kcal/100g)	349	355	350	350

Source: Dayakar et al, 2018. Nutritional and health benefits of nutria-cereals. ICAR-IIMR Hyderabad, India. Pp 96.

Table 7. Macro and micro nutrient changes during sorghum processing (per 100g)

Parameters	Medium rawa	Flakes	Vermicelli	Pasta	Pops	Biscuits
Moisture	8.97	13.80	8.43	11.47	5.87	5.67
Ash (%)	2.03	0.63	0.77	0.77	0.63	2.00
Protein	7.15	5.09	8.39	8.39	5.04	4.59
Fat (%)	1.20	2.40	1.38	1.38	2.60	24.50
Carbohydrates (%)	77.74	74.99	76.21	76.21	83.06	60.29
Iron (mg)	5.10	87.78	64.51	64.51	2.40	2.25
Calcium (mg)	5.75	93.15	54.51	64.51	10.26	68.80
Chromium (mg)	1.47	0.90	0.20	0.215	1.40	0.51
Zinc (mg)	1.38	8.78	7.49	5.74	4.51	BDL
Magnesium (mg)	86.02	80.51	67.48	67.48	86.77	56.10
Riboflavin (mg)	01.09	0.02	1.28	1.28	0.15	2.26
Energy (KCal/100g)	350	342	355	355	376	481

Source: Dayakar et al, 2018. Nutritional and health benefits of nutria-cereals. ICAR-IIMR Hyderabad, India, pp 96.

These infrastructure of Millets Primary Processing Units (PPUs) can also be utilized to promote further processing that is secondary processing of millets to prepare food items at village level as mentioned below.

Secondary processing of millets

Secondary processing is a process converting primary processed quality raw material into product which is suitable for food uses or consumption such as ready-to-eat (RTE) and ready-to-cook (RTC) products, minimize cooking time and make it convenient foods and have more commercial value. The primary processing was the pre-requisite for secondary processing. The traditional (popping and flaking) as well as contemporary methods (roller-drying and extrusion-cooking) of cereal processing could be successfully applied to millets to prepare ready-to-eat products and thereby, increasing its utilization as a food.

The pop making technology significantly reduces crude fat and crude fiber contents more significantly than raw millet, while the carbohydrate and energy values were significantly higher. This is mainly because, fat and fiber contents are higher in outer coat of grains, thus more affected by processing compared with nutrients located in inner layer. Therefore, the use of new technology optimization of puffing conditions and popping technique can be used as a strategy or in combination with other pre-treatments to produce RTE expands from millet grains on a commercial scale, thus promoting utilization of millet grains.

However, because of the rigid endosperm texture, nearly spherical shape and smaller size, heavy duty roller-flaker is essential for flaking unlike the edge runner used for flaking of rice. The hydrothermal treatments exploit the thermo-physical properties of starch and prepare flakes. During this process the Maillard reaction takes place in which the sugars present in the aleurone layer react with amino acids of the millet and gives pleasant and highly desired aroma to the puffed product. It also reduces anti-nutrients like phytates, tannins, etc., increase bio-availability of minerals, give pleasing texture to the product, and enhances protein and carbohydrate digestibility.

In addition to these, baking technologies can also be used as affective alternatives. Several studies recommended millets as the nutritional composition, biological and sensory characteristic values are found to be on par with wheat-based products. This has come as a morale-booster and has boost-up the demand for millet-based food products (Table 8).

Table 8. Different value-added food products of millets

1.	Malt from finger millet	9.	Millet instant laddu mix
2.	Millets puffs	10.	Sorghum muesli
3.	Extruded snacks	11.	Millet semolina and pasta
4.	Extruded flakes	12.	Millets vermicelli
5.	Instant sorghum idli mix	13.	Millet cookies
6.	Instant upma mix	14.	Millet bread/bun
7.	Instant dosa mix	15.	Millet cake
8.	Instant pongal mix	16.	Millet pizza

Keeping advantages of post-harvest processing operation done by machineries reasons for low consumption and low market price for unprocessed produce of farmer in mind this book has been brought out to guide the stakeholders especially, millet growers and entrepreneurs how to proceed for processing of the millets after harvesting. It would not only enhance consumption of millets products but also enhance market demand and farmer's income. Such primary processing

facilities were created at villages in different millets growing areas of the country with help of All Indian Coordinated Research Project (AICRP) on sorghum and small millets and NGOs. These are operationalized by the AICRPs and NGOs at grassroot level. They are providing services on custom hiring basis with minimal charges of Rs. 10-15 per kg. Consequently, the millet growers are gaining 3-5 times higher prices for their processed materials than the unprocessed one. Some of the secondary processing activities were also organized at the site and the beneficiary farmers were linked with traders and entrepreneurs for marketing. It found to be one of the proven interventions towards enabling farmers to double or triple their income from the millets production. The details of such established facilities are elaborated in this manuscript as success stories of the institute efforts made under various programmes especially, scheduled tribe sub-plan (STSP), scheduled caste sub-plan (SCSP), farmer FIRST programme on millets (FFP) and NASF-funded Farmer-led extension project.

Millet puff gun machine

MAHARASTRA STATE

1. Primary processing unit (PPU) established by AICRP-S, Parbhani, Maharastra State

Address of centre:
Dr. K. R. Kamble
Former Sr. Sorghum Breeder & Officer In-charge
All India Co-Ordinated Research Project on Sorghum
VNMKV, Parbhani, Maharashtra State

Importance of millets in the area

The millets are grown on less fertile soils where rice or wheat cannot be grown. Due to thier high resistance capacity against harsh conditions, they are beneficial to the environment, to the farmer and provide high nutrient food at affordable price to all consumers. Millets are providing food security and plays an important role in providing nutritional and fodder security. They have high are fibre in content, magnesium, Niacin (Vitamin B3), gluten free and high protein content. They are also known as dry crops because they can be grown in the drought regions of the country. Sorghum is one of member of the millets family that was grown on an area of 8.43 lakh ha with 8.05 lakh ton production and average productivity of 774 kg/ha in Marathwada region of Maharashtra during the year 2019-20.

About tribal population in the area

Total population of the village Wai, Tq. Kalamnuri, Dist. Hingoli is 2280, who are all belongs to from tribal community where the PPU was established**.** Sorghum and Pearl millet are grown in the district.

Post harvesting operation in millets

Primary processing is done manually

- Winnowing, sundrying of panicles
- Manual cleaning, destonong and grading

Secondary Processing

- Traditional flour making, flatbread (*roti*) preparation
- Preparation of poridge (*Ambil*, Malt)
- Broken and infected sorghum grains are used to feed poultry
- Traditional preparation Vermicelli, jowar flakes, laddu with chickpea flour blend

Problems in current post-harvest operations

Farmers do not have knowledge and skill to operate the machines like threshers, winnower, gravity separator. Separation of panicles, grains and stalk is expensive. Due to rainfall at grain filling stage, severity of grain mold is more that's why they do not able to harvest quality grains. After harvesting of *kharif* sorghum, they do not have infrastructure facility at village level to complete post harvesting operations like drying and threshing.

Need of processing facility

The farmers are producing millets especially sorghum and pearl millet in good quantity in this region. Every farmer has surplus of sorghum production. Therefore, the farmers are making farmer

groups or FMC's for value-addition at primary and secondary level and to avail market facility for millets. However, they do not access processing facilities at village level and getting low price for their unprocessed produce.

Keeping the above problems in view, the ICAR-Indian Institute of Millets Research, Hyderabad had supported financially and technically to develop primary processing facilities at farm gate (village level) under Tribal sub-plan (TSP) and Scheduled Caste sub-paln (SCSP) programme.

Funds used: Rs. 7.00 lakh were allocated from Tribal sub-plan (TSP) and SCSP of the programme IIMR.

Location of the PPU		
Village	:	Wai
Block	:	Kalamnuri
District	:	Hingoli
State	:	Maharashtra - 431 702

Machineries available in the unit for services

1. Rotary mode assembly with shaft bearing differential
   - Flour mill.
   - Powder making machine
   - Vermicelli making machine
   - Sorghum papad making machine
2. Solar tunnel dryer machine
3. Grader cum grain cleaner unit
4. Gravity separator
5. Aspirator

Implementing group at village: All members of the Wai Grampanchyat took active participation to operationalize the unit on the basis of custom hiring mode since 2019.

Beneficiaries feedback

The village people are very much happy and thankful for establishment of Primary Processing Unit by the ICAR-IIMR, Hyderabad at their village. The people from adjoining villages are also visiting the unit and taking benefits of the facilities. Due to this PPU, Grampanchyat received more income and name in the block. People also get benefited by low-cost processing services which save the expenditure of electricity and utilizing available bullock power. The people also get regular employment. Now, the people in this region are having business plan on value-added millets products.

Utility: Around 500-700 farmers are taking advantages of the facilities annually.

Operational limitations of PPU

The farmers are unable to do grader and cleaner setting properly due to lack of technical knowledge. The instruments and spare parts are not easily available; the mechanics are not available in time if any problem arises. The people do not have the knowledge of servicing of the machineries.

Bullocks operated rotary mode assembly

View of flour mill

View of thin bread (papad) making machine

Grader and gravity separater

1. Location of the PPU

Village	:	Wai
Block	:	Kalamnuri
District	:	Hingoli
State	:	Maharashtra

PPU completion certificate from local authority

VASANTRAO NAIK MARATHWADA AGRICULTURAL UNIVERSITY
ALL INDIA CO-ORDINATED SORGHUM IMPROVEMENT PROJECT
Sorghum Research Station Parbhani- 431 402

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2016-17 to 2020-21 jointly by AICSIP, SRS, VNMKV, Parbhani and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	At Wai Tq. Kalamnuri Dist. Hingoli	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
कृषि सहायक
मुख्यालय -वाई
Official

State Government Department

Signature with name
O/c D. K.R. Kamble
OFFICER INCHARGE
Sorghum Research Station,
VNMKV, Parbhani

वाई

2. Location of PPU

Village	:	Walkyachiwadi
Block	:	Himayatnagar
District	:	Nanded
State	:	Maharashtra

PPU completion certificate from local authority

VASANTRAO NAIK MARATHWADA AGRICULTURAL UNIVERSITY
ALL INDIA CO-ORDINATED SORGHUM IMPROVEMENT PROJECT
Sorghum Research Station Parbhani- 431 402

PPU COMPLETETION CERTIFICATE

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S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	At Gargotewadi Tq. Bhokar Dist. Nanded	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official

State Government Department

Signature with name
O/ic D. K. R. Kamble
OFFICER INCHARGE
AICSIP, SRS, VNMKV,
Parbhani

3. Location of the PPU

Village	:	Gargotewadi
Block	:	Bhokar
District	:	Nanded
State	:	Maharashtra

PPU completion certificate from the local authority

VASANTRAO NAIK MARATHWADA AGRICULTURAL UNIVERSITY
ALL INDIA CO-ORDINATED SORGHUM IMPROVEMENT PROJECT
Sorghum Research Station Parbhani- 431 402

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2016-17 to 2020-21 jointly by AICSIP, SRS, VNMKV, Parbhani and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	At Gargotewadi Tq. Bhokar Dist. Nanded	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official

State Government Department

Signature with name

O/ic D. K. R. Kamble
OFFICER INCHARGE
AICSIP, SRS, VNMKV,
Parbhani

2. Primary processing unit established by AICRP-S, Akola, Maharastra State

Address of centre:

Dr. R.B. Ghorade

Sr. Sorghum Breeder, Officer-incharge

AICRP on Sorghum, PDKV, Akola, Maharashtra

Importance of millets in area

Millets are one of the oldest foods known to human and possibly, the first cereal grain to be used for domestic purposes. They are small-seeded grasses that are hardy and grow well in dry zones as rain-fed crops, under marginal conditions of soil fertility and moisture. They are also unique due to their short growing period. They can develop from planted seeds to mature, ready to harvest plants in little period of 65 to 110 days. When properly stored, whole millets can be kept for two or more years. They are nutritious, non-glutinous and not acid forming foods. Hence, they are soothing to digestive system. They are considered to be the least allergenic and most digestible grains. They lower the risk of diabetes due to lack of glutenin content. They are particularly high in minerals like iron, magnesium, phosphorous and potassium. Finger millet (*Ragi*) is the richest in calcium content, about 10 times more than rice or wheat. Unlike, rice and wheat, they require low inputs in terms of soil fertility and water. The millets grow well in dry regions as rain-fed crops. More millets consumption will be encouraging farmers in dry land areas to grow crops which are best suited for those regions. It will boost sustainable cropping and adding diversity in our diets.

About the area

Melghat is the tribal area of Amravati district in Maharashtra state which is the largest producer of many kinds of millets where this PPU is established. The small millets cultivated were; Finger millet (*ragi*), Proso millet, Barnyard millet, Italian millet, Kodo millet, Little millet apart from the sorghum.

Millets grown in the district

- Sorghum (*Sorghum bicolor* (L.))
- Finger millet (*Eleusine coracana* (L.))
- Foxtail millet Italian millet (*Setaria italica* (L.))
- Proso millet (Common and white millet) (*Panicum miliaceum* (L.))
- Kodo millet (*Paspalum scrobiculatum* (L.))
- Barnyard millet (*Echinochloa frumentacea)*

Area and population of the PPU location

Meghlat is a core forest tract spread over two blocks (*tahsils*) of Amravati district namely, Chikhaldara and Dharni. It covers a geographical area of about 4,426 km^2. Of this, 3,630 km^2 is in Chikhaldara. This *tahsil* retains its dense forest cover because it has comparatively low population (about 76,000 people) in 197 villages. In total, 796 km^2 of Dharni block (*tehsil)* has thin forest due to the pressure of 1.13 lakh people living in 153 villages. It was earlier estimated that the deaths of tribal (*adivasi*)

children mostly occurred in Dharni due to mannutrient and health related issues and not in the Melghat tiger reserve santury. The problem has now spread, with deaths in 39 villages of the multiple use area (MUA) of the tiger reserve. The reserve covers 1,676 km^2 of forests. It includes the Gugamal National Park (361.28 km^2), which has no village within its boundaries. The Melghat Wildlife Sanctuary (788.75 km^2) with 19 villages and a MUA (526.90 km^2) with the 39 villages.

The reserve has a human population of 25,000 and only 8,000 people lives in 19 villages of the sanctuary and 17,000 tribals live in the 39 villages of the MUA. One of the reasons for the rising child deaths among the (scheduled tribe) *Korkus* of Melghat was that they are denied access to traditional foods like wild flowers, tubers, fruits, crabs and fish from the rich forest.

Post-harvesting operation in millets

- Pre-drying manually
- Drying on open floor
- Manual threshing
- Manual winnowing
- Storage of grains with traditional way
- Manual processing and milling

Need of the processing facilities

Millets are affordable source of nutrition in lack of resources and poor socio-economic status of the tribal area tribal. The availability of millets and skill of the processing of millets is kind of boon for the local community for their livelihood and to address the problem of child malnutrition.

Keeping the above problems in view, the ICAR-Indian Institute of Millets Research, Hyderabad had supported financially and technically to develop primary processing facilities at farm gate (village level) under Tribal sub-plan (TSP) and Scheduled Caste sub-paln (SCSP) programme.

Funds used: Rs. 20,00,000/- were allocated from Tribal sub-plan (TSP) programme of the IIMR.

Machineries available in the unit

- Destoner-cum-grader
- Aspirator
- Millet De-husker
- Grader
- Pulverizer
- Vermicelli machine
- Popping machine
- Flour blender
- Roti making machine
- Packing machine

Utility: Around 500 - 700 farmer are taking advantages of the facilities annually (Annexure-I).

Location of the PPU

Agriculture technology school

Village : Dharni (Melghat)

District : Amravathi

State : Maharashtra

Popping machine

Aspirator cum destoner cum grader

Roti making machine

Pulverizer

PPU completion certificate from the local authority

SORGHUM RESEARCH UNIT
Dr. PANJABRAO DESHMUKH KRISHI VIDYAPEETH,
AKOLA (M.S.) 444 104

Dr. R.B. Ghorade
Senior Research Scientist

Email Id: - akola@millets.res.in;
srssorghum@pdkv.ac.in
Phone no.: - 0724-2256035

No.SOR/ESST/ 366 /2021 Dated: - 3 / 12 /2021

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2016-17 to 2020-21 jointly by AICRP, Sorghum Research Unit, Dr. PDKV, Akola and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

SN	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	Agriculture Technology School, Dharni (Melghat), Dist. Amravati , Maharashtra State	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official
State Government Department

धिरज प्रकाश मोहेकर
कृषि अधिकारी
ता.फ.वा./ता.बी.के./कृ.वि.
कुसुमकोट(खु.)ता.धारणी
जि.अमरावती

Signature with name
O/ic, AICRP, Sorghum Res.
Unit, Dr. PDKV, Akola

3. Primary Processing Unit established by AICRP-S, Rahuri, Maharastra State

Address of centre:

Dr. A. S. Jadhav

Former Senior Sorghum Breeder and Officer-incharge

Sorghum Improvement Project

Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra State

Importance of millets in the area

In view of installation of Primary Processing unit, survey was conducted by the AICRP-S in Nandurbar district and studied *kharif* and *rabi* season cropping pattern in different blocks (tahsils) of the district. It was observed that majority area was under crops like sorghum, pearl millet, rice, maize, pigeonpea, soybean, green gram, urdbean in *kharif* season and *rabi* sorghum, wheat and maize, sorghum and pearl millet in *rabi* season as depicted in below Table.

S. No	Crop	Area in ('000ha)	Productivity (kg/ha)
1	*Kharif* Sorghum	46.1	1101
2	Paddy	26.7	861
3	Pearl millet	21.3	658
4	Maize	20.7	1481
5	Rabi Sorghum	22.4	882
6	Wheat	6.4	1566
7	Chick pea	7.6	681

About tribal population (*Khandbara* village of Nandurbar District) in the area

Number of households	1,282
Population	6,511
Male Population	3,289 (50.51%)
Female Population	3,222 (49.49%)
Children Population	788
Scheduled Tribes (ST) %	37.84%
Scheduled Caste (SC) %	7.76%

Millets cultivated in region

- In *kharif* season, sorghum, pearl millet, paddy, maize, pigeonpea, soybean, green gram, urdbean were grown.
- In *rabi* season, sorghum, pearl millet, horse gram, wheat and maize were cultivated.

Post Harvesting Operations in the area

S. No	Machines	Capacity
1	Rice mill	25 kg, 500 kg and 1500 kg per hour
2	Dal Mill	1000 kg per hour
3	Oil Mill	20 liters per hour

Problems in Current Post harvesting operation

- Lack of adequate electric supply unit machinery
- Solar-base electricity supply which was costly
- Lack of millets-specific processing machineries and operational skills.
- Getting low price for millets produce

Need of Processing Facility

- Due to unavailability of primary processing facilities for millets, the farmers faced lots of drudgeries in post-harvest operations and thereby, gets motivated.
- Farmers could not produce quality millets produce and therefore, they could not get fair price in market. It leads to reduce area under millets cultivation.

Keeping the above problems in view, the ICAR-Indian Institute of Millets Research, Hyderabad had supported financially and technically to develop primary processing facilities at farm gate (village level) under Tribal sub-plan (TSP) and Scheduled Caste sub-paln (SCSP) programme.

Initial budget of unit: Rs. 6,00,000/- were allocated from Tribal sub-plan (TSP) programme 2018-19.

Equipments: Specific Gravity Separator, Vertical Bucket Elevator, Seed Cleaner Cum Grader are in process. This unit is operationalized since 2019.

Location of the PPU:

Village	:	Khandbara
Block	:	Navapur
District	:	Nandurbar
State	:	Maharashtra

Utility: Around 500-700 farmers are taking advantages of the facilities annually.

Name of implementing group: The PPU was operatinalised by Nesu Nadi Parisar Farmer Producer Company on the basis of custom hiring mode with minimal charges.

View of primary processing machinaries

PPU completion certificate from local authority

Sorghum Improvement Project
Mahatma Phule Krishi
Vidyapeeth, Rahuri 413722

अन्नं वहु कुर्वीत तद् व्रतम्

Phone No.02426-233080 email : rahuri@millets.res.in

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2016-17 to 2020-21 jointly by AICRP, Sorghum, Rahuri and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	Nesu Nadi Parisar Farmers Producer Company, Khandbara Taluka Navapur Dist : Nandurbar 425 416	Seed Cleaner cum Grader, Seed Processing Plant with Comprise of VB Elevator and Specific Gravity Separator Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official
State Government Department

Taluka Agri. Office
Navapur Dist Nandurbar

Signature with name
O/ic, AICRP-Sorghum,
MPKV, Rahuri, M.S.

4. Primary processing unit established by AICRP-SM, Kolhapur, Maharashtra State

Address of centre:

Dr. Ban, Officer-incharge

AICRP on Small Millets, Zonal Agricultural Research Station (MPKV)

Sub-montane Zone, NARP, Shenda Park, Kolhapur – 416 012 (MS)

Importance of millets in the area

In Maharashtra, small millets are grown mostly along the hilly side on sloppy lands that includes Western hills (*ghat*) which includes, Konkan, Nasik, Pune and Kolhapur divisions of Maharashtra. Small millets are predominantly grown in *kharif* season under rainfed conditions. They have the capability to withstand under the adverse soil and climatic conditions. These millets are the predominant food and nutritional source of tribal people. Finger millet *(nachani/nagli/ragi*) is the most important millet grown in these areas of Maharashtra which alone account for about 50 per cent area, more than 2/3rd production of total small millets.

The area, production and productivity of Finger millet (Table 9) indicated that, the area under finger millet was the highest during 2000-01. And the production (1, 82,000 mt) and productivity (1205 kg/ha) was highest during 2001-02. However, the area and production of finger millet during the period of 1999 to 2010 showed declining trend. During 2018-19, in Maharashtra indicated (Table 10) that area under finger millet was 80,100 ha with average productivity of 1058 kg/ha and total production of 84800 tonnes.

Table 9. Year-wise area, production and productivity of finger millet in Maharashtra State

Sl. No.	Year	Area (00 ha)	Production (00 ton)	Productivity (kg/ha)
1	1999-2000	1736	1680	1075
2	2000-2001	1800	1290	830
3	2001-2002	1399	1820	1205
4	2002-2003	1459	1242	851
5	2003-2004	1469	1700	1157
6	2004-2005	1446	1472	1018
7	2005-2006	1358	1323	974
8	2006-2007	1360	1230	904
9	2007-2008	1297	1157	923
10	2008-2009	1255	1250	996
11	2009-2010	1157	1123	970
12	2010-2011	1200	1174	978
13	2011-2012	1359	1397	1028
14	2012-2013	1245	1389	1116
15	2013-2014	1245	1424	1144
16	2014-2015	966	1008	1043
17	2015-2016	927	1111	1198
18	2016-2017	969	1127	1163
19	2017-2018	964	1141	1183
20	2018-2019	801	848	1058

Table 10. District-wise area, production and productivity of finger millet 2018-19

Sl. No.	Name of district	Finger millet		
		Area (00 ha)	Production (00 ton)	Productivity (kg/ha)
	Konkan Division			
1.	Thane	11.5	9.5	832.5
2.	Palghar	121.7	64.6	530.5
3.	Raigad	56.3	55.9	991.9
4.	Ratnagiri	99.0	150.1	1515.3
5.	Sindhudurg	13.8	22.9	1652.6
	Sub-total	**302.4**	**303.0**	**1001.8**
	Nasik Division			
6.	Nasik	202.7	158.9	783.8
7.	Dhule	18.6	9.8	529.1
8.	Nandurbar	0	0	0
9.	Jalgaon	0	0	0
	Sub-total	**221.3**	**168.7**	**762.4**
	Pune Division			
10.	Ahmednagar	0	0	0
11.	Pune	27.1	22.5	830.3
12.	Solapur	0	0	0
	Sub-total	**27.1**	**22.5**	**830.3**
	Kolhapur Division			
13.	Satara	53.6	51.5	961.5
14.	Sangli	1.3	2.3	1831.8
15.	Kolhapur	195.6	300.4	1535.9
	Sub-total	**250.5**	**354.3**	**1414.5**
	Maharashtra Total	**801.3**	**848.5**	**1058.9**

Source: Department of Agriculture, Govt. Of Maharashtra

Background of the location

The Akole block (*tahsil*) of Ahmednagar district was selected to establish primary processing unit (PPU) considering tribal area and density of finger millet growing area in view. The village Waki was selected which was adjacent to the tribal block namely, Igatpuri and Shahapur. The PPU was operationalized by the Chairman, Akole Mahila Farmer Producer Company Ltd., Waki village, *Tal*-Akole, Dist-Ahmednagar. Millets cultivated in the district were: Finger millet, Little millet and Foxtail millet.

Problems in post-harvesting operation of millets

- Harvesting and threshing of small millets was done manually with traditional methods which was tedious and demotivating the millets growers.
- The raw millets produce was sold in market at low price by the farmers.
- Shortage of laboures in time.

Need of processing facility

Since, the mechanical threshing facility was not available, the area under millets were reduced and consumption, as well. The establishment of PPU with threshing, grading, cleaning and dehulling facilities for small millets were much essential. It will enable to get good price to millets in market. Further demonstration of improved varieties and package of practices will also ensure increase in quality and productivity of millets. It will encourage the tribal farmers to grow more millets for better income and their nutritional status.

Keeping the above problems in view, the ICAR-Indian Institute of Millets Research, Hyderabad had supported financially and technically to develop primary processing facilities at farm gate (village level) under Tribal sub-plan (TSP) and Scheduled Caste sub-paln (SCSP) programme.

Funds used: Rs. 6,00,000/- were allocated from Tribal sub-plan (TSP) of the IIMR.
The PPU had been established in coordination with BAIF Institute for Sustainable Livlihoods and Development (BISLD), BAIF, Nasik. The institute conducted many agricultural related activities on improved technologies in Akole *tahsil*. The necessary machineries were installed for post-harvest operations as mentioned in below.

Processing machineries available in the unit

1. Small implements (*Vaibhav* sickle, *Laxmi* Sickle, Cycle hoe, *Khurpi*)
2. Millet pulveriser
3. Destoner cum Grader cum aspirator
4. Grain Polisher
5. Millet Thresher
6. Millet Dehuller

Location of the PPU

Village	:	Waki
Block (Tahsil)	:	Akola
District	:	Ahmednagar
State	:	Maharahstra - 422 604

Implementing group

Akole Mahila Farmer Producer Company Ltd., Waki, Tal-Akole, Dist-Ahmednagar (Contact: Mr. Jitin Sathe- 09423020136 of BAIF, Mitra Institute, Nasik) had been operationalized the unit facilities on custom hiring basis.

Utility: Around 500-700 farmers are taking advantages of the facilities annually.

Location of PPU at Waki

Destoner cum Grader cum aspirator

Visit of ZARS experts to millet processing unit

Grain polisher

Dehuller in the unit

PPU completion certificate from local authority

Government of Maharashtra
Mahatma Phule Krishi Vidyapeeth, Rahuri
ZONAL AGRICULTURAL RESEARCH STATION, KOLHAPUR

Phone: 0231/ 2692416, Fax: 0231- 2693017
E mail: adrkolhapur@rediffmail.com
Address: Zonal Agricultultural Research Station, Shenda Park, Kolhapur- 416 012

No.ADR/ZARS/Millet/PPU-Cert/ 1341 /2021 Date: / /2021
29 DEC 2021

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established under 'Socio-economic up-liftment of tribal farmers using primary processing technology of millets under component of Tribal Sub Plan (TSP)' during 2018-19 to 2020-21 jointly by AICRP on Small Millets, Zonal Agricultural Research Station, (MPKV, Rahuri), Shenda Park, Kolhapur and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

Sr. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	Village Waki, Taluka-Akole, District-Ahmednagar, Pin- 422 604, State- Maharashtra **Coordinators:** 1) Akole Mahila Farmer Producer Company Ltd., Akole 2) BAIF Institute of Sustainable Livelihoods and Development, Nashik	Purchased primary processing machineries Pulveriser, Destoner cum Grader cum Aspirator, Grain Polisher, Millet Thresher for small millets processing. Completed and providing millets processing services to the farmers on custom hiring basis.

हिराबाई लहु शेळके
Akole Mahila Farmers Producer Co.Ltd.
A/P. Khirvire, Tal. Akole, Dist.A'Nagar
Maharashtra - India - 422 601.
Chairman,
Akole Mahila Famers Producer Company, Tal-Akole, Dist-Ahmednagar

Mr J.G. Satkar
Regional Officer,
Nashik Region,
BAIF Institute of Sustainable Livelihoods and Development

Signature with name & Designation Official
गट विकास अधिकारी (उ.श्रे.)
पंचायत समिती, अकोले, जि.अ.नगर

(Y.G.Ban)
Junior Breeder
AICRP on Small Millets,
ZARS, Shenda Park, Kolhapur

(U.B.Hole)
Associate Director of Research
Zonal Agricultural Research Station,
Shenda Park, Kolhapur (MS)

TELANGANA STATE

5. Primary processing unit established under Farmer FIRST Project on millets (FFP) in Telangana State

Address of centre:

Mr. Veershetty Biradar

Local coordinator of FFP on millets

CEO, Swayam Shakti Foundation,

Ganagpur, Sangareddy, Telangana-502257

Importance of millets in the area

Central Telangana zone is having low average rainfall of 800-1150 mm where crops namely, paddy, maize, cotton, chillies, soybean, pigeonpea, sorghum, pearl millet, finger millet and groundnut were grown in both sole and in intercropping system. The Sangareddy district is known for its dryland agriculture comprising of 44% of black soils. Recently, because of low market prices coupled with poor yields and changing consumer behaviours, farmers were avoiding millet and sorghum cultivation instead of inclined towards commercial crops like sugarcane, soybean, cotton, etc. However, production of sorghum and pearl millet has increased from 1970s due to development and wide adoption of high yielding varieties. Over the years, disease-resistant and high productive varieties increased yields and positively impacted 6.00 milion millet producing households and 3.00 million sorghum producing households.

Description about population in area

In Telangana, majority of farm holdings comprised of marginal and small farmers (86%). In Sangareddy, these marginal and small farmers come from highly backward classes, Scheduled Caste and Scheduled Tribe communities. They have poor socio-economic conditions with very low literacy rate and dependent on resource - poor crops for food and nutrition.

Post harvesting operations in the area

- Threshing, winnowing, drying manually
- Traditional method of cleaning and de-husking

Problems in current post-harvesting operation

- Substantial post-harvest losses due to handling traditionally
- Unavailability of processing machineries unavailability
- Low quality of raw millets produce
- Lack of awareness of post-harvest processing technologies
- Inadequate transport facilities and electric supply

Need of farm gate processing facility

- Essential for producing quality of raw materials
- Secondary processing was also essential for value addition and enhance benefits
- Reducing drudgeries of the farmers especially of farm women in post-harvest operations

Keeping the above problems in view, the ICAR-Indian Institute of Millets Research, Hyderabad had supported financially and technically to develop primary processing facilities at farm gate (village level) under enterprise module of the Farmer FIRST Project on millets.

Funds used: It was established with the help of Bhavani Foods Pvt Ltd. with machineries provided from Farmer FIRST project of ICAR-IIMR, Hyderabad.

Location of the PPU

Village	:	Gangapur
Block	:	Raikode
District	:	Sangareddy
State	:	Telangana - 502 257

Processing machineries installed

1. Destoner
2. Aspirator
3. Grader
4. De-huller
5. Pulveriser

Operational limitations of PPU

- Season-bound processing of small millets followed by uneven processing
- Marginal land holding famers are processing meager quantities of millets produce

Utility: Around 500-700 farmers are taking advantages of the facilities annually.

Beneficiaries feedback

Latest knowledge and trainings on primary as well as about secondary processing and marketing opportunities are essential.

View of pulveriser

View of aspirator and shifter

View of Grader

View of small millet Dehuller

Farmer performing de-hulling of millets

PPU certificate issued by local authority

BHAVANI FOODS

Plot no: 24, Hig, Huda colony, Chandanagar,Hyd-50
Reg No : TS09B0035241

Date:

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring center was established in January, 2018 in collaboration with Bhavani Foods (Reg. No. TS09B0035241) and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Farmer FIRST Project (FFP) on Millets which has been handled by *Dr. Rajendra R. Chapke*, Principal Scientist and Principal Investigator (PI), FFP, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Millets primary processing unit (PPU) as custom hiring centre	Gangapur village, Jerasangham block, Sangareddy district, Telangana State, India	Completed and providing millets processing and implements services to the farmers on custom hiring basis

Signature with name & designation
Official
State Government Department

(B. Veer Shetty)
Proprietor, Bhavani Foods,
Hyderabad

6. Primary processing unit established by AICRP-Sorghum Palem, Telangana State

Address of centre:

Dr. S. Maheshwaramma

Scientist (Plant Breeding) & Officer-incharge

PJTAU, AICRP-Sorghum, RARS, Palem, Telangana State

Importance of millets in Telangana

Millets are ancient super grains and the reservoirs of nutrition for a better health. Millets are the important food and fodder crops in semi-arid regions, and are predominantly gaining more importance in this area. These crops are adapted to wide range of temperatures and grow well in dry lands as rain-fed crops, under marginal conditions of soil fertility and moisture. Besides, they are also source of important raw material for potable alcohol and starch production in industrialized countries. Millets (Sorghum, Pearl millet, Finger millet, Foxtail millet, Little millet, Proso millet, Barnyard millet and Kodo millet) are hardy and stable yielders in harsh climate conditions.

Millets have high protein content makes up for energy deficiency in vegetarian diet. Millets are the super foods for the present and future. Their short growing life span from planted seeds to mature, ready to harvest, make them farmers' friendly. Sorghum crop is grown in both in *Kharif* and *Rabi* seasons mostly under rain-fed conditions. The crop is predominantly grown in the districts of Mahabubnagar, Adilabad, Medak, Rangareddy and Nizamabad of Telangana state. Particularly Mahabubnagar district, millets are cultivated on 46,615 ha with productivity of 912 kg/ha during *Kharif* 2019. While in 2016-17, the area under millets cultivation was 25,236 ha which decreased to 14,747 ha in 2021-22 (Table 11) due to lack of processing and assured market facilities.

About tribal population in the area

In Telangana, total tribal population is 36,44,453. In Mahabubnagar district, it is 1,56,325. The traditional habitat of *Chenchus* tribe is found in contiguous forest tracts of Nallamalai hills in the districts of Mahaboobnagar, Nalgonda and Vikarabad areas of Ranga Reddy district. Some of the other tribals were *Banjara, Lambadi, Gondu, Keslavath, Modavath, Udathanoor* and *Katraj*. The tribal farmers from Mahabubnagar region cultivate millets namely, yellow sorghum (*jowar*), pearl millet (*bajra*), finger millet (*ragi*), foxtail millet (*korra*) and browntop millet (*andu korra*) in low rainfall areas. They are an aboriginal tribe whose traditional way of life has been based-on agriculture, farm labours, hunting and forest collections. The *Chenchus* are specialized in collecting some forest products besides farming and to sale in semi urban and urban areas for their livelihood.

Millets cultivated in the district

1. Sorghum (*Jowar*)
2. Pearl millet (*Bajra*)
3. Finger millet (*Ragi*)
4. Foxtail millet (*Korra*)
5. Brown top millet (*Andu korra*)
6. Little millet (*Saamalu*)

These millets are mostly cultivated in the blocks namely, Mahabubnagar, Kosgi, Hanwada, Timmajipet, Amrabad, Kodangal, Vikarabad and Bomraspet of Mahabubnagar district.

Table 11. Year-wise production of millets in Mahabubnagar, Telangana

S.No.	Year	Production (kg/ha)		
		Pearl millet	Finger millet	Foxtail millet
1.	2016-17	1204	1084	789
2.	2017-18	1223	1092	823
3.	2018-19	1303	1123	865
4.	2019-20	1324	1145	876
5.	2020-21	1294	1100	924
6.	2021-22	1298	1110	956

Post-harvest operations were done manually and traditionally

1. Threshing
2. Drying
3. Cleaning and dehulling
4. Grading
5. Packing
6. Storing

Problems in current post-harvest operation

1. Laborious drying method of panicles
2. Fungus infection to millets during *kharif* season
3. Shattering of small millets due to hard drying in sunlight
4. Lack of machineries for removal of grain husk and primary processing

Need of processing facility

It is a vital process to obtain grain for further processing of cooking and consumption. Small millets other than finger millet are well protected in glume encasements. Hence, the conversion of the grain to rice and other consumable forms are time consuming and laborious.

Keeping the above problems in view, the ICAR-Indian Institute of Millets Research, Hyderabad had supported financially and technically to develop primary processing facilities at farm gate (village level) under Tribal sub-plan (TSP) and Scheduled Caste sub-paln (SCSP) programme.

Funds used: Rs.6,00,000 were allocated from tribal sub-plan (TSP) programme of the IIMR.

Location of the PPU

Village : Meghanath chouhan tanda
Block : Jadcherla
District : Mahabubnagar
State : Telangana State

Processing machineries installed

The following equipments were made available in the PPU

S. No	Name of the equipment
1	Pre-cleaner, grader cum grain cleaner
2	De-stoner cum aspirator
3	De huller machine
4	Multipurpose pulveriser
5	Multipurpose grinding machine
6	Vibro flour sifter
7	*Bajra, Ragi, Jowar,* Multi purpose thresher

Implementing group at village : Small tribal farmers of Meghanath Chouhan Tanda is operating the unit.

Utility : Around 500-700 farmers are taking advantages of the facilities annually.

Beneficiaries feedback : Processing of more produce in less time while obtaining clean and quality seed.

Dehuller for millets

Grader installed in PPU

Destoner in PPU

Grinder in PPU

PPU completion certificate from local authority

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2018-19 to 2022-23 jointly by AICRP- SM, Palem and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	Macharam (V), Amrabad (M), Nagarkurnool (D),Telangana state 509201	Completed and providing millets processing services to the farmers on custom hiring basis

Visited & observed PPU unit functioning at Macharam on 24/05/2024 (AEO, Amrabad)

24/05/2024

Signature with name & designation
Official
State Government Department

Mandal Agriculture Officer
AMRABAD (MD)
Nagarkurnool (Dist) 509201

Signature with name
Offic, AICRP-SM, RARS, Palem
PJTSAU, Nagarkurnool
Telangana

(C.S. Maheshwaramma)
Scientist
RARS, Palem
Nagarkurnool

SCIENTIST (Pl.Br.)
RARS, PALEM
Dist. Nagarkurnool.

TAMIL NADU STATE

7. Primary processing unit established by AICRP-SM, Athiyandal, Tamil Nadu

Address of centre:

Dr. M. Vaithiyalingan

Professor and Head, Centre of Excellence in Millets

Athiyandal, TNAU, Tiruvannamalai District

Tamil Nadu – 606 603

Importance of millets in the area

Mainly, little millet was grown in Tiruvannamalai, Dharmapuri, Vellore, Salem, Krishnagiri, Villupuram and Namakkal districts of Tamil Nadu. It occupies an area of 0.15 lakh ha with an annual production of 0.16 lakh tonnes and productivity of 1059 kg/ha (2016 – 17). It is highly tolerant to heat and drought. It was preferred for extreme soil and climatic conditions of tribal farming. This apart, other millet crops namely, finger millet, foxtail millet and proso millet were also grown on large scale (Table 12).

Table 12: Millets cultivated in Tiruvannamalai district

S.No.	Crops	Area (ha)	Productivity (kg/ha)	Production (Tonne)
1.	Finger millet	1129	2435	2749
2.	Little millet	5520	1260	6956
3.	Foxtail millet	43	320	13
4.	Kodo millet	10	844	8
5.	Barnyard millet	30	-	-
6.	Proso millet	50	-	-

(Ref: Season and Crop Report of Tamil Nadu 2016-17)

Description about tribal population in the area

According to 2011 census, Tiruvannamalai District had a population of 2,464,875, out of which, scheduled tribes (ST) accounted for 3.69% (1,88,897 numbers). The average literacy of ST was 42.12% and had poor socio-economic conditions and dependent on dryland crops for their food.

Post harvesting operations in the area

- Threshing, winnowing, drying manually
- Traditional method of cleaning and de-husking

Problems in current post-harvesting operation

- Substantial post-harvest losses due to handling traditionally and transportations
- Cost of processing the small millets
- Unavailability of processing machineries at village level
- Low quality of raw millets produce
- Inadequate storage facility

- Distant location to avail of processing facility which was not economical
- Lack of awareness of post-harvest processing technologies
- Inadequate transport facilities and electric supply

Need of farm gate processing facility

- Essential for producing quality of raw materials
- Secondary processing was also essential for value addition and enhance benefits
- Reducing drudgeries of the farmers especially of farm women in post-harvest operations

Keeping the above problems in view, the ICAR-Indian Institute of Millets Research, Hyderabad had supported financially and technically to develop primary processing facilities at farm gate (village level) under Tribal sub-plan (TSP) and Scheduled Caste sub-paln (SCSP) programme.

Funds used: Rs.8,00,000/- were allocated from the IIMR tribal sub-plan (TSP) programme, 2019.

- Created infra structure like, shednet for processing unit.
- Electricity with three phase connection and storage facilities were arranged.
- This primary unit (PPU) was operationalized since 14.11.2019 on the basis of custom hiring basis

Location of the PPU

Village	:	Palamarathur (Chinnakuttai)
Block	:	Jawadhuhills
District	:	Tiruvannamalai
State	:	Tamil Nadu - 635 703

Processing machineries installed

1. Destoner,
2. Grader cum aspirator and
3. Dehuller (Single chamber centrifugal)

Name of implementing group at village

Siruthanya Makathuva Kulu, a local organization of farmers

Operational limitations of PPU

- Season-bound processing of small millets followed by uneven processing
- Marginal farmers are processing meager quantities of millets produce
- Irregular electricity supply (three phase)

Utility: Around 500-700 farmers are taking advantages of the facilities annually.

Beneficiaries feedback

Latest knowledge and trainings on primary as well as about secondary processing and marketing opportunities are essential.

View of the unit with processing activities

Machineries operation in the PPU in presence of monitoring team of scientists

Demonstration of the facilities to the tribal farmers

Interaction of AICRP-SM scientists with tribal farmers

Processing of Little millet observed by the monitoring team of scientists

PPU completion certificate from local authority

PPU COMPLETION CERTIFICATE

It is to state that the following Primary Processing Unit (PPU) as custom hiring centre was established during 2016-17 to 2020-21 jointly by AICRP on Small Millets, Centre for Excellence in Millets, Athiyandal and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	Yelagiri Tribal Farmers Association, Nilavoor Village, Yelagiri Hills, Thirupattur District, Pin 635 853, Tamil Nadu	Completed and providing millets processing services to the farmers on custom hiring basis

(A. Navaneetha Krishnan, AO)
Signature with name & designation
Official/ State Government
Department

Professor and Head
Centre of Excellence in Millets,
Athiyandal

Professor and Head
Centre of Excellence in Millets
Athiyandal, Tiruvannamalai Dist-606601

Asst. Agriculture Officer
Jolarpet, (TPT.Dist.)

8. Primary processing unit established by MSSRF, Kolli Hills, TN

Address of centre:

Dr. Oliver King

Principal Scientist (Economic Botany),

M. S. Swaminathan Research Foundation (MSSRF)

Kolli hills, Namakkal district, Tamil Nadu

Millets related detailed in the area

- Millet cultivation was taken up annually by 500 to 700 tribal farmers across Kolli Hills covering approximately 250 ha in Kolli Hills.
- After heavy work in the field, women used to do hand pounding in the evening to process the millet and cooking as well simultaneously in addition with child care.
- The villagers were going to Namakkal city to process the millet as per their requirement at weekly or a fortnight on payment basis with travel expenses and time.
- There was an urgent need to take up better millet marketing initiative

M.S. Swaminathan Research Foundation (MSSRF) had initiated millet promotion with improved on-farm and post-harvest technologies in Kolli Hills of Tamil Nadu with financial and technical support from ICAR-Indian Institute of Millet Research, Hyderabad under tribal-sub plan (TSP) and NASF-funded extension project on millets. Since 2016, every year about 250 to 350 tribal farmers were supported for millet cultivation by quality seeds, demonstrating on stration of inputs, farm implements, improved agronomic technologies and providing various training and capacity building programmes on production and processing of millets.

As part of these activities, an initiative was taken to establish integrated millet processing in main hubs of each locations. This integrated centre had one set of de-stoner, grader, de-husker and pulveriser to reduce drudgeries involved in processing of millet, preparation of Millet value-added products and marketing which was already initiated in the name of Kolli Hills Natural Foods.

In the Kolli Hills, four millet processing units were purposely established in Kuchakiraipatti village of Valavanthi Nadu panchayat which was very nearest to main city of Kolli Hills. This processing unit housed in concrete infrastructure facilities which was established and managed by *Nanbargal Self Hep Group* under umbrella of *Kolli Hills Agro biodiversity conserver's Federation (KHABCOFED)*. In and around the location, about 2000 tribal households from 5 to 8 villages had accessed to processing facilities. It was needed to enlarge the volume of millet processing, value-addition and linking with mainstream markets within and outside the state.

Millet Processing: Capacity of the each processing units is 100 kgs per hour. It was decided to increase the production of millet value added products from 750 kgs to 1500 kgs per month of this unit.

Utility: Around 500-700 farmers are taking advantages of the facilities annually.

Location of the PPU

Expert monitoring the unit

View of the primary processing unit of millets

Farmers availing processing services

Value-added products of millets

Machines of the PPU

Group of the beneficiary farmers

Group of women participants with their food products

Food recipie mela

Preparation and marketing of the products


View of primary proceesing machineries


Threshing using mechanical thresher

a. Location of Primary processing units established in Kolli Hills

1. Location of the PPU

Village : Alleripatti,
Block : Alathurnadu,
Dist : Nammakal,
State : Tamil Nadu-637411

PPU completion certificate from local authority

M.S.SWAMINATHAN RESEARCH FOUNDATION

Dr.E.D.ISRAEL OLIVER KING
Principal Scientist

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2019 – 2020 to 2021 - 2022 jointly by MSSRF and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under NASF programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	Aleripatti, Alathurnadu, Kolli hills, Namakkal, TamilNadu - 637411.	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official
State Government Department

Signature with name
O/cMSSRF

Dr.E.D.Israel Oliver King
Principal Scientist,
M.S. Swaminathan Research Foundation
42 B2, President Venkat Rao Street,
Gandhi Nagar, Mohanur Road,
Namakkal - 637 001.
Ph: 04286-224499, 9443364287.

42 B2, PVR Street, Gandhi Nagar, Mohanur Road, Namakkal - 637 001 INDIA
Mobile : 9443364287, Phone +91-4286-224499.
E-Mail : oliverking@mssrf.res.in, ediok151173@gmail.com,
web : www.mssrf.org

2. Location of the PPU

Village : Ettatiparai
Block : Gundaninadu
Dist : Nammakal
State : Tamil Nadu-637411

PPU completion certificate from local authority

M.S.SWAMINATHAN RESEARCH FOUNDATION

Dr.E.D.ISRAEL OLIVER KING
Principal Scientist

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2019 – 2020 to 2021 - 2022 jointly by MSSRF and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under NASFprogramme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	Ettatiparai, Gundaninadu Kolli hills, Namakkal, TamilNadu- 637411.	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official
State Government Department

Signature with name
OficMSSRF
Dr.E.D.Israel Oliver King
Principal Scientist,
M.S. Swaminathan Research Foundation
42 B2, President Venkat Rao Street,
Gandhi Nagar, Mohanur Road,
Namakkal - 637 001.
Ph: 04286-224499, 9443364287,

42 B2, PVR Street, Gandhi Nagar, Mohanur Road, Namakkal - 637 001 INDIA
Mobile : 9443364287, Phone +91-4286-224499.
E-Mail : oliverking@mssrf.res.in, ediok151173@gmail.com,
web : www.mssrf.org

3. Location of the PPU

Village : Kochakiraipatty
Block : Valavanthinadu
Dist : Nammakal
State : Tamil Nadu-637411

PPU completion certificate from local authority

M.S.SWAMINATHAN RESEARCH FOUNDATION

Dr.E.D.ISRAEL OLIVER KING
Principal Scientist

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2016-17 to 2020-21 jointly by MSSRF and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	Kochakiraipatty, Valavanthinadu, Kolli hills, Namakkal, TamilNadu - 637411	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official
State Government Department

Signature with name
O/IC MSSRF
Dr.E.D.Israel Oliver King
Principal Scientist,
M.S. Swaminathan Research Foundation
42 B2, Provident Venkat Rao Street,
Gandhi Nagar, Mohanur Road,
Namakkal - 637 001.
Ph: 04286-224499, 9443364287.

42 B2, PVR Street, Gandhi Nagar, Mohanur Road, Namakkal - 637 001 INDIA
Mobile : 9443364287, Phone +91-4286-224499.
E-Mail : oliverking@mssrf.res.in, ediok151173@gmail.com,
web : www.mssrf.org

4. Location of the PPU

Village : Sundakadu
Block : Bailnadu
Dist : Nammakal
State : Tamil Nadu-637411

PPU completion certificate from local authority

M.S.SWAMINATHAN RESEARCH FOUNDATION

Dr.E.D.ISRAEL OLIVER KING
Principal Scientist

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2016-17 to 2020-21 jointly by MSSRF and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	Sundakadu, Bailnadu, Kolli hills, Namakkal, TamilNadu – 637411.	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official
State Government Department

Signature with name
O/IC MSSRF

Dr.E.D.Israel Oliver King
Principal Scientist,
M.S. Swaminathan Research Foundation
42 B2, President Venkat Rao Street,
Gandhi Nagar, Mohanur Road,
Namakkal - 637 001.
Ph: 04286-224499, 9443364287.

42 B2, PVR Street, Gandhi Nagar, Mohanur Road, Namakkal - 637 001 INDIA
Mobile : 9443364287, Phone +91-4286-224499.
E-Mail : oliverking@mssrf.res.in, ediok151173@gmail.com,
web : www.mssrf.org

MADHYA PRADESH STATE

9. Primary processing unit established by AICRP-SM, Dindori, Madhya Pradesh

Address of centre:

Dr. O.P. Dubey
Former Principal Scientist (Agronomy), Officer-incharge
AICRP-SM, RARS, JNKVV, Dindori, Madhya Pradesh

Importance of millets in the area

Mainly, Kodo millet and Little millet were being cultivated in about 1.5 lakh ha in the Northern Hill Region comprising Dindori, Mandla, Umaria, Anooppur, Shahdol and Singrouli districts of Madhya Pradesh (MP). The small millets were grown in about 2.25 lakh ha in the MP and were the main staple food of tribals. Kodo and Little Millet are being cultivated on about 25000 ha in the Dindori district and in about 1.5 lakh ha in the Northern Hill Region of the MP.

Post-harvesting operations of millets in the area

(i) Harvesting by using local (*desi*) sickle
(ii) Threshing was being done with help of bullock's feet
(iii) Winnowing by natural air drift manually
(iv) Milling by using traditional implements *(Jata /Kunaita)*
(v) Dehulling by using traditional equipments

About tribal population in the area

About 62% occupancy is contributed by tribals in Dindori district of Madhya Pradesh (M.P.), while it is about 55% in the entire region. The different tribes includes, *Gond, Baiga, Pardhan, Kol, Bharia, Panika* among the scheduled tribes (STs).

Problems in post harvest operations of millets

(i) Harvesting with traditional method: It is labour and time consuming and not cost-effective.
(ii) Manual threshing: Yield loss due to ineffective threshing and the grains are going with straw.
(iii) Manual winnowing by natural air drift: It is labour and time consuming and not cost effective.
(iv) Traditional milling using *Jata /Kunaita:* Milling operations of grains is carried out by traditional equipments (*Jata /Kunaita*) which is very tedious and time consuming. It is resulted into producing poor quality of grain, which was not have good market price and less preferred by consumers.
(v) Traditional dehulling: It is very time taking and laborious operation done manually by women.

Need of processing facility

The tribal farmers were not getting desired market price to their millets produce because they were compelled to sell out unprocessed material just after manual threshing. They do not have access to

suitable equipments, knowledge and storage facility to keep their produce. The installation of an efficient PPU would enable them to fetch reasonable remuneration to their produce and certainly contribute to their economic up-liftment and nutritional status.

Keeping the above problems in view, the ICAR-Indian Institute of Millets Research, Hyderabad had supported financially and technically to develop primary processing facilities at farm gate (village level) under Tribal sub-plan (TSP) and Scheduled Caste sub-paln (SCSP) programme.

Funds used: Rs. 6.0 lakh were allocated from tribal sub-plan (TSP) programme of the IIMR.

Location of the PPU:

Village	:	Tantar / Shivri
Block	:	Bajag
District	:	Dindori
State	:	Madhya Pradesh-481880

Processing machineries installed

1. Millet pulverizer
2. Millet destoner
3. Millet Dehuller
4. Grader

Utility: Around 500-700 farmers are taking advantages of the facilities annually.

Inauguration of Millets Primary Processing Unit

Demonstration of processing of millets

Scientists are monitoring processing operation

Media coverage of the PPU

PPU completion certificate from local authority

JAWAHARLAL NEHRU KRISHI VISHWA VIDYALAYA
REGIONAL AGRICULTURAL RESEARCH STATIONDINDORI (M. P.)
क्षेत्रीय कृषि अनुसंधान केन्द्र, डिण्डौरी – 481880 (म.प्र.)
Phone (फोन) – 07644-234016 E-mail: - rarsdindori@rediffmail.com

No/RARS/Estt./2021-22/273 Date 16.12.2021

PPU COMPLETION CERTIFICATE

It is to state that the following primary processing unit (PPU) for Small millet(Kodo and Little millet) as custom hiring centre was established during 2020-21 jointly by AICRP on Small millet/ MSSRF and ICAR- Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under tribal Sub-Plan (TSP) programme led by Dr Rajendra R. Chapke, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	AICRP on Small millet, JNKVV, Regional Agricultural Research Station, Dindori	Regional Agricultural Research Station, District-Dindori, Ward No.-11, Near KVK, Block-Dindori, Pin code- 481880, State- Madhya Pradesh	Completed and providing millets processing services to the farmers on custom hiring basis. The village covered by custom hiring centre were Dewra, Mudki, Ghanaghat, Mohda, Kohka, Jogitikariya, Sunpuri, Shivri, Suniamar, Kanaisangwa.

Signature with name & designation
Official
State Government Department
उप संचालक कृषि
डिण्डौरी जिला डिण्डौरी (म. प्र.)

(Dr. D.N. Shrivas)
Signature with name
O/ic, AICRP on Small millet/MSSRF
Senior Scientist
RARS, Dindori

ANDHRA PRADESH STATE

10. Primary processing unit established by AICRP-SM, Vizianagaram, Andhra Pradesh

Address of centre:

Dr. Samuel Patro
Principal Scientist, Officer-incharge
Agricultural Research Station
ANGRAU, Vizianagaram-535001, Andhra Pradesh

Importance of millets

Small millets are treated as the staple food for millions living in the harshest and food insecure regions of the Andhra Pradesh (A.P.). The period between 1961 and 2009 was of dramatic decreased in cultivated area under millets (76%) and a steep fall in overall millet consumption. During recent years, millets have gained its importance as they bears a set of characteristics which make them uniqe among cereals. Small millet crops had gained attention owing to their inherent quality of early maturity, high yields due to C_4 plant type, capacity to yield even in poor soil under low rainfall and drought conditions. Hence, they are popularly known as 'climate resilient crops'. Besides, they are nutritionally rich having high fibre with protein, minerals and essential aminoacids and they are notably called as 'Nutricereals' since 2018.

Tribal population in the area

North Coastal Zone of Andhra Pradesh covering three districts *viz*., Srikakulam, Vizianagaram and Visakhapatnam having tribal population of 9,07,608 and mostly consisting of *Jatapu, Kondadora, Sawara* and *Gadaba* tribes.

Millets in Vizianagaram district:

Finger millet, Little millet, Foxtail millet, Barnyard millet, Brown top millet, Sorghum and Pearl millet were cultivated in the district.

Post-harvesting operations in millets

1. Manual threshing
2. Threshing with tractor
3. Manual dehulling

Problems in current post-harvesting operation of millets

1. Lack of mechanization in post harvest processing
2. Manual threshing, dehulling and cleaning process involve more drudgery
3. More time and labour requirement
4. Quality of the raw produce is poor and low price in market

Need of processing facility

Due to increased awareness about nutritional importance, millet consumption is gaining momentum in recent times. However, in order to meet the increased demand from the consumers, improved

production, post-harvest and processing facilities are much needed within the reach of the millet growing farmers.

Keeping the above problems in view, the ICAR-Indian Institute of Millets Research, Hyderabad had supported financially and technically to develop primary processing facilities at farm gate (village level) under Tribal sub-plan (TSP) and Scheduled Caste sub-paln (SCSP) programme.

Funds used: Rs. 6,00,000/- were allocated from Tribal sub-plan (TSP) programme and Rs. 8,00,000/- from SCSP. Two PPUs were established. One unit at Tummikapalli village of Vizianagaram district and other unit at Hiramandalam of Srikakulam district as highlighted below.

Location of the PPU

Village : Tummikapalli
Block : Kothavalasa
District : Vizianagaram
State : Andhra Pradesh-535 183

Location of the PPU

College of community science,
Lam farm,
District : Guntur
State : Andhra Pradesh (A.P.)

Primary processing machinery at PPU

Millets are being processed in PPU

View of grinder in the PPU

Implementing group at village: it was operationalized by the members of NGO 'Chinnaya Adivasa Vikasa Society, Hiramandalam on custom hiring basis.

Utility: Around 500-700 farmers are taking advantages of the each facilities annually.

Beneficiaries' feedback

Beneficiaries are very happy as the drudgery was reduced and saved lot of time in processing of small millets due to the PPU facilities. Farmers group at Tummikapalli village also started retail outlet for selling of processed grain and value added products to this effect and there by earning lot of revenue.

PPU completion certificate from local authority

Dr.T.Samuel SK Patro
Ph.D.(IARI), FPSI, FPFAI, FSAB, FSMPP, FABSc, FEAS
Principal Scientist (Plant Pathology) & Head
ICAR - AICRP on Smallmillets

ANGRAU

Agricultural Research Station
Vizianagaram - 535001
Andhra pradesh, India.

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2016-17 to 2020-21 jointly by AICRP(Small millets), Vizianagaramand ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R.Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	One unit at Agricultural Research Station, Gajularega village, Vizianagaram 535001, Andhra Pradesh	Completed and providing millets processing services to the farmers on custom hiring basis

T.S.S.K. Patro
O/ic, AICRP, Small millets
Principal Scientist & Head,
Agricultural Research Station,
Vizianagaram

Signature with name & designation
Official
State Government Department

Office of the Principal Scientist & Head, ARS
Dt. VIZIANAGARAM 535 001

e-mail : drsamuelpatro@gmail.com
ars.vzm@gmail.com
samuelpatro@yahoo.com

Office ☎ : 08922 - 225983
Fax : 08922 - 225983
Mobile : 91-9701023194

PPU certificate issued by local authority

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2021-22 jointly by AICRP on Small millets, Agricultural Research Station, Vizianagaram and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme and Scheduled Castes Sub Plan (SCSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	College of Community Science, Lam, Guntur - 522034, Andhra Pradesh	Completed and providing millets processing services to the farmers on custom hiring basis

Coordinator, MPU and Associate Dean
College of Community Science, ANGRAU
LAM, GUNTUR-522 034, A.P.

Principal Scientist & Head
Agricultural Research Station
Vizianagaram

ODISHA
STATE

11. Primary processing unit established by MSSRF, Koraput in Odisha State

Address of centre:

Dr. Prashanta Parida
Sr. Scientist & Development coordinator,
Biju Patnaik Tribal Agrobiodiversity Centre, MSSRF
Jeypore, Koraput, Odisha State

Millets related details in the area

- The annual production of millet is more than 1192 quintals of the Machhara village cluster.
- In Koraput, the farmer sells the millet with low price to the middle men and local shops due to lack of processing, awareness and to celebrate festivals. Thereby, the farmers were not getting the desired price of their millets produce.
- After heavy work in the field, women used to do hand pounding in the evening to process the millet for cooking in addition to the child care activities.
- The villagers were going to Koraput city to process the millets produce as per their requirement at weekly or a fortnight on payment basis with travel expenses and time.
- There was need to take up better millet processing and marketing initiative

M.S. Swaminathan Research Foundation (MSSRF) had initiated millet promotion with improved on-farm and post-harvest technologies in Koraput of Odisha with financial and technical support of ICAR-Indian Institute of Millet Research, Hyderabad under tribal sub plan (TSP) since 2016. Every year about 250 to 350 tribal farmers were supported for millet cultivation by demonstrating quality seeds, demonstration of key inputs, farm implements, improved agronomic technologies, and providing various training and capacity building programmes on production and processing of millets.

As part of these activities, an initiative was taken to establish integrated millet processing unit in main hubs of each locations of the MSSRF. This integrated centre had one set of de-stoner, grader, de-husker and pulveriser to reduce drudgeries involved in processing of millet and to increasing the consumption of millet value-added products and marketing in the name of 'Organic Millet Selling Counter. There were no processing units available within 7 km.

In Koraput, Machhara is the middle place and accessible to the villages Umuri Gram Panchayat of Koraput. It is surrounded by other villages namely, Sukriguda, Umuri, Padeiguda, Chhappar, Khillaput, Mendhaguda, etc. In total, 1250 households of the surrounding villages of Machhara were benefited from this millet processing unit, annually. Thus, the people were dependant on Koraput city to process the millet which is 7 km away from Machhara cluster. Further, there is no millet dehusking machine available in Koraput.

Millet Processing

Capacity of these processing units is 100 kgs per hour. It was decided to increase the production of millet value-added products from 750 kgs to 1500 kg per month of this unit. In Koraput,

after processing of millet, testing will be done by preparing different recipes of millet and also demonstrated. Total four PPU were established with support of ICAR-IIMR, Hyderabad under TSP, SCSP and NASF-Funded Extension projects.

- Training and exposure was organized to Maa Dangardei Women SHG on value addition of Finger millet, Foxtail millet and Little millet. Initiatives on the basis of Kolli Hills model.
- Training on packaging, labeling and marketing were conducted for the group members.
- The group was marketing millet products through "Organic Millet Selling Counter" at Koraput.

View of the primary processing unit of millets

Interaction of scientists with tribal farmers

Location of Primary processing unit:

1. Location of the PPU		
Village	:	Bagraguda
Po	:	Mastiput
Block and Dist	:	Koraput
State	:	Odisha-764 021

PPU completion certificate from local authority

M S SWAMINATHAN RESEARCH FOUNDATION
Biju Patnaik Tribal Agro-biodiversity Centre, Jeypore

Prashant Kumar Parida
Development Coordinator

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2020-21to 2021-22 jointly by MSSRF and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under NASF programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	Grain Storage Godown Village: Bagraguda Po: Mastiput Block & Dist: Koraput State: Odisha PIN- 764021	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official
State Government Department

PEO
Mastiput GP

Prashant Kumar Parida
Development Coordinator

Signature with name
O/c, MSSRF

M.S. SWAMINATHAN RESEARCH FOUNDATION
Phulabad, Jeypore, Koraput
Odisha - 764002, India
Ph : 06854 - 231773

Regional Centre, Phulbad, Po: Umuri, Jeypore-764002, Koraput Dist. (Odisha)
Ph: 9439511579/7008871184, E-mail: prashantparida@mssrf.res.in,

2. Location of the PPU

Village	:	Khilloput
Po	:	Umuri
Block and Dist	:	Koraput
State	:	Odisha-764 021

PPU completion certificate from local authority

M S SWAMINATHAN RESEARCH FOUNDATION
Biju Patnaik Tribal Agro-biodiversity Centre, Jeypore

Prashant Kumar Parida
Development Coordinator

PPU COMPLETETION CERTIFICATE

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Sl. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
3	Primary processing unit (PPU) as custom hiring centre	Millet Primary Processing Centre Village: Khilloput Po: Umuri Block & Dist : Koraput State :Odisha PIN - 764021	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official
State Government Department

Prashant Kumar Parida
Development Coordinator

Signature with name
O/ic, MSSRF
M.S. SWAMINATHAN RESEARCH FOUNDATION
Phulabad, Jeypore, Koraput
Odisha - 764002, India
Ph : 06854 - 231773

Regional Centre, Phulbad, Po: Umuri, Jeypore-764002, Koraput Dist. (Odisha)
Ph: 9439511573/7008871184, E-mail: prashantparida@mssrf.res.in,

3. Location of the PPU

Village	:	Machhara
Po	:	Umuri
Block and Dist	:	Koraput
State	:	Odisha-764 021

PPU completion certificate from local authority

M S SWAMINATHAN RESEARCH FOUNDATION
Biju Patnaik Tribal Agro-biodiversity Centre, Jeypore

Prashant Kumar Parida
Development Coordinator

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2016-17 to 2019-20 jointly by MSSRF and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

Sl. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
3	Primary processing unit (PPU) as custom hiring centre	Sabari Producer Group Village: Machhara Po: Umuri Block/ Dist: Koraput State :Odisha PIN - 764021	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official
State Government Department

Prashant Kumar Parida
Development Coordinator

Signature with name
O/ic, MSSRF

M.S. SWAMINATHAN RESEARCH FOUNDATION
Phulabad, Jeypore, Koraput
Odisha - 764002, India
Ph : 06854 - 231773

Regional Centre, Phulbad, Po: Umuri, Jeypore-764002, Koraput Dist. (Odisha)
Ph: 9439511573/7008871194, E-mail: prashantparida@mssrf.res.in,

4. Location of the PPU

Village	:	Talalimka
Po	:	Padampur
Block and Dist	:	Koraput
State	:	Odisha-764 021

PPU completion certificate from local authority

MSSRF

M S SWAMINATHAN RESEARCH FOUNDATION
Biju Patnaik Tribal Agro-biodiversity Centre, Jeypore

Prashant Kumar Parida
Development Coordinator

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2020-21to 2021-22 jointly by MSSRF and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under NASF programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
2	Primary processing unit (PPU) as custom hiring centre	Millet Processing Centre Village :Talalimka Po: Padampur Block & Dist :Koraput State :Odisha PIN - 764021	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official
State Government Department

Prashant Kumar Parida
Development Coordinator

Signature with name
O/c. /MSSRF

M.S. SWAMINATHAN RESEARCH FOUNDATION
Phulabad, Jeypore, Koraput
Odisha - 764002, India
Ph : 06654 - 231773

Regional Centre, Phulbad, Po: Umuri, Jeypore-764002, Koraput Dist. (Odisha)
Ph: 9439511573/7008871184, E-mail: prashantparida@mssrf.res.in

CHATTISGARH STATE

12. Primary processing unit established by AICRP-DA, Jagadalpur, Chattisgarh State

Address of centre:

Dr. Pradhan
Pri. Scientist & Officer-in-charge
AICRP-Dryland Agriculture (DA)
S. G. College of Agriculture & Research Station
Indira Gandhi Krishi Vishwavidhyalaya
Jabalpur, Chattisgarh State

Importance of millets in the area

In Chattisgarh state, the average rainfall of 1404 mm per annum divides in four parts and among four south western monsoons (June to September) gives 1121.5 mm with 55 rainy days in the *kharif* season. The normal onset and cessation of monsoon are 10th June and 15th September, respectively. The predominantly light textured soil that is more suited to finger millet cultivation which is recognized as upland (locally called *Marhaan*). Rainfall play an important role in agricultural planning, the rainfall distribution helps in deciding times of sowing, weed management and fertilizer application. Most of the tribal predominantly cultivate local landraces of finger millet *viz*. *Ladu mandiya, Jhatari mandiya, Laam mandiya* and *Denga mandiya* with age old agronomical practices. Finger millet is preferably raised in *kharif* (June-October) on unbunded sloppy uplands with negligible additional inputs, either as a sole or mixed crop with pulses and oilseeds under primitive cropping systems. It is sold directly as grain or use in preparing poridge "*Pej*" (broken rice+ragi flour in liquid form) during summer and fermented beverage "*Laanda*" for home consumption or to sale in local market. Despite great value associated with this crop, there has been declined of 11.85% during five years from 11905 ha in 2013 to 10494 ha in 2017 in Bastar district. With traditional cultivation practices, finger millet yields was below than 0.5 t/ha and 1.0 t/ha following broadcasting and traditional transplanting, respectively. The prime factors for poor yield potential was, poor crop management which includes local varieties, broadcasting method and no fertilizer use, leading to sub-optimal plant population, and upto some extend, replacement by commercial maize cultivation. The change in land use pattern has kept in less area coverage of finger millet in the plateau.

About tribal population in the area

In census 2011, the geographical area of the district was 10469.50 sq kms which was 7.74 % of the total area of the state. The total population of Bastar district is 14,13,199 with 6,98,487 males and 7,14,712 females. Rural population is 12,19,705 and urban population is 1,93,494. The district has registered growth rate of 18.0% in the state during the decade 2001-2011. The proportion of scheduled tribes (STs) population in the district was 65.93% as per Census 2011. There has been an increase of 0.51 per cent in the ST population during the decade 2001- 2011. The proportion of SC population in the State in the Census was 2.91%.

Millets in Bastar district

Major area coverage of particular crops in the region were by Finger millet, Kodo millet, Little millet and Barnyard millet.

Post-harvesting operations in millets

The important small cereals among tribes of Bastar district after paddy crop were Finger millet [*Eleusine coracana* (L.) Gaertn.], Kodo millet (*Paspalum scrobiculatum* L.) and Little millet (*Panicum sumatrense*). The problem of kodo millet is the difficult milling process of the grains. The milling drudgery associated with upper husk sticking endosperm tightly that reduces the efficiency of grain recovery from each spikelet. Indigenous mill (*Jatta*) was made out of well mixture of soil and stone that helps it to check deflocculating while working, which was used by turning the upper plate. Milling process required nearly half day to mill only 20-30 kg of kodo millet grains with grain recovery of 40 ± 5%. Finger millet is placed first position with good potential in rain-fed farming system and slightly drought tolerant during growing periods.

Problems in the post-harvesting operations of millets

Threshing of finger millet is major issue because grains are separated from the fingers by beating hard manually or spreading over road for separately of grains from the panicles. Whereas, other millets (Kodo millet, Little millet and Barnyard millet) are subjected to milling processes which could not easily separate their glumes from endosperms. Sometimes, they used rice milling machine but grain breakage percentage were high. The manual processing and grading and separation is another drudgery associated factor. That is the reason, most of tribals process their grain with traditional way with hand or leg pounding mechanism resulted into poor quantity produce which led to discourage to grow small millets.

Need of processing facility

It is urgent need of processing facilities for millets especially for little millet and kodo millet. Otherwise, whole produce would be bought by middlemen at cheaper price who sells it at next level with high price. One problem associated with these crops was that there was no procurement done on the basis of minimum support price (MSP) from government of the state. The intervention of processing technology has an important role in enhancing income and food security of tribal farmers in the region.

Keeping the above problems in view, the ICAR-Indian Institute of Millets Research, Hyderabad had supported financially and technically to develop primary processing facilities at farm gate (village level) under Tribal sub-plan (TSP) and Scheduled Caste sub-paln (SCSP) programme.

Funds used: Rs. 6,00,000/- were allocated from tribal sub-plan (TSP) programme of the IIMR (vide letter No. Dir.Office/IIMR-TSP/2018-19).

Location of the PPU

Village	:	Bad Marenga
Block	:	Tokapal
District	:	Bastar
State	:	Chhattisgarh-494001

Processing machineries installed for services

1. Millet dehuller (double stage)
2. Millet Polisher (Horizontal)
3. Flour mill (*Atta chakki*)

Implementing group at village: The PPU was operatinalised by *Rupseela Mata group, Bade Marenga* group on the basis of custom hiring basis with minimal charges since 1st September, 2020.

Utility: Around 500-700 farmers are taking advantages of the facilities annually.

Operational limitations of PPU

- Lack of storage facilities and irregular supply of raw materials for processing of small millets
- Finance support for maintaining the facilities and regular watching activities is bit difficult at village level
- Upward linking for selling products in markets are lacking

Beneficiaries' feedback

- Good support to the tribal farmers for enhancing income and consumption at household level
- It needs human resource development through trainings on processing of millets
- Coordination among the group members for common understanding is reequired

Visit of district Officers to the unit

Visit of Hon'ble VC, IGKV, Raipur

Traditional milled kodo millet

Exposure visit of Odisha Millet mission

View of millet de-huller

View of flour mill

Drying of finger millet for threshing

PPU completion certificate from the local authority

इंदिरा गांधी कृषि विश्वविद्यालय
Indira Gandhi Krishi Vishwavidyalaya
शहीद गुंडाधूर कृषि महाविद्यालय एवं अनुसंधान केन्द्र
Shaheed Gundadhoor College of Agriculture & Research Station
कुम्हरावण्ड, जगदलपुर – 494005 Kumhrawand, Jagdalpur – 494005 (C.G.)
Ph. (0) - 07782 - 229150, (Fax) 229360 (R) 229343 Email - rars_igau@rediffmail.com

No/SGCARS/Dean/ 2570 Date- 06/12/2021

PPU COMPLETETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2016-17 to 2020-21 jointly by AICRP Dryland Agriculture and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	Village-Bade Marenga, Block-Tokapal, District-Bastar, State-Chhattisgarh, Pin-494442	Completed and providing millets processing services to the farmers on custom hiring basis

Signature with name & designation
Official
State Government Department
R.A.F.O
Bademarenga
Bhupendra Tekam

Signature with name
O/ic, AICRP-Dryland Agriculture
Dr. T. Chapke

DEAN 12/21
S.G.C.A.R.S. JAGDALPUR

NAGALAND STATE

13. Primary processing unit established by SASRD, Nagaland University, Nagaland State

Address of centre:

Dr. Pankaj Shaha
Associate Professor (Plant Breeding)
School of Agricultural Sciences & Rural Development
Nagaland University, Medziphema, Nagaland-797106 (Nagaland)

Importance of millets in Nagaland

Millets are group of small grained cereal crops which are tolerant to drought and other extreme weather conditions, and are grown with low chemical inputs such as fertilizers and pesticides. Most of millet crops are native of India and are popularly known as Nutri-cereals and now Shri Anna as they provide most of the nutrients required for normal functioning of human body. The traditional farming system of Nagaland has been ensuring food security under changing weather conditions. The state of Nagaland is a hilly region located in the North Eastern part of India. It is largely inhabited by Scheduled Tribes (STs) who are recognized as a historically disadvantaged population in India. Nagaland's mountainous terrain offers a rich diversity of farmlands and agricultural practices. It has red and yellow, deep, acidic soil with low fertility.

Nagaland is a state where millets such as Pearl millet, Sorghum, Finger millet and other small millets are cultivated on small acreages. The productivity levels are generally lower than national average especially, in finger millet. Millets are mainly grown in the districts of Mon, Phek, Tuensang, Kiphire and some areas of Kohima. Traditionally, millets were commonly known for making brew and formed an integral part of community diet. As per a report of APEDA, the Nagaland has 11450 ha area under millets cultivation with the total production of 11443 metric tonnes with an average productivity of 999 kg/ha.

About tribal population in Nagaland

Nagaland is the hilly and tribal state of the north east India. It comprises of 17 different scheduled tribes residing in different districts of Nagaland. As per the *Aadhar* statistics, the population of Nagaland in 2022-2023 was 2,189,297 (2.19 Millions). The names of different tribes of Nagaland are listed below.

1. Angami
2. Ao
3. Chakhesang
4. Chang
5. Khiamniungan
6. Kuki
7. Konyak
8. Kachari
9. Lotha
10. Phom
11. Pochury
12. Rengma
13. Sumi
14. Sangtam
15. Tikhir
16. Yimkhiung
17. Zeliang

Nagaland, the 16th State of the Indian Union came into existence on 1st December, 1963. It has a geographical area of about 16,579 Sq. km lies between 25°60" and 27°40" North latitude and 93°20" and 95°15" East longitude. The state is bounded by Assam in the North and by Myanmar in West and Arunachal Pradesh in the East and by Manipur in the South. The inhabitants of Nagaland are almost entirely tribal with distinct dialects and cultural features. The state is predominantly rural with

82.26% of population living in villages. The current practice of agriculture is largely unsustainable owing to the traditional *Jhum* (shifting cultivation) in cycle mode of operation. Agriculture is one of the significant contributor to the Net State Domestic Product and is the largest employer of the working force in the state. Though, the dependency of employment on agriculture has declined from 96.50% in the 1950s to 68% in 2000, it continues to be the main source of livelihood. Shifting and terraced cultivation remains the dominant forms of land use practice in the state. The traditional form of shifting cultivation (*jhum*), is the method of cultivation that is widely practiced across Nagaland due to low topography.

Millets cultivated in Nagaland

District	Millet crops grown (area in ha)			
	Small Millets	Job's tears	Pearl millet	Finger millet
Kohima	1792	212	90	-
Phek	2102	161	70	-
Mon	822	191	100	40
Wokha	1531	131	40	40
Zunheboto	821	121	60	-

* **Source:** E-catalogue for export of Millets & Value-added products Northeastern states, 2023. Ministry of Commerce & Industry, Government of India.

Post-harvesting operations of millets

The produce is traditionally processed and use for domestic consumption. It is also used for preparation of special wine, meal with many varieties of items. Traditionally, millets were commonly known for making beverages and formed an integral part of community diet.

Problems in current post harvesting operation

Traditional practices are followed for processing which are highly laborious and time consuming. Lack of millet-specific processing machineries and skills were also the major constraints.

Need of processing facility

As the drudgeries in post-harvest operation is one of the major demotivating factor in millets production, primary processing facilities are very much essential in the districts with suitable machineries and skill for operations.

Keeping the above problems in view, the ICAR-Indian Institute of Millets Research, Hyderabad had supported financially and technically to develop primary processing facilities at farm gate (village level) under Tribal sub-plan (TSP) and Scheduled Caste sub-paln (SCSP) programme.

Funds used: Rs. 16.47 lakhs were allocated from NEH (capital) funds of the IIMR.

Implementing Agency: The PPU was operationalized by the SASRD, Medziphema since 18.03.2023 on custom hiring basis with minimal charges.

Location of the PPU

At the SASRD, Nagaland University

Block : Medziphema

Dist. : Chumoukedima

State : Nagaland-797106

Processing machineries available for services

1. Millets Destoner
2. Millets Polisher
3. Millets Vacuum Packing Machine
4. Millets Pulverizer
5. Millets Dehuller
6. Millets Grader

Problems in operational of PPU

The machineries of processing plant have not fully been utilized for commercial purpose because of low area under millets cultivation. However, millets cultivation is taking momentum due to these facilities.

Utility: Around 100-200 farmers are taking advantages of the facilities annually.

Beneficiaries' feedback

During the visit of farmers groups to the processing unit, they learned how to use different machines. They were happy to have such facilities in the SASRD main campus and its nearby villages.

Millets Polisher

Grader

Pulverizer

Dehuller

Destoner cum grader cum aspirator

Vacuum Packing machine

PPU completion certificate from the local authority

NAGALAND UNIVERSITY

(A Central University Established by an Act of Parliament 1989)

DEPARTMENT OF GENETICS & PLANT BREEDING

SCHOOL OF AGRICULTURAL SCIENCES

CAMPUS: MEDZIPHEMA - 797106 NAGALAND

Ref. No.....Date: 13/05/2024

PPU COMPLETION CERTIFICATE

It is to state that the following primary processing unit (PPU) as custom hiring centre was established during 2022-23 jointly by Millets Promotion Scheme, SAS, Nagaland University, Medziphema and ICAR-Indian Institute of Millets Research, Hyderabad for enhancing quality millets production and their consumption under Tribal Sub-Plan (TSP) programme led by *Dr. Rajendra R. Chapke*, Principal Scientist and Nodal Officer, ICAR-IIMR, Hyderabad.

S. No.	Name of centre	Location (Village, block, district, pin code, state)	Status
1	Primary processing unit (PPU) as custom hiring centre	Department of GPB, SAS, Nagaland University, Medziphema Dist. Chumoukedima 797106 Nagaland	Completed and available to provide millets processing services to the farmers on custom hiring basis

13/05/2024

DR. WATIENUNGLA JAMIR

(PRINCIPAL I/C & DIRECTOR SAMETI NAGALAND)

Signature with name & designation

Official

State Government Department

Principal I/C & Director SAMETI

Medziphema : Nagaland

(Pankaj K. Shah) 13/05/2024

Signature with name,

Coordinator, Millets Scheme

SAS, Nagaland University,

Medziphema

Coordinator
Millets Promotion Scheme
SASRD, Nagaland University,
Medziphema

ADVANTAGES OF THE PPUS

14. Advantages of the PPUs

The millet growers mostly sell their produce just after harvest of their crop, a few sell it after making primary processing and de-hulling of grains which fetch them higher net returns than normal at different levels. To estimate yield and economic returns obtained by the different category of the farmers from millet cultivation, data of extension programmes namely, field trials organized under Farmer FIRST project (FFP) on millets under enterprise module at PPU, Gangapur village of Sangareddy district, Telangana State and frontline demonstrations (FLDs) during 2022-23 were analysed and highlighted in this chapter. To know benefits of these models, economics of raw produce, primary processed and dehulled produce sold by the millet farmers of the FFP were analysed. The progressive farmers were classified based-on millets yield obtained above than average yield and possession of their farm assets. Those farmers who got yield below than average yield and possessed common farm assets were treated as "common farmers". Primary processed grains mean, after threshing of grains from the panicles, the produce were undergone cleaning, de-stoning, de-husking and grading operations to obtain quality grains using these facilities. De-hulled grain means, the outer cover was removed by machinery that is de-husking and de-hulling using dehuller machine after primary processing for making value-added food products. Yield and economic returns realised by the progressive and non-progressive (common farmers) millet farmers were computed separately under improved practice (IP), farmer's practice (FP), improved practice with primary processed produce and improved practice with de-hulled grains they sold.

1. Sorghum (Table 13)

- A substantial difference in yield (7.90 q/ha) and net returns of Rs. 20,814/- was found between improved practice (IP), and farmer practice (FP) of sorghum cultivation which ranged between 39% and 55%.
- Wide yield gap of 5.76 q/ha was also observed between progressive farmers and common farmers yield. It indicated that improved sorghum technology responded well under rich soils and good crop management practices followed by the progressive farmers.
- However, very marginal yield difference (1.00 q/ha) was found between performance of sorghum hybrid and variety in farmer's fields.
- 45% higher net returns (Rs. 26,548/-) was obtained by the farmers from primary processed grains due to high market price than just harvested grains that was raw produce.
- More than one and half times 68% higher net returns were obtained from de-hulled grains compared to just harvested grains i.e. raw produce.

Table 13. Yield and economics of sorghum

FFP trails on Sorghum variety (CSV 36) during 2022-23

Parameters	Progressive farmers				Common farmers			
	IP	FP	IP (primary processing)	IP (dehulled)	IP	FP	IP (primary processing)	IP (dehulled)
Grain yield (q/ha)	24.00	19.50	23.00	22.00	18.24	16.23	17.11	16.22
Fodder yield (q/ha)	59.50	42.00	59.50	59.50	23.00	20.34	23.00	23.00
Cost of cultivation (Rs./ha)	28409	31125	28409	28500	23068	30382	23068	23068
Price of grain yield (Rs./q)	3000	2800	4000	5000	3000	2800	3876	5000
Price of fodder yield (Rs./q)	300	300	300	300	300	300	300	300
Gross returns (Rs./ha)	89850	67200	109850	127850	61620	51546	73226	88000
Net returns (Rs./ha)	61441	36075	81441	99350	38553	21164	50159	64933
B:C ratio	3.16	2.16	3.87	4.49	2.67	1.70	3.17	3.81

FFP trails on Sorghum hybrid (CSH 41) during 2022-23

Parameters	Progressive farmers				Common farmers			
	IP	FP	IP (primary processing)	IP (dehulled)	IP	FP	IP (primary processing)	IP (dehulled)
Grain yield (q/ha)	25.25	18.13	23.10	20.15	20.00	16.38	19.45	18.02
Fodder yield (q/ha)	45.88	33.96	44.75	43.75	38.13	33.41	38.13	38.13
Cost of cultivation (Rs./ha)	25036	31479	25036	25036	24836	29688	24836	24836
Price of grain yield (Rs./q)	3000	2800	4000	5000	3000	2800	4000	5000
Price of fodder yield (Rs./q)	300	300	300	300	300	300	300	300
Gross returns (Rs./ha)	89514	60952	105825	113875	71439	55887	89239	101539
Net returns (Rs./ha)	64478	29473	80789	88839	46603	26200	64403	76703
B:C ratio	3.58	1.94	4.23	4.55	2.88	1.88	3.59	4.09

FFP trials on Yellow Sorghum (PYPS 2) during 2022-23

Parameters	Progressive farmers				Common farmers			
	IP	FP	IP (primary processing)	IP (dehulled)	IP	FP	IP (primary processing)	IP (dehulled)
Grain yield (q/ha)	20.74	14.61	19.11	18.01	18.75	13.31	16.04	15.00
Fodder yield (q/ha)	36.00	24.44	36.00	36.00	34.50	26.55	34.50	34.50
Cost of cultivation (Rs./ha)	27914	29169	27914	27914	24603	27483	24603	24603
Price of grain yield (Rs./q)	4200	4000	5000	6000	4200	4000	5000	6000
Price of fodder yield (Rs./q)	200	200	200	200	200	200	200	200
Gross returns (Rs./ha)	94308	63328	102750	115260	85650	58550	87100	96900
Net returns (Rs./ha)	66394	34159	74836	87346	61048	31067	62498	72298
B:C ratio	3.38	2.17	3.68	4.13	3.48	2.13	3.54	3.94

2. Finger millet (Table 14)

- A substantial difference in yield (5.41q/ha) and net returns of Rs. 16,166/- was found between improved practice (IP) and farmer practice (FP) of finger millet cultivation which ranged between 30% and 80%.
- Yield gap of 3.86 q/ha was also observed between progressive farmers and common farmers yield. It indicated that improved production technology responded well to resourced-rich conditions and good crop management done by the progressive farmers.
- Moreover, 26 % higher net returns (Rs. 9,562/-) was obtained from primary processed grains due to high market price for quality grains than just harvested grains.
- More than double, 71% higher net returns were obtained from de-hulled grains compared to just harvested grains i.e. raw produce.

Table 14. Yield and economics of finger millet

FFP trials on Finger millet (GPU 67) during 2022-23

Parameters	Progressive farmers				Common farmers			
	IP	FP	IP (primary processing)	IP (dehulled)	IP	FP	IP (primary processing)	IP (dehulled)
Grain yield(q/ha)	21.36	17.50	20.00	18.00	17.50	17.50	16.00	14.24
Fodder yield (q/ha)	15.68	13.86	15.68	15.68	13.00	14.00	13.00	13.00
Cost of cultivation (Rs./ha)	20236	24875	20236	20236	22325	26917	22325	22325
Price of grain yield (Rs./q)	2000	1890	2800	3500	2000	1890	2800	3500
Price of fodder yield (Rs./q)	250	250	250	250	250	250	250	250
Gross returns (Rs./ha)	46648	36541	59920	66920	38333	36617	48133	53173
Net returns (Rs./ha)	26411	11666	39684	46684	16008	9700	25808	30848
B:C ratio	2.31	1.47	2.96	3.31	1.72	1.36	2.16	2.38

3. Foxtail millet (Table 15)

- A substantial difference in yield (4.69 q/ha) and net returns of Rs. 15,112/- was found between improved practice and farmer practice (FP) of foxtail millet cultivation which ranged between 35% and 118%.
- Yield gap of 2.00 q/ha was observed between progressive farmers and common farmers practice. It indicated that improved production technology responded well to resource-rich condition and good crop management practices adopted by progressive farmers.
- Moreover, 91% higher net returns of Rs. 25,924/- was obtained from primary processed grains due to higher market price for quality produce than just harvested grains.
- More than double 119% higher net returns were obtained from de-hulled grains compared to just harvested grains i.e.raw produce.

Table 15. Yield and economics of foxtail millet

FFP trials on Foxtail millet (SiA 3085) during 2022-23

Parameters	Progressive farmers				Common farmers			
	IP	FP	IP (primary processing)	IP (dehulled)	IP	FP	IP (primary processing)	IP (dehulled)
Grain yield (q/ha)	18.00	15.00	16.20	12.96	16.00	14.70	13.55	10.16
Cost of cultivation (Rs./ha)	28414	32475	29413	29413	28000	29475	28000	28000
Price of grain yield (Rs./q)	2500	2400	5000	7000	2500	2400	5000	7000
Gross returns (Rs./ha)	45000	36000	81000	90720	40000	35280	67750	71138
Net returns (Rs./ha)	16586	3525	51587	61307	12000	5805	39750	43138
B:C ratio	1.58	1.11	2.75	3.08	1.43	1.20	2.42	2.54

4. Pearl millet (Table 16)

- A substantial difference in yield (4.7 q/ha) and net returns of Rs. 16,480/- was found between improved practice (IP) and farmer practice (FP) of pearl millet which ranged between 30% and 70%.
- Wide yield gap of 5.00 q/ha was also observed between progressive farmers and common farmers yield. It indicated that improved production technology responded well to resource-rich condition and good crop management practices adopted by progressive farmers.
- Moreover, 94% higher net returns of Rs. 37,182/- was obtained from primary processed grains due to high market price for quality produce than just harvested grains.
- More than triple 173% higher net returns were obtained from de-hulled grains compared to just harvested grains i.e. raw produce.

Table 16: Yield and economics of pearl millet

FFP trails on Pearl Millet (HHB 272) during 2022-23

Parameters	Progressive farmers				Common farmers			
	IP	FP	IP (primary processing)	IP (dehulled)	IP	FP	IP (primary processing)	IP (dehulled)
Grain yield (q/ha)	20.00	14.66	17.68	16.71	15.00	15.63	14.08	13.31
Fodder yield (q/ha)	29.32	18.41	29.32	29.32	20.00	20.00	20.00	20.00
Cost of cultivation (Rs./ha)	25439	24364	25439	25439	24439	23364	25439	25439
Price of grain yield (Rs./q)	2500	2500	5000	7000	2500	2500	4900	7000
Price of fodder yield (Rs./q)	250	250	250	250	250	250	250	250
Gross returns (Rs./ha)	57330	41250	95730	124300	42500	44063	73992	98139
Net returns (Rs./ha)	31891	16886	70291	98861	18061	20699	48553	72700
B:C ratio	2.25	1.69	3.76	4.89	1.74	1.89	2.91	3.86

5. Barnyard millet (Table 17)

- A substantial difference in yield (5.24 q/ha) and net returns of Rs. 17,633/- was found between improved practice (IP) and farmer practice (FP) which ranged between 42% and 93%.
- Wide yield gap of 6.25 q/ha was also observed between progressive farmers and common farmers practice. It indicated that improved production technology responded well to resource-rich condition and good crop management practices adopted by progressive farmers.
- Moreover, 114% higher net returns of Rs. 41,841/- was obtained from primary processed grains due to higher market price for quality produce than just harvested grains.
- Similarly, 198% higher net returns were obtained from de-hulled grains compared to just harvested grains i.e. raw produce.

Table 17. Yield and economics of barnyard millet

FFP trails on Barnyard Millet (VL Madira 207) during 2022-23

Parameters	Progressive farmers				Common farmers			
	IP	FP	IP (primary processing)	IP (dehulled)	IP	FP	IP (primary processing)	IP (dehulled)
Grain yield (q/ha)	16.25	13.44	14.00	9.80	10.00	7.00	8.00	5.60
Fodder yield (q/ha)	19.06	17.19	19.06	19.06	17.50	15.00	17.50	17.00
Cost of cultivation (Rs./ha)	19455	22441	19455	19455	15875	18375	15875	15875
Price of grain yield (Rs./q)	2800	2800	5000	9000	2800	2800	5000	9000
Price of fodder yield (Rs./q)	200	200	200	200	200	200	200	200
Gross returns (Rs./ha)	49313	41063	73813	92013	31500	22600	43500	50495
Net returns (Rs./ha)	29858	18622	54358	72558	15625	4225	27625	34620
B:C ratio	2.53	1.83	3.79	4.73	1.98	1.23	2.74	3.18

6. Little millet (Table 18)

- A substantial difference in yield (3.41 q/ha) and net returns of Rs. 11,539/- was found between improved practice (IP) and farmer practice (FP) of little millet cultivation which ranged between 35% and 88%.
- Moreover, 101% higher net returns of Rs. 24,843/- was obtained from primary processed grains due to higher market price for quality produce than just harvested grains.
- More than double, 177% higher net returns were obtained from de-hulled grains compared to just harvested grains i.e. raw produce.

Table 18. Yield and economics of little millet

FFP trails on Little Millet (DHLM 36-3) during 2022-23				
Parameters	**Progressive farmers**			
	IP	**FP**	**IP (primary processing)**	**IP (dehulled)**
Grain yield (q/ha)	11.25	10.00	9.88	6.92
Cost of cultivation (Rs./ha)	21625	21625	21625	21625
Farmers price of grain yield (Rs./q)	3500	3200	6000	12000
Gross returns (Rs./ha)	39375	32000	59280	82992
Net returns (Rs./ha)	17750	10375	37655	61367
B:C ratio	1.82	1.48	2.74	3.84
FLDs report on Little millet 2021-22				
Parameters	**IP**	**FP**	**IP (primary processing)**	**IP (dehulled)**
Grain yield (q/ha)	15.30	9.73	13.80	9.66
Fodder yield (q/ha)	36.35	26.01	36.35	36.35
Cost of cultivation (Rs./ha)	21502	16539	21502	21502
Gross returns (Rs./ha)	53019	32353	82800	96600
Net returns (Rs./ha)	31517	15815	61298	75098
B:C ratio	2.51	2.09	3.85	4.49
Meanof the above				
Parameters	**IP**	**FP**	**IP (primary processing)**	**IP (dehulled)**
Grain yield (q/ha)	13.28	9.87	11.84	8.29
Fodder yield (q/ha)	36.35	26.01	36.35	36.35
Cost of cultivation (Rs./ha)	21564	19082	21564	21564
Gross returns (Rs./ha)	46197	32177	71040	89796
Net returns (Rs./ha)	24634	13095	49477	68233
B:C ratio	2.14	1.69	3.29	4.16

7. *Rabi* sorghum (Table 19)

- A substantial difference in yield (4.5 q/ha) and net returns of Rs. 16,124/- was found between improved practice (IP) and farmer practice (FP) of *rabi* sorghum cultivation which ranged between28% and 43%.
- Wide yield gap of 14.5 q/ha was observed between progressive farmers and common farmers yield. The good resources and crop management done by progressive farmers resulted in good yields than common farmers.
- Moreover, 34% higher net returns of Rs. 18,127/- was obtained from primary processed grains due to higher market price obtained by farmers for quality grains than just harvested grains.
- More than double, 124% higher net returns were obtained from de-hulled grains compared to just harvested grains i.e. raw produce.

Table 19. Yield and economics of *rabi* sorghum

FFP trails on *Rabi* Sorghum variety (CSV 29R) during 2022-23

Parameters	Progressive farmers				Common farmers			
	IP	FP	IP (primary processing)	IP (dehulled)	IP	FP	IP (primary processing)	IP (dehulled)
Grain yield (q/ha)	22.5	18.00	19.33	18.36	8.00	8.00	7.00	6.20
Fodder yield (q/ha)	29.00	24.00	29.00	29.00	33.00	22.00	33.00	30.00
Cost of cultivation (Rs./ha)	23780	24460	23780	23780	19820	19640	19820	19820
Farmers price of grain yield (Rs./q)	3000	3000	5000	8000	3500	3100	5000	8000
Farmers price of fodder yield (Rs./q)	300	300	300	300	300	300	300	300
Gross returns (Rs./ha)	76200	61200	105350	155608	37900	31400	44900	58600
Net returns (Rs./ha)	52420	36740	81570	131828	18080	11760	25080	38780
B:C ratio	3.20	2.50	4.43	6.54	1.91	1.60	2.27	2.96

Overall observations

- The substantial difference was found between just harvest produce and de-hulled grains ranged between 69 - 198% of net returns (up to five times) across all the millets.
- Also, a difference was observed between net returns obtained from just harvest produce and primary processed grains ranged between 26 - 114% (up to four times).
- However, there is no significant difference between yield and net returns obtained from sorghum hybrid and variety.
- Viablelinkages for buy-back of processed and de-hulled grains by the traders, food industries or entrepreneurs should be addressed.

The major advantages of primary millet processing in custom hiring models are summarized below for enhancing farmers' income and nutritional security.

1. **Access to cost-effective technology**: Custom hiring centers allow millet farmers especially, small and marginal farmers to access advanced processing machineries without heavy investments, making latest technology more affordable.
2. **Time and labor efficiency**: Modern processing methods enabled to save time and reduce the need for manual labor, allowing farmers to focus on other aspects of farming and income generation.
3. **Reduced post-harvest losses**: Improved processing techniques minimize grain losses that happened during traditional threshing, drying, and storage, ensuring higher recoverable yields.
4. **Enhanced farmer income**: By reducing waste and increasing the quality of the millets produce and market value of processed millets, farmers can achieve better prices up to four times higher led to greater profitability.
5. **Improved nutritional security**: Primary processed millets retain essential nutrients and can be easily stored, used for food preparation and consumed, and thus, contributing to the nutritional security of rural households and local communities.
6. **Market-ready products**: Processing millets at local levels provides conducive environment to prepare value-added products that are ready for direct sale, increasing market access and demand for millets.
7. **Sustainable agriculture**: Millets are climate-resilient crops, and promoting their cultivation and processing aligns with sustainable and eco-friendly farming practices, benefiting both farmers and the environment.
8. **Inclusive growth**: Custom hiring models support small-scale farmers and marginalized groups, promoting equitable access to resources and economic growth in rural and tribal areas.

THE WAY FORWARD

It provides knowledge about improved production technologies, primary processing, secondary processing and market information in English and Telugu language

This app provides single-window platform to buyers and producers for marketing of millets' produce and Timely advisory to millet farm ers

15. The Way Forward

Prime objective to grow millets is to obtain higher income and quality produce. However the millets farmers couldn't get fair price in market for their produce especially for grains due to poor quality which contains dirt materials, stones and damage grains. Lack of primary processing facilities including cleaning, destoning, and grading at village level was one of the major reasons for low price of their produce. The advantages of primary processing facilities of millets through custom hiring models could focus on practical steps, future strategies, and policy provisions to promote millet processing as a sustainable model. A structured outline of key points are suggested for consideration.

1. Promoting millet-based value chains

Strengthening supply chains: Develop localized processing units to reduce post-harvest losses and ensure quality output.

Custom hiring centers: There is need to establish more custom hiring centers on millet processing with equipment to make processing accessible and affordable at grass-root level.

Partnerships with agro-industries: Collaboration with agro-industries and cooperatives farmers groups like FPOs should be developed to expand market access for processed millet products.

Skill development: Trainings to farmers and rural entrepreneurs on millet processing techniques and value-added products are essential for utilizing these facilities efficiently.

2. Government and policy support

Subsidies and financial incentives: Subsidies on millet processing equipment, and financial assistance are required for setting up such custom hiring centers including skill development.

Public-private partnerships (PPP): Partnerships between the government, private sector, and farmer collectives should be built-up to promote millet processing at scale.

3. Creating awareness and demand for millets

Health and nutritional campaigns: Mass awareness among consumers about the health benefits of millets should be created through audience targeted campaigns.

Promoting millets in urban markets: Innovative products that cater to urban markets needs to be developed focusing on millets as a superfood.

Branding and certification: Quality certification and branding for millet products are to be introduced to boost consumer trust and demand.

4. Sustainable agriculture practices

Integrating millets with climate-resilient farming: Millets as a climate-smart crop should be promoted in policies to improve resilience against droughts and erractic weather as a part of government policy.

Agroecological approaches: Encourage crop rotation and organic practices, making millet cultivation more sustainable.

5. Scaling up technology and innovation

Innovative processing technologies: The development of affordable, practicable and efficient millet-wise processing technologies should be supported to small and marginal farmers. There is scope to promote these models through Farmer Producer Organizations (FPOs) and other community approaches.

Digitalizing custom hiring systems: Create digital platforms (mobile apps) to streamline the custom hiring process, improving accessibility for farmers.

6. Inclusive growth and gender empowerment

Engaging women and marginalized groups: Promotion of millet processing as an income generating activity is essential for women and marginalized communities. They should be focused while creating such facilities.

7. Monitoring and impact evaluation

Tracking farmer income: The monitoring mechanism is need to be developed to assess the impact of the millet processing on farmer income and livelihood security.

Nutritional impact studies: Regular studies to evaluate the nutritional outcomes of households those engaged in millet processing and consumption to be conducted.

In support of the above points, improvements in traditional threshing methods, yield losses, in storage and traditional practices, especially for crops like millets, are crucial for enhancing agricultural efficiency and farmer income. A brief overview of these issues are mentioned here under.

Lack of infrastructure for post-harvest operations at village level

Lack of adequate threshing yards in villages that have resulted in farmers threshing crops in public roads. Farmers spread their harvested crops, like millets including *ragi*, pulse crops and paddy, on the road to be threshed under the wheels of vehicles that pass. The pressure on land owing to fragmentation, besides the nuclear family system, has resulted in farmers doing away with the system of having family threshing yards due to the costs involved. Threshing crops on public roads not only results in huge loss of grains, but also leads to desperate sale due to fear of quality being hit during rainy season and lack of storage facilities. This practice also affects quality of grains as well as fodder due to mix of petrol, diesel, engine oil, urine and dung. It is very essential to take measures to build multi-purpose threshing yards and storage facilities at every panchayat (village administration office) for the use of farmers on the payment of rent so that quality and yield losses could be avoided. The village panchayat should provide requisite infrastructure to establish primary processing facilities including cleaning, destoning and grading, storage facilities so that farmers can operate such processing facilities by their community or groups and avail on custom hiring basis with minimal charges to obtain quality produce.

Drying of harvested produce on public roads

Improvements in traditional threshing

Traditional threshing methods, often involving manual labour or animals, those are labour-intensive, time-consuming, and inefficient. Mechanical threshers separate grains more efficiently and quickly, reducing manual effort. They ensure better grain recovery, less wastage, and higher output. Farmers can rent such threshing machines on custom hiring basis making advanced technologies accessible to small and marginal farmers without the need for large investments. Newer threshers are designed to be energy-efficient, reducing fuel or electricity costs while being user and environmentally friendly as shown in the following right side picture.

Labourious small millets threshing traditionally

A view of millet thresher

Machine-operated millets threshing reduce drudgeries

Improved storage practices

Traditional storage methods, such as mud bins or jute bags, are prone to pest infestations, moisture absorption, and fungal growth, which cause post-harvest losses. Improved storage methods like, airtight containers or bags that prevent oxygen from entering, which limits pest activity and preserves grain quality. More durable and pest-resistant, metal silos offer better protection against environmental factors like humidity and temperature fluctuations. Solar or mechanical dryers can be used to ensure grains are properly dried before storage, preventing fungal growth and spoilage.

Enhancing traditional threshing methods, reducing yield losses, and improving storage practices are essential steps toward maximizing millet productivity. With the adoption of modern technologies and practices, farmers can increase efficiency, reduce waste, and improve their incomes while ensuring better food security.

VISIT OF EMINENT PERSONALITIES

Visit of Dr. S. L. Mehta, Chairman, Research Advisory Committee (RAC) & Ex. Vice-chancellor MPUAT, Udaipur, Rajasthan along with scientists of the institute to millets primary processing unit established at Gangapur village, Sangareddy district of Telangana State under "Farmer FIRST Project" on 24th April, 2022






Visit of Dr. Ranajit Kumar Samanta, Chairman, Advisory Committee & Ex., Vice-chancellor, BCKV, Mohanpur, West Bengal along with scientist of the institute to millets primary processing unit established at Barbeda village, Koraput, Odisha State under ICAR-NASF-funded extension project on 10th March, 2022






Millets processing enable to strengthen entrepreneurs

Visit of foreign delegates of (G20 meet 2023) to live demonstrations of millets

भाकृअनुप
ICAR

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