Understanding Small Millet Processing

Quality Issues and Suitable Options

NITI Aayog

WASSAN

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Illustrations : M. Sreekanth Kumar (WASSAN)

Photo Images : Satya Sainath (WASSAN and RRA Network)

Layout Design : WASSAN

For Copies, write to

Watershed Support Services and Activities Network (WASSAN)

Plot Nos. 685 and 686, Narasimha Swamy Colony, Street No. 12,

Nagole, Hyderabad - 500 068, Telangana India

Email: mail@wassan.org

Website: www.wassan.org

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Introduction

A project on Inclusion of Millet based recipes as hot cooked meals through ICDS scheme was launched in three aspirational districts of Telangana with the support of NITI Aayog. The programme aimed to establish a decentralised, integrated & scalable local circular economy model of promoting millets in food, nutrition, agriculture and livelihood systems & setting up of decentralised processing units. To realise this objective, it is important to overcome the major challenge of quality processing. There is dire need for understanding the value chain of small millet processing & fine-tuning the existing processing methods to improve the quantity and quality of output. This manual aims to demystify the processing of small millets processing. Millets belong to the grass family and are usually grown in rainfed conditions. They are rich in a huge spectrum of micro nutrients like calcium, iron, phosphorous, magnesium etc. They are highly nutritious, rich in fiber and are gluten free, making them easily absorbable. At the same time, they are slow digesting foods which do not cause a sudden spike in blood sugars like polished rice. Millets therefore can help in preventing early onset of diabetes and also in maintaining the sugar levels in diabetic patients. They are distinguished as major and minor millets, depending on their availability.

Though the green revolution has reduced the usage of millets for the past few years, they are now being seen as crops with the potential to address the nutritional imbalance in present day diets and tackle the agrarian crisis. With climate change majorly affecting agriculture and rainfall becoming more unpredictable, millets are regaining their importance.

Millet revival is only possible when the issues related to **CONSUMPTION**, **PRODUCTION**, **PROCESSING** and **MARKETS** are simultaneously addressed.

Processing is the critical link between production and consumption, in the millet supply chain. Difficulties and inefficiencies in processing are hindering the growth of consumption. Some of the major challenges in processing millets are the varying size of the grains, the many varieties, cultivation practices, due to pest infestation & rancidity, low shelf-life of the processed products etc. While the presence of un-hulled grain bothers consumers, processors are bogged down by the high cost of processing to achieve acceptable quality that effects the final price and volume of sales. One of the major challenges in bringing minor millets into the mainstream is the availability of efficient processing technology at village or mandal level. In this context, there is a need to understand the millet processing value chain and fine-tune the existing processing methods to improve the quantity and quality of output.

2

Understanding Millet Value Chain and Challenges at Various Stages

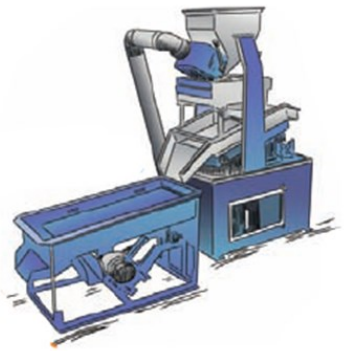
1. Lack of availability of quality seed
2. Inadequate knowledge on appropriate agronomic practices for better productivity
3. Inadequate knowledge on clean harvesting, threshing, packing and storage methods
4. Uncertain price realization.

Farmers

Local Traders

1. Lack of knowledge on quality standards to assess the grain quality
2. Lack of regular supply of grains (both quality and quantity
3. Lack of local processing units at village and block level

1. Lack of standardized and efficiency processing technology
2. Lack of regular supply from farmers
3. Poor quality of the primary raw material
4. Lack of local market development due to poor price realization at local level



Processors

Wholesalers and Retailers

1. Final product lacking the desired quality
2. Erratic supply of material by processors
3. Demand mostly in urban areas
4. Lack knowledge on proper packing, branding, safe storage and poor other marketing skills

3 Issues faced by Consumer

- Unhulled grains getting mixed with the millet rice due to inefficient processing technologies
- Presence of sand particles, small stones and other impurities along with the millet rice
- Pest infestation due to inefficient processing and poor packaging
- Lack of uniform size whole grain rice due to mixing of broken millet rice
- Lack of uniform size rava particles due to poor grading
- High moisture in the grain translates to poor quality millet rice
- Lack of availability of quality millet products
- Lack of knowledge on millet products and recipes
- Lack of knowledge on the health and nutritional benefits of millets
- Priced quite high

Challenges in Small Millet Processing

- Small size of grains needs careful inspection at every stage of processing
- No standard husk removal technologies for different types of millets
- Breakage of kernel
- Mixture of rice, broken kernel, unhulled grain and husk
- No quality standards available for raw material and final products
- Pest infestation is a challenge for chemical free processing
- Non availability of customized sieves for grading and better separation of material
- Variations in the grain sizes.

4

Understanding Quality Issues during Raw Material Procurement

To understand what constitutes **"Quality Raw Material"**, we need to understand the various components of the raw material that gets transported from the farm. Usually the material coming from the farm consists of the following:-

What comes from the farmers?

- Good quality grain *(This goes for processing)*
- Shriveled filled grain *(can be used bird or cattle feed)*
- Unfilled grain *(can be used for manure)*
- Big and small sticks *(waste)*
- Small stones *(impurities)*
- Big stones *(impurities)*
- Coarse sand *(impurities)*
- Find sand *(impurities)*
- Other impurities *(grass, mud pellets, other grains and etc.)*

"Except the good quality grain that goes for further processing, all the remaining components need to be separated. The quality depends to a greater extent on the percentage of these components in the raw material"

How to access the Quality of the Raw Material while Procuring?

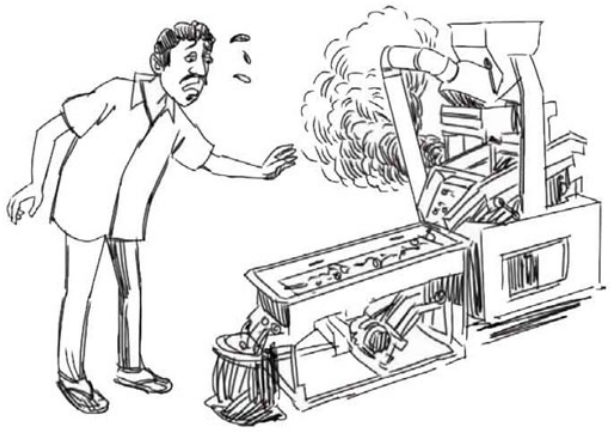
The most decisive parameters for assessing the quality of the raw material are as follows:-

- Percentage of foreign matter / impurities
- Moisture content in the material
- Checking for the moulds / cakes

The material can be physically checked for the quality. This can include randomly selecting a bag of raw material and grading it to check for the percentage of foreign matter / impurities present in it. The quality standards an be based on this, say we can arrive at a permissible value of foreign matter / impurities per quintal for procuring.

The raw can be given different quality grades based on the content of foreign matter / impurities against FAQ standards for the material. Moisture content in the raw material can also be checked physically, by inserting the hand deep into the bag. One can be feel the moisture on our hand if the material is not dried properly. Same can also be done using moisture meter. A moisture meter is a device which gives the moisture content in the raw material in percentage terms (moisture should be less than 12 percent). The moisture content in the raw material is a very important parameter for assessing the quality, which directly affects the quality of the final product. The material also needs to be checked for mould / cake formation. Formation of moulds / cakes leads to bad odour. This will rule out the presence of any harmful chemicals or any other quality issues in the material. Good quality raw material is usually odourless and presence of any strong smell in the material is a case for suspect.

Problems faced due to Presence of foreign matter / impurities in the Raw Material



- Increase in Processing duration
- Reduction in Life of the Processing Machines
- Inferior Quality of the Millet Product
- Reduced price realization due to poor quality

Problems faced due to Presence of Moisture in the Raw Material

- Percentage of Rice recovery **goes down**, rava and flour percentage **goes up**
- Cooked rice will have Bad Odour
- Processing Time increases

How to Store the Raw Material?

The following measures need to be taken for storing the raw material:-

1

The material should be filled in the gunny bags for storage only after sun drying for 2-3 days.

2

The material has to be stored in a close dry place with proper roofing for protection from rain.

3

The storage godown should be repaired, cleaned and fumigated properly before storage of the grains.

4

The floor has to be covered with proper dunnage and tarpaulin sheets may be further used to avoid absorption of moisture before placing the bags on the floor.

5

The raw material bags should not lean on the walls just to make sure that water does not seep through the walls into the bags during the heavy rains.

6

A clear distinction has to be made between different types of raw material while storing to avoid mix up. Once the materials get mixed up, it is very difficult to separate them.

7

Proper measures need to be taken for rodent control if the material is stored for longer duration

5 Machines required for Small Millet Processing at Block (or) Panchayat Level

Multi Thresher

Threshing is the process of loosening the edible part of grain (or other crop) from the chaff. Threshing does not remove the bran from the grain. Millet is traditionally threshed manually on the mud floor which increases impurities such as mud, sand and dust particles. This makes further processing very difficult.

Grader cum Aspirator

Primary cleaning is done using a grader cum aspirator with support of different sieve sizes. Grader separates good quality grain from sticks, big stones, sand, grass etc. Here the material with different shapes and sizes gets separated. Selection of the correct sieve type and size is crucial in this process. Before brining raw material for processing, it should be properly dried in sunlight for 2-3 days to bring the moisture levels to below 12%.

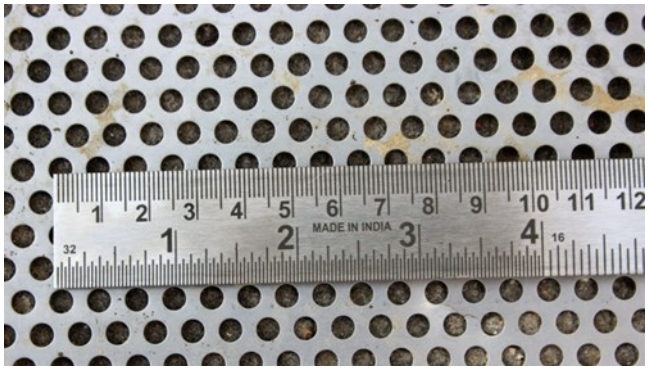
Proper care should be taken to prevent material from clogging Machine operator should use a brush to make sure the material doesn't clog. The good quality grains are sent for secondary cleaning for removing stones and mud balls. Graders come in three variants namely single deck, double deck and triple deck depending upon number sieves that can be used at a given point of time. For small millet processing, we normally use a triple deck grader with three sieves.

The top sieve will separate long sticks, big stones, grass etc., which are bigger in size than the gram, the middle sieve will separate the good grain and the bottom sieve will separate coarse and fine sand. The aspirator attached to the grader will have a small fan which will send the fine dust and sand particles to the rear end.

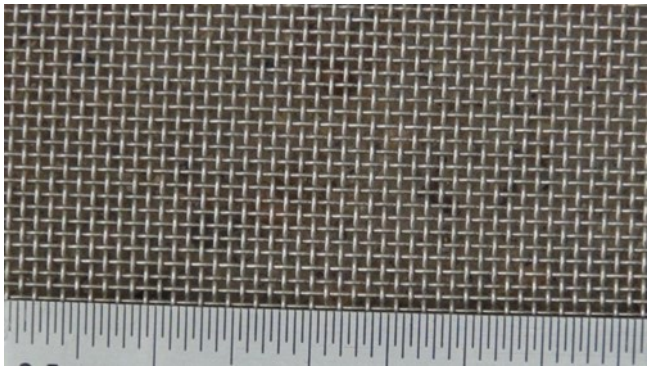
6

Sieves can be classified into Three Categories depending upon the Shape of the Holes

Slotted Punch Mesh



Round Punch Mesh



Wire Mesh

Standarization of sieve type and size is difficult due to variations in grains of the same type and we may need customized sieves.

Destoner

The material coming from the grader is sent to a destoner for removing small stones and mud balls which are identical in size. Destoner is a gravity separator which separates material based on the weight of the material. The material may have to go through many iterations depending upon the quality.

The cleaned grain from the destoner is sent for dehulling / dehusking. A destoner has two sieves under the hopper which grades the material coming from the hopper The graded material falls on the destoner bed where the lighter material moves towards the front end and the heavier material moves towards the rear end.

In some machines as per requirement, aspirator is also attached to the Destoner to remove the fine dust and sand particles. The air adjustment slot has to be adjusted carefully depending upon the material.

Dehuller cum Aspirator

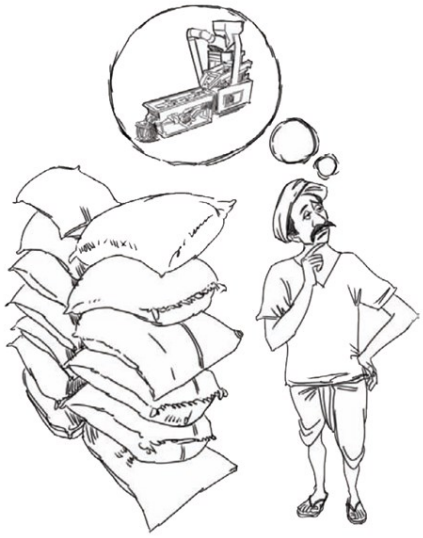
The raw material after going through a rigorous process of cleaning in the Grader and Destoner is sent for husk removal to the dehuller. Dehullers can be broadly classified into two types.

(a) Centrifugal dehullers: A centrifugal dehuller has an impeller which is responsible for the husk removal. The material is sent to the hopper which then enters the impeller, where it gets thrown with a great centrifugal force onto the impeller casing. Due to the heavy impact the husk gets separated from the rice and is sent to the aspirator where the lighter husk is collected at the back and the rice cum grain mixture is collected at the front. Usually a good quality centrifugal dehuller retains the bran on the rice, which is one of the main reason for its

(b) Abrasive Dehuller: Abrasive dehullers can be classified into two types namely (i) Emery type abrasive and (ii) Rubber roller type abrasive. In an Emery type dehuller two grinding stones are used for husk removal, where one stone is stationery and the other rotates at a constant speed. The raw material passes through these two grinding stones and the husk gets sheared or abrased off. In a rubber roller, type rubber rollers are used instead of grinding stones.

7

Challenges with Current Hulling Technologies



As we increase the hulling efficiency the percentage of broken rice also increases and as we decrease the hulling efficiency the percentage of unhulled grains increase. This is a major challenge with the current hulling technologies.

It is not possible to get cleaned whole grain rice in one pass using the above technologies. We have to use Grader and Destoner for separation of mixture containing whole grain rice, broken rice, rava and unhulled. grains Unhulled grains have to be separated and sent to the dehuller for husk removal again.

The performance of the machines is not same for all types of grains The percentage of rice recovered from foxtail millet is usually high when compared with other grains. The machine getting overheated when used for long hours is commonly seen in these machines.

8 Steps involved in Small Millet Processing

- It is advised to process the material in batches. A batch production is a technique used in manufacturing wherein the final product is created stage by stage over a series of work stations This mode of production is economical when we need repetitive iterations of the same process.
- We should make sure that we take atleast 500kg of raw material in one batch It is crucial that we analyse the results of each batch once the processing is completed.
- A sample batch report format is given in ***Annexure -3***.
- Firstly we should start the process by sending the raw material to the Grader hopper.
- In the grader bottom sieve (usually 1mm round punch mesh) will filter out coarse and fine sand from the material, the middle sieve (usually 19mm slotted punch mesh) will grade out the good material which will be sent to the Destoner for further cleaning. The top sieve (usually 2mm round punch mesh) will separate the big stones, sticks, big mud balls, grass etc.)

- The aspirator attached to the grader will push the fine dust particles, unfilled grains and other light particles to the rear end.
- The material separated from the middle sieve will have a mixture of good grain and small stones. This mixture will be sent to Destoner for further cleaning.
- Once the material is sent to the Destoner hopper, it passes through two sieves under the hopper. These sieves grade the material and make sure that only the best quality grain falls on the Destoner bed. We have to properly adjust the air adjustment slot in the blower the bottom of the destoner for efficient performance.
- The material after falling on the Destoner bed, due the periodic and upward motion gets separated using gravity The heavier stones jump towards the back and the best quality grain is collected at the front.
- The aspirator attached to the Destoner will push the fine dust particles, unfilled grains and other light particles to the rear end.
- Before we send the grain for dehusking we should check whether the grain has any stones or impurities left in it. If the material still has impurities left in it has to be destoned again.
- Efficiency of the hulling process depends on the moisture content of the grains and cleanliness of the material. Hence grains should have less moisture than 12%.
- The cleaned raw material has to be sent to the dehuller for removing the husk In the dehuller the husk comes from the back and the rice grain mixture comes from the front.
- The nice grain mixture coming from the Dehuller will contain whole grain rice, broken rice, rava, and unhulled grains Now this has to be sent to a grader for separation.
- We use 3 deck grader with different sized sieves (usually wire meshed sieves) for separation. From the bottom sieve we get rava kodo mix from the middle sieve we get whole grain rice mixed with some unhulled grains and from the top sieve we get unhulled grains.
- The whole grain rice mixed with some unhulled grains will be sent to the destoner. From the back side of destoner we get best quality whole grain rice and from the front we get rice mixed with unhulled grain.
- This process might have to be repeated depending upon the quality of the mixture coming from the dehuller. After separating the unhulled grains, they will be sent to Dehuller for further processing.
- Broken rice (*Nooles*) rava mix coming from the bottom sieve of the Grader and the rava mix collected in the destoner blower will be sent to round vibrator for further separation into upma rava (coarse rava) and idli rava (fine rava).
- The husk coming from the dehuller can be mixed with other grains and can be sent as animal feed after making it into powder. It can also be used as manure in the fields.
- Process layout diagram is given in ***Annexure–2***.

9 By-products coming from the Processed Material

- Unfilled and semi-filled grains - These can be used as bird feed and also can be mixed with cattle feed.
- Unhulled grains - The unhulled grains which are being separated can be mixed with same type grains in the next batch for processing.
- Broken kernel mixture (nooka mix) can be separated into upma rava (coarse rava), idli rava (fine rava) and flour. These can be marketed as separate products.
- Husk can be mixed with other broken millet kernels or naked millets and it's flour can be marketed as cattle feed. It can also be used as manure in the fields.

10 Machines available for Value Addition

The following are some of the machines available for value addition.

Rava Plate Mill

- Broken rice and second quality rice can be used for making Suji.
- Suji / Rava machine is used to break the rice into fine particles.

Triple Deck Round Vibrator

- The suji coming from the suji machine can be separated into coarse, fine and extra fine suji using the round vibrator.
- The coarse suji is generally used for making upma, fine suji for making idlis and extra fine suji for making halwa, kheer, sweets etc.

Pulverizer

- This machine is used for making millet flour

Food Extruder

- This machine can be used for making ready to eat snacks like pasta, flakes, bred flakes, etc.

11 Potential for Value Addition in Millets

- Unpolished whole grain rice can become a direct alternative to paddy rice.

- The coarse and fine ravas can be marketed as Upma rava and Idli rava respectively.

- All food varieties that can be made using paddy rice can be made using millets with minor changes in the method of preparation.

- Ready to cook products like Dosa mix, roti mix, kichdi mix, laddu mix, nutria mix can be marketed using processed millets.

12 Processing of Small Millets

Mini-dehullers to address millet processing issues at village level

- Dehulling is the process of removing the outer hull/husk from the minor millet grains. Traditionally dehulling process involves lot of drudgery and time consuming too. Traditionally, small millets (little millet, foxtail millet, kodo millet, proso millet, barnyard millets) were processed manually by women in the production regions using wooden ladles, pestle & mortar, wooden/stoner grinders, as there is little to no local processing infrastructure in the villages as that of paddy processing facilities. This process involves significant drudgery and time particularly to women. Due to this one of the reasons, the consumption of small millets has drastically declined in the production regions.
- There are many types of dehullers based on the need. Mini-dehullers are one such kind to address the issue related to processing at village level.

Millet Processing Now Made Easy

Millet Mixer (De-huller)

Technology Support for Traditional Food

Step Wise Operating Guide

(Tested For Foxtail and Little Millet only)

1 CLEANING RAW MATERIAL

Step-1 :

Sun dry millets to ensure moisture is in between 10-12% (check by hand inside the bag for dampness)

Step-2 :

Manually remove foreign particles (like stones, sticks, sand, other grains, etc.) using S1-white (2mm) & then S3-black (1mm) sieve, winnowing if required

2 DEHULLING

Step-3 :

Fill the millets in measuring jar provided (approx. – 100 grams)

Step-4 :

Pour measured quantity in mixer jar x 3 times (approx. – 300 grams)

Step-5 :

Cover jar with lid & run mixer for 30 seconds (max). Time keeping can be done using mobile or stop watch

Step-6 :

De-hulled millet is ready

3 GRADING

Step-8 :

De-hulled Millet to be graded in S2-grey (1.5mm) & then in S3-black (1mm) sieves

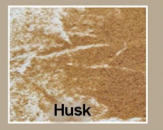
Step-7 :

Winnowing manually (if required) to remove husk, before using sieves

Step-9 :

Collect output from each sieve after grading and store separately

Millet Rawa (Foxtail)



Husk

Millet Rice (Foxtail)

Note: DO NOT throw away the un-hulled grains after grading; Store them separately till the quantity is 300 grams and then process in the mixer

Note: Repeat STEPS 3 to 6 till 1 Kg of Millets are processed; then STOP Mixer to cool for 5 minutes minimum

PRECAUTIONS

- DO NOT use millets with more than 12% moisture content / ungraded millets
- NEVER put more than 300 grams millets in the jar
- After processing 1kg millets, STOP mixer for 5 minutes to allow motor to cool
- NEVER run the mixer continuously for more than 2 minutes
- ONLY process millets and no other material in these mixers
- To use standard parts only for replacement after CONSULTING with local team member

Resetting over load switch

If the overload switch trips and mixer stops, WAIT for 2 minutes, before resetting the switch (location of the switch shown in the figure)

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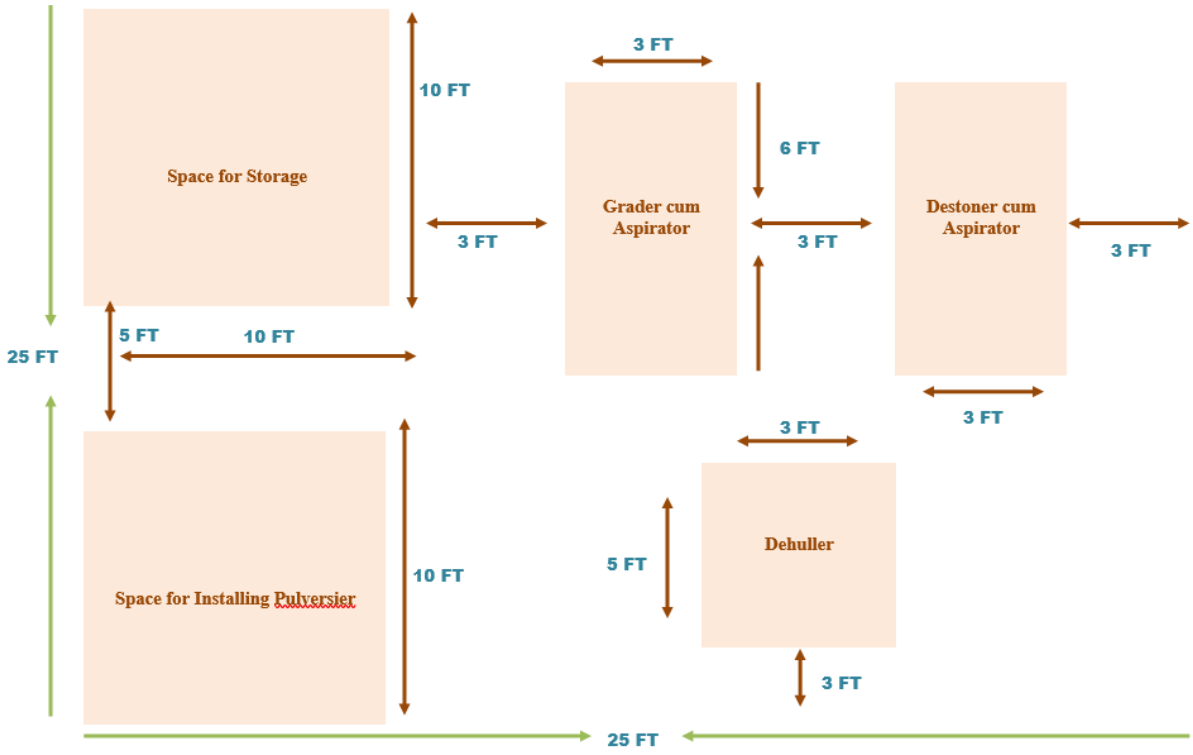
e-mail: info@gofarmeasy.in,
Ph.No. 95502 61862

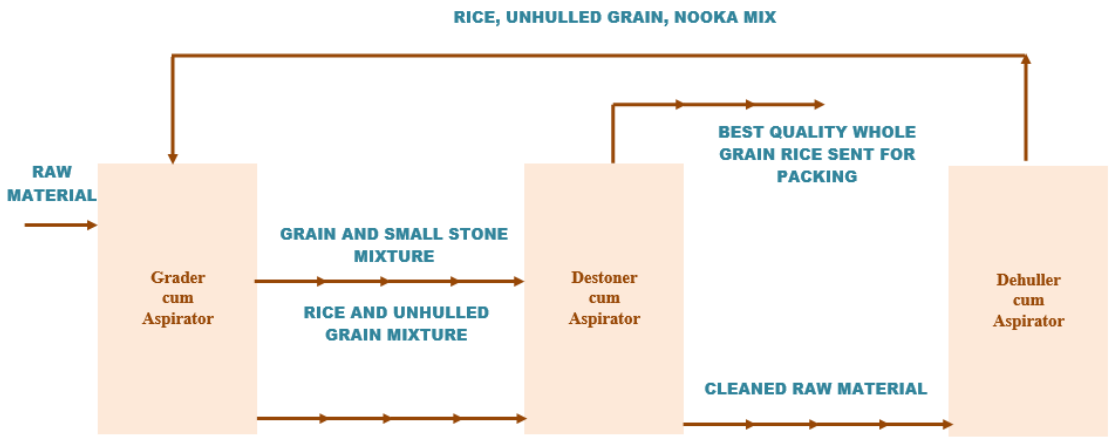
13 Annexure - 1

1.1 Processing Unit Design and Layout

- To establish a processing unit at village or block level you need at least 25 x 25 ft storage space with proper flooring and dunnage. At least half feet concrete laid under the flooring where the machines will be installed. The height of the walls should be least be 15 ft tall with exhaust fans in all the four corners.
- All machines have to be installed using foundation bolts to arrest vibrations and also balanced properly. Machine installation is critical because it would directly affect the performance and life of the machine.



1.2. Process Flow of Small Millet Processing



1.3 Batch Report Format

Batch Number	Date	Raw Material to be Processed

Weight of the Raw Material (Kgs)	Time Taken for Processing

Processing details of Grader cum Aspirator	Processing Details of Destoner cum Aspirator	Processing Details of Dehuller
Waste from outlet 1 kg	Waste from outlet 1 kg	Waste from outlet 1 kg
Waste from output 2 kgs	Waste from output 2 kgs	Waste from output 2 kgs
Waste from outlet 3 kgs	Waste from outlet 3 kgs	Waste from outlet 3 kgs
Waste from outlet 4 kgs	Waste from outlet 4 kgs	Waste from outlet 4 kgs

Note

UNDERSTANDING SMALL MILLET PROCESSING QUALITY ISSUES AND SUITABLE OPTIONS