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# Development of Portable Ragi Thresher and Winnowing Machine

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**ABSTRACT**

Ragi (finger millet) is a vital crop in many parts of India and other regions in Africa and Asia, known for its high nutritional value. The traditional methods of threshing and winnowing ragi are labor-intensive, time-consuming, and low yield. The present research work presents the Development of a portable ragi thresher and winnowing machine aimed at addressing these challenges. The proposed machine integrates both threshing and winnowing processes into a single compact and portable unit, making it suitable for small-scale farmers and rural communities.

The portable ragi thresher reduces the physical effort and time required for threshing. The winnowing component uses air flow generated by a fan system to separate the lighter chaff from the heavier ragi grains, ensuring a cleaner and more efficient process compared to manual winnowing. The machine is powered by a small motor.

This innovative solution aims to improve productivity, reduce post-harvest losses, and make ragi processing more accessible to smallholder farmers. The design is lightweight, mobile, and economical, making it feasible for widespread adoption in rural areas. The machine's efficiency, ease of use, and low maintenance requirements are expected to significantly enhance the overall agricultural value chain for ragi cultivation. This development could contribute to improved food security, higher income for farmers, and promote the sustainable use of local agricultural resources.

**Keywords:** Ragi, Finger millet, Thresher and Winnowing machine, Agriculture, Design, Labour

## 1. INTRODUCTION

Agriculture is the backbone of many economies, and technological advancements in farming tools have revolutionized the way crops are processed. Among these innovations, ragi threshers and winnowing machines play a crucial role in the efficient post-harvest processing of small grains such as ragi (finger millet). These machines are essential for improving productivity, reducing manual labor, and ensuring better quality and yield of grains.[1,2]

Ragi, also known as finger millet, is a staple food crop widely cultivated in various parts of India, particularly in Karnataka, Tamil Nadu, and Andhra Pradesh. Despite its nutritional value and importance in dryland farming systems, post-harvest processing of ragi remains a labor-intensive and time-consuming task. The traditional methods, including manual beating or bullock trampling, often result in inconsistent grain quality and substantial post-harvest losses.[1,2]

Small and marginal farmers, who constitute the majority of ragi producers, often lack access to large-scale mechanized equipment due to high costs, space constraints, and maintenance requirements. As a

result, there's a significant need for portable, affordable, and efficient machinery that can handle threshing and winnowing in a single setup.

This project aims to address these issues by designing and fabricating a compact, portable ragi thresher and winnowing machine. The goal is to offer a multi-functional solution that is not only low-cost and easy to operate but also suitable for use in rural settings with limited resources. The system is designed to work using electric power or manual pedaling, making it operable even in areas with unstable electricity.

By integrating threshing, winnowing, and optional grinding into one unit, the proposed machine provides an all-in-one post-harvest solution. This innovation can significantly reduce labor dependency, minimize grain loss, and enhance processing speed and grain quality, ultimately improving the economic return for small-scale ragi farmers.

### 1.1 RAGI THRESHER:

A Ragi thresher is a specialized agricultural machine designed to separate ragi grains from their stalks efficiently. Traditional methods of threshing, such as manual beating or animal- powered techniques, are labour intensive and time-consuming. A Ragi Threshing Machine plays a pivotal role in the post-harvest processing of finger millet. Its primary function is to separate the ragi grains from their stalks and husks efficiently and with minimal loss.[1]

### 1.2 RAGI WINNOWING:

A Ragi winnowing machine is an essential agricultural tool designed to separate ragi grains (finger millet) from chaff, husks, and other impurities after threshing. This machine mechanizes the traditional winnowing process, which relies on manual labour or natural wind, making it more efficient and consistent. The winnowing machine operates on the principle of air currents and gravity. The ragi mixture is fed into the machine, where a controlled stream of air is used to blow away lighter materials like chaff and dust, while the heavier grains settle and are collected. Many models include adjustable airflow settings to suit different grain sizes and levels of impurity, ensuring precise cleaning without grain loss. The machine is often portable and powered by electricity or diesel, making it suitable for both small-scale and large-scale farming operations. Its ability to quickly and effectively clean grains reduces labour costs, saves time, and enhances the quality of the final product, making it a valuable investment for farmers in regions where ragi is a staple crop.[3]

## 2. TRADITIONAL AND CURRENT PRACTICES

### 2.1 MANUAL BEATING WITH STICKS

**Fig 2.1 Manual beating**

The harvested ragi stalks are gathered into small bundles. These bundles are either beaten manually against a hard floor or stone slab, or beaten with sticks by hand while laid on the ground or a tarpaulin sheet. The impact causes the grains to detach from the stalk and fall to the ground. The separated grains are then collected and cleaned manually or by winnowing with baskets.

**Limitations:**

Labor-intensive: Requires a significant amount of manpower, especially when processing larger quantities.

Time-consuming: The process is slow and inefficient compared to mechanized alternatives.

Inconsistent results: Not all grains may separate evenly; some may remain attached or get damaged.

Grain loss and contamination: Grains may scatter, get crushed, or mix with dirt or debris on the floor.

**2.2 ANIMAL TRAMPLING**

**Fig 2.2 Threshing by bullocks**

Harvested ragi stalks are spread in a circular pattern on a hard surface or a threshing floor (usually made of mud, stone, or concrete). One or two bullocks are tied together and made to walk in circles over the ragi repeatedly. The weight and motion of the animals crush the stalks under their hooves, loosening and separating the grains. After sufficient threshing, the mixture is swept and collected. The grain is then winnowed using natural wind or hand-operated winnowing baskets to remove husk and chaff. The grain is then winnowed using natural wind or hand-operated winnowing baskets to remove husk and chaff.

**Limitations:**

Time and labor intensive: The process takes several hours and requires constant supervision.

Animal maintenance: Bullocks require feeding, care, and rest, adding to the operational burden.

Uneven threshing: Grains may remain partially attached or get crushed due to over-trampling.

Weather dependency: This process typically takes place in open fields, making it vulnerable to sudden rains or strong winds.

Hygiene issues: Animal droppings or dust can contaminate the grains during processing.

## 2.3 THRESHING USING TRACTOR-DRAWN STONE ROLLER:

**Fig 2.3 Tractor-drawn stone roller**

A large cylindrical stone or concrete roller is attached to a tractor using a chain or rigid drawbar. Harvested ragi stalks are evenly spread out over a prepared threshing floor. The tractor pulls the heavy roller in circular or figure-eight paths over the ragi repeatedly. The rolling and compressive action of the stone roller separates the grains from the stalks by crushing the husk and loosening the grain heads. After multiple passes, the grain-straw mixture is collected and cleaned through manual or mechanical winnowing.

**Limitations:**

Requires tractor availability: Not suitable for farmers who don't own or have access to a tractor.

Inefficient grain separation: Unlike dedicated threshers, this method may not fully separate the grains or may require repeated passes.

Grain breakage risk: Excessive pressure from the roller can damage or crush ragi grains.

Bulky equipment: The stone roller is heavy and hard to transport to distant fields.

Manual collection still needed: Post-threshing tasks like gathering grains and winnowing are still done manually.

## 2.4 CURRENTLY PRACTICED METHOD


**Fig 2.4 Combine harvester**

One of the most advanced methods currently used in large-scale ragi and millet cultivation is the use of combined harvesters. These machines are capable of harvesting, threshing, and cleaning grains in a single operation.

The working procedure of this method: The header of the harvester cuts the standing ragi crop. The cut crop is fed into the threshing drum where grains are separated from the stalks using a rotating cylinder and concave mechanism. A cleaning system with sieves and fans helps separate chaff and light debris. The clean grain is collected in a grain tank, while the residue is expelled.

**Limitations:**

Not affordable for small or marginal farmers.

These machines are generally optimized for paddy, wheat, and maize. Ragi threshing efficiency may be lower or require modification.

Cannot be used in small or terraced landholdings.

Increases operational costs and environmental impact.

**2.5 MANUAL V/S MACHINE METHOD: COMPARATIVE ANALYSIS:**

To understand the benefits and trade-offs between manual and machine-based threshing and winnowing of ragi, a comparison was made based on real-world feedback and cost-performance data. While machines offer labor and time savings, some farmers still prefer manual methods due to lower grain loss and better control over the process.

**Comparative loss metrics:**

| Method | Grain loss (%) | Labor required | Cost per acre (₹) |
|---|---|---|---|
| **Manual** | 5–8% | 10–12 people | ₹2,500 |
| **Machine** | 12–15% | 2–3 people | ₹1,000 |

**2.6 COMPARATIVE TABLE: MARKET COST AND FUNCTIONALITY**

| Machine Type | Functionality | Cost (Rs) |
|---|---|---|
| Thresher Machine | Grain separation only | ₹70,000 – ₹1.2 Lakh |
| Winnowing Machine | Chaff/husk removal | ₹40,000 – ₹80,000 |
| Flour Mill Machine | Grain to flour conversion | ₹50,000 – ₹1.5 Lakh |
| Total (3 Machines) | Separate, space-consuming units | ₹1.6 – ₹3.5 Lakhs |
| SSIT Combined Machine | Threshing + Winnowing + Flouring in 1 | ₹19,470 |

| Machine | Functionality | Cost (Rs) |
|---|---|---|
| John Deere W70 Combine | Harvest + Thresh + Partial Cleaning | ₹25–30 Lakhs |
| + Flour Mill (separate unit) | Required for grinding | ₹50,000 – ₹1.5 Lakhs |
| Total System (High-End) | Multi-unit, high area/power need | ₹25.5 – ₹31.5 Lakhs |
| SSIT Combined Machine | All 3 functions in one portable unit | ₹19,470 |

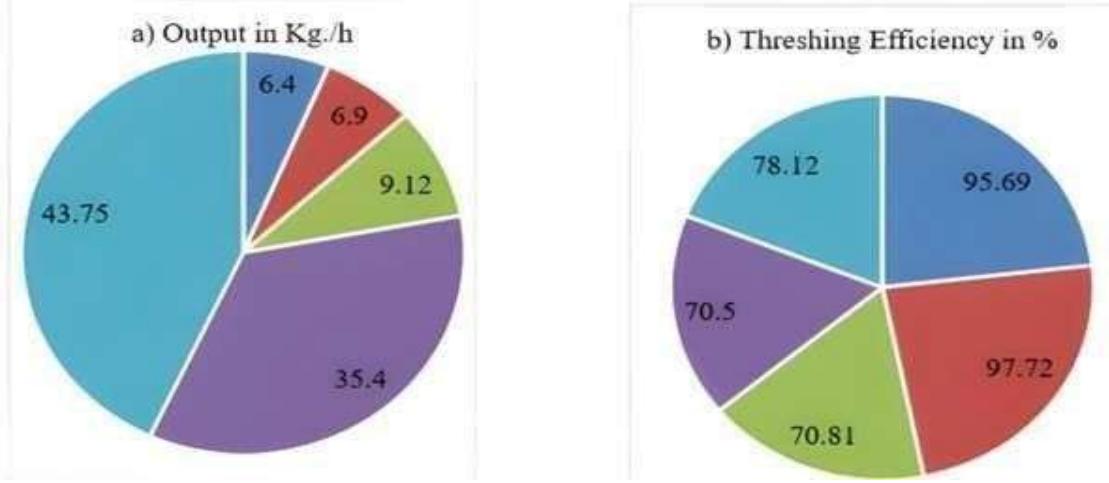


**Fig 2.5 Pie chart of output and threshing efficiency**

Where,

- Where, Manual hand beating
- Manual foot trampling
- Pedal operated thresher
- Ragi thresher-cum-pearlier with blower

**The pie chart (a)** displays the productivity of various threshing methods:

a. Ragi thresher-cum-pearlier with blower: 43.75 Kg/h
b. Pedal operated thresher: 28.25 Kg/h
c. Cage wheel method: 15.60 Kg/h
d. Manual hand beating: 6.40 Kg/h

**The pie chart (b)** highlights the efficiency of different threshing methods:

a. Pedal operated thresher: 97.72%
b. Manual hand beating: 97.16%
c. Cage wheel method: 95.62%
d. Ragi thresher-cum-pearlier with blower: 70.50%

## 2.7 PROBLEM IDENTIFICATION

1. In traditional way, farmers were separating ragi manually by beating the husk. This method requires lot of manpower which also consumes more time.
2. The machineries that are being used nowadays are much bigger in size. It cannot be moved around from one place to another easily. And this machines also requires skilled labors too.
3. The existing machines consumes more fuel which also cause pollution on burning the fuel in the environment.
4. The existing machineries like threshers and winnowing machines cannot be affordable for small scale farmers.
5. Existing machines is highly expensive.
6. The machines that are now required high maintenance and difficult to service.
7. The existing machines do not have a combining threshing and winnowing machine.

## 2.8 HOW TO OVERCOME THE PROBLEM

1. Developing compact and portable threshing and winnowing machines that are easy to operate and transport, requiring less manpower. These machines could be designed to be lightweight, with a sma-

ll footprint, making them more practical for small-scale farmers.

2. Manufacturing lightweight machine that are easy to transport and move from one location to another. The modular design could also allow farmers to choose specific components (threshing, winnowing, or both) according to their needs.
3. Transition to energy-efficient, electric-powered machines instead of diesel-powered ones. These would not only reduce fuel consumption but also lower the environmental impact by eliminating pollution from burning fuel.
4. Implementing cost-effective manufacturing methods, such as using available materials or simplifying machine designs, to reduce the production costs of threshers and winnowing machines. Economies of scale could help bring down costs as demand increases.
5. Developing combined threshing and winnowing machine that can perform both functions in a single, efficient unit. This would reduce the number of machines farmers need to purchase, saving on both space and cost. A multi-functional machine would streamline operations, reduce setup times, and improve overall efficiency.
6. Establish collaborative partnerships between agricultural universities, government bodies, and agricultural technology companies to fund research aimed at creating more affordable, efficient, and sustainable threshing and winnowing machines.

**2.9 OBJECTIVES**

1. This machine is operated by using electrical power.
2. To increase the efficiency of thresher and winnowing machine.
3. Thresher, winnowing and flour operation can be done in the same machine.

## 3. DEVELOPMENT OF MACHINE

### 3.1 DEVELOPMENT OF MODEL

**2-D SKETCH AND 3-D MODEL**

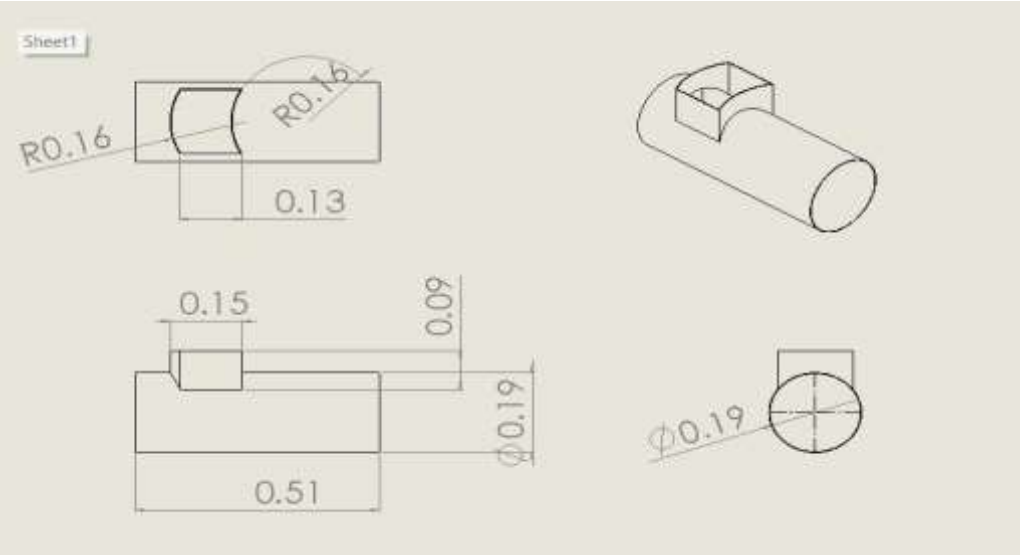


**Fig 3.1: 2-D sketch of model**

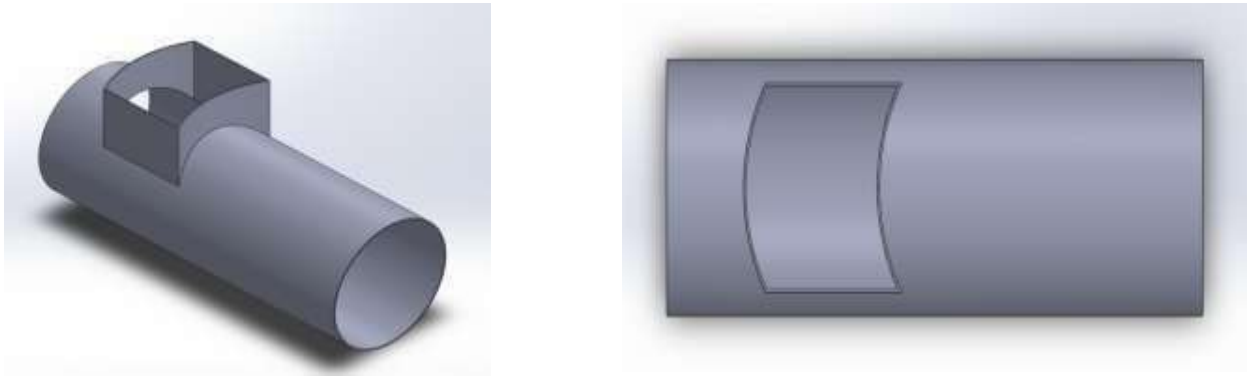

**Fig 3.2 3-D model**

### 3.2 COMPONENTS USED

**Circular plate with pattern:**

**Fig 3.3 Circular plate with pattern (thresher)**

This is a stationary threshing plate with patterned ridges that help in gently crushing or rubbing the ragi husk as it passes through. The design helps loosen the grains from the husk with minimal damage. It plays a crucial role in pre-separation before airflow winnowing.

**Discharge chute:**

**Fig 3.4 Discharge chute**

The discharge chute is an outlet component that directs the processed material either cleaned grains or separated husk—out of the machine. Its curved and enclosed structure ensures smooth flow and prevents spillage, making the collection process cleaner and more controlled.

### 3.3 COMPONENTS DEVELOPED:

#### 3.3.1 Funnel:

**Fig 3.5 Funnel preparation**

This image shows the cutting and welding of metal sheets to form the funnel or feeding hopper. The funnel directs the ragi husk smoothly into the auger screw. Proper shaping and angling are critical to ensure uninterrupted material flow. Workers are seen using welding to join the metal cone.

#### 3.3.2 Drum:

**Fig 3.6 Drum preparation**

A square hole is cut in the cylindrical body for material input or discharge. An angle grinder is used to smooth out the metal edges and prepare it for assembly. This drum is placed slanted inside the machine for grain and husk separation. The main separation drum or chute is being fabricated. A square hole is cut in the cylindrical body for material input or discharge. An angle grinder is used to smooth out the metal edges and prepare it for assembly. This drum is placed slanted inside the machine for grain and husk separation.

#### 3.3.3 Screw conveyer:

**Fig 3.7 Screw conveyer**

The auger screw is being turned on a lathe machine. The helical structure is precisely machined to ensure effective transport of ragi husk from the funnel to the processing section. The turning process helps maintain symmetry and smooth surface finish for efficient rotation and movement.

**3.3.4 Pulley:**

**Fig 3.8 Pulley preparation**

In this stage, the pulley is being drilled to create a center bore and mounting holes, which allow it to be securely fixed. Accurate drilling ensures proper alignment and balance, which is essential for smooth power transmission without vibrations. This pulley will be used to drive components like the auger screw via belt mechanism.

**3.3.5 Stand preparation:**

**Fig 3.9 Stand preparation**

The image shows the preparation of the supporting frame (stand) using mild steel square pipes. The structure is measured, cut, and assembled using welding equipment. The stand acts as the base for mounting all machine components such as the funnel, auger screw, motor, and bins. The rectangular layout provides mechanical stability, and mounting brackets are welded at specific points to hold various parts. Precision in fabrication ensures alignment of components and durability under operating loads.

### 3.3.6 Motor:

**Fig 3.10 Motor**

This stage involves the installation of the electric motor onto the fabricated frame. The motor is positioned on a metal plate.

### 3.4 FINAL MODEL:


**Fig 6.9 Final model**

The final assembly stage shows the complete integration of all components onto the fabricated frame. This includes the feeding funnel, auger screw, slanted separation drum, fan unit, motor, chain and pulley system, and collecting bins for ragi and dust. Each component is aligned and fixed securely in place, ensuring smooth flow from input to output. The pulley is connected to the motor and auger via a belt or chain, and the fan is positioned to generate the airflow needed for winnowing.

### 3.5 WORKING PROCEDURE

**Loading ragi husk:** The process begins by pouring the harvested ragi husk into the feeding funnel located at the top of the machine. The funnel is designed with an optimal inclination and width to ensure a consistent flow of material. This step initiates the movement of raw husk through the system for further processing

**Transportation to thresher:** An auger screw mechanism is installed below the funnel, which rotates and transfers the ragi husk horizontally to the threshing section. The screw conveyor ensures a uniform and continuous flow of material, preventing blockages and ensuring steady throughput during operation.

**Threshing process:** The core of the machine involves a threshing section where the ragi husk is fed between two fixed or slightly adjustable circular plates with patterned surfaces. These plates apply controlled pressure and friction to the husk, facilitating the separation of ragi grains from the husk. The design prevents grain breakage while ensuring high separation efficiency. Since the drum does not rotate

(as clarified), friction occurs due to the movement against the patterned surfaces and directional flow control.

**Winnowing process:** Once separated, the mixture of grains and husk enters the winnowing section, where an integrated electric fan or blower is activated. The fan produces a targeted airflow that effectively blows away lighter impurities such as husk, dust, and chaff. The heavier ragi grains naturally fall into the collection bin, resulting in clean and ready-to-use grains. The airflow may be adjustable to optimize cleaning for different grain types or impurity levels.

**Reprocessing for flour:** For value-added processing, the cleaned ragi grains are re-fed into the funnel, where the space between the circular plates is narrowed. This reduced clearance allows the grains to be crushed into fine flour using controlled mechanical pressure. This secondary pass transforms the machine into a flour mill, capable of producing fine ragi flour suitable for direct use in cooking or packaging.

**Versatility:** One of the key advantages of this machine is its multi-functionality. The design supports not just ragi but also other small millets such as foxtail millet, little millet, or barnyard millet. The ability to switch between threshing, winnowing, and grinding operations in a single compact unit adds significant value for small-scale or marginal farmers, especially in diverse cropping systems.

### 3.6 FINAL OUTPUT:

At the end of the process, the machine delivers:

a. Clean ragi grains, free from husk and chaff, ready for sale, storage, or consumption.
b. Fine ragi flour, in case grinding is carried out, suitable for immediate culinary use or retail packaging.
c. This makes the machine a complete post-harvest processing unit, improving both efficiency and the economic value of the produce.

### 3.7 EFFICIENCY OF THE MODEL

| Trial No. | Input Weight (kg) | Clean Ragi Output (kg) | Waste Output (kg) | Unthreshed (kg) | Crushed Ragi Wastage (kg) | Efficiency (%) | Ragi Output per Hour (kg) |
|---|---|---|---|---|---|---|---|
| 1 | 5.0 | 4.25 | 0.4 | 0.2 | 0.15 | 85% | 8.5 |
| 2 | 5.0 | 4.40 | 0.3 | 0.2 | 0.1 | 88% | 8.8 |
| 3 | 5.0 | 4.50 | 0.25 | 0.15 | 0.1 | 90% | 9.0 |

## 4. CONCLUSIONS:

**1. Efficient grain separation**

The threshing machine effectively separates the ragi grains from the stalks, reducing manual labor significantly. It can handle large volumes in less time, which is ideal for bulk processing.

**2. Reduced labor and time costs**

The machine automates the labor-intensive processes of threshing and winnowing, allowing farmers to save time and reduce dependency on manual labor, which can be costly and challenging to source during peak harvest seasons.

**3. Improved grain quality**

The winnowing function separates unwanted chaff, husks, and debris, resulting in cleaner, higher quality ragi grains. This improves the market value and usability of the grains for various purposes, including flour and food production.

**4. Consistency in processing**

Machines ensure a uniform, consistent quality of grains by providing a standardized method of separation and cleaning. This consistency can improve the end-product quality in food processing industries.

**5. Limited reduced physical strain on farmers**

Mechanical threshing and winnowing reduce the physical effort required by farmers, particularly helpful for older farmers or those with manpower.

## 5. SCOPE FOR FUTURE WORK:

1. There is a significant opportunity for developing smaller, more portable threshers and winnowing machines that can be easily transported and stored by small-scale farmers. This could be achieved through the use of lightweight materials, collapsible components, and compact designs.
2. The incorporation of Internet of Things (IoT) and Artificial Intelligence (AI) into ragi threshers and winnowing machines can help create smart systems that optimize machine performance, monitor conditions, and predict maintenance needs. These technologies can also automate the process further, reducing the need for manual labor.
3. To make threshers and winnowing machines more affordable for small-scale farmers, future work could focus on local production techniques such as 3D printing and decentralized manufacturing. These methods could lower production costs and allow for the creation of custom parts and machines tailored to local needs.
4. Future designs should prioritize easy-to-repair machines with durable materials that can withstand harsh field conditions. This would include creating modular components that can be quickly replaced and reducing the complexity of machines so that local technicians can maintain them with minimal expertise.
5. There is considerable potential in designing multi-functional machines that combine threshing, winnowing, and even additional processes like cleaning, sorting, and grading. This would streamline the post-harvest process and reduce the need for multiple machines.

## 9. REFERENCES

1. Hanumantharaju K N, Poornima D S, Ramya H N, Ashoksuraj Byrapura Sheshagiri Rao, "DEVELOPMENT AND PERFORMANCE EVALUATION OF WHOLE CROP FINGER MILLET THRESHER", 2019, An International Refereed, Peer Reviewed & Indexed Quarterly Journal in Science, Agriculture & Engineering, Page 110-115, Vol 09, Issue 31, Publisher: DEPARTMENT & RESEARCH CENTRE IN BOTANY, YASHVANTRAO CHAVAN MAHAVIDYALAYA MANGRULPIR, DIST WASHIM, MAHARASHTRA, INDIA, PIN 444403.
2. Subir Chakraborty, Narendra Singh Chandel, Champat Raj Mehta, "Role of Mechanization Towards a Sustainable Revival of Millet Cultivation" 2025, Centre for Sustainable Agriculture Mechanization
3. Rajesh Rajkolhe, Hrushikesh Gangane, Gaurav Bhatkar, Kishor Dabhade, "Design Optimization of Multi Crop Mini Thresher", International Research Journal of Engineering and Technology (IRJET),

Volume: 08 Issue: 07 July 2021, Page: 4765-4767

4. Sushant Nikam, Prathamesh Gosavi, Akshay Bhoir, Yogesh Dhekale, Prof. Megha Korde,"Design and Fabrication of Rice Threshing Machine" , International Research Journal of Engineering and Technology (IRJET), Volume: 08 Issue: 05 | May 2021, Page 2191-2200
5. Anbumalar, Aswin, Mohammed Safah, Muthuvel, "RAGI THRESHER MACHINE WITH IOT", International Research Journal of Modernization in Engineering Technology and Science, Volume:07/Issue:04/April-2025, Page:9644-9650,
6. HS Sridhar, Bhaskar G, "Development of single wheel multi use manually operated weed remover", 2013, International Journal of Modern Engineering Research, Volume 3, Issue 6, Pages 3836-3840.