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Low-Cost Indigenous Paddy Collector and Spreading Machine for the Benefit of the Farmer

N.Kawin[1], S.L.Harish[2], A.B.Hirthik Roshan[3], D.Dharmarajan[4]

Assistant Professor Mechanical Engineering, Kongunadu college of engineering and technology, Trichy, India[1]
Mechanical Engineering, Kongunadu college of engineering and technology, Trichy, India[2,3,4]

Abstract- The project aims to address the challenges faced by farmers in the manual sun-drying process of harvested grains by introducing a low-cost indigenous paddy collecting and spreading machine. Currently, the sun-drying process involves the labour-intensive efforts of 20-30 workers and is financially burdensome for farmers. Additionally, alternative methods utilizing fuel or expensive foreign machines present additional barriers to adoption due to cost and maintenance concerns. The proposed machine, constructed from recycled plastic and powered solely by mechanical energy, offers an affordable and sustainable solution to grain drying. By automating the collecting and spreading of paddy, the machine streamlines the drying process, reducing labour requirements and operational costs for farmers. Moreover, its indigenous design ensures that maintenance and replacement of parts are feasible and cost-effective. Through the development and implementation of this innovative machine, farmers can enhance the efficiency of their grain-drying operations while reducing dependency on manual labour and costly equipment. The project underscores the potential of indigenous technology to empower farmers and improve agricultural practices, ultimately contributing to sustainable rural development and food security.

Keywords: Spiral baffles, Helical coil spring, Double pipe heat exchanger, Overall heat transfer coefficient, Pressure drop.

I. INTRODUCTION

In agriculture, the post-harvest handling of crops, particularly grains like paddy, is a critical aspect that significantly impacts both the quality of the produce and the livelihoods of farmers. Among the various post-harvest processes, drying the harvested grains is of utmost importance to prevent spoilage and ensure market readiness. However, traditional methods of sun drying, while effective, often pose challenges in terms of labour, time, and cost, particularly for small- scale farmers.

In many agricultural regions, the sun drying process for paddy involves the manual labour of 20-30 workers, making it both labour-intensive and financially burdensome for farmers. Moreover, alternative methods such as fuel-based drying or expensive imported machinery are not always feasible due to cost constraints and maintenance issues. The need for a low-cost, efficient, and sustainable solution to grain drying is evident, especially in regions where access to modern equipment is limited.

The project seeks to address this pressing need by developing a low-cost indigenous paddy collecting and spreading machine tailored specifically for the drying process of harvested grains. By leveraging recycled plastic materials and mechanical energy,

the machine aims to streamline the labour-intensive aspects of grain drying while remaining affordable and environmentally sustainable. Unlike conventional methods or costly imported machinery, the proposed solution offers farmers a practical and accessible means to improve post-harvest operations.

In the subsequent sections, we will delve into the design, development, and implementation of the paddy collecting and spreading machine, exploring its technical specifications, operational benefits, and potential impact on the farming community. By examining the project from various angles, we aim to highlight its significance in addressing critical issues in agricultural production and advancing sustainable rural development.

In the heart of India's agricultural landscape, where rice cultivation is not merely a livelihood but a deeply ingrained tradition, the post-harvest drying process of paddy grains holds paramount importance. For generations, farmers have relied on manual sun-drying techniques, a method that, while effective, presents numerous challenges and inefficiencies.

II. LITERATURE REVIEW

The literature survey conducted for this project explores recent advancements and innovations in agricultural machinery, particularly focusing on post-harvest handling techniques such as grain drying. The survey highlights the importance of affordable and sustainable solutions in agricultural practices, emphasizing the need for machinery that reduces labour, energy costs, and environmental impact. Various publications discuss the design, development, and application of indigenous technologies aimed at improving post-harvest processes, including grain drying and storage. Through a review of existing literature, the survey aims to identify key trends, challenges, and opportunities in the field of agricultural machinery, providing valuable insights for the development of a low-cost indigenous paddy-collecting and spreading machine.

Ahmad, N. et.al., (2018). [1] "Design and Development of Indigenous Rice Processing Machine." ARPN Journal of Engineering and Applied Sciences. This paper presents a study on the design and development of indigenous rice processing machines, focusing on enhancing post-harvest handling processes.

Alomar, T. et.al., (2019). [2] "Design and Development of Low-Cost Agricultural Machinery for Rural Communities: A Review." Journal of Agricultural Engineering. The review discusses the design and development of low-cost agricultural machinery, emphasizing its relevance for rural communities.

Dey, S. et.al., (2020). [3] "Innovations in Rice Harvesting and Processing Machinery: A Review." International Journal of Agriculture, Environment and Biotechnology. This review explores recent innovations in rice harvesting and processing machinery, highlighting advancements in post-harvest handling techniques.

Gupta, A. et al., (2017). [4] "Innovative Design and Development of Low-Cost Agriculture Equipment: A Review." Journal of Agricultural Engineering. The paper reviews innovative designs and developments in low-cost agricultural equipment, addressing the need for affordable solutions in agriculture.

Islam, M. S. et al., (2018). [5] "Design and Development of a Low-Cost Paddy Drying System for Rural Areas." International Journal of Agricultural Research, Innovation and Technology. This study focuses on the design and development of a low-cost paddy drying system suitable for rural areas, aiming to improve post-harvest processing efficiency.

Jha, S. K. et al., (2019). [6] "Sustainable Design of Agricultural Machinery: A Review." Journal of Agricultural Engineering. The review discusses sustainable design principles in agricultural machinery, highlighting the importance of environmental considerations in design processes.

Khan, M. A. et al., (2017). [7] "Development of Low-Cost Agricultural Machinery: A Case Study of South Asian Countries." Journal of Agricultural Machinery. This paper presents a case study on the development of low-cost agricultural machinery in South Asian countries, emphasizing the need for cost- effective solutions in agriculture.

Kumar, et al., (2019). [8] contribute to the discourse with their study on "Sustainable Solutions for Rice Cultivation: Design and Development of Low- Cost Paddy Collector and Spreader." Their research emphasizes the need for environmentally friendly and resource-efficient technologies to promote sustainable agricultural practices. By focusing on the development of low-cost machinery tailored to the needs of farmers, they aim to enhance productivity while minimizing environmental impact.

Patil, S. et al. (2018). [10] "Low-Cost Agricultural Machinery for Small-Scale Farmers: A Review." Journal of Agricultural Science and Technology. This review discusses the development of low-cost agricultural machinery tailored for small-scale farmers, addressing the need for affordable solutions in agriculture.
Rahman, M. M. et al., (2019). [11] "Design and Development of Indigenous Paddy Collecting Machine." Journal of Mechanical Engineering Research and Developments. The paper presents the design and development process of an indigenous paddy collecting machine, aiming to enhance post-harvest handling efficiency in rice cultivation.

III. PROBLEM IDENTIFICATION

The traditional method of manually drying paddy grains in the Indian agricultural context presents a myriad of challenges. It heavily relies on labor, demanding significant manpower and time to complete the process. The use of manual equipment like sweepers and trolleys further compounds the labor intensity. Adding to these difficulties is the scarcity of labor, a common issue faced by farmers due to rural-to-urban migration and changing demographics. High labour costs only exacerbate the problem, making traditional drying methods economically burdensome. In the search for alternatives, existing solutions in the form of expensive Chinese machines, resembling vacuum cleaners, have emerged.

However, these machines come with their own set of issues, including exorbitant costs and fuel consumption, which only add to the financial strain on farmers. Moreover, the unavailability of locally sourced components for repairs renders these solutions impractical in the long run. Thus, there is a pressing need for a low-cost, indigenous paddy collector and spreader that can effectively streamline the drying process while addressing the challenges faced by farmers. Such a solution would not only alleviate the labour burden and reduce time consumption but also offer an affordable and sustainable alternative to existing options, fostering greater resilience and prosperity within the agricultural community.

IV. PROPOSED SOLUTION

The proposed solution is a low-cost indigenous paddy collector and spreader designed to revolutionize the drying process for paddy grains in the Indian agricultural landscape. Unlike existing solutions, which are often costly and inaccessible to small-scale farmers, this innovative machine offers an affordable alternative tailored to the needs of local farmers. Crafted from recycled vehicle parts and durable recycled plastics, the paddy collector and spreader embody sustainability and resourcefulness, minimizing environmental impact while keeping manufacturing costs low.

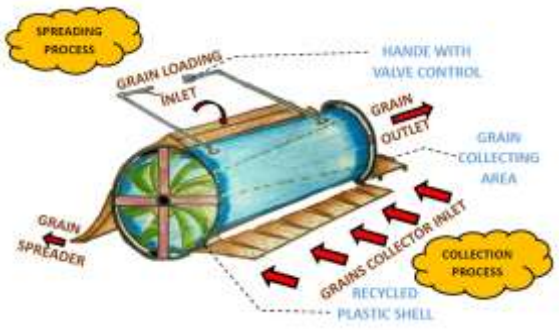
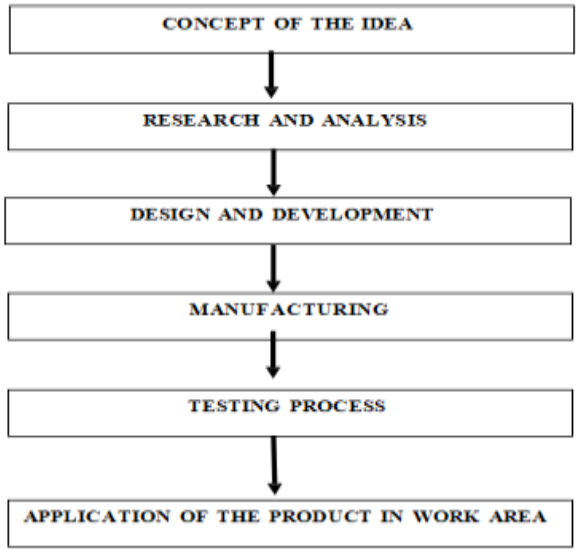


Figure 1 Technical Descriptio

Operating without the need for fuel and relying on manual movement, the machine significantly reduces operational expenses and environmental pollution. Its simple yet effective design allows for easy maintenance and repair, addressing the challenge of sourcing components locally in case of breakdowns. By streamlining the drying process, reducing labor dependency, and mitigating associated risks, the low-cost indigenous paddy collector and spreader empower farmers to optimize productivity and profitability while fostering sustainability in the agricultural sector

V. EXPERIMENTAL METHODOLOGY

The detailed process flow for the project is mentioned below.



The basic concept of the "Low-Cost Indigenous Paddy Collection and Spreading Machine" revolves around providing a simple and efficient solution for the spreading and collection of grains during the manual drying process of harvested grains, particularly in the context of traditional methods used to remove moisture content from the grains. Apart from recycled plastics, exploring bio- based and biodegradable materials can enhance sustainability and reduce environmental impact. Utilizing innovative materials such as bamboo fibers, agricultural waste-based composites, or bio-based polymers can offer durability while aligning with eco-friendly principles. Conducting life cycle assessments and environmental impact analyses can guide material selection processes, ensuring the machine's sustainability throughout its lifecycle. The product comprises several interconnected structures crucial to the machine's functionality.

VI. DESIGN AND DEVELOPMENT

The product comprises several interconnected structures crucial to the machine's functionality. These components are meticulously designed using advanced software tools such as CATIA V5 and NX Siemens PLM software. Below is an overview of the designed components and their measurements are listed in table

Table 1 Dimensions and Measurements

S.No	Dimension	Measurement
1.	Wheel Diameter	600 mm
2.	Length of the outer case	1000 mm
3.	The diameter of the outer case	580 mm
4.	Collection plate thickness	3 mm
5.	Collection blade diameter	570 mm
6.	Collection blade length	850 mm
7.	Collection blade thickness	3 mm
8.	Collector outlet diameter	65mm
9.	Length and breadth of the spreader hopper	1000 x 250 mm
10.	Length and breadth of the spreader outlet nozzle	1000 x 7 mm
11.	Length and breadth of the spreader Inlet nozzle	1000 x 20 mm

VII. COST ESTIMATION

Developing a manufacturing plan for the "Low-Cost Indigenous Paddy Collector and Spreader Machine" involves several key steps, from initial design considerations to the final assembly process. This plan aims to ensure efficient production, maintain quality, and keep costs low, especially by utilizing recycled materials. The cost estimation for the development of the product is listed in table

Table 2. Cost Estimation

S. No.	Description of Parts	Quantity	Rate (Rs.)
1	Acrylic sheet (8x4 ft)	4	19,400
2	3mm-Metal rods for frame (1m)	8	3,200
3	Wheels- ISO 559 (639mm)	2	2,400
4	Bearing (SKF 30317)	2	6,000
5	5-inch PVC pipe (2 m)	1	200
6	Adhesive and Epoxy resin	1.8 Kg	1,200
7	Screws and Revert gun	-	1,000
8	Tools, equipment and machining charges	-	8,000
9	Transportation of materials	-	4,000
10	3mm-Wooden plank board (8x4 ft)	3	3,900
11	L-clamp (3m)	2	5,000
12	Testing Cost	-	10000
Total			64,300

VIII. DESIGN CONSIDERATION

The collection blade must be carefully designed to ensure it can collect grains effectively without crushing or damaging them. It is typically made from a flexible, yet durable material that can adapt to minor variations in the ground surface. The edge of the blade is finely tuned to be effective in picking up grains while avoiding harm to the crop or soil. The angle and pressure of the blade against the ground can often be adjusted to optimize collection efficiency across different conditions. The synergy between the collection plate inlet, collection plate, and collection blade forms the core of the collector setup, ensuring that the machine can efficiently collect dried paddy grains with minimal effort and maximum efficacy. This setup not only streamlines the collection process but also significantly reduces the labour and time traditionally required for this task, offering a practical and economical solution for farmers.

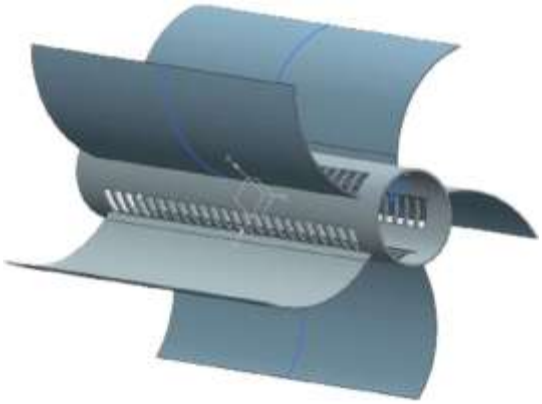


Figure 2. Collection Blade Design

Figure 3. Collection Plate Design

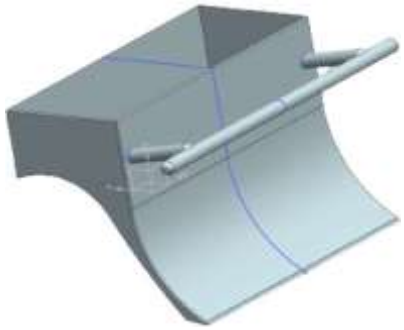


Figure 4. Spreader Design

IX. CONCLUSION

Through extensive research, innovative design, and meticulous fabrication, we have successfully addressed the pressing challenges associated with the rice grain collection and spreading and have developed the "Low-Cost Indigenous Paddy Collector and Spreader Machine" emerges as a transformative solution for the agricultural sector, addressing longstanding challenges associated with manual grain drying processes.Its innovative design, fuelled by recycled materials and powered by mechanical energy, promises to revolutionize grain handling, significantly reducing labour

requirements, operational costs, and environmental impact. With its user-friendly interface and versatile applications across various industries, the machine stands as a beacon of efficiency, sustainability, and progress in agricultural technology. Its successful implementation heralds a new era of productivity and prosperity for farmers, manufacturers, and stakeholders alike, reaffirming its pivotal role in shaping the future of grain processing and distribution.

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