# Functionality, Usability, and Acceptability Assessment of Dual Blade Coconut Dehusker

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## ABSTRACT

The coconut industry is a cornerstone of the Philippine economy, supporting livelihoods and contributing significantly to the agricultural sector. Traditional manual dehusking methods, however, pose substantial challenges, including safety risks, inefficiencies, and physical strain. This study addresses these issues by designing and developing a Dual Blade Coconut Dehusker prototype, which was assessed for functionality, usability, and acceptability. Employing a mixed-methods approach, the research involved 40 farmers and laborers from Mati City, Davao Oriental. Results indicate high functionality (mean = 4.52), usability (mean = 4.19), and acceptability (mean = 4.21), suggesting the prototype's potential to transform dehusking practices. Recommendations include design enhancements, broad distribution strategies, and intellectual property protection to ensure widespread adoption and sustained impact.

**Keywords:** Coconut Dehusker, Post-Harvest Innovation, Prototype Development, Occupational Safety, Agricultural Tools

## INTRODUCTION

Coconuts (Cocos nucifera) are among the most versatile and economically significant crops globally, providing essential resources such as food, drink, oil, and industrial raw materials (Ramadurai et al., 2019). In the Philippines, the coconut industry contributes significantly to the agricultural sector, with the country ranking as the second-largest producer of coconuts worldwide. Regions such as Davao are pivotal to the country's output, accounting for a substantial share of national production (Philippine Statistics Authority, 2022).

Despite the economic importance of coconuts, the traditional methods of dehusking remain inefficient and hazardous. Manual dehusking tools, such as machetes and spikes, are labor-intensive and pose significant safety risks, particularly for small-scale farmers (Adzimah & Turkson, 2015). Additionally, the process often leads to long-term physical strain, limiting the productivity of workers (Patil et al., 2015). While mechanized solutions have been developed, their high costs and complex maintenance requirements render them inaccessible to most small-scale farmers (Navaneethan et al., 2020).

The need for cost-effective, efficient, and user-friendly tools has never been more critical. By addressing the limitations of traditional methods, this study introduces the Dual Blade Coconut Dehusker. This innovation seeks to improve dehusking efficiency while ensuring the safety and comfort of users. The design incorporates feedback from local farmers, making it highly adaptable to real-world conditions.

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The findings of this research aim to bridge the gap between traditional and modern practices in coconut farming, contributing not only to local agricultural development but also to the global discourse on sustainable farming innovations (Varghese & Jacob, 2014).

## METHODOLOGY

This study employed a mixed-methods research design, combining quantitative and qualitative approaches to evaluate the Dual Blade Coconut Dehusker.

The prototype consists of two wedge-like blades, a spring-loaded lever, and a sturdy base for stability. Materials such as high-grade steel were used to ensure durability and resistance to wear and tear. The lever was designed to be adjustable, accommodating both left- and right-handed users.

### Data Collection

A survey was conducted among 40 farmers and laborers in Mati City, Davao Oriental. Respondents tested the prototype under controlled conditions and provided feedback on its functionality, usability, and acceptability. Data were gathered using a validated questionnaire with Likert-scale ratings.

### Testing Procedure

Participants were instructed on the prototype's operation through a demonstration. Each respondent then dehusked a set of coconuts, following standardized operating procedures. Observations were recorded to assess the tool's performance.

### Data Analysis

Quantitative data were analyzed using descriptive statistics, calculating mean scores and standard deviations for each criterion. Qualitative data from open-ended survey questions were thematically analyzed to identify recurring insights and recommendations.

### Ethical Considerations

This study adhered to the highest ethical standards in conducting research. Informed consent was obtained from all participants before their involvement in the study, ensuring they were fully aware of the purpose, procedures, and potential risks. Participants were assured of their anonymity and confidentiality, with all data securely stored and used solely for research purposes. No participant was subjected to harm, and they were free to withdraw from the study at any time without penalty.

## RESULTS AND DISCUSSION

Table 1. Functionality Assessment

| Statement | Mean | Standard Deviation | Descriptive Level |
|---|---|---|---|
| The tool is appropriate for both left- and right-handed users. | 4.63 | 0.49 | Very Functional |
| The design is highly functional. | 4.55 | 0.50 | Very Functional |
| The prototype can dehusk coconut effectively. | 4.55 | 0.50 | Very Functional |
| The prototype functions well according to its purpose. | 4.50 | 0.51 | Very Functional |
| The prototype has low maintenance. | 4.35 | 0.58 | Very Functional |
| **Overall** | **4.52** | **0.52** | **Very Functional** |

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The functionality assessment indicates that the prototype performs exceptionally well in its intended purpose. The high mean score of 4.63 for adaptability to both left- and right-handed users highlights its inclusivity and ergonomic design. Farmers appreciated the design's simplicity and effectiveness, as reflected in the consistent high ratings across all parameters. The slightly lower mean of 4.35 for maintenance suggests room for improvement in ensuring long-term durability and ease of upkeep (Patil et al., 2018).

Table 2. Usability Assessment

| **Statement** | **Mean** | **Standard Deviation** | **Descriptive Level** |
|---|---|---|---|
| The prototype provides safety in dehusking coconut. | 4.53 | 0.51 | Very Usable |
| The prototype is easy to operate. | 4.23 | 0.80 | Very Usable |
| The prototype is portable. | 4.23 | 0.70 | Very Usable |
| The prototype is convenient to use. | 4.15 | 0.89 | Usable |
| The prototype is comfortable to use. | 3.83 | 1.22 | Usable |
| **Overall** | **4.19** | **0.82** | **Usable** |

The usability results show that the prototype is practical and safe for regular use. A mean score of 4.53 for safety confirms that the design effectively reduces the risk of injuries associated with manual dehusking (Adzimah & Turkson, 2015). However, the slightly lower scores for comfort and convenience (3.83 and 4.15, respectively) suggest potential areas for ergonomic improvements. Portability and ease of operation received favorable evaluations, reinforcing the tool's suitability for field conditions.

Table 3. Acceptability Assessment

| **Statement** | **Mean** | **Standard Deviation** | **Descriptive Level** |
|---|---|---|---|
| The prototype provides safety to the users. | 4.45 | 0.71 | Very Acceptable |
| The prototype has good quality. | 4.40 | 0.50 | Very Acceptable |
| The prototype is essential in post-harvest operations. | 4.25 | 0.82 | Very Acceptable |
| The prototype has affordable components. | 4.23 | 0.62 | Very Acceptable |
| The prototype is very affordable. | 3.73 | 1.09 | Acceptable |
| **Overall** | **4.21** | **0.75** | **Very Acceptable** |

The acceptability assessment highlights the prototype's alignment with farmers' needs. High scores for safety and quality affirm the effectiveness of the design. The score of 3.73 for affordability, while still acceptable, suggests that cost may be a barrier for some farmers. This finding underscores the importance of exploring cost-reduction strategies to enhance accessibility (Navaneethan et al., 2020).

The evaluation of the Dual Blade Coconut Dehusker reveals its strengths in functionality, usability, and acceptability. Farmers found the tool effective in reducing the physical effort and risks associated with traditional methods. The prototype's high functionality scores reflect its innovative design, which accommodates various user preferences (Senthilnathan et al., 2020).

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While usability results confirm its practicality, the feedback on comfort and convenience highlights the need for ergonomic refinements. Similarly, the acceptability assessment underscores the importance of affordability in ensuring widespread adoption. These findings align with existing literature advocating for cost-effective and user-friendly agricultural tools (Patil et al., 2018).

Future improvements should focus on enhancing durability, reducing production costs, and incorporating ergonomic features. Collaborative efforts with stakeholders, including government agencies and farmer cooperatives, will be crucial in scaling this innovation (Ramadurai et al., 2019).

## CONCLUSION

The Dual Blade Coconut Dehusker successfully addresses the longstanding challenges associated with traditional dehusking methods. By prioritizing safety, efficiency, and usability, the prototype presents a significant advancement in post-harvest processing for coconut farmers. The study's findings indicate that the innovation meets high standards of functionality (mean = 4.52), usability (mean = 4.19), and acceptability (mean = 4.21), demonstrating its potential to replace hazardous manual dehusking techniques. The integration of user-centered design elements, such as ambidextrous adaptability and low-maintenance components, further enhances its practicality for small-scale farmers and laborers.

Results from the functionality, usability, and acceptability assessments highlight the dehusker's viability as a post-harvest innovation. Farmers acknowledged its ability to minimize physical strain and optimize productivity, reinforcing the importance of mechanization in agricultural workflows. Despite these strengths, feedback regarding ergonomic enhancements and cost considerations suggests that further design iterations could improve user satisfaction and accessibility.

Given its promising performance, the Dual Blade Coconut Dehusker has the potential to be scaled for broader distribution. Strategic partnerships with government agencies, agricultural cooperatives, and private investors can facilitate mass production and subsidized access for smallholder farmers. Additionally, securing intellectual property protection and exploring local manufacturing opportunities will enhance its commercial viability. Future research should focus on refining the design, integrating cost-effective materials, and evaluating long-term durability in real-world farming conditions.

In conclusion, the Dual Blade Coconut Dehusker represents a step toward modernizing coconut farming practices. By addressing the inefficiencies and risks associated with traditional methods, this innovation holds the potential to improve productivity, enhance farmer safety, and contribute to the overall sustainability of the coconut industry. Continuous improvements, collaborative efforts, and targeted dissemination strategies will be essential in maximizing its benefits and ensuring that coconut farmers reap the full advantages of this technological advancement.

**Features**

(1) Lever- used to exert a large force in opening the blades

(2) Shaft Mechanism - used to transmit power from one part to another

(4) Support Bearings - used to reduce friction and allow for smoother rotation

(5) Dual wedge-like-blades – used to open coconut husk

(6) Safety lock- designed to lock the lever

(3) Spring – designed to return the moving blade to its close position

(7) Height Adjuster- designed to adjust the preferred height of the user

(8) Base- designed to support the force of the husking operation

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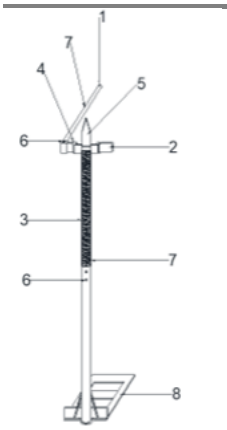


Figure 1. Perspective View

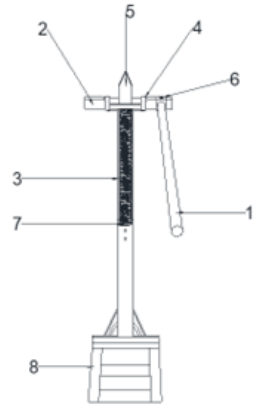


Figure 2. Front View


Figure 3. Side View

## RECOMMENDATIONS

1. Ergonomic Improvements – Future iterations should prioritize enhanced comfort and usability to reduce physical strain on users. Adjustments to handle design and weight distribution could enhance the overall user experience.

2. Cost Reduction Strategies – Exploring affordable yet durable materials and optimizing production processes will make the dehusker more accessible to smallholder farmers, ensuring broader adoption.

3. Long-Term Testing and Comparison – Conducting extended field trials and benchmarking the dehusker against existing mechanized tools will provide deeper insights into its long-term efficiency and durability.

4. Stakeholder Collaboration – Engaging with government agencies, private sector partners, and farmer cooperatives can facilitate funding, training, and wider dissemination of the innovation.

5. Sustainability Considerations – Investigating eco-friendly manufacturing options and ensuring that the tool is designed for long-term use with minimal environmental impact will support sustainable agricultural development.

**Contributions of Authors**

The authors contributed significantly to this study. Kc R. Monton led the conception and design of the prototype, as well as the analysis and interpretation of results. Venson B. Sarita played a key role in manuscript writing and revisions. All authors reviewed and approved the final manuscript.

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**Conflicts of Interest**

The authors declare no conflicts of interest in the conduct and publication of this study.

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