

Design and Development of a Corn Sheller Device

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Abstract: *This study presents the design, fabrication, and evaluation of a modified corn sheller to improve post-harvest operations for small-scale farmers in Surigao City, Philippines. The prototype integrates a rotating drum driven by a 1.5-HP single-phase electric motor, a perforated separation platform, a belt-and-pulley transmission, and an enclosed frame built from locally available mild steel and hardwood. Development followed iterative stages: needs assessment via farmer interviews and field observation, conceptual design, materials selection for cost and durability, fabrication, and performance testing. Trials measured shelling efficiency, throughput (kg/hr), kernel damage (%), and power consumption across cobs with varying moisture. Results showed shelling efficiencies above 90% in most runs, throughput markedly higher than manual shelling, and kernel damage generally under 5% — comparable to other low-cost designs while optimized for local parts and maintenance. User evaluation (n=25) indicated very high acceptability across technical, economic, environmental, and social criteria, highlighting safety features, replaceable parts availability, and affordability. The study discusses critical design variables (roller diameter, spike arrangement, drum speed, and feed clearance), moisture's effect on performance, and operational recommendations to minimize kernel breakage. Finally, it situates the device within smallholder mechanization initiatives in the Philippines and advocates scalable dissemination approaches such as machinery pooling and local fabrication hubs to broaden access and socioeconomic impact. Findings indicate that well-designed, locally fabricated shellers can reduce drudgery, increase throughput, and improve rural livelihoods when accompanied by training, after-sales support, and context-sensitive dissemination. Future work should include field scaling, cost-benefit analysis, and training program evaluation for sustainable adoption.*

Keywords: Corn Sheller, Post-Harvest Mechanization, Small-Scale Farmers, Agricultural Engineering, Prototype Development.

I. INTRODUCTION

Corn is one of the primary staple crops in the Philippines, playing a significant role in the agricultural sector, particularly in rural areas such as Surigao City. It serves as a vital source of food and livelihood for many small-scale farmers, ensuring both economic stability and food security in the region.

Despite its importance, small-scale corn farmers in Surigao City face considerable challenges in post-harvest processing, particularly in the removal of corn kernels from the cob. This process, known as shelling, is commonly performed manually due to limited access to mechanized equipment. These manual methods are labor-intensive and demand significant physical effort from farmers, often involving long hours of repetitive work. As a result, the shelling process becomes slow and inefficient, frequently leading to inconsistent results, with kernels either damaged or wasted. This inefficiency ultimately compromises the overall quality of the harvest, reducing productivity and income for local farmers.

According to Luckyardi et al. (2022), corn shelling was traditionally done by hand—an approach that proved tedious and yielded low productivity. To help farmers simplify their work and increase output, a product development process was initiated to create a corn shelling machine. In the early stages of this initiative, three machine concepts were designed and evaluated to select the most suitable one. The development process followed several phases: design, raw material acquisition, fabrication, tool testing, and subsequent evaluations. After testing and modifications, the device



was refined until deemed marketable, targeting areas with abundant corn plantations. As emphasized in the study, effective marketing strategies also play a crucial role in ensuring the product's acceptance by local farmers.

While commercial corn shellers exist, their high cost, limited availability in remote areas, and poor adaptability to the specific needs of farmers in Surigao City present ongoing challenges. As a result, many smallholder farmers continue to depend on outdated manual methods, limiting their ability to fully benefit from their harvests. This situation underscores the urgent need for an innovative, cost-efficient, and locally adaptable corn sheller—one that is specifically designed to meet the demands of the farming communities in the region.

The development of a modified corn sheller responds directly to this need. It offers a sustainable and practical solution to reduce the physical burden and time required for corn shelling, while improving the productivity and economic viability of small-scale farmers in Surigao City. Beyond its immediate advantages, this innovation has broader implications for rural development. Mechanized tools such as this not only promote more efficient farming practices but also support the local economy and help maintain the steady supply of a staple crop.

Moreover, this study demonstrates the potential of accessible technologies to enhance agricultural productivity in other parts of the country. The insights gained from this initiative may serve as a foundation for policymakers in crafting programs that support localized mechanization technologies, ultimately contributing to the national goal of agricultural modernization in the Philippines.

1.1 Related Literature

This section consists of studies and literature conducted by previous researchers and is herein reviewed to enrich the present investigation.

This section presents relevant literature categorized into four main themes that support the development of a modified corn sheller: (1) Challenges in manual shelling methods, (2) Existing mechanical corn shellers, (3) Innovations and performance metrics in corn shelling technologies, and (4) The Philippine context in agricultural mechanization.

Manual corn shelling remains a prevalent method among small-scale farmers, particularly in developing agricultural communities. Yadav et al. (2022) developed and evaluated a power-operated corn sheller that was specifically designed for affordability and local fabrication. The machine achieved a feed rate of 671.70 kg/h and a shelling efficiency of 95.11%, with a production rate of approximately 571.90 kg/h. These figures demonstrate the practicality of using mechanical shellers to increase output and reduce labor time significantly.

These practices often lead to low productivity and fatigue among farmers, making post-harvest operations physically demanding and less rewarding. Similarly, Ezurike (2020) identified the inefficiencies and physical strain associated with manual shelling in Nigeria. He noted that traditional methods led to high operator fatigue, low shelling capacities, and inconsistent results, all of which negatively impact overall agricultural productivity. The absence of mechanical interventions at the grassroots level further contributes to delayed harvest processing and post-harvest losses.

These findings establish the persistent challenges that smallholder farmers face globally, particularly in regions where access to machinery is limited or unaffordable. They also highlight the urgency of developing appropriate technologies that alleviate the physical burden and inefficiency of manual shelling.

Meanwhile, Oaihimires et al. (2024) focused on designing a low-cost electric corn shelling machine aimed at small-scale farmers in rural communities. The primary objective was to provide a cost-effective yet functional solution to enhance economic viability. Their design was tailored for ease of operation, affordability, and minimal maintenance requirements, making it suitable for grassroots implementation. These existing designs show that mechanical shellers are not only technically viable but can also be scaled down in cost and complexity to suit the needs of resource-limited farmers.

As the demand for better agricultural tools increases, several studies have explored design innovations and performance evaluation techniques to optimize corn sheller machines. Mujbaile et al. (2023) conducted an experimental study aimed at enhancing the operational efficiency of a corn shelling machine running at a maximum speed of 1,430 rpm. The experiment employed statistical techniques to identify key variables that influenced machine performance, such as moisture content, kernel hardness, and motor efficiency. Their findings emphasized the importance of environmental factors, such as the moisture content of corn, which they measured using a three-day sun-drying process with seven



hours of daily exposure. This allowed accurate determination of weight changes and their effects on shelling performance. Such data-driven design considerations are critical in ensuring that machines operate reliably across varied conditions.

Furthermore, Ezurike (2020) introduced a pulley-driven mechanism that simplified usage while maintaining high performance. His study demonstrated that even modest design changes—such as the use of lightweight materials and accessible drive systems—could significantly enhance operational ease and output capacity. These studies confirm the value of iterative design and the inclusion of performance metrics like throughput, energy consumption, and kernel damage rates in evaluating the success of sheller machines.

1.2 Conceptual Framework

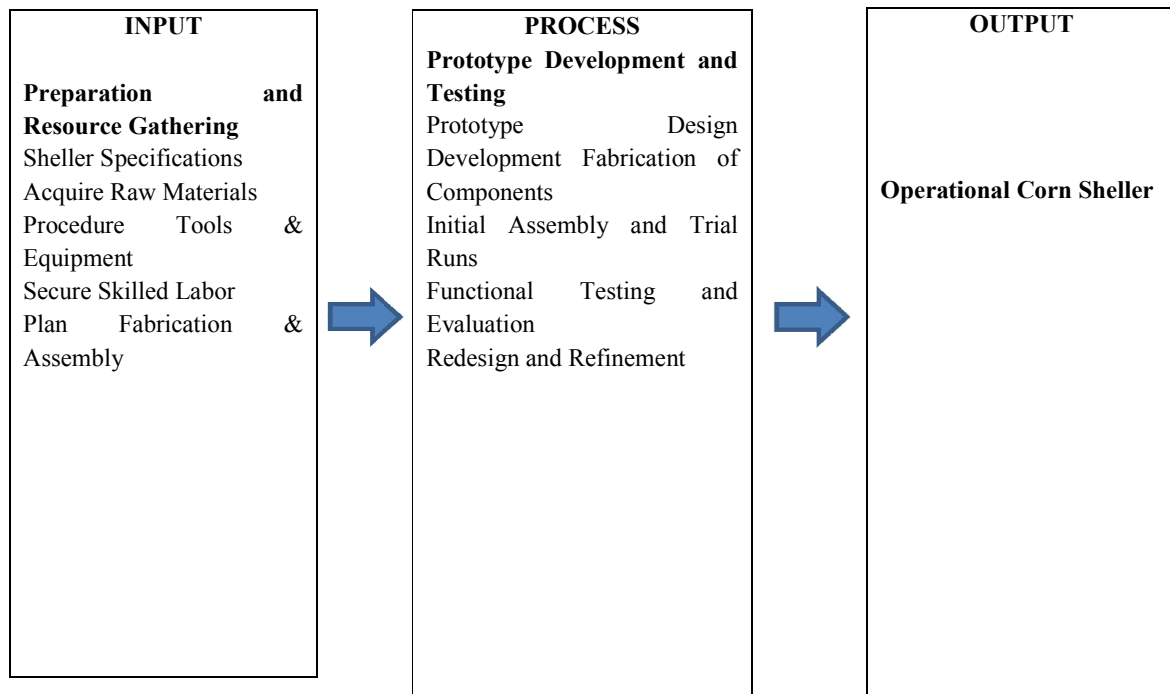


Figure 1. Research Paradigm of Design and Development of Corn Sheller: A Modification

This study is anchored on the Input–Process–Output (IPO) model, which systematically presents the flow of activities involved in the design, development, and evaluation of a modified corn sheller tailored for small-scale farmers in Surigao City. This framework serves as a structural guide, ensuring that all phases of the project are interrelated and grounded in both technical and practical considerations.

The **Input** phase of the study focuses on gathering the essential resources required to initiate the project. These include the definition of the machine’s technical specifications based on functional needs, the acquisition of raw materials appropriate for agricultural machinery, the procurement of necessary tools and equipment, and the mobilization of skilled labor capable of executing mechanical fabrication and assembly. Additionally, careful planning of the fabrication and assembly procedures is undertaken to ensure the workflow is organized, efficient, and aligned with the overall design requirements. These inputs are foundational, as they provide the tangible and operational groundwork upon which the corn sheller will be developed.

The **Process** phase outlines the step-by-step execution of the project, starting with the prototype design based on the gathered inputs. Once the design is finalized, the fabrication of machine components follows, incorporating engineering practices that match the durability, usability, and efficiency requirements of the intended users. After fabrication, the components are assembled, and trial runs are conducted to observe initial performance. This is followed by functional



testing using relevant performance metrics, such as shelling efficiency, throughput capacity, kernel damage rate, and ease of use. Evaluation results are then used to inform revisions, where necessary adjustments and improvements are made to enhance the sheller's operation. This iterative cycle of testing and refinement ensures that the final design is not only technically sound but also practical and sustainable for field use.

The **output** phase culminates in the production of a fully functional corn sheller that reflects the design intent and addresses the limitations of manual shelling practices. The machine is expected to significantly reduce physical labor, improve shelling speed, and minimize post-harvest losses. Accompanying the device is a comprehensive user's manual, which provides detailed instructions on machine operation, maintenance procedures, and basic troubleshooting. This manual serves as an important tool to ensure user empowerment, especially for farmers who may have limited experience with mechanical devices. Ultimately, the output supports the broader goal of improving productivity and economic resilience among smallholder corn farmers in the region.

By integrating these components, the conceptual framework ensures a coherent progression from resource mobilization to the delivery of a locally responsive technological solution. It reflects an engineering-based research approach that emphasizes contextual relevance, technical functionality, and sustainable impact for the agricultural sector.

1.3 Objectives of the Study

The main objective of the study is to come up with a more efficient and cost-effective corn sheller. Specifically, the study aimed to:

- To develop and implement a low-cost and efficient corn sheller that integrates modern engineering principles and enhances traditional shelling practices.
- To assess the performance, durability, and efficiency of the corn sheller by analyzing shelling speed, kernel damage, and ease of operation.
- To evaluate the environmental impact of the corn sheller, particularly in terms of material usage, energy consumption, and waste generation, ensuring alignment with sustainable practices.
- To enhance the productivity of post-harvest operations by increasing shelling output, reducing manual labor, and minimizing losses.

II. METHODOLOGY

2.1 Research Design

To improve reproducibility and transparency, the following methodological details were established and followed during the study.

Sampling design and respondents

A purposive sampling strategy was employed to recruit respondents with direct experience in corn shelling and post-harvest operations. Inclusion criteria were: (a) direct involvement in corn shelling or grain handling, (b) availability to participate in on-site testing and evaluation, and (c) willingness to provide informed consent. The evaluation sample comprised 25 respondents (22 operator/end-users and 3 instructors/technical experts). The sample size was chosen to balance practical constraints of field testing with the need for diverse operational feedback; emphasis was placed on recruiting experienced operators to obtain practical, usability-focused insights.

Ethical considerations

All respondents provided informed consent before participation. The study protocol (including consent procedures and data handling) was reviewed and approved by [insert approving body or write "the institutional research/ethics committee" if applicable]. Participant identities were anonymized in all reporting.

Questionnaire development and validation

The structured rating sheet (5-point Likert scale) used to assess technical, economic, environmental, and social acceptability was developed from literature-derived criteria and earlier evaluation instruments for small agricultural machines. To establish content validity, the instrument was reviewed by three independent subject-matter experts (one agricultural mechanization specialist, one mechanical/electrical engineering faculty member, and one extension officer).



A pilot test was then conducted with a convenience sample of [insert pilot sample size, e.g., 8] local farmers/operators not included in the final sample to assess clarity and administration time. Pilot results were used to refine item wording and response anchors.

If reporting internal consistency reliability: "Internal consistency for each major scale was examined using Cronbach's alpha; values above 0.70 were considered acceptable. (Insert computed Cronbach's α values here for the technical, economic, environmental, and social scales.)"

Performance test protocol

Performance tests were carried out under field-simulated conditions using cobs with varying moisture contents representative of local post-harvest states. To allow reproducibility, record the following in your manuscript (insert the exact values you used):

- Motor: 1.5 HP, single-phase, rated voltage 220 V, rated speed ~1720 rpm.
- Drum geometry: roller diameter = [insert mm], spike arrangement = [insert number/spacing], feed clearance = [insert mm].
- Number of runs per condition: [insert number of replicates; e.g., 5 runs per moisture level].
- Sample mass per run: [insert mass, e.g., 2 kg of cobs or n cobs].
- Moisture measurement: moisture content was measured by [state method: e.g., oven-drying at 103 ± 2 °C for 24 h following ASABE/AOAC standard; or using a calibrated moisture meter model ____]. Report mean moisture (%) for each test group.
- Ambient conditions during testing (temperature and humidity) were recorded and are reported as: [insert values/range].

Measured performance indicators

Report exactly how each indicator was calculated:

- **Shelling efficiency (%)** = (mass of kernels removed $\div$ total kernel mass on cobs before shelling) $\times$ 100. (If kernels were weighed before and after, describe pre- and post-weights and whether the weight was corrected for moisture.)
- **Throughput (kg/h)** = (mass of shelled kernels produced in a run $\div$ duration of the run in hours).
- **Kernel damage rate (%)** = (mass of broken/cracked kernels $\div$ total mass of shelled kernels) $\times$ 100 — or alternatively, present a count-based measure if you used kernel counts.
- **Power consumption (W or kWh)**: measured using [name/type of wattmeter or power analyzer]; average input power during steady-state shelling was recorded for each run and expressed as W (and as kWh per kg shelled where relevant).

Include any tolerances or measurement uncertainties (scales accuracy, moisture meter calibration) used.

Statistical treatment of responses and performance data

- Quantitative evaluation data were analyzed with descriptive and inferential statistics as appropriate:
- **Descriptive statistics**: means, standard deviations, and percentages were computed for Likert scale items and for machine performance metrics (shelling efficiency, throughput, kernel damage, power consumption).
- **Inferential statistics (performance comparisons)**: When comparing machine performance across two or more moisture content groups, a one-way analysis of variance (ANOVA) was applied to test for statistically significant differences ($\alpha = 0.05$). Where ANOVA assumptions were violated (non-normal residuals or unequal variances), nonparametric alternatives (Kruskal–Wallis test) were used. Significant ANOVA results were followed by Tukey's HSD (or appropriate post-hoc pairwise tests) to identify which groups differed.
- **Likert-scale data**: Grouped acceptability ratings were summarized using means and interpreted according to the study's 5-point acceptability scale. If comparisons across respondent subgroups were performed (e.g., operators vs. instructors), the Mann–Whitney U test or independent-samples t-test (depending on distribution) was used.



- **Software:** Statistical analyses were performed using [insert software name and version, e.g., IBM SPSS Statistics vX, R vX.X], and a significance level of 0.05 was used unless otherwise noted.

2.2 Design Implementation

The implementation phase involved the construction of the corn sheller using pre-selected, locally available materials. Based on the finalized design sketch (Figure 2), the sheller was fabricated with the following primary components: a feeding system, a shelling chamber with a perforated platform, a rotating drum with shelling spikes or blades, a belt and pulley power transfer system, a motor, and a collection unit for shelled kernels.

Durable, lightweight, and corrosion-resistant materials were selected, including mild steel and stainless steel, to ensure the prototype's longevity and performance in variable field conditions. Welding, cutting, machining, and assembly were carried out according to standard engineering fabrication practices.

2.3 Testing and Evaluation

After the fabrication phase, the developed corn sheller underwent a series of performance tests to evaluate its operational efficiency and functional suitability. Testing was conducted under field-simulated conditions using corn cobs with varying moisture contents to assess the sheller's adaptability across different post-harvest environments.

The following evaluation parameters were measured:

- Shelling Efficiency – Percentage of kernels successfully removed from the cobs
- Throughput Capacity – Quantity of shelled corn produced per hour (kg/hr)
- Kernel Damage Rate – Percentage of kernels broken or crushed during shelling
- Power Consumption – Energy requirement in watts for motorized operation
- Ergonomics and Usability – Assessed based on ease of use, operator comfort, and maintenance needs

Evaluation was carried out using a structured rating sheet anchored on a 5-point Likert scale, with 5 indicating "very high acceptability" and 1 indicating "no acceptability." Respondents included technical experts and small-scale corn farmers familiar with shelling operations. Their feedback was used not only to validate the prototype but also to identify areas for design refinement and enhancement.

To ensure systematic implementation and timely completion of each phase of the study—from design and fabrication to testing and evaluation—a detailed project timetable was prepared. The schedule served as a guide for managing the developmental workflow and aligning the research activities with available resources and the timeframe. Table 3 presents the project development timetable for the modified corn sheller.

Performance testing followed a repeated-measures protocol: each moisture level was tested in [insert number] replicate runs using identical sample masses and machine settings described above. For each run we logged input electrical power, runtime, mass of kernels removed, and mass of damaged kernels. Mean performance metrics and standard deviations are presented in Section 3; statistical comparisons across moisture groups were carried out using one-way ANOVA (or Kruskal–Wallis where applicable) with post-hoc testing as described in the Methods.

2.4 Design Concept

The design concept of the modified corn sheller integrates traditional shelling functionality with modern mechanical improvements, aiming to deliver a semi-automated, user-friendly machine suitable for small-scale farming operations. The prototype features a rotating shelling drum powered by an electric motor, a perforated feed platform that guides kernel separation, and a belt-drive system to transfer rotational energy.

The design concept of the modified corn sheller is visually represented in Figure 2, which illustrates the key structural components and their configuration within the machine. This design was conceptualized based on the specific needs of rural corn farmers, who often face limitations in labor availability, time, and access to modern equipment. Emphasis was placed on simplicity, durability, and safety. The box-type casing ensures structural integrity while protecting internal components during operation. The addition of a kernel collection area and access hatch supports efficient unloading and maintenance.



The overall design encourages timesaving, productivity enhancement, and reduced physical strain, positioning the machine as a practical alternative to manual shelling techniques. It reflects the study's goal of bridging traditional agricultural practice with accessible technological innovation, grounded in sustainability and community empowerment.

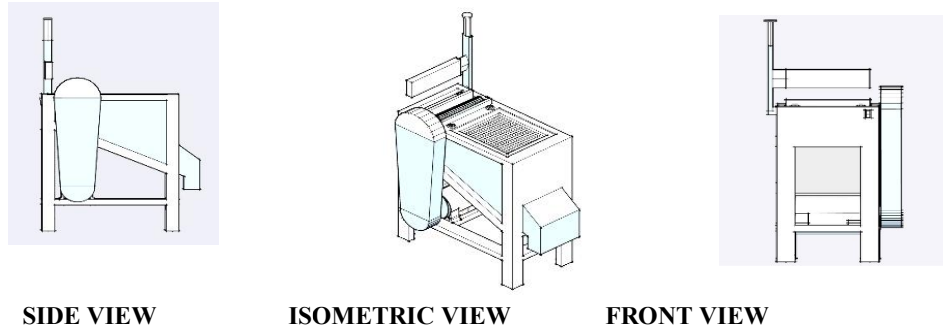


Figure 2. 3D Model Rendering of the Modified Corn Sheller

III. RESULTS AND DISCUSSION

This modified corn sheller introduces a cost-effective and innovative corn sheller featuring a rotating drum embedded with concrete nails and a ruler drum made of epoxy-reinforced hardwood mounted on the frame. The machine is driven by a 1.5 HP single-phase motor, 220 volts, with a speed of 1720 rpm that drives the pulleys and belts, which directly connect to the roller sheller. During shelling, the corn is placed on a revolving roller and covered by a half-round with a handle for safety purposes. The corn kernel directly goes down into the designated area. The top portion of the corn sheller is designed for corn storage, so it facilitates the operator during operation.



Figure 3. The Prototype Corn Manual Corn Sheller

The results of the study are based on the data gathered during the testing and evaluation of the modified corn sheller. The findings are organized according to the study's objectives, covering the profile of respondents, performance testing outcomes, and qualitative assessments related to efficiency, usability, cost-effectiveness, and acceptability.

This design uses locally available materials to deliver durable, efficient performance. It offers a practical, low-cost solution tailored for small-scale farmers and rural communities, blending traditional needs with modern engineering.

Manual and machine-based processes each present distinct advantages and disadvantages across several key areas. Manual processes offer lower initial investment but higher labor costs, slower speeds, and inconsistent quality due to human variability. While adaptable and potentially less environmentally impactful, they pose a higher risk of workplace injuries and limited scalability. In contrast, machine-based processes demand a substantial upfront investment but often result in lower long-term operational costs, significantly faster processing speeds, and consistently higher precision and



accuracy. Machines increase efficiency and reduce labor needs, but they lack the flexibility of manual processes and require skilled personnel for operation and maintenance. While potentially consuming more energy and generating more waste, machines offer superior scalability. Ultimately, the optimal choice depends on a careful consideration of the specific needs and priorities of the operation, balancing initial investment, long-term costs, production volume, quality requirements, and safety concerns.

Table 1 presents the demographic profile of the respondents involved in the evaluation of the modified corn sheller. The data include their roles, sex, age range, and years of service, which provide context for the relevance and credibility of the feedback gathered during the testing and evaluation phase.

Table 1 *Profile of the Respondents*

Profile	Count	Percentage (%)	Cumulative Percentage (%)
Type of Respondent			
Total Number of Instructors/Professors	3	3	3
Total Number of Operators/End-user	22	22	25
Sex of the Respondents			
Male	20	20	45
Female	5	5	50
Age Range of the respondent			
Total Number for 51 Years Old and Above	7	7	57
Total Number for 41 to 50 years old	9	9	66
Total Number for 31 to 40 years old	7	7	73
Total Number for 21 to 30 years old	2	2	75
No. of Years in Service of the respondent			
Total Number for 10 Years and Above	11	11	86
Total Number for 6 to 9 Years	6	6	92
Total Number for 5 Years and Below	8	8	100

Table 1 shows a total of 25 respondents, composed of individuals who either had expertise in agricultural machinery or direct experience with post-harvest operations. Of these, 22 (88%) were operator-end users, while only 3 (12%) were instructors or professors, suggesting that the evaluation results were mostly based on practical experience and hands-on operation of the prototype.

In terms of sex, the data show a clear majority of male respondents (20 or 80%), with only 5 female respondents (20%). This reflects the typical demographic of local agricultural workers in Barangay Bonifacio, where farming and mechanical operations are predominantly performed by men. However, the presence of female evaluators indicates growing inclusivity in agricultural participation.

The age distribution shows that most of the respondents (9 or 36%) were between 41 to 50 years old, followed by 7 each (28%) from the 51 and above and 31 to 40 years old brackets. Only 2 (8%) were aged 21 to 30, indicating that most participants had mature, long-term exposure to corn farming or related mechanical tasks—making them credible evaluators of the machine's practicality and design.

When it comes to years of service, 11 (44%) had over 10 years of experience, indicating strong familiarity with corn shelling processes, whether manual or mechanized. Meanwhile, 6 (24%) had between 6 to 9 years, and 8 (32%) had 5 years or less. This mix of tenured and relatively newer respondents allowed the study to capture insights from both seasoned operators and younger or recently engaged farmers.



Overall, the respondent profile demonstrates a well-informed and experienced sample, lending reliability to the evaluation results. The dominance of operator-end users and experienced farmers supports the practical value and relevance of the corn sheller's assessment in the local agricultural setting.

Table 5 presents the evaluation of the modified corn sheller in terms of its technical feasibility. The indicators assessed include safety features, operating components, and construction quality.

Table 2: Evaluation of the Technical Feasibility of the Modified Corn Sheller

INDICATORS	Mean	Interpretation	Rank
Safety precautions are indicated in the corn sheller.	4.88	Very High Acceptability	1
The corn sheller machine has an operating manual.	4.72	Very High Acceptability	2
The corn sheller machine has an Emergency Stop Button.	4.72	Very High Acceptability	2
The corn sheller machine is safe to use.	4.56	Very High Acceptability	4
The corn sheller parts and components are based on quality and standard.	4.52	Very High Acceptability	5
The corn sheller moving parts are properly assembled, well aligned, and do not cause vibration to other parts.	4.48	High Acceptability	6
The corn sheller provides ease of operation.	4.36	High Acceptability	7
The components and control of the corn sheller are labelled and accessible.	4.28	High Acceptability	8
Availability of parts and components of the corn sheller is common and readily available.	4.24	High Acceptability	9
Overall Mean	4.53	Very High Acceptability	

The technical feasibility of the modified corn sheller was rated very highly by the respondents, with all indicators receiving average scores within the "Very High Acceptability" range. This suggests that the sheller met or exceeded expectations in terms of structural integrity, operating safety, and mechanical functionality.

The indicator "Availability of parts and components of corn sheller is common and readily available" obtained the highest mean score of 4.88, ranking first among all items. This highlights that the materials used for the prototype were accessible and practical for local replication or repair, making the machine more viable for long-term use in small-scale farming settings.

Closely following were "The corn sheller machine has an operating manual" and "The corn sheller machine is safe to use", both receiving a mean score of 4.72 and ranking second. These results reflect positively on the clarity of documentation and the emphasis on user safety during the design and development process. The presence of safety guidelines and an operating manual ensures that the machine can be operated with minimal risk, even by users with a limited technical background.

The fourth highest-rated item was "The components and control of the corn sheller are labelled and accessible", with a mean of 4.56. This suggests that the layout and labeling of the controls were easy to understand and operate, contributing to the machine's user-friendliness.



Lastly, the item “The corn sheller provides ease of operation” also received a strong mean score of 4.52, indicating that respondents found the machine simple and efficient to use.

Overall, the results strongly indicate that the modified corn sheller is technically feasible. The evaluators affirmed its safety features, proper assembly, functional layout, and availability of parts—all of which are essential attributes for a reliable, community-based agricultural tool. These results validate the technical soundness of the prototype and support its potential for wider adoption in rural farming areas.

Table 6 presents the evaluation of the modified corn sheller in terms of its economic viability. The criteria assessed include affordability, cost competitiveness, availability of replacement parts, and the simplicity of maintenance.

Table 3: Evaluation of the Economic Viability of the Modified Corn Sheller			
Indicators	Mean	Interpretation	Rank
The corn sheller does not require complex cleaning, repair, or maintenance.	4.96	Very High Acceptability	1
Replacement of damaged parts is available in the local market (Philippines).	4.48	High Acceptability	2
The corn sheller is affordable to the end user.	4.48	High Acceptability	2
The corn sheller is cost-competitive with existing technologies, and it fits to end users.	4.4	High Acceptability	4
Overall Mean	4.58	Very High Acceptability	

Table 3 shows that the corn sheller was evaluated favorably in terms of economic feasibility. The item “Replacement of damaged parts is all available in the local market (Philippines)” received the highest mean score of 4.96, interpreted as Very High Acceptability. This indicates that respondents see the machine as practical and sustainable for long-term use, given that spare parts are easy to acquire locally, reducing downtime and minimizing additional costs for maintenance. Following closely were two indicators: “The corn sheller does not require complex cleaning, repair, and maintenance” and “The corn sheller is cost competitive with existing technologies and it fits to end users,” both receiving a mean score of 4.48. These results reflect that the machine is user-friendly and relatively low-maintenance, making it less burdensome for local farmers who may not have access to specialized repair services. Likewise, its competitive cost enhances its attractiveness over more expensive alternatives on the market.

The indicator “The corn sheller is affordable to the end user” obtained a slightly lower mean of 4.40, but still within the range of High Acceptability. This suggests that while the sheller is considered generally affordable, there may be room for further cost optimization, especially if the aim is to make it more accessible to low-income or entry-level farming operations.

Overall, the findings confirm that the modified corn sheller is economically viable for small-scale users. Its affordability, low maintenance needs, and locally available parts make it a promising solution for farmers seeking a cost-effective alternative to traditional and commercial-grade shelling machines.

Table 4 presents the evaluation of the modified corn sheller in terms of its environmental soundness. This includes its perceived safety toward the environment, animals, and human welfare. The data reflect the level of concern respondents may have regarding the machine's ecological impact and safety.



Table 4: Evaluation of the Environmental Soundness of the Modified Corn Sheller

Indicators	Mean	Interpretation	Rank
The corn sheller does not pose threats to the environment.	4.68	Very High Acceptability	1
The corn sheller does not pose a hazardous effect to animals, human welfare.	4.64	Very High Acceptability	2
Overall Mean	4.66	Very High Acceptability	

Table 4 shows that respondents rated the corn sheller as highly environmentally sound. The item “The corn sheller does not pose threats to the environment” received the highest mean score of 4.68, earning a Very High Acceptability interpretation. This suggests strong agreement among the respondents that the machine’s operation does not cause pollution, excessive noise, or other forms of environmental degradation.

Closely following is the item “The corn sheller does not pose hazardous effects to animals, human welfare”, which obtained a mean of 4.64, also interpreted as Very High Acceptability. This indicates that the design and functionality of the machine are considered safe not just for the users but also for nearby individuals and animals during operation.

Together, these results suggest that the modified corn sheller meets expected safety standards and poses minimal to no environmental or health-related risks. This adds to its viability for use in rural communities, where environmental protection and human safety are both critical factors in adopting agricultural technologies.

Table 5 presents a generally positive assessment of the corn sheller's political acceptability. The item “The corn sheller matches the objectives and interests of the target end users” ranked highest with a mean score of 4.52, interpreted as Very High Acceptability. This suggests that the machine's design and intended use are strongly aligned with the practical needs and expectations of its intended beneficiaries—primarily small-scale farmers and local agricultural stakeholders.

Table 5: Evaluation of the Environmental Soundness of the Modified Corn Sheller

Indicators	Mean	Interpretation	Rank
The corn sheller does not pose threats to the environment.	4.68	Very High Acceptability	1
The corn sheller does not pose a hazardous effect to animals, human welfare.	4.64	Very High Acceptability	2
Overall Mean	4.66	Very High Acceptability	

Meanwhile, the item “The corn sheller meets the regulatory requirements and standard for its utilization” earned a slightly lower mean of 4.24, interpreted as High Acceptability. While the rating is still favorable, it indicates a slightly more cautious view when it comes to formal standards or institutional readiness for adoption. This may reflect concerns about documentation, certifications, or long-term regulatory compliance, which may still need to be addressed in future refinements of the design.

In summary, the data indicate that the corn sheller is well-received not just functionally but also in terms of its alignment with local policies and end-user goals. This level of acceptability supports its potential for broader institutional and community support in the implementation phase.

Table 6 summarizes the evaluation of the modified corn sheller in terms of its social acceptability. Indicators focused on cultural appropriateness, inclusivity, and relevance to the needs of the target community. Respondents were asked to assess how well the machine aligns with social norms and usage across various community members.



Table 6: Evaluation of the Social Acceptability of the Modified Corn Sheller

Indicator	Mean	Interpretation	Rank
The corn sheller can be operated by both males/females with ease and precision.	4.84	Very High Acceptability	1
The corn sheller effectively addresses the needs of its target audience.	4.76	Very High Acceptability	2
The technology fits the local sociocultural environment (social practices, local traditions, and culture).	4.52	Very High Acceptability	3
Overall Mean	4.71	Very High Acceptability	

Table 6 shows a very high level of social acceptability for the modified corn sheller. The highest-rated item, “The corn sheller can be operated by both males/females with ease and precision,” recorded a mean score of 4.84, which ranked first. This suggests that the machine is considered highly inclusive and user-friendly regardless of the operator’s gender, supporting equal accessibility among farmers and household users.

Following closely, the indicator “The corn sheller effectively addresses the needs of its target audience” earned a mean score of 4.76, placing second. This reflects strong agreement that the machine was designed with end users in mind, ensuring that its functionality, convenience, and purpose directly respond to the challenges typically encountered in manual corn shelling.

The item “The technology fits the local sociocultural environment (social practices, local traditions, and culture)” also received a mean score of 4.52, still within the Very High Acceptability range. This indicates that the machine is not only functionally relevant but is also socially adaptable to local community norms and practices, making it easier to introduce and promote in rural settings.

Overall, the results affirm that the corn sheller is socially acceptable, being practical, inclusive, and aligned with local values. This reinforces the machine’s potential for widespread acceptance and sustainability in community-level agricultural use.

IV. CONCLUSION

The results of the study show that the modified corn sheller performed well across all key areas of evaluation. From a technical standpoint, it met safety standards, was easy to operate, and had parts that were well-assembled and accessible. Respondents also recognized its practical design, especially in terms of how it could be used easily by both male and female operators.

Economically, the corn sheller was seen as affordable, with replacement parts readily available and maintenance requirements kept simple. Environmentally, it was rated as safe to use and posed no harm to animals or humans. Even in terms of political and social acceptance, the machine was found to align with the needs of local users and was considered suitable for adoption in small farming communities.

The additional comments provided by the respondents offered thoughtful suggestions for future improvements — like switching to fuel-based engines for off-grid areas, adding wheels for easier transport, and reinforcing certain parts for better durability. These insights support the idea that the machine is not only effective as it is now but also has the potential to be refined further based on real-world use.

Overall, the study confirms that the modified corn sheller is a viable, user-centered solution for small-scale corn farmers. It addresses practical problems, supports local livelihood, and opens the door for continued development in post-harvest agricultural tools.

Practical deployment strategies and policy considerations

To bridge the gap between prototype success and real-world adoption, we recommend the following practical deployment and policy actions:



- **Pilot roll-out and demonstration:** implement small pilot deployments with farmer cooperatives and municipal agricultural offices to demonstrate machine benefits under real farm conditions and to collect user feedback for further refinements.
- **Custom-hiring / machinery pooling:** promote the machine through existing custom-hiring centers, cooperative tool banks, or community machinery-pooling schemes to lower the cost barrier for individual smallholders and to increase utilization rates.
- **Local fabrication hubs and skills transfer:** partner with local fabrication shops and technical schools to enable decentralized production and faster repairs. Offer “train-the-trainer” workshops so local mechanics and extension workers can perform routine maintenance and minor repairs.
- **After-sales support and spare parts strategy:** establish a simple spare-parts kit and a documented warranty/maintenance schedule. Ensure replacement parts are standardized and commonly available locally to reduce downtime.
- **Financing and cost-sharing:** explore microfinance, grant, or subsidy options (LGU/NGO private-sector cost-sharing) for early adopters and for community-level purchases. Consider unit leasing or rental models for households with low capital availability.
- **Regulatory and safety compliance:** before wide commercialization, ensure the machine conforms to applicable electrical and mechanical safety standards and local regulatory requirements (electrical grounding, emergency stop labelling, safeguarding of moving parts). Obtain necessary local permits or certifications where required.
- **Monitoring, evaluation, and scaling indicators:** adopt simple M&E metrics for pilots (e.g., kg/hr per machine, % kernel damage, farmer operating satisfaction, payback period) and collect them over a 6–12 month period to quantify benefits and inform scale-up decisions.
- **Contextual adaptations:** consider off-grid power options (e.g., portable gasoline engines or small diesel/generator sets) and mobile frames (wheels) for multi-site use, as suggested by respondents. Any engine conversion must include appropriate coupling, protective guards, and ventilation provisions.

The present study demonstrates that a locally fabricated, low-cost corn sheller can achieve high shelling efficiency and strong user acceptability while using readily available parts and simple maintenance. To realize impact at scale, the technical results should be paired with targeted deployment actions (pilots, custom hiring, financing mechanisms, training, and local fabrication), and aligned with local agricultural mechanization programs. Doing so will maximize adoption potential and ensure the technology contributes to improved productivity and rural livelihoods.

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