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TECHNICAL PERFORMANCE AND EFFICIENCY ANALYSIS OF A 300 KG/H CORN SHELLING MACHINE USING EXPERIMENTAL METHOD

Eka Putra Dairi Boangmanalu[1]*, Jandri Fan HT Saragi[2] Angga Bahri Pratama[3]
[1] Program Studi Teknologi Rekayasa Manufaktur, Jurusan Teknik Mesin, Politeknik Negeri Medan, Jl. Almamater No.1, Padang Bulan, Medan Baru, Medan City, North Sumatra 20155
[2] Program Studi Teknik Mesin, Jurusan Teknik Mesin, Politeknik Negeri Medan, Jl. Almamater No.1, Padang Bulan, Medan Baru, Medan City, North Sumatra 20155
[3] Program Studi Teknik Konversi Energi, Jurusan Teknik Mesin, Politeknik Negeri Medan, Jl. Almamater No.1, Padang Bulan, Medan Baru, Medan City, North Sumatra 20155
Correspondence Author : ekaboangmanalu@polmed.ac.id

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Abstract
This study evaluates the technical performance and efficiency of a corn shelling machine with a capacity of 300 kg/h using an experimental method under field conditions. The research aims to determine machine performance in terms of working capacity, shelling efficiency, unshelled kernels, and total losses. Data were collected through three repeated experimental trials involving measurement of input-output weight and processing time. The results show that the machine operates at a stable capacity of 300 kg/h, consistent with its design specification. The average shelling efficiency reached 94.1%, indicating high separation performance. Unshelled kernels were recorded at 3.3%, while total losses were 2.6%, indicating low material waste. The machine demonstrates effective performance suitable for small to medium-scale corn processing. However, improvements in feeding uniformity and moisture control are recommended to enhance overall efficiency.

Keywords: capacity, corn sheller, efficiency, experimental method, post-harvest

INTRODUCTION

Corn is one of the most widely cultivated cereal crops globally and plays an important role in food security and industrial raw materials (Grote et al., 2021). In many developing agricultural regions, corn is used not only for human consumption but also as animal feed and bioenergy raw material. Post-harvest processing is a critical stage in corn production, particularly shelling, which involves separating kernels from the cob (Layuk et al., 2021)& (Becerra-Sanchez & Taylor, 2021). This process significantly affects grain quality, yield, and economic value. Traditionally, shelling is done manually using simple tools or physical force, which is inefficient and time-consuming. The introduction of mechanical corn shelling machines has significantly improved productivity. These machines reduce labor requirements and increase processing speed. However, machine performance depends on operational factors such as feeding rate, machine speed, and moisture content of the corn. In rural agricultural systems, medium-scale machines such as 300 kg/h shellers are widely used due to their affordability and practicality. Therefore, evaluating their technical performance under real operating conditions is essential to ensure efficiency and effectiveness. The objective of this study is to analyze the technical performance and efficiency of a 300 kg/h corn shelling machine using an experimental method under field conditions.

LITERATURE REVIEW

Mechanization in agriculture has been widely adopted to improve productivity and reduce labor costs. According to (Kabir & Fedele, 2018) mechanical shelling increases efficiency up to several times compared to manual methods. Efficiency is influenced by machine operational parameters such as rotor speed, feeding rate, and material moisture content. Improper adjustment can lead to incomplete shelling and increased losses (Wang et al., 2021).

Performance evaluation should include capacity, efficiency, and loss percentage as key indicators of effectiveness. Other studies indicate that kernel damage is influenced by mechanical impact during shelling. Excessive force or improper clearance settings between components may increase breakage rates.
(Kumar et al., 2013) & (Li et al., 2020).

METHOD

Research Design

This study used an experimental method conducted under field conditions to simulate real operational performance. The object was a corn shelling machine with a capacity of 300 kg/h.

Materials and Equipment

- Corn shelling machine (300 kg/h)
- Dried corn cobs
- Digital weighing scale
- Stopwatch
- Collection containers

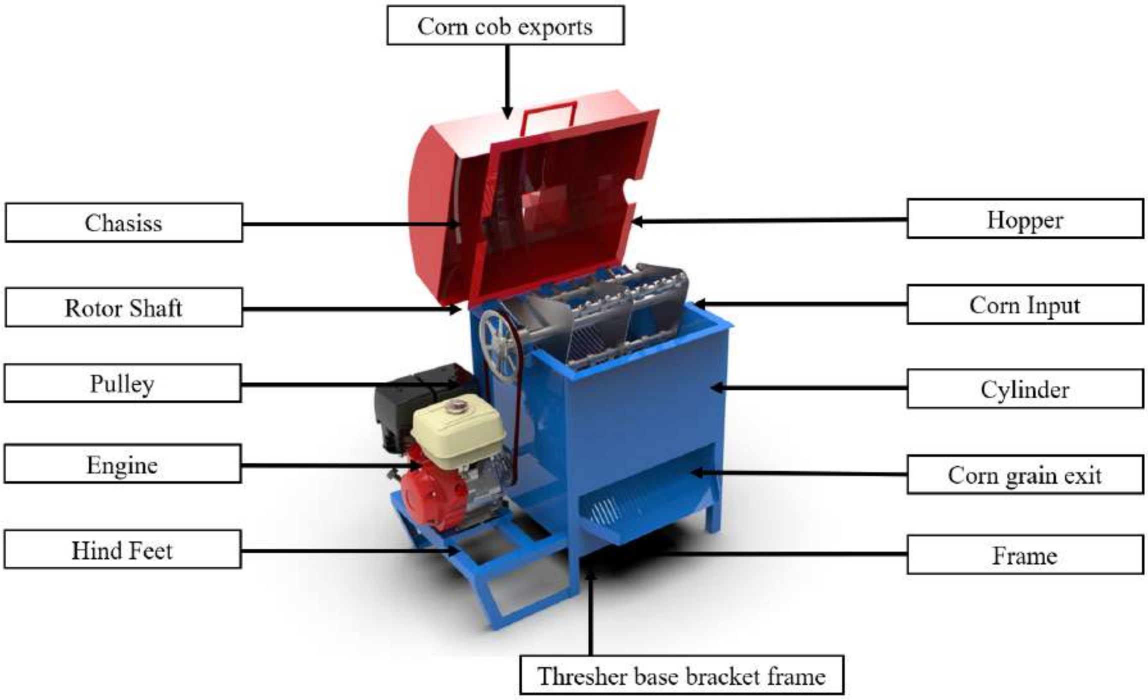

Figure 1. Corn shelling machine (300 kg/h)

Experimental Procedure

- Prepare corn sample (300 kg per trial)
- Feed corn into machine at steady rate
- Record processing time
- Collect output kernels, unshelled corn, and losses
- Repeat experiment 3 times

Flowchart of Process

The process used in using the machine can be seen in the image below.

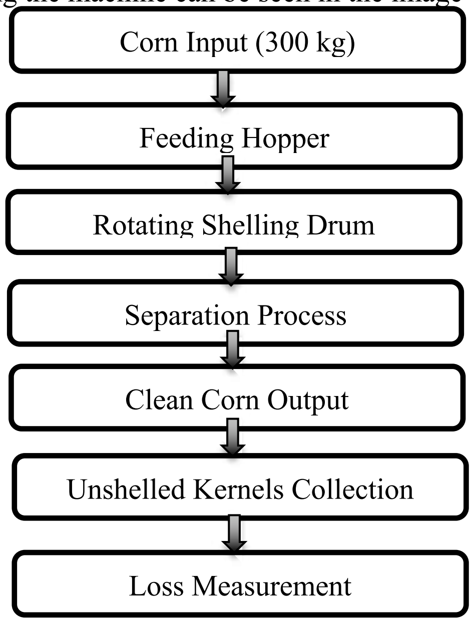

Figure 2. Flowchart of Process

Data Analysis

Performance parameters:

$C = W / T$

$\eta = (\text{Output} / \text{Input}) \times 100\%$

$\text{Loss} = (\text{Unshelled} / \text{Input}) \times 100\%$

RESULTS AND DISCUSSION (TNR, 12 BOLD)

This section presents the results obtained from experimental testing of the 300 kg/h corn shelling machine. The results are described in detail and supported by tables and graphical representations to facilitate interpretation. The discussion provides an analytical explanation of the findings, linking them to relevant engineering principles and previous studies in agricultural mechanization.

Experimental Results Overview

The performance of the corn shelling machine was evaluated through three repeated experimental trials under identical operating conditions. The main parameters observed include machine capacity, shelling efficiency, unshelled kernels, and total losses.

Table 1. Experimental Results of Corn Shelling Machine

Trial	Input (kg)	Output (kg)	Unshelled (kg)	Losses (kg)	Time (h)
1	300	282	10	8	1.0
2	300	285	8	7	1.0
3	300	280	12	8	1.0

The results indicate relatively small variations between trials, showing that the machine operates under stable mechanical conditions.

Machine Capacity Performance

The machine capacity is calculated based on the ratio between input mass and processing time. In all trials, the machine consistently processed 300 kg of corn per hour, indicating that the system operates according to its design specification. This stable performance suggests that the engine power and transmission system are sufficient to maintain continuous shelling without significant load fluctuation. According to agricultural machinery principles, stable capacity is an important indicator of operational reliability.

Shelling Efficiency Analysis

Shelling efficiency is a key indicator of machine performance. The results show efficiency values of:

- 94.0% (Trial 1)
- 95.0% (Trial 2)
- 93.3% (Trial 3)

The average efficiency is 94.1%, which is considered high for medium-scale agricultural shelling machines.This high efficiency indicates that the mechanical interaction between the rotating drum and concave system is effective in separating corn kernels from the cob. Similar findings were reported in previous studies, where efficient shelling is strongly influenced by rotor speed stability and proper feeding rate contro

Unshelled Kernels and Material Losses

The percentage of unshelled kernels ranges from 2.6% to 4.0%, with an average of 3.3%. Meanwhile, total losses range from 2.3% to 2.7%, with an average of 2.6%. These values indicate that the machine has good material recovery performance, with minimal loss during processing. In mechanical shelling systems, losses typically occur due to incomplete separation, kernel scattering, or improper feeding alignment. The relatively low loss percentage confirms that the machine design is efficient in minimizing post-harvest waste.

Discussion of Findings

The experimental results demonstrate that the corn shelling machine performs effectively under field conditions. The consistency of capacity (300 kg/h) indicates that the machine is capable of sustaining continuous operation without performance degradation. The efficiency level of 94.1% suggests that the machine has a well-optimized shelling mechanism. This performance is comparable to other studies in agricultural mechanization, where efficiency above 90% is generally considered satisfactory for small to medium-scale machines.

Variations in unshelled kernels and losses are mainly caused by differences in corn physical properties such as hardness, size uniformity, and moisture content. Additionally, feeding stability during operation also influences performance consistency. From an engineering perspective, the results indicate that the machine has good design compatibility between power input, rotational speed, and shelling mechanism. However, further improvements in feeding control and material uniformity could enhance overall efficiency and reduce losses further.

Implications of the Study

The findings of this study have practical implications for agricultural mechanization. The machine can be effectively used in rural and small-scale farming systems to improve post-harvest productivity. High efficiency and low losses contribute directly to increased farmer income and reduced processing time. Furthermore, this study provides a basis for future development of improved shelling machines with higher precision and lower energy consumption.

CONCLUSION

This study aimed to evaluate the technical performance and efficiency of a corn shelling machine with a capacity of 300 kg/h using an experimental method under field conditions. Based on the results and discussion, the machine demonstrates stable operational performance with a consistent working capacity of 300 kg/h across all experimental trials. The average shelling efficiency obtained was 94.1%, indicating that the machine is highly effective in separating corn kernels from the cob. In addition, the average unshelled kernel percentage was 3.3%, while total losses were relatively low at 2.6%. These results show that the machine operates with good efficiency and minimal material loss, which is important for improving post-harvest productivity. Overall, the corn shelling machine is suitable for small to medium-scale agricultural applications due to its stable performance, high efficiency, and low losses. However, further improvements are recommended, particularly in feeding uniformity and operational consistency, to enhance efficiency and reduce kernel losses in future development. Future work may focus on optimizing machine design parameters such as rotor speed, concave clearance, and feeding system to improve performance under varying corn conditions.

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