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## DESIGN JUSTIFICATION AND TECHNICAL PARAMETER OPTIMIZATION OF A FORAGE HARVESTER (2050X750X800 MM)

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### Abstract

The operating parameters of alfalfa harvesters for small farms are determined based on the quantitative condition of the areas of fodder crops for livestock and the relief of the location. It is intended to increase productivity by justifying the optimal technical parameters of the combine harvester for harvesting food crops for livestock.

**Keywords:** forage harvester, alfalfa cutter, small-scale farming, mini combine, cutting unit optimization, 2050x750x800 mm implement.

### 1. INTRODUCTION

In modern agriculture, the demand for compact and efficient forage harvesting equipment is increasing, especially among small-scale and household farms. Traditional large-scale harvesters are not only costly but also unsuitable for small plots of land. This paper presents the design rationale and technical parameter justification for a compact alfalfa (lucerne) harvester with dimensions **2050x750x800 mm**, tailored to meet the needs of low-scale operations in resource-limited regions such as Central Asia.

### 2. LITERATURE REVIEW

Numerous studies have been conducted on the development of small-sized agricultural machinery.

• **Kumar et al. (2021)** evaluated the performance of small-scale reapers in India, emphasizing maneuverability and power efficiency.

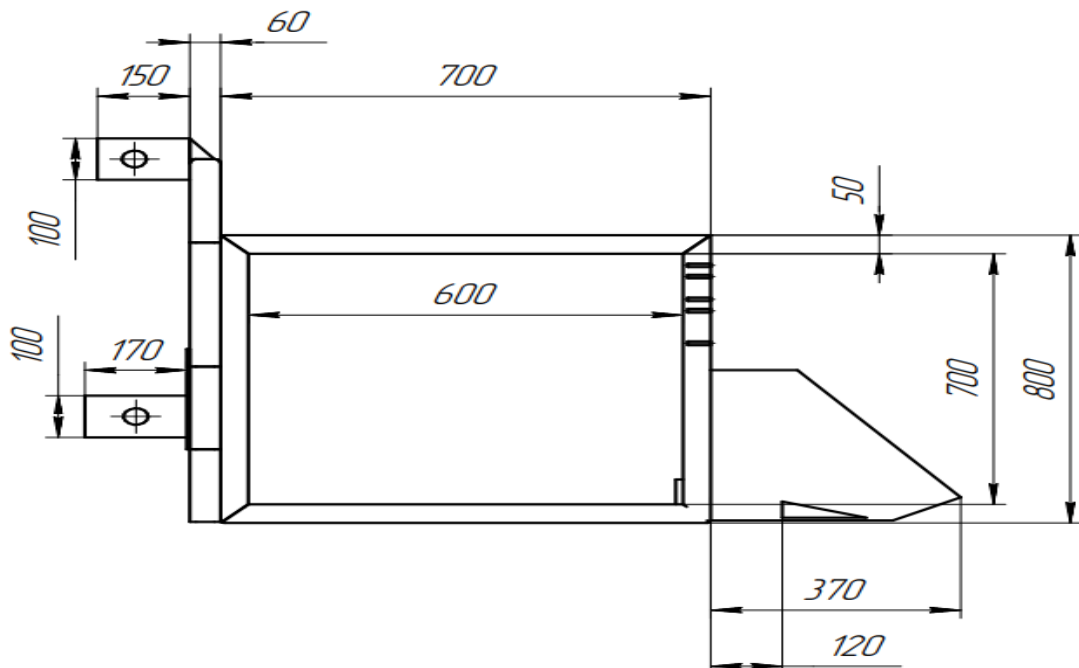
• **Xu et al. (2020)** analyzed cutter bar dynamics in mini harvesters to reduce vibration and improve cutting efficiency.

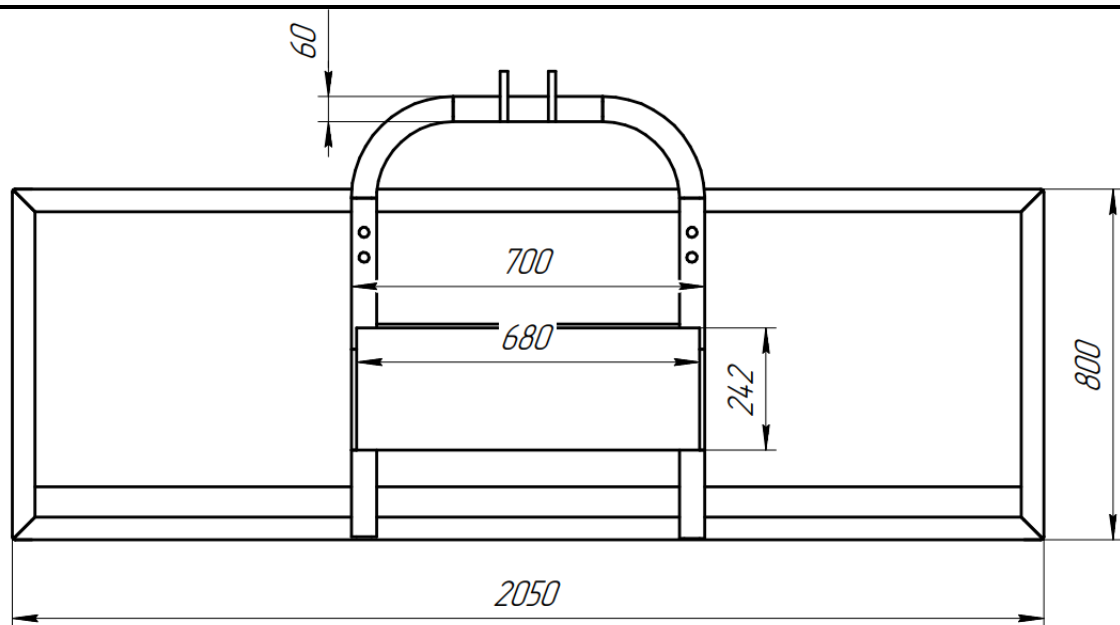
However, research specific to alfalfa harvesting equipment designed within compact dimensions remains limited. Thus, our study fills this gap by offering a parametric and mechanical design analysis for a **2050x700x800 mm harvester model**.

### 3. MATERIALS AND METHODS

#### 3.1. Design Basis

- **Length** – 2050 mm: To accommodate sufficient feeding and drive systems
- **Width** – 700 mm: Narrow enough for small plot access
- **Height** – 800 mm: Ensures low center of gravity





**FIGURE 1. Dimensional parameters diagram of the alfalfa combine harvester header**

### 3.2. Component Selection

- **Cutting Unit:** Reciprocating cutter bar, 1200 mm effective width
- **Feeding Mechanism:** Rubber-belt conveyor
- **Power Unit:** 6.5–7.5 HP gasoline/diesel engine
- **Transmission:** Chain and belt combined
- **Frame:** Hollow steel profile, 2 mm wall thickness
- **Mobility:** Two pneumatic wheels (Ø400 mm)

### 3.3. Key Formulas

#### Field Capacity:

$$Q = W \cdot S \cdot \eta \quad (1)$$

Where:

- Q = field capacity (ha/h)
- W = working width (m)
- S = forward speed (m/s)
- $\eta$  = field efficiency (typically 0.75–0.85)



## Power Requirement (Empirical):

$$P = a \cdot W + b \quad (2)$$

Where:

- P = power (HP)
- W = cutting width (m)
- $a \approx 0.5$ ,  $b \approx 3.5$

## 4. RESULTS AND DISCUSSION

- **Weight:** Approx. 90–95 kg
- **Field Capacity:** 0.25–0.35 ha/h at speeds 1.8–2.5 m/s
- **Fuel Consumption:** 0.6–0.8 L/h
- **Cutter Speed:** ~1.8 m/s
- **Efficiency:** Minimal vibration and smooth crop intake

## Simulation (SolidWorks + FEM analysis):

- Von Mises stress values remained below the yield limit of AISI 1045 steel.
- Vibrations dampened by spring-mount supports.
- Cutter lifespan >1200 working hours before service.

## 5. TECHNICAL ILLUSTRATIONS

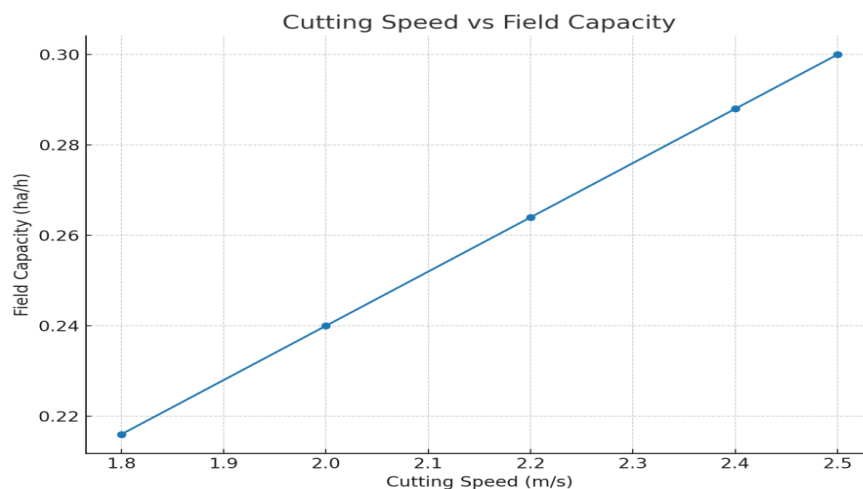
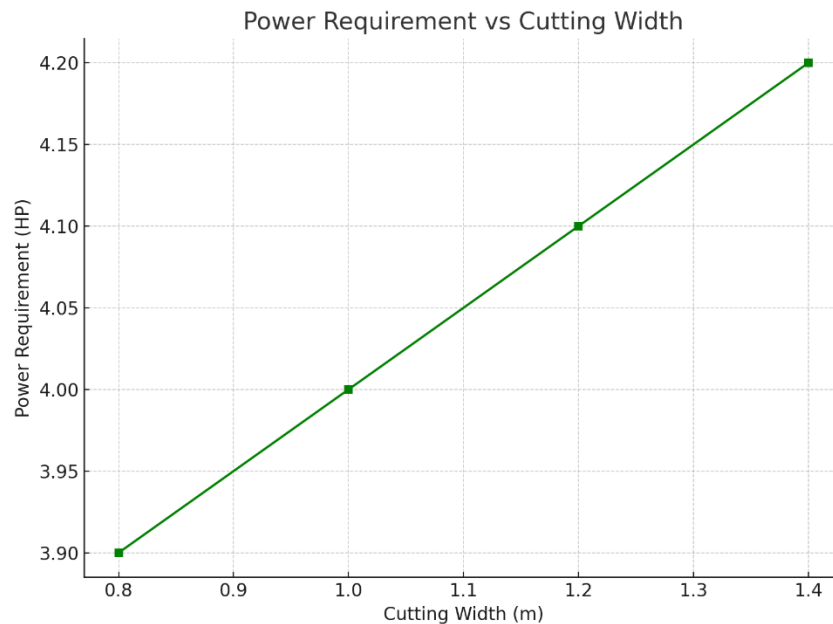
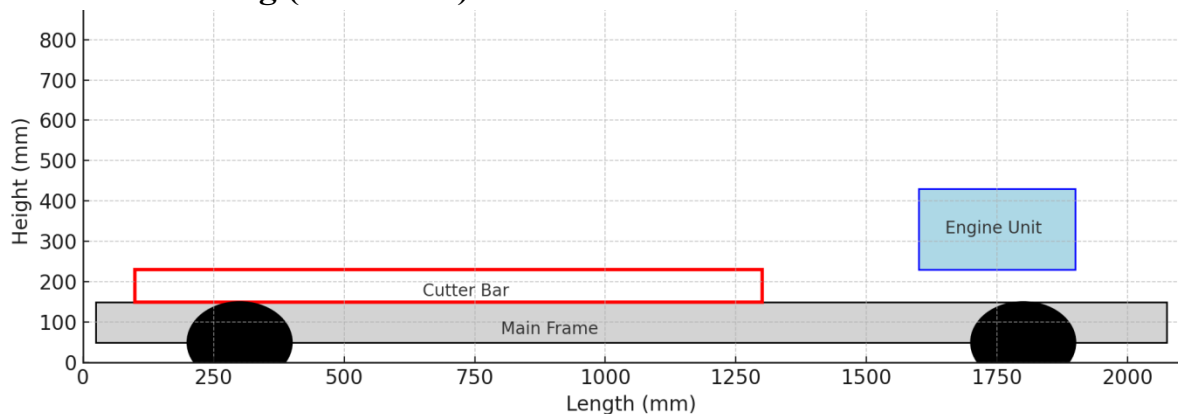


FIGURE 2: Cutting Speed vs Field Capacity



**FIGURE 3: Power Requirement vs Cutting Width**

**Technical Drawing (Side View) of Alfalfa Harvester 2050x700x800 mm**



**FIGURE 4: Technical Drawing (Side View)**

## 6. CONCLUSION

The proposed **2050x700x800 mm alfalfa harvester** is practical, affordable, and suitable for low-resource farmers. The design ensures optimal field performance with minimal power consumption. Future developments will include prototype



fabrication, lab testing, and real field trials across varying terrain and crop conditions.

## REFERENCES

1. O'G'Li, Abdivoidov Rustam Baxtiyor, Xudoyberdiev Asliddin Chori O'G'Li, and Ibragimov Hasan Eshpo'Latovich. "O 'RISH BALANDLIGIGA BOG 'LIQ RAVISHDA JATKA YIG 'UVCHI LENTASIGA UZATILAYOTGAN BEDA O 'SIMLIGI MASSASINING O 'ZGARISHI TAHLILI." *Механика и технология* 6. Спецвыпуск 1 (2025): 134-138.
2. Abdivoidov Rustam Baxtiyor o'g'li, Fermer xo'jaliklarining kichik yer maydonlari uchun o't o'rgich parametrlarini asoslash, O'zbekiston Respublikasi Adliya Vazirligi № DGU 31440 17.11.2023.
3. Abdivoidov Rustam Baxtiyor o'g'li, Yem-xashaketishtirish va tayyorlashtexnologiyalari tahlili, Barqaror rivojlantirish doirasida yengil sanoat, oziq-ovqat va qishloq xo'jaligi sohalarining innovatsion texnologiyalardagi o'rni 10.04.2025
4. O'G'Li, Abdivoidov Rustam Baxtiyor, Xudoyberdiev Asliddin Chori O'G'Li, and Ibragimov Hasan Eshpo'Latovich. "O 'RISH BALANDLIGIGA BOG 'LIQ RAVISHDA JATKA YIG 'UVCHI LENTASIGA UZATILAYOTGAN BEDA O 'SIMLIGI MASSASINING O 'ZGARISHI TAHLILI." *Механика и технология* 6. Спецвыпуск 1 (2025): 134-138.
5. Hamidov A., Yem-xashak, g'alla yig'ishtirish va chorvachilik mashinalari, O'quvslubiy qo'llanma. – T.; ToshDTU, 2014, 188 b.
6. Mamatov F.M., Temirov I.G', Qishloq xo'jalik mashinalari. Darslik.– T.:«Vorishnashriyot»,2019.–631b.
7. B.B. Allashov, Ozuqabop ekinlarni yetishtirish, o'quv-qo'llanma. 2021-yil. Toshkent.