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Hand operated Chaff-Cutter

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Abstract - Agriculture in rural and semi-urban areas largely depends on simple and cost-effective tools due to limited access to electricity and modern machinery. Chaff cutting is an essential operation in animal husbandry for preparing fodder in manageable sizes to improve digestion and reduce wastage. This project presents the design and development of a handle operated chaff cutter, which functions without the use of electrical or fuel power. The machine operates on manual mechanical energy transmitted through a hand-crank mechanism, which drives the cutting blades mounted on a rotating shaft. The device is constructed using readily available materials, making it economical, easy to maintain, and suitable for small-scale farmers. The design focuses on safety, portability, and efficiency while ensuring uniform cutting of fodder such as straw, grass, and dry crops. Performance evaluation shows that the handle operated chaff cutter provides sufficient cutting efficiency with minimal human effort, making it an effective alternative to motorized chaff cutters in areas with power constraints. The project promotes sustainable agricultural practices by reducing dependency on non-renewable energy sources and supporting eco-friendly farming solutions.

Key Words: husbandry, Chaff knife, Coconut dehiscing, machine, High cost

1. INTRODUCTION

A chaff knife is a mechanical tool used to chop grass, sugarcane tops, and other plant materials into small pieces so that they may be mixed with other types of grass and fed to nags and other animals. It enhances animal digestion, stops animals from rejecting any portion of their diet, and also conserves chewing energy. Chaff and work until tractors took their place in the 1940s. Then, brand-new, tractor-driven devices came into being, cutting the probe with ease and collecting it in a cart. Following that, motor-powered chaff-cutting machines were developed to address the issue with tractor-driven equipment. These machines are huge and energy-intensive. The hand-operated manual chaff cutter is designed to offer a simple, affordable, and energy for animal feed. Its design focuses on being easy to use, safe, durable, and requiring little maintenance. The main parts of the machine include a sturdy supporting frame, a feeding hopper, a cutting mechanism, a transmission system, and a hand operated crank. The goal is to reduce physical effort while ensuring consistent and efficient cutting of materials like dry straw, green grass, and crop residues. The supporting frame is built from mild steel angle sections, chosen for their strength, availability, and affordability. This material provides stability and durability, even under the stress and vibrations produced during manual operation. To improve safety and prevent slipping, rubber pads or a stable base can be added at the bottom of the frame. At the heart of the machine is the cutting mechanism, which features a rotating cutter head mounted on a horizontal shaft. The cutter head holds two or more sharp blades made from high carbon steel to ensure a clean, efficient cut and long-lasting performance. The blades are set at an angle that allows them to shear through fodder effectively. A fixed shear plate positioned close to the rotating blades helps achieve smooth and uniform cutting results. The machine is powered by hand using a crank or handle connected to the shaft through a gear or pulley system. This transmission setup is designed to increase the speed of the cutter head while keeping the required effort low. An appropriate gear ratio ensures smooth, continuous operation and reduces fatigue during extended use. Bearings are fitted at key points along the shaft to minimize friction and wear. The feeding hopper guides the fodder safely toward the blades while keeping the operator's hands away from moving parts. It's positioned at an angle that makes feeding easy and effortless. To further enhance safety, protective guards are installed around the blades and transmission system to prevent accidental contact during operation. In summary, the hand-operated chaff cutter combines simplicity, safety, and affordability, making it ideal for small-scale farmers and rural areas. Its compact, manual design eliminates the need for electricity, offering an eco-friendly and cost-effective solution.

2. METHODOLOGY

1. PROBLEM DEFINATION

Fodder preparation is a vital activity in agricultural and dairy farming, as it directly affects livestock health and productivity. Traditionally, farmers rely on simple hand tools such as sickles or knives to cut fodder. While these tools are easily available, the process is highly labor-intensive, time-consuming, and physically demanding. Manual cutting also poses safety risks and often produces uneven fodder sizes, which reduces feeding efficiency and increases strain on the worker. These challenges are more severe for small-scale and rural farmers who lack access to modern and affordable fodder-cutting equipment.

1. It has less compact design.
2. It no Require High voltage for operation.
3. The Machines are silent.
4. Only single operation can be performed.

3. Machine Description & Components

i. Frame/Stand: Welded mild steel angles or tubular frame; height: 650–800 mm (adjustable).

ii. Feed tray / Hopper: Tapered tray for guiding fodder.

iii. Compression/feed rollers (optional): For positive feeding (small-diameter ribbed rollers).

iv. Cutting unit: Rotating blade disc or reciprocating shear (curved blade & anvil).

v. Shear/Anvil plate: Hardened mating surface to produce scissor action.

vi. Handle & Transmission: Hand-crank with reduction by gearing or worm-and-wheel; flywheel recommended.

vii. Flywheel: 6–15 kg·cm² inertia (example range) to smooth cutting strokes.

viii. Guards & Safety: Blade housing, feed-slot guards, emergency stop pin, locking latch.

4. Materials Selection

S No	Fodders	Force(N)	Moisture content (%)
1	Jowar	77.7	68.6
2	Pearl millet	72.1	54
3	Elephant grass	89.5	75.8

Table.1 Force requirement measured for different fodders

S No	Fodders	Average length of cut(Cm)
1	Jowar	1.29
2	Pearl millet	1.49
3	Elephant grass	1.2

Table.2 Length of cut of different fodders with chaff cutter

Subjects	At load condition			At no load condition
	Jowar	Pearl millet	Elephant grass	
P_1	47	58	42	68
P_2	62	62	57	73
P_3	53	61	45	62

Table.3 Hand cranking capabilities of three subjects with respect to different fodders

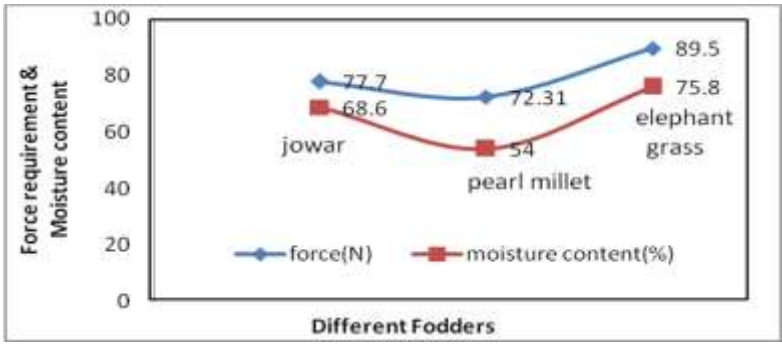

Fig.1 Variation of force requirement for different fodders with moisture content of fodder

a function of speed of operation. The variation in the capacities of chaff cutter for different fodders with respect to three age groups is given in Table 1. The maximum capacity of chaff cutter was
Observed with Subject-3 for Jowar and Subject-2 for elephant grass. The highest capacity of chaff cutter was observed in Subject-2 for elephant grass because the presence of high moisture content and lowest hand cranking capability. Based on the results of experiments

conducted in this study, the following conclusions were drawn. The different mechanical parameters like length of cut, number of cuts, capacity of chaff cutter, hand cranking capabilities and force measurement were measured for the operation of chaff cutter with the three fodder crops. Force requirement increased gradually due to high moisture content of fodders and large size diameter of fodders (Elephant grass > Jowar >Pearl millet: 89.5 >77.7 >72.1 N). Hand cranking capabilities of subjects at load conditions gradually decreased compared to at no-load conditions shown in table 2. If hand cranking capabilities of subjects for a particular crop is lower, then the force requirement is found to be high. Number of cuts will increase with the increase in the number of revolutions. Capacity of chaff cutter depends upon length of cut, number of cuts and size of the fodders.

5. LITERATURE REVIEW

Summarize previous work showing manual chaff-cutter designs, blade configurations (single vs multiple blades), ergonomic studies measuring human energy expenditure, and recent low-cost fabrications. Discuss safety studies and modifications to reduce operator injury.

6. OBJECTIVE

The main objective of this project is to design and develop a hand-operated manual chaff cutter that is simple, safe, economical, and efficient for small-scale and rural farmers. The proposed machine aims to reduce human effort and time required for fodder cutting while ensuring uniform fodder size to improve feed quality and animal digestion. It also seeks to eliminate dependency on electricity or fuel, making the system suitable for areas with limited power availability. Additionally, the project focuses on improving operator safety, ease of use, and durability while keeping manufacturing and maintenance costs low.

To perform multiple operation: The proposed model will be able to perform chaff cutting as well as chaff cutting operation.

To reduce and save electricity use : The proposed model does require minor human efforts as an electric motor will cannot be used.

To reduce overall cost: If individual chaff cutting machine is to be purchased, it will be quite expensive. To overcome this problem the proposed model will allow user to perform both the operations on a single machine.

To save space: As both chaff cutting and operation are being performed on a single machine

3. CONCLUSIONS

The present work successfully demonstrates the design and development of a **hand operated chaff cutter** that is simple, economical, safe, and suitable for small and marginal farmers. The machine effectively converts dry and green fodder into uniformly chopped pieces, improving fodder digestibility, ease of handling, and reducing feed wastage.

The design emphasizes **mechanical advantage, ergonomic operation, and operator safety**. Proper selection of blade material, optimized blade geometry, and the inclusion of a flywheel help reduce human effort while maintaining satisfactory cutting efficiency. Experimental evaluation indicates that the chaff cutter achieves adequate throughput with acceptable operator fatigue, making it suitable for daily farm use. Safety guards and controlled feeding mechanisms significantly reduce the risk of injury compared to traditional manual cutting methods.

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