International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 10 Issue: 03 | March - 2026 SJIF Rating: 8.659 ISSN: 2582-3930

Agricultural Crop Cutter

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Abstract- I Agriculture plays a vital role in the Indian economy, where efficient harvesting methods are essential for increasing productivity and reducing labor dependency, Traditional crop cutting methods using manual tools are time consuming, Labor-intensive, and less efficient, The aim of this project is to design and develop an agricultural Crop cutter that improves cutting efficiency while minimizing human effort and operational cost.

Keywords-

1. Iron pipe
2. Pulley
3. Spring
4. Ball bearings
5. Iron plate
6. Circular plate
7. Shaft
8. Wheels
9. Base frame
10. Cutter

I. INTRODUCTION

Agriculture is the backbone of the Indian economy and plays a crucial role in providing employment and food security. A large portion of the population in India depends on farming for their livelihood. Despite technological advancements, many agricultural operations, especially harvesting, are still performed manually in rural areas. Traditional harvesting methods using hand tools such as sickles are labor-intensive, time-consuming, and physically demanding. Moreover, the increasing shortage of agricultural labor and rising labor costs have created a need for efficient mechanized solutions.

To overcome these challenges, agricultural mechanization has become essential. Crop cutting is one of the most important stages in farming, directly affecting productivity and crop quality. The use of mechanical crop cutters significantly reduces human effort, increases operational speed, and improves harvesting efficiency. However, large harvesting machines such as combine harvesters are expensive and not affordable for small and medium-scale farmers.

The Agricultural Crop Cutter project aims to design and develop a compact, cost-effective, and easy-to-operate machine suitable for small-scale farming conditions. The machine consists of a cutting mechanism, power transmission system, supporting frame, and drive arrangement. It is designed to provide efficient cutting of crops such as wheat, rice, and grass while ensuring safety, reliability, and low maintenance.

This project focuses on applying mechanical engineering principles such as machine design, power transmission, material selection, and fabrication techniques to develop an efficient harvesting solution. The proposed system contributes to agricultural development by increasing productivity, reducing labor dependency, and promoting affordable mechanization in rural areas.

II. DETAILED METHODOLOGY

1. Problem Identification

Agricultural harvesting in many rural areas is still performed manually using sickles. This method:

Requires more manpower.

Takes more time to harvest large areas.

Causes physical strain and fatigue.

Increases labor cost due to shortage of workers.

Large machines like combine harvesters are expensive and not suitable for small farms. Therefore, there is a need to develop a compact, affordable, and efficient crop cutter suitable for small and medium-scale farmers.

2. Literature Survey

A detailed review of previous research papers, agricultural journals, and existing crop cutter models was conducted.

The study focused on:

- Rotary blade mechanisms
- Reciprocating cutter bar mechanisms
- Petrol engine driven systems
- Electric motor driven systems
- Pedal operated machines
- From the literature review, it was observed that:
- Rotary systems provide faster cutting.
- Reciprocating systems provide cleaner cutting.
- Electric systems are eco-friendly but limited by battery life.
- Petrol systems provide high power but increase operating cost.

- Based on this study, a suitable mechanism was selected considering cost, efficiency, and simplicity.

3. Conceptual Design

Different design concepts were prepared through hand sketches and basic layout drawings. The following factors were considered:

Easy operation

Lightweight structure

Stability during operation

Ease of maintenance

Safety features

After comparing multiple concepts, the final design included:

A rigid MS frame

A motor/engine mounted on the frame

Belt and pulley power transmission

Rotary cutting blade at the front

Supporting wheels for mobility

4.Design Calculations

4.1 Power Requirement Calculation

The power required for cutting depends on:

Crop thickness

Blade speed

Cutting force

Power formula:

Power formula:

$$P = \frac{2\pi NT}{60}$$

Where:

P = Power (W)

N = Speed (RPM)

T = Torque (Nm)

The cutting force was estimated based on crop resistance and blade sharpness. After calculation, suitable motor power (for example 1–3 HP) was selected.

4.2 Shaft Design

The shaft transmits power from motor to blade.

Using torsion equation:

$$T = \frac{\pi}{16}\tau d^3$$

Where:

T = Torque

τ = Shear stress

d = Shaft diameter

The shaft diameter was calculated considering safety factor and allowable shear stress.

4.3 Blade Design

Blade material selected: High Carbon Steel

Reasons:

High hardness

Good wear resistance

Sharp cutting edge

Parameters considered:

Blade thickness

Blade diameter

Cutting angle

Speed of rotation

The blade was designed to minimize vibration and maximize cutting efficiency.

4.4 Frame Design

Material selected: Mild Steel

Frame design considerations:

Load carrying capacity

Motor weight support

Vibration resistance

Stability during movement

The frame was welded using arc welding process

IV. CONCLUSION

The development of the Agricultural Crop Cutter successfully demonstrates the practical application of mechanical engineering principles in solving real-world agricultural problems. The project aimed to design and fabricate a compact, efficient, and cost-effective harvesting machine suitable for small and medium-scale farmers. Based on design, fabrication, and testing,

V. WORKING

The agricultural crop cutter is a mechanical machine designed to cut crops efficiently with minimum human effort and time. The working of the crop cutter is based on the principle of converting

electrical or mechanical energy into rotational motion to operate the cutting mechanism. The machine mainly consists of a power source such as an electric motor or

petrol engine, a power transmission system, a shaft, pulleys, a cutting blade, and a supporting frame.

When the machine is started, the motor or engine begins to rotate and produces mechanical power. This rotational motion is transmitted to the cutting mechanism through a belt and pulley arrangement. The pulley attached to the motor shaft acts as the driving pulley, while another pulley connected to the cutter shaft acts as the driven pulley. A V-belt connects these two pulleys and transfers the rotational motion from the motor to the cutter shaft efficiently.

Spring Flywheel Mechanism

The spring flywheel mechanism is an important mechanical system used to store and release energy during the operation of machines. In an agricultural crop cutter, this mechanism helps maintain smooth and continuous rotation of the cutting blade and improves the overall efficiency of the machine. It combines the functions of a spring and a flywheel to regulate the speed of the cutting mechanism and reduce sudden load variations.

A flywheel is a heavy rotating disc attached to the shaft of a machine. Its main function is to store rotational energy when the machine is running and release this energy when the load on the machine increases. During crop cutting, the resistance from thick or dense crops may cause fluctuations in the rotational speed of the cutting blade. The flywheel helps maintain a uniform speed by storing excess energy and supplying it when required.

The spring in the mechanism acts as an energy storage element. When the machine is in operation, the spring compresses or stretches depending on the design of the system. This allows the spring to store potential energy. When the load on the machine increases, the stored energy in the spring is released, assisting the flywheel in maintaining stable motion. This combination of spring and flywheel helps reduce vibration and ensures smoother machine operation.

The spring flywheel mechanism generally consists of components such as the flywheel, spring, shaft, bearings, and supporting frame. The flywheel is mounted on the rotating shaft and connected to the power transmission system. The spring is placed in such a way that it absorbs sudden shocks or load changes during cutting. Bearings are used to support the shaft and allow smooth rotation with minimal friction.

When the motor or engine of the crop cutter starts, it rotates the shaft through the pulley and belt arrangement. The flywheel attached to the shaft begins to rotate and stores kinetic energy. At the same time, the spring stores potential energy as it compresses

or stretches during operation. When the machine encounters heavy crop resistance, the stored energy in the flywheel and spring is released to maintain constant rotational speed. This helps the cutting blade continue its motion smoothly without sudden speed drops.

VI..ADVANTAGES

1.Reduction in Manual Labor

The agricultural crop cutter significantly reduces the need for manual labor during harvesting. Traditional methods require a large number of workers, while the machine can perform the same task with minimal human effort.

2. Time Saving

The machine can cut crops much faster than manual harvesting using sickles. This reduces the overall harvesting time and allows farmers to complete the work quickly.

3. Increased Productivity

By reducing harvesting time and labor requirements, the agricultural crop cutter increases the productivity of farming operations and helps farmers harvest larger areas in a shorter time.

4. Reduced Physical Effort

Manual harvesting causes physical strain and fatigue for workers. The crop cutter minimizes physical effort and makes harvesting more comfortable for the operator.

5. Cost Effective

The machine reduces the cost of labor and harvesting operations. It is an economical solution for farmers, especially small and medium-scale farmers.

6. Uniform Cutting of Crops

The crop cutter provides consistent and uniform cutting height, which improves the quality of harvesting and reduces crop damage.

7. Easy Operation

The machine is designed to be simple and easy to operate. Farmers can use it with basic training and minimal technical knowledge.

8. Portable and Lightweight

Most agricultural crop cutters are compact and lightweight, making

them easy to move from one field to another and operate in small or uneven fields.

9. Low Maintenance

The machine requires only basic maintenance such as lubrication, cleaning, and periodic inspection of

components, which keeps maintenance costs low.

10. Suitable for Small Farms

Unlike large combine harvesters, the agricultural crop cutter is suitable for small and medium-sized farms where large machines cannot operate efficiently.

VII..DISADVANTAGES

1. Risk of Mechanical Failure

If components such as the blade, pulley, belt, or shaft are not properly maintained, they may wear out or fail, which can interrupt the harvesting process.

2. Safety Concerns

The rotating blades used for cutting crops can be dangerous if the machine is not handled carefully. Improper operation may lead to injuries.

3. Training Required for Operation

Farmers may require basic training to operate and maintain the crop cutter effectively, especially when using motor-driven machines.

VIII. APPLICATIONS

1. Harvesting of Grain Crops

The agricultural crop cutter is widely used for harvesting grain crops such as wheat, rice, barley, and oats. It helps farmers cut these crops quickly and efficiently compared to traditional manual methods.

2. Cutting of Grass and Fodder

Crop cutters are used to cut grass and fodder crops that are used as food for livestock. This helps farmers collect animal feed easily and in less time.

3. Small and Medium-Scale Farming

The machine is especially useful for small and medium-sized farms where large harvesting machines such as combine harvesters cannot operate efficiently due to limited space.

4. Crop Field Maintenance

Agricultural crop cutters are used to maintain crop fields by cutting unwanted plants, weeds, and overgrown vegetation, which helps improve crop growth and field cleanliness.

5. Horticulture and Plantation Fields

The crop cutter can be used in horticulture farms, orchards, and plantation areas to cut small plants, grass, and weeds between crop rows.

6. Agricultural Research and Training

Crop cutters are used in agricultural universities, training institutes, and research centers for studying and demonstrating

modern farming equipment.

7. Rural Agricultural Mechanization

The crop cutter promotes mechanization in rural areas by providing farmers with a simple and affordable machine for harvesting operations.

8. Harvesting in Difficult or Narrow Fields

The compact design of the crop cutter allows it to operate in narrow fields, uneven terrain, and areas where large machines cannot reach.

9. Multi-Crop Harvesting

Some crop cutters can be used for harvesting multiple types of crops with slight adjustments in blade speed or cutting height.

10. Time-Sensitive Harvesting Operations

The machine helps farmers complete harvesting quickly during time-sensitive seasons, preventing crop loss due to weather conditions.

IX.ACKNOWLEDGEMENT

I would like to express my sincere gratitude to all those who helped and supported me during the completion of my final year project titled “Agricultural Crop Cutter.” This project would not have been possible without the guidance and encouragement of several individuals.

First and foremost, I would like to thank my project guide for providing valuable guidance, continuous support, and useful suggestions throughout the development of this project. Their knowledge and motivation helped me to understand the subject better and complete the project successfully.

I am also grateful to the Head of the Mechanical Engineering Department and all the faculty members for providing the necessary facilities, resources, and encouragement during the project work.

I would like to extend my thanks to the laboratory staff and workshop technicians for their assistance during the fabrication and testing of the project components.

Finally, I would like to thank my parents, friends, and classmates for their constant support, motivation, and encouragement throughout the completion of this project.

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