

# Development of agriculture cutter by using 4 bar mechanism

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**Abstract** - The conventional method of planting and growing crops is a laborious process, and therefore there is a shortage of manpower, resulting in a delay in agriculture operations. In this work, semiautomatic mechanical cutter was developed and fabricated by using 4 bar mechanism for cutting agricultural products like sugarcane bud and forage. The agriculture cutter was simple in construction than the existing machines and affordable to farmer and also save the time. The newly designed agriculture cutter was subjected to performance evaluation. Parameters such as cutting effectiveness were measured by calculating the number of buds feed and no of buds loss. Average cutting effectiveness of agriculture cutter was somewhat low (93.90%) as compared to mechanical cutter (94.33%) with less bud loss of sugarcane per lot during cutting.

**Key Words:** Agriculture cutter, 4 bar mechanism, sugarcane bud, cutting effectiveness.

## 1. INTRODUCTION

Agriculture plays a vital role in the Indian economy. Over 70% of rural households depend on agriculture. Agriculture is an important sector of the Indian economy, contributing approximately 8.4% to the total GDP and providing employment for over 60% of the population. Indian agriculture has experienced impressive growth over the past few decades.

Average land holding capacity of farmer in India is 1.08 ha and it can feed up to 8 persons. But the land holding capacity is decreasing day by day with increase in population. The conventional method of planting and growing crops is a laborious process which leads to shortage of manpower for other agriculture operations also.

Agricultural cutting equipment is the basic and main equipment involved in agriculture for maximum performance. At present, there are different types of cutters available that can be categorized into various groups based on their technology, working mechanism and the crops they are designed to cut. In terms of technology cutters can be classified into autonomous, semi-autonomous and manually operated. Regarding their working mechanism cutters can be grouped as crop cutter, chaff cutter, sugarcane bud cutter, reaper binder, forage cutter, and lawn mower. Lastly, cutters can also be categorized based on the type of crops they are designed to cut such as sugarcane cutter, paddy cutter and rice straw cutter.

Multipurpose agricultural cutting equipment can be designed based on the four bar chain mechanism. It is a much preferred mechanical device for the mechanization and control of motion due to its simplicity and versatility. Basically, it consists of four rigid links which are connected in the form of quadrilateral by four-pin joints. When one of the links is fixed, it is known as a linkage or mechanism. Link that rotate complete revolution is called the crank, the link opposite to the fixed link is called the coupler, and the fourth link is called the lever or rocker if it oscillates or another crank if it rotates.

Prices of semiautomatic and automatic cutters (1 HP) commercially available in the market ranges from Rs. 21,239/- to Rs. 35,800/- and prices of manually operated chaff cutter ranges from Rs.6800/-to Rs.12900/-. While prices of manually operated sugarcane bud cutters ranges from Rs. 1500/- to Rs.1600/-.

Due to high initial cost of existing chaff cutter and sugarcane bud cutter, low build quality of local brand cutter and does only single function, it is required to develop and fabricate the simple semiautomatic mechanical cutter using four bar mechanism affordable to farmer for cutting agricultural products like sugarcane bud and forage.

## 2. MATERIALS AND METHODS

The survey was conducted in different regions of the solapur district to collect information regarding land holding, types of crops cultivated, types of cutter used, problems faced by farmers in existing cutter, and improvement required in existing cutter. Agricultural cutter was fabricated using 4 bar mechanism and Performance of cutter was evaluated in terms of cutting efficiency, cutting capacity per hour, bud loss per hour and compared with traditional cutter.

### 2.1 Working principle

A four-bar linkage is a mechanical linkage of frame, rocker, connecting rod and crank connected by joints or pivots. It forms a closed loop and exhibits a motion. It can be used in various machineries and robotics to achieve controlled rotating or oscillating movements.

### 2.2 Development and fabrication of agriculture cutter

Agricultural cutter was fabricated using MS strips (25mm width and 4mm thickness), bearing (to support rotating

shaft), MS round bar (to make shaft & lever), pulley two in number (9 inch & 4 inch diameter to connect shaft), V belt drive over pulleys, motor (single phase 1.5 HP, 1.1 KW, 2200 rpm to supply power) and other miscellaneous material.

### 2.3 Performance evaluation

Performance of cutter was evaluated in terms of cutting efficiency, cutting capacity per hour, bud loss per hour and compared with traditional cutter.

#### Cutting effectiveness

The cutting efficiency of the developed agriculture cutter refers to its ability to effectively cut the agriculture produce. The cutting efficiency was measured by evaluating the number of buds cut per hour and buds loss per hour.

#### Cutting capacity per hour

The number of buds cut per hour was an essential parameter to determine the productivity of the cutter. This parameter measures the speed and effectiveness of the cutter in terms of the quantity of work accomplished within a specific time frame.

#### Buds loss per hour

It measures the accuracy of the cutting mechanism and its ability to minimize any unintended damage or loss of plant material. A lower number of buds lost per hour signifies a more efficient and precise cutter.

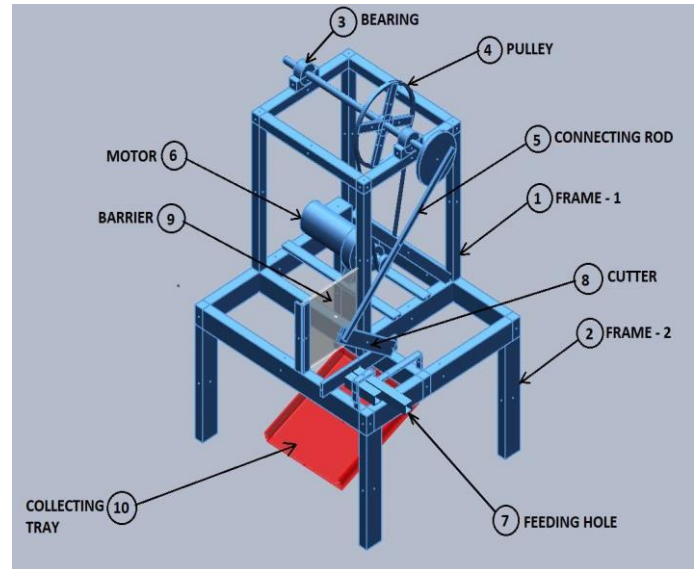


Fig. 2 3D view of Agriculture cutter

## 3. RESULT AND DISCUSSION

Farmers survey (100 farmers) was carried out to understand problems in existing agriculture cutter and analyze the data to overcome such problems in development of agriculture cutter by using 4 bar mechanism. Average land holding of about 85% farmers ranged less than 1 ha. Generally farmers used to cultivate millets, cash crops, vegetable crops etc. Most of the farmers used the traditional instruments like sickle, bota and manual cutter to cut the farm produce. Very less number of farmers found using mechanical cutter for cutting purpose. Only few farmers were purchased mechanical cutter with high cost. Small land holders avoided to purchase the mechanical cutter. Some farmers faced problems of blunt blades, poor quality of cut, high initial cost of cutter and high maintenance cost in existing cutter. Based on the responses of farmers some improvements were made while fabricating new agricultural cutter. The total cost required to manufacture agriculture cutter by using 4 bar mechanism was around Rs. 5,070/- which was easily affordable by farmers.

The performance evaluation provided valuable insights into the strengths and weaknesses of the new agriculture cutter. It was observed that the 4 bar mechanism-based cutter demonstrated improved cutting efficiency, affordable to farmers and enhanced ease of operation compared to conventional counterparts. Additionally, the maintenance requirements were found to be manageable and increased overall productivity.

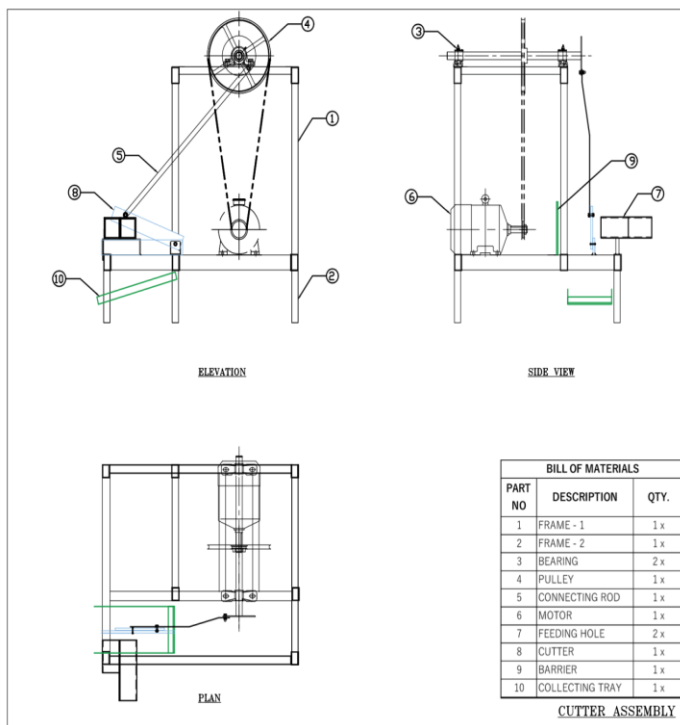


Fig.1 Orthographic view of Agriculture cutter

**Table -1: Comparison of performance evaluation of agriculture cutter**

Parameters	Traditional Instruments	Mechanical Cutter	Agriculture cutter
Number of buds feed	1800	1800	1800
Number of buds loss	300	102	110
Number of proper buds	1500	1698	1690
Cutting effectiveness (%)	83.33	94.33	93.90



**Fig. 3 Sugarcane buds cutting through agriculture cutter**

### 3. CONCLUSIONS

1) Problems faced by farmers in existing agriculture cutters are low effectiveness, high maintenance cost and poor quality of cut due to dull blades.

2) It was observed that the 4 bar mechanism-based cutter demonstrated improved cutting efficiency, affordable to farmers and enhanced ease of operation compared to conventional or manually operated cutters.

3) Average cutting effectiveness of agriculture cutter was somewhat low (93.90%) as compared to mechanical cutter (94.33%) with less bud loss of sugarcane per lot during cutting.

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