

Review Paper on Various Aspects of Portable Sugarcane Harvester

Mayur Vasant Raole¹ Prashant N. Awachat²

¹M Tech Student ² Assistant Professor

¹Department of CAD/CAM ²Department of Mechanical Engineering

^{1,2}G.H. Rasoni Academy of Engineering & Technology Nagpur, MH, India

Abstract— This paper discusses the overview of the sugarcane harvesting, current processes used for sugarcane harvesting, need of the portable sugarcane harvester, various designs of sugarcane harvesting machines, problems regarding the current design of portable sugarcane harvester and possible solutions are also suggested to make the portable sugarcane harvester more efficient, economical and reliable for small scale sugarcane producers.

Key words: harvesting; design; harvester; harvesting machines

I. INTRODUCTION

As the name explains itself this machine is used sugarcane harvesting, this machine is designed for the small-scale sugarcane producers. Sugar can be assumed as important as salt which is produced from the sugarcane. India is the one of the largest producers of sugar. India was the second largest producer. Sugarcane harvesting is one of the most time consuming as well as laborious job. Sugarcane is tall grass with thick stalk and harvested manually by cane cutter and transported to nearby mill. Portable sugarcane harvester is the better option for the small-scale sugarcane producers.

A. Objective:

As we all know agriculture product demand is increasing day by day at the same time labor wages are also increasing. Today's world demanding of production of agriculture products in faster rate. This project aims to modify the current design of the portable sugarcane harvester to improve its efficiency and reliability

B. Scope of Problem:

The sugarcane harvester available in market are too big in size and possess huge cutting capacity. Due to their size it is impossible to use these automatic harvesters in the small farm. The study of various harvesting process and various automatic and semiautomatic harvesting machine reveal that there is scope for modification in design of conventional semiautomatic harvester.

C. Reason for selecting the problem:

The main reason of selecting this problem is to help the farmers whose production rate is low. Most of the times the machines developed for the high production volumes, there are very few machines which are developed for the small as well as medium production rate. So we are willing to develop a machine which can help the farmers who are having less or medium production rate of sugarcane.

II. LITERATURE SURVEY

Literature survey contain various studies carried out by different researchers related to the physical properties of sugarcane as well as different methods of sugarcane harvesting.

Siddaling S proposed a concept of a small sugarcane harvester which will be economical and efficient. He used two stroke petrol engine to generate power which used to drive the front blade. According to the results mentioned in the paper this machine can cut up to 3 tone sugarcane per hour.

T. Moontree presented a review paper in June 2012 he developed a sugarcane harvester which is operated by 180hp (134.28KW) at 2500 rpm. Further paper results says that payback period of sugarcane harvester is 2 years.

Rohit J. Masute has reviewed various processes of sugarcane harvesting and explained advantages and limitations of both of sugarcane harvesting. This paper also explains the challenges in harvesting practices.

Joby Bastian described the physical properties of sugarcane. This paper defines the dimensions of different kind of sugarcane. This paper discusses about diameter of sugarcane, length of sugarcane, row spacing of sugarcane.

Shubham H. Makde developed a sugarcane harvester which was more economical than other harvesters. He reported the harvester cutting speed is 1109.73 m²/hr with the fuel consumption of 20.03 lit/hr. From literature review it was found that many researchers are working on the portable sugarcane harvester development. To overcome the drawbacks of the manual sugarcane harvesting and large sugarcane harvesters.

A. Physical properties of sugarcane:

Physical properties of sugarcane is the most important parameter to be noted while designing the sugarcane harvester. These properties included length of sugarcane, diameter of sugarcane and row spacing between sugarcanes for both manual and mechanical harvesting.

1) Length of sugarcane:

Parameter (mm)		Locations			over all
		Sirugamani	Telungupalayam	Gobichettipalayam	
Length mm	Max	2100	2000	2700	2700
	Min	1700	1500	1800	1500

Table 1:

Table I shows the length of different sugarcanes at different locations in Tamil Nadu. Length of sugarcane is measured with 3m tape and minimum and maximum sugarcane lengths are tabulated in the Table I.

2) Diameter of sugarcane

Diameter of cane		Locations			over all
		Sirugamani	Telungupalayam	Gobichettipalayam	
Top	Max	34.0	22.2	35	35
	Min	27.8	20.0	20.5	20.0

Middle	Max	39.5	29.5	37.5	39.5
	Min	28.5	19.0	23.5	19.0
Bottom	Max	39.0	28.5	40.0	40.0
	Min	28.5	19.5	28.5	19.5

Table 2: Diameter of sugarcane

Table II shows the diameter of different sugarcane at different locations in Tamil Nadu. Diameter of sugarcane is measured in three different positions viz., top middle and bottom. The diameter varied from top to bottom and the variations depend upon the soil type and the weather conditions. It is observed that in dry land the growth of sugarcane crop is less as compared to wet land.

3) *Row spacing:*

The row spacing at the farmer’s field varied from 900 to 1500 mm. In case of manual harvesting the row spacing is kept narrow it may vary from 750 to 900mm. in case of mechanical harvesters farmers have adopted wider row spacing of 1200 to 1500 mm.

B. *Sugarcane harvesting methods:*

There are two types of sugarcane harvesting methods generally used both processes as well as the advantages and limitations are further discussed in paper.

1) *Manual sugarcane harvesting:*

Manual sugarcane harvesting is the method in which sugarcane is harvested with the help of human labors. In manual harvesting method first the field is set aflame. The fire catches only dry leaves, the root and the stalks remain safe. Then labors cut the cane just above the ground level using cane knives. It is observed that a skilled labor is able to cut approximately 500 kilograms (1,100lb) of sugarcane in an hour. Rohit J. Masute says in manual harvesting 15-16 labors are required to cut one acre of sugarcane. Each of them is paid 500-550 Rupees/ton. Hence, we can conclude here that manual harvesting takes 3 days to cut one acre and cost 30,000-35000 Rupees. So, we can say from above discussion that manual harvesting process has following limitations.

- Time consuming
- Less profit
- Shortage of labor
- Labor fatigue

2) *Mechanized sugarcane harvesting:*

In many countries mechanized sugarcane harvesting is popular for sugarcane harvesting. It is beneficial for large sugarcane producers. This type of harvesting is done by large scale sugarcane harvesting machine. It takes approximately 6-7 hours for harvesting one acre with labor wages around 3,500- 4,000 Rupees per hour hence the total cost of harvesting per acre will be 20,000-25,000 Rupees. So, this tells us that mechanized harvesting is

- High initial cost
- High operating cost
- Area require for operation is more
- Skilled worker is required
- Applicable for only large areas

C. *Need of Portable Sugarcane Harvester:*

After discussing versus kind of harvesting process we understood advantages and limitations of both mechanical and manual harvesting processes. We understood that manual harvesting is very time consuming and laborious job and it cost more than mechanized harvesting too. In case of mechanical harvesting it is applicable for large amount of sugarcane producers. Initial cost required for the machinery is also not affordable by the small sugarcane producers. Hence there is a need of development of a portable sugarcane harvester which can be used by small sugarcane producers.

III. DEVELOPMENT OF PORTABLE SUGARCANE HARVESTER

In this particular section of the paper four different designs of portable sugarcane harvesters are discussed in brief.

A. *Development of sugarcane harvester using small engine by T. Moontree:*

Table III contain the details about the sugarcane harvester like engine capacity, total length, total width, height, width of rear wheel, wheel base and net weight. Table IV give details information about economic evolution of the harvester like harvester costs fixed costs selling price per unit, variable costs, annual cash revenues, breakeven point, breakeven point, packback period . all the tabulated parameters help us to understand the specifications of the sugarcane harvester.

Item	Details
Disel engine	180hp
Total length	6m
Total width	1.6m
Height	4.5m
Width of rear wheel	2m
Wheel base	1.2m
Net weight	1200kg

Table 3: *Specifications of sugarcane harvester*

Item	Values
Harvester costs	\$32,466.4
Fixed costs	3,366.67\$/year
Selling price per unit	\$0.03
Variable cost	\$0.0052
Annual cash revenues	\$25,280
Breakven point	122,572.8 kg/year
Net weight	2 years

Table 4: *Economical evaluation of harvester*



Fig. 1:

B. Concept Model of Small Scale Sugarcane Harvester by Siddalling S.:



Fig. 2:

This sugarcane harvester is designed to reduce the cost of the current design of the portable harvesters. Siddalling S used a petrol engine of Kinatic Honda to generate power. The driver sprocket is mounted on the engine shaft, it rotates the driven sprocket through chain drive. The driven sprocket is mounted on a shaft which transmit the power to the bevel gears. The bevel gears powers the cutters through vertical shaft. This was the mechanism which drives the small scale sugarcane harvester.

C. Design of small sugarcane harvesting machine by Adarsh J Jain.:



Fig. 3:

Fig. 3 shows sugarcane harvester designed by Adarsh J Jain, This machine uses a small petrol engine to drive both cutters and wheel. Gears drives are used to drive the wheel and chain drive is used to drive the front cutters. Cutters are kept inclined to cut the sugarcane more easily. This machine cost 40,000 Rupees. This machine can be helpful for small scale sugarcane producers.

D. Portable Sugarcane Harvester By Shubham H. Makde:

This machine was developed in year of 2015, Shubham H. Makde used Bajaj Scooter engine for driving the machine. This harvester replaced the two cutters with the rotating saw. Which made harvester more efficient as shown



Fig. 4:

IV. SUGGESTION FOR DESIGN MODIFICATION OF PORTABLE SUGARCANE HARVESTER

A. Problems identification in Portable sugarcane harvester:

After tasting it is found that there are some issues in portable sugarcane harvester hence there is a wide scope of design modification in the portable sugarcane harvester. Basically the aim behind the design modification is to make the sugarcane harvester more reliable and efficient.

1) Position of engine

As we already discussed there is a Bajaj scooter engine used for driving the cutter blade. Bajaj scooter engine is needed to be start with the help of kick. There is no other option for starting the engine without kick. As we can see in "Fig 4" the position of engine is on the top side of the frame. This position is very difficult for starting the engine with the kick.

2) Design of handel

As we can see the design of handle is compact. Distance between two holders is 300mm. this distance is very uncomfortable while applying force to cut the sugarcane. This may cause fatigue to the operator.

3) Sugarcane get dropped on operator and machine

As we can see there is no arrangement to properly drop the sugarcanes. This cause when the sugarcane is harvested it get dropped on the operator and machine itself.

4) Machine is overweighted on one side

As we can see in "Fig 4" machine is overweighted on right side. This cause due to more components are mounted on the right side of the machine. But if we see the left side of the machine there is no component mounted. This make the machine imbalance. If accidently operator apply excess force on the right side of the machine then machine may get rolled to right side.

B. Suggested design modification in Portable sugarcane harvester:

As we discussed the problems occurs in portable sugarcane harvester. To make machine more reliable remedies to the above problems are suggested in further discussion.



Fig. 5:

As shown in “Fig 5” modifications are suggested to be done to the portable sugarcane harvester.

- To solve the problem of position of engine is kept on the bottom side of the frame.
- Handel made suitably wide this may cause comfortable for operator to hold and apply force while harvesting the sugarcane. For better holding grip made at the end of the handle this will avoid the fatigue to the operator.
- Rigid structure is made in front side to guard the machine and operator both. This structure avoids the sugarcane to drop on the machine or the operator.
- To balance the overweight of the machine engine kept on the left-hand side of the machine. This cause the center of gravity of machine is moved to the center of the frame. This make the machine stable and not to roll on applying excess pressure on either side.

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