

Development of Low Cost Sugarcane Harvester for Maharashtra Region: A Review

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Abstract – In today's world agriculture plays a very important role in India compared to other sectors. Around 4.6 million hectares of land is used for cultivation of sugarcane. India stands second in the growth of sugarcane in the world. Farmers are facing a vast problem labour day by day because people migrating from rural to urban places is causing of labour shortage in the rural areas. Sugarcane is a major crop of India. Sugarcane harvesting has been mechanized using automated harvesting and a new set of mechanisms has been introduced to make the existing machine more efficient, economical and less complicated for serviceability. At present there are good sugarcane harvesters in market. But these sugarcane harvesters are very costlier and generally owned by Sugarcane factories. Today we have surplus sugar production in our country. Sugarcane cultivation and harvesting costs are tremendously increased. In short Industry is facing lot of difficulties. Only way to survive is to adopt creative ways to cut production cost. So there is the need of new sugarcane harvester that can be coupled with Tractor PTO (Power Take Off).

Keywords: Agricultural sector, Indian Farming, Sugarcane harvester, Tractor Mechanization, Modernization, Inventions.

1. INTRODUCTION

With this Sugarcane Harvester mechanization attached to tractor Sugarcane industry will have their harvesting costs reduced. Labour associated with harvesting will be reduced without reducing employment. Sugarcane harvesting could also be side business to farmers. Sugarcane Industries no more have to worry about investments associated with harvesting. It will be developed in such a way that it can be attached to any tractor available with farmers. The harvested sugarcane will be dumped in the trailing trolley associated with the tractor. There is also a possibility of using an extra engine apart from that of tractor engine. Harvesting of sugarcane at a proper time i.e., peak maturity, by adopting right technique is necessary to realize maximum weight of the millable canes (thus sugar) produced with least possible field losses under the given growing environment. On the other hand harvesting either under-aged or over-aged cane with improper method of harvesting leads to loss in cane yield, sugar recovery, poor juice quality and problems in milling due to extraneous matter. Therefore, proper harvesting should ensure:

- To harvest the cane at peak maturity (i.e., avoiding cutting of either over-matured or under-matured cane)
- Cutting cane to ground level so that the bottom sugar rich internodes are harvested which add to yield and sugar
- De-topping at appropriate height so that the top immature internodes are eliminated
- Proper cleaning of the cane i.e., removing the extraneous matter such as leaves, trash, roots etc.
- Quick disposal of the harvested cane to factory

Several standard analytical methods are available to determine the peak maturity or quality so that the cane is harvested at right time. Without such analysis also several farmers take-up cane harvesting based on crop age and appearance. Sometimes farmers

harvest the crop even before the crop fully matures due to necessity to supply cane to the mills early.

2. MANUAL VERSACE MACHINE HARVESTING:

After consultation with number of sugarcane factories in Maharashtra state of India following facts are found:

1. Only 30% of total sugarcane is harvested using sugarcane harvester. Major reason is high initial cost. Other reason includes maintenance and skilled operators. As sugarcane harvesters are functional only for 6 months a year, they remain idle for next 6 months. Because of this idle period these are prone to heavy to moderate maintenance.
2. Manual harvesting has lot of problems. Manpower management is difficult. Fatigue in harvesting workers limit the manual harvesting rate. Operating costs associated with manual sugarcane harvesting are high.
3. Sugarcane harvested from harvesters is to be crushed in limited time. It is because of the fact that sugarcane is cut into number of small pieces using harvesters.

3. RESEARCH METHODOLOGY

In manufacturing and assembling of different parts of the machine. The machine parts are fabricated after determining the dimensions of the machine parts. The designing job is more like a logical and referred as a highly technical work which involves selection of material properties ascertaining, sizes and dimensions of machine components. But when converts the design into real parts it seems to be very tedious. So manufacturing is considered as a very prominent as well as crucial process which should be carried in a systematic manner and it should be carried out with specified standard. Otherwise machine could fail. Sugarcane industry will have their harvesting costs reduced. Labour associated with harvesting will be reduced without reducing employment. Sugarcane harvesting could also be side business to farmers. Sugarcane Industries no more have to worry about investments associated with harvesting.

For Cutter

Cutting Force required to cut a sugarcane: 150N (This value is found with experiments. Most of the sugarcane harvester literature assume the same value)

If diameter of cutter is 300mm. then,

Cutting torque = $F \cdot D/2$

$$=150 \cdot 0.3/2$$

$$=22.5Nm$$

Now,

$$P=2 \cdot 3.14 \cdot N \cdot T/60$$

$$N=P \cdot 60/(2 \cdot 3.14 \cdot 22.5)$$

$$N=0.42 \cdot P$$

When P is in hp,

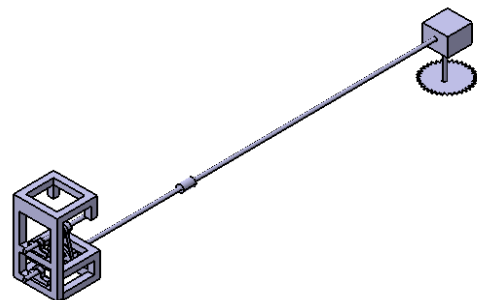
$$N=0.42 \cdot 746 \cdot P \quad (P \text{ is in hp})$$

Tractor has power take off (PTO). PTO delivers rated power at rated rpm. Using this power as I/P sugarcane harvester is actuated. Cutting as well as dumping mechanism is actuated by coupling them with the PTO. This Mechanization can be attached to tractors of power output in the range of 5hp to 25hp. We have tractors available in the market from companies such as:

1. Mahindra
2. Cubota
3. Sonalika
4. John Deers

They have variety of tractors depending upon the purpose of their use. Most of the tractors having PTO shaft delivering power in the range of 5hp to 25hp. Some of the models are also capable of delivering power up to 35hp. This mechanization can be fitted on to any of the tractors. Only following things will change.

1. Selection of tractor specific PTO shaft attachment.
2. Selection of driving and driven pulley in case rated power rpm is different.



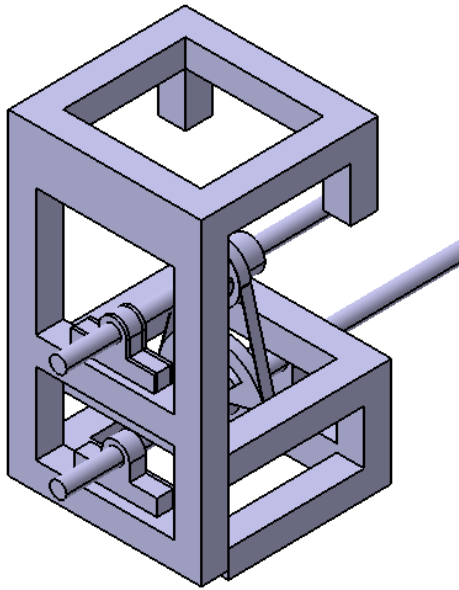


Fig. 1 Rear Attachment Assembly

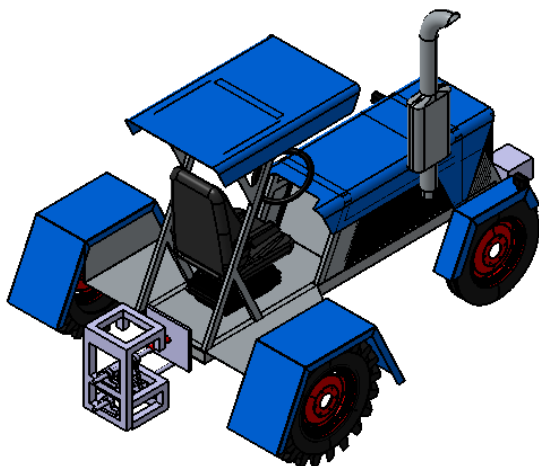


Fig. 2 Assembly of sugarcane harvester with tractor



Fig. 3 Manual Harvesting



Fig. 4 Costly Sugarcane Harvesters

5. RESULT AND DISSCUSSION

- Existing machines are complex technologies involving huge costs. Ours is a simple one that can be attached to tractor.
- Operational cost using our machine will be much lower.



Fig. 5 Developed Assembly of sugarcane harvester with tractor

Table 1.1 Cost Comparisons in Rupees: Both Fixed & Operational both Fixed & Operational

| | Manual Harvesting | Harvesting with old sugarcane harvester | Harvesting with new harvester |
|----------------------------------|-------------------|---|-------------------------------|
| Fixed cost | 0 | 10000000 | 250000 |
| Variable Cost per tonnage | 550 | 350 | 300 |
| | 0 | 10000000 | 250000 |
| | 2750000 | 11750000 | 1750000 |
| | 5500000 | 13500000 | 3250000 |
| | 8250000 | 15250000 | 4750000 |
| | 11000000 | 17000000 | 6250000 |
| | 13750000 | 18750000 | 7750000 |
| | 16500000 | 20500000 | 9250000 |
| | 19250000 | 22250000 | 10750000 |
| | 22000000 | 24000000 | 12250000 |
| | 24750000 | 25750000 | 13750000 |
| | 27500000 | 27500000 | 15250000 |
| | 30250000 | 29250000 | 16750000 |
| | 33000000 | 31000000 | 18250000 |
| | 35750000 | 32750000 | 19750000 |
| | 38500000 | 34500000 | 21250000 |
| 41250000 | 36250000 | 22750000 | |
| 44000000 | 38000000 | 24250000 | |
| 46750000 | 39750000 | 25750000 | |
| 49500000 | 41500000 | 27250000 | |
| 52250000 | 43250000 | 28750000 | |

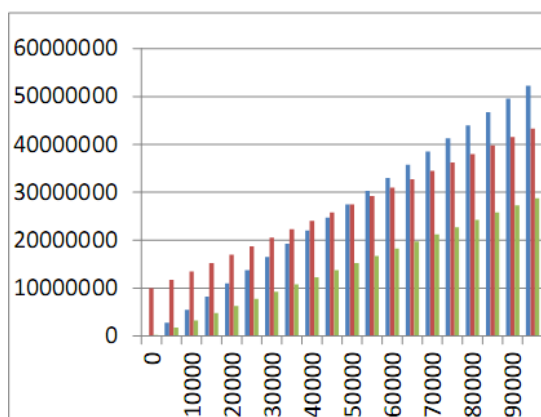
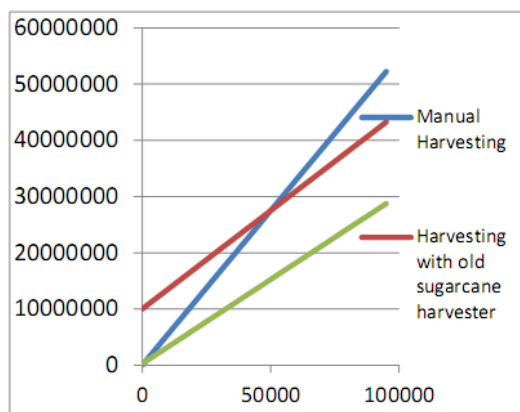


Fig. 6 Change of sugarcane harvesting costs along with conditions

6. CONCLUSION

A sugarcane mechanical gathering system is also manual and Machine gathering systems. Within the Manual gathering systems, the mechanisms of the sugarcane harvester perform a collection of functions in sequence to finish gathering operation. Full mechanization systems of sugarcane gathering might either be self-propelled whole-stalk harvesters or the chopper harvesters.

Machine gathering technology diagrammatical within the tractor mounted and tiny cane harvesters perform one or a lot of the functions done by the total mechanization harvester. Variable styles of tractor mounted further as little sugarcane cutters are developed for the conditions of developing countries.

Several styles of sugarcane mechanical harvesters are regionally incontestable for farmers' acceptance. Most of the incontestable harvesters cut the bases of cane stalks and leave them lying on the bottom. The farmer should decide the cane stalks, top it, clean dry leaves and prepare it during a pile appropriate for loading. Therefore, the farmers verify that the employment of cane cutters don't save price or effort. The makes an attempt of developing a neighborhood cane harvester restricted to graduate students analysis with no probability for field demonstration. It looks like all the countries manufacturing sugarcane have developed undefeated cane harvester for his or her native conditions.

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