Development of Portable Sugarcane Harvester

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Abstract. The present study is focused on development of sugarcane harvester with less manufacturing cost. Now-a-days, the fast production of agriculture product is needed even though the labour demand increased. In this work, the portable sugarcane harvesting machine is designed instead of manual machine which can cut the two sides from the upper and lower portion of sugarcane. The height of the upper blade is adjustable which is completely with electrical motor. This machine will reduce the harvesting time and labour fatigue efforts with increased productivity to all class farmers. Comparing with manual harvesting only 10% of labour is required for entire operation. Also, it reduces the labour cost with faster process. The machine is used by maximum number of farmers and overcome the labour shortage problem with increased productivity. This work is designed for two important sustainable development goal which are responsible and consumption production industry innovation and infrastructure.

Keywords: Harvesting machine; Sugarcane; Portable; Productivity

1. Introduction

1.1 Harvesting machine

The modern combine harvester is a versatile machine designed to efficiently harvest a variety of grain crops. The name derives from its combining three separate harvesting operations such as reaping, threshing, and winnowing into a single process.

1.1.1. Etymology of Harvest

Harvest is a noun which came from the Old English word (coined before the Angles moved from Angeln to Great Britain) meaning "autumn" (the season), "harvest-time", or "August". (It continues to mean "autumn" in British dialect, and "season of gathering crops" generally.) The harvest came to also mean the activity of reaping, gathering, and storing grain and other grown products during the autumn, and also the grain and other grown products themselves. "Harvest" was also "To harvest" means to reap, gather, and store the harvest (or) the crop. People who harvest and equipment that harvests are harvesters; while they do it, they are harvesting [1].
1.1.2. Harvesting process

Harvesting is the process of gathering a ripe crop from the fields. Reaping is the cutting of grain or pulse for harvest, typically using a scythe, sickle, or reaper. On smaller farms with minimal mechanization, harvesting is the most labour-intensive activity of the growing season. On large mechanized farms, harvesting utilizes the most expensive and sophisticated farm machinery, such as the combine harvester. Process automation has increased the efficiency of both the seeding and harvesting process [2]. Specialized harvesting equipment utilizing conveyor belts to mimic gentle gripping and mass transport replaces the manual task of removing each seedling by hand. The term "harvesting" in general usage may include immediate post harvest handling, including cleaning, sorting, packing, and cooling. The completion of harvesting marks the end of the growing season, or the growing cycle for a particular crop, and the social importance of this event makes it the focus of seasonal celebrations such as harvest festivals, found in many religions.

Harvesting commonly refers to grain and produce, but also has other uses: fishing and logging are also referred to as harvesting. The term harvest is also used in reference to harvesting grapes for wine. Within the context of irrigation, water harvesting refers to the collection and run-off of rainwater for agricultural or domestic uses. Instead of harvest, the term exploit is also used, as in exploiting fisheries or water resources. Energy harvesting is the process of capturing and storing energy (such as solar power, thermal energy, wind energy, salinity gradients, and kinetic energy) that would otherwise go unexploited [3-4]. Body harvesting, or cadaver harvesting, is the process of collecting and preparing cadavers for anatomical study. In a similar sense, organ harvesting is the removal of tissues or organs from a donor for purposes of transplanting. In a non-agricultural sense, the word "harvesting" is an economic principle which is known as an exit event or liquidity event. For example, if a person or business was to cash out of an ownership position in a company or eliminate their investment in a product, it is known as a harvest strategy.

1.2 History of harvesting machine

The Bell machine was pushed by horses. A few Bell machines were available in the United States. In 1835, in the United States, Hiram Moore built and patented the first combine harvester, which was capable of reaping, threshing and winnowing cereal grain. Early versions were pulled by horse, mule or ox teams.

1.3 History of sugarcane harvester

A sugarcane harvester is a large piece of agricultural machinery used to harvest and partially process sugarcane. The machine, originally developed in the 1920s, remains similar in function and design to the combine harvester. Essentially a storage vessel on a truck with a mechanical extension, the machine cuts the stalks at the base, strips the leaves off, and then cuts the cane into segments [5]. These are then deposited into either the on-board container, or a separate vehicle travelling alongside. Waste material is then ejected back onto the field, where it acts as fertilizer.
1.4 Inventor of sugarcane harvester

The inventor of sugarcane harvester is Mr. Wurtele. He invented sugarcane harvester in 1938. He is attempting to repair the machine, Mix, Louisiana at the time he found the sugarcane harvester. The Wurtele machine has to be handled only in hand. So, it needs a lot of effort from the operator. The machine cannot be handled for more time due to its weight and cutting vibration.

2. Experimental work

In worldwide production of sugar, main countries are Brazil, India, China produced up to 78% of global sugar. The chassis frame of the main base of vehicle on which body is mounted with wheels and machinery is presented in Figure 1. Sheet metal is cut by a cutting machine as per the chassis dimension and it is weld on chassis frame for carrying load on the vehicle. Two cutters are fixed on the chassis frame at upper and lower portion [6]. Cutter is controlled by the sensor for protection. The machine is completely electrical with the help of motor and the height of the upper blade is adjustable [7]. The design methodology of harvesting machine is represented in Figure 2.

![Figure 1. Sugarcane harvesting machine](image)

![Figure 2. Design Methodology](image)
3. Model development and ANSYS analysis

This is conceptual CAD model of laboratory setup for cutting unit for estimated optimum speed and force coming on cutting disc for smooth and good quality cutting of sugarcane [8] is represented in Figure 3.

![Figure 3. View of Harvester](image)

The four different views of sugarcane harvester are presented in Figures 4 to 7 respectively using the CAD design.

![Figure 4 Back view](image)

![Figure 5 Bottom view](image)

![Figure 6 Front view](image)

![Figure 7 Isometric view](image)
4. Results and Discussion

A detailed static analysis was done on the component using ANSYS software [9-10]. This was mainly done to identify the main points of the component where the majority of the load acts. This, in turn helps us identify the points of constraint necessary for effective sugarcane harvester optimization.

4.1 Analysis of Different Parameters

The analysis results of all the simulations are represented in Figures 8 and 9 respectively for the two different approaches, such as (i) component load is applied on Front and (ii) Fixed support applied on back. The mass properties of the portable harvesting machine are represented in Figure 10. Our vehicle is completely analysed by using ANSYS software. The vehicle is completely safe.

![Figure 8. Load is applied on Front and Fixed support applied on back](image-url)
Figure 9. Fixed support is applied on front and load is applied on back

Figure 10. Mass properties of Harvester
5. Conclusions

Comparing with manual harvesting only 10% of labour is required for entire operation. So, it reduces the labor cost and process become faster and easy. The machine is used by maximum number of farmers definitely and farmer can overcome the labour shortage problem. The productivity is also increased. There is a view that Industrialization is harmful to farmers, but the same Industrialization could be moulded to promote farming. The farming scale has reduced exponentially and one of the reasons is that it requires great human skill and effort and even then the cost yield is less. In extended vision, the reduction of the human efforts and the natural investment proves significance in the mere future. The attempt of making small scale sugarcane harvester might have few drawbacks but few modifications could be made. The following modifications could be made in the machine:

- Solar panel could be installed so that the machine is environment friendly.
- Complete automation could be brought. Installation of sensors improves the efficiency.
- Installation of pallets or trolleys so that the cut canes be carried to the tractors or even to the mills.
- Packing mechanism for the cut canes could be designed and developed effectively.

6. References

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