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Design and Fabrication of Sugarcane Harvesting Machine

[1]Thirumalaisamy, [2]N.Rajiv Kumar

[1]Lecturer, Department of Mechanical Engineering, Christian Polytechnic College, Oddanchatram - 624 619, Dindugal, Tamilnadu, India

[2]Assistant Professor, Department of Mechanical Engineering, KGISL Institute of Technology, Coimbatore - 641035, Tamilnadu, India

[1]thirumalain86@gmail.com, [2]rajivkumar.n@kgkite.ac.in

Abstract

This project work aims to develop sugarcane harvesting machine which is more efficient and having simple mechanism for cutting the sugarcane at a faster rate and should low cost that is affordable by the rural farmers, easy to maintain and less laborious to use. The machine consisted of main parts i.e. engine (petrol, 3.73 kW, 3000 rpm), gear box (20:1), coupling, frame, cutter frame, counter shaft, horizontal shaft, vertical shaft, cutter and ground wheel. All this parts of a machine was mounted on the frame. The wheel was attached to this frame. The petrol engine was mounted on the frame which provides the power to the wheels to move by means of a gear and chain mechanism and it also provides the power to the cutter. Frame was constructed by joining angle of mild steel of rectangular box section members to get rectangular shaped frame of used drilled machine for fixed cutter frame to the main frame by used nut and bolts.

Keywords: Sugarcane harvesting machine, design, fabrication.

1. INTRODUCTION

In primitive India, agri-related activities were taken care of by manual means. But in most of the parts of our country, there is a scarcity of labours and hence labours are not available when required. This gives an opportunity to develop some new method. So, mechanization of agriculture equipment becomes necessary. INDIA is the country of farmers and near about 70% of its Population depends on agriculture. The History of Indian farmers tells us today how they have achieved the comfortable position. He acquired the skill of

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raising crops which provided food whenever he found good fertile land, he settled down and took to agriculture and also followed other pursuits of its which made him richer and more comfortable.As the population increased food was not sufficient and surplus population of more on the other areas not so productive. As a result of demand of food is increased, man is trying to bring and more land under cultivation, under these circumstances we are in need of fast cutting procedure instead of manual crop cutting.So we have to adopt mechanical means for the purpose of cutting crops. This alternative is not only fast but also very cheaper than the conventional manual crop, cutting.

In agricultural harvesting we require maximum man power, ample money and also it is more time consuming process. In cutting process we face various problems and these are not easily solved. The design of this machine is very simple also easy to implement. In this manner we are designing the Sugarcane Cutting Machine to reduce effort and time. In sugar cane farms we are using this machine for cutting purpose. This is user friendly cutting machine, anyone can handle this machine in any working condition. Skilled persons aren't required for operating this machine.

As India's population is growing so the demand for food will definitely increase for those better techniques of farming will require increasing production. In India agriculture has facing serious challenges like scarcity of agricultural labour, not only in peak working seasons but also in normal time. This is mainly for increased non- farm job opportunities having higher wage, migration of labour force to cities and low status of agricultural labours in the society. Sugarcane is the world's largest crop 2010 Food Agricultural Organization (FAO) estimates it was cultivated on about 23.8 million hectares in more than 90 countries, with a worldwide harvest of 1.69 billion tons. Harvesting is a process of cutting and gathering of mature crop from the field. Harvester is a machine used for harvesting. Different types of harvesting machines are available in the market namely paddy harvester, Tea harvester, Potato harvester, Wheat harvester and sugarcane harvester as mentioned above all are available in small scale except sugarcane harvesting machine. Hand knives, cutting blade or hand axes are used for manual harvesting. It requires skilled labours as improper harvest of cane leads to loss of cane and sugar yield, poor juice quality and problems in milling due to extraneous matter. Labours can't cut sugarcane properly at ground level.

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2. LITERATURE REVIEW

Sugarcane trash (leaves + tops) removal takes 65% time of manual harvesting. Conventional trash burning in standing crop wastes all biomass material which can be used for trash farming and as a source of renewable energy to mitigate natural resources and energy crisis. Shortage of skilled labour and machinery for leaf removal during peak harvesting season causes late harvesting and about 10% deduction in selling price. A small sugarcane leaf stripping machine was designed and fabricated to deduce these problems. Main components of stripping machine were intake rollers, cleaning element, out take rollers, power transmission system and an engine as power source [1].

In today's world there is a heavy demand for sugar and its byproducts. The major states growing sugarcane are Maharashtra, Uttar Pradesh and Karnataka. Now India is the leading producer of sugarcane in the world. This project aims to design and fabricate small scale sugarcane harvesting machine for sugarcane harvesting to reduce farmer's effort and to increase the output of agricultural products. When compared to manual harvesting, this machine can cut the lower and upper portion of the sugar cane containing leaves, simultaneously by setting the optimum movement of the rotary blades [2].

A sugarcane harvester prototype was fabricated and evaluated to save time, labor, and harvesting expenses, which are included in production costs. The single-row harvester prototype fits the functional needs of the physical qualities of sugarcane and was designed to be installed on a tractor. One serrated edge cutter disc, three forward speeds, and three cutter disc speeds were used to evaluate the performance of the fabricated sugarcane harvester [3].

The aims of this research were to design and fabricate an inter-row cultivator for mounting on a medium-sized tractor (25.3 or 37.3 kW) for sugarcane fields, and to assess the performance of the cultivator when harvesting is conducted either by hand or with a sugarcane harvester. Moreover, this study was also designed to assess the performance of the cultivator in mixing sugarcane residues in the field [4].

The project aims to design and fabricate small scale sugarcane harvesting machine with solar power operated for sugarcane harvesting to reduce farmer's effort and to increase the output of agricultural products. It is easy to operate, less maintenance, ecofriendly and no skilled labors are required [5].

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In this research work, a solar powered small scale sugarcane harvesting machine is designed and fabricated It was concluded that by using this machine only 20% labor was required compared to manual harvesting [6].

This research paper helps to design and fabricate small scale sugarcane cutting machine for sugarcane harvesting to reduce farmer's effort and to increase production of agricultural goods. Compared to manual harvesting this machine has a capacity to cut canes in faster rate. It is economical. This paper helps in laying design foundation for any aspiring user to fabricate a machine for application in their farms. It helps improve economic growth of the nation [7].

3. COMPONENTS AND DESIGN CALCULATIONS

3.1 Engine

98 CC Kinetic Honda engine with power of 5.741 kW and 2000 rpm is used.

3.2 Frame

A suitable frame of desired strength and according to the row spacing was fabricated to hold power unit, power transmission and reduction unit (Engine and Gear box). The consideration has been given that the frame to be light in weight and strong enough to with stand the imposed load during field operation with appropriate materials. It constructed by joining angle of mild steel of size 50×50×5 mm in rectangular box section members to get rectangular shaped frame of 1200×500 mm respectively, using drilling machine for fixing cutter frame to the main frame by using nut and bolts shape frame of 1700×200 mm respectively. Frame is the main base of the vehicle on which body is mounted with wheels and machinery. As per the design, marking has done on each angle. As per the marking angles are cut by cutting machine and holes are drilled on angles by using drilling machine for fixing cutter frame assembly and plumber blocks. The Bending moment of frame, suppose the frame was simply supported beam, therefore the bending moment is given in the following equation.

Bending Moment (BM) = (W×L)/4 (kg-cm)

Where,

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- W = Total weight on frame in kg
- L = Total length of frame in cm

Design Stress (or) Working Stress = Ultimate Stress/Factor of Safety

Factor of safety in design of Agricultural machinery was 2 - 4, we select maximum factor of safety 4. The ultimate stress of the material (Mild steel) was 1000 kg/cm^2.

3.3 Power Transmission

The Fuel from the tank is supplied to the Engine and the power is generated to the shaft inside the engine. The driver bevel gear mesh to the same teeth of driven bevel gear and then, the driver pulley which is attached to the driven bevel shaft rotates the driven pulley through v-belt drive mechanism. The driven pulley that is connected to the longer shaft will transmit the power to the either sides of the Bevel gears through the shaft. The longer shafts will be mounted between the two plumber blocks which provide support to the shaft. The rotating Bevel gears are in turn connected to the cutters through vertical rods which rotates the cutters. Another gear box attach to the engine which reduce the speed of the ground wheel by chain and sprocket.

3.4Design of Pulley and Belt Drive

If the power ranges 1.5 to 15 kW, diameter, it is preferred to use a pulley having 200 mm diameter and B- belt section.

Table 1 Specifications of V Belt

Sl.No.	Section Belt	Top Width (mm)	Bottom With (mm)	Thickness(mm)	Weight Per Meter Length (N)	Power Range (kW)
1	B-Section	17	9	11	1.98	2-15

4. WORKING PRINCIPLE

The Fuel from the tank is supplied to the Engine and the power is generated to the shaft inside the engine. The driver sprocket which is attached to the engine shaft rotates the driven sprocket through chain drive mechanism. The driven sprocket that is connected to the

longer shaft will transmit the power to the either sides of the Bevel gears through the shaft.The longer shafts will be mounted between the two plumber blocks which provide support to the shaft. The rotating Bevel gears are in turn connected to the cutters through vertical rods which rotates the cutters. By this way the small scale sugarcane harvesting machine works. The operations involved are simple and easy to operate.

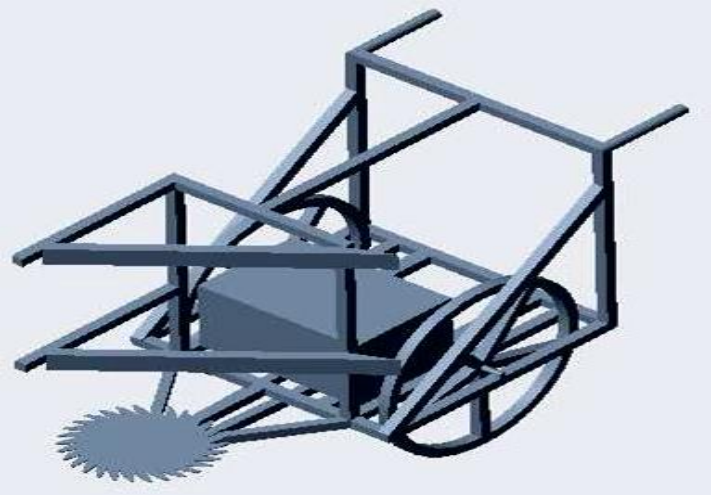

Figure 1Three Dimensional Model of a Proposed Sugarcane Harvesting Machine

5. ADVANTAGES

Its most help full in small and big scale formers, faster process for harvesting and tt reduces the human effort.

6. APPLICATIONS

It is used for sugarcane cutting, corn plant harvesting and grass cutting.

7. CONCLUSIONS

This design permits to have a capacity to cut approximately half acres of sugarcane cultivated land/hr. Comparing with manual harvesting half of harvesting time and need of labours are reduced. The cost of harvesting is reduced by many folds when compare to manual harvesting.

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