Design And Fabrication Of Small Scale Sugarcane Harvesting Machine

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Abstract: Majority of the sugarcane harvesters are small scale farmers.The small scale farmers are facing serious problems in harvesting the canes. Firstly, there is a labour scarcity for sugarcane harvesting. It is due to lesser wages or moving of the work force to the urban cities for higher wages. Moreover, the manual harvesting method is a time consuming one and also the labours face problems such as fatigue and safety concerns as they are likely to be exposed to harmful pests from plantations. There are number of machines available for the large scale cultivation..This makes it difficult for small scale farmers to bring their canes to the market on time during the season. In order to help the small scale farmers we have designed a small scale sugarcane harvesting machine with the affordable cost. It will help the farmers to harvest the sugarcane with less labour charge and health issues will be avoided. Moreover it will help the small farmers to transport the sugarcane to the market on time.

Index Terms: Bevel Gear, Chain drive, Cutting Blades,Shaft,Small scale farmers, Sugarcane Harvesting Machine, Two Stroke engine,

1 INTRODUCTION

India is one of the major agricultural countries in the world.As India's population is growing the demand for food will definitely increase for that better techniques of farming is required to increase production. In India agriculture is 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. In order to eliminate the difficulties faced by those cultivators, we decided to design the small scale harvester for the sugarcane crop with low cost and this will help the cultivators to cultivate with less labour charge and reach the industries on time.

2 LITERATURE REVIEW

Siddaling et al [1] work to plan and make a little scale sugarcane procuring machine for sugarcane gathering, to decrease rancher's effort and extends the yield of agrarian items.At the moment that appeared differently in relation to manual gathering, this machine cuts lower and upper pieces of the sugar stick which contains leaves additionally, at the same time sets the perfect advancement of the pivoting sharp edges. Jamadar et al [2] introduced a paper that plans and makes low scale sugarcane slicing machine for sugarcane gathering to diminish effort and to fabricate range for agrarian items. Contrasted and manual social occasion, machine can cut sticks at a quicker rate.

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It is for all intents and purposes found in this machine and blueprints structure for any customer to deliver a machine for their residences applications. Shekle et al [3] likewise arranged an ease sugarcane reaping machine that can make perform shearing move with insignificant endeavors and in less time. T.Moontree,S. Rittidech* and B. Bubphachot [4] "Development of the sugarcane harvester using a small engine in Northeast Thailand" International Journal of Physical Sciences Vol. 7(44), pp. 5910-5917, 23 November, 2012 This research presents the developing sugarcane harvester using small engine in order to focus on its appropriateness in sugarcane farming for farmers who are encountering problems of labor shortage and sugar factories lacking sugar cane for producing sugar. Chaudhari et al [5] went for planning and manufacturing small scale sugarcane gatherer for sugarcane collecting to minimize rancher's exertion and to expand generation of rural items. Machine comprises of oil motor and distinctive instruments. At the point when contrast with manual gathering by utilizing this machine has an ability to chop off sticks at quick rate and it is very efficient. The machine is useful for all types of homesteads

3 OBJECTIVES

Subsequent to experiencing the writing, the flaw that was found was that the sugarcane reapers created are not affordable as they can cut the grains however there is an issue of gathering the grains. The business sugarcane gatherers are accessible in huge sizes and that is excessively expensive so to beat these troubles, the accompanying targets are recorded down:

1. To make an ease sugarcane shearing machine, that can cut the grains with insignificant expense.
2. To set up a machine that is profitable and have straight forward instrument for cutting the sugarcane at a quick rate.
3. To help the small scale farmers to bring their crops to market on time during the season..
4. To deliver an affordable machine for little scale farmers.

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4 METHODOLOGY

To totally give a plan of the machine, the accompanying phases of the structure were joined to have an appropriate structure technique

- Plan Conceptualization: In view of necessities of the farmers and the market study led. Various emphasess of the structure of machine were readied.
- Estimation and framework approval: arranging stage is basic stage as quality, exhaustion, factor of security, each and every particular point was taken while doing the calculations and arrangement.
- Model making and testing: In the wake of completing the computations, a three-dimensional get together was made for all intents and purposes on the product inside the real conditions which gave a point of view of this present reality and its quality that permits doing testing of any kind possible.
- Testing: In the wake of amassing the model, testing was done to check the attainability of the model.

5 DESIGN CALCULATIONS

A .Power required to run the harvester:
Power of Engine, P= 3.5 HP = 2.61 kw
Speed of Engine, N = 3500 rpm
Engine Torque = 5 Nm @ 3500 rpm
Power = (weight x velocity x gravity)/1000; velocity required V= 2km/hr = 0.55 m/s = (100 x 0.55 X 9.81)/1000 = 540 W
Field resistance = (M/r)-Pu = (4.98/0.23) – 6.75 = 15.2 N x 2
FR = 30.4 N
Field resistance (Nm/s) = 30.4 x 1.38 = 41.95Nm/s = 0.0419 kw Power required by the cutter :
P=(2∏NT)/60=(2x3.14x1166x2.57)/60x1000 = 610 W
Total Power required = 1.147 kw < 2.61kw
Calculation of cutter speed :
Cutter speed = RPS x (L.D + R.D)
RPM of sprocket which connects the blade = 3500/3= 1166 rpm
RPS = 1166/60 = 19.43 rps
Cutter Speed = 19.43 (150+150) = 5.82 m /sec

B. Design of Shaft:
Design Torque, N-m
Td = (60 P*Kl)/2πN
And we also have
Td = π/16*d^3*τmax
Where, d = diameter of shaft
τmax = maximum shear stress = < 0.18 Sut or < 0.3 Syt
Selecting material M.S. C-20
Sut = ultimate stress = 520 Mpa
Syt = yield strength = 280 Mpa
From this we get
τmax = 84 Mpa or 93.6 Mpa
Selecting lower value
τmax= 84 Mpa
If we used key then we can reduced the stress
τmax= .75*88.8 = 66.6 Mpa
Design Torque, Td = 21.38 N-m
Therefore we get
d = 10.09 mm
Increase the diameter by 50% to sustaining the various load
Then , d = 10.09 *1.5 = 15.13 mm
Selecting standard value
ds = 20 mm.

C.Design of Bevel gear:
Design power PD = PR*kl
Kl = 1.25 for steady and continuous work
PR = rated power = 2.61 kw
PD = 3.26 kw
N = 1666 rpm
gear ratio = 1
tg = tp = 20 teeth
Pitch angles , γ
For acute angles gears
For pinion, tan γ = sinθ/(Tg/Tp+cosθ)
θ = angle between axes of shafts = 90o
γ = 45o for pinion
Now For gear ,
tan γ = sinθ/(Tp/Tg+cosθ)
γ = 45o for gear
Cone distance , L
L = 0.5√(〖Dg〗 ^2+ 〖Dp〗 ^2) ; m = D/T
L = 14.14 m mm D = 20m
Formative no of teeth
Tf for pinion = 1/cosγ = 25.45=26teeth
Tf for gear = 1/cosγ = 25.45 = 26 teeth
Now for tooth load Ft = Pd / Vp
Vp = πDN/(60*1000) = 1.743m m/s
Ft = 1870.338/m N
Beam strength , FB
FB = So*Cv*Y*m*b*(1 – b/L)
So = yield stress
Selecting cast steel 0.25% carbon , heat treated
So = 210 Mpa
Assume 20o full depth tooth profile
Y = form factor
Yp = 0.485 - 2.87/Tp = 0.375
Yg = 0.485 - 2.87/Tg. = 0.375
Cv = velocity factor ;Assume 0.3
b = face width ;Assume from 6m to 7m
FB = 81.60 m2 N
Comparing FB and FT
We get module ,m = 2.840 mm
standard module m = 5 mm
Actual Parameter
Dg = 100 mm ;Dp = 100 mm
Vp = 8.715m/s ;FB = 2040 N
FT = 374.06 N ;L = 70.7 mm

6 VIRTUAL MODEL

The conceptual model of the small scale sugarcane harvester is provided in Fig 1.The main components of the machine are frame,shaft,bevel gear,chain drive,engine,moving blade,wheel,sprocket and cam shaft

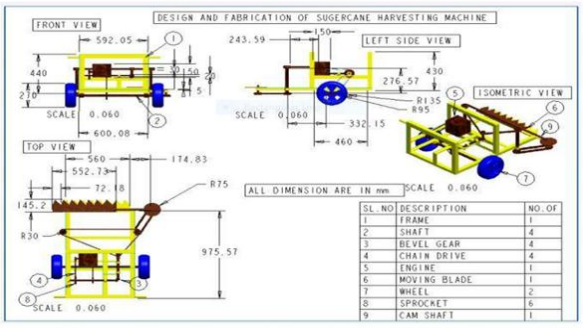

***Fig. 1**: Virtual Model*

7 WORKING PROCEDURE

- Firstly, the harvester is kept in the sugarcane field.The two wheels are fixed at both the sides of the sugarcane stalk.
- The engine is started and the acceleration is given to drive the wheels and to move the machine linearly towards the direction of the sugarcane stalk.
- Simultaneously, the pulley at the top which contains the hook is rotating and the blades are moving linearly.
- The blades cut the sugarcane at the bottom to the desired height from the ground.
- Soon after the sugarcanes were cut, the hooks which are already rotated by the pulleys pushes the crops and makes the sugarcanes to fall away from the wheels.

Fig 2 *Working Model*

8 CONCLUSION

This Small Scale Harvester fabricated will be benefitical for small scale sugarcane harvesters to harvest their crops with low cost and time.When the harvester runs 2km/hr as we designed it takes 5 hours to cultivate an acre of sugarcane.For an acre the harvesting cost using this machine will be approximately equal to 1600 rupees. For manual harvesting the cost per acre will be 2600 rupees,comparing the manual with machine harvesting ,we can save 40% of the cost in machine harvesting. This will help the farmers to bring their crops to market on time. In future, we can develop the harvester by adding the cutters at the top of the harvester to cutdown the sugarcane leaves simultaneously at the time of sugarcane cutting which will be useful for the sugarcane cultivators

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