DESIGN & MANUFACTURING OF RICE TRANSPLANTING MACHINE

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***Abstract*—This Horticulture area is the principle wellspring of food. This area additionally shapes nation's spine and gives business. With expanding populace, it is important to deliver food in a supported way. This can be refined by motorizing the cultivating activities. Another benefit of motorization is that it dodges the issue of work lack when required in the rush hour of land readiness and reaping. The region that an individual can plant around increments by utilizing this system. It likewise expands the yield through legitimate planning of land, crop insurance, proficient water system and limiting the misfortune during the collect. This paper centers around the motorization of rice planting. With this plan one can plant the seedling vertical to the ground at adequate profundity. This maintains a strategic distance from the removal of the seedlings as well as guarantees uniform maturing of the rice plants.**

Keywords*—*rice transplanter, yield, labor.

I. INTRODUCTION

Rice is an essential food for many people across the world. It is largely grown in many countries and is also a major crop in India, China and other countries of South-East Asia.

Agriculture plays an important role in the Indian economy. About one sixth of the GDP is occupied by the agricultural sector. The time and technology is been developing and changing day-by-day. Hence there is a need to develop the methods and the equipments too. The rice planting can be done in two main methods namely: i) Direct seeding and ii) Transplanting. In direct seeding, the seeds are sown (either by row seeding or broadcasting of germinated or non-germinated seeds) in the field under dry or wet condition at the beginning of rainy season. This method of seeding requires minimum labor and well suited for upland farms. However, it suffers from few limitations. The rate of germination of all seeds is not uniform; heavy rains extricate the seeds from the soil; seeds are vulnerable for birds. Due to these inherent demerits of direct seeding, transplanting method is preferred. In this method, saplings are raised in nursery or an open farm at least a month before planting. These saplings are then planted manually or mechanically in the soil. The advantages of transplanting are:

i) Saplings are planted at uniform spacing of 250mm which aids in easy weed removal and intercultural operations with adequate nutrients for all plants.

ii) Requires minimum amount of seeds relative to direct seeding

iii) Faster yields as the time dwell period of the crop in the land is reduced by 3-4 weeks

iv) All the crops ripe averagely the same time. However, the process is expensive, requires many number of labors and also requires highly skilled labor.

The objective of this paper is to review the rice transplanting methods, existing machines for transplantation and their merits and demerits. Based on the observations from the review, a new design is proposed which overcomes the limitations of the existing designs.

Figure 1. Traditional method of rice planting

A rice transplanter is a special type of machine fitted with transplanter mechanism having a reciprocating motion, in order to transplant the rice seedling into the fields. As we all know that rice is a staple food of India, majority of the farmers are involved in the process of rice cultivation.

Generally, cultivation of rice or any other crop requires number of skilled labors and majority of time. The process of rice transplantation is not so efficient as compared to the mechanized rice transplantation. Mechanized transplantation using rice transplanter considerably requires less labor than in manual transplanting and less time. Introducing the mechanism of the rice transplanter to the rice farming will result in a number of advantages.

II. LITERATURE REVIEW

S. Pradhan and S.K. Mohanty presented,Transplanting of paddy is very tedious job mostly done by female workers during Kharif season and by 2020 there would be 50 percent women against 42 percent at present. Manual hand transplanting consumes a lot of energy and time and full of fatigue, but the poor socio-economic condition of the farmers does not allow them to adopt power operated transplanter. Transplanting operation by different research centres have been developed as 2 row, 3 rows, 4 row paddy transplanter.[7]

M. V. Manjunatha, b. G. Masthana reddy explained, Studies were conducted at Agricultural Research Station, Gangavathi, Karnataka state during 2002 to 2004 on the feasibility of mechanizing transplanting operations in paddy crop with a view to reduce the cost of cultivation. An eight row self-propelled paddy transplanter was used for the purpose. The performance of the mechanical transplanter was quite satisfactory.[4]

During the period of 2008 A.K. Goel et al. conducted an research on three planters namely OUAT, CRRI and Yanji rice planter. Here they concluded that in accordance with the torn apart plot design of experiments 32 hours of sedimentation period was suitable for operation of manual planter while the same was 57 hours for Yanji planter. In 2013 Rampuram reddy & Dr. N. Sandhya Shenoy conducted an financial examination of Traditional SRI rice farming applies in Mahabubnagar district of Andra-Pradesh. It was concluded that the SRI method of farming is beneficial to the paddy farmers as associated to outdated method.[5]

Uttam Kumar and E V Thomas presented " Determination of Force Acting on Rice Transplanter Finger" from this paper we understood that the forces acting on a fixed fork type transplanting finger during separation of rice seedlings, a laboratory model transplanter was developed. It was equipped with transducers to measure the forces and to measure the speed of rotation of the crank that give motion to the finger. The nursery seed rate was varied from 0.35 to 1.15 kg/m2. Planting velocity varied from 0.29 to 0.55 m/s. Average tangential force on the finger had minimum and maximum magnitudes of 3.68 N and 4.70 N, respectively for 15 mm mat and 3.10 N and 5.32 N, respectively for 20 mm mat. However, one millisecond peak value of the resultant forces had a maximum value of 28.3 N and 29.7 N for 15 mm and 20 mm mats respectively. These values can be used for calculating the magnitude of deflection during the design of the transplanting finger. [1]

III. DESIGN METHODOLOGY

Rice are grown in small portion of agriculture field and are known as sampling, when the rise gets bigger they have to shifted in big field so that they can grow healthier. in our project we have designed and fabricated rice transplanter machine which is a semi-automatic system for agriculture of small rice sampling. The sampling has to be placed in the tray designed for their size. there are two columns of tray. At a time two rows of rice transplantation can be done simultaneously.

The sampling of rice plants is put on the tray fabricated for them. After proper placement of sampling the machine is pulled by the farmer. While pulling the machine from one hand, at the same time farmer will pull the hook mechanism from another hand the hook mechanism is then released and will go down by gravitational force. farmer need not to push the mechanism it will go down by its own weight while going down the hook will take a single rice plant it with it and will properly sow it in the field. But when the hook comes up it can take the plant with itself so here, we have developed a spring mechanism which will push the seed inside field at the same time when the hooks come up.

The rice sampling comes down by gravity by sliding on the tray but for travelling horizontally we have developed a mechanism for moving the tray in horizontal direction. The mechanism for moving the tray requires power which can be taken by using the hook mechanism when it is coming down. So, the link is connected to the rotating mechanism when the front hooks come down it will push the link with it and give the power to rotating mechanism. The rotating mechanism is powered by the link which moves up and down. The mechanism goes up by the spring mounted on it. While coming up it does not transfer any power to the rotating mechanism because we have used the free wheel bearing on it. The free will allow the mechanism to move one side.

The rotating mechanism give power to the chain sprocket mounted on it. Small link is welded on the chain drive and that links transfer the power to the sliding tray. Top of the sliding tray slides on bearing mounted on it on both the side. And bottom of the tray just slides on the angle. Use of sliding mechanism the rice sampling gets horizontal motion and vertical motion is given to it by gravity because the tray is mounted on 45-degree angle. On the bottom of the rice transplanter sheet metal is mounted so that it will float on mud and can be easily slides on it by using very less power.

IV. WORKING

As the method is manual the worker has to provide the initial motion. When the rice planter will move forward the ground wheels will get rotate. The wheels are provided with the fins so that they can travel easily in the mud. The ground wheels are used to keep constant distance between the two successive plants. Then we have larger sprocket is provided on the same shaft with the ground wheels and hence at the same time sprocket will also rotate. Sprocket is in engagement with the smaller sprocket by using the chain drive. As the power will get transmitted to the smaller sprocket, it will rotate.

Speed is increased from driver to driven shaft as we used 3:1 bar linkage so that it will oscillate for certain angle. As the drive is provided by the worker it will not have high speed and hence through this sprocket arrangement we have increase the planting finger speed. As the planting speed ratio. On the same shaft planting finger will be fixed through the four finger will oscillate, it will pick the rice plant from the tray and plant in mud. The planting finger is designed in such a way that rice plant should be easy to pick during the motion and also it should pick during the downward motion only.

In addition some other parameter also provided which even planter machines. This parameters contains height adjuster of main wheel, depth adjuster of picking arm, additional power source to drive the wheel etc.[5]

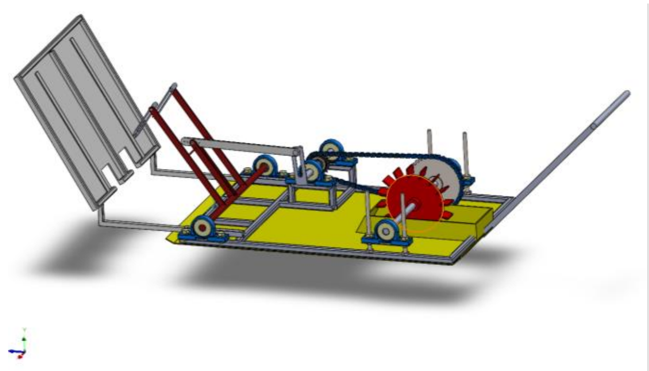

Figure 2. Cad Model

V. PART LIST

SR NO	PART NAME	MAT	SIZE	QTY
1	SQUARE TUBE	MS	15*15	13FT
2	CHASIS FRAME TUBE	MS	20*20	15FT
3	CHAIN	MS	#410	1NOS
4	SPROCKET	MS	18TEETH 42TEETH	2NOS
5	MS FLAT	SS	5MM	7FT
6	MS L ANGLE	SS	3MM	5FT
8	NUT BOLT	MS	3/8INCH	18NOS
9	PEDESTAL BEARING	MS	P-204	6NOS
10	SHAFT	MS	20MM	2KG
11	SHEET METAL	MS	600*930MM	1NOS
12	HEX HEAD NUT BOLT	SS	M6	4NOS
13	COLOUR	STD		0.5L

VI. DRAWING

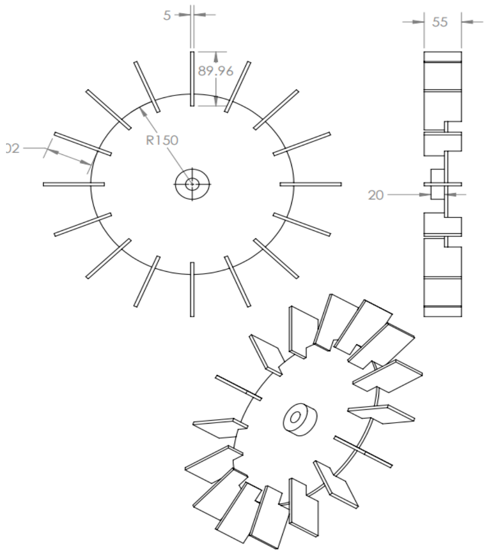

Figure 3. Teeth wheel

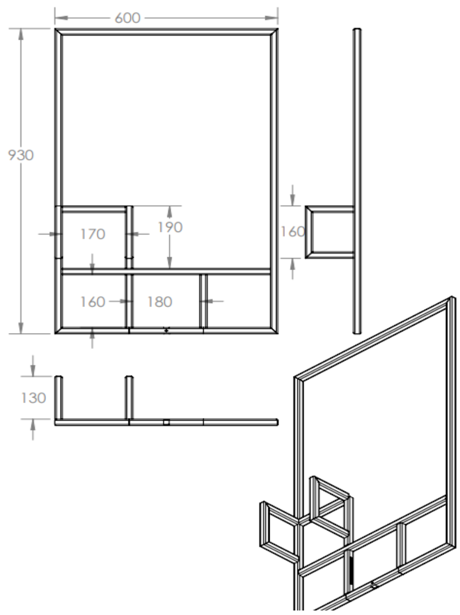

Figure 4. Frame

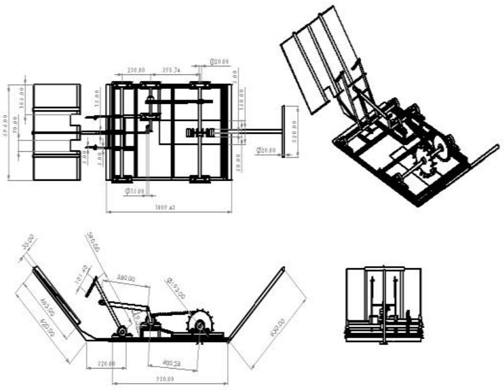

Figure 5. Assembly drawing

VII. STRESS ANALYSIS

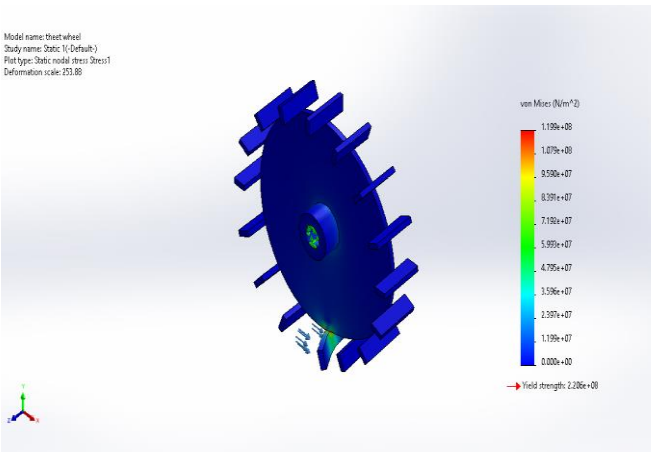

Figure 6. Stress Analysis of teeth wheel.

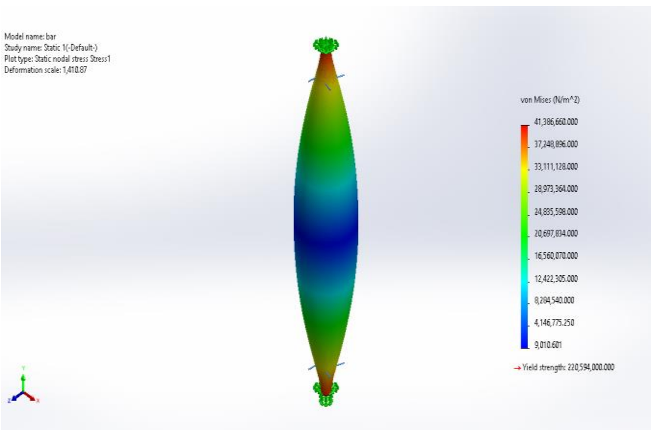

Figure 7. Stress Analysis of rod

VIII. CALCULATION

Material = C 45 (mild steel)
Take fos 2
$\sigma_t = \sigma_b = 540/fos = 270\ N/mm^2$
$\sigma_s = 0.5$
$\sigma_t = 0.5 \times 270$
$= 135\ N/mm^2$

Diameter of Crank:
Rice sowing distance requirement is 250mm
When the crank rotates at 360-degree one seed sowing is done
Circumference $= \pi D$
$250 = 3.142 \times D$
$D = 79.5mm$
This is the diameter of crank. Now we are using chain sprocket of 44 and 18 teeth
Ratio is 1 : 2.44
So, the diameter of bigger rear wheel will be
$D = 193.98$ mm

Let the farmer is pulling the rice transplanter machine with 5 km/hr. speed.

So, V = 1.39 m/s (1 m/s = 3.6 km/hr.)
Size of wheel is 194 mm diameter

$V = \pi DN/60$
$1.39 = 3.142 \times 0.194 \times N/60$
N = 136.8 rpm (big wheel)

So, the wheel is rotating with 137 rpm, on the same shaft chain sprocket is mounted.
Ratio is 1 : 2.44
$N_2 = 334.4$ rpm (small wheel)

When considering human-powered equipment, a healthy human can produce about 1.2 Hp is 895.2 watt.

$P = 2\pi NT/60$
$895 = 2 \times 3.142 \times 136.8 \times T/60$
T= 62.46 N-m
= 62467 N-mm

The total weight on shaft coming is

W= 8 kg= 80 N
The Bending Moment is as follows:
M= FxL/4
M = W L / 4 = 80 X 260/ 4 =5200 N.mm

Equivalent Torque
$T_e = \sqrt{M^2+T^2} = \sqrt{5200^2+62467^2}$
T_e= 62683.06 N-mm
$T_e = \pi/16 \times 135 \times d^3$
d= 13 mm

Design of bearing:-

Figure 8. Bearing

but we are using-20 mm shaft so design is safe.
For 20mm Shaft diameter we take standard breaking no. **P204**

Design of bolt: -

Bolt is acting here as a pivot. Stress for C-45 steel ft =420 kg/cm^2.
Std nominal diameter of bolt is 4 mm. From table in design data book, diameter corresponding to M6 bolt is 5 mm
Let us check the strength: -
Also initial tension in the bolt when belt is fully tightened.
P = 80 N is the value of force
Also, $P = \Pi /4\, d_c^2 \times \sigma$

$$\sigma = \frac{80 \times 4}{3.14 \times (4)^2} = 320/50.2 = 6.36\ N / mm^2$$

The calculated σ is less than the $\sigma_{tensile}$ and σ_{shear} hence our design is safe.

Figure 9. Bolt

Design of Square pipe

25x25 section is used as a column, we will check for its bending load.

The maximum load applied is 8 kg = 80 N
M = W L / 4 = 80 X 260/ 4 =5200 N.mm
$Z = B^3 – b^3 / 6 = 25^3 - 21^3 / 6 = 1060.6\ mm^3$
$\sigma_b = M / Z$
$\sigma_b = 5200 / 1060.6 = 4.90\ N/mm^2$
$\sigma_{b\ INDUCED} < \sigma_{b\ ALLOWED}$
$4.90\ N/mm^2 < 270\ N/mm^2$
Hence our design is safe.

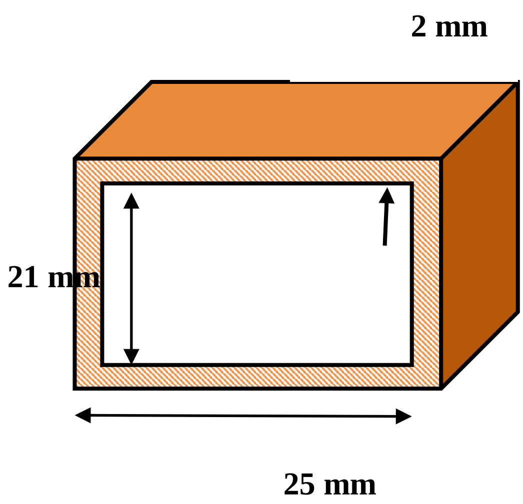

Figure 10. Square pipe

IX. CONCLUSION

Design and development of low cost and efficient farm implement plays a vital role in sustaining the farmers holding small fields due to the sparse availability of laborers. Several designs though available in the market cannot be afforded by these farmers due to high initial investment and maintenance. Hence a simple and cost effective rice planter is the most promising in these circumstances.

Nevertheless, there are few limitations with these transplanters as for the planting mechanism concerned. Due to the circular trajectory of the planter, the seedlings are planted in an inclined direction which is susceptible for extrication and improper growth. Hence, a new planter design is proposed in this work which overcomes this problem. With the proposed design, seedlings are planted vertically to the ground at sufficient depth by making the planter to travel in the straight path.

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