ECONOMIC RICE TRANSPLANTER

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***Abstract*—**In the field of agricultural also we had seen remarkable development.India is one of the world's largest production of rice accounting of 20%of all world rice population But farmers in our country till today make use of traditional method .To help in increasing the crop yield through proper preparation of land, crop protection, efficient irrigation and minimizing the loss during the harvest. This paper focuses on the mechanization of rice planting. A review of the available rice planting methods, transplanting machines and their merits and limitations are elaborated. A new design has been proposed to overcome the problems in the existing design. With this design one can plant the seedling vertical to the ground at sufficient depth. This not only avoids the extrication of the seedlings but also ensures uniform ripening of the rice plants.

I.INTRODUCTION

Transplanting is one of the major process for establishment of paddy in India. In this method seed is sown in one place and seedlings after they have grown a little are transplanted to another. This is done in order to get higher yields and less weeding. Transplanting of electric rice transplanting is highly labour intensive and it may require 250-350 man-hours per hectares. Seedling are prepared in nurseries where they grow for 15-20 days. After these seedling are been prepared, these are been transplanted manually by labour. The orientation of the labour at the time of transplanting is hazardous for their health. With manual transplantation the cost of production of electric rice transplanting also increases. With the help of a Electric rice transplanting Transplanting Machine, the transplantation cost as well as time will decreases with increase in efficiency.

Mechanical transplanting of electric rice transplanting (MTR) is a cost-effective establishment method for electric rice transplanting when compared to the existing and common method of manual transplanting. The primary drivers of the adoption of machine transplanting are rising labor scarcity and the high costs associated with manual transplanting. An increasing number of farmers adopting this technology in South Asia and are eager to learn the procedure of MTR. It is therefore important to develop a cadre of master trainers to assist many MTR service providers interested in expanding farmers' access to the technology. As master trainers need to have good knowledge of the technology and should have in-depth understanding of how to perform mechanical transplanting as well as nursery raising, this "Training of trainers (ToT) module" aims to provide overall instruction and information on how to conduct the ToT. This training module covers critical topics on the principles and practices of MTR in the context of smallholder farming in South Asia, with emphasis on hands-on learning. The contents of the module provide guidance to the training facilitators on how to conduct rapid, two-day trainings on MTR, including detailed instructions on how to facilitate the training, training material requirements and how to conduct pre-and post-tests for training participants. MTR is better learned through multiple training sessions or as part of a farmer field school rather than in individual one-day trainings. Hence, while this module covers four training sessions that can be conducted consecutively over two days, they can also be split and applied as individual modules during a season-long farmer field school, or for more targeted training sessions.

II. EXISTING SYSTEM

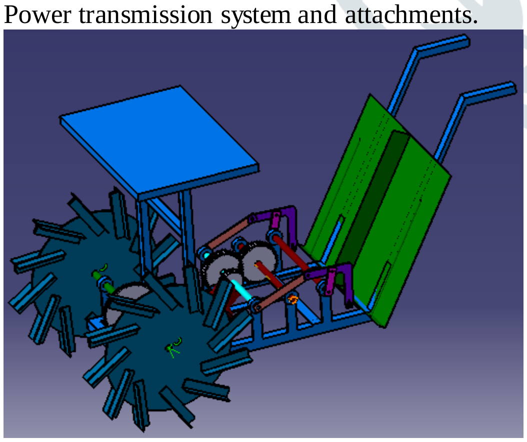
The first rice transplanter was developed by Japan during industrialization and it was patented in 1898. The development was sluggish until 1955 as the focus was on commercializing the existing one. During the same time Korea mechanized the transplantation process by borrowing the technology from Japan. Further, two-wheel tractors or power tillers were developed in Japan. The first tractor was brought to India in 1914. In 1956, China fabricated a 6-row rice transplanter. This machine was used sparsely due to its inherent problems of planting seedlings unevenly and requiring considerable human effort to drive. China acquired four wheel tractors from Russia and constructed the tractor factory with the aid of Russia. In 1965, transplanters using washed-seedlings and soil-bearing nursery was first produced. From then, various transplanters were developed and marketed involving several modifications in the mechanism .

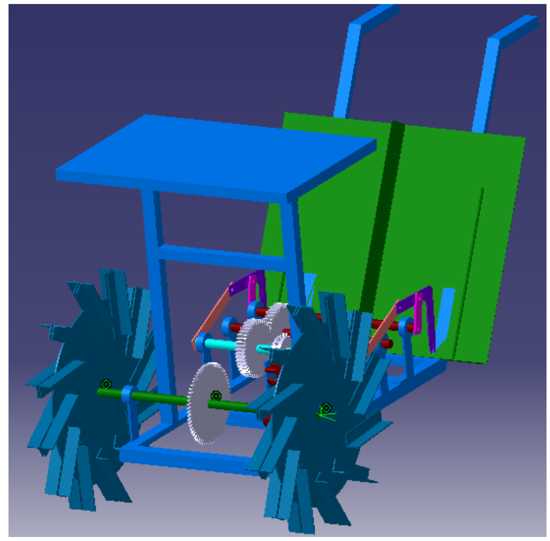
III. CONSTRUCTIONAL DETAILS

C.I RODS	-
BEARINGS	8
CHAIN DRIVE	2
SPROCKET	4
PULLEY	1
SHEET METAL	1
METAL BASE	1
WHEEL	2
OTHER MATERIALS	-
WELDING,CUTTING	-
BEVEL GEAR & SPUR GEAR Mfg, Labour, travel	1 -

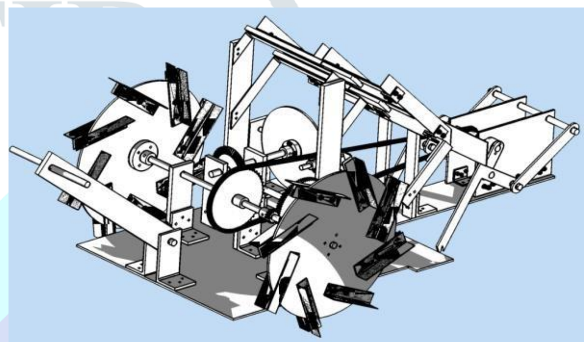
IV DESIGN

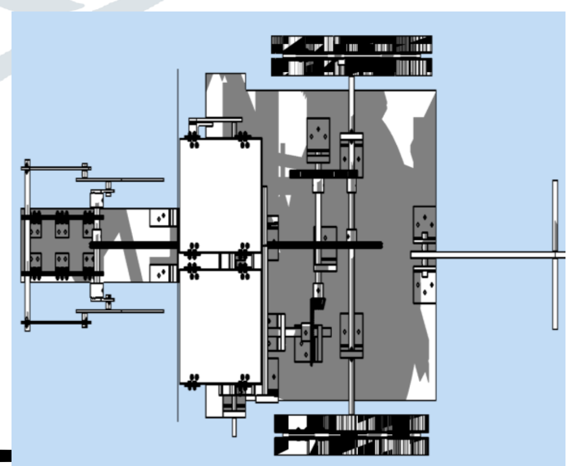
For demonstration purpose we have designed in small machine concept with working model from the scratch material. The Electric rice transplanting Transplanting machine's most important mechanisms are for the planting unit, paddy seedling tray and Power transmission system and attachments.

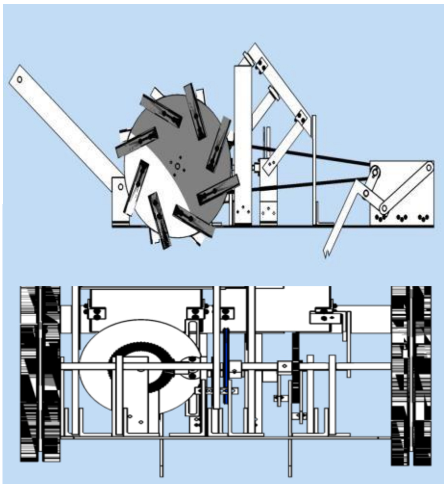




A. CAD Design







B.CALCULATION DETAILS

a) PLANTING UNIT

When designing the planting Mechanism following aspects were considered:

- Moving pathway
- Speed of travelling
- Plant catching mechanism
- Depth of planting

SPUR GEAR MECHANISM:

No. of teeth on DRIVEN SPUR GEAR= 38
No. of teeth on DRIVER SPUR GEAR= 18
Motor RPM = 45
Therefore,

$$\frac{\text{No. of teeth on driven gear}}{\text{No. of teeth on drive gear}} = \frac{x}{\text{Speed of Motor}}$$

18/38=x/45
X= 21.31

Speed of PAINT MACHINE= 21.31 RPM

b)TORQUE REQUIRED TO MECHANISM:

Torque:

$$\tau = F \times L$$

In the case of our sprocket, the force exerted is due to the mass being accelerated by gravity:

$$\tau = (mass[kg] \times g) \times radius[m]$$

where $g = 9.81ms^{-2}$

we want to lift a 8.3kg mass using a 40cm diameter pulley. We can find the torque load created by the mass using equation

$$\tau[Nm] = mass[kg] \times g \times radius$$

=8.3 X 9.81 X 0.40
= **3.2580 N-m**

Calculation of chain

Pitch of chain
P=AB = 2 AO sin (ϴ/2) = 2* (D/2) sin (ϴ/2)
D= diameter of the pitch circle
T= No. of teeth on the sprocket

So,
P = D sin (360/2T)
P = 16.8 sin (360/2*45)
P = 1.171

Pitch circle diameter

D= p cosec (180 /T)
P = D sin (180/T)
D=1.171 cosec (180/45)
D= 16.8cm

Length of chain

L = K.P
K= no. of the chain links
P= pitch of chain
K = (T1 + T2 /2) + (2x /P) + {T2 – T1 / 2π} 2 (P/x)
= (45 + 18 /2) + (2*48 /1.17) + {18 – 45/2π}2 (1.171/48)
K = 1.13m

Therefore,

L= K*P
= 113*1.171
L = 1.32 m

Analytical calculations of current and charging time of the battery:

The current produced by the solar panel (I) was calculated by knowing the maximum power (P) of the solar panel and the voltage rating (v) of the battery that is given by

I=P/V

Therefore, I=20/12=1.7 Ampere

Charging time (T) was computed by taking the ratio rating of battery in ampere hour (Ah) to the total current consumed by the solar panel.

T=(battery rating in ampere hour)/ (total current consumed by the solar panel)

Therefore,
T=12/1.7=7.05 hours

V. FABRICATION:

MACHINING PROCESSES**:**

The various machining processes those were used in making The Bucket Conveyor and The Belt Conveyor are described below:

1. Metal Cutting:

Various metal cutting tools were used here such as-
i Sniping tool: To cut the thin metal sheet to form the shape of bucket
ii Hack Saw: To cut the shaft into desired length.
iii Grinder cutting: To cut the thick metal bar into required length for making frame.

Figure 4: Cutting Sheet metal with sniping tool (left), shaft with Grinding C

Figure 11: Cutting Sheet metal with sniping tool (left), shaft with Grinding Cutter (right).

2. Welding:

In this process welding was widely used. As the project was to make a small prototype and there was a small budget for it, welding was used here for most of the joining process. Welding was used to:

i. Attach the sprocket to the shaft.
ii. Attach the bearing to the shaft.
iii. Hold the bearing in the bearing holder.
iv. Attach the bearing holder to the frame.
v. Form the frame of both bucket and belt conveyor.
vi. Join the bucket conveyor's driving shaft and belt conveyor's driving shaft to the electric motors.
vii. And to join many other parts to the frame.

3. Boring:

The sprocket was bought from the market. As the hole of the sprockets was smaller than the outer diameter of the shaft, these holes were enlarged by boring method with the help of lathe machine.

Figure 7: Boring with Lathe Machine.

4. Drilling:

Drilling process was also used here for different purposes such as:
i The shaft of the pulley of the belt conveyor on loading portion is stationary while the pulley is rotatable with the help of bearing. This shaft is held by two metal bars and these bars were drilled to hold the shaft.
ii In this project two wooden pulleys were used. Both these pulleys were drilled along its central axis to make a path of shaft.

iii The bottom portion of the frame was drilled in different points to make hole to screw the whole frame to a wooden board.

Figure 8: Drilling operation.

6. Grinding:

It has been already mentioned that the welding process was widely used here. So, grinding process was also used here to grind the various parts after cutting to get a plane surface for welding. The welded parts were also grinded for fine surface.
Figure 9: Grinding operation.

7. Facing and Turning:

Turning process was adopted for two purposes:
i To match the outer diameter of the shaft to the inner diameter of the bearing.
ii To convert rectangular wooden bar into cylindrical pulley.

Figure 10: Facing operation (left), turning operation (right) with Lathe Machine.

And where there is used turning process there is also used facing process for centering in the lathe machine. Figure 10: Facing operation (left), turning operation (right) with Lathe Machine**.**

TESTING THE MACHINE ON DRY LAND

To check whether the chain drives will work properly or not, machine was tested on dryland/loose soil. The main objective of the test was to check if whether the motion is transmittedfrom the wheel shaft to the machine or not. For testing purpose machine was dragged on loosesoil by hand. The test was performed within the company premises only. After the test plantingspacing was found out to be in the range of 16 cm. This slippage of 1-2 cm is may be caused dueto inadequate penetration of steel wheel into the solid ground.Hence after performing the test it was confirmed that motion is transmitted from wheels tothe machine.

After the assembly of wheels and chain drives, to check the performance of machine inmuddy field, mud field test was performed. The test field was prepared at rose nursery. Theobjective of this test was to check the functioning of machine in actual conditions.To check working of transplanting mechanism of the machine we show some electric rice transplanting seeds to get some electric rice transplanting seedlings, so that we could use them during the test to create actual conditions. However even after several attempts electric rice transplanting seedlings could not grow because of unfavourable climate.The test was carried out in mud field of around 5-6m long. The depth of mud was around15cm.The first difficulty which we experienced was while doing forward walking. Inforward walking, we experienced huge force and strength to pull the machine. Whereas in backward walking very small force is required to pull the machine as compared to forward walking. Another problem associated with forward walking was the machine tended to topple. Hence backward walking was comfortable and preferable.The next observation we made was the wheels and chain drive were functioning properly. The wheels were receiving adequate traction and rotating properly without any slippage.The plate strips attached at the end of the spokes were providing adequate grip. The transplanting mechanism was also working properly.

VI. RESULT & DISCUSSION

The modified machine was tested in the mud field, and it worked. In this machine ground wheelsupplies the power to operate transplanting mechanism. Pulling the machine rotates the steelwheel. But we could not test the machine with actual electric rice transplanting seedlings due to unfavourable climate.The machine should be pulled to operate. Ergonomically it is easier to apply pushing force ratherthan pulling force. However, as the machine will be planting seedlings behind it as we pull itthrough the field, it is better to stay ahead of the machine rather than walking behind it as it maydamage the planted seedlings.Another observation was made about the ways by which we can pull the machine, i.e. by eitherbackward walking or walking straight. During forward walking, more force was required to pullthe machine and it was difficult to maintain balance during walking. Also, machine tends totopple. This may be caused since while forward walking force applied morehorizontally which tends to rotate the machine about leading edge of the float. Operating themachine was way easier while pulling it by backward walking

VII. 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.

VIII. REFERENCES

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