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DESIGN ANALYSIS OF MANUAL RICE TRANSPLANTER

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Abstract: Agriculture is most important sector of the Indian economy. It is most important source of employment for the majority of the work force in the country. Rice is primary and major crop cultivated in India. About 70% of Indians are dependent on agriculture for their livelihood. As the large work force is engaged in this sector, Traditional method is costly, time consuming and labour intensive work. These problems can be solved with the help of rice planting machine. This study is focused on design analysis of a manually operated rice transplanter for small scale Indian rice cultivators. By achieving the goals like simplifying the mechanism, reduce cost and reduced weight of present rice transplanter. The availability and use of manual rice transplanter in Western Maharashtra is very rare, so design of this project is useful to farmers. This machine can bring revolution in rice production.

Keywords: Agriculture, rice planting machine, mechanism,transplanter.

I. INTRODUCTION[1]

India is a country of villages, having large population around two third of its population are dependent on agriculture. In India, average rice production per hectare is

2.2 tonne. Unlike upland row crops, cultivation of low land rice crop is a labour intensive process. In spite of the common belief of availability of surplus agricultural labour in India, there actually exists a scarcity of skilled agricultural workers. SO rice transplanter is a specialized machine fitted with a transplanter mechanism driven by the power from the live axle, in order to the transplant rice seedlings onto paddy field. Distribution of food grain production which shows rice production is major in India.

Table1: Crops production in India in million tonnes.

Crops	Production in million tonnes
RICE	111.01
WHEAT	97.11
Coarse cereals	45.42
Maize	27.14
Pulses	23.95

The process of manual rice translation is not so efficient as compared to the mechanical rice transplanting.The rice translation process is generally manual which involves number of labour. Machine transplanting using rice transplanter requires considerably less time and labour than manual transplanting. But here in India the rice transplanter is not affordable to the farmers. The rice transplanter in foreign country is runned on diesel engine and the current situation of the Indian farmers is not well enough to buy the transplanters to use it. So, a manual rice transplanter is being developed in India so that the cost of transplanter decreases. It increases the approximate area that a person can plant. Use of pregerminated paddy seeders in puddled wetland condition give similar yield like manual transplanting but reduce labour requirement by 75-80%.

II. LITERATURE REVIEW

They used 4 row,3 row, and 2 row rice transplanter on the basis of their study of various parameters they concluded that the 3 row rice transplanter was the best among all transplanting methods.So due to highest costing for 3 row rice transplanter, we are manufacturing 2 row rice transplanter .[1]

Plug type technology is used to develop manually operated rice transplanter.It consist of ground wheel,revolving magazine, seedling tube, power transmission system,seedling tray and handle.The machine resulted into high weight of 45 kg which was responsible for seedling spacing.The average speed is 0.3km/hr.The field capacity of the transplanting machine is 0.0149 ha/hr.It required three operator in the field. [2]

They conduced an economic analysis of traditional SRI rice cultivation practices in mahbubnagar district of andrapradesh. It was concluded that the SRI(System of Rice Intensification)method of cultivation is advantageous to the paddy farmers as compared to traditional method.[3]

III. DESIGN

The main components of rice planting machine are base wheels, chain drive, gear pair, mechanical arm and paddy support plate. Base wheels: Wheels are basic yet important part of the whole rice planting mechanism. The power is generated from wheels. As the wheel rotates the power will be transmitted to mechanical arms. The wheels are given guide rods so that wheel can move easily in wet lands. The guide rods are placed such that the holes made by it are actually the place where the paddy seedlings are planted by the mechanical arms.

Chain Drive: It is used to transmit the power produced by base wheels to the mechanical arms as a result of which it oscillates.

Gear Pair: It is used to reverse the rotational direction from anticlockwise to clockwise direction.

Mechanical Arm:The mechanical arms are placed parallel to the wheels. The work of the mechanical arms is to grasp the paddy seedlings from the paddy support plate and plant it in the field. The reason to place the mechanical arms parallel to the wheels is that the mechanical arms plant the paddy seedlings in the holes made by the guide rods of the wheel.

Sprockets: The main function of sprockets is to transmit torque through chain. There are two sprocket-one drivers and other driven mounted on respective shafts.

Four Bar Linkage: In this four bar linkage one link is fixed and other three linkages are in motion. The links are connecting rod, lever, crank and planting finger or fork. It is mounted on the driven shaft.

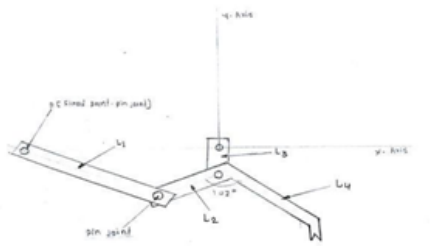

Fig 1 Mechanical Arm

Paddy Support Plate: The paddy support plate is used to place the paddy seedlings. The main objective of it is to place seedlings such that the seedlings do not fall off while plantation process and the mechanical arms can grasp it easily and the seedlings are not damaged.

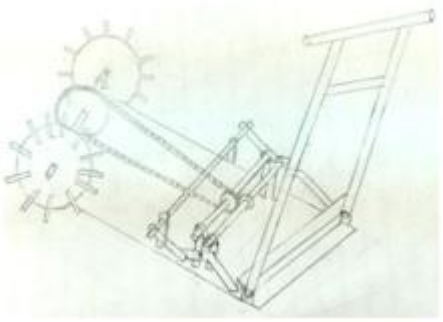

Fig 2 Isometric View of Rice Planting Machine

IV. CALCULATION

1) Length of mechanical arms: L1=150mm, L2=60mm, L3=50mm, L4=160mm, Delta=102°.

2) Calculation of speed of driving sprocket

$N_{1=}$ $\times 60/2\pi$ =angular velocity of wheel

3) Calculation of driven sprocket speed:- N_2/N_1 Where N_1 and N_2 speed of driver and driven sprocket.

4) Sprocket velocity ratio:-$N_2/N_1 = Z_1/Z_2$

Where Z_1 and Z_2 are no. of teeth on driver and driven sprocket

Driver and driven sprocket parameter:-

No. of teeth, outside diameter, Pitch diameter, Maximum Bore, Hub diameter, Length through bore (LTB)

5) Chain Selection parameter:-Size,Pitch, inside width, Roller diameter, Roller width

The length of the chain(L) must be equal to product of chain links(K) and the pitch of the chain(p).Mathematically

$$L=K.p$$

No. of chain links $K=Z_1+Z_2/2 +2_x/p +[Z_1-Z_2/2\pi]^2\ p/x$

The centre distance is given by

$x=p/4\ [K - Z_1+Z_2/2 + \sqrt{((K-T1+T2/2)^2-8(Z1-Z2/2\pi)^2)}]$

Linear velocity of Chain: - V= 1× × 1/60 ×10∧3

Power transmitted by chain on the basis of breaking load

$P =_{\times / \times}$

Where, Wb = Breaking load in Newtons
V= velocity of chain in m/s n = factor of safety

Ks = service factor
Factor of safety= $=W_b/W$

K1 = Load factor, K2= Lubrication factor, K3 = Rating factor, K_s=Service factor= $K_1 \times K_2 \times K_3$

6) Shaft Design: - The shaft design is based on the load consideration on shaft with the help of shear force diagram and bending moment diagram. The diameter for shaft is then calculated from power transferred as

$P = 2\pi NMt/60000$

max= 0.30 Syt&0.18 Sut(Take lowest value)
max =16/π× 3×√(^2 + ( )^2)

7) Bearing Design:-

$P = XVF_r + YFa$Dynamic Load = $C = P(L_{10})^{1/p} = P(L_{10})^{1/3}$

Select Life in hour from catalogue:

$L_{10} = 60 \times n \times L10h/100000$

V. WORKING

In the present experimental set up when the machine is pushed from paddy support plate in the field for operating it, the base wheels rotate in anticlockwise direction. This produces power which is transmitted towards mechanical arms with the help of chain drive. Here, gear pair plays a vital role as it changes the rotational direction from anti-clockwise to clockwise direction. The mechanical arms start oscillating on its axis. While oscillating it grabs the paddy seedlings from paddy support plate and plants it in the field. So, finally rice planting of rice seedlings can be performed.

VI. ADVANTAGES

- It saves labour cost.
- It saves operating time and saving on cost of operation as compared to traditional method.
- It is light in weight as compared to other devices.
- It reduced the use of man power up to 50%.
- It is cheaper so poorer farmer can also afford this modern devices.

VII. SUMMERY

The rice planting machine has been designed and fabricated satisfactorily. Finally we can say that it is an user friendly and efficient machine with low production cost. But, there is always a room for improvement. So, the improvements can be done before introducing it to the farmers. The machine is driven by man power but engine can be coupled to enhance the performance. Machine can be developed to transplant several rows simultaneously. The dapog must have thin mud layer for easy removal of seedlings.

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