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A Step towards Increasing Paddy Cultivation by Mechanical Transplanting Mechanism

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ABSTRACT

Agriculture is considered as one of the most important occupation in our lives and one of the main reasons for stability of Indian Economy. Rice, Cotton, Wheat, Tea, etc are few of the crops grown in India; of which Rice is most cultivated crops of all and India stands 2nd in the World in Rice production. In India, Rice is typically cultivated by traditional method using hands; whereas other regions use Semi-Automatic or Fully-Automatic machines to grow Rice. In this approach, we will design a Semi-Automatic machine at an affordable price to grow Rice at a much faster pace and more efficiently. A Four-Bar Chain Mechanism will be used as base for the design of the machine and will be operated by pedals. Again the movement of the machine has to be done by applying human effort, while crops will be cultivated automatically and hence called Semi-Automatic Machine Rice Cultivating Machine. The proposed design will not only increase the rate of crop production, but will also reduce human labor effort compared to traditional method of cultivating rice by hands.

Keywords*: Rice Cultivation Machine, Paddy Cultivation, Paddy Transplanter, Paddy Seeder.*

INTRODUCTION

In India, Agricultural Farming is one of the most important occupations for the stability of Indian Economy. More than 58% of rural households depends primarily on agriculture and contributes around 14% to total Gross Development Product (GDP) of India [1]. The weather conditions and types of soils make India most favorable to cultivate variety of crops including Rice, Wheat, Cotton, Tea, Coffee, etc.

Despite Agriculture being an important occupation, India lacks in rate of production of crops due to poor farming techniques. Farming in India is carried out by traditional approach using hands and not via modern farming tools and equipments. The reason for lacking includes poor knowledge about farming tools, not enough motivated to use automated tools and poor financial condition [2].

In India, young seedlings of rice are transplanted over direct seedlings for better crop management. But, such transplantation requires enormous man power (about 400 man-hour / Ha) and working in mudding field in stooping posture [3]. Hence automation technique needs to be implanted to reduce laborious works of farmers and increase productivity rate.

Rice can be planted via three different methods listed as follows:

1) Planting by Hand
2) Planting by Manual Machine (Powered by Hand)
3) Planting by Automatic Machine (Driven by Engine)

Planting done by hands is laborious and time consuming method; but for small area of field, it is best method. No initial investment of heavy machineries is required and can be done in areas having

varying water levels. Healthy seedlings are produced when they are raised using this method. The method is time consuming and may result in back injury to workers due to continuously sitting position.

Planting done by machines powered by hands is a cheap alternative to planting done by hands. Planting done by the method is more rapid compared to planting done by hands. The method requires one labor for movement of machine while seedlings are planted automatically. These machines are small in size and increases rate of planting compared to previous method. One operator has to continuously move with the machine for handling it. The semi-automatic types of machines are not much efficient as their wheels slip under wet conditions resisting crop planting.

The more advanced technique for planting Rice is by fully Automatic Rice Transplanter. This machine is powered by an engine and operator sits on top of it for maneuvering the vehicle while rest of the work is done by the machine on its own. Although this type of machines have highest rate of production, they are not very much incorporated in India due to high initial investment, higher maintenance cost and higher operating cost.

RELATED WORK

From planting rice by hands to planting rice by automatic machines, technology has evolved hugely making it possible. Four-Bar Chain Mechanism has been used for semi-automatic rice transplanter, Four or Six rows self propelled paddy translpanters are manufactured making it easier for farmer to grow rice effortlessly with higher efficiency.

A group of researchers developed a mechanized manual rice transplanting machine [4] to reduce the efforts by farmers required to transplant rice in muddy water. A Four-Bar mechanism has been incorporated to develop a mechanized rice transplanter at very economical price, so as to make it available to small-scale farmers also. A Cam and Rocker-arm were used to oscillate the fork for planting the rice seedling. The fork is the main part of machine which oscillates up to certain degree of freedom for picking the seedling from tray and plant in the muddy field. The motion to fork was given using chain sprocket assembly driven by humans manually.

The Four Row Self Propelled Paddy Transplanter [5] developed by researchers is one of a kind Semi-Automatic Rice Transplanter. The Four Rows in the transplanter cultivates seedlings in 4 consecutive rows at a time having row spacing of 23.8 cm. The seedlings were planted to a depth of 3 cm keeping distance of 13 cm between 2 consecutive seedlings.

The developed transplanter not only increases rate of production by cultivating multiple seedlings simultaneously but also reduces fuel consumption and man-power labor. However, the ground wheel does not works well in wet lands and occasionally slips away missing the seedling. Also 2 persons are required to operate the transplanter; one for operating machine and another for feeding mats.

A Six Row Self-Propelled Paddy Transplanter [6] was designed with an aim to reduce the cost of operation and increase rate of planting. The transplanter was a four wheeled machine powered by Gasoline engine. The seedlings were planted in six rows simultaneously having around 20 cm of gap between consecutive rows. The seedlings having maximum height of 25 cm could be planted up to 5 cm of depth.

An automatic Rice Transplanter [7] equipped with Real-time Kinematic GPS (RTKGPS) and Fiber Optic Gyro (FOG) is a unique self propelled and self planting machine. The RTKGPS assists in measuring the position of the machine by transmitting the generated pulses every second. The inclination of the vehicle was calculated by FOG sensor to correct the vehicle inclination. The steering, clutch, brakes, engine throttle and movement of attachment are all controlled and monitored by main computer.

PROPOSED SOLUTION

In the proposed system, we have designed a human powered, self transplanting machine for planting rice in muddy field. The aim behind the research was to increase productivity by planting crops mechanically with less effort using cost-effective mechanical machine. The proposed model will not only be cost-effective but will also relieve labors from back-pain, assists in planting crops up to more uniform depth and increased rate of production.

The proposed model will consist of list of components as listed herewith:

1) **Jaw Fork:** The jaw will pick plant from tray and fork will plant it inside the land.
2) **Sprocket:** Sprocket will transmit power to three-jaw wheel upon rotating the handle provided.
3) **Three-Jaw Wheel:** Three-Jaw wheel actuates the Cam and Follower resulting in movement of Jaw Fork.
4) **Tray:** Plants will be resting on tray from where jaw will pick and plant in land.

The block diagram of Mechanized Paddy Transplanting machine is depicted in fig. 1.

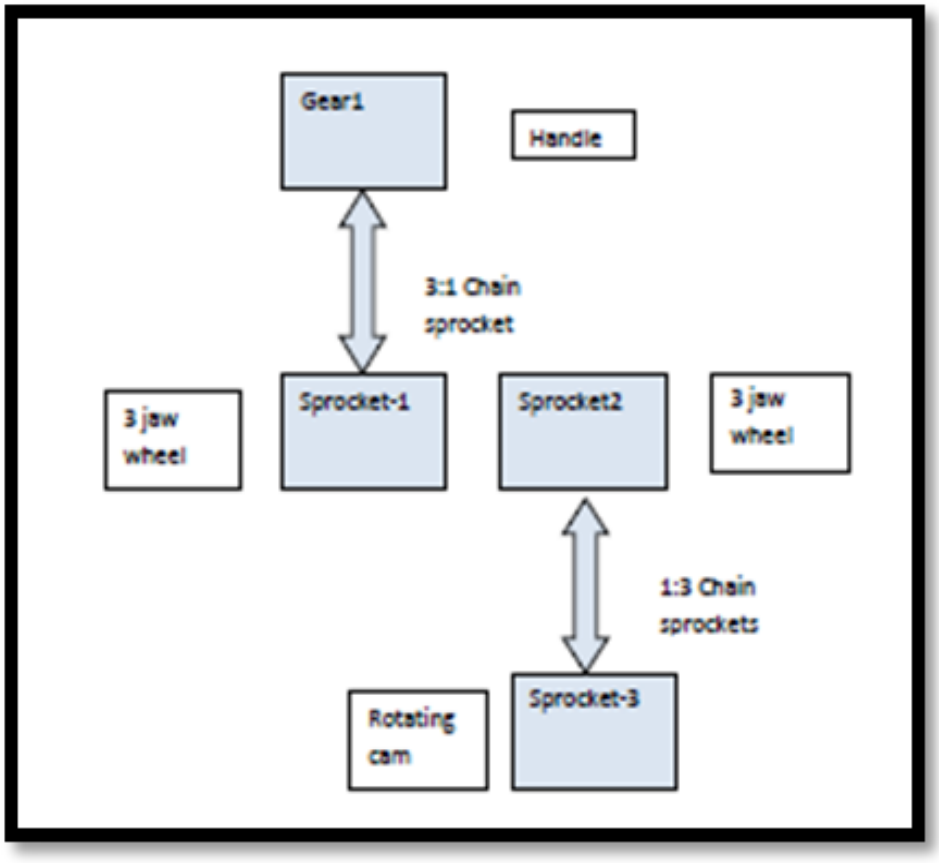

Fig. 1. Block Diagram of Paddy Transplanting Machine

Working of Paddy Transplanter

Step 1. Gear–1 is rotated by rotating the handle provided manually.
Step 2. Chain between Gear–1 and Sprocket–1 helps rotating sprocket–1, resting on a shaft and having a 3-Jaw Wheel on each side.
Step 3. Sprocket–2 attached to the same shaft as sprocket–1 is attached to sprocket–3 via chain mechanism and transmits power further.
Step 4. Sprocket–3 rotates cam on receiving power from sprocket–3 and transmits the same to pair of Jaw and Fork.
Step 5. The Cam actuates Jaw and Fork which finally plants the paddy in to the soil by picking it from plant tray.

Following Fig. 2, shows the working mechanism of proposed model:

The proposed model has been designed in Creo and is shown in Figure 3.

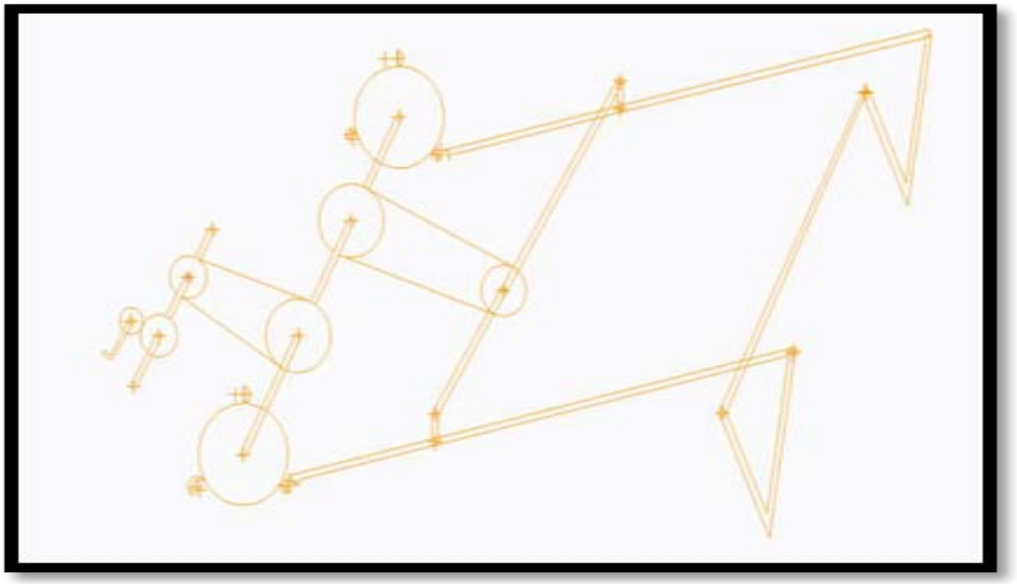

Fig. 2. Working Mechanism of Paddy Transplanter

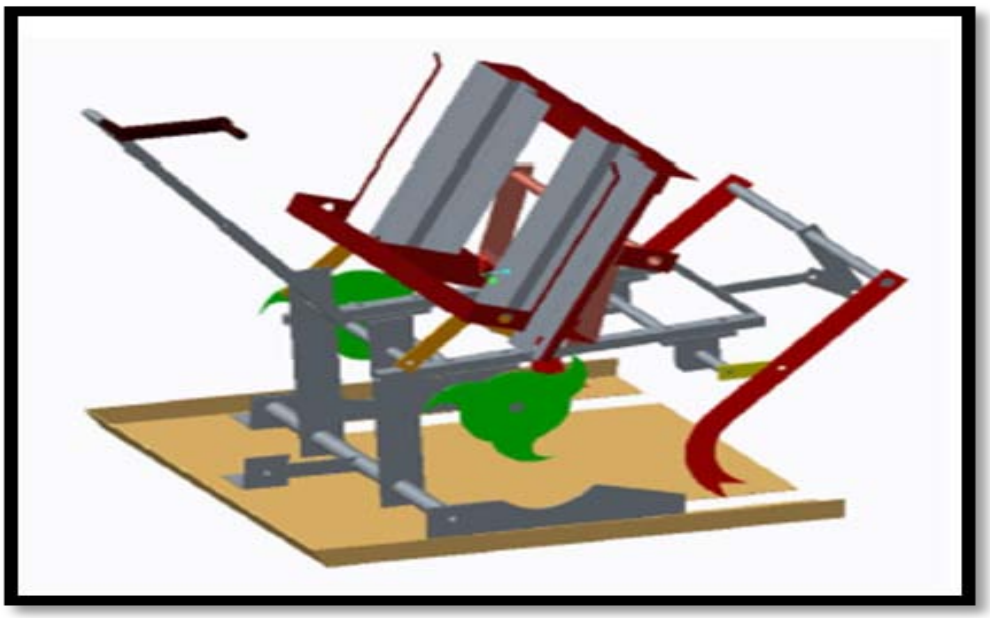

Fig. 3. Designed Model of Paddy Transplanter

The 3-Jaws wheel will plant three seedlings in one rotation of handle resulting in increased rate of production and decreased human effort. Also the fork will maintain uniformity in depth up to which seedlings should be planted inside land. Such a mechanism will overall increase the quality of rice grown with lesser human effort.

CONCLUSION

The proposed design of rice transplanting machine plants three seedlings in single rotation of handle resulting in increased performance, higher efficiency with reduced human effort. Also, Forks on either end planted multiple rows simultaneously compared to one row at a time in case of manual transplantation. The initial investment of the transplanting machine is also very less compared to fully automatic machines, making it affordable to small scale farmers also. The rice planted by the machine will be of higher quality, as seedlings are planted up to uniform depth. However, the proposed design needs human effort to operate which can be replaced by employing an engine rather than handle.

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