Journal for Research | Volume 04 | Issue 01 | March 2018
ISSN: 2395-7549

Design Analysis & Fabrication of Manual Rice Transplanting Machine

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Abstract

Need of rice transplanting machine is growing nowadays because of unique feature seeding in well sequence and well manners. This will save too much efforts of human being. Class of people who uses this kind of machine is farmers and they are having poor economic background. To feed growing population is a huge challenge. Importation of rice will lead to drain out the economy of the country. Mechanization of paddy sector will lead to higher productivity with releasing of work force to other sectors. The objective of this project is to design a paddy transplanting mechanism to transplant paddy seedling by small scale farmers in the country. Hence, this is considered as an activity that needed mechanization. For mechanization the modeling and simulation evaluated for hand operated rice seeding machine, which is help the farmers to planting more and more amount of rice in good quality with low energy consumption and less harm to the environment. India is predominately an agricultural country with rice as one of its main food crop. It Produce about 80 million tons rice annually which is about 22% of the world rice production. Culturally transplanting of young seeding is preferred over direct seeding for better yield and better crop management practice. But this operation requires large amount of manpower (about 400 Man-Hour/ha) and task is very laborious involving working in stopping posture and moving in muddy field.

Keywords: Higher Productivity, Paddy Seeding, Small Scale Farmers

I. INTRODUCTION

Over one billion people in the world are engaged in rice cultivation, and over three and a half billion people worldwide depend on rice as a major food source. Due to the world population's dependence on rice, it is crucial to implement efficient methods to increase rice yields as much as possible. Many countries have experimented with new technologies to obtain improved results. Thailand is the world's second largest rice exporter. India is predominately an agricultural country with rice as one of its main food crop. It Produce about 80 million tons rice annually which is about 22% of the world rice production. We are looking to introduce new technologies that could potentially make the rice cultivation process more efficient for small-scale farmers. This new seeding machine is designed to provide a new planting option that will decrease the amount of seed used and lower production costs. [1]

The final objective consisted of determining how appropriate the new rice seeding technology could be for use by small-scale farmers. Our findings revealed that farmers had never design of the rice seeding technology. The goal of this project was to provide recommendations of possible changes that could be made to a new rice sewing machine to better fit the needs of the farmers. Minimizing the amount of seed used in planting and reducing the costs of planting the rice are two goals of the new seeding technology. In order to reach this goal, we identified what methods farmers currently use to grow rice and determined the differences in yields and costs between traditional and new cultivation practices. We identified what actions the Rice Seed Center had already taken to introduce the new technology and determined that the farmers had no experience with the new rice sowing technology prior to our arrival. Finally, we determined the appropriateness of the new rice sowing technology for use by the small-scale farmers. [2]

II. AIM & OBJECTIVE

The basic aim of this paper is to study and know the research gap between the use of traditional method and the mechanized transplanters for rice transplantation in India, along with the parameters related to the existing transplanters. In India very few people are aware about different existing transplanter, their benefits and requirements in order to achieve higher productivity and yield. Hence we aim to study about Rice transplanter, their benefits, requirements and help to popularize it amongst the people especially amongst small scale labours in our country so as to minimize cost of production and have better quality of rice. Use of

rice transplanter also generates an alternate source of income for rural youth through custom services on nursery raising and mechanical transplanting.

III. LITERATURE REVIEW

Rajvir Yadav et al. (2007) had conducted an ergonomic evaluation of six row manually operated rice transplanter. Under their study the field capacity of transplanter was more than as compared to traditional method and average force required for pulling the transplanter was considered to be 130.32 N for male and 145.12 N for female subjects. Martin and Chaffin (1972), Ayoub and McDaniel (1974), and Chaffin et al. (1983) found that heights at which push-pull forces are applied are the most important variable which hugely affects the force output. [3]

During the period of 2008 A.K. Goel et al. conducted an experiment on three transplanters namely OUAT, CRRI and Yanji rice transplanter. Here they concluded that in accordance with the split plot design of experiments 32 hours of sedimentation period was suitable for operation of manual transplanter while the same was 56 hours for Yanji transplanter. [4]

In 2013 Rampuram Jayapal reddy & Dr. N. Sandhya Shenoy conducted an economic analysis of Traditional SRI rice cultivation practices in Mahabubnagar district of AndraPradesh. It was concluded that the SRI method of cultivation is advantageous to the paddy farmers as compared to Traditional method. [5]

The required different types of information regarding of transplanting field with literature review of different research paper. The literature review is divided into different field of analysis like Ergo-Economical analysis of different paddy transplanting operation, performance of self-propelled rice transplanter and its effect on crop yield, theoretical development of rice transplanting machine. This development and experiments were conducted which gives the parameters, specification, problems arising in already exists transplanter and development & design methodology of transplanter. The unavailability of the rice transplanter in western Maharashtra zone gave the reason to find proper research in this zone and designing transplanter. The unawareness of use of this transplanter in the farmers which leads to makes the handy use. The research and literature on the design analysis of hand cranked and self-propelled with the cam-follower mechanism.

IV. MATERIALS / TOOLS REQUIRED

The following materials are required for successfully assemble and development of rice seeding machine:

1) 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.

2) Chain

The function of chain is to transmit torque from driver to driven sprockets. The chain is simplex type

3) 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.

4) Tray

This is used to store the rice plant from where the planting finger pick the plant and saw in the ground. This tray has two vertical guide slots.

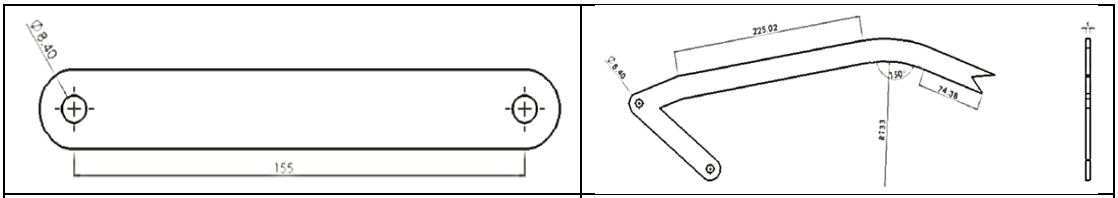
5) Planting Fork

The planting fork is the main element which is responsible for the plantation of the nursery seed. It has the specific shape which picks the nursery seed and plant in mud. It oscillates at certain angle and it is called as fixed fork mechanism.

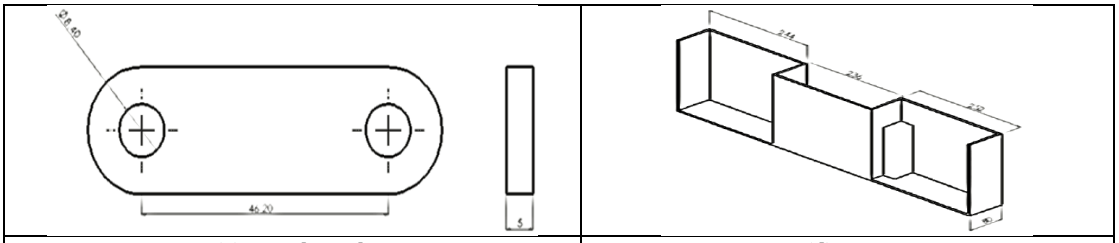
6) Frame

The main function of rigid frame is to locate all the different components onto it and held it rigid so the proper function of the operation can be delivered.

V. DESIGN OF MACHINE COMPONENTS



(a) Roacker Link (b) Fork



(c) Crank Link (d) Tray

Fig. 1: Different Components of Macine

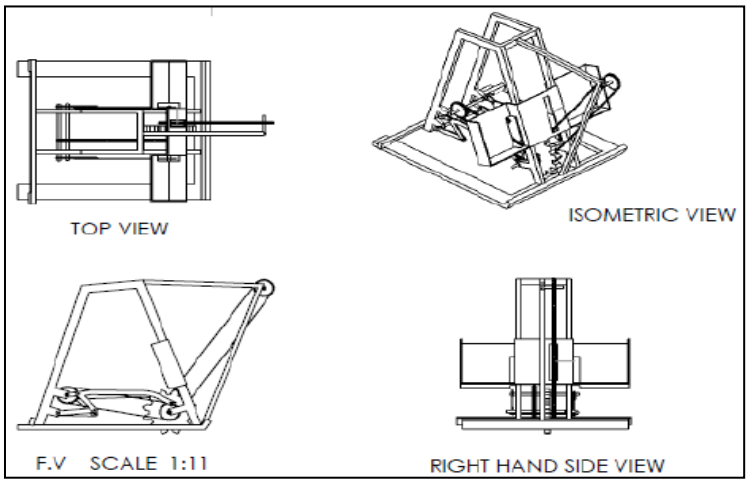
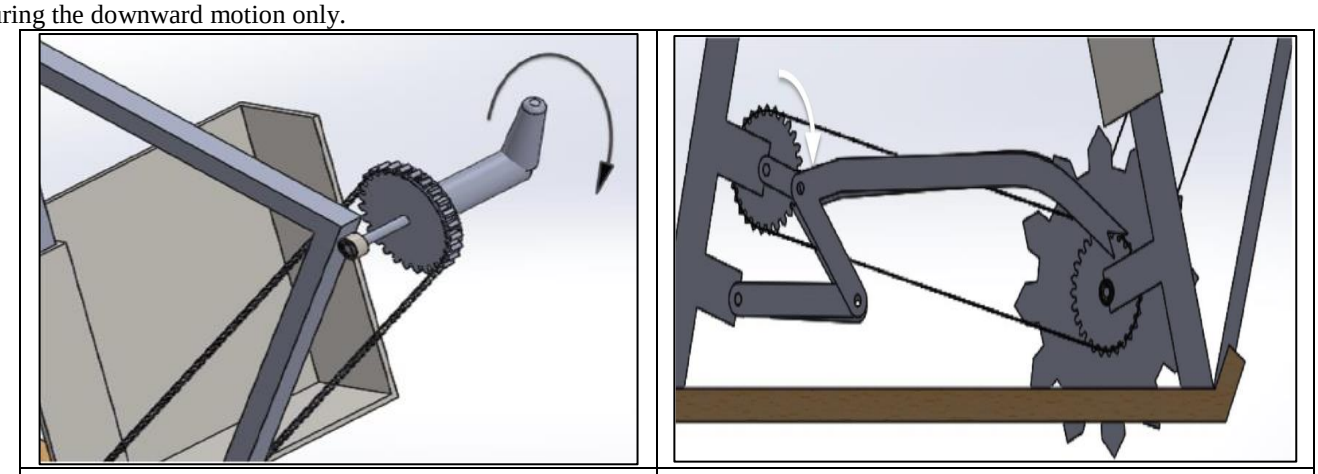


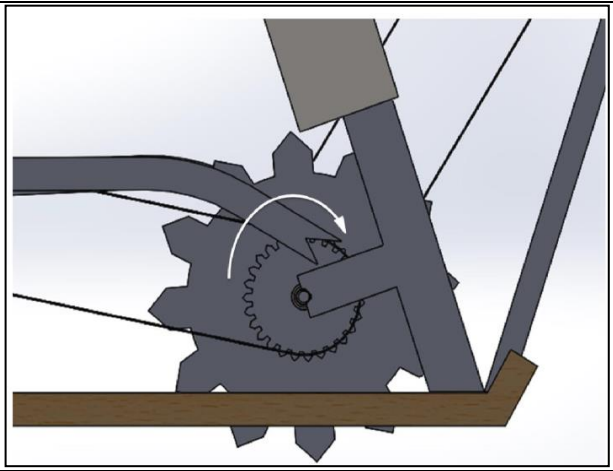
Fig. 2: Final Assembly of Machine with Different Views

VI. WORKING

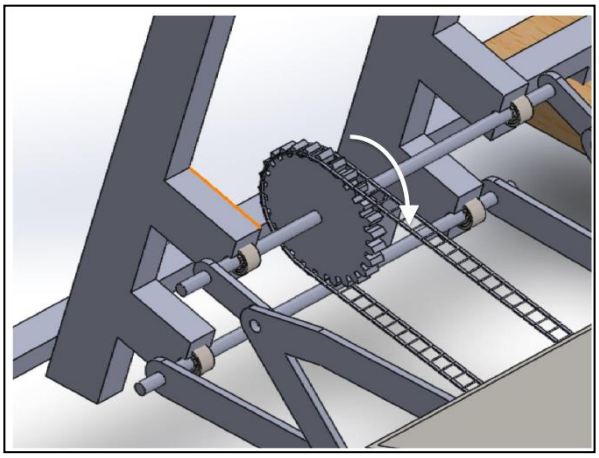
As the process is manual the worker has to provide the initial motion. The wooden plate boards are used to maintain constant distance between the two successive plants. Then larger sprocket is provided on the same shaft with the ground wheels and hence at the same time sprocket will also rotate. The larger 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. The speed is increased from driver to driven shaft as we used 3:1 speed ratio. On the same shaft planting fork will be fixed through the four 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 finger will oscillate, it will pick the rice plant from the tray and plant in mud. The planting fork 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.



(a) Handle Motion Clockwise (b) Sprocket Motion Clockwise



(c) Main Wheel Motion Clockwise.



(d) Sprocket Allow Arm To Move Down.

Fig. 3: Working Sequence of Rice Transplanter

VII. EXPERIMENTAL RESULTS & DISCUSSION

The design of rice transplanter is easy as the basic machine design knowledge is applied to design the parts like shafts, bearings, wheels, chain and sprocket assembly and synthesis of four bar mechanism which uses the standards formulas. The cost of the transplanter is low as possible because use available and local material which leads to lower downs the price in case of mass production. The mechanism used is four bar mechanism in place of cam-follower and rocker-arm mechanism. The availability and use of transplanter makes us to fabricate the transplanter with minimum cost used by small scale farmers.

Parameters	Values
No. of teeth on driving sprocket	44
Driving shaft diameter	20 mm
Driven shaft diameter	20 mm
No. of teeth on driven sprocket	10
Length of chain	90 links

Table 1: Different Parameters and its Values

A successful Trial run of transplanter is conducted to test the effectiveness of the transplanter

VIII. BENEFITS

1) Efficient utilization of resources by saving labour & cost of overall production.
2) Timely transplanting of seedlings of optimal age.
3) Ensures uniform spacing and optimum plant density.
4) Higher productivity compared to traditional methods.
5) Less incidence of disease in seedlings due to less root injury generated due to shock while transplanting.
6) Improving soil health through eliminating puddling.
7) Generates an alternate source of income for rural youth through custom services on nursery raising and mechanical transplanting.

IX. CONCLUSIONS

The modeling and simulation of the rice seeding machine performed on the SOLIDWORKS. The Rice seeding machine manufactured as per modeling and work satisfactorily. It will help the farmer for easy seeding of the rice and at the same time it will reduce the time of seeding with effective cost cutting to help work in budget.

The high energy consumption, heavy pollution and high cost condition caused by using diesel and gasoline as the energy source have been improved. The low efficiency condition caused by using man power or animal power as the traction source has also been improved. It accords with the requirement of the ecological agriculture development. It would also help in decreasing the over dependence of farmers upon labour for transplantation. Transplanter helps to acquire lesser cost of production with higher yield and production moreover the quality of produced rice is also good.

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