Student Design Project

Project Brief:
To Design and development of rice planter machine to transplant seeding of rice in paddy field

MSME Unit:
PREET is India’s largest Combine Harvester manufacturer and PREET Tractors are the most sought after tractors in India as well as International market. PREET already is market leader in segment of Self Propelled Combine Harvester in India and PREET Tractors has got attention of global market and the demand PREET Tractors has growing day by day.

Salient Features of New Design:
- Prevent back-problems in field workers
- Extremely low-cost
- Simple and rugged
- Easily transportable
- Can be repaired using local material
- Usable in a variety of terrains

Commercial Viability:
The prototype proves the functionality of the concept, a fully developed product has good commercial potential
1. Project Title:

To Design and development of rice planter machine to transplant seedling of rice in paddy field

Abstract:

A rice transplanter is a specialized transplanter fitted to transplant rice seedlings in the paddy field.

Rice transplanters are used mainly in East, Southeast, and South Asia. This is because rice can be grown without transplanting, by simply sowing seeds on field, and farmers outside Asia prefer this fuss-free way at the expense of reduced yield.

A common rice transplanter comprises:

- a seedling tray like a shed roof on which mat type rice nursery is set;
- a seedling tray shifter that shifts the seedling tray like a carriage of typewriters;
- Plural pickup forks that pick up a seedling from mat type nursery on the seedling tray and put the seedling into the earth, as if the seedling were taken between human fingers.

Machine transplanting using rice transplanters requires considerably less time and labour than manual transplanting. It increases the approximate area that a person can plant from 700 to 10,000 square metres per day.

However, rice transplanters are considerably expensive for almost all Asian small-hold farmers. Rice transplanters are popular in industrialized countries where labor cost is high, for example in South Korea.

Rice transplanters were first developed in Japan in 1960s, whereas the earliest attempt to mechanize rice transplanting dates back to late 19th century. In Japan, development and spread of rice transplanters progressed rapidly during 1970s and 1980s.

Project Category:

This project belongs to the Innovation in agricultural category, as the labour of manual rice plantation is expensive in INDIA. So, this manual plantation needed to be replaced by a efficient machinery, which has been done by this project. Though the wash-root type Rice planter were invented quite earlier but didn’t survived for a longer period as it was replaced by the Automatic Rice Transplanter. But this automatic machine also failed to survive in market due to:

- Too Expensive
- Difficult to plant at edges and corners of the field
- Gets stuck in the field
- Difficult to repair
2. INTRODUCTION

In this project, we built a rice transplanter for transplanting the rice seedlings in the paddy field. The following are the main objectives that were considered during designing and manufacturing of the rice transplanter.

- Prevent back-problems in field workers
- Extremely low-cost
- Simple and rugged
- Easily transportable
- Can be repaired using local material
- Usable in a variety of terrains

3. CURRENT MARKET

The implemented Rice transplanters that are available in Market are:

- Walk behind type (or walker type)
  - Kubota rice transplanter

- Riding Type
  - Japanese rice Transplanter - Yanmar (4 Wheeled)
  - Chinese rice Transplanter (3 Wheeled)

Both the Chinese and Japanese rice transplanters are self propelled
RIDING TYPE

WALK BEHIND TYPE
4.1 ADVANTAGES & DISADVANTAGES

The following are the advantages and disadvantages of the available Rice transplanters in the market

DISADVANTAGES

- Too Expensive
- Difficult to plant at edges and corners of the field
- Gets stuck in the field
- Difficult to repair

ADVANTAGES

- High Efficiency
- Fast (with adjustable speed)
- Rugged

Yanmar VP8D
5. DESIGNING

5.1 Design of planting mechanisms used in power operated transplanters

Most of the planting devices of power operated transplanters can be classified as crank and rocker mechanisms of four-bar linkage. A planting finger, which is a part of the coupler link of the mechanism, separates the seedlings from the seedling tray and places them in the soil. The curve traced by the planting finger may have an influence on the stability of the planted seedlings. The kinematic analysis of the planting mechanisms is considered essential for an understanding of its operation and its further improvements.

5.2 Design of mechanism

Most mechanism tasks require a single input to be transferred to a single output. Therefore, single-degree-of-freedom mechanisms are the forms used most frequently. Grubler’s criterion is concerned with the number of links in the mechanism and with the number and kinds of kinematic pairs. It can be used for determining the degree of freedom of a mechanism. Analysis techniques can be used to replace costly and time consuming building and testing of physical prototypes in a trial and error design process. Analysis techniques generally form a basic part of most synthesis methods. The four-bar linkage should be among the first solutions to motion control problems to be investigated. The fewest parts that can do the job will usually give the least expensive and most reliable solution. The Grashof condition can be used as a very simple relationship, which predicts the behavior of a four-bar linkage, based on the link lengths. A four-bar mechanism is physically impossible if one of the links has a length greater than the sum of the other three. In a four-bar linkage, distinct types of mechanisms could be obtained by inversion. A crank-rocker mechanism is obtained by fixing one of the two links paired with the shortest link. Newton–Raphson method could be used to solve the non-linear equations developed for solving the four-bar linkage position problem. One basic mechanism design problem for which the four-bar chain can provide solutions is that of finding a point of the coupler of a four-bar mechanism, which describes a path closely approximating the desired one.

5.3 Methodology

In a mechanical transplanter the finger follow a desired path of motion. A planar four-bar linkage with all revolute pairs is chosen, as this is very simple, a mechanism made of that may be easy to maintain and may cost less to manufacture. The input motion is applied to the crank so that the motion is continuous and rotary. The output motion follow a suitable path in order to meet the requirements of a transplanter specified below. The mechanism should have one degree of freedom and a coupler point that is capable of making a loop may be incorporated. The planting finger will be attached at the coupler point.
5.6. Analysis of the linkage

The mechanism shown above in the figure was analysed in the SAM 6.0 software. According to the calculated parameters such as Length of Crank, Length of coupler, Length of fixed link, length of the follower, length of the extension of the coupler and the angle of the extension, the above shown profile was generated (detailed view in seedling profile)

The following figures shows the series screenshots of the simulation of the mechanism
6.2 Feeding Conveyor

Feeding conveyor is used to feed seedlings in a definite amount from seedling tray

- Material Used: Flexible Rubber
- Thickness: 2mm
- Width: 110mm
- No. of strips on conveyor: 14
- Adhesive used: Feviquick
6.3 Pickup Forks

- Pickup forks are used to put seedlings from feeding conveyor to the paddy field
- They move in a definite profile
- Material Used: MS
6.4 Base/ Floater

Wooden base acts as a floater while planting seedlings in the paddy field

- Material Used: Ply Wood
6.5 Complete Project