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Design and fabrication of manually operated paddy transplanter machine

Dr. Naveen Ankegowda[1], Kushal H B[2], Manoja M[*3], Monish A S[4], Mahadeva Swami S[5]

[1]Associate Professor, Department of Mechanical Engineering, Vidyavardhaka College of engineering, Mysuru, Karnataka, India
[3]Students of Mechanical engineering, Vidyavardhaka college of engineering, Mysuru, Karnataka, India
[2-5] Students of Mechanical engineering, Vidyavardhaka college of engineering, Mysuru, Karnataka, India

**Corresponding Author: Manoja M*
Email: manoja1718@gmail.com

Abstract:

Rice is staple food in many Asian countries Most of the agriculture process are manual process and this needs to mechanize. Most of the farmers belong to low-income background and cannot afford equipment's due to its high initial investment. In our research work we propose an idea of manually operated paddy transplanter that can transplant paddy when it is being pulled. The machine shall be mainly designed for farmers so as to mechanize the farming process and benefit to the income of the farmer. The project aims to design and fabricate a manually operated paddy transplanter machine for enhancing the efficiency of paddy cultivation. The design incorporates user-friendly features, ergonomic considerations, and an adjustable mechanism to accommodate various paddy varieties and field conditions. The fabrication process involves precision cutting, shaping, and machining of selected materials, ensuring high-quality components. Integration of mechanical systems, including spacing and depth control mechanisms, is optimized for planting efficiency. Safety features are integrated to comply with industry standards. The fabrication process is followed by thorough testing, documentation, and packaging for shipment. The project encompasses user training, post-delivery support, and continuous improvement based on user feedback, aiming to provide a reliable and efficient solution for manual paddy transplantation.

1. Introduction:

In South Asia, there aren't enough workers for farming, especially in places like Odisha where there's not much rain. Farmers need ways to grow rice with fewer people and still plant it on time. One solution is using machines to help with planting. Instead of deep ploughing, farmers can use shallow ploughing, which saves water and makes it easier to plant without machines.They can also use a special nursery system to grow rice seedlings. This way, they'll always have the right plants ready to go when it's time to plant. Using machines instead of manual labour makes things easier, but there are still some problems to solve.

Women do a lot of the hard work on farms, like planting and harvesting rice. Transplanting rice, in particular, is tough and takes up a lot of time. In India, they're trying different machines to help with this, which should make farming easier and less tiring.

In India, farming is a big deal for the economy. With technology always improving, it's important to find better ways to do things. There are two main ways to plant rice: putting seeds directly in the ground or planting seedlings. Planting seedlings has some advantages, like making it easier to control weeds and using fewer seeds. It also means the rice grows faster. But planting seedlings is expensive and needs a lot of workers who know what they're doing.

2. Material description:

Steel pipe a square profile pipe is a type of Mild Steel (MS) made from steel or other materials. It's often used in construction and engineering for its strength and versatility, particularly in applications where a square shape is preferable or necessary for easy handle and weight less. It is mainly used in pulling handle. Flat mm bars these bars are commonly used for structural support for mechanism. Gauge sheet metal 16-gauge sheet metal is a sheet of metal that has a thickness of approximately 0.0598 inches or 1.519 millimetres. It is used for variety of applications such as roofing, automotive body panels, HVAC ductwork, and general fabrication. Angular bar An angular bar, also known as an angle iron or angle bar, is a metal bar that has been bent at a 90-degree angle along its length, forming an L-shape. It is used in wheels support and easy to move in watery soil, it is also used for structural movement. Wheel base a 14-inch wheelbase has been used for movement of the machine and it is connected to chain drive.

2.7. Chain drive:

A chain drive is like a way to pass power from one part of a machine to another. You see it a lot in vehicles like bikes and motorcycles. It's also used in all sorts of other machines. Basically, you have a chain that goes around a gear with teeth. When the gear turns, it pulls the chain, making things move in the machine.

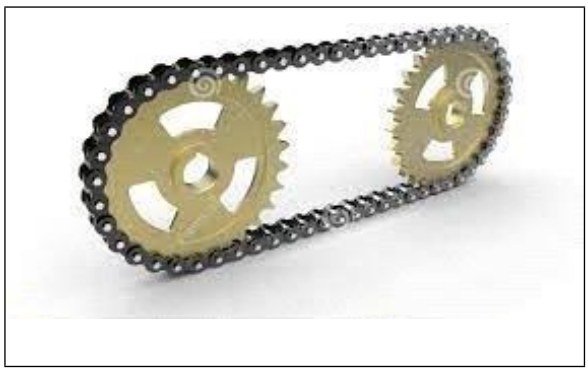

Figure. 2.7: chain drive

In this case, it's used to move power from the wheel part to the planting arm part.

2.8 20 mm shaft:

The 20 mm shaft is used to mount the sprockets. It also serves as a crank rod

3. Working:

3.1. Working principle:

This rice planter needs the worker to pull to start. As it moves, the wheels turn, helping it move through the mud. The wheels also make sure each plant is planted at the right distance from the others. There's a special gear system that makes sure everything moves smoothly. This system helps the planting fingers move faster, making the planting process quicker. The planting fingers are designed to pick up the rice plants easily and plant them in the mud as the planter moves forward. There are many different types of rice planters available, but some can be complicated and expensive because they have lots of parts. Simplifying the design could make them easier and cheaper to use.

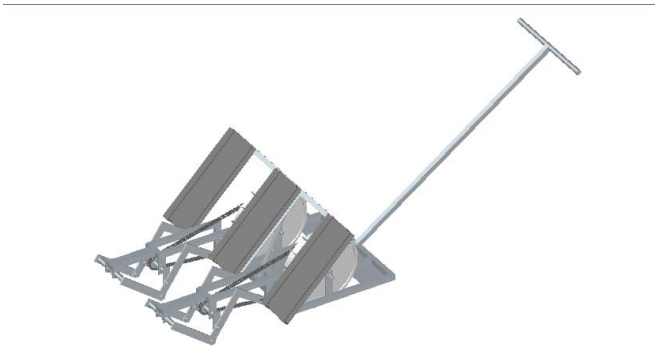

Figure. 3.1.1 3: D Model

3.2. Working procedure:

The machine has a chassis on which all the parts are mounted. The handle of the machine helps to pull the machine. The plant feeder part helps to stack the paddy plants feed it for transplantation. The transplanting arms of the machine operate by the pull provided by the operator. Initially the paddy plants should be stacked into the feeder. Now the machine should be pulled over the field so as to transplant the paddy. When the machine is pulled, the wheels rotate. The crank of the arms also rotates since it is connected by chain drive. The plants are pulls from the stack and planted to the ground. Equal spacing is obtained from chain drive mechanism.

Figure. 3.2.2: Fabricated Model

3.3. Calculations:

Sprocket ratio required: -

$Sprocket\ ratio = circumference\ of\ the\ wheel$

$plant\ spacing\ required$

$=2\pi r$

$= 15$

$2 \times 3.14 \times 14cm$

$= 15cm$

1

$= 5.8$

Sprocket ratio of 1:5.8 should be maintained so as to achieve plant spacing of 15 cm For every 1 rotation of wheel the crank of planter arm rotates 5.8 times

2. Area of field planted in 1 hour: -

Average walking speed of humans in paddy field = 2.09 Km/hr = 2090m/hr

Width of plantation of the machine = 0.6m

Area of field planted in 1 hour =Speed of walking & width of plantation

2090 X 0.6 = 1254m2/hr

1254 m^2 = 0.3 A/hr

4046.8m^2

0.3 Acre/hour (Theoretical value)

Force Analysis: -

F =Wheel Sprocket

O=crank sprocket

OA=crank

EC=Link1 (constrainer)

DBC=Link2 (arm)

E=Fixed point of Link 1

Average pulling force of human (average adult)

250 Newton

This force shall be greater to overcome the Soil stickiness & friction force

The force rotates the wheels so as to drive the mechanism

The 250 newtons shall be distributed between two wheels

Now let us consider one wheel for instance

Force applied at the end of the wheel = 125 N

This force creates 2 torsions at point F

i.e., $T1=F1\times r2$

=125 NX m

(r1 = radius of wheel)

T1=1750N-CM

This is transmitted to wheel sprocket & the wheel sprocket transform the force. F2 to crank O

T1= F2Xr1

(r=radius of sprocket)

$T1=F2\times r2$

1750 Ncm= F2 x 9 cm

F2=194.5N

This force F2 produces torsion of crank shaft. (T3)

$T2=F2\times r3$

T2 = 194.5NX 4.8cm (r3=radius of crank shaft)

T2 = 933.6N-cm

The Force (F3) acts at end point A which moves the arms for planting action.

$T2= OA\times F3$ (OA crank arm length)

933.6 N-cm = 8cm x F3

F3= 116.7 Newton

There are two arms on each crank so

F3=58.35 Newton in force acting on each individual arm.

$= \frac{2}{5}$

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