Design And Fabrication Of Agricultural Land Tilling And Planting Machine

Dr.P.Selvakumar, Dhanishk M, Ashwin V, Arun Kumar P N

Abstract: In Agriculture, before every farming process the first and foremost important step is tilling and ploughing of the land which we are going to cultivate. Our Project will help everyone individually to plough and cultivate crops in their own land and garden. The main objective of this is to design a machine which will do multipurpose work like tilling, ploughing and seed sowing simultaneously, so that it makes work so simple and reduces man power. The idea of our project had arisen from the problems in the existing model. One of the problem is high cost and the other is single functional purpose only. Based on the problems, we got the idea of developing a multipurpose agricultural machine at lesser cost than existing one. We used an Electric Induction motor for driving the shaft instead of Diesel Engine which greatly reduces the cost and avoids the use of fossil fuels. The farming events will occur in a sequential manner like tilling the blades followed by sowing of seeds from hopper and finally hilling of sand by shovel. Since we designed our product with one wheel at front end and two wheels at the rear end, it can be easily portable in all surfaces and gives a tapered look so that it helps in the flowing of seeds. Single man can handle the machine for farming process with less effort and energy.

Index Terms: Wheels, Rotary Blade, J-Blade, Hopper, Shovel, Electrical Power, Hand Brake.

1. INTRODUCTION

India is a land of vast population, where food is the top most need for each and every citizen of it. Indian economy is mainly based on the Agriculture and it will continue to remain so for a long period of time. Due to liberalization and globalization of the Agricultural sector it has been changing the socio-economic environment of the population. About 75% people living in the rural area are still dependent on agricultural foods. About 43% of geographical area is used for agricultural activity. As Indian population is growing continuously, the demand for producing crop per hectare is also increasing. It is unfortunate that, the new ideas are not being implemented properly in actual field. The major fall back in farming is due to various reasons. The major ones are

1. Increase in the cost of gasoline which is the fuel for tractors. Due to this, the cost of cultivating per acre of land has increased and this affects the farmers from earning money so most of them have left cultivation.
2. Unavailability of man power. Since the cost of cultivation had increased, the cost for wage have also increased. This makes the farmers impossible to employ workers.

In order to overcome these two problems, we formulated an idea of manufacturing a cost effective, multipurpose machine that uses electricity for its function instead of natural fuels. The product we proposed will do multi functions at a time. The different works that the product will do are : Tilling, Ploughing, Sowing and Hilling. In market there is a machine available for a single purpose, that is to till the land but it is of high cost. So we planned to construct a cost effective machine that can perform multiple tasks.

- *Dr.P.Selvakumar is Associate Professor in Department of Mechanical Engineering, Kongu Engineering College, Erode, India.*
- *E-Mail ID:selvakumar@kongu.ac.in*
- *Dhanishk M is currently pursuing bachelor of engineering in Department of Mechanical Engineering, Kongu Engineering College, Erode, India. E-Mail ID: dhanishkm.16mech@kongu.edu*
- *Ashwin V is currently pursuing bachelor of engineering in Department of Mechanical Engineering, Kongu Engineering College, Erode, India. E-Mail ID: ashwin33v@gmail.com*
- *Arun Kumar P N is currently pursuing bachelor of engineering in Department of Mechanical Engineering, Kongu Engineering College, Erode, India.*
- *E-Mail ID: thokaiarun9899@gmail.com*

2 PROBLEM DEFINITION AND OBJECTIVE

2.1 Problems in the existing system:

- The cost of ploughing the land and the wages for man power.
- Individuals may get hurt while working with hand tools and suffers pain.
- In order to use hand tools, people needs high physical strength to work in the land and may get tired once the work is done.
- Usage of fossil fuels which causes global warming.
- More consumption of time in doing various works separately.
- Usage of seed increases the damages caused by insects like ant, grass hopper and rodents etc., and also prevents the seeds from birds.

2.2 Objective of the Fabricated system:

By analysing the above problems and the literature reviews we designed our product with the following objectives:

- The main objective is to design a multi-purpose agricultural machine
- To reduce the requirement of man power and the need for cost involved in employing workers.
- To reduce the time consumption during multiple tasks of farming.
- To improve the productivity rate of the crops.
- To reduce the planting time.

3 COMPONENTS AND DESCRIPTION

The major parts that are involved in the seed balls sowing machine are briefly discussed below:

A. Rotavator Blades

Rotavators are mostly available at a working length of 1.20–1.80 m and are ideal for 45 hp and above tractors. In addition, rotavator may have the shape of ' L, ' shape of ' C, ' shape of ' J, ' hook tines or straight knife blades to suit different operating conditions. It is a complex mechanical device used by a set of blades to plough the ground that are used to churn the dirt. The soil texture will be a result of soil conditions, blade geometry,

and soil flow dynamics when a tillage operation is conducted in the field. Depending on the soil conditions, blade geometry and speed ratio, blade back and uncut soil interference can result in severe soil compaction and high power consumption. On all flanges, except the stub axle flange (RH end flange), Blades are bolted to the left of the each flange, with left hand blade leading. Only the cutting edges of the blade make contact with the soil whereas the back surface is free from the soil. The blades are so designed that use in average soil keeps them sharp. The efficiency of the blades should be determined largely by the condition of blades. If they are left bend or distorted the striking the solid obstacles in the ground and are not straightened, they will require double the power to drive, the quality of work is poor and the blade will wear much more quickly. Trouble will also arise with clogging under the shield.

***Fig.1**. Rotovator Blades*

B. AC Motor

An AC motor is an alternating current (AC) electric motor. The AC motor is commonly made up of two basic parts, an external stator with alternating current supplied coils to generate a rotating magnetic field, and an internal rotor connected to the output shaft to create a second rotating magnetic field. Permanent magnets, reluctance saliency, or electrical windings of DC or AC may produce the rotor magnetic field. The induction motor (or asynchronous motor) is always based on a small difference in frequency between the spinning magnetic field of the stator and the speed of the rotor shaft called slip to cause rotor current in the AC winding of the rotor. As a result, the induction motor cannot produce torque near synchronous speed where induction (or slip) is irrelevant or ceases to exist.

C. Pulley

A pulley is just a set of one or more wheels this you loop a rope over to make moving things easier. Pulleys are examples of what are called simple devices by scientists. That doesn't mean they're filled with engines and gears; it just means they're helping us multiply strengths. If you want to lift a really heavy weight, your muscles can only provide so much strength, even if you are the strongest man in the world. But use a simple machine like a pulley and you can calculate the force that your body produces effectively. A pulley is a simple machine consisting of a string (or rope) wrapped around a wheel (sometimes with a groove) with one end of the string attached to an object and the other end attached to a person or a motor. Pulleys may seem simple, but they can provide a powerful mechanical advantage so lifting tasks may be done easily.

D. Hopper

In any bulk solids handling installation, Hopper is one of the most critical equipment pieces, as a poorly flowing hopper can have consequences that reach throughout the facility. All too often hoppers are ' squeezed in ' after the rest of the process has been built, which can lead to numerous flow issues, such as those generally described as ' arching ' or rat-holing. Clearly, if this happens, due to the unpredictable supply of material, even the most advanced and costly equipment downstream of the hopper is unable to work effectively. Part of the problem is often a lack of appreciation by designers and operators that, for a system to operate satisfactorily, bulk solid must flow from the hopper when required and in a predictable manner. Thus, as with any other part of the handling system, gravity-flow storage hoppers should be designed or selected to handle the actual product under consideration.

***Fig.2**. Hopper*

E. Shovel

A shovel is a tool to dig, raise, or move bulk materials such as dirt, coal, gravel, snow, sand, or rock. Most shovels are hand tools consisting of a large blade connected to a medium-length handle. Typically shovel blades are made of sheet steel or hard plastics and are very solid. Normally shovel handles are made of wood (especially ash) or glass-reinforced plastic. Usually hand shovel blades made of sheet steel have a folded seam or hem on the back to make a handle socket. This fold often generally gives the blade extra stiffness. Usually the handles are riveting in place. Because of comprehensive mechanization, such as bulldozers and other machinery, the science of shoveling [that is, hand shoveling] has long since mostly died out of commercial interest. Once again, humans are mostly able to let one coal scoop handle different bulk materials of varying densities. But there is still a huge existing shovel market as shovels are still needed for precise manual work, where excavators are unable to reach.

Fig.3. *Shovel*

4 DESIGN AND CALCULATION

A. Design

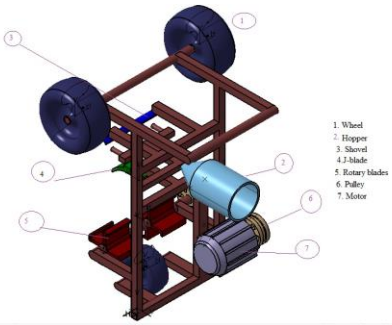

Fig.4. *3-D Model*

B. CALCULATION

i). Design calculation of pulley

1.1st Pulley outer diameter = 125 mm

2.1st Pulley inner diameter = 14±1 mm

3.2nd Pulley outer diameter = 17.5 mm

5. $$\frac{\text{Outer diameter of large pulley}}{\text{Outer diameter of small pulley}} = \frac{\text{Speed of large pulley}}{\text{Speed of small pulley}}$$

$$\text{Outer diameter of small pulley} = \frac{125}{7.2}$$

$$\text{Outer diameter of small pulley} = 17.3 \text{ mm}$$

4.2nd Pulley inner diameter = 10 mm

ii). Design calculation of motor

1.Initial Speed of Motor = 1440 rpm

2.Diameter of Motor Shaft = 14 mm

4. $$\text{Speed of Motor} = \frac{(2 \times 60 \times \text{frequency})}{\text{Number of poles}}$$

$$= \frac{(2 \times 60 \times 50)}{4}$$

$$= 1440 \text{ rpm}$$

3.Power of the Motor = 1 hp

5. $$\text{Load } P_i = \frac{(v \times I \times P_f \times \sqrt{3})}{1000}$$

$$= \frac{(415 \times 1.91 \times .72 \times \sqrt{3})}{1000}$$

$$P_i = 0.988 \text{ kW}$$

6. $$\text{Efficiency} = \frac{(0.75 \times Hp \times Load)}{P_i}$$

$$= \frac{(0.75 \times 1 \times .988)}{.988} \times 100$$

$$= 75\%$$

7. $$\text{Torque of Motor} = \frac{(Hp \times 5252)}{\text{Speed}}$$

$$= \frac{(1 \times 5252)}{1440}$$

$$= 3.96 \text{ N-m}$$

8. $$\text{Watt} = \text{volt} \times \text{amps}$$

$$= 220 \times 1.91$$

$$= 420 \text{ W}$$

iii). Design calculation of blades

1.Speed of the Blades = 250 rpm

2. Blade

For Tiller Blade,

v = 40 to 60 cm/sec

N = 150 to 300 rpm

Relief angle $\gamma = 20^o$ to 30^o

Specific work of tiller blade

C_o = Relative co-efficient of Soil type

K_o = Specific strength of soil (kg/dm^3)

$A_o = 0.1 C_o K_o$ For Heavy Soils, $C_o = 2.5$

K_o = 50 (kg/dm^3)

$A_o = (0.1 \times 2.5 \times 50)$

A_o = 11.25 (kg/dm^3)

Depth of working,

H = C + ((cosβ)/2)

C = 35 mm (inclined position) ;

$\beta = 61^o$

H = 35 + ((cos 61)/2)

H = 42 mm

Length of blade = 130 mm

Width of blade = 50 mm

Thickness of blades = 3mm

iv). Design calculation of shaft

1.Diameter of Shaft carrying Blades = 23 mm

2.Diameter of Shaft carrying Blades

T =

T = 37.75 N-m

T

$\tau \times (\Pi/16) \times d^3$ d = 23 mm.

$$\text{Power} = \frac{2\pi NT}{60}$$

$$= \frac{P_i \times 60}{2\pi N}$$

$$= \frac{(988 \times 60)}{(2 \times 3.14 \times 250)}$$

$$\tau = 1.627 \times 10^7 \text{ Pa}$$

$$= \tau \times \frac{\pi}{16} \times d^3$$

$$37.75 = 1.627 \times 10^7 \times (\frac{3.14}{16}) \times d^3$$

5 PROPOSED SYSTEM

The machine consists of 1hp AC motor which gets supply from the current directly through wires. Since we are using AC motor there isn't a need for the installation of battery, this helps the machine with less weight. The motor shaft is connected with pulley. The rotary blades are fitted in the flange, each flange is connected with 4 blades. This flange is inserted into a shaft and at the end of the shaft another pulley which is of large diameter is connected. The two pulleys are connected through the belt drive. When the electric current supplies current to the motor then the shaft rotates and this causes the pulley to rotate and the belt in the pulley transmits this power to the another large pulley and transmits the power to the shaft thus causing the rotational motion in the shaft and makes the blades to rotate.

FIG.5. FABRICATED MODEL

A. Working Principle

First the seeds are fed into the hopper and we need to ensure that the hopper is closed at the bottom through the pressing of brakes. Then the motor is powered through the current supply and the pulleys are rotated and transmit the power to the shafts carrying blades and when this blades hit the ground then softens the soil. Then the J-Blade in the middle ploughs the land suitable for sowing. Now when the machine is given motion the hopper is opened and the seeds starts to fall in the ploughed land. The shovel make sure that the seed is closed with sand by moving the sand along with the shovel.

B. Advantages and Application

- Compactness.
- Less Maintenance is enough.
- Higher efficiency.
- Effective processing.
- Zero fuel cost.
- Reduced man power.

It can be applied in the agricultural field for the cultivation of various crops like Groundnut, Corn, Soya Beans.

6 CONCLUSION

AGRICULTURAL LAND TILLING AND PLANTING MACHINE is designed and fabricated and it is working satisfactorily. As mentioned earlier it will greatly reduces the need for man power and functions in an efficient way. This system will help the farmers in cultivating the crops in the respective farm fields with eco-friendly planting of seeds and in an easily accessible manner. It also reduces the time consumption for plantation of crops and results in an increased productivity rate. The cost of the plantation is greatly reduced by using this system in comparison with conventional methods. In this machine, there is no use of fossil fuel like Petrol, Diesel, Coal etc., Hence, this machine is pollution free. Thus this system is flexible for the farmers to keep this whole setup in a minimum space. By using more techniques, this system can be advanced and developed according to the requirements of the Farmers.

REFERENCES

[1] Achyut S Raut, Akshay T Agalave, Sanket S, Kelaskar Rahul B, Mane Ravindra R Sutar., (2016) "Design and Fabrication of Single Axle, Self-Propelled Multi Attachment Agricultural Machine" VOL.4 pp.21-31.

[2] Amardeep Singh Kanga, Gurjinder Singha, Gurmeet Singh Cheemaa., (2017) “Improving wear resistance via hard facing of cultivator shovel” VOL.4 pp.91-99.
[3] Golden Renjith Nimal R.J, M.Ajmal Ali Khan.,(2017) “Design and Fabrication of Agricultural Cultivator” VOL.116 pp.509-514.
[4] Kumar S, Mishra B P, Patel S K., (2014) “Design and development of a power tiller operated seed-cum-ferti till-drill-machine” VOL.9 pp.776-781.
[5] Minsung Kim and Jintai Chung., (2018) “Dynamic analysis of a pulley-belt system with different pulley radii and support stiffness” VOL.32 pp.597-613.
[6] Ramesh Kumar D and Mohanraj P., (2017) “Design and Analysis of Rotavator Blades for its Enhanced Performance in Tractors” VOL.1 pp.160-185.
[7] Subrata Kr. Mandal, Basudeb Bhattacharyya, Somenath Mukherjee, Priyabrata Chattopadhyay., (2013) “Design & Development of Rotavator blade: Interrogation of CAD Method” VOL.1 pp.439-447.
[8] Tharoon T, Tharanitharan G, Tamilselvam P, Aravind Raj A., (2017)“Design and Fabrication of Rotary Tiller Blade” VOL.4 pp.56-72.