Design and Fabrication of Paddy Weeder with Fertilizer Feeder

Vinay D R
Department of Mechanical Engineering, New Horizon College of Engineering, Bengaluru, Karnataka, India

Praveen S B
Department of Mechanical Engineering, New Horizon College of Engineering, Bengaluru, Karnataka, India

Abstract – In this modern era research in the agricultural field is going on. Day by day the population of India is increasing and to fulfill the need of food, modernization of agricultural sectors is important. Mechanization gives higher productivity in minimum input. Farmers are using same traditional methods. Paddy is one of the major crops grown in India. The problems in paddy cultivation are availability of labors, low productivity rate and more manual efforts required for fertilizer feeding and weeding. For paddy cultivation, more time is required because of fertilizer feeding and weeding processes. For reducing these problems design and fabrication of paddy weeder with fertilizer feeder is done.

This is an agricultural equipment which is useful for farmer, this equipment is known as weeder with fertilizer feeder. This machine is designed first in solid edge and then fabricated. The weeder will remove weeds between two rows. It will remove multiple weeds in less time along with this fertilizer are uniformly distributed to each crop through dispensers, so two operations are completed simultaneously. Therefore, it reduces the manpower, labour cost and also time.

Index Terms – Agriculture, Paddy, Weeder, Feeder, Fertilizer.

1. INTRODUCTION

India is agriculture-based country. Our economy also depends on agricultural products. Nowadays tremendous changes have occurred in conventional methods of agriculture like seed plantation, irrigation system, pesticides and spray used. For developing our Economic condition, it is necessary to increase our agricultural productivity and quality. Majority of the Indian population depends on agriculture and agro-based industries and businesses.

In Indian agriculture paddy cultivation is one of the main commercial crop. Rice is one of the chief grains of India. Rice is the basic food crop and being a tropical plant, it flourishes comfortably in hot and humid climate. Rice is mainly grown in rain fed areas that receive heavy annual rainfall. Rice is the staple food of eastern and southern parts of India.

Rice can be cultivated by different methods based on the type of region. Rice grows on a variety of soils like silts, loams and gravels. It can also tolerate alkaline as well as acid soils. However, clayey loam is well suited to the raising of this crop. Actually, the clayey soil can be easily converted into mud in which rice seedlings can be transplanted easily. Proper care has to be taken as this crop thrives if the soil remains wet and is under water during its growing years. Rice fields should be level and should have low mud walls for retaining water. In the plain areas, excess rainwater is allowed to inundate the rice fields and flow slowly. Rice raised in the well-watered lowland areas is known as lowland or wet rice. In the hilly areas, slopes are cut into terraces for the cultivation of rice. Thus, the rice grown in the hilly areas is known as dry or upland rice. Interestingly, per hectare yield of upland rice is comparatively less than that of the wet rice.

1.1 Mechanical Weeding

Mechanical control is the use of powered tools and machinery to manage weeds. It is suitable for larger infestations because it reduces the weed bulk with less manual effort. Mechanical control consists of methods that kill or suppress weeds through physical disruption. Such methods include pulling, digging, disking, plowing and mowing.

Figure 1.1: Picture of Mechanical Weeding Method

1.2 Manual Weeding

Manual control is the use of the hands or handheld tools to deal with weeds. Extensive amount of cheap manual labor is necessary for manual weeding. Manual weeding is commonly employed by smaller Indian framers for weed removal.

Figure 1.2: Picture of Manual Weeding Method

1.3 Weeder

A weeder is a mechanical implement used in agriculture primarily to suppress and control the amount of pest weeds in cultivated field, which can be operated by one or more operator and it moves in a straight line.

1.4 Fertilizer Spreader

It is based on motion of ground wheel using gear arrangement. The flow of fertilizer is maintained by using spring mechanism. It is a machine for spreading the fertilizer in continuous and controlled flow at uniform rate. It can cover an acre of farm within half an hour. Three wheels are used in this machine. In front axle two wheels are located to carry the load of the machine in proper way and last wheel is used to balance overall load of the machine. First two ground wheels transmit the input power by the operator to the rotor by gearing arrangement. On rotor, Hooper is located to reservoir of fertilizer, of which flow is controlled by spring mechanism. The control of spring mechanism is under control of operator. This machine is operated is operated using a motion of ground wheel through gear transmission arrangement.

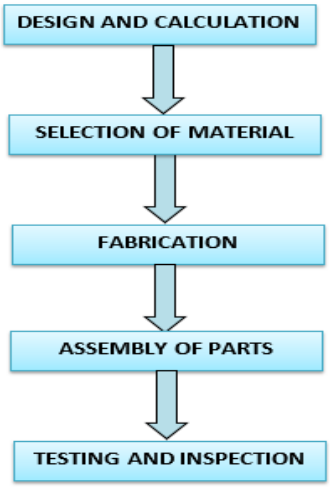
1.5 Problem Discussion

In the recent days it has been found that farmers are unable to gain more crop production by use of conventional agricultural methods. From the survey we found major reasons for lack of productivity are weeds and uneven distribution of fertilizers. So, there is big need for the development of engineering system for compensating these drawbacks. It is well known that by using farm equipment's, farmer's yields more crop productions which ultimately have impact on national economy. As we can see today, the major problem faced by the farmers is shortage of labors and also the time required for fertilization and weeding is more. So, in order to have solution to it, a model fabricated which do the both operation that is weeding and feeding of fertilizer simultaneously. So, the farmers can work more easy and functional.

2. EXPERIMENTAL DETAILS

2.1. Methodology

The methodology is the processes that is followed to complete the work. By looking at the methodology one can understand the process involved in the fabrication process of machine. The methodology followed for the fabrication of equipment is shown in below flowchart.



Initial step is the collection of data about paddy cultivation and problems faced by the farmers during paddy cultivation. Then designed an equipment for removal of weeds and equal distribution of fertilizers in the paddy field as per the collected data and calculations made.

Next process is the selection of material which is suitable to use in paddy field and having some good mechanical and physical properties like high strength, weight and easily machinable and formable. Later proceeded to the fabrication of each and every part. After completing the fabrication and assembling process testing of the equipment is done.

Weeder is the weed removing machine in agricultural field which consists of weeding wheel and sharp blades are located on its cylindrical surface. This equipment also consists of fertilizer dispenser which is circular in shape and consists slots on it, as it rotates it takes fertilizer from container and dispenses it to the crops. Design of weeder with fertilizer feeder requires following components.

2.2. Main Wheel

It is the primary component of our machine. It moves with the help of manual force. Rotation of this wheel causes working of entire operations of machine. By this wheel only it is possible to give proper direction of movement for our machine. Since it needs to be strong it is made up of mild steel.

2.3. Dispenser Plate

It is used to dispense the fertilizer from main container to the exit container. It operates due to the rotation of main wheel, as it is connected to main wheel through chain and sprocket. It has two dispensers which is housed inside the container. Each dispenser has 4 slots. These slots are made by drilling and milling process and has central 15 mm diameter of hole for the mounting purposes. The material used for dispenser plate is mild steel.

2.4. Container

Containers are used to store materials, either of solid, liquid or gas. It is possible can design the container as per our requirements like size, pressure, volume etc. Design of container depends upon state of the material and properties. In this work, container used for two purposes one for storage to hold fertilizer in it, the other use is for housing of the dispenser plates. These are mounted on the shaft and housed inside the container. The whole assembly of container consists of two parts namely main container and exit container. Exit container attached to main container through welding work. It is Design in such a way that its bottom part has a hollow pipe projected towards crops. It is further extended by flexible plastic pipes. It has guide way for the fertilizer to reach the crops. Material used for the container is mild steel.

2.5. Weeding Wheel

It is the type of wheel with sharp edged blades on its circumference. It is used in paddy cultivation to suppress and control the number of weeds in field which can be operated by one or more operator and it moves in a straight line.

Weeding wheel is a part of paddy weeder, which will be in contact with the soil. As the weeder (machine) moves forward, the weed plant which will come in contact with cutter, will be cut into pieces. Due to motion apply to the main wheel, the cutter blade experiences couple and this causes the weeder wheel to rotate. It is attached in the required position by vertical and inclined supports. The material used for weeder wheel is mild steel.

2.6. Supporting Wheel

Supporting wheels are type of wheels which is used to support or balance the entire equipment. In the absence of supporting wheel it is quite difficult to balance the equipment. In this equipment supporting wheel is the small made up of plastic & it is attached to rare side of equipment. It has two advantages, one is for balancing and other one is to adjust the height of the weeder wheel from the ground level.

2.7. Sprocket and Chain

For the transmission of power from one shaft to another shaft sprocket and chain drives are used. The chain and sprocket used is of motorcycle. The chain sprocket is coupled with another shaft. Since drive sprocket and driven sprocket are connected by chain the rotation of drive sprocket is transmitted to driven sprocket. As driven sprocket and dispenser plate are mounted on same shaft this helps to transmit rotational motion of main wheel to dispenser plate.

3. DESIGN OF PARTS

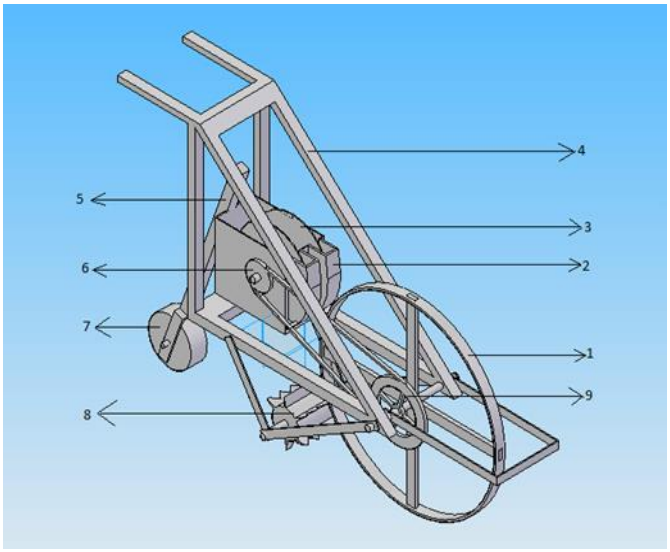


Figure 3.1 CAD Model

1. Main Wheel, 2. Container, 3. Dispenser plate

4. Frame, 5. Support wheel holder, 6. Driven sprocket

7. Support wheel, 8. Weeder wheel, 9. Drive sprocket

3.1 Wheel

This is made out of mild steel flat being cut from the size of 25mm x 6mm of length 1570mm, hammered for flattening and then bent to the circle shape by manual process and joined by arc welding to make the circle with outer diameter of 500mm, another two flats are cut from the size of 25mm x 6mm of length 490mm—2nos, hammered for flattening and then marked for the center hole of 15mm and drilled to have the center hole and then welded to the circle to make the wheel as per the requirement on which the axle is inserted and welded.

3.2 Support Wheel Holder

Support wheel vertical holder guide is made out of mild steel pipe cut from the size of 30mm x 30mm of length 100mm and ground at both the ends to remove the cutting burr and welded on the base frame and used in this as support for wheel holder guide in which the support wheel holder is inserted.

Support wheel holder is made out of mild steel pipe cut from the size of 25mm x 25mm of length 250mm and ground at both the ends to remove the cutting burr and then flats of 20mm x

5mm are cut for the lengths of 135mm and hammered for flattening and then marking for the hole drilling to insert the 10mm axle into it to hold the support wheel and then bent to the shape to be able to hold the wheel with width of 35mm and welded to the pipe to make it as wheel holder.

3.3 Frame

This is made out of mild steel pipe being cut from the size of 20mm x 20mm of length 800mm—2nos, 440mm---2nos, 530mm—2nos. all are ground at the ends to remove the cutting burr and then 800mm pipe are marked for the bends and then partial cutting is done and then bent to the required shape as per the sketch and then joined by arc welding to make the frame and joined by the vertical supports and handle. This frame is welded with the wheel holding axle and dispenser assembly is welded on this frame as per the requirement.

3.4 Axles

Drive axle: This is made out of C30 steel round bar being cut from the diameter of 20mm of length 205mm and then turned on lathe machine to make the diameter as 15mm to suit the ball bearing inner diameter for the entire length and then faced from both the sides to make the total length as 200mm.

Support wheel axle: This is made out of C30 steel round bar being cut from the diameter of 12mm of length 50mm and turned on lathe machine to make the diameter as 10mm for the entire length and faced and used in this work to hold the support wheel in this axle.

Driven axle: This is made out of C30 steel round bar being cut from the diameter of 25mm of length 205mm and then turned on lathe machine to make the diameter as 20mm to suit the ball bearing inner diameter for the entire length and then faced from both the sides to make the total length as 200mm.

3.5 Dispenser Plate

This is made out of mild steel plate cut from the thickness of 5mm by gas cutting for the diameter of 205mm and turned on lathe machine to make the diameter as 200mm and center drilled and bored to make the hole diameter as 20mm to suit the axle diameter. Such two number of plates are turned. Then it is marked on circumference and milled to make the slots for the depth of 10mm at four places equi-distance on the circumference of both the plates. These two plates are welded from both the sides with the support plates as per the requirement.

3.6 Drive Sprocket

This is a standard sprocket being used in motorcycle which is made of C30 steel with the outer diameter as 185mm with inner diameter as 44mm with 44 number of teeth which is matching to the chain. Such one sprocket is bought from market and bush is made and press fitted and welded to this sprocket

3.7 Ball Bearings

10mm inner diameter ball bearings are the standard roller ball bearings of outer diameter 27mm, inner diameter 10mm, of thickness 8mm, such two number of ball bearings are used.

20mm inner diameter ball bearings are the standard roller ball bearing of outer diameter of 42mm and thickness 10mm, such two number of bearings are used in this work.

3.8 Container

Dispenser container this is made out of CRCA steel sheet of 1.5mm thick being cut to the shape and joined to make the rectangular container in which the plates assembly are held. At the side walls drilling is done to be able to insert the axles into this and ball bearing housings are welded on this container and then ground to remove the welding burr.

Dispenser exit container is made out of CRCA steel sheet of 1.5mm thick being cut for the shape and joined to make the exit container as per the requirement and then slots are made to be able to fix the exit ports on this and then welded by arc welding and this exit container is joined with the dispenser container and ground to remove the welding burr.

3.9 Weeder Wheel

Weeder wheel side support is made out of mild steel flat being cut from the size of 25mm x 6mm of length 350mm-2set, hammered for flattening and are used as side support.

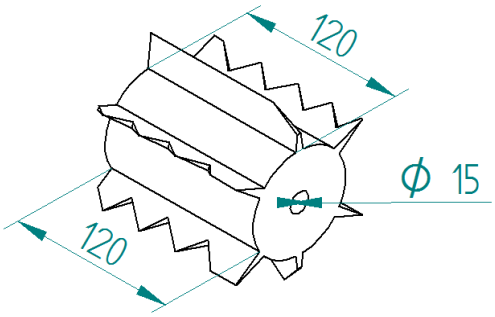


Figure 3.2 Sketch of Weeder Wheel

Weeder wheel vertical support is made out of mild steel flat being cut from the size of 25mm x 6mm of length 200mm---2nos, hammered for flattening and then are welded to the weeder wheel holding supporting vertically. Such two flats are welded by arc welding and ground to remove the welding burr.

Weeder flap plain is made out of mild steel sheet, 2mm thick being cut for the size of 45mm x 120mm--2nos, hammered for flattening and then marked for the taper cutting as per the requirement and cut by using chisel and ground to remove the cutting burr and hammered for flattening and equi-spaced is welded on the weeder wheel drum to make it as weeder wheel.

4. CALCULATIONS

4.1. Container Calculation

Container dimensions are,

Length L = 0.175m,

Width, B = 0.15m

Height, H = 0.08m

Volume of the container = L×B×H

$= 0.175 \times 0.15 \times 0.08$

$= 2.1 \times 10^{-3}\ m^3$

4.2. Dispenser Plate Calculation

Distance of dispersion = 116mm.

Here it has 4 slots,

Therefore, Perimeter of dispensers = 4×116

P = 464 mm

Radius of dispenser, $P = 2\pi r$

$r = P/2\pi$

$r = 73.88\ mm \approx 74\ mm$

Diameter of dispenser = 2× 74 = 148mm

4.3. Weeder Wheel Calculation

This made up of 2 mild steel plate of 2 mm thickness being cut and turned to make diameter as

The wheel is of 500 mm diameter.

Travel distance per rotation of wheel = $2\pi r$

$= 2 \times \pi \times 250 = 1571\ mm$

4.4. Gear Ratio

As we need drive sprocket to be bigger than driven sprocket,

No. teeth in drive sprocket (bigger) = 44 teeth

No. teeth in driven sprocket (smaller) = 14

Therefore, gear ratio of these two sprockets = 44/14

Gear ratio = 3.143

From the above gear ratio, it is known that, for every rotation of main wheel dispenser plate completes 3.13 rotations.

5. WORKING PRINCIPLE

Initially this machine starts moving in the paddy field that is between rows of paddy plantation. For this process to happen the main wheel must rotate, and it is connected to drive sprocket, this rotates drive sprocket in same speed as that of main wheel. This in turn is connected to driven sprocket. Driven sprocket and dispenser plate are mounted on same axle this makes dispenser to rotate. Dispenser plate housed inside the dispenser tank which carries fertilizers, while rotating it carries fertilizers and drops it in exit container. From exit container it directly reaches the crops through pipes connected to it.

As the main wheel moves forward the weeder wheel which touches the ground or field, experiences couple. Each blade of weeder wheel experience couple which makes it to rotate. While it is moving forward it cuts the weeds between two rows of crops. Thus, equipment works efficiently.

Figure 5.1 Complete Assembly of Model

6. RESULT AND DISCUSSION

Parameter	Manual method	Through this machine	Percentage time saved
Time taken for weed removal per person	20 hours	3 hours	70.83%
Time taken for fertilizer distribution per person	1hour	-------	100%

Table 6.1 Time Comparison Between Manual Method and Using Machine

Parameter	Standard (grams)	Using machine (grams)	Difference (grams)
Amount of fertilizer fed per crop	3	3.28	0.28

Table 6.2 Result of Fertilizer Feeding

In traditional method of weed removal process for a person per acre it takes around 20 hours and for fertilization it takes another 1 hour. In our machine it takes around 3 hours to complete the weeding of an acre land and it completely saves time for fertilizer spreading. This machine ensures the uniform feeding of fertilizers to each crop that is 3grams to each crop and it can be adjustable as for our requirement. It is time saving and economical machine as it performs two tasks at same time.

7. CONCLUSION

As study says that in our country about 70% of population lives in villages & their mainly income depend on the agricultural source. Hence the prominent aim of this work is to complete the weed removing and fertilizer spreading in same time.

The above topic shows the details of agricultural technology, this machine can be used to reduce labour cost and time of a middle class and small sector farmers. This is the little effort to make comfort to farmers also this machine is manufactured in less cost as compared to other machines. The result from this work outcomes are assurance of much efficiency, less time consuming, worker friendly machine respective to the conventional method of weeding. It assures the maximum work done with minimum work effort. It has solved the problem of traditional way of Fertilization.

All the manufacturing process are carried out with the great concentration; any wrong calculation may have result in the failure of model. And this equipment saves the fuel for the larger extent because here we don't use any fuel for its working. At the same time environment pollution can also be reduced. Thus, aiming to save the revenue of government & also most demanded fossil fuel.

REFERENCES

[1] Rajshekar M "Simulation and Analysis of Low Cost Weeder" *International Journal of Research in Engineering and Technology* eISSN: 2319 pISSN:2321-7308, Volume: 03 Special Issue: 03|May-2014|NCRIET (2014).

[2] A.O Hannure, S.P Ksheer Sagar, V.S Kodam, O.N Pathange "Literature review on automatic seed feeder*". International Journal of Engineering Trends and Technologies*, Volume 36, No7, 2016.

[3] Mane Deshmuk Vijay "Design & fabrication of agriculture weeder" *International journal of innovation in engineering research & technology*, Volume03, Issue 03, 2016.

[4] HP Pathade, Priya Shinde, Nilesh Magar, Sainath Mundaware "Multipurpose weeding machine". *International Journal of Multidisciplinary Research and Development*, Volume :2, Issue :4, 402-405, April 2015.

[5] Roshan V Marode1, Gajanan P Tayade1 and Swapnil K Agrawal1 "Design and implementation of multi seed sowing machine". *International journal of mechanical engineering and research*, ISSN 2278 – 0149 www.ijmerr.com Vol. 2, No. 4, October 2013.

[6] Narode, Sonawane, Mahale, Nisal, Chaudhari, Bhane "Manually Operated Fertilizer Spreader". *International Journal of Emerging Technology and Advanced Engineering*, ISSN 2250-2459, ISO 90001: 2008 Certified Journal, Volume 5, Issue 2, February 2015.