

Fabrication of Multipurpose Agricultural Tiller

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Abstract: *The main objective of the project is development and fabrication of a multipurpose agricultural tiller which will perform a wide range of operations such as rotary, ploughing, seeding, pesticide spraying, harvesting, weeding at a reasonable cost to overcome the challenges faced by the farmer. The multipurpose agricultural tiller has been fabricated on a rigid chassis frame which holds a universal shaft on which rotary and wheels can be mounted. This universal shaft derives 8 BHP of power from a 4-Stroke IC engine placed firmly on the chassis frame. The mechanism used is such that the same engine drives the wheels, rotavator, harvester, pesticide sprayer, seeder, leaver, plough and trolley. The reciprocating motion provided to the harvester cuts the crop precisely, consuming less time as compared to conventional techniques of harvesting. A power sprayer is used which will facilitate spraying of pesticide at different heights of crop cultivation. A multi-way adjustable plough is also used whose position can be adjusted on a slide through frame according to the requirement of the farmer. A multi variety seeding operation is also setup. Multipurpose agricultural tiller can be easily afforded by average and marginal class of farmers.*

I. INTRODUCTION

Very lengthy and time consuming work of farming causes the farmer to face a lot of burdensome situations every day. A farmer has to face a number of stumbling blocks like unavailability of labor which is a root of industrialization. The accessible labors demand much higher fee. The efficiency and the quality of the work by these labors are not much appreciable. On the other end the hiring and purchasing farming equipments, viz. tillers, cultivators, tractors and their attachments, pesticide sprayers., is a big-budget for an average land holding farmers. In India only 10 to 20% of farmers are rich but the remaining farmers cannot afford these equipments. Due to these difficulties significance is given towards modernizing the agricultural.

The outcome of this project is the added significance to today's modern farming. The aim is at providing access to farm equipments at a much reasonable price. And to make an average or marginal class of farmers to be able to take up advanced farming technology over conventional techniques being used currently.

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“Multipurpose agricultural tiller” is single farming equipment with attachments. So that a farmer can use this single machine right from tilling and preparing seedbed till the harvesting of the crops. The operations it can carry out are comparably more than the tiller which is available in the market. And it prices 60 percent less than the tiller. The performed operation includes transportation of goods, rotary, ploughing, drives paddy wheels, seeding, leveling pesticide spraying, weed removing and harvesting. Assuring to the future scope the multipurpose agricultural cultivator can performing 10 operations.

II. CONSTRUCTION AND OPERATION RESULTS

Multipurpose agricultural tiller has rigidly constructed structures with attachments that are not more less than the any available tiller when comes to the strength and stability. Its components are as follows.

- A. Chassis frame
- B. Engine and Transmission
- C. Handle
- D. Universal shaft
- E. Rotavator
- F. Adjustable frog plough
- G. Leveler
- H. Seed sower
- I. Pesticide sprayer
- J. Weeder
- K. Harvester

A. Chassis frame

A rigid chassis frame is fabricated to provide required support and strength to the model. The frame is developed in such a manner that it occupies lesser floor space and adds up less weight to the complete model. Mild steel hollow bars and plates are utilized in the fabrication of the frame in order to provide more strength. The engine can be mounted upon this frame so that the entire load acting is directed towards the wheels and keeping it well balanced. To this frame the frog plough can be attached with the aid of fasteners in the rear end. And in the front harvester along with its attachments can be mounted. The pesticide sprayer, pump and seed sower can be bolted. All these attachments are of temporary usage and can be detached from frame when not in use.

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B. Engine and Transmission

The Multipurpose Agricultural Tiller runs by a 4 stroke IC engine. The engine churns out enough power and torque to run the whole setup. The engine used in this project is a Honda Activa 110cc engine. The petrol engine used can be started either by self-switch starter or by kick start. A 12V battery is used for the purpose of starting the engine. Two types of control switches are being used. One is a toggle switch through which the whole circuit can be energized or de-energized. Another is ignition switch which is to crank the engine. A 14 teeth sprocket is keyed to the engine output shaft and it is a driving shaft. The endless chain runs over the driving sprocket and transmits the rotary motion to the driven sprocket which is having 24 teethes and is mounted on the universal shaft using a rectangular key arrangement. The transmission speed can be adjusted by throttle lever. The engine specification is tabulated below.

Table I: Engine Specifications

Particulars	Specifications
Engine displacement	109.2CC
No. of cylinders	Single cylinder
Max Power	8BHP @ 7500rpm
Max Torque	8.83Nm @ 5500rpm
Valves Per Cylinder	2
Fuel Delivery	Carburetor
Starting Mechanism	Self / Kick start

C. Handle

An adjustable handle is being equipped that can be moved along the guides provided in the chassis frame. It can be locked at the required position. The handle bar is designed by using the law of lever so that the entire weight is balanced upon the wheels. This also favors the person gripping the tiller to control it effortlessly. The toggle switch, ignition switch and the throttle controller is made accessible by the driver at the edge of his fingers. The handle is designed by using hollow mild steel rods which are raised at an angle of 30 degrees from a height of 1.7 feet from the ground so that the arms witnesses stress free.



Fig 1: Assembly of chassis frame and engine with all other attachments.

D. Universal shaft

The name universal shaft is given to the driven shaft for its compatibility with different rotating attachments, viz. tire wheels, rotavator and paddy wheels. It is a mild steel shaft

which is driven by an endless chain. The shaft is assembled with FKD UC207 bearings and is bolted to the chassis frame at the bottom. The shaft was initially of 40mm in diameter then lathe turned to 34mm in diameter so that the bearings can be fitted over it. The attachments can be assembled on the universal shaft by using lock pin technique. The shaft is strong enough to withstand the total weight and various loads acting on it.

E. Rotavator

Rotavator is the robust piece of farming machinery, often used in fields, to breakup, churn and aerate the soil prior to planting seeds or bulbs turf. It consist a set of 8 blades on either side as shown in Fig 3. These blades are fastened to the plates welded perpendicularly on the hollow circular shaft which is inserted onto the universal shaft. The blades are designed in such a way that it slices the maximum soil with minimum torque so that the soil gets pulverized.

In the operation, the rotavator blade assembly is mounted onto the universal shaft using lock pin technique. The speed of the rotation can be controlled by adjusting the throttle. The power generated by the engine is sufficient to slice and pulverize the soil. The rotating power of the rotavator is more sufficient to propel the tiller forward. The blades penetrate inside the soil for an about half a foot (i.e. 6 inches) and 2.5 foot wide.



Fig 2: Univaersal shaft with rotavator and wheel assembly

F. Leveler

Leveling is the operation done right after tilling. After the tilling is done on the field soil lumps and uneven surfaces formed across the field. This field condition is prone to various issues such as soil erosion by which the land loses its fertility.



Fig 3: Rotavator setup

To safeguard the field from such issues, leveling is done. To carry out this operation, a half bucket shaped leveler is implemented which is attached to the rear end of the multipurpose tiller. Then

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this is moved across the field along straight paths. The bucket shaped leveler evens the surface and carries the excess soil with it and dumps it wherever needed.

The rotary and leveling operations can be carried out simultaneously i.e. by replacing the plough with leveler.

G. Adjustable frog plough

The purpose of the ploughing is to bring the fresh nutrients beneath soil to the surface by turning over the upper layer of soil and burying the weeds and the remains previous crops and letting them to break down. Ploughs were conventionally drawn by oxen or horses but in modern times are mostly drawn by tractors and tillers.

The name frog plough is because of its design which resembles the body of the frog as shown in the Fig 4. It is mild steel plates which forms wings and is hinged to a thick angle bar. The plough used for the tiller is of adjustable type. The wings of the plough can be adjusted as per the width of the dig required. It can be varies at step of three i.e. 6 inches, 9 inches and 12 inches in width. The plough can also be varied in different heights in order to get the various depth of dig. This plough can modify the upper 5 to 10 inches of soil homogeneously.



Fig 4: Adjustable frog plough

H. Seed sower

Sowing or seeding is the operation of burying seeds in the soil. Manual sowing has always been a very tiring and time consuming task for farmers even with a small piece of land. In this project this work is also simplified. A seed hopper is fixed or placed on the top of the frame which holds the seeds to be sown. Seeds are dispensed after equal intervals of time through conical flask directly into the soil. The duration between two consecutive seed drops can be manually controlled by varying the throttle speed. In this operation the seeds are dispensed depending upon the rotation of the

wheels. Greater the wheel speed greater will be the frequency at which seeds are dispensed. This type of mechanization is favorable to both farmers owing small piece of land and farmers with a large hectares of land. Considerably lesser time is required for sowing of seeds over conventional farming methods

I. Pesticide sprayer

Farmers have to keep spraying pesticides very often to save crops from pests, control specific weed species, killing bacteria, killing parasitic fungi and to avoid crop from damage. Carrying large pesticide sprayer tanks to different places manually is a very fatigue causing job. To help farmers in this operation a piston type sprayer pump is used which can pump pesticides up to longer distances. The sprayer pump mounted on a frame is fastened to the chassis frame. An extension rod is taken from the engine output shaft and a pulley is keyed to it. An endless belt runs over the driving pulley and transmits the motion to the sprayer pulley. The hoses can be pulled and carried out to different places where pesticide spraying is to be done. Length of the sprayer hose can be easily changed as per the land area and requirements of the farmers.

Table II: GAT 22 sprayer specification

PARTICULARS	SPECIFICATION
Pressure	21-45 kg/cm ²
Operation	800-1200 r.p.m
Capacity	14-22 L
Required power	1.5-2 KW

J. Weeder

To be productive in farming the unwanted plants which is termed as weeds should be regularly and consistently removed. Weeds are the plants like dandelions, crabgrass, or some other plants which pops up all over the land. As the part of crop maintenance weeds must to be removed periodically. To perform this operation 8 right angled weeder blades 4 on either sides is implemented. These blades are fastened to the hollow shaft which rotates over the universal shaft. The width of the weeder attachment can be adjusted from 1.25 to 2 feet. This width can be varied according to the width of the gap between the two consecutive crop lanes.

K. Harvesting

Harvesting is the final and ultimate step in farming. Harvesting refers to cutting down the final produce. Harvesting has to be done at the most accurate time preventing the produce to over dry. Harvester setup consists of 8 triangular blades. These blades reciprocate in between 4 harvest fingers. Total width of the setup is 2 feet. The single slider crank chain mechanism is used to reciprocate the blades at their positions while cutting down the crops. Once the crop is cut completely it is pushed to



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either sides of the machine preventing any kind of damage to the produce. Once the complete produce is harvested the crops can be collected and stacked at one place.

III. ADVANTAGES AND LIMITATIONS OF THE TILLER

Advantages of Multipurpose Agricultural Tiller

1. Single and compact machine can be used right from cultivating and preparing seedbed till the harvesting of the crops.
2. The cost is about 60 percent lesser than the tiller now available in the market.
3. Equipments like plough, rotavator, sprayer, seed sower and other can be removed when not in use.
4. Single person is sufficient for doing every operation.
5. More than one operations can be performed simultaneously
6. A major amount of time is saved.

Limitations of Multipurpose Agricultural Tiller

1. It lack of proper suspension system.
2. Poor breaking capability.
3. The tiers are slippery.
4. The engine lacks of rectifier circuit.

IV. FUTURE SCOPE

1. Further focus is made towards providing a comfortable driver seating.
2. A trolley is to be provided as an attachment so that heavy goods can be transported.
3. Metal tires can be implemented for the purpose of land preparation for plantation of paddy. This metal tires also helps in cultivating in wet soil like in clay soil with high moisture.
4. By implementing a proper gear transmission system, the tiller can be further extended in irrigation purpose.
5. Main concern is towards improving the tier gripping.
6. Total weight need to be reduced by using aluminum alloys for chassis.

V. CONCLUSION

The Multipurpose Agricultural Cultivator can be used to perform various farm operations by reducing labor cost and other expenses, which will result in better crop production. The model is aimed to build at a reasonable cost so that it can be afforded by average class of farmers also. The ultimate aim of this project is to help farmers by reducing their workload and farming expenses.

1. We are trying to implement a model of ploughing, weeding, seed sowing, leveling, pesticide spraying and harvesting within the limited available source and economy.
2. The system can be subjected to further development using advanced techniques.

3. It may become a success if our project can be implemented throughout our country.
4. Maintain row spacing and controls seed rate.
5. Proper utilization of seeds can be done with less loss.
6. Since seeds are placed in a sowing hopper over wastage of the same is eliminated, thus it will reduce the cost in planting.
7. Perform the various simultaneous operations and hence saves labor requirement, labor cost, labor time, total cost of saving and can be affordable for the farmers.
8. Single equipment performing more objectives with flexibility in changing the operation will motivate the farmers.

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