

## DESIGN AND FABRICATION OF SMART MULTI-PURPOSE AGRICULTURAL VEHICLE

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### Abstract

The paper aims on the design, development and the fabrication of the vehicle which can dig the soil, sow the seeds, leveller to close the soil and pump to spray water. The whole systems of the vehicle work with the battery and solar power and the vehicle is controlled by toggle switch. In recent years the development of the autonomous vehicles in the agriculture has experienced increased interest. The advantages of these vehicles are hands-free and fast input operations. In the field of agricultural autonomous vehicle, a concept is been developed to investigate if multiple small autonomous machine could be more efficient than traditional large tractors and human forces.

Keeping the above ideology in mind, a unit with the following feature is designed; Ploughing is one of the first steps in farming. Presently, small land holding farmers use work bulls mostly for land preparation. Their use can be increased and made more economical by using them for other farm operations such as ploughing, harrowing, fertilizer application, sowing and weeding. Improved hand tools will also facilitate farm work. Oxen can be used to pull a cart throughout the year which keeps them in training.

Ploughs, ridgers, seeders and weeders are all seasonal implements. Manual method of seed planting, results in low seed placement, low crop yield and serious back ache for the farmer which limits the size of field that can be planted. The cost price of imported planters has gone beyond the purchasing power of most of our farmers. Farmers can do much to increase crop production especially grains if drudgery can be reduced or totally removed from their planting operations.

This project work is focused on the fabrication of multipurpose agriculture vehicle which is used for land cultivation, sowing, fertilizing, levelling and

ploughing. The multi-crop planter has the capability of delivering the seeds precisely with uniform depth in the furrow, and also with uniform spacing between the seeds .The seed planter consist of the main frame, adjustable handle, seed hopper, seed metering disc, adjustable furrow opener, adjustable furrow closer, drive wheels, seed tube . Seed metering disc was designed to be interchangeable to allow for sowing of the different varieties of seeds. The multipurpose agricultural vehicle is very simple to use, the various adjustments are made with ease, and it is maintenance free.

Sustainable improvement in the livelihoods of poor farmers in developing countries depends largely on the adoption of improved resource conserving cropping systems. While most of the necessary components already exist, information on the availability and performance of equipment is lacking and effective communication between farmers and agricultural research and development department is unsuccessful.

**Key Word:-** Agricultural equipments, Cultivation, Seed Hooper, Fertilizing, plugging hinge, Harvesting.

## INTRODUCTION

Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. A man without food for three days will quarrel, for a week will fight and for a month or so will die. Agriculture is a branch of applied science. Agriculture is the science and art of farming including cultivating the soil, producing crops and raising livestock. It is the most important enterprise in the world. Over the years, agricultural practices have been carried out by small-holders cultivating between 2 to 3 hectare, using human labour and traditional tools such as wooden plough, yoke, leveller, harrow, mallet, spade, big sickle etc. These tools are used in land preparation, for sowing of seeds, weeding and harvesting. Modern agricultural techniques and equipment's are not used by small land holders because these equipment's are too expensive and difficult to acquire. By adopting scientific farming methods we can get maximum yield and good quality crops which can save a farmer from going bankrupt but majority of farmers still uses primitive method of farming techniques due to lack of knowledge or lack of investment for utilizing modern equipment. The use of hand tools for land cultivation is still predominant in India because tractors require resources that many Indian farmers do not have easy access to. The need for agricultural mechanization in India must therefore be assessed with a deeper understanding of the small holder farmer's activities.

There is huge gap in technology adoption and Implement used with small and marginal farmers. Sustainable improvement in the livelihoods of poor farmers in developing countries depends largely on the adoption of improved resource conserving cropping systems. While most of the necessary components already exist, information on the availability and performance of equipment is lacking and effective communication between farmers and agricultural research and development department is unsuccessful.

### 1 Scope of the Project

- The seed sowing mechanism is modified into simple

- mechanism The multipurpose agriculture vehicle is designed for
- small farmers in future The project will become an example for future works

### 2 Objective of the Project

- The primary objective is to develop a harvester which is
- simple and cost effective The reduction of cost of the Ploughing tool
- The life of the Ploughing tool is increase

## LITERATURE REVIEW

There is huge gap in technology adoption and Implement used with small and marginal farmers. Sustainable improvement in the livelihoods of poor farmers in developing countries depends largely on the adoption of improved resource conserving cropping systems. While most of the necessary components already exist, information on the availability and performance of equipment is lacking and effective communication between farmers and agricultural research and development department is unsuccessful. Following are some literatures influenced this work. F.A. Adamu, B. G. Jahun and B. Babangida [2014] In this paper authors draws our attention towards the performance factor of a power tiller. Among those demand for light weight power tiller was sought out most. Fuel efficiency and field capacity such parameters are also discussed. We took those points in consideration while designing a sustainable multifunctional agricultural vehicle. V.K. Tewari, A. Ashok Kumar, Satya Prakash Kumar, Brajesh Nare[2012] In this research papers author have done case study on farm mechanization in west Bengal as being part of India it give clear status about availability and progress in India. This ensured us to take right steps compared to current steps. D.A. Mada, Sunday Mahai, [2013], In this research paper author has mentioned importance of mechanization in agricultural by giving examples. The conclusion from the paper was need of multifunctional single axel vehicle for pre and post harvesting. We have taken this as base for our research and further production of our multifunctional agricultural vehicle.

## Fabrication Method

### 1.Chassis Frame

We have designed the chassis frame of the multipurpose agriculture vehicle in small and compact size after designing completed we have fabricated the whole design with the mild steel as per dimensions. The reason we have chosen the mild steel it is cheap and gives the high strength to the chassis frame in low cost. It contains a rectangular shape frame in this we have mountain the engine and in the other type that is in the triangle type frame we have placed the seeding equipment and at the end we have fixed the handle.

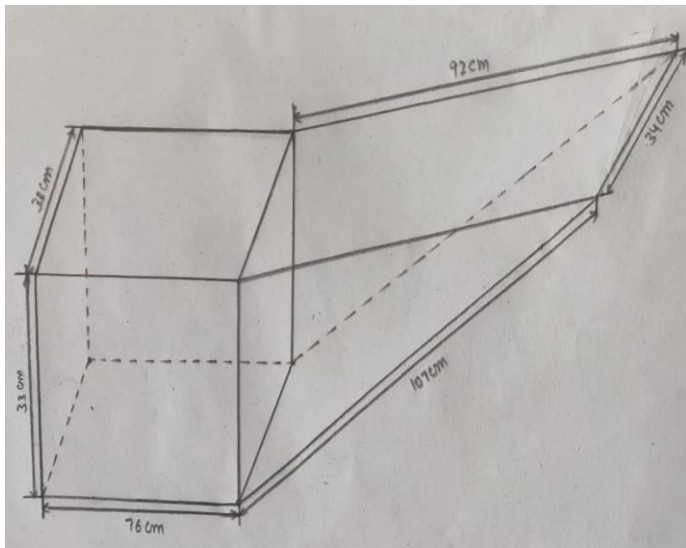


Figure 1: Chassis Frame design



Figure 2: Chassis and frame after fabrication

### 2.Engine

In this vehicle we have use 110cc 4 stroke petrol engine, it is mounted at the front of the chassis frame. The engine is heart of the vehicle, from where the power is transmitted to all the required equipments. The key specifications of the engine are mentioned below.



Figure 3: Engine

#### Engine Specifications

|                                |  |
|--------------------------------|--|
| <b>Model</b>                   | 110CC (RW157FMJ)                               |
| <b>Type</b>                    | Vertical, four-stroke, single cylinder         |
| <b>Displacement</b>            | 106.7 cc (6.51 cu-in)                          |
| <b>Max. Horsepower</b>         | 6.9 PS (5.1 KW; 6.8 HP) at 7,500 rpm           |
| <b>Max. torque (crank PTO)</b> | 7.2 Nm (0.73 kg·m; 5.31 ft·lb) at 5,500 rpm    |
| <b>Clutch method</b>           | Automatic wet multi-plate                      |
| <b>Gearshift method</b>        | 4-speed gearshift                              |
| <b>Cooling system</b>          | Forced-air                                     |
| <b>Ignition system</b>         | Capacitance discharge ignition (CDI)           |
| <b>Lubricating system</b>      | Splash   |
| <b>Starting system</b>         | Electric and kick                              |
| <b>Fuel used</b>               | Unleaded gasoline (octane number 86 or higher) |
| <b>Fuel consumption</b>        | 367 g/kw·h                                     |

**DIMENSIONS AND WEIGHT**

|                     | Rato 110CC (RW157FMJ) |
|---------------------|-----------------------|
| Length, mm (in)     | 450 (17.7)            |
| Width, mm (in)      | 310 (12.2)            |
| Height, mm (in)     | 260 (10.2)            |
| Dry weight, kg (lb) | 22 (48.5)             |

**SERVICE INFORMATION**

**Oil system**

**Oil capacity** 0.8 L

**Ignition system**

**Spark plug** A7RTC

**3.Ploughing Tool**

Construction is simple, sturdy & durable. It is useful for all soils. Also useful for ridging and clod breaking. In this we have designed the equipment with the three ploughing blades, so that the size would be small and compact useful for low end farmers. After three tubes are coming from the seeder with this after ploughing seeding would be takes place and also the depth can be changed according to our requirement with the help of leveller.

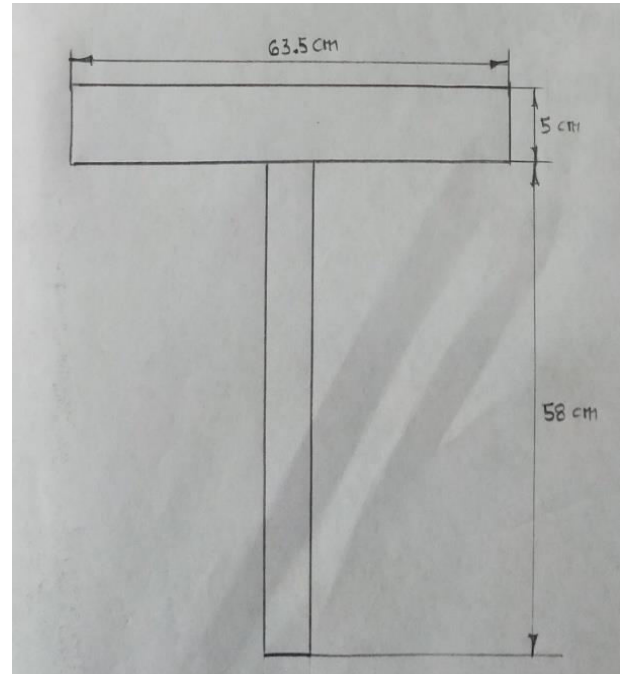


Figure 4: Ploughing tool design

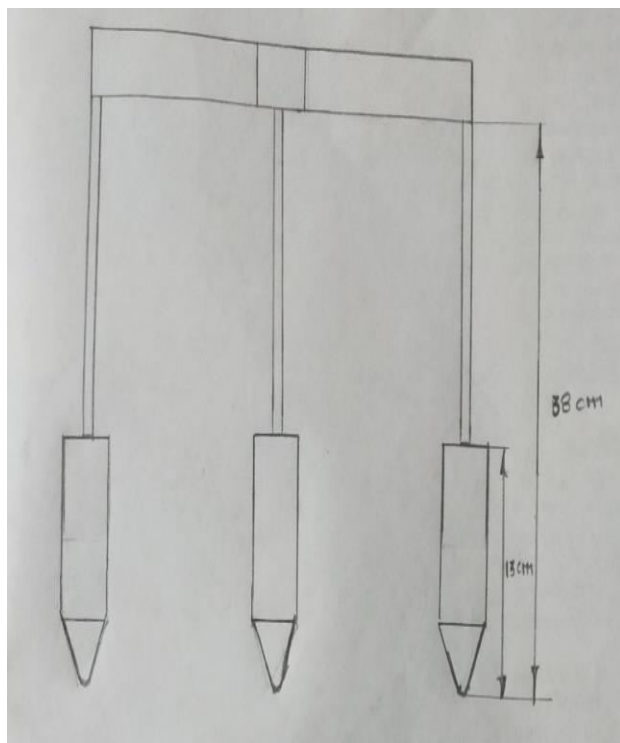


Figure 5: Ploughing tool

#### 4. Handle

Handle acts as an armrest for farmer and also helps him in guiding the man to walk in straight path.



Figure 6: Handle

#### 5. Wheels

The vehicle contains two wheels, it also act as a cage wheel to wet the land properly. Because of the load on the engine the speed of the vehicle is 300rpm. The wheel design is given below, each of the wheel contains 12 cultivating blade the dimension of the blade is also shown in figure.

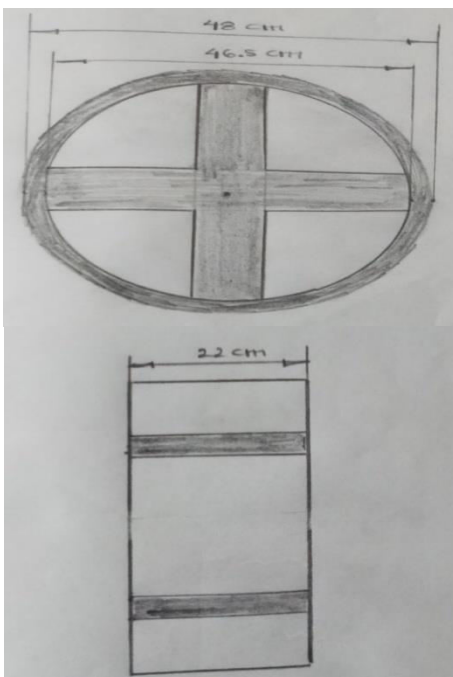


Figure 7: Wheel design



Figure 8: Wheel fabrication

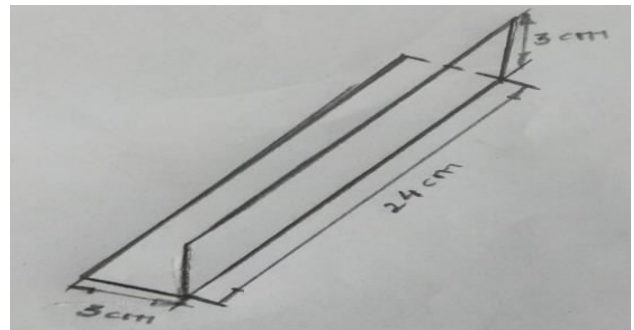


Figure 9: Design and fabrication of cultivating blade

the container the seeds one by one fall along the ploughing area.

### 6. Leveller

Leveller is used to change the depth of the field, so that farmer has ploughing the land with the desired depth.



Figure 10: Leveller



Figure 12: Seed cum fertilizer container



Figure 11: Shaft



Figure 13: Tubes

### 7. Shaft

Shaft is made up of a 47cm long threaded rod of 1.5cm diameter. It connects the two spike wheels on either side of the equipment and all the seed metering and fertilizer metering discs are mounted upon the shaft, such that when the wheel rotates, metering of seeds and fertilizer takes place.

### 8. Seed cum fertilizer container

In this project we have use water container for seed or fertilizer storage. The three tubes are coming from the tank, these are goes to the three ploughing blades whenever we on open the valve on

### 9. Tubes

We have use 3 tubes in this project from container to ploughing tool for drop the seed along the ploughing area. The seed coming from the container and travel along the tube and placed in ploughing area.

### 10. Other components

The other components of the vehicle are:

- I. Gears ,
- II. Pillow block bearing.

Gears:

In this project we have use 3 types of gears the two small one and one large one, the small one are having 32 teeth and large one are having 24 teeth. The

larger one is used to transform the mechanical energy into rotational energy, this is useful for rotating the cage wheels.

**Pillow block bearing:**

This pillow block housing fits insert bearings with 90mm OD curved outer race. This housing is cast iron and has a high shaft center height compared to other pillow block housings. The housing includes a grease fitting for lubricating re-lube style bearings.

**Diminisions:**

|                          |                   |
|--------------------------|-------------------|
| Fits bearings with OD of | :90MM             |
| Bolt hole to bolt hole   | :6.25in.(159mm)   |
| Overall length           | :8.125in.(206mm)  |
| Shaft height             | :2.25in.(57.2mm)  |
| Overall height           | :4.41in.(112.2mm) |
| Bolt hole                | :.781 in. (20mm)  |



Figure 14 Pillow block bearing



Figure 15 Bearings, Shafts and Gears

**5. Working**

Generally cultivation of any crop involves various steps like seed selection, field preparation, fertilizing, sowing, irrigation, germination, thinning and filling, weed removal, vegetative stage, flowering stage, pesticide spraying, fruit or pod formation stage, harvesting and threshing. In the all the above steps the major operations of the agriculture are seeding, ploughing, cultivating and fertilizing, for these operations farmer has to use various agricultural equipments and labours for caring out those steps, our purpose is to combine all the major individual tools to form a multipurpose agricultural vehicle which reduces the overall equipment cost and labour cost and also increases the yield of the crop by implementing scientific farming method.

Initially chassis frame is designed based on requirements and after fabricating chassis frame with mild steel based on design dimensions. After that engine is mounted on a chassis frame for giving energy to the all the required parts, then ploughing tool is attached to the back of the chassis frame, cultivating wheels and seed sowing equipment are attached. Coming to the working whenever we ON the engine the vehicle started the cultivating wheels cultivating the land, the ploughing tool ploughing the field area and if we open the seeds container valve the seeds one by one placed along the ploughing area, we can also place fertilizer in place of seeds whenever we required.

**Table 1 Comparison between present technologies of farming**

| <b>Steps involved in agriculture and features of the mechanization</b> | <b>Primitive method with manual workers and bullock equipment</b> | <b>Tractor powered modern method equipment</b>                   | <b>Multipurpose agricultural vehicle</b>                |
|--|---|--|---|
| <b>1.Crops selection</b>   | All types of crops can be cultivated                              | Only predesigned type of cultivation can be done                 | Suitable for all types of seed to seed cultivation      |
| <b>2.Field operation</b>   | Oxen ploughing – 3 times  | Tilling using cultivator once and gyrovator once and harrow once | Single man is enough to ploughing the land.             |
| <b>3.Fertilizer application</b>  | Single worker and one day is enough                               | Seeder and fertilizer has to be used                             | seed sowing or fertilizer application takes place.      |
| <b>4.Sowing</b>  | Single worker is enough   | One hour for seed sowing in seeder                               | No need of additional worker                            |
| <b>5.Irrigational canals</b>   | Furrows and ridges to be created for surface irrigation           | Furrows and ridges cannot be done                                | Furrows and ridges to be created for surface irrigation |
| <b>6.Thinning and filling</b>  | One worker is required  | One worker is required   | One worker is required                                  |
| <b>7.Weeding</b>   | Extra workers required depends on the area of the land            | Weeding cannot be done by using tractor                          | Weeding is mechanized here and no need of extra workers |



|   |                                   |                          |                          |
|---|-----------------------------------|--------------------------|--------------------------|
| <b>8.Implementation of scientific method and precision farming.</b> | No                                | Yes                      | Yes                      |
| <b>9.Quality and yield of crops</b>                                 | Moderate                          | High                     | High                     |
| <b>10.Suitable for total area of land</b>                           | Less than 3 acres                 | More than 8 acres        | Less than 4 acres        |
| <b>11.Number of workers involved</b>                                | High                              | low                      | Low                      |
| <b>12.Time consumed for working</b>                                 | More                              | Less                     | Moderate                 |
| <b>13.Flexible for multipurpose operation</b>                       | Yes                               | No                       | Yes                      |
| <b>14.Worker condition</b>  | Unskilled workers can do the job. | Required skilled workers | Required skilled workers |
| <b>15.Initial investment</b>  | Very less                         | High                     | Very less                |

**Results and conclusion**

Practically our multipurpose agricultural vehicle can be used for cultivating, fertilizing, sowing, leveling and also ploughing. All the parts are connected in such a way that in every stage of agriculture the equipment can be rearranged or easily assembled with fasteners to required length and specifications of field operation.

Our team has successfully combined many ideas from various fields of mechanical engineering and agricultural knowledge to improve the yield and by reducing the labor effort and expenses. The whole idea of multipurpose equipment is a new concept, patentable and can be successfully implement in real life situations.

**Scope for future work**

By increasing the equipment strength and quality to its peak, we can have multipurpose agricultural vehicle for life time usage. By providing hydraulics, gear arrangements and some minor adjustments the equipment can also be made as tractor powered equipment.

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