

# Design and Fabrication of Multi-Purpose Agriculture Vehicle

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**Abstract**— Agriculture plays an important role in the Indian economy. Mechanized agriculture is a process of using agricultural machinery for different processes of agriculture. The aim of the project is to design and develop a multipurpose agricultural vehicle, to perform different agricultural processes such as ploughing, sowing, weeding, spraying, and levelling. In this project a rechargeable battery and motor is used to run the vehicle. The power from battery is also used for seed sowing process which is done automatically. A rotavator is installed for soil preparation process. A sprayer pump is installed for pesticide spraying operation. The different parts are easily adjustable.

**Keywords**— Agriculture vehicle, Battery powered, Leveller, Multi purpose, Ploughing, Sowing, Spraying, Weeding.

## 1 INTRODUCTION

Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. India ranks second worldwide in farm outputs. As per 2018, agriculture employed more than 50% of the Indian work force and contributed 17–18% to country's GDP. Agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. In FY19, exports of agricultural and processed food products totalled US\$ 38.49 billion.

In spite of the large-scale mechanization of agriculture in some parts of the country, most of the agricultural operations in larger parts are carried on by human hand using simple and conventional tools and implements like wooden plough, sickle etc. Little or no use of machines is made in ploughing, sowing, irrigating, thinning and pruning, weeding, harvesting threshing and transporting the crops. This is specially the case with small and marginal farmers. It results in huge wastage of human labour and in low yields per capita labour force. There is urgent need to mechanize the agricultural operations so that wastage of labour force is avoided and farming is made convenient and efficient. Agricultural implements and machinery are a crucial input for efficient and timely agricultural operations, facilitating multiple cropping and thereby increasing production.

Modern agriculture techniques and equipment's are not used by small land hold because this equipment are too expensive and difficult to acquire. The use of hand tools for land cultivation is still predominant in India because tractors require resource that many farmers do not access. There is huge gap in technology adoption and implement used with small and marginal farmers. The main aim of our project is to develop a battery powered multipurpose agriculture vehicle.

The proposed idea implements the vehicle to perform the functions such as weed removing, ploughing, seed sowing, spraying and levelling operation. These functions can integrate into a single vehicle. As day by day labour availability becomes the great concern for the farmer and labour cost is more, this machine reduces the efforts and total cost of the farmer.

## 2 LITERATURE REVIEW

**Thange R.B et. al [2016]** discusses that the available automatic machines are imported from foreign countries. The imported machines are not only bulk in size but also costing around rupees one Lakh. In this project an attempt has been made for the design and fabrication of maintenance free multipurpose agricultural equipment exclusively for small farmers at cost not exceeding rupees 20000 per unit. The modelled components are fabricated and assembled together to form a complete machine.

**Dhatchanamoorthy.N et. al [2018]** carried out a project to develop multipurpose agricultural vehicle, for performing major agricultural operations like ploughing, seeding, harvesting. The modification includes fabricating a vehicle which is small, compact in size. The project is about a machine design which makes cultivation much simpler. The design of the chassis of the vehicle is made in such a way that it is suitable for the operations. The design for automatic seed sowing equipment is made. The plough is designed and modified the currently available plough tool in such a way that it with stand the load. The harvester (cutter) is designed and working by scotch yoke mechanism.

**D.Ramesh et. al [2014]** discusses brief information about the various types of innovations done in seed sowing equipments. The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. The recommended row to row spacing, seed rate, seed to seed spacing and depth of seed placement vary from crop to crop and for different agro-climatic conditions to achieve optimum yields. Seed sowing devices plays a wide role in agriculture field.

**Jinlin Xue [2013]** discussed about agricultural electric vehicle (AEV) based on photovoltaics, taking into consideration three aspects, i.e., power supply mode for agricultural electric

vehicle, power of agricultural electric vehicle, and economy analysis. The power supply mode, whether on-board photovoltaic system or off-board photovoltaic system, is subjected to the size and the power of the designed agricultural electric vehicle, but the agricultural electric vehicle's power depends on the area of photovoltaic panels which affects the initial investment cost of the photovoltaic system and the agricultural electric vehicle. Three analysis indicators including payback period, net present value, and benefit-cost ratio were taken into consideration when comparing the projects of 10 kW and 30 kW agricultural electric vehicles based on photovoltaic system and the respective conventional tractors. Results show that the off-board photovoltaic system is more applicable to the agricultural electric vehicle, the photovoltaic based agricultural electric vehicle with low power is a wise, economical investment, and this type of system is particularly appropriate for rural and remote areas.

**Ben McFADZEAN et. al [2017]** carried out research on feasibility of hybrid and all-electric agricultural machines. This project used a three-stage approach to investigate whether current hybrid and all-electric drivetrains could feasibly replace the diesel engine in an agricultural tractor. Firstly, a current systems review, gathered information from a range of industries where alternative powertrains have been successful, to gain an understanding of the properties and capabilities of available systems. The second element; a series of real-world practical tests, collected data about the requirements of agricultural tractors in use, this would be used to determine whether the alternative technology currently available could cope with the demands placed on a machine. Finally, a questionnaire, collected data from those working in the agricultural sector; this would be used to gauge attitudes and opinions towards alternative power systems.

**M. Kamaraj et. al [2017]** says as until now most of implemented ideas for cultivation were found out of reach or unaffordable for poor farmers or small scale cultivation. But now a days Indian government is focusing more on new techniques and technologies to boost up agricultural activities in cheaper way basically up till now for any type of fast cultivation techniques farmers had to depend on tractors or any other fuel consumable devices or vehicles, which by the side increases air pollution, just to speed up the process. We found a cheapest and easy way for poor farmers and cultivation on small land. The design of multi-purpose farming tool equipped mobility cycle was done after consider some major factors i.e. decreasing cost of cultivation, making cultivation pollution free.

**Dr. C.N.Sakhale et. al [2016]** has carried out project to develop a multipurpose equipment. In this equipment a 24cc engine is used for digging operation. And for spraying a motor with 12V battery is used. Next two operations are manual base which is cultivation and sowing. This machine performs four farming operation digging, sowing, cultivation, spraying which is used for small scale farming. By using this attachments one may perform various farming operations in less time and economically.

**Kyada et, al [2014]** has designed a manually operated template

row planter to improve planting efficiency and reduce drudgery involved in manual planting method. Seed planting is also possible for different size of seed at variable depth and space between two seed. Also it increased seed planting, seed/fertilizer placement accuracies and it was made of durable and cheap material affordable for the small scale peasant farmers. The operating, adjusting and maintaining principles were made simple for effective handling by unskilled operators.

**Ms. Trupti A.Shinde et, al [2017]** have discussed the seed sowing processes and tried to solve the problem. In seed sowing machine system they are used battery powered wheels and dc motor inbuilt in these wheels. When the seeds are empty it detects the level of storage seed and indicates the alarm. When any obstacle comes in the in-front of machine or divert path the seed sowing machine can detect this obstacle very easily. In each complete rotation of rotating wheel there is seeds falls from this seed drum and the seed plantation process can take place smoothly as well as without wastage of seeds. The end of system machine reached and it create alarm. this system provides all the facility which can work efficiently.

**Jacek Caban et, al [2018]** has discussed the market of electric field tractors. There are individual models in offers dedicated to the agriculture made by foreign producers. However, these offers are presented mainly at agricultural fairs. The article presents the research on the needs of farms for electric tractors and presents the possibilities of developing electro mobility in this sector of the economy. Questionnaire was presented, data were collected from those working in the agricultural sector. The data will be used to gauge attitudes and opinions towards alternative power systems implemented in agriculture.

### 3 OBJECTIVES AND METHODOLOGY

#### 3.1 Objectives of the Project

- To Design and fabricate a multi-purpose agricultural vehicle that can perform number of functions such as Ploughing, Sowing, Weeding, Levelling and Spraying.
- To use eclectic battery as source of fuel.

#### 3.2 Methodology

Extensive study of existing literature on experimental and numerical analysis of different types of agricultural machines and tools has been done. Study on Electric vehicles in agricultural processes has been done. Study on design and fabrication .3D modelling of leveller, seed hopper, weedicide container, fertilizer container and chassis frame of the vehicle is done on CATIA and SOLID EDGE software. Appropriate materials for different parts of the multi-purpose vehicle are selected. Selection of battery and motor required for the vehicle is done. Fabrication of parts is done. The vehicle is fitted with steering to control the movement of the vehicle. A seeder motor is fixed to control the distribution of the seed and fertilizers. A tiller motor is placed to control the speed of rotavator. Pesticide sprayer of

#### 4 DESIGN OF PARTS

Design Of different parts was done using CATIA Software and SOLID EDGE Software.

##### 4.1 Seed Hopper

We have provided hole to the hallow cylinder which is coupled to the DC motor shaft, where the funnel is placed above it, The DC motor is powered by a battery. A motor drive mechanism is used.

Fig 1: 3-d model of Seed hopper

##### 4.2 Weedicide Container

Weedicide containers consist of weedicides which helps in avoiding of weed formation by dripping it along the path between the crop.

Fig 1: 3-d model of Weedicide container

##### 4.3 Leveller

Leveller blades are designed to levell the soil when vehicle moves forward.

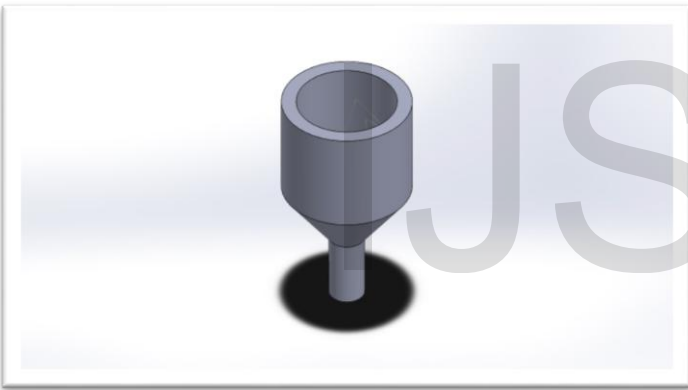
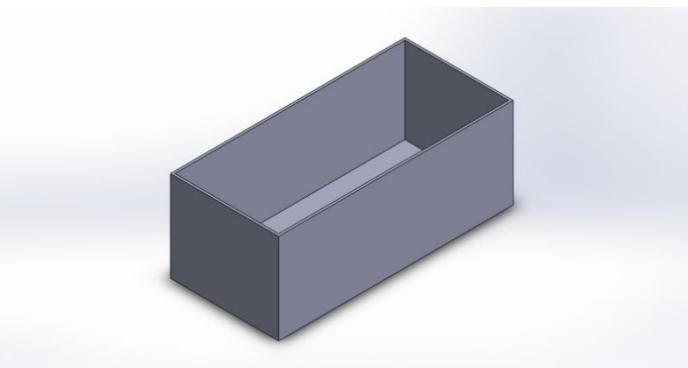


Fig 1: 3-d model of Leveller blade

##### 4.4 Assembly

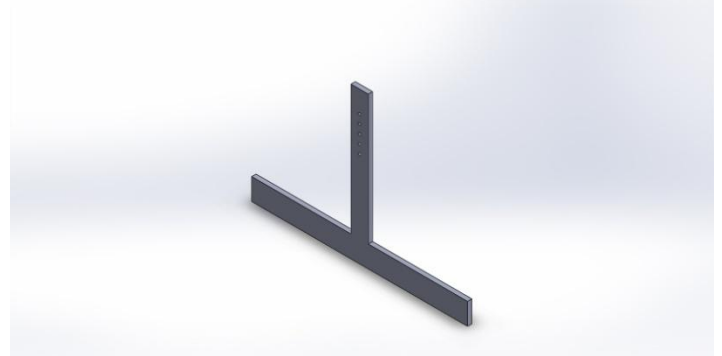
Fig 4. Top view of the proposed multipurpose agriculture vehicle



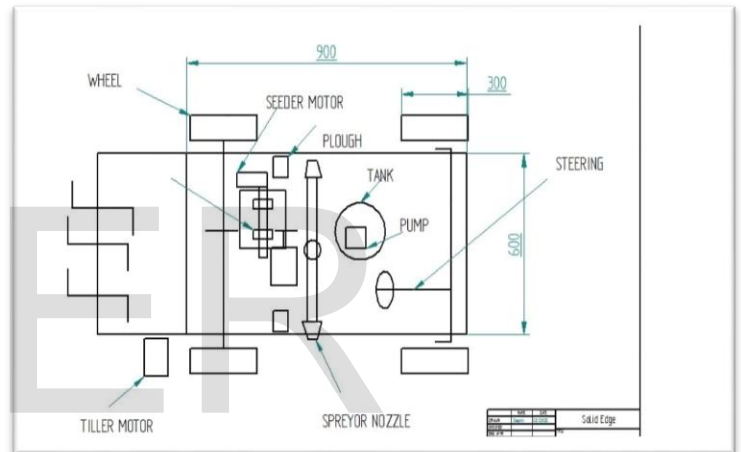
## 5 COMPONENTS OF VEHICLE

### 5.1 Chassis Frame

Mild steel bars and plates are utilized in the fabrication of



frame in order to provide more strength even after keeping the weight low.



### 5.2 Rotavator

High strength mild steel is used to make these rotavators in order to provide them with ample strength to cut through larger soil lumps easily.

### 5.2 Plough

The purpose of ploughing is to turn over the upper layer of the soil, bringing fresh nutrients to the surface, while burying weeds and the remains of previous crops and allowing them to break down. As the plough is drawn through the soil it creates long trenches of fertile soil called furrows. In modern use, a ploughed field is typically left to dry out, and is then harrowed before planting. Ploughing the soil modifies the upper 12 to 25 cm of the soil to form a plough layer. The material used for plough tool is High carbon steel.

### 5.3 Sprayer

- **Pressure:** 21-45 kg/cm<sup>2</sup>
- **Operation:** 800-1200 r.p.m
- **Capacity:** 14-22 L
- **Required power:** 1.5-2 KW

#### 5.4 Battery

Two 12v 28ah rechargeable batteries are used for the power supply.

#### 5.4 Motor

- **Voltage:** 24v
- **Wattage:** 350w
- **Rotation:** 2650 rpm
- **Torque:** 2.5nm – 4nm
- **Efficiency:** 75%

#### 5.4 Seed Hopper

It is a box like structure made up of mild steel and provided with a lid. A motor drive mechanism is used.

#### 5.4 Weedicide Container

It is a box made up of either mild steel or galvanized iron which contains weedicide in it.

### 6 RESULTS AND CONCLUSION

Based on literature review we have procured the materials required for the fabrication of multipurpose agriculture vehicle.

Based on literature review [6], M. Kamaraj et, al [2017] have explained the results of three mechanisms ploughing, seeding and covering mechanism achieved on Irrigated land. Maximum achieved depth is 7cm using plough.

- Each seed will fall at the interval of 9.81cm.
- The level of covering mechanism should be rigidly fixed 0.5cm deep inside the soil.
- Height leveller mechanism of plougher, Seating and covering mechanism is achieved.
- Maximum bearable weight of person is 65Kg
- Maximum working stress of the frame is 185M Pa.
- Minimum Torque required to drive vehicle is 57.62N-m

The proposed idea implements the vehicle to perform the functions such as weed removing, ploughing, seed sowing, spraying and levelling operation. These functions are successfully integrate into a single vehicle. Manual testing on field also gives enough idea about the vehicle. The system is performing 85% correctly as per the expectations. There is a lag of 15 % of working because of loose fitting of seeder support and some machining defects due to cutting tools or tolerance negotiation. The system is properly moving but due to the meshing problem of bevel geared seeder is somewhat lagging in performance.

Based on literature review [2], Dhatchanamoorthy.N et. al [2018] The plough tool life is compared with the commonly used material and the result obtained is the life of the tool is

more efficient. The operations like ploughing, seed sowing and harvesting is done in the same vehicle, so the cost is reduced. The existing seed sowing machine is weighs more and complex working metering mechanism. But in this sowing machine, the weight is reduced and the working method is simple by connection a separate motor.

#### 6.1 Conclusion

The Multi-purpose Agricultural Vehicle costs approximately 24000. This is cheaper compared to other farming vehicles commonly used. This type of vehicle is mostly suitable for small land owners. Advantage of using such vehicles for farming is important as the manual work costs high with lower efficiency. Also this type of vehicles is useful in a rapidly urbanising country like India. 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. The use of electricity to run a multi-purpose agricultural vehicle is affordable only for smaller vehicles which can be used for small land areas. The use of battery run vehicles will help in reducing pollution by a large extent.

#### 6.2 Scope for Future Work

- The vehicle can be modified such that more operations can be added such as harvester.
- The seed sower can be modified according to the type of crops grown in the region.
- The tyres of vehicle can be changed according to type of land.
- Solar panels can be used to power the vehicle.

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