

Multi Utility Agricultural Vehicle

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Abstract: Agriculture is the backbone of India. Conventional methods of farming that includes ploughing, seed sowing, pesticide spraying etc. are time consuming and tedious. So there is a need for mechanization of processes. We cannot develop a fully automated vehicle which in turn can be costly and it requires electricity which is not available in most of the rural areas. So this Multi Utility Agricultural Vehicle was developed keeping in mind the above considerations and this vehicle utilizes some basic kinematics mechanisms to actuate processes such as seed sowing, ploughing and pesticide spraying thus proving to be cost efficient and less time consuming

Index Terms:—Chain, linear motion, rotary motion, round steel plate, sprocket.

I. INTRODUCTION

India is set to be an agricultural based country approximately 75% of population of India is dependent on farming directly or indirectly. Our farmers are using the same methods and equipment for the ages. e.g. seed sowing, spraying, weeding etc. There is need for development of effective spraying and weeding machine for increasing the productivity.

1.1. Status of agriculture in India:

Most of the developing countries of Asia have the problem of high population and low level of land productivity as compared to the developed nations. One of the main reasons for low productivity is insufficient power availability on the farms and low level of farm mechanization. This is especially true for India. It is now realized the world over that in order to meet requirements of the growing population and rapid industrialization, modernization of agriculture is inescapable.

Mechanization enables the conservation of inputs through precision in metering, ensuring better distribution, reducing quantity needed for better response and prevention of losses or wastage of input applied. Agricultural implement and machinery program of the government has been one of selective mechanization with a view to optimize the use of human, animal and other sources of power. Category. It is generally said that mechanization of small farms is difficult.

Japan having average land holding even smaller than ours, with proper mechanization has led agriculture to great heights. In order to minimize the drudgery of small farmers, to increase efficiency and save farmer's time for taking up additional /supplementary generating activities, the use of modern time saving machines/implements of appropriate size needed to be suitably promoted.

1.2. Research & Development System:

The Indian Council of Agricultural Research (ICAR) is the main organization looking after all agricultural research, including agricultural implements and machinery. It coordinates a number of research projects with centers at different places in the country. Agriculture plays a vital role in Indian economy. Around 65% of population in the state is depending on agriculture. Although its contribution to GDP is now around one sixth, it provides 56% of Indian work force. As far as Indian scenario is concerned, more than 75 percent farmers are belonging to small and marginal land carrying. So any improvement in the productivity related task help to increase Indian farmer's status and economy.

1.3. Importance of agricultural development in our country:

Presenting India's national budget for 2016-17, ArunJaitley said India was "a bright spot of the global economy" as he outlined his nine focus areas, with social programs and rural development taking the number two and three slots.

While Rs.35,984crore was allocated for agriculture in the next fiscal, Jaitley said the outlay under the Mahatma Gandhi National Rural Employment Guarantee Act

(MGNREGA) program was being enhanced to Rs.38,500 crore. Four in 10 Indians rely directly on farming for their livelihoods, the government estimates. Jaitley also assured that the government intended to double the income of farmers in five years, besides allotting Rs.35,984 crore towards welfare of farmers. Jaitley said the government had targeted agriculture credit of Rs.8.5 lakh crore in 2015-16, which was being enhanced to Rs.9 lakh crore in the next fiscal

II. AGRICULTURAL PROCESSES

2.1. Pesticide Spraying:

Farmers spray pesticides on crops to kill the insects that may reduce crop yield. They also spray herbicides to kill weeds that may compete with the crops. Some of these chemicals may remain on the surface of, for example, fruit. Others may be absorbed by the plant and therefore be present in the crop. Many farmers choose to use chemicals to keep weeds and pests from destroying their crops and to add more nutrients to the soil. There are three different kinds of pesticides; herbicides, insecticides and fungicides. All three of these pesticides are used to kill different kinds of pests that can be found on a farm.

2.2. Seed Sowing:

Sowing is the process of planting seeds. An area or object that has had seeds planted will be described as being sowed. Among the major field crops, oats, wheat, and rye are sown, grasses and legumes are seeded, and maize and soybeans are planted. In planting, wider rows (generally 75 cm (30 in) or more) are used, and the intent is to have precise, even spacing between individual seeds in the row; various mechanisms have been devised to count out individual seeds at exact intervals. In sowing, little if any soil is placed over the seeds. More precisely, seeds can be generally sown into the soil by maintaining a planting depth of about 2-3 times the size of the seed.

For hand sowing, several sowing types exist; these include:

1. Flat sowing
2. Ridge sowing
3. Wide bed sowing

Several patterns for sowing may be used together with these types; these include:

1. Regular rows
2. Rows that are indented at the even rows (so that the seeds are placed in a crossed pattern). This method is much better, as more light may fall on the seedlings as they come out.
3. Symmetrical grid pattern – using the quincunx pattern described in The Garden of Cyrus

2.3. Ploughing

A plough is a tool or Farm implement used in farming for initial cultivation of soil in preparation for sowing seed or planting to loosen or turn the soil. Ploughs are traditionally drawn by working animals such as horses or cattle, but in modern times may be drawn by tractors. A plough may be made of wood, iron, or steel frame with an attached blade or stick used to cut the earth. It has been a basic instrument for most of recorded history, although written references to the plough do not appear in English until 1100 CE at which point it is referenced frequently. The plough represents one of the major advances in agriculture. The primary 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. Plowing and cultivating a soil homogenizes and modifies the upper 12 to 25 cm of the soil to form a plow layer. In many soils, the majority of fine plant feeder roots can be found in the topsoil or plow layer.

III. AGRICULTURAL MACHINES AVAILABLE

3.1 Agricultural Machinery

The main purpose of mechanization in agriculture is to improve the overall productivity and production. Planting is conventionally done manually which involves both animate (humans and draught animals), this result in higher cost of cultivation and delay in planting. The main purpose of this paper is to compare between the conventional sowing

Methods and the new proposed machine which can perform much number of simultaneous operations. The required row to row spacing, seed rate, seed to seed spacing and fertilizers placement varies from crop to crop can be achieved by the proposed machine. This machine reduces the sowing time, human efforts and labour cost

3.2 Agricultural Sprayer Vehicle

The spraying is traditionally done by labor carrying backpack type sprayer which requires more human effort. A multifunction device will come in handy that can be put to use in different stages of farming. Forward and backward motion give pump action and increase pressure inside the pump which is further used to spray the pesticide when the valve is opened on the sprayer pipe. When the handle is pushed the sprayer vehicle moves forward rotating the wheels, hence the spur pinion makes the crank gear to rotate. The Crank gear acts like the crank which in turn drives the connecting rod and makes the connecting link to oscillate about the boom hinge. The connecting link is

engaged to the piston of the sprayer pump which moves as per requirement.

3.3 Semi Automated Multipurpose Wheel Hoe

A Wheel hoe is a mechanical device used by farmers for ploughing, weeding and cultivating. Indian farmers have Tractors but all the farmers cannot afford tractor. There is an alternative for tractor that is power tillers which is also expensive. There exists another alternative called wheel hoe. It is manual driven equipment used for agricultural operations. Aim is to reduce the man power required

for the operation of the wheel hoe. The only way is to automate it but we cannot fully automate it due to few constraints such as it will require electricity which will not be mostly available in villages, we will be requiring Microprocessor and sensors which will again increase the cost and might require skill to use it.

3.4 Seed Sower

It is the process of planting seeds. We are well aware that sowing of grains by hand is by far one of the most laborious and difficult operations of a farmer's profession. However surpassing technologies have ensured that sowing grains will no longer be a sturdy task and various machines had been suitably designed for this purpose will perform the tougher task in no time. The seed sower is designed in order to use mechanical energy efficiently to perform desired work. In this if we pull the machine the digger which is present in the front digs the land sufficiently. Now the seeder which is mounted on the shaft drops the seeds to the field at equal interval of space. Finally the dropped seeds are closed by soil using the leveler at the back.

3.5. Backpack sprayer:

One type of backpack sprayer is a compressed air sprayer with a harness that allows it to be carried on the operator's back. Another type of backpack sprayer has a hand-operated hydraulic pump that forces liquid pesticide through a hose and one or more nozzles. Sprayers convert a pesticide formulation, often containing a mixture of water (or another liquid chemical carrier, such as fertilizer) and chemical, into droplets, which can be large raintype drops or tiny almost-invisible particles. This conversion is accomplished by forcing the spray mixture through a spray nozzle under pressure.

3.6. Motorcycle driven Spraying:

It could plough one acre (0.4 ha) of land in less than half an hour on just two liters of diesel oil. Using motorbike-santi, the cost of weeding a typical field was found to be just Rs.8/ha because as much as 10 ha land could be covered in a single day. But, this spraying

equipment needs fuel for its running and proper operation which increases its operating cost.

IV. LIST OF COMPONENTS USED

4.1. Vehicle frame:

A vehicle frame, also known as its chassis, is the main supporting structure of a motor vehicle to which all other components are attached, comparable to the skeleton of an organism. Until the 1930s, virtually every (motor) vehicle had a structural frame, separate from the car's body. This construction design is known as body-on frame. Since then, nearly all passenger cars have received unibody construction, meaning their chassis and bodywork has been integrated into one another. The last UK mass-produced car with a separate chassis was the Triumph Herald, which was discontinued in 1971. However, nearly all trucks, buses and pickups continue to use a separate frame as their chassis.

Functions:

The main functions of a frame in motor vehicles are:

1. To support the vehicle's mechanical components and body
2. To deal with static and dynamic loads, without undue deflection or distortion, it includes
 - Weight of the body, passengers, and cargo loads.
 - Transverse lateral forces caused by road conditions, Sidewind and steering the vehicle.
 - Torque from the engine and transmission.
 - Longitudinal tensile forces from starting and Acceleration, as well as compression from braking.
 - Sudden impacts from collisions.

4.2. Hand Pump:

Hand pumps are manually operated pumps; they use human power and mechanical advantage to move fluids or air from one place to another. They are widely used in every country in the world for a variety of industrial, marine, irrigation and leisure activities. There are many different types of hand pump available, mainly operating on a piston, diaphragm or rotary vane principle with a check valve on the entry and exit ports to the chamber operating in opposing directions. Most hand pumps have plungers or reciprocating pistons, and are positive displacement. For our application, we use Suction and lift hand pump

Suction and lift hand pumps

Suction and lift are important considerations when pumping fluids. Suction is the vertical distance between the fluid to be pumped and the centre of the pump, while lift is the vertical distance between the pump and the delivery point. The depth from which a hand pump will suck is

limited by atmospheric pressure to an operating depth of less than 7 meter. The height to which a hand pump will lift is governed by the ability of the pump and the operator to lift the weight in the delivery pipe. Thus the same pump and operator will be able to achieve a greater lift with a smaller diameter pipe than they could with a larger diameter pipe.

4.3. Wheel:

A wheel is a circular component that is intended to rotate on an axle bearing. The wheel is one of the main components of the wheel and axle which is one of the six simple machines. Wheels, in conjunction with axles, allow heavy objects to be moved easily facilitating movement or transportation while

Supporting a load, or performing labor in machines. Wheels are also used for other purposes, such as a ship's wheel, steering wheel, potter's wheel and flywheel.

Common examples are found in transport applications. A wheel greatly reduces friction by facilitating motion by rolling together with the use of axles. In order for wheels to rotate, a moment needs to be applied to the wheel about its axis,

Either by way of gravity, or by the application of another external force or torque.

In this application we use two types of wheels,

1. Cycle wheel
2. Filled rubbers wheel

4.4. Chain and Sprocket:

A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs, or even sprockets that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth. Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc. Perhaps the most common form of sprocket may be found in the bicycle, in which the pedal shaft carries a large sprocket-wheel, which drives a chain, which, in turn, drives a small sprocket on the axle of the rear wheel. Early automobiles were also largely driven by sprocket and chain mechanism, a practice largely copied from bicycles.

In the case of bicycle chains, it is possible to modify the overall gear ratio of the chain drive by varying the diameter of the sprockets on each side of the chain. This is the basis of derailleur gears. A multi-speed bicycle, by providing two or three different-sized driving sprockets and up to 11 different-sized driven sprockets, allows up to 33 different gear ratios. The resulting lower gear ratios make

the bike easier to pedal up hills while the higher gear ratios make the bike more powerful to pedal on flats and downhill's. In a similar way, manually changing the sprockets on a motorcycle can change the characteristics of acceleration and top speed by modifying the final drive gear ratio.

4.5. Power transmitting Shaft:

A drive shaft, or is a mechanical component for transmitting torque and rotation, usually used to connect other components of a drive train that cannot be connected directly because of distance or the need to allow for relative movement between them. As torque carriers, drive shafts are subject to torsion and shear stress, equivalent to the difference between the input torque and the load. They must therefore be strong enough to bear the stress, whilst avoiding too much additional weight as that would in turn increase their inertia. To allow for variations in the alignment and distance between the driving and driven components, drive shafts frequently incorporate one or more universal joints, jaw couplings, or rag joints, and sometimes a splined joint or prismatic joint.

4.6. Bearings:

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Many bearings also facilitate the desired motion as much as possible, such as by minimizing friction. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts. The term "bearing" is derived from the verb "to bear", a bearing being a machine element that allows one part to bear (i.e., to support) another. The simplest bearings are bearing surfaces, cut or formed into a part, with varying degrees of control over the form, size, roughness and location of the surface. Other bearings are separate devices installed into a machine or machine part. The most sophisticated bearings for the most demanding applications are very precise devices; their manufacture requires some of the highest standards of current technology.

Types:

- ❖ Plain bearing
- ❖ Rolling element bearing
- ❖ Jewel bearing
- ❖ Fluid bearing
- ❖ Magnetic bearings
- ❖ Flexure bearing

For our application we use Ball Bearing.

4.7. Round steel plate:

Disks and plates come in steel, stainless steel, aluminum, brass and bronze, and are stocked for quick shipment at competitive prices. Metal disks and plates are supplied with a mill finish. They can be supplied in special finishes; and with custom size and whole configurations. Our flat laser can create any size that you may require.

4.8. Connecting link:

A mechanical linkage is an assembly of bodies connected to manage forces and movement. The movement of a body, or link, is studied using geometry so the link is considered to be rigid. The connections between links are modeled as providing ideal movement, pure rotation or sliding for example, and are called joints. A linkage modeled as a network of rigid links and ideal joints is called a kinematic chain. Linkages may be constructed from open chains, closed chains, or a combination of open and closed chains. Each link in a chain is connected by a joint to one or more other links. Thus, a kinematic chain can be modeled as a graph in which the links are paths and the joints are vertices, which is called a linkage graph. The movement of an ideal joint is generally associated with a subgroup of the group of Euclidean displacements. The number of parameters in the subgroup is called the degrees of freedom (DOF) of the joint. Mechanical linkages are usually designed to transform a given input force and movement into a desired output force and movement. The ratio of the output force to the input force is known as the mechanical advantage of the linkage, while the ratio of the input speed to the output speed is known as the speed ratio. The speed ratio and mechanical advantage are defined so they yield the same number in an ideal linkage.

4.9. Pipe Bends, Couplings and Joints:

Piping Elbows and Bends are very important pipe fitting which are used very frequently for changing direction in piping system. Piping Elbow and Piping bend are not the same, even though sometimes these two terms are interchangeably used. A BEND is simply a generic term in piping for an "offset" – a change in direction of the piping. It signifies that there is a "bend" i.e., a change in direction of the piping (usually for some specific reason) – but it lacks specific, engineering definition as to direction and degree. Bends are usually made by using a bending machine (hot bending and cold bending) on site and suited for a specific need. Use of bends is economic as it reduces number of expensive fittings. An ELBOW, on the other hand, is a specific, standard, engineered bend pre-fabricated as a spool piece (based on ASME B 16.9) and designed to either be screwed, flanged, or welded to the piping it is associated with. An elbow can be 45 degree or 90 degree. There can also be custom-designed elbows, although most are

categorized as either "short radius" or long radius". In short "All bends are elbows but all elbows are not bends". Whenever the term elbow is used, it must also carry the qualifiers of type (45 or 90 degree) and radius (short or long) – besides the nominal size.

4.10. Pipe hose:

A hose is a flexible hollow tube designed to carry fluids from one location to another. Hoses are also sometimes called pipes (the word pipe usually refers to a rigid tube, whereas a hose is usually a flexible one), or more generally tubing. The shape of a hose is usually cylindrical (having a Circular cross section). Hose design is based on a combination of application and performance. Common factors are size, pressure rating, weight, length, straight hose or coil hose, and chemical compatibility. Hoses are made from one or a combination of many different materials. Applications mostly use nylon, polyurethane, polyethylene, PVC, or synthetic or natural rubbers, based on the environment and pressure rating needed. In recent years, hoses can also be manufactured from special grades of Polyethylene (LDPE and especially LLDPE). Other hose materials include PTFE (Teflon), stainless steel and other metals. To achieve a better pressure resistance, hoses can be reinforced with fibers or steel cord. Commonly used reinforcement methods are braiding, spiraling, knitting and wrapping of fabric plies. The reinforcement increases the pressure resistance but also the stiffness. To obtain flexibility, corrugations or bellows are used. Usually, circumferential or helical reinforcement rings are applied to maintain these corrugated or bellowed structures under internal pressure.

4.11. Reservoir:

A reservoir is a storage space for fluids. These fluids may be water, hydrocarbons or gas. A reservoir usually means an enlarged natural or artificial lake, storage pond or impoundment created using a dam or lock to store water.

Reservoirs can be created by controlling a stream that drains an existing body of water. They can also be constructed in river valleys using a dam. Alternately, a reservoir can be built by excavating flat ground and/or constructing retaining walls and levees. Tank reservoirs store liquids or gases in storage tanks that may be elevated, at grade level, or buried. Tank reservoirs for water are also called cisterns.

For our application we use a water can for storing the fluid.

4.12. Fasteners:

A fastener is a hardware device that mechanically joins or affixes two or more objects together. Fasteners can also be used to close a container such as a bag, a box, or an envelope; or they may involve keeping together the sides of an opening of flexible material, attaching a lid to a

container, etc. There are also special-purpose closing devices, e.g. a bread clip. Fasteners used in these manners are often temporary, in that they may be fastened and unfastened repeatedly.

Some types of woodworking joints make use of separate internal reinforcements, such as dowels or biscuits, which in a sense can be considered fasteners within the scope of the joint system, although on their own they are not general purpose fasteners. Furniture supplied in flat-pack form often uses cam dowels locked by cam locks, also known as conformat fasteners. Items like a rope, string, wire (e.g. metal wire, possibly coated with plastic, or multiple parallel wires kept together by a plastic strip coating), cable, chain, or plastic wrap may be used to mechanically join objects; but are not generally categorized as fasteners because they have additional common uses. Likewise, hinges and springs may join objects together, but are ordinarily not considered fasteners because their primary purpose is to allow articulation rather than rigid affixment.

There are three major steel fasteners used in industries: stainless steel, carbon steel, and alloy steel. The major grade used in stainless steel fasteners: 200 series, 300 series, and 400 series.

V. DESIGN OF THE VEHICLE

5.1. Introduction:

Computer-aided design (CAD) is the use of computer systems to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations.

5.2. CAD Model:

The CAD Model of our Multi Utility Agricultural vehicle was done in **Creo 3.0 Software**.

Fig 5.1.CAD Model of our Proposed Vehicle-1



Fig 5.2.CAD model of our proposed Vehicle-2



Fig. 5.3 analysis of vehicle.(max. stress developed)

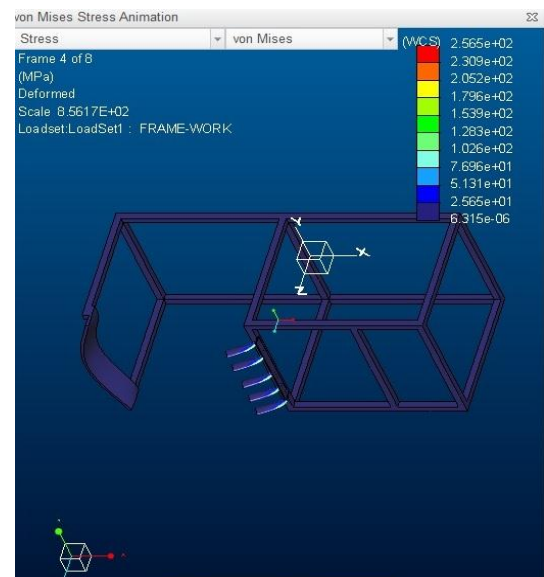
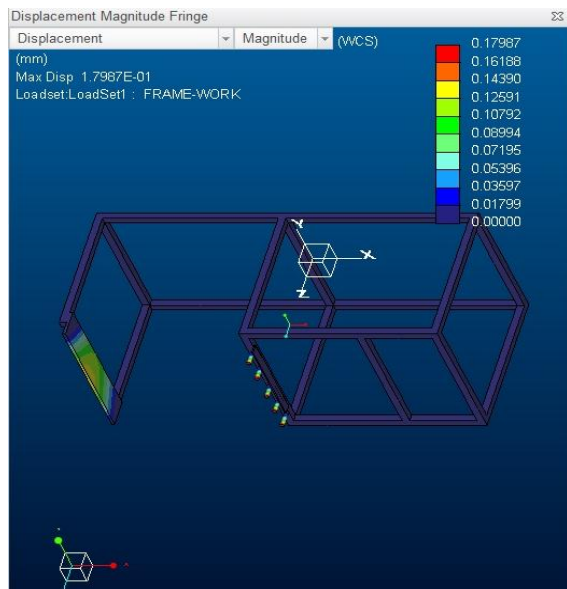


Fig. 5.4 analysis of vehicle (max. Displacement)



5.3. Construction and Working:

Multi Utility Agricultural vehicle works on the simple concept that “Rotary motion gets converted into linear motion”. When the vehicle is pushed in front, the wheels start rotating accordingly. That is the front wheel connected to the shaft via sprocket and chain rotates. This makes the sprockets rotate which in turn rotates the Round steel plate. The Connecting link connects the actuating rod and the round steel plate, thus thereby actuates the pump. The Discharge from the pump is passed via the pipe hose, thereby spraying the pesticide from the reservoir. Meanwhile, for the same motion we take out another rotary motion via another pair of chain and sprocket. The Shaft is made to rotate along with the link, which has the slot for sowing the seed. The link reciprocates along the Rectangular slot via the sower frame. Thereby, allows a seed for every rotation

VI. SPECIFICATIONS AND MATERIALS OF COMPONENTS

Table 6.1: List of Components, Their Specifications and Dimensions

S.NO	COMPONENTS	SPECIFICATI ONS	MATER IALS
1.	Roller chain for pump actuation	Small sprocket dia.=108mm Large sprocket dia.=237mm Length of chain=1728mm	Steel(spr ocket)

2.	Roller chain for seed sower	Small sprocket dia.=121.5mm Large sprocket dia.=121.5mm Length of chain=1143mm	Steel(spr ocket)
3.	Ball bearings	bearing no.300 basic dynamic load rating C=6.5KN	Steel
4.	Shaft diameter	diameter= 20mm	M.S.brig ht bar
5.	Seed sower	Circumference =314mm	
6.	Pump	Speed=40rpm, discharge=1000 m ³ /s, diameter=70mm, length=175mm	Stainless steel
7.	Pipe Bends, Couplings and Elbows	Diameter= 20mm	Galvanis ed iron
8.	Pipe hose	Diameter=20mm	Plastic
9.	Cycle wheel	Diameter=35cm	Steel
10.	Frame-square block	Area=15ft*15ft	Mild steel
11.	Connecting link	30cm*3cm*1cm	Mild steel
12.	Round steel plate	Diameter=20cm	Steel
13.	Weed Plate	61 cm *5cm *1cm	Stainless steel
14.	Screw rod	M20	Mild steel

VII. FINAL FABRICATED MODEL



VIII. MERITS AND DEMERITS

8.1. Merits:

- ❖ It ensures simple and safety operation.
- ❖ It is more suitable for small farmers.
- ❖ It does not require any maintenance.
- ❖ Cost of the machine is very less.
- ❖ Human effort in pumping is saved.
- ❖ Less tiresome as compared to the conventional
- ❖ Sprayer as the tank is carried on vehicle.
- ❖ Electricity not required.

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8.2. Demerits:

- ❖ It has the manual type mechanism depending upon the seeds.
- ❖ It is designed to suit only for small farmers.
- ❖ Overflow of seeds.
- ❖ Free movement of the vehicle.

IX. CONCLUSION

The Multi Utility Agricultural Vehicle is purposely design for the farmers having small farming land say 5-6 acre. It is suitable for spraying, ploughing, seed sowing, weeding and tilling at minimum cost for the farmer so that he can afford it. The equipment will results more beneficial when it is subjected to moist soil for weeding purpose, due to moist soil the weed cutter can easily penetrate and dig out the soil and hence will easily accomplished the weeding process. The performance of the equipment will increase when it is operates on the smooth surface or less uneven surface and also it will be more effective when it is used on the crop shaving nearly similar height and having the less space between two crops.

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