Abstract:
Agricultural industry is one of the major industries driving our country. The equipment's that have been used in agricultural has evolved over the period of history. The processes involved in agriculture like seed sowing, watering, ploughing and level of the soil are taken up by using different set up of components of the system. When the engine starts the vehicle, movement take place along with adjustable ploughing tool digs the soil. Seed sowing could be performed with the help of motor the circular plate rotates take seed from hopper and place into the soil. After the seed sowing leveling of soil take place. Then the water is pouring to the surface of the bed. Despite of all these benefits multi-purpose agricultural vehicle performs the various operations like ploughing, seed-sowing, water-pouring and soil-leveling. In conventional method it requires a greater number of employees and more time consuming this necessitates the development of multi-purpose vehicle. In this direction literature survey, market survey and concept generation were carried out and according to the literature survey the best concept was selected based on concept selection strategy is based on chain and sprocket mechanism because of its ease of operation. In this mechanism specially designed circular plate is attached to the shaft made of mild-steel material and its attached to the engine through chain-drive and circular plate drops the seed according to the requirement and collecting tank pour sufficient amount of water and furrow opener also level the sand after completing its operation. The prototype model is tested and initial result indicated that equipment has reduced manual effort, increased productivity with reduction of overall time compared to traditional method for agriculture. The multi-purpose agricultural vehicle is designed and fabricated with additional safety measures.

Keywords: Ploughing, Seed sowing, Water pouring, Chain and Sprocket mechanism, Cultivation, Agriculture, Operation.

1. INTRODUCTION
Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. It has to support Almost 17 percent of world population from 2.3 percent of world geographical area and 4.2 percent of world’s water resources. In developing countries like India mechanization of agriculture was started on the use of improved hand tools and bullock drawn improvements. Farm mechanization aims at higher production rate reduction in human drudgery. India’s achievements have been increasing tremendously, but not in mechanization. One of the barriers achieving complete mechanization is the land holdings and its fragmentation. Due to small land holding is not possible to mechanize all the farming operations. Large machines cannot be operated these small farms. Also, our farmers cannot afford to buy large costly machines. One of the most important process in agriculture to increase revenue is seed sowing. Sowing is an art of placing seeds in the soil to have good germination in the field. An area or object that had seeds planted will be described as being sowed. Among the major field crops, ground nut, corn, oats, wheat, grasses and legumes are seeded, and maize and soybeans are planted.

The proper seed sowing gives a following result
a. Correct amount of seed per unit area.
b. Correct depth at which seed is placed in the soil.
c. Correct spacing between row-to-row and plant-to-plant.

Different types of seed sowing methods,
(i) Broadcasting
In the figure 1 shows the Broadcasting is the process of random scattering of seed on the surface of seedbeds. It can be done manually or mechanically both. When broadcasting is done manually, uniformity of seed depends upon skill of the man. Soon after broadcasting the seeds are covered by planking or some other devices.

Figure 1.1 Broadcasting
(ii) Seed dropping behind the plough
In the figure 2 shows that is very common method used in villages. It consists of a bamboo tube provided with a funnel shaped mouth. One man drops the seeds through the funnel and other man handles the plough and the bullocks. This is a slow and laborious method.
1. Sharath Chandra. N, et al., MAE (Multipurpose Agriculture Equipment) has developed to meet agriculture needs & find new ways to improve efficiency. To reduce and target energy inputs in more effective ways than in the past. The advent of new concept gives the opportunity to develop a completely new range of agricultural equipment based on small smart machines that can do the right thing, in the right place, at the right time in the right way. The various components required for building the multipurpose agricultural equipment has been designed as planned. MAE is single system which can perform multi operations like Sowing, fertilizer Chemical sprayer, Weeding and inter cultivation. It can also be used for local transportation purpose as a bicycle. MAE will reduce external charges like fuels; electricity etc. MAE this will be helpful for poor farmers. The equipment weight is around 8 to 10 kg (Excluding bicycle attachment) thus it can be carried easily in farmland.

2. Shreeharsha B T, et al., The paper aims on the design, development and the fabrication of the vehicle which can dig the soil, sow the seeds, leveler to close the soil and pump to spray water, these whole systems of the vehicle works with the battery and solar power, the vehicle is controlled by toggle switch. 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. Overall performance of the machine we can definitely say that the project will satisfy the need of small-scale farmer, because they are not able to purchase costly agricultural equipment the machine required less man power and less time compared to traditional methods.

3. H.A. Hussain et al., The multipurpose farming machine is doing four operations i.e. ploughing, seed sowing irrigation and transportation purpose. The multipurpose farming machine is driven by 100cc engine. The machine is divided into two parts assembly. assembly is the main machine. The part-assembly is doing three operations i.e. Ploughing (also called as loosening of soil), seed sowing and irrigation. The main aim of joining part-2 assembly to the machine is transportation goods, seed, fertilizers etc. from farmer home to farming place or farming place to farmer home. This multipurpose farming machine has considerable potential to greatly increase productivity of crops. So, I am designing and fabricating a multipurpose farming machine which will do multiple-operation simultaneously i.e. ploughing, seeding, irrigation and carrying or transporting goods. This machine is more beneficial to small farmer who cannot afford farming equipment at higher cost. And one person can be easily handling this machine.

Summary of the Literature survey
In our project, the seed sowing machine design in such a way that it not only does the seed sowing operation but also do the multiple operations like ploughing using furrow opener, and loosening the soil by freely rotating bearing and shaft mechanism and also closing the soil by furrow closer and water pouring from the tank. These are works on the Chain and sprocket mechanism.

2. OBJECTIVES
The main aim of the project is to develop multipurpose agricultural vehicle and to achieve multiple operations in one single machine.
- To achieve proper distance in two seed in seeding mechanism for proper nutrition and growth of plants.
- To adjust proper depth in variable soil in any weather condition.
- To provide this machine in lowest cost.
- Is to put the seed in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed.

3. METHODOLOGY

3.1 WORKING PRINCIPLE
The figure 3.1 shows the working principle of multipurpose agricultural vehicle and it works on the chain and sprocket mechanism and it receives the power form Internal combustion engine. Here engine is placed on the rear side of the vehicle, output shaft from the engine is connected to the rear axle of the vehicle and required speed of the vehicle achieved by accelerator. Simultaneously another stepper motor is used to sowing the seed from bucket to the surface of the bed. Here stepper motor connected to the shaft below the seed sower equipment and its used to maintain the same speed to provide the rotational effect as that of rear axle rotates. As this shaft consists of two circular plates and made a slot at specified distance to easily pick the seeds from the hopper as the rear axle wheels turns due to power transmission from the engine, seed are dropped by the circular plate and the circular plates are turned in clockwise direction and seed is dropped into the ground. We are maintaining the speed of the machine very low so it produces maximum amount of torque. Hence the model can be run smoothly on agricultural land. As per deign of our project it not only does seed sowing but also does the multiple operations to make the seed sowing process more efficiently and also to get good nutrition crops. These operations would solve the problem.
faced by earlier methods. These operations done by the model only after the agricultural land is processed by tractors. The multiple operations or working conducted by our model is:

- Seed bed preparation
- Seed sowing
- Leveling of the soil
- Water pouring

Figure 3.1. Working principle of Multipurpose Agricultural vehicle

4. DESIGN AND CALCULATIONS

The main objective of the project is to design and develop an eco-friendly vehicle. In our project, we made the design of Shaft, Chain drive, Furrow opener and closer and seed planting consecutive distances. The design calculations are given below.

NOTE: We have used K. Balaveera Reddy data hand book.

4.1. Design of shaft

It is a rotating member, in general has a circular cross-section and is used to transmit power. The shaft we used is a solid-Shaft. The shaft is generally acted upon by bending moment, torsion and axial forces.

Diameter of the shaft = 15mm
Length of the shaft = 620mm

We selected chain drive for power transmission.

Material used is MILD STEEL

Ultimate tensile stress, Sut=740 N/mm²
Yield stress, Syt =600 N/mm²

4.1.1 Calculation of Shear stress,

\[ \tau_s = 0.75 \times 0.3 \times 600 \]
\[ \tau_s = 126 \text{ N/mm}^2 \]

\[ \tau_s = 0.75 \times 0.18 \times 740 \]
\[ \tau_s = 99.9 \text{ N/mm}^2 \]

For safer design we have selected minimum value of the shear stress. \( \tau_s = 99.9 \text{ N/mm}^2 \)

4.1.2 Calculation of Torque

Assume, Power required =5 kW (Maximum engine torque from 2-stroke engine @ 5500rpm)

Torque

\[ T = 9.55 \times 10^6 \times \frac{P}{n} \text{ (eq}3.3a, \text{ pg.} 50) \]

where, \( n \) = Number of rotations of shaft in rpm.

\[ T = 9550 \times 1000 \times \frac{5}{300} \]
\[ T = 159166.67 \text{ N-m} \]

4.1.3 Calculation of Axial Force

\[ T = F \times R \]
\[ 159166.67 = \text{Force} \times 90 \]

Force, \( F = 1768.5 \text{ N} \)

4.1.4 Calculation of Bending moment,

\[ \sum M_A = 0 \]
\[ 1 \times 150 + 1768.5 \times 300 + 1 \times 450 = R_B \times 600 \]
\[ R_A = 885.25 \text{ N} \]

Hence, Maximum Bending moment occurs at Point C, \( M_C = 26560 \text{ N-mm}^2 \)

4.1.5. Shaft diameter calculation

\[ D^3 = \frac{16}{\pi^3} (K_b \times \tau_s)^2 \text{ (eq}3.6b, \text{ pg.} 501) \]

Where, \( \tau_s \) = Permissible shear stress,
\( M_b \) = Bending moment,
\( M_t \) = Twisting moment,
\( K_b \) = Shock factor,
\( K_t \) = Endurance factor.

Select the value of \( K_b = 1.5 \) and \( K_t = 1 \). (From Data hand book)

\[ D^3 = \frac{16}{\pi^3} (1.5 \times 265650)^2 + (1 \times 159166.67)^2 \]

Diameter of shaft, \( D = 11.20 \text{ mm} \)

We have selected Standard diameter of the shaft is \( D=20\text{mm} \) for the better performance and is also available in market survey.

4.2. Design of furrow opener

The major function of furrow openers is to create a well-defined groove in the soil where the seed can be placed at the proper depth. Furrow opener type used is Shovel Type furrow opener

Material = Forged steel
Length = 32 cm  
Width = 6 cm  
Thickness = 2mm  
Drag force of soil for each furrow opener = 4400 N

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Soil Resistance, kg/cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>0.12</td>
</tr>
<tr>
<td>Medium</td>
<td>0.15</td>
</tr>
<tr>
<td>Heavy</td>
<td>0.20</td>
</tr>
<tr>
<td>Very Heavy</td>
<td>0.25</td>
</tr>
</tbody>
</table>

4.2.1 Calculation of Draft Force

Force exert on the opener is $D = K_o \times w \times d$

$D$ – Draft force, Kgf  
$K_o$ – Specific Soil Resistance – 0.25 kg/cm²

Take $K_o$ – 3 times higher as a factor of safety

$w$ – Width of opener, cm  
$d$ – Depth of opener, cm

$D = 3 \times 0.25 \times 6 \times 48$

$D = 144$ Kgf

Take factor of safety – 3 (assumed)

$3 \times 144 = 440$ Kgf = 4300 N is the Total Draft

Hence, the design consideration of furrow opener is correct.

4.3. Design of seed planting consecutive distances

Calculation on distance between the Sowing plate. The seed metering plate is connected to the motor for seed sowing purpose,

Material of circular plate = Wood  
Diameter of circular plate = 180 mm  
No of slots in circular plate = 4 Slots

Practical consecutive distance = 120 mm

Circumference of Circular plate = $\pi \times D$

$= \pi \times 180$

$= 565.5$ mm

Distance between of sowing seed

$= \frac{\text{Circumference of circular plate}}{\text{number of slots}}$

$= \frac{565.5}{4}$

Distance between of sowing seed = 138 mm

Hence, the design consideration is accepted.

FABRICATION AND ASSEMBLY

The fabrication of the device is one of the important works which is to be perfect for working of the device. The fabrication is done to give each part required dimensions and finishing. If little error occurs in any dimensions, then the assembly of the parts cannot be done perfectly. So, this is the major problem generally we encounter in our design fabrication.

5.1. Chassis and frame mounting

The main frame is the skeletal structure of the seed sower on which all other components are mounted. The two design factors considered in the determination of the material required for the frame are the weight and strength. In this model, we have used mild steel and having a cross-section of rectangular frame were used to give the required rigidity. Arc welding is used to weld the chassis.

5.2 Assembly of 2-Stroke engine to the Frame

In the figure 5.2 Engine assembled to the front end of the frame with the help of fasteners. The main function of the engine is to transmit maximum power of 5KW at 5500 rpm to run the various other parts of the vehicle.

5.3. Assembly of Furrow opener to the frame

In the figure shovel type of furrow opener is fixed to the frame with the help of mechanical fasteners like a nut and bolt. The adjustable furrow opener permits the agricultural to planting at different depth by providing slots at different lengths.
5.4 Assembly of seed hopper to the Frame
In the figure seed hopper is fixed to the solid frame and having a capacity of 0.75 to 1 kg. Hopper is provided with a small at the center to drop the seed and with design wastage of seeds can be avoided.

Figure.5.4. Assembly of seed hopper

5.5 Assembly of water tank to the Frame
In the figure 5.5 water tank is placed above the front of the vehicle and water tank with a capacity of 3 to 4 liters. The water is poured after seed sowing through pipe connection and it does not require any power source because the tank placed at higher head therefore the water flows from higher level to lower level.

Figure.5.5. Assembly of water tank

5.6 Final assembled model
In the figure 5.6 shows the final assembled model of multi-purpose agricultural vehicle with the assembly of two-stroke engine are mounted over the frame along with wheel assembly and collecting tank of 3 to 4 liters capacity of water and also furrow opener is attached to frame with a shaft and its running and performing operations like ploughing, seed sowing etc with an chain and sprocket mechanisms.

Figure.5.6. Final assembled model

6. RESULTS AND DISCUSSION
Practically our multipurpose agricultural vehicle can be used for ploughing, seed sowing, water pouring, leveling of soil. All the parts are connected in such a way that in every stage of agriculture the vehicle can be rearranged or easily assembled with fasteners to required lengths and specification 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 labour effort and expenses. The whole idea of multipurpose vehicle is a new concept and successfully implemented in real life situations. This greatly depends on the number of slots and diameter of the circular disk.

<table>
<thead>
<tr>
<th>Seed name</th>
<th>Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beet</td>
<td>7.5</td>
</tr>
<tr>
<td>Cabbage</td>
<td>3.5</td>
</tr>
<tr>
<td>Carrot</td>
<td>3.5</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>3.5</td>
</tr>
<tr>
<td>Sweet Corn</td>
<td>13.5</td>
</tr>
<tr>
<td>Okra</td>
<td>7.5</td>
</tr>
<tr>
<td>Chickpea</td>
<td>10</td>
</tr>
<tr>
<td>Ground Nut</td>
<td>4</td>
</tr>
</tbody>
</table>

Table.2. Diameters Of Different Seed

Comparison table
The comparison table is done by assuming one acre of land is being processed.

<table>
<thead>
<tr>
<th>Sl no</th>
<th>Parameter</th>
<th>Manual</th>
<th>Current seed sower</th>
<th>Designed Seed sowing machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Man power</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Time Taken to plough</td>
<td>1hr</td>
<td>30min</td>
<td>30min</td>
</tr>
<tr>
<td>3</td>
<td>Sowing technique</td>
<td>Manual</td>
<td>Automatic</td>
<td>Automatic</td>
</tr>
<tr>
<td>4</td>
<td>Time Taken to Sow</td>
<td>5hr</td>
<td>3hr</td>
<td>3hr</td>
</tr>
<tr>
<td>4</td>
<td>Distance between seeds</td>
<td>Fixed</td>
<td>Fixed</td>
<td>Not Fixed</td>
</tr>
<tr>
<td>5</td>
<td>Wastage of seed</td>
<td>Less</td>
<td>Moderate</td>
<td>Less</td>
</tr>
<tr>
<td>6</td>
<td>Required Energy</td>
<td>Very High</td>
<td>Moderate</td>
<td>Less</td>
</tr>
<tr>
<td>7</td>
<td>Pollution</td>
<td>NO</td>
<td>More</td>
<td>Moderate</td>
</tr>
<tr>
<td>8</td>
<td>Cost of machine</td>
<td>Less</td>
<td>Very high</td>
<td>Less</td>
</tr>
</tbody>
</table>

Table.3. Comparison Table

The designed seed planter machine has considerable potential to greatly increase productivity. It can be readily made from local components in workshops. By using of this machine, achievement of flexibility of distance and depth variation for different seed plantation is possible.

7. CONCLUSION
This project entitled Design and Fabrication of Multipurpose Agriculture Vehicle is successfully completed and the results obtained are satisfactory. It will be easier for the people who are going to take the project for the further modifications. After the development and trail on the “Multipurpose Agricultural vehicle (Seed Sower)” conclusion which we made are as follows:
Based on the overall performance of the machine we can definitely say that the project will satisfy the need of small-scale farmer, because of their requirements is full filled. The machine requires less man power and less time compared to traditional methods, the unit cost of the product can greatly reduce by mass production and we hope this will satisfy the partial thrust of Indian agriculture. Today’s major labour problem in farming can be solved.

8. REFERENCE

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