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# Multipurpose Agriculture Machine

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**Abstract -** *Farming is the backbone of Indian economy. In this agriculture sector, there is a lot of fieldwork, such as ploughing, reaping, sowing etc. these operations previously were done by traditional equipment's. This field faces some problems such as how to minimize the losses, how to increase productivity and how to minimize cost. In India, two types of agricultural methods are used, manual method (conventional method) and mechanize type method. In Manual method they are working with those equipment's was tedious and laborious. Also traditional ways are time consuming. Mechanization involves the use of a hybrid device between the power source and the work. This hybrid device usually transfers motion, such as rotary to linear, or provides sample of mechanical advantages. Mechanization in agriculture made farming easier and quick. There are variety of machines are available for almost every task in agriculture. Beginning with preparing land to the harvesting of crop and further process can be done by machines. This machines not only easier way to do this task but also very efficient. The agriculture machineries that are used now days are costlier and cannot be afforded by most of farmer with rural background. Most of the farmers in India own very small pieces of land and owning these costlier machines may not be feasible for them. Most farmers are still stick to their old ways. The fact that most of the farmer are low level income earners, they cannot invest on the purchase of large machine. Considering above mentioned factors there is need to develop such an equipment, which will be of multiple use and especially will be of low cost.*

***Key Words*: Ploughing, digging, seed sowing, fertilizer pouring, soil covering.**

## 1. INTRODUCTION

Agriculture being one of the major occupations in India, it is very essential to discover and implement new idea in this field, though lot of work has been done in this area. Talking about past in 1951, there were just 8635 tractors being used and every one of them were imported. Creation of tractors initiated during 1961-62, turning out 880 of them. This figure has crested to more than 262,000 out of 1999-2000. The offer of tractors in 2003-2004 was 172,000. Now, India is the biggest maker of tractors on the planet. Farmers nowadays pay plenty of cash on machines that facilitate them to decrease labor work and increase yield of crops. Due to the fact that agriculture plays an important role in the development of the economy of our country, some problem are still associated with the production of agriculture. The attitude of the farmer towards production of crops, little did they know about new technology of modern farming. It is essential to increase the productivity of agriculture and farming processes to improve yields and cost effectiveness with this technology, so we are introducing this multipurpose agriculture machine. Generally, cultivation of any crop involves various steps like ploughing, harvesting, sowing, and irrigation. Farmer has to use various agricultural equipment's and labors for caring out these steps, our purpose is to combine all the individual tools to provide farmers with multipurpose equipment which implements all the scientific farming techniques and specifications, suitable for all type of seed to seed cultivation with minimum cost as possible. All this can be done in this same machine. This multipurpose agro machine is designed and fabricated as multipurpose equipment which is used for agricultural processes like ploughing, sowing seeds and sprinkling water.

## 2. OBJECTIVES

The design of multipurpose agro equipment machine will help Indian farmers in rural side and small farm. It will reduce the cost of seed feeding, pesticides sprinkling and crop cutting the field and will help to increase economic standard of an Indian farmer.

1. The main objective of this project is to design and fabricate multipurpose agriculture machine.

2. To minimize the cost so that it should be affordable for everyone.

3. To reduce Human efforts, all operations can be performed by single person, thus it will reduce the labor cost.

4. To reduce amount of time for operation.

## 3. PROBLEM STATEMENT

In India, Agriculture with its allied sectors, is the largest source of livelihoods. 70 percent of its rural households still depend primarily on agriculture for their livelihood, with 82 percent of farmers being small and marginal. These farmers can't afford costly equipment's and machines. And they have to put more human and animal effort.

1. Lack of mechanization in farming.
2. Required excess efforts for different process.
3. Required more man power.
4. Excess time consumption for performing individual process.

These are the main points to work on, our project will work on and to minimize these problems them.

## 4. LITERATURE REVIEW

1.M.V. Achutha, Sharath Chandra. N, Nataraj.G.K, [2016], In this research paper author has mentioned the four plans for Design and development. Basic concept is from bicycle on bicycle they have doing operation. And their expected cost is nearby about 24,000/-Rs. Also, they have done the analysis on Ansys software to check on load condition to avoid the failure problem while fabrication of the project. They are doing one or two operation on each plan. Here more manpower is required as they are not using the engine. The Conclusion from the paper is to decrease the cost. From this paper we are looking how they are doing the operation to minimise the cost and the analysis are done.

2. D.A. Mada, Mahai, [2013], In this research paper author has mentioned the magnitude of automation in agricultural field by giving some instance. The conclusion from the paper was need of multifunctional vehicle for pre and post harvesting. We have taken this as base of our research and take further changes in production of our multipurpose agricultural vehicle.

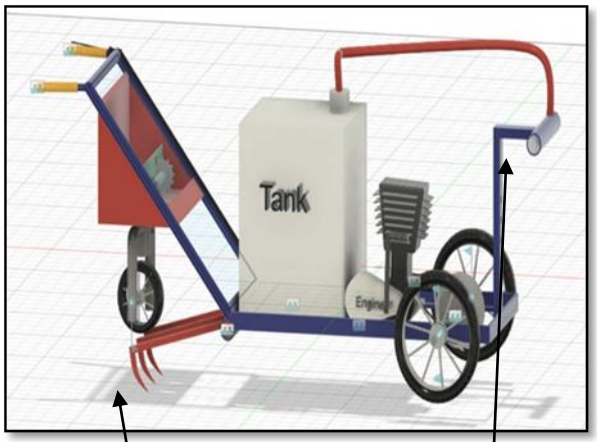
3. V.K. Tewari, A. Ashok Kumar, Satya Prakash Kumar, Brajesh Nare[2012] In this research papers author have done case study on farm mechanization in west Bengal as being part of India it gives clear status about availability and progress in India. This ensured us to take right steps compared to current steps.

4. 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 taken those points in consideration while designing a sustainable multifunctional agricultural vehicle.

## 5. METHODOLOGY

The operation which needs to be perform, the equipment is attached to the machine and by starting the engine the machine will move forward by performing desired work.

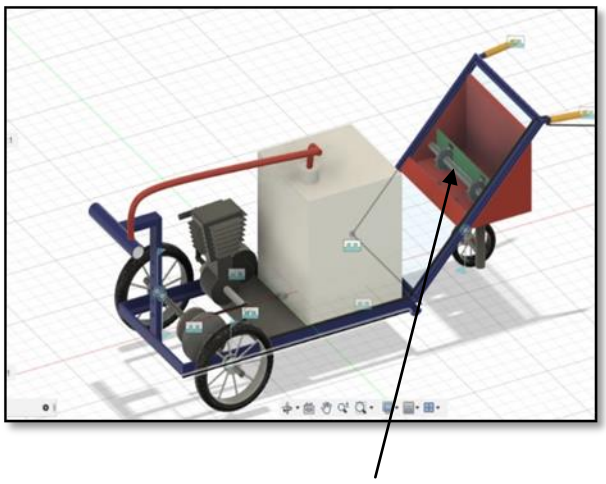
**Ploughing :** For ploughing we have to attach the equipment to vehicle and start engine by giving acceleration vehicle will move and the plough will take out the sand and ploughing will perform[11].




**Sprinkler :** In the sprinkling method water is sprayed into the air and allowed to fall on the ground surface. The spray is developed by the flow of water under pressure through small orifices or nozzles. The pressure is usually obtained by pumping with the help of the DC Motor which acts as a pump. Storage tank is used to store water or chemical fertilizers and PVC pipes are used to carry that fluid from the tank to nozzles for spraying operation[10]. With selection of nozzle sizes, operating pressure and sprinkler spacing we can supply the amount of water required for the different crops. Adjustable pipes are use at front end so that we can extend nozzle pipes and cover larger spraying area.

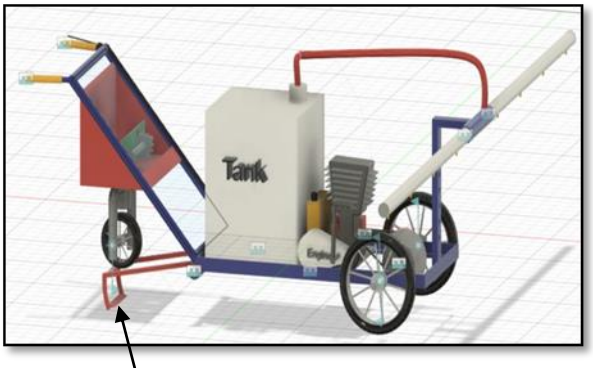
**Sowing operation :** In the seed sowing operation seeds are placed in soil. This operation is done after the ploughing is completed. Mechanism used for this operation having seed storage box from that seed are get collected with help of gear type collector. The seed are get collected after equal interval

of time and this is achieve with help of the stepper motor . Because of seeds collected after equal interval of time they get sowed at equal distance in the soil and seeds are sowed in orderly mannered. Once seed collector drop seed into the hole provided at bottom of box , they are carried from top of the mechanism to bottom for sowing operation with the help of the pipe [9]. Further they get sowed properly in the soil with help of projection provided .



**Seed sowing**

**Kolapani operation:**Kolapani is device used to cut the unwanted grass present in between two rows of crops. Sitting on the ground and weeding hurts the knees. This work can be done vertically using improved hand clamps. If the machine is used, better work can be done by reducing the number of workers.




**Kolpani yantra**

**Working:**

Let's us discuss about working of the project. Firstly we can run our machine on road as well as in farm. The engine is used to transmit the motion from engine to shaft. To control the vehicle we have accelerator and brake system on handles. The arrangement of the third wheel on the backside is made to run on road which can be adjust up and down according to need.i.e. Suppose that we are running our machine on road, wheel will be kept down so as to balance the vehicle. On reaching the farm we have to lift the wheel up. Then the work which has to be done we have to arrange the equipment to base and carry on the work by starting the engine and accelerate the machine to move the our model if the land is hard then we require more power so can do operation in slow speed so that operation can perform in good way, if the farm land is soft then we don't require so much power in this case can easily cover up operation in high speed so we can save our time. In short we can arrange speed according to the farm condition. While doing the spraying operation the we don't require to keep any joint attachment to the bottom side so remove all operation and 3rd wheel will be kept down if we have to cover large area then we can go in slow speed and we spraying are is smaller then we do operation in high speed as well and this way work can be done. Lastly we can stop the engine by turning off the nob.

Let's see the operations which we will be performed:

For ploughing we have to keep the 3rd wheel up and attach the equipment to vehicle and start engine and by giving acceleration the vehicle will move forward and the plough will take out the sand and ploughing will perform.

For seed bowing we use mechanism which consists of seed box, pipe and the small wheel having teeth's which will rotate by motor. The Wheel rotating through the bucket full of seeds will carry seed in the small teeth's which will fall in the funnel to pipe to ground and this is how the sowing operation will be performed.

For sprinkling water/pesticides, the tank is provided in which we store the water/pesticides. The motor will pump the water to main pipe through which it will sprinkle over the area. The range over sprinkling need to be done can be widened or shortened according to the need. This way the sprinkling operation will be done.

Kolapani is device used to cut the unwanted grass present in between two rows of crops. This work can be done vertically using improved hand clamps. If the machine is used, better work can be done by reducing the number of workers.

## 6. PARTS TO BE USED:

**Chassis :** They are made up of Mild steel it gives support to all the assembly of the machine. A chassis consists of an internal vehicle frame that supports all the objects on it. And it will absorb all the forces and supports the assembly.

**Engine :** The engine is used to run the tire of the machine with some gear and chain assembly. Specification of engine are 109 cc, air-cooled, OHC, four stroke, single cylinder, CVT Transmission engine.

**Wheels** : This are used to drive the whole machine . There are two wheels in the front side and one adjustable wheel at back end

**Plough :** A plough is one of the agricultural tools and used for the initial soil cultivation in preparation for seed sowing or planting to loosen or turn the soil. It has been used since ancient times for tiling, turning the soil and adding fertilizers.Chiesel plough is used in this project[11].

**Nozzle :** Primary function of the nozzle is to control flow rate[10]

**Brake :** A brake is a mechanical device that inhibits motion by absorbing energy from a moving system. It is used for slowing or stopping a moving vehicle . Disc / Drum brake is used in this project .

**Accelerator :** It is control the air-fuel mixture into the cylinder by control mechanism. In the carburetor engine it is placed in carburetor and it is control the air-fuel mixture. It is use to control the speed of vehicle.

**Tank:** A spray tank is a container for storing spray liquid like fertilizers and pesticides.[10]

**Gear :** It is the rotating machine part having cut teeths on it which mesh with the another toothed part to transmit the torque . Geared device can change the speed torque and direction of power source.

**Water spray pipe :** Transferring water or pesticide from tank to nozzle end for spraying operation . Plastic pipe is use for it.[10]

**Chain :** It is used to transmit the power from engine to shaft.Roller chain and sockets is very efficient method for power transmission.

## 7. EXPECTED OUTCOMES

1.Multipurpose operation can be performed on single machine.
2. Machine should easy to operate.

3.Cost of the equipment should be as low as possible. (That can be affordable to every farmer)

4.Multiple operations to be done on this machine so as to reduce time and efforts.

5.This machine should be one time investment.

6.This Machine should have less maintenance cost.

## 8. THEORETICAL CALCULATIONS:

**Design of chain drive :**

**Engine specification :** 7 hp (power)

$N_1$ =7000 rpm (speed)

$Z_1$ = 27 ....(smaller sprocket teeth)

$$i=\frac{Z2}{Z1}$$

$Z_2$=54....(bigger sprocket teeth )

Selection of pitch & calculation of PCD of sprocket

**Smaller sprocket diameter**

$$d_1=\frac{P1}{\sin(\frac{180}{Z1})} = 109.4 \text{ mm .....(psg)}$$

**bigger sprocket diameter**

$$d_2 = \frac{P2}{\sin(\frac{180}{Z2})}=218.42 \text{ mm ....(psg)}$$

**Let us select standard size of chain from psg.**

R1230
Weight per meter =0.28 kgf
Breaking load =1000 kgf

$L_P$ = 121 ... (multiples of pitches)

**Length of chain**
l= 1549.4 mm
exact centre distance

a = 514.63 mm

We select R1230 chain type where area is 0.17 $cm^2$ ,weight per meter = 0.28 kgf,breaking load = 1000 kgf ,pitch =12.7 mm

**Design of shaft**

Design torque

$T_d = \frac{\pi}{16} \times (ds)^3 \times \tau max$ ...(psg)

**Designation:**

EN36C

Ultimate tensile strength ($N/mm^2$) = 900

Yield Strength ($N/mm^2$) = 700

ASME code for design of shaft

Since the loads on most shafts is connected to machinery are not constant ,it is necessary to make proper allowance for the harmful effects of load fluctuation .[6]

ds = 15.9 mm ....(dia increased by 50%)

Standard diameter

$d_{std}$ = 25 mm

**Design of bearing:**

Let us we select bearing

NRB 6205

d= 25 mm deep groove ball bearing

D=52 mm

Fa =177.5 N

Fr=806.81 N

From psg 4.13

C= 1100 KGF=11000 N

Co = 710 kgf =7100 N

Pe =(X V Fr + Y Fa) S Kt ...(psg )

Pe = 968.172 N

$L_{10} = (\frac{C}{Pe})^K$

K= 3 ....Ball bearing

$L = \frac{N \times 60 \times Lh}{10^6}$

$L_h$ = 2347.26 hrs

**Calculation for nozzle flow rate, pump capacity**

**Formula used-**

$$gpm = \frac{gpa \times mph \times w}{5940} \quad .....[4]$$

gpm = gallons per minute, the nozzle flow rate.

gpa = gallons per acre, a decision made based on label recommendations, field conditions, spray equipment and water supply.

mph = the ground speed you select, miles per hour.

w= band width or spacing between nozzles in inches.

Pump Capacity= (Boom requirement)*(1.2) Boom requirement=Nozzle flow rate (gpm).

1.2=factor to provide agitation and offset pump wear (20% greater capacity)

For 1 acre of land we require 60lit. Solution (as a rule of thumb)

Gpa =gallons per acre

=15.50

(3.875 lit = 1 gallon)

The average walking speed of man is 5km/hr.

= 3.1 miles/hr.

Therefore, Mph (miles per hour) =velocity ofvehicle

= 3.1mph

W = band width (spacing of nozzles)

= 120 cm = 47.2 inches

Therefore, **Nozzle flow rate**

(gpm) = (gpa*mph*w)/5940

gpm=0.38

Pump Capacity= (nozzle flow rate )*(1.2)

=1.764 lit/min

Hence, the nozzle flow rate of our design is 0.38(gpm) & Pump capacity 1.764 lit/min.

**Seed sowing calculations:**

Sliding velocity of the seeds

$V = \frac{\pi dN}{60}$

V = 1.57 m/s.

**Calculation of distance between two seeds**

As we have maintained the gear ratio as 2 between rear wheels and the seeder, one revolution of the rear wheel will transmit one revolution to seeder mechanism.

As the radius of the rear wheel is 70mm, for one revolution of the rear wheel the distance (D) travelled is given by,

D = 2 x π x radius of rear wheel

D = 440 mm (approx.)

This is large distance between two seeds. Hence we have to provide two slots in the seeder/profiler so that distance can be reduced between two seeds. Therefore, the distance between two seeds if two slots are provided will be 220 mm.

**Motor used:**

**At n = 60 rpm**

r x n = 2.42 m-rev per minute

r = 40.33 mm

The moving speed of the vehicle at this rpm can be calculated as,

Velocity = angular velocity x radius of the front wheel

Velocity = 2.7143 km/hr.

At this speed, the area that can be covered is,

Area covered = vehicle speed x space between 2 rows of ploughing blade x 2

Area covered = 1085.72 $m^2$/hr.

This means on 1 acre (4046.86 $m^2$) land, the seeds can be sown in 3 hours 45 minutes.

**At n = 100 rpm**

r x n = 2.42 m-rev per minute

r = 24.2 mm

The moving speed of the vehicle at this rpm can be calculate as,

Velocity = angular velocity x radius of the front wheel

Velocity = 4.5239 km/hr

At this speed, the area that can be covered is,

Area covered = Speed of the vehicle x space between 2 row of ploughing blade x 2

Area covered = 1809.56 $m^2$/hr.

This means on 1 acre (4046.86 $m^2$) land, the seeds can be sown in 2 hours 15 minutes

**Calculations for pump motor power requirements**

It is brushless, magnetic water pump motor,it is 12 V , 700 lph.

Water Horsepower = (Flow Rate in gpm x Water Head in feet) / 3960

Assuming water flow rate 200 lph & efficiency 55%

Water Horsepower= 0.02

Break Horsepower (BHP) = Water Horsepower / efficiency

For calculation in lpm and meters, conversion tables may be used.

General formula for the same calculation is as follows taking the specific gravity of the liquid also into consideration.

BHP = (Total Head *Flow Rate*Sp. Gravity) / (efficiency*3960)

Total head =3.03+1(friction) = 4.03

BHP = 0.4 hp

## 9 . FUTURE SCOPE

1. In the multipurpose farming machine in place of petrol engine, the diesel engine and other gasoline engine can be used for improving performance and the environmental friendly.

2. In multipurpose machine in addition to ploughing and seed sowing, the arrangement for fertilizer and manure can be made.

3. In this machine instead of sowing in two rows it may be increased further.

4. In our machine farmer is walking with machine during seed sowing and ploughing, providing seating arrangement into the machine will be beneficial.

## 10 . CONCLUSIONS

After the designing and analysis of the "Multipurpose Agricultural Machine" conclusion which we made are as follows:

Based on the overall performance of themachine 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, so if we manufacture it on a large scale its cost gets significantly reduce and we hope this will satisfy the partial thrust of Indian agriculture.So in this way we solve the labour problem that is the need of today's farming in India.
Unique machine designed to carry out the task of spraying the fertilizers and sowing of seeds is developed.The complete calculations along with the software model are presented in this paper. It overcomes the problem associated with conventional spray such as back pain due to weight carried on back on person.

This is a handy machine which will be helpful to improve the performance during farming operations.The device is made such that can be easily operated in field. The vehicle power is provided by two stroke petrol engine, and controls are given at handles. The steering mechanism is easier to operate and simple. Equipment controls are handy and easily accessible. The control switch is provided for spraying operations. Thus, this fabrication is value for money.

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