Design and Fabrication of Multipurpose Agricultural Machine

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ABSTRACT: India is an agricultural country where 70% of the populations are dependent on agricultural performance. But if we seethat as the population increases, the farm is spread out among families, and for that reason, the farmer in India owned on average only two acres of farms. Also economically, farmers are very poor due to which they are unable to purchase tractors and other costly equipment hence they use traditional methods of farming. Essentially, a lot of farmers in India also use oxen, horses and buffaloes for farming. This will not address the energy needs of agriculture relative to other countries in the world. So we are thinking that the efforts of man and animal can be replaced by advanced mechanization which will be adapted to small farmers from the point of view of the economy and effort. We are therefore developing this equipment that will meet all these needs and resolve the problem of work.

Index Terms **– Agricultural performance, Energy needs, Advanced mechanization, small farmers, Costly equipment, Economy and Effort.**

I. INTRODUCTION

Agriculture has been and will continue to be an economic cornerstone and it has been the key development in the rise of settled human civilization. The study of farming is referred to as agricultural science. Agriculture has a history of thousands of years, andits development has been motivated and defined by very different climates, crops, and technologies. Modern agronomy, plant improvement, agrochemicals such as pesticides and fertilizers, and technological advances have in many cases significantly increased crop yields, but in the meantime have caused extensive ecological damage. Agricultural food production and water management are increasingly emerging as global challenges. Mechanized farming is the process of using agricultural machinery to mechanize agricultural labor, the substantial increase in productivity of agricultural workers in modern times, and mechanical machinery has replaced many agricultural jobs previously carried out by manual labor, either through working animals such as oxen, horses and mules.

The whole history of agriculture includes numerous examples of the use of tools, such as hoe and plough. But the continued integration of machinery since the Industrial Revolution has enabled agriculture to become significantly less labor intensive, today's mechanized agriculture involves the use of tractors, trucks, combine harvesters, countless types of agricultural instruments,aircraft and other vehicles. Precision farming even uses computers associated with satellite imaging and satellite navigation to increase returns. Mechanization has been one of the main drivers of urbanization and industrial economies. In addition to improvingproduction efficiency, mechanization promotes large-scale production and may sometimes improve the quality of agricultural products. On the other hand, it can displace unskilled farm workers and cause environmental degradation, especially if it is appliedin a short-term rather than holistic manner.

II. PROBLEM DEFINITION

Nowadays with use of modern technologies new automobile vehicles/Machines or instruments are being automatically operatedor controlled.

During survey (Survey of local villages or farm) we found that, farmers are using old traditional methods for farming like bullock cart or farming by tractors. Some farmer cannot afford tractors as fuel costs high and it also spreads lots of pollution whichis very dangerous to human as well as it also affects environment. Combustion of fuel makes dangerous gases like SO_2, CO_2, SO_3, CO etc. farmer having cart has to make more effort. This both processing of cultivating and seeding consume time as well as human effort. We try to solve all problems which is face farmers during seed sowing.

As we took project title as “DESIGN AND FABRICATION OF MULTIPURPOSE AGRICULTURAL MACHINE” We will try to make a mechanism which is capable of digging, seeding seed at equal interval and leveling of land.

III. OBJECTIVES OF THE RESEARCH

The project aims on the design, development and the fabrication of the vehicle which can dig the soil, sow the seeds, leveler toclose the soil and pump to spray water. Over the past few years, there has been growing interest in developing autonomous vehiclesin agriculture. In the area of autonomous agricultural vehicles, a concept has been developed to determine whether several small autonomous machineries could be more effective than conventional large tractors and human forces. Bearing in mind the above ideology, a unity with the following characteristic is conceived; Laborer is one of the early stages in agriculture. During this process, the land is ploughed and prepared for seeding. Through this, we mean that, a plough will be used that will have a structuresimilar to the teeth at the end and will be able to reverse the top layer of soil down and back. The seeding then comes where the

seeds should be released from the tank at regular intervals and after that reservoir water sprinkled over the fallen seeds. For fertilization, the hopper is connected to the back wheel via the drive chain, so that the seeds are abandoned by giving a manual movement of the machine. At the end, the land levelling tool has been fixed with a knob so that we can adjust it according torequirements.

Fig -1: Traditional farming

IV. LITERATURE SURVEY

I. Pratikkumar V. Patel*[1], Mukesh Ahuja*[2] RESEARCH AND DESIGN OF MULTIPURPOSE AGRICULTURE EQUIPMENT. In this research paper, we found that how conventional machines can be designed into modern agricultural machine. The study also helped in the design of the fertilizer distributer that works with the help of seed hopper.

II. Dr. C.N. SAKHALE, S.N. WAGHMARE, Rashmi S.Chimote A Review Paper on " MULTIPURPOSE FARM MACHINE". In this research paper, the author has mentioned the mechanization of machine and the concept of ploughing tool. From that we understood that by replacing the ploughing teeth, the life of ploughing tool can be increased.

III. Dhatchanamoorthy. N[1], Arunkumar. J[2], Dinesh Kumar. P[3], Jagadeesh. K[4] Madhavan. P[5] Design and Fabrication of Multipurpose Agriculture Vehicle. This research paper drew our attention to the design of chassis and frame of the machine and it has helped in selecting some light weight material to lower the cost.

IV. R.M. Chandima Ratnayake University of Stavanger (UiS) Re-Design, Fabrication, and Performance Evaluation of Manual Conical Drum Seeder. From this research paper we have modified the assembly of the drum seeder and direct seeding can be done by manually operating machine.

V. Mysuru Venkataramaiah Achutha, *[2]Mysore Sharath Chandra Nagaraju, Concept Design and Analysis of MultipurposeFarm Equipment. This research paper outlines the concept of chain gear mechanism in multipurpose agriculture machine.

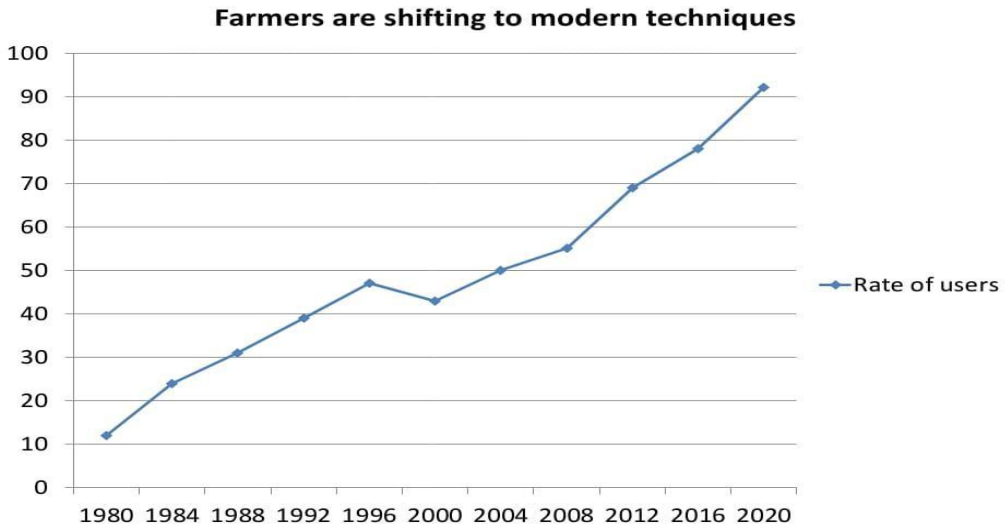

Fig -2: Utilization of agricultural equipment

- The graph clearly demonstrates that farmers have begun to use the modern technologies in place of the traditional equipment's. As a result, many farmers get accustomed to this approach and take full advantage of modern technology.

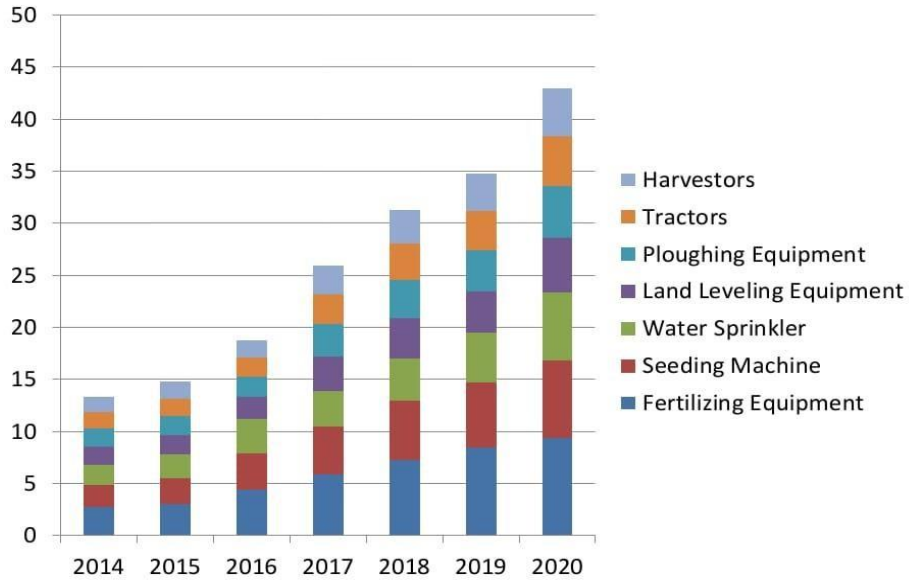

Fig -3: Demand for Different Types of Agricultural Machinery

The above graph illustrates the demand for several agricultural machines between the years 2014 and 2020. It is evident that the popularity of traditional equipments such as tractors and harvesters are considerably lower than the modern equipments. Moreover, the famers have shown more interest in Fertilizing Equipment, Seeding Machine and Water Sprinkler. However, we have designed a machine which can perform five different operations at the time. So, we can definitely say that our machine will improve the financial situation of the farmers and reduces their efforts.

V. CONSTRUCTIONAL DETAILS

Table-1 Selection of materials

S. N0	Part Name	Material Specification	Reason
1	M. S. Square Pipe	Iron	Good tensile strength
2	Wheel	Plastic	Cheaper
3	Chain	Standard	Cheaper
4	Ploughing tool	Iron	Corrosion resistance
5	Water tank	Plastic	Light weight
6	Bearing blocks	Iron	For best movement
7	Sprocket	Iron	Transmission
8	Solar Pannel	Silicon	To generate power
9	Battery(12v)	Lithium-ion	To store power
10	Water pump	Plastic	To pump the water
11	Drum seeder	Plastic	More durable &light weight

VI. BASIC CONCEPT DESIGN

For better understanding of different parts of our project first we made sketches on paper so we can understand different components of our project and get idea to how we will make project model.

VII. DESIGNING IN PARAMETRIC SOFTWARE

For the design of the final product, we made a 3D model in SOLIDWORKS Software, in which we made different individual components and finally we put together different components.

For the production of any machine, it is first necessary to make individual parts with the desired shape and dimensions containing in whole machine and then we need to assemble each of the parts together to make the final machine.

Fig -4: Ploughing tool

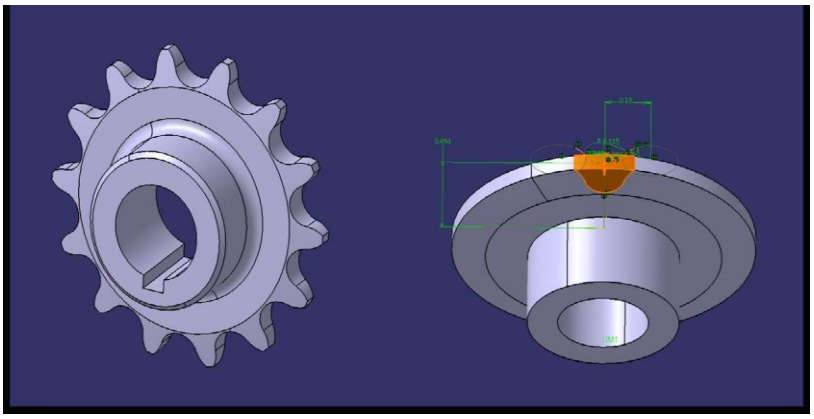

Fig -5: Sprocket

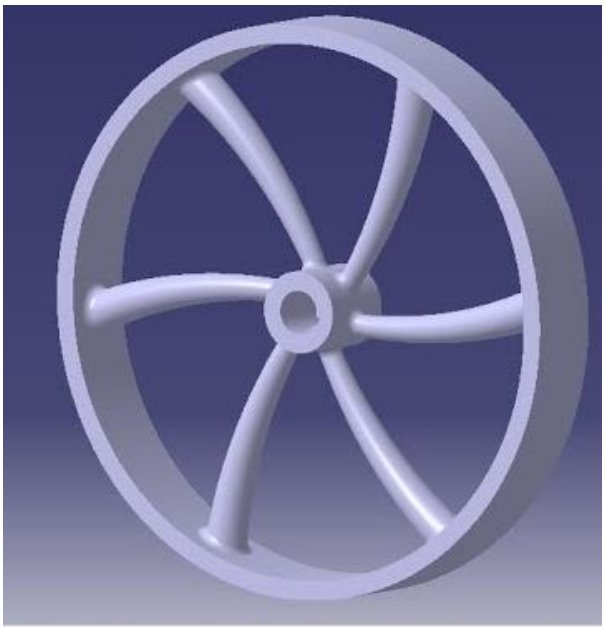

Fig -6: Wheel

VIII. WORKING MACHINE

This multipurpose agricultural machine is manually operated & designed and fabricated as multi-purpose equipment used in agricultural processes such as ploughing, seeding, water sprinkling, fertilizing and land leveling. When driven forward, it ploughs the field with the aid of a plough. The plough is adjustable in height.
The drum seeder is attached to the front wheel using the chain drive and seeding will begin with manual movement of the machine.

The fertilizer distributor is fixed to the rear wheel using the chain drive and works on the chain-gear mechanism.

The water tank is connected to the PVC pipes which have 4 holes on it and water can be sprinkled through the openingof the tap.

As in India 10-20% of farmers are rich but rest of farmers doesn't have much source to purchase heavy equipment and machines. So, here we have designed a machine which can fulfill basis needs of farming and price of machine should be very less as compared to market.

Fig -8: Physical model

IX. ANALYTICAL CALCULATIONS

1) <u>For ploughing tool</u>:-
Depth of cut= 5cm
Considering Speed of the tool as 2.5 km/hr = 41.64 m/minNo.
of tool= 4

Feed rate can be calculated as,
= (Speed of tool*depth of cut*Number of tool)
= 41.64*6*0.05
= 12.492 m^2/min

2) <u>Calculation of torque transmitted on the wheel</u>:
Calculation of torque transmitted on the wheel
TW= Kw * Wt * Rw

Where, Kw= Coefficient of the rolling resistance (0.3for metallic wheel)
Wt= weight of the machine (50kg approx.)
Rw= Radius of the ground wheel

We have Kw= 0.3,
Wt = 50kg * 9.81 = 490.5N
Rw = 150mm = 0.15m

Tw = Kw * Wt * Rw
= 0.3 * 50 * 9.81 * 0.15
= 22.072 Nm

$P = \frac{2 * \pi * N * T}{60} = \frac{2 * 3.14 * 30 * 22.072}{60} = 69.306$ (watts)

So, Distance covered in one min. = 30 rpm * 2* π *r
= 28.27 meter
= 25 to 30 meters

3) Calculations for seeding:

Speed = 30 rpm Row
spacing= 25 cm
Seed sowing time= 2 seed/ sec
Opening no.= 5

Seed dropping per minute = 5*30*(1/2) = 75 seeds

Hence, if the speed of the wheel is 28 m/min, then for 28 meter 75 seeds will be dropped.

4) Calculations for water sprinkler:

Velocity of the water,
$v = \sqrt{(2gh)} = \sqrt{(2*9.81*0.50)} = 3.13$ m/s

Flow rate of the water,
$Q = (\pi/4) * d^2 * v = (3.14/4) *(0.005^2) *3.13$
$= 6.1457*10^{-5}$ m^3/s
Time for 30-liter water tank,30
liters = 0.030 m^3/s

$6.1457*10^{-5}$ m^3 ----------> 1 sec
0.030 m^3 ---------->?
t = 488.1416 sect
= 8.13 min
t = 7 to 10 min

Time for 20-liter water tank,20
liters = 0.020 m^3/s

$6.1457*10^{-5}$ m^3 ----------> 1 sec
0.020 m^3 ---------->?
t = 325.43 sect
= 5.42 min
t = 6 min

X. COST ANALYSIS

Table -2: Bill of material

S. No	Part Name	Cost	Qty	Total cost
1	M. S. Square pipe	900	2	1800
2	Wheel	500	4	1000
3	Chain	150	1	150
4	Water tank	150	1	150
5	Bearing blocks	500	4	2000
6	Sprocket	250	2	500
7	Solar panel	950	1	950
8	Battery(12v)	250	1	250
9	Water pump	200	1	200
10	Drum seeder	180	1	180
11	Flanges	75	2	150

12	Other	2000	-	2000
13	Fabrication cost	4800	-	4800
Total Cost				**14980**

XI. CONCLUSIONS

- Based on the design, the overall output of the machine will meet the needs of small farmers as they are unable to buy expensive farm equipment.
- The machine required less human power and less time than traditional techniques, so if we make it on a large scale, itscost will be dramatically reduced, and we hope that will respond to the partial impetus of Indian agriculture.
- So in this way we can overcome the labour problem that is the need of today's farming in India.

XII. FUTURE SCOPE

- We can connect the sensors to this machine so that it can control some of the parameters.
- We can put Wireless Technology on the Control machine.
- The machine can also be combined with the tractor.
- We can add solar panel for spraying system and for other mechanism.

XIII. REFERENCES

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