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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 see that 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

Keywords: 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, and its development has been motivated and defined by very different climates, crops, and technologies. Modern agronomy, plant improvement, agro-chemicals 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 labour, the substantial increase in productivity of agricultural workers in modern times, and mechanical machinery has replaced many agricultural jobs previously carried out by manual labour, 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 labour 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 improving production 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 applied in a short-term rather than holistic manner.

II. 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, leveller to close the soil and pump to spray water. Over the past few years, there has been growing interest in developing autonomous vehicles in 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; Labourer 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 structure similar 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 to requirements.

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Fig -1: Traditional farming

III. LITERATURE SURVEY

1) 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.
2) 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.
3) Dhatchanamoorthy. N1 , Arunkumar. J2, Dinesh Kumar. P3, Jagadeesh. K4 Madhava. P5 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.
4) 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.
5) 1Mysuru Venkata Ramaiah Achutha, *2Mysore Sharath Chandra Nagaraju, Concept Design and Analysis of Multipurpose Farm Equipment. This research paper outlines the concept of chain gear mechanism in multipurpose agriculture machine.

IV. WORKING PRINCIPLE

In this paper, engine is placed at top of model and with the help of engine belt of pulley going too rotated and with help belt and gear box chain is rotated. The wheel shaft is rotated with the help chain and wheel base with blades are going to start its rolling motion, due to tractive effort, plough is moving forward in linear direction. For support and changing the direction of plough handle is placed.

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A. Design Calculation for Shaft

Power of the engine, P = 5kW
Displacement = 196cc
Power, P = 2πNT/60 5000= (2 * 3.14 * 3600* T)/60
Torque, T = 13.26 Nm = 13260 N-mm
Now T is the maximum torque among all shaft, checking the shaft for failure T= (π/16) * 135 * d3 13260= (3.14/16) x135xd3
D = 7.96 = 8 mm
But in this project, the diameter of the shaft is 35mm. So the design is safe.

B. Bending Stress Calculation of the Axle Shaft

Consider the weight of 1500 N is acting on the shaft, Induced stress,
σ = M/Z Moment,
M = (WL)/4 Where
W = load; L = Length
M = (1500 * 1100)/4
M = 412500 N/mm
Section modulus,
z = (π/16) *
d3 Z = (3.14/16) * 353
Z = 8414.21 mm3
σ = (412500/8414.21)
σ = 49.02 N/mm2
Therefore, induced stress < Allowed stress
49.02 N/mm2< 270 N/mm2
(Hence the design is safe)

C. Calculation for Cutter

P = 2πNT/60 watts
P = Power N = Speed of motor T = Torque
Then, P = V * I
V= Voltage I= Current
Power input to the motor,
Pin = I * V Pin = 8*12
Pin = 96W (1)
Power output from motor to shaft
Pout = T * ω (2)
Motor Efficiency,
From equation1 & 2, E = Pout / Pin
0.36 = [T * (2π * N/60)] / 96
T * (2π * 65/60) = 34.56
T = 5.0773Nm

Here, the power, torque and speed generated on the motor shaft is transmitted wholly to the crank of the crank and slotted lever mechanism. The cutting velocity of the blade can be determined by the relation between lever speed and the stroke length of the blade.

Here, β = Cutting Angle α = Return Angle
In ACB2, Cos (α/2) = CB2/AC =0.0750.08807
α = 63.23
Also, β = 360 - α
β = 360 – 63.23
β = 296.77

Quick Return Ratio or Time ratio,
β/α = 296.77/63.23
β/α = 4.9635
Stroke length,
R1R2 = P1P2 = 2P1Q
Here, P1Q = AP1 * Sin (90 – α/2)
P1Q = 176.14 * Sin (90 –63.23/2)
P1Q = 150mm
Therefore, R1R2 = 2 * 150
R1R2 = 300mm 31
Now, Cutting speed of the blade, Vc = (s ∗ Ns/1000) (1+1/QRR)
Where, S = Stroke Length Ns = Number of strokes per minute.
QRR = Quick Return Ratio
Vc = 0.300 ∗ 251000 (1+14.9635)
Vc = 0.0075 * 1.2015
Vc = 0.00901103 m/min
Vc = 1.5018 x 10-4 m/s
Vc = 1.5018 x 10-4 x 3600 x 103
Vc = 540.648 mm/hr
Now, Volume of grass cut per hour is given by,
Vg = Vex Clearance Area
Vg = 540.648 x 3 x 800
Vg = 1297555.2 mm3/hr
Vg = 0.0012975552 x 109 m3/hr

D. Tool Life Calculation

From Taylor's tool life equation,
vTn= C
Where, v= velocity
T= tool life
C, n= Taylor coefficient
For HSS, n=0.2 V= 41.6 m/min
41.6xT^n=100
T= 2.4x10^20cycles
For mild steel, T= 2.4x10^10 cycles

V. CONCLUSIONS

1) 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.
2) The machine required less human power and less time than traditional techniques, so if we make it on a large scale, its cost will be dramatically reduced, and we hope that will respond to the partial impetus of Indian agriculture.
3) So, in this way we can overcome the labour problem that is the need of today's farming in India.

VI. FUTURE SCOPE

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

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