e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:03/March-2022 Impact Factor- 6.752 www.irjmets.com

MULTIPURPOSE AGRICULTURE MACHINE

Prof. D.S. Pawar[*1], Mr. Shubham Patare[*2], Mr. Sachin Dale[*3],
Mr. Akshay Hase[*4], Mr. Vishal Gandole[*5]
[*1]Assit. Professor, Dept. Of Mechanical Engineering, Pravara Rural Engineering College Loni, India.
[*2,3,4,5]Student, Dept. Of Mechanical Engineering, Pravara Rural Engineering College Loni, India.

ABSTRACT

The Indian economy is based on agriculture. There is a lot of fieldwork in the agriculture industry, such as plowing, reaping, sowing, and other processes that were formerly done with traditional machinery. This field is confronted with issues such as minimizing losses, increasing production and lowering costs. In India, there are two types of agricultural methods: manual (traditional) and mechanized (mechanized). Working with that equipment was tedious and hard in a manual way. The main aim of the project is to develop a multipurpose agricultural machine, for performing major agricultural operations like digging the ground and sowing the seed into the ground. The modification includes fabricating a vehicle that is small, compact. The project is about a machine design that makes cultivation much simpler. The design of the chassis of the machine vehicle is made in such a way that it is suitable for operations. The design of rotary tiller (rotavator) is needed, power transmission, various machine components. This operation machine can handle it simultaneously.

Keywords: Digging, Seed Sowing, Soil Covering.

I. INTRODUCTION

Agriculture is one of India's most important occupations, and it is critical to discover and apply new ideas in this subject, even though much work has already been done. In 1951, there were only a few tractors in use, and every single one of them was imported. Tractor production began in 1961-62, with 880 tractors produced. The farmer's attitude toward crop output was influenced by their lack of knowledge of current farming techniques.(.V. Achutha, Sharath Chandra. N, Nataraj.G.K, [2016] We are offering this multipurpose agriculture machine to raise the productivity of agriculture and farming processes to improve yields and cost-effectiveness with this technology. Ploughing, harvesting, seeding, and irrigation are all common phrases in the cultivation of any crop. For these steps, farmers must use various agricultural equipment and labours; our goal is to combine all of the individual tools to provide farmers with multipurpose equipment that implements all of the scientific farming techniques and specifications, suitable for all types of seed to seed cultivation at the lowest possible cost. All of this may be accomplished with the same machine.

India is the world's largest tractor manufacturer. Farmers increasingly spend a lot of money on machines that help them reduce labour costs and enhance crop yields. Agriculture continues to be associated with various concerns because it plays such an essential role in the growth of our country's economy. This multifunctional agro machine is developed and manufactured as a versatile piece of equipment that may be used for agricultural tasks such as digging, sowing, seed covering.

OBJECTIVE

The design of Multipurpose Agriculture machine will help Indian farmers in rural side and small farm. It will reduce the cost of seed feeding, pesticides digging the field and will help to increase economic standard of an Indian farmer. The main objective of this project is to design and fabricate Multipurpose Agriculture Machine. To minimize the cost so that it should be affordable for everyone. To reduce Human efforts, all operations can be performed by single person, thus it will reduce the labour cost. To reduce amount of time for operation.

II. LITERATURE REVIEW

M.V. Achutha, Sharath Chandra. N, Nataraj.G.K, [2016]

In this research, the paper author has mentioned the four plans for Design and development. They have analyzed to check on load condition to avoid the failure problem while fabrication of the project. They are doing one or two operations on each plan. Here more manpower is required as they are not using the engine. The Conclusion of the paper is to decrease the cost. From this paper, we are looking at how they are doing the operation to minimize the cost and the analysis are done.

D.A. Mada, Mahai, [2013]

In this research, the paper author has mentioned the magnitude of automation in the agricultural field by giving some instances. The conclusion from the paper was the need for a multifunctional vehicle for pre and post-harvesting. We have taken this as the base of our research and made further changes in the production of our multipurpose agricultural vehicle.

BrajeshNare, V.K. Tewari, A. Ashok Kumar, Satya Prakash Kumar, [2012]

The author of this research article conducted a case study on farm mechanization in West Bengal, which is a part of India, and provides a clear picture of availability and advancement in India. In comparison to the present stages, this ensured that we took the correct actions.

B. Babangida, B. G. Jahun, and F.A. Adamu [2014]

The writers of this research emphasize the importance of a power tiller's performance. The tiller was the most popular choice among those looking for lightweight power. Such elements as fuel efficiency and field capacity are also considered. When creating a sustainable multipurpose agricultural vehicle, we took these considerations into account.

K. Mahalle and Mahesh R. Pundkar

Is there a brief description of the many sorts of advances made in seed sowing devices available for plantation in the review? The seed sowing machine is an important part of the agriculture industry. Seed sowing equipment performance has a significant impact on the cost and yield of agricultural products. There are numerous methods for detecting the functioning of seed-sowing equipment now available.

Raut, Laukik P., andet. Al.

Modernization of agriculture is unavoidable to meet the food needs of a rapidly growing population and rapid industrialization. Mechanization allows for input conservation by ensuring better distribution, reducing quantity required for better response, and preventing losses or wastage of applied inputs. By increasing productivity and conserving inputs, mechanization lowers the unit cost of production.

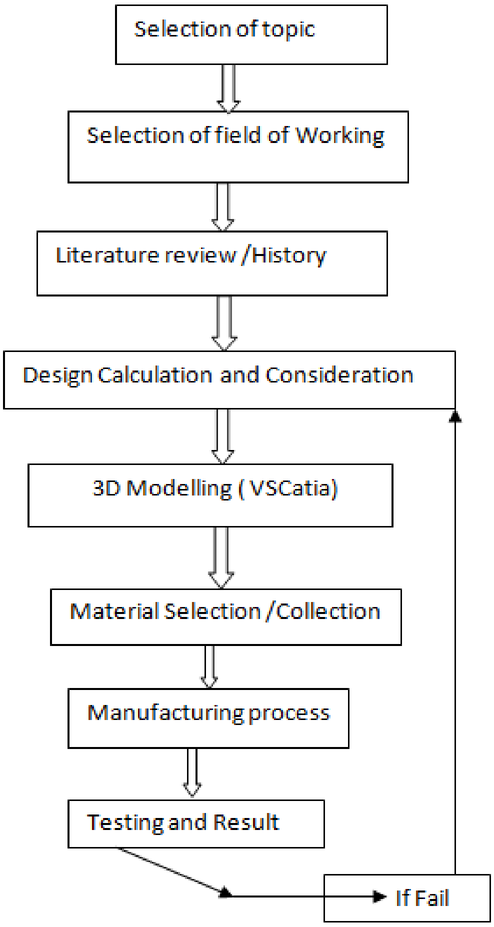
H. P. Girish Kumar and D. Ramesh

This paper provides a summary of the various types of seed sowing equipment innovations. The primary goal of the sowing operation is to place the seed and seedlings in rows at the desired depth and seed-to-seed spacing, cover the seeds with soil and compact the soil over the seed. To achieve optimal yields, the recommended row to row spacing, seed rate, seed to seed spacing, and seed placement depth vary from crop to crop and for different agro-climatic conditions. Seed sowing devices play an important role in agriculture.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:03/March-2022 Impact Factor- 6.752 www.irjmets.com

III. METHODOLOGY

Flow chart :



IV. WORKING

The equipment is connected to the machine, and the engine is started to complete the operation. Initially, the engine must be started, and engine power is transferred to the system via a specially designed chain and sprocket. The digging rotor as well as the wheel receive adequate power thanks to the arrangement and designed speed ratio. The vehicle follows the wheel's path. A rotor mounted on the vehicle's front side can cut up the soil and prepare the land. This process is used to prepare the soil for seed sowing. It is completed in the primary stage. Seed sowing was followed by a secondary mechanism. The plug creates a passage for seeds that have already been fed into seed containers in this operation. The container has a spike wheel arrangement to follow the rotation of the wheels, which is connected by a chain and sprocket transmission system. This is made to hold a variety of seeds. The proper distance in planting seeds is determined by the mechanism's design.

Digging Operation

It is a tillage machine that is used to prepare land for seed sowing. In comparison to conventional tillage, it provides a faster seedbed. When compared to cultivator tillage, it saved 30 to 35 percent of the time and 20 to 25 percent of the cost of operation. The rotor blade and rotating shaft make up the rotor. The rotor blade resembles a digging component. As a result, it can cultivate the land and loosen the soil, which is beneficial for crop growth and increases water storage capacity. [1which is very helpful for crop growing and increasing water holding capacity.[6,7]

Rotor

The rotor is a component of the system that receives power from the system and is used in digging operations. When the machine is running, the rotor provides support to the blade assembly. The rotor is the rotating component that rotates both the blade assembly and its axis.[6]

Flange

Flanges will be used to support blade members; each flange is made up of three balancing blades that are stacked on top of each other. Flanges are circular and are divided into three sections to improve inertia path and prevent centrifugal force losses.[7]

Blade

With an efficient frictional angle made up of the land surface, the blade is mounted on the flanges. The blades are cut to the maximum soil area and are ready to sowing.[6]

Cover Shell

This is the rotor's half-cylindrical metallic cover, which protects the rotor from harmful dust and stones. It enables the driver to work efficiently in a clean environment.

Bearing

Bearings are needed to support the rotor assembly during operation, since a smooth operating bearing can improve efficiency and prevent power loss. For the load consumption on the rotor, we will employ a twin pedestal type roller bearing.

Chain and sprocket

We require a high power rate of transmission with minimal losses for power transmission. The higher rate of power transfer in the shortest distance is achieved by chain and sprocket, and this transmission system has the highest locking propensity. This is useful for short-distance power transmission.

Supporting Arm

we use a 1-inch mild steel bar to support the entire digging assembly; arms are constructed according to the needed weight carrying capacity; it will withstand shocks and vibration and provide support to prevent an accident.

Adjusting Mechanism

Variation in farm and different kinds of soils, in the machine, need to adjust the level of rotor mechanism, this mechanism helps to the adjust the cutting depth as required to the farmer. In the mechanism we use mild steel 'L' shape angles which thread key on itself and body frame having holes on it, on body holes are drilled with measurements which can easily adjust the setting of up and down, the nut is used in another side to fix the whole support.[4]

Working of Sowing mechanism

Seeds are planted in the soil during the seed sowing process. After the digging is finished, this operation is carried out. The mechanism for this operation is a seed storage box from which seeds are obtained over time, which is accomplished with the help of spike wheel rotation. Seeds are sown at an equal distance in the soil and an orderly manner because they are collected after an equal interval of time. Seeds are carried from the top of the machine to the bottom for sowing operation by the pipe, once the seed collector drops a seed into the hole provided at the bottom of the box.

Seed metering disc Cell feed mechanism:

Table no.1: Seed size cart

Seed size(average diameter of seed)	
10 mm diameter(large)	5 mm diameter(small)
Maize	Wheat
Ground nut	Black gram
Soybean	Ragi
Pea	Jowar
Chickpea	Sesame
Sunflower	Moog bean

Cowpea	Moog bean
Castor	Pigeon pea
Field bean	Cotton

A series of evenly spaced cells engraved on the periphery of a circular plate or wheel collect and deliver seeds in this mechanism. Seeds can be easily classified based on their average diameter, so we have two types of cells in our cell feed mechanism. To pick large seeds, a series of 14mm diameter and 8mm depth cells is machined, and to pick small seeds, a series of 8mm diameter and 4mm depth cells is created. The cells are designed so that the angle between one cell and the next is 15 degrees, and the seeds are spaced every 10cm. Close every alternative cell so that the seeds are placed every 20cm apart, and close two alternative cells so that the seeds are placed every 30cm apart, if the distance between one plant and another plant needs to be changed. This mechanism is the only one that allows for all types of seed-to-seed cultivation and can work with a variety of seed spacing specifications. Any simple tape or plaster can be used to close the cells.

Hopper

Hopper is the container that is used to store the seeds, in the shape of a funnel it helps to drain all seeds by gravity.

Seed tubes

Seed tubes are placed vertically which make seed flow downward direction by gravity, tubes are made up of plastic.

Cell feed mechanism

It is a mechanism in which seeds are collected and delivered by a series of equally spaced cells engraved on the periphery of a circular plate or wheel.

Brush feed mechanism

A rotating brush regulates the flow of seed from the hopper into the seed tube in this mechanism. A brush feed mechanism is used in several bullock-drawn planters across the country.

Seed Covering Mechanism

The plunger creates a passage for the seed, which is covered by a seed mechanism that allows the seed to go deep into the passage while leaving the passage open. In agriculture, Indian farmers use a traditional method to cover the seed. This will be accomplished with the assistance of animals. However, after sowing, our machine has an arrangement of tilted angles on the back side of the vehicle that helps cover the seed into the soil. This procedure aids in the fertilisation of the seeds. There is no need to do it separately in our machine. [5]

Engine

The engine used for purpose of prime mover should be efficient. Engine speed can be controlled by the operator should easy. The machine required power and efficiency should be proved by the engine.[8]

Frame and Chassis

The choice of material for the vehicle is the first and most important factor for automotive design. There is a variety of materials that can be used in the automotive body and chassis. The most important criteria that material should meet are lightweight, economic effectiveness, safety, recyclability, and life cycle consideration. Some of these criteria are the result of legislation and regulation. The material for the frame and chassis is steel. The main factors for selecting material, especially for the body is a wide variety of characteristics such as thermal, chemical, and mechanical resistance which are easy for manufacturing and durability. In the frame, only the main supporting structures such as the engine of the vehicle, the digging, and the sowing tool are mounted on it. It supports the tool static and dynamic load of the vehicle.

V. THEOROTICAL CALCULATION

Design rotor for 610mm cutting length

(610mmisdistance between interior farming)

Selection of blade for rotor:

Type – MAB Tiller blade .... [6]

Dimension – Bw=30mm

Ld = 50mm

Be = 10mm

He = 20mm

Where,

Bw = width of soil cut

Ld = depth of soil cut

Be = thickness of the blade

Speed required to rotor:

Vf = 2πNR/60................[7]

Where,

N = rpm

R = radius of shaft (25mm)

Vf = 2 π*375*0.0125/ (60)

Vf = 0.49m/sec

Forward velocity of rotor:

P_{cut}=power required to cut the soil

P_{cut}= K_{sp}*Bw*Ld*Vf.................[7]

Where,

K_{sp}= specific soil resistance (700kg*m2)

Bw = Width of soil cut

Ld = Depth of soil cut

Vf = Forward Velocity

P_{cut}= 4000*0.05*0.49 = 145k.watt(on single blade)

To calculate peripheral force (K_0) Acting Blade arm:

Power = K_0*(2π*N*R/60)..................[7]

Where,R is the radius of total rotor blade assembly

5.145 = K_0(2π*375*0.065/60)

K_0 = 2.1K.watt

Permissible Distance Between Disc = 15cm

Total length of disc is 610mm

So, Number of Disc = 610mm/150mm =4.06mm(4 Disc)

No. of blades = (2*2)+(2*4)=4+8=12 blades

Arrangement of the blades on the disc at an angular interval A^0:

A^0 = 360 / No. of Blade

A^0= 360/12=30^0

Material of blade is Iron.........................[10]

Power required to run vehicle:

P = f*v.....................[6]

Where,

F = Force

V = velocity

V= 2π*94*0.02/60

V=1500N*0.19m/s on flat surface

But, Adding the Working resistance with soil (μ) Which is

P =1500+(1500/1500)*0.19

P = 360Watt = 0.36Kwatt

Design of shaft:

Material Type = MS

T = (**π**/16)*Tough* D^3 …………(V.B..pg-331)

τ = 0.75(0.3*Syt)

Syt = 200 mpa

τ= 45 mpa

$13.4*10^3$ = (**π**/16)*45*d^3

d = 7mm

For safety = 25mm

Length = 2 ft = 610mm

Bending stress calculation of the shaft:

Consider weight near about(1500N)

L=610mm

Induced stress,

σ = m/z…………(V.B..pg-331-334)

Moment

M = wl/4 …………(V.B..pg-331)

=(1500*610)/4

M=228750N/mm

Section Modulus

Z=(**π** /16)*(d^3)……………………[6]

= **π**/16$(25)^3$

Z=3067.96mm^3

σ=74.56 N/mm^2

74.56<200 N/mm^2

Induced stress<Allowable stress

By Calculation Design is safe

Selection of Bearing on The Basis of Shaft:

Bearing number=UP305. …………(V.B..pg-575)

(linear Diameter) d=25mm

(Outer Diameter) D=56mm deep grove ball bearing

(width) W=15

Specification,

Dynamic Load C=14.8KN

Static Load lo=7.8KN

Fatigue Load (fu) = 0.335KN

Limit Speed = 1800rpm

Minimum Load (kr)=0.025

Calculation Factor (f_o) =14

Chain drive from engine to middle shaft:

P = 10-297 kw

N = 6000rpm

output shaft of engine there sprocket teeth.

Z_1 = 14

pitch = is 12-7

Reduction ratio is 3:1

Therefore,

Z_2 = 42

Diameter of first sprocket is (d1) = 57.07mm = 58mm

d_2 = Diameter of second sprocket.

d2 = π/sin(180/22) =169.94mm = 170 mm

width (w) of sprocket size of chain of (V.B pg- 547-549)

Chain Number	Measuring Load	Breaking load
0822	190	18.7

length of chain = 610 mm

Chain drive from middle shaft to wheel shaft:

Z1 = 42

Z2 = 14

D1 =169.94mm = 170mm

D2 = 57.07mm = 58mm

Width (w) = 11.18mm = 12 mm

Chain specification of (V.B pg- 547-549)

Chain Number	Measuring load	Breaking load
0822	190N	18.7KN

Length = 800mm

Chain drive from middle shaft to rotor shaft :

Z1 = 14

Z2 = 14

d1 = d2 = 58mm

w = 12mm

chain number = 0822

l = 1100mm

Chain drive from wheel to chain sprocket:

Z1 = Z2 = 14

D1 = D2 = 58mm

L = 1100mm

Chain number = 0822

Calculation of Seed mechanism:

Seed box shape and dimension

n = 17.5*20(9)*22(cm)..................[1]

Seed plate shape = circular

Diameter = 120mm

Thickness = 6mm

Seed cell shape elongated

Number of cells on plate = 6 NOS

Material for seed plate = polyvinyl chloride

Sliding velocity of seed

V =(π*d*N)/60...........................[3]

= (π*120*10^-3 *666)/60

V = 4.18m/sec

Area covered = vehicle speed * Space between two rows of ploughing blade

=(666/ 60) * (2* π*60/6)

= 697.524 m^3/hr

Engine Specification On The Basis Of Required Power:

Displacement = 149cc

Engine Type = 4 stroke , air cooled , single cylinder DTS – I

Max power = 14 PS @ 8000rpm

Max torque = 13.4 KN.m@ 6000rpm

Fuel type = Petrol

Final drive = chain drive,power = 13 Kw.....[10]

Reduction ratio of drives:

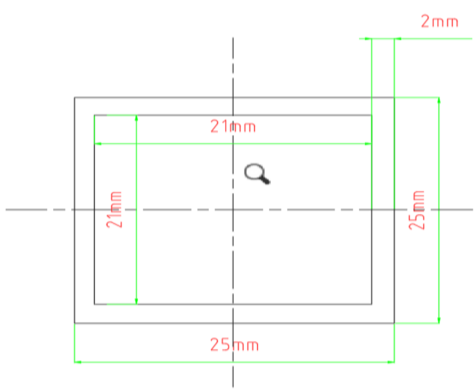
1. From engine to middle shaft = 3:1
2. From middle shaft to wheel axle = 1:3
3. From middle shaft to rotor axle blade = 1:1
4. From wheel shaft to seed mechanism = 1:1..........[12]

Design Chassis:

Bending stresses of chassis material σ* b/y=m/I=E/R....................[6]

Where,

1. σ =bending stress
2. y = distance from neutral axis
3. m = bending moment
4. I = moment of inertia
5. E = modulus of elasticity
6. R =radius of curvature



D = 25mm

B = 25mm

d = 21mm

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:03/March-2022 Impact Factor- 6.752 www.irjmets.com

b = 21mm

M.S. material yield strength =200mpa

$I = (BD^3/12)-(bd^3/12)$

$I = (0.025)^4/12 - (0.021)^4/12$

$I = 1.63*10^{-8} m^4$

y = 0.0225m

$m = w*l^2/8$..........2 ft length

m = 1500*0.6096/8

m = 114.3 N.m

σ = m*y/I

$=114.3*0.0225/1.63*10^{-8}$

$σ = 157.77*10^3$

Wheel capacity to take load :

Wheel material-=harden plastic

Diameter= 14inch

the wheel can carry a load of 84 to 100 kg and is designed to have four wheels so, the selected wheel can easily carry the load of the component and provide suitable height for operating, and gives a long lifetime.

VI. RESULT

Relative Efficiency:

Comparison between traditional m/c efficiency of cultivation digging

Mini – Power required = 13 HP

Fuel required = 5.5 lit

Area covered = 4046.8 m^2............. [11]

Design project m/ c efficiency of cultivation design

Power used = 13HP

Fuel required = 4l

Area covered 4346 m^2 ....[11]

Relative Efficiency :-Traditional m/c = Area/ fuel required

= 4046.8/4.5

= 899.28 m^2/lit

Project m/c = Area / fuel required

= 4046.8/4

= 1086.5 m^2/lit

Relative efficiency = (P.M – Tm) *100

= (1086- 899.28 / 1086) * 100

Relative efficiency = 17 % more than traditional m/c

1. Expected Outcome

1. Multipurpose operation can be performed on a single machine.
2. Machine should be 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 has one-time investment.
6. This Machine should have less maintenance cost
7. This machine should be use in intercrops.

8. Machine should be digging the space in farm which traditional can not reach.
9. Trample the area should be minimum

VII. CONCLUSION

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

Based on the overall performance of the machine we can say that the project will satisfy the need of small-scale farmers because they are not able to purchase costly agricultural equipment. The machine required less manpower and less time compared to traditional methods, so if we manufacture it on a large scale with proper and standard components.

VIII. REFERENCES

[1] Ashwin Chandran ,k. Varun Krishnan,T.V Arjun ,Vignesh, Nitin Joshwa “ design and Fabrication of multipurpose farming equipment” International Journal of research in engineering, Science & Management (2020).

[2] Jayshree kurakula “An efficient design and development of multipurpose agro machine” journal of Xi’an University of architecture and Technology.

[3] Senthilnathan N ,Shivangi Gupta, Keshav Pureha and Shreya Verma “fabrication and automation of seed sowing machine using IOT” International Journal of mechanical engineering and technology (IJMET) (2018).

[4] Patil Nikhil, Shaikh Ajaharuddin ,Deore Ganesh, Choure Ganesh, prof. P.G. Tathe “multipurpose agriculture vehicle” International Journal of Advanced research in computer and communication engineering (IJARCCE) (2018).

[5] Prof. P.V. Butet, Shailesh Deshmukh ,Govind Rai, Chetan Patil, Vishal Deshmukh, “design and Fabrication of multipurpose Agro system”, International research journal of Engineering and Technology (IRJET)(2018)

[6] Topakci, M., Celik, H. K. and Yilmaz, D. (2008), Stress analysis on transmission gears of a rotary tiller using finite element method. Akendiz Ünivresitesi Ziraat Fakultesi Dergisi. 21(2): 155-160.

[7] Subrata Kumar Mandal, Somenath Mukherjee and Ashok Kumar Prasad are working as Scientists; Basudeb Bhattacharyya as Professor DOI: http://Dx.Doi.Org/10.14741/Ijcet/22774106/6.4.2015.31

[8] V.B. Bhandari (Machine Design Data Book)

[9] https://www.sciencedirect.com/topics/engineering/gear-ratio

[10] https://m.indiamart.com/impcat/car-engine.html

[11] https://www.britannica.com/technology/sprocket

[12] Car - Required Power and Torque (engineeringtoolbox.com)