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Fabrication and Experimental Performance Investigetion of Economical Multi-objective Agriculture Equipment

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Abstract— India is a land of Agriculture which consist of all marginal, medium and few amount of rich farmer. Yielding of crop depend on cost, time and human efforts. Hence, we have to reduce above parameters by developing multipurpose agricultural equipment. This study is carried out to developed multiobjective agricultural equipment which perform agriculture operations like ploughing, cultivating, weeding and spraying. The project represent modeling, fabrication and testing of low cost multiobjective agriculture equipment. Equipment having cost upto 50000 Rupees and it can be easily assembled and disassembled by single person. Efficiency of multipurpose agricultural equipment is more than bullock operated equipment by comparing operation time, field work. Also, it is more efficient than tractor about fuel efficiency, vibration and primary maintenance cost.

Index Terms— Multipurpose, compact size, low cost, simple engagement and disengagement, easily handled by single person.

1 INTRODUCTION

THE agriculture has always of India's sustained growth. As the population of India's continues to grow the demand for produce grows as well. Hence, there is greater need for multiple cropping in the farms and this in turn requires efficient and time saving machine. Here we discuss multipurpose agricultural equipment which will be helpful for agricultural industry to move toward mechanization traditional sowing methods: it includes broadcasting manually opening furrows by country plough and dropping seeds by hand and dropping seeds in the furrow through a bamboo or metal funnel attach to a country plough. For sowing in small areas dibbling that is making holes or slit by a stick or tool and dropping seeds by hand, is practiced. In manual seeding, it is not possible to archive uniformity in distribution of seeds.

Agriculture plays a vital role in Indian economy. Around 65% of population in the state is depending on agriculture. Although its contribution to GDP is now around one sixth, it provides 56% of Indian work force. Table 1 shows that share of marginal and small farmer is around 81% and land operated is 44 % in 1960-61. As far as Indian scenario is concerned, more than 75 percent farmers are belonging to small and marginal land carrying and cotton is alone which provide about 80 % employment to Indian workforce. So any improvement in the productivity related task help to increase Indian farmer's status and economy. The current backpack sprayer has lot of limitation and it required more energy to operate. The percentage distribution of farm holding land for marginal farmers is 39.1 percentage, for small farmers 22.6 percentage, for small and marginal farmers 61.7 percentage, for semi-medium farmers 19.8 percentage, for medium farmers 14 percentage and for large farmers 4.5 percentage in year 1960-61.Table 1 clearly explain that the maximum percentage of farm distribution belonged to small and marginal category. Growth of these farmers requires advanced equipment which will work faster than existing one. [1]

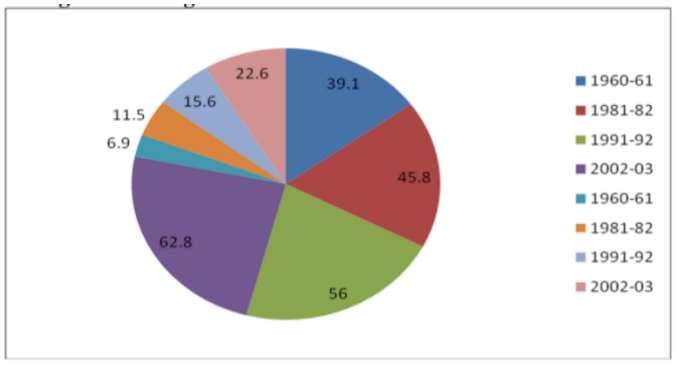

Fig. 1. Percentage of land distribution from 1960 to 2003. [1]

The production and productivity of groundnuts, corns, etc., were quite low, when India became independent in 1947. The production was not sufficient to feed the population. The country used to import large quantities for fulfilling that need of our people from many countries. The reasons of low production and productivity were unavailability of machines in cultivation field, in India most of the farming work is done manually when compared with foreign countries. There are no viabilities of machines and it done by man power. The cost for manpower was more and speed of operation is very less. When small farmers with minimal physical resources or financial assets attempt to improve productivity, they have limited

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choice. The only resource they can maximize in knowledge in which they are not poor. To prove the above statement, Mr. Shivraj was invented a first bullock driven sowing in year 1987 at Madhya Pradesh to improve his productivity.[2] It was light weight and performs 6 agriculture operations. India world leader in groundnut farming in 8 million hectare of cultivated area in 2003. The government of India appointed commission to assess the feasibility of increasing the crop productivity under prevailing Indian ecological conditions. In order to develop the standard of living of small farmer we should make the machine with low cost. Then only small farmer can implement the recent modern machine for farming machine for farming purpose.

2 Design of Studied System

2.1 Selection of Engine

Total tractive force=Force of rolling resistance + force of inertia + force of aerodynamic resistance
Ft=Fr + Fi + Fad
1) F= μ×R
= 0.4×150 =60 Kg=600N
2) Fi = m×(dv/dt)
Vf = 20 km/Hr=5.56 m/s, Vi=0 m/s, Time=5 sec
Fi=150 × (5.56/5)=166.6 N
3) Fad=100 N
*Ft=100 + 166.6 + 600 =866.6 N
Now, power = Ft×V = 866.6*5.56 =4.8 Kw
Hence, Select more than 5 Kw engine =6 Kw Engine

2.2 Design of Shaft

Shaft material =EN8
Syt=320 MPa, Sut=560 MPa
Kt=1.2, Km=1...For suddenly applied load with minor shocks……(Machine design by khurmi gupta)
Power=5 Kw, Torque=12 Nm, Speed=360 rpm= 6 rps
Wt of our Equipment-
Consider Engine = 20Kg
Sprocket + Chain=5kg
Chasis=50 kg
Total=110kg=120kg≈1200 N
Wt. supported by each wheel=600 N
FOS=2
*Permissible Shear Stress:
T=Sut/Fs=0.5 Syt/2=0.5×320/2=80 N/mm2
*Torsional moment
P=2×π×N×T/60×103
T=5×60×103 /2×π×360=132629.11 Nmm
*Bending moment
B1 =600 N, B2 =600 N
MB1 =M=600×120=72000 Nmm
*Equivalent Twisting Moment:
Te=$\sqrt{[(Km \times M)2 + (Kt \times t)2]}$
=Sqrt[(72000×1.5)2 + (1.2×132629.11)2]
=192339 N.mm
192339=π×τ×d3/16
192339= π×80×d3/16
D=23 mm≈ 25mm……(From std. table)

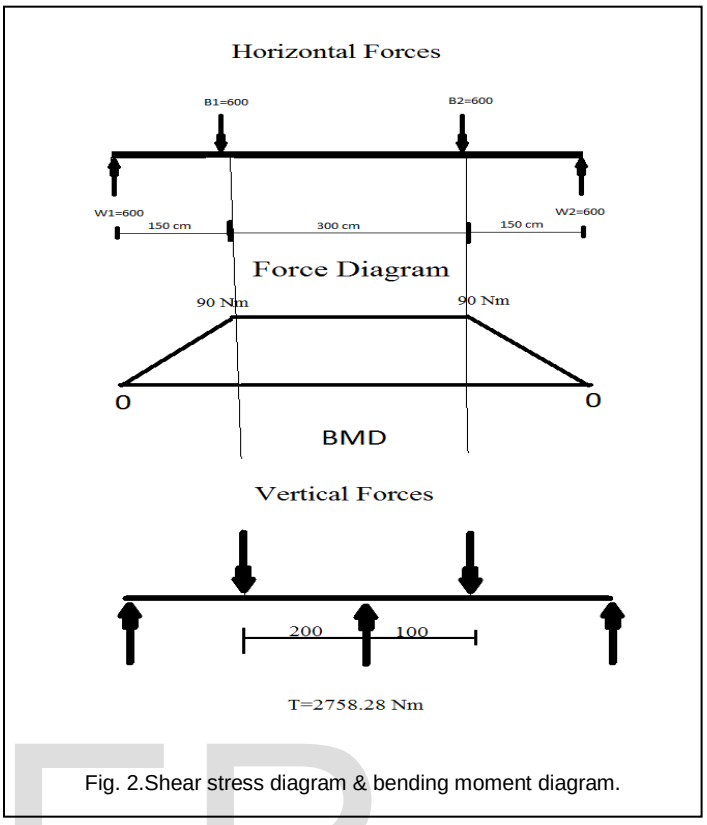

Fig. 2.Shear stress diagram & bending moment diagram.

2.3 Design of Bearings

L10 life for mini tractor = 100 rev.(In million)VBB page no 573
L10=(60×n×Lh10)/106, 100=(60×360×Lh10)/106
Lh10=4630 hr L10=(C/Pe)a
V= πDN/60= π×0.17×360/60=3.2044
P=(T1+T2) ×V , 5×103=(T1+T2) ×3.2044
T1+T2=1560.54
T1/T2=eμθ
Θ=210× π/180=3.66
T1/T2=e0.35×3.66
T1=2159.44N, T2=598.84 N
T=T1+T2=2758.28
B1=919.42, B2=1838.85
R1= sqrt[(Rv1)2+(Rh1)2]
= sqrt[(919.42)2+(600)2] =1097.88 N
R1= sqrt[(Rv2)2+(Rh2)2]
R1= sqrt[(1838.85)2+(600)2]
R1= 1934.2650 N
AXIAL Thrust =0
So dynamic load capacities
P1=1097.88 N, P2=1934.2050 N
C1=P1×(C10)2×load factor
C1=1097.88×(100)0.33×1.5 =7643.86 N
C2=P2×(C10)2×load factor
=1934.2650×(100)0.33×1.5
=13467.09 N
From standerd table. Selection of bearing for
D=25 mm
C=11200 for bearing -6005
C=19000 for bearing no-6205

So select bearing - 6205

3 Details of Parts

3.1 Chassis

It consists of an internal vehicle frame that supports man-made objects in it. It analogous to animal skeleton. In the case of vehicle, the term rolling chassis means the frame plus running gear like engine, transmission, drive shaft and suspension. For project instrument chassis construction is as shown in fig. it is made from angles. Intention behind that is that material easily available at low cost and having sufficient strength. Engine is placed at middle.

3.2 Spraying Pump

It is used to for spraying pesticide and fertilizers on crop. It consists of centrifugal compressor which works on engine power. This pesticides is sprayed on crop through nozzle. There will be provision of long pipe for supplying pesticides far away so we can spray when our equipment is state of rest.

TABLE 1
Specification of Pump

Capacity	40 ltr
Pump type	Reciprocating

It is placed at Front side of engine and attached by using belt drive. It is light in weight. A sprayer is device used to spray fertilizer, herbicides, pesticides etc.

Fig. 3. Submersible Turbine Pump (STP)

3.3 Shaft

It is rotating machine element, usually circular in circular cross section which is used to transmit power one part to another. The various members such as pulley, sprocket, and gears are mounting on it a drive shaft, driven shaft use to transmit torque and rotation. As torque carries, drive shaft subjected to torsion and shear are subject to equivalent to the difference between input torque and load. So they must be strong enough to bear stress. Engine is mounted at center of chassis.

1. Transmission shaft
2. Machine shaft

Transmission shaft are used to transmit power between source and machine absorbing power. Egg counter shaft and line shaft. A machine shaft is the internal part of machine.

TABLE 2
Specification of Engine

Type	Petrol
Cooling type	Air cooled
Capacity	169 cc
Max. power	6 KW
Max. Torque	12 N-M
Ignition type	Spark Ignition
Power transmission	Chain Drive
Fuel type	Petrol
Starter	Kick
Number of cylinders	One
Number of speed gears	3
Weight	22 kg
Fuel capacity	1.5 Liter

3.4 Engine

A two stroke engine is type of internal engine which completes a power cycle with two stroke of piston during one crankshaft revolution. This in contrast to a "two stroke engine", which requires two stroke of the piston to complete power cycle. In two stroke engine, the end of the combustion stroke and the beginning of the compression stroke happen simultaneously, with the intake and exhaust functions occurring at the same time .Compare to four stroke engine, two stroke engine have a greatly reduce moving parts ,and so can more compact and significantly lighter.

3.5 Bearings

A bearing is a device that is used to enabled the rotational or linear movement, while reducing friction and handling stress. When friction is reduced this also enhance speed and efficiency. The housing is bolted to a foundation through the hole in the base. Bearing housing is usually made of grey cast iron. However various grades of metal can be used to manufacture the same.

TABLE 3
Field Testing Result

Sr. No.	Operations	Time required Min/2 gunte	Fuel consumption In ml
1.	Ploughing	20	350
2.	Weeding	15	200
3.	Cultivation	18	300
4.	Spraying	12min/50 trees	250

4 Observation and Result

When we actually do the field work for 2 gunthas area .In that number of operations like ploughing, weeding, cultivation, and spraying are done. In which we got the results like for the ploughing we required 20 minutes in that particular

area also 350 ml fuel is consume. Similarly, all the operations are done with specific time and fuel consumption requirement as shown in above table. But the operations are depends on nature of land, type of crops etc.

5 Acknowledgement

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Fig. 4. Setup

6 Conclusion

The multipurpose equipment relatively cheap. Cost of machine is estimated as RS.50000. The major advantage of equipment is to perform several operations, weeding, cultivation, ploughing, spraying, etc. The drawback of existing machine will be rectifying successfully in present model. It will be more useful for poor farmers and agricultural society. Low cost operations and low investments. Light in weight, low cost durable with minimum repairs which saves time during operations.

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