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Design and Fabrication of Soil Overturning Equipment

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Abstract -*Tillage is the agricultural preparation of soil by mechanical agitation of various types such as digging, stirring, and overturning. The soil Overturning is one of the many farm mechanizations in promoting soil Overturning and weeding especially considering the fact that the majority of farmers are having small land. It reduces human effort. The implements are mostly self-guided. Working of the project is based on engine which moves the cutter or over turner. It is a great saver of time and expenses on field operations. Thus, it will have very effective uses on the farm field either for Overturning as well as for weeding. Development of high capacity energy efficient versatile machines and combination machinery for increased labor productivity, reduced unit cost of operation, improved timeliness of operation and suitable for custom hiring*.

Key Words:Tillage, soil Overturning.

1. INTRODUCTION

Agriculture forms the backbone of our country economy; about 55% of citizen is depending on agriculture. Thus developing our country means providing our farmers with more "Sophisticated" and "Advanced Tool" which would decreases overall time required for the task and the task will become more easy and convenient. Soil overturning in farming takes maximum time of farmer among all farming process. In India overturning is generally done manually. Thus our intention is to provide farmer a "SOIL OVERTURNING EQUIPMENT". This machine consists of simple mechanism make to run by an engine which will be economical to farmer and will take less time for overturning operation. Soil overturning is a process of digging the Soils closed to the ground or pulling out the solid soil to make it loose when they are ripped out. On the basis of this large number of Soil overturner are in use at today's date, which are available at different shape and size and on different power supply. Some of them are pneumatic SOIL overturner, hydraulic Soils overturner and Soil overturner running on tractor engine. Since they are costlier keeping in to consideration the economic ability of our farmer it is required that is should be simple and should fulfill the same intention which are achieved by "SOIL OVERTURNING EQUIOMENT". This machine is made to run by a single cylinder two stroke petrol engine of 69.9cc and having a speed of nearly 3750 rpm.

2. LITERTURE REVIEW

Design And Development of Colour Sorting Robot Lim JieShen*, IrDA Hassan –This gave us the knowledge of how a robot is used for the sorting process and no manual help or labour was needed[4]

Automated Object Sorting Using Raspberry Pi N.Aarthi1, P.Sahithi2, P.V.Sitaramaih, M.InduVardhani, N. Ranjith Kumar, D. SuneelVarma –This published work gave different ideas in which this sorting mechanism can be taken into consideration [3]

SortingOfObjectsBasedOnColour,WeightAndTypeOnAConveyorLineUsingPLC,S.V. Rautu,A.P.Shinde,N.R.Darda,A, V.Vaghule,C,B.Meshram,S.S.Sarawade–theirgaveus the knowledge of how different sensors are responsible and helpful for the sorting based on weight, colour and metal[5]

3. HISTORY

The basic idea of soil scratching for weed control is ancient and was done with hoes or mattocks for millennia before cultivators were developed. Cultivators were originally drawn [13] by draft animals (such as horses, mules, or oxen) or were pushed or drawn by people. In modern commercial agriculture, the amount of cultivating done for weed control has been greatly reduced via use of herbicides instead. [7] However,herbicides are not always desirable-for example, in organic farming. [15]

The powered rotary hoe was invented by Arthur Clifford Howard who, in 1912, began experimenting with rotary tillage on his father's farm at Gilgandra, New South Wales, Australia. Initially using his father's steam tractor engine as a power source, he found that ground could be mechanically tilled without soil-packing occurring, as was the case with normal ploughing. His earliest designs threw the tilled soil sideways, until he improved his invention by designing an L-shaped blade mounted on widely spaced flanges fixed to a small-diameter rotor. With fellow apprentice EverardMcCleary, he established a company to make his machine, but plans were interrupted by World War I. In 1919 Howard returned to Australia and resumed his design work, patenting a design with 5 rotary hoe cultivator blades and an internal combustion engine in 1920.

4. OBJECTIVES

- The main objective of this project is to reduce human effort in soil overturning process.
- To reduce unit cost of operation.
- To attain a better quality of the soil.
- To reduce soil erosion due to wind and water.
- To reduce labor requirements

5. PROBLEM IDENTIFICATION

Ownership of agricultural land in India is fairly widely distributed, there is some degree of concentration of land holding. Inequality in land distribution is also due to the fact that there are frequent changes in land ownership in India. It is believed that large parcels of land in India are owned by a relatively small section of the rich farmers, landlords and money-lenders, while the vast majority of farmers own very little amount of land or no land at all.
Moreover, most holdings are small and uneconomic. So the advantages of large-scale farming cannot be derived and cost per unit with 'uneconomic' holdings is high, output per hectare is low. As a result peasants cannot generate sufficient marketable surplus. So they are not only poor but are often in debt. As a result they are unable to use advanced equipment's.
Conventional Soil overturner available now in the market costs around 30000 including Govt subsidy.
It is too difficult for small farmers to buy and use such equipment's in order to facilitate such small farmers low cost and easily maintainable equipment's are necessary.
Advance machineries available are not suitable for small land it is not possible to use in tight spaces without damaging the plants in order to overcome this problem a small and compact equipment is necessary.

6. FACTORS AFFECTING COMPACTION IN THE FIELD

COMPACTIVE EFFORT

In modern construction projects, heavy compaction machinery is deployed to provide compaction energy. Types of machinery required are decided based on type of Soil to be 2 compacted. The method of compaction is primarily of four types such as kneading, static, dynamic or impact and vibratory compaction. Different type of action is effective in different type of Soils such as for cohesive Soils; sheepsfoot rollers or pneumatic rollers provide the kneading action. Silty Soils can be effectively compacted by sheepsfoot roller/pneumatic roller or smooth wheel roller. For compacting sandy and gravelly Soil, vibratory rollers are most effective. If granular Soils have some fines, both smooth wheel and pneumatic rollers can be used.

MOISTURE CONTENT

Proper control of moisture content in Soil is necessary for achieving desired density. Maximum density with minimum compacting effort can be achieved by compaction of Soil near its OMC (Optimum Moisture Content). If natural moisture content of the Soil is less than OMC, calculated amount of water should be added to Soil with sprinkler attached to water tanker and mixed with Soil by motor grader for uniform moisture content. When Soil is too wet, it is required to be dried by aeration to reach up to OMC.

SOIL TYPE

Type of Soil has a great influence on its compaction characteristics. Normally, heavy clays, clays and silt offer higher resistance to compaction where as sandy Soils and coarse grained or gravelly Soils are amenable for easy compaction. The coarse-grained Soils yield higher densities in comparison to clays. A well-graded Soil can be compacted to higher density.

LAYER THICKNESS

The more the thickness of layer of earth subjected to field compaction, the less the energy input per unit weight of Soil and hence, less is the compaction under each pass of the roller. Suitable thickness of Soil of each layer is necessary to achieve uniform thickness. Layer thickness depends upon type of Soil involved and type of roller, its weight and contact pressure of its drums. Normally, 200-300 mm layer thickness is optimum in the field for achieving homogeneous compaction.

CONTACT PRESSURE

Contact pressure depends on the weight of the roller wheel and the contact area. In case of pneumatic roller, the tyre inflation pressure also determines the contact pressure in addition to wheel load. A higher contact pressure increases the dry density and lowers the optimum moisture content.

7. IMPORTANCE OF ADEQUATE COMPACTION OF SOIL OVERTURNERING

Compaction is the process of increasing the density of Soil by mechanical means by packing Soil particles closer together with reduction of air voids and to obtain a homogeneous Soil mass having improved Soil properties.

Compaction brings many desirable changes in Soil properties as follow:

(a) Helps Soil to acquire increase in shear strength
(b) Reduces compressibility thus minimizing uneven settlement during service
(c) Increase density and reduces permeability, thereby reducing susceptibility to change in moisture content
(d) Reduction in erodability
(e) Results in homogeneous uniform Soil mass of known properties
(f) Reduction in frost susceptibility in cold regions
(g) Helps the pavement designer in assessing the sub-grade strength to a reasonably accurate strength and thereby produce a safe and economical design
(h) Results in little change in volume under traffic loads, thus minimizing deformation and maintaining good rideability characteristics of the pavement
(i) Reduces expenditure on maintenance of formation during service

8. CONCEPTUAL BACKGROUND

In 14th century the 'Leonardo Da-vinci' is a one man who is an architect, engineer, geologist, and painter, he is shown various inventions and thought through his drawing and we take our project concept from this picture.
This picture show the war when the horse is running, wheel is rotate in circular motion and this motion give the cutter through the propeller shaft by using the bevel gear which is connected to the wheel of chariot. This cutter act's like a weapon and it used in war. So this concept we use for a agricultural approach and we decided to create a new invention in agricultural and we make a demo model.
In this invention we used the engine which generated the power and this power we can used for rotating the cutter with the help of pulleys and belt to cut the SOIL in the farm.

9. BASIC COMPONENTS

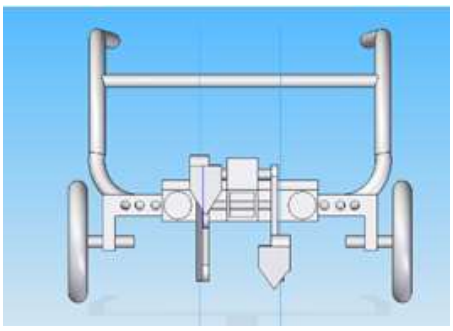

Fig-1: BasicComponents

Proposed project involve combination of mechanical components having Rigid frame & wheel built out of steel bars Which is the main structural support of the equipment above which all the components are assembled Power is developed by a two stroke petrol engine which is coupled to a Rotary-oscillating mechanism which consists of a set of arms and blades which is utilized to overturn the top soil.

8.1 Rigid Frame & Wheel

Frame is the structural support member of the equipment which holds all the other parts it is made up two inch hallow square bar for the base and handles are made using the 1 inch hallow circular bar the has wheels attached to it in order to move the equipment in the agricultural field wheel base has an adjustable frame who's width can be adjusted according to our requirements.

Fig-2: Rigid Frame & Wheel

8.2 Engine

Engine is the main power provider for the soil overturning equipment it is a 2 stroke petrol engine with a specification as fallows.

Bore	:	69.9 cc
Max Speed	:	3750 RPM
Engine Power	:	3.5 bhp
Fuel Capacity	:	600 mm

Fig-3: Engine

Power from the two stroke petrol engine is transmitted to the rotary oscillating mechanism through a chain and sprocket arrangement. A sprocket is coupled to the input shaft from the gearbox which receives the power from the engine and transmits it to the output mechanism.

8.3 Rotary - oscillating Mechanism

Rotary -oscillation mechanism it is the mechanism which dose the actual work a set of links connected to each other in order to obtain the oscillation required to overturn the soil it has two flexible arms at the end of each arms blades are attached which is utilized for digging the soil.
The power from the engine is received from the gear box which is transferred to the arms using a shaft the rotary motion is converted to oscillation motion using set of cam plates as shown in the figure.

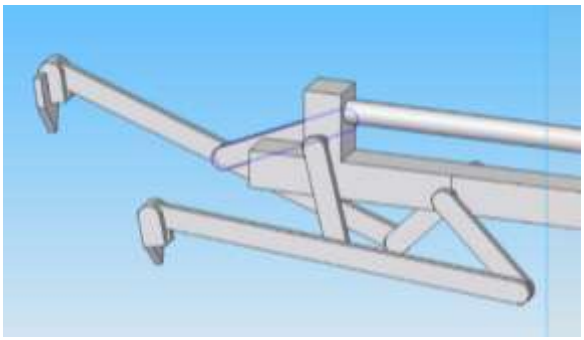

Fig-4: Rotary – Oscillating Mechanism

8.4 Gear arrangements

Fig-5 : Gear Arrangements

Gear arrangements are used to control the speed of the engine and to change the direction of the rotation of the shaft it is used in order to reduce speed and increase torque to facilitate more power at the blades for better soil removal.

A set of warm and warm wheel arrangement is used to change the direction of rotation of the shaft in order to achieve desired motion this arrangement is enclosed in a metal box in order to provide lubrication and support and at the ends of the warm shaft two cam plates are attached which converts rotary motion in to oscillation motion of the arms.

8.5 Blades

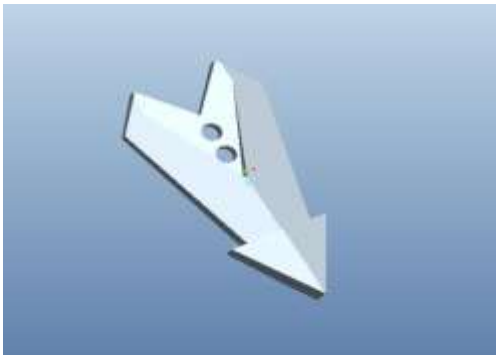

Fig-6: Blades

Blades are made of Plane Carbon steel with a thickness of about one centimeter it is shaped accordingly for better dinging of soil it breaks the soil and lifts above in order to turn it over.

This blades are attached to the ends of each arm which delivers power in order to dig the soil, the blades are sharpened at the ends in order to facilitate better digging of the hard soil.

9. METHODOLOGY

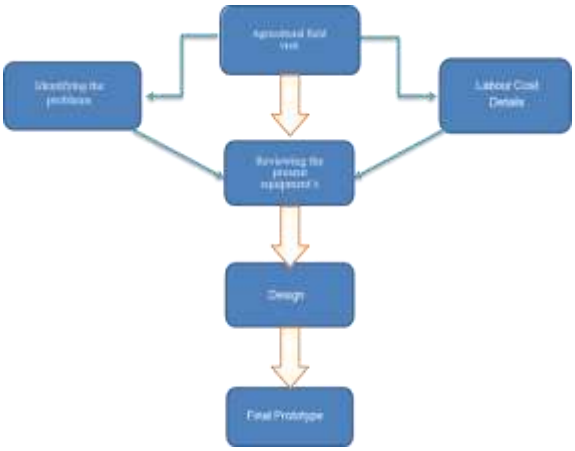

Fig-7: Methodology

- Visiting the agricultural fields and plantations and collecting the information regarding soil overturning and tillage process.
- Identifying the problems faced in the present soil overturning process.
- Reviewing the equipment's present in the market.
- Designing the compact and efficient equipment.
- Fabricating the actual model.

- Testing the effectiveness of the equipment under different scenarios.
  Reviewing the output and rectifying the problems if any.

10. WORKING

The proposed project mainly consists of a rotory-oscilating mechanism which is powered by a 2-stroke petrol engine. Engine output shaft and rotary- oscillating mechanism are connected using set of gear arrangements. These are fastened to a metallic frame which is the main structural support which has a set of wheels using which the whole equipment can be moved using human effort.
The power from the engine transmitted is transmitted using a shaft and that is in turn coupled to a set of gears which in turn moves the oscillating mechanism. This mechanism possess a set of blades at the end of its arms which gets an oscillating motion by which the blades go deep into the soil around 2 to 3 inches through which the bottom layer of the soil can be brought up to the top extreme. Thereby carrying out the soil overturning process.

Engine is started by starting lever once the engine starts the power from the engine is transferred to the rotary – oscillating mechanism through a chain drive which is coupled to a shaft which is in turn connected to a gear box arrangement, gear box is used to change the direction of rotation of shaft and at the ends of the gear box cam plates are connected which converts rotary mechanism to oscillating mechanism of the arms which carries the blades which turns the soil.

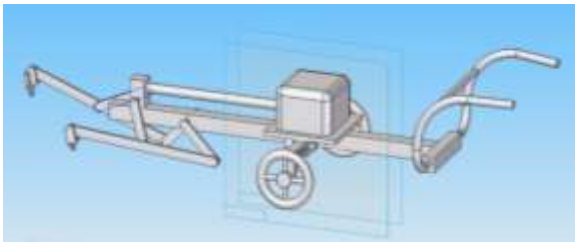

Fig-8: Soil Overturner

11. ADVANTAGES

- To reduce the unit cost of operation.
- To reduce the dependency over the labors.
- To control the growth of weeds.
- To improve soil quality with minimum cost.
- Comparatively cheaper than the regular conventional machines.
- Can be used in tight spaces without damaging the crops/plants.

12. APPLICATIONS

The overturnering of different Soils is carried out at present only by manual labors and the tools are used are only ordinary sickle, the cutting edge of which is specially serrated for this purpose. They vary slightly in shapes different part of country, but they are all adopted for cutting only one handful of stems or stalks of the grain SOIL at each cut. This kind of overturnering needs of large labour force and as the overturnering has to be carried out quickly and almost simultaneously in each tract, the demand for labour is very more, the work become very expensive and labour to very difficult to get even at high wages therefore "SOIL OVERTURNERING EQUPMENT" has brought into existence which carry out this process easier and faster.

13. FUTURE SCOPES

Cultivators - A cultivator is any of several types of farm implement used for secondary tillage. One sense of the name refers to frames with teeth (also called shanks) that pierce the Soil as they are dragged through it linearly. Another sense refers to machines that use rotary motion of disks or teeth to accomplish a similar result. The rotary overturnering is a principal example.

Floors cleaner - A floor cleaner machine to use cleaning of a floor in home, mall, offices, etc. so in this machine remove the cutter & fix floor cleaning brush. This process is easy to clean floor as compare to the human effort.

14. EXPECTED OUTCOME

The design of the system is capable to meet the objectives of the proposed project. The project will reduce the overall cost involved in the soil overturning process and minimizing the human effort and thus improving quality of the soil by bringing the nutrients to top level and helps in improving the water holding capacity of the soil. To facilitate the small scale farmers who cannot afford the conventional machines which is bit costlier. And also it helps in removal of weeds which damages the actual crop/plant. Thereby it acts as a multi-purpose equipment for small scale farmers.

15. CONCLUSIONS

In this way we made a demo model "SOIL OVERTURNERING IN AGRICULTURAL APPROACH" for the use of SOIL cutting in the farm. In this project the following conclusions were drawn from the study & observation:

For Machine:

Machine is working in 1 acre area the fuel consumption is = 1.5 liter /-

Fuel cost is Rs.115 + labour cost is Rs.35 + M/C cost is Rs.50 = Rs.200 /-

For Labour

Labour working in 1 acre area the associated cost is = Rs.400 /-

Cutting time for 2 labour in 1 acre area of farm = 6 hr

Hence in above comparison it is clear that the cost of working by machine in the farm for said application is less as compared to labour cost.

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