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Research Article

Design and Fabrication of Mini Multipurpose Cultivator and Tiller

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A B S T R A C T

A mini-multi-purpose cultivator and tiller is a farming or gardening tool that breaks up soil and removes weeds in the lines where plants are growing or will be grown. The soil cultivator and tiller are one of the important mechanizations of farming. Tractors, soil tiller, mini cultivator and weedier are non-conventional so far as the displacement of labour is concerned. Mini cultivator especially considering the fact that the majority of farmers are having small land, and it is also useful for trilling and weeding without destroying crops like groundnuts, paddy, soya bin crops, cultivation of sugarcane in particular, and other crops in general for the smaller farmers, which increases the productivity of crops. Small farmer Can hardly afford expensive tractors. So, the tiller and weeder is one of useful machine.

Keywords: Smart Farming, Flowchart of Research Methodology, Engine, Tiller, Frame, Belt & Pulley, Fabrication Work

Introduction

A mini-multi-purpose cultivator and tiller is a farming or gardening tool that breaks up soil and removes weeds in the lines where plants are growing or will be grown. The soil cultivator and tiller are one of the important mechanizations of farming. Tractors, soil tiller, mini cultivator and weedier are non-conventional so far as the displacement of labor is concerned. Mini cultivator especially considering the fact that the majority of farmers are having small land, and it is also useful for trilling and weeding without destroying crops like groundnuts, paddy, soya bin crops, cultivation of sugarcane in particular, and other crops in general for the smaller farmers, which increases the productivity of crops. Small farmer Can hardly afford expensive tractors. So, the tiller and weeder is one of useful machine. In India, almost 75% of the population are dependent on agricultural for economic growth. So, the agricultural system in our country should be changed to reduce the manual efforts of farmers required while farming. Sugar industry is a big business in India. Around 525 mills produced more than 30 million tons of sugar, this makes it the world's largest producer, unseating Brazil. Some 50 million farmers and millions of more workers, are involved in sugarcane industry. farming. India is the world's largest consumer of sugar. Sugarcane grows along with weed which decrease the production. Traditional weed control methods such as hand hoes and donkey pulled cultivators have still good weeding efficiency but not recommended to be used because of their high cost, more labour consuming and more human effort done. So, the developed cultivator must have many advantages such as being suitable for the small-scale farmers, solve the problems of common cultivators, suitable for weeding operation in most types of crops and in addition to simple construction. The rate and effectiveness of weed removal depends on number of parameters related to machine performance parameters and soil properties such as types of cutting blades used, machine efficiency, moisture content,

etc. Studies have been conducted on the effect of moisture content and the type of cutting blades like flat blades, spike tooth blades and curved blades on the performance of weeding machines. Mechanical weeding was found to be less effective when soils are wet during or after the weeding operation. Mechanical weeding is the use of powered tools and machinery to manage weeds. It is suitable for larger infestations because it reduces the weed bulk with less manual effort. Mechanical control consists of methods that kill or suppress weeds through physical disruption. Such methods include pulling, digging, disking, plowing and mowing. Machines meant solely for the purpose of weed removal are not easily available in India. Although some agricultural manufacturers are making efforts and made certain equipment available which are mainly intended for weed removal in farms. These machines are again primarily intended for use after sugarcane grow up to 4-5 feet. These machines are also low costly and operate on petrol powered engines. Operational cost of these is lower than other available equipment but even these machines can only be used for weed removal when crops are small. With most mechanical weeding implements, operator skill, experience and knowledge are critical to success. Drawbacks to mechanical weed control include low work rates, delays due to wet conditions, and the subsequent risk of weed control failure as weeds become larger Hence it is important to develop machines and implements which can perform mechanical weeding in an efficient and cost-effective manner to represent a viable alternative.

Literature Review

Design, Development and Fabrication of Soil Tiller and Weeder

Hand operated soil tiller of 1.5 HP 4-stroke petrol starts kerosene running engine, the blade cutter of EN 8 material, Gear assembly, pulley, body frame, wheels weeder makes the manual of that wastage grass by cutting it in small piece and thoroughly mixed with soil during operation.

Design, Development and Fabrication of Mini Cultivator and Tiller

Hand operated two-wheel cultivator of 4.5 HP engine is placed at top of model for ploughing initial cavitation of soil in preparation for bowing seed.

Design and Fabrication of Single Axle, Self-propelled Multi Attachment Agricultural Machine

Design and manufacturing of multifunctional agricultural machine by using worm and worm wheel gearbox mainly used for inter agricultural purpose. As worm wheel gear box is utilized for producing less speed and more torque, hence introduced in machine further speed reduction is carried out by chain drive. It is nothing but two wheeled tractors popularly known as power tiller. The conventional power tiller is having many drawbacks. As like fails to delivered high torque and fails to absorb shocks during agricultural operation. The project relates with to develop more torque and design different attachments to it. Plough implement is firstly introduced to power tiller via this project. As per the name multifunctional, machine utilized for pump set, material handling, pesticide spraying etc.

Agricultural Mini Cultivator

Most models of the lightweight power turner being made in India have been furnished with a front or back mounted fuelled rotating unit for progress ahead just as for culturing activity. There is scope for these force turners to be utilized as seedbed arrangement and entomb culture activity in wide separated column crops like cotton and sugarcane. To evaluate the exhibition of lightweight force turner, one such model was assessed at Central Mechanical Engineering.[1] Their performance results were analysed in terms of machine performance parameters. The effect of treatments on machine parameters like fuel consumption and field efficiency was evaluated. Also, the cost of operation was worked out. The average values of field efficiency and fuel consumption were found at 78.89%, 12.94 l/ ha respectively.[2] The regular power turner is having numerous disadvantages. Like neglects to convey high torque and neglects to retain stuns during horticultural activity. The task relates to creating more torque and structure various connections to it. Furrow actualize is right off the bat acquainted with power turner employing this venture.[3] Data are introduced on the measure of soybean seed harm and the precision of seed dividing when different grower meters were utilized. Different factors include soybean assortment and seed dampness. Both huge and little seed assortments were utilized. The machine is used for mechanical weed control and hoeing. It was observed that the worm gear used in its transmission often failed due to surface wear of gear teeth. Worm gears made from three different copper alloys were tested against soil resistance in sandy loam soil bin.[4] Five business grower meters were analysed: A fluted roller meter, an air plane meter, a solitary run feed cup meter, an air drum meter and a level plate meter.[5] The food and agriculture sector needs to achieve higher productivity and sustainability to respond to increasing and changing global demand for food, feed, fuel, and fibre without damaging natural resources. Environmental sustainability and energy efficiency factors are key factors for the better utilization of the resources. The review the literature and suggest the alternate green dielectrics and the environment for improved operational safety, less environmental impact.[6] In the field of agricultural also we had seen remarkable development, big farmers are now a day's using cultivator, harvester, tractor, advance machine tools and advance farm pieces of equipment, but in the country like India where more than 80% of farmers

are small and marginal and they are still doing farming by traditional method only they are also in need of improved agricultural tools that may be hand driven or bullock driven.[7] The precision geometry, optimum energy utilization, multi-operational design, easy transport, and flexible attachments are some of the features which result in achieving some of the important parameters such as the width of cut Max 18 cm & Min 8 cm, depth of cut Max 17cm and Min 8 cm, Speed of operation 4.2 km/ hr. Field capacity 0.42 ha/hr. and Field efficiency of 78%. Theoretical field capacity 0.33ha/ hr. Theoretical draft 6. 5kN.Cost of operation $12/ha.[8] On the-row mechanical cultivation however is still problematic mainly because of the risks of damaging the crop that is associated with this cultural practice. The objective of this study was todetermine the optimum operational requirements for the specific type of rotary tillage tool used for on-the-row cultivation that would result in an appropriate control of weeds and minimal damage to the corn plants.[9] Agricultural productivity is measured as the ratio of agricultural outputs to agricultural inputs. While individual products are usually measured by weight, their varying densities make measuring overall agricultural output difficult.[10] Such material and technological conversion should enable a longer life of these elements without an increase in production costs, and as a result, it should increase the competitiveness of the produced elements.[11] Novelty production strengthens the transformation of (potentially) available resources into territorially specific resources; it supports territorial distinctiveness. Novelty production creates capacity to perform better and, in that way, increases the competitiveness.[12] Creative design seems more to be a matter of developing and refining together both the formulation of a problem and ideas for a solution, with constant iteration of analysis, synthesis and evaluation processes between the two notional design 'spaces' problem space and solution space.[13] Now the creative industry is no longer merely a concept. Instead, it boasts immense potential for economic benefits and is considered a new growth point for global economy.[14] The creative life is everywhere in agriculture. The earth creates new things, man gives them shape. He trains plants, intervenes, puts his mark on them. With respect and creativity. New farmers are utilizing a variety of creative innovations to ensure the success and profitability of their farms. Creativity and Innovative Business Ideas are requirements of the future in agriculture and farming. It can create monopoly in market. In subsequent decades, people overcame this initial imbalance and came to realize that herbicidal weed control has limitations and externalities, andit must be managed intelligently.

Scope of the Study

"Smart farming" is an emerging concept that refers to managing farms using technologies like IoT, robotics, drones, and AI to increase the quantity and quality of products while optimizing the human labour required by production.

What is a Smart Farm?

Smart Farming is an emerging concept that refers to managing farms using modern Information and Communication Technologies to increase the quantity and quality of products while optimizing the human labour required. Among the technologies available for present-day farmers are:

- Sensors: Soil, water, light, humidity, temperature management
- Software: Specialized software solutions that target specific farm types or Applicationsagnostic IoT Platforms
- Connectivity: Cellular, Lora
- Location: GPS, Satellite
- Robotics: Autonomous tractors, processing facilities
- Data analytics: standalone analytics solutions, data pipelines for downstreamsolutions
- Armed with such tools, farmers can monitor field conditions without even going to thefield and make strategic decisions for the whole farm or for a single plant
- The driving force of smart farming is IoT connecting smart machines and sensorsintegrated on farms to make farming processes data-driven and data-en

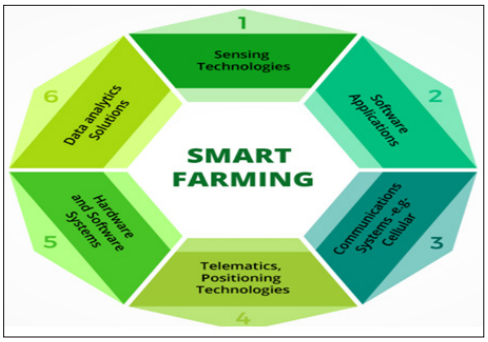

Figure 1

Objectives and the Hypothesis of the Study

A two-wheeled tractor has some expertise in pulling any of various sorts of executes, while rotational turners represent considerable authority in soil culturing with their committed burrowing devices. Basic and discretionary soil control is the key activity required for the advancement of any kind of item. Soil working instruments, for the model, form board wrinkles, plate wrinkles, and ridges has for quite a while been recognized and viably used by farmers under typical field conditions. The primary objectives of the present project work are listed below.

- To control weeds, and to mix and incorporate the soil to ensure the growing crop has enough water and nutrients
- The primary purpose of ploughing is to turn over the

upper layer of the soil, bringing fresh nutrients to the surface
- To decrease the operational cost by further introducing new mechanisms
- To provide overall support for good quality sugarcane production
- To make the sugarcane field suitable for sugarcane without any harm to it

Research Method

In this project, we have developed mini-multi-purpose cultivator and tiller that breaks up soil and removes weeds in the lines where plants are growing or will be grown this methodology includes six stages shown in Figure 2, below.

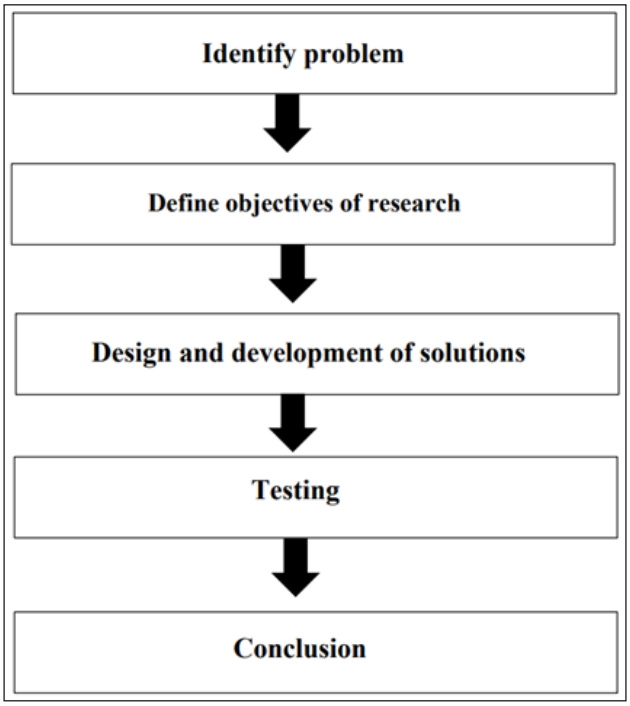

Figure 2.Flowchart of Research Methodology

Identify Problem

At this stage, we have identified the problems that removing weed manually as conventional way is time consuming and have low efficiency and required more manpower to complete the same Identify problem Define.

Objectives of Research

The purpose and benefits of this research are to reduce the cost of machine and simplify the processof removing unwanted weed in sugarcane and pour soil on the root of sugarcane. The machine is expected to be useful for small farmer for various types of cultivation for farming Moreover, itwill modernize the current working process and increase productivity of sugarcane and other crops.

Design and Development of Solution

At this stage make the design and development of cultivator based on research objectives by usingwaterfall model. Waterfall model is a system development method that each stage can't continuebefore the previous step is complete. The design of machine is made to facilitate to make anoverview of the design of mini-multi-purpose cultivator and tiller.

Testing

After design and fabrication is done then test in field todetermine whether the machine can workproperly or not. Testing is done to check whether a cultivator really works in field. If there is ashortage in system development it will be redesigned, but if it does not exist then the test isconsidered to have been completed.

Complete Work Plan

Strategy

The mini multi-purpose cultivator fertilize are the first of their kind. Developed on the sugarcane land of removing weeds. Some features and benefits offered by the mini multi-purpose cultivator and tiller are:

- Adjustable blade and tool's
- Highly economical
- Eco friendly
- Easy to operate and maintain
- Save farmers trouble and time

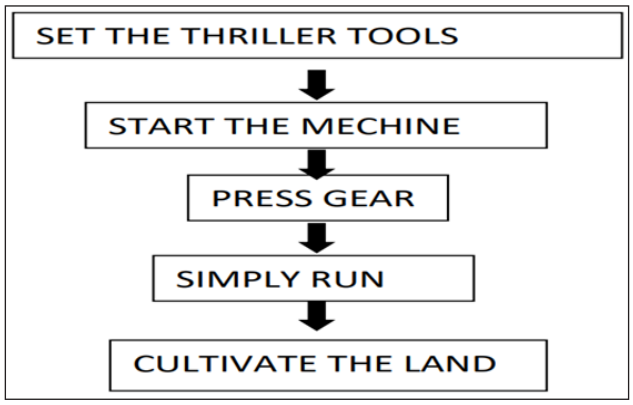

Figure 3

Benefits offered by the mini multi-purpose cultivator and tiller are the specific tasks to achievethis goal.

- Accurately complete the construction of the mini multi-tool calibrator
- Finally, check out the Mini Multi-Tools Cultivator

Expected Outcomes of the Study

The tractor-drawn prototype cultivator-cum-seed drill and conventional seed drills were evaluated in the laboratory. Firstly, both machines were calibrated in the laboratory for the desired seed rate by adjusting the exposed length of the fluted rollers. Both machines were tested for different hopper filling one fourth, half, three fourth, and found that

hopper filling does not affect the seed rate at a 5 % level of significance. The seed rate close to the recommended seed rate for cultivator mounted seed drill was found 80.87 kg/ ha with fluted exposure was 15 mm. Same was found 80.26 kg/ ha. The main function of the mini cultivator is to prepare a proper seedbed. For the crop to be planted and to control weeds (A weed may also be defined as any plant growing where it is not wanted. And to mix and incorporate the soil to ensure the growing crop has enough water and nutrients to grow well. In this we are using one-row type cultivator by attaching a one-row type cultivator you will have the ability to quickly and easily till each side of the row in your farms. A cultivator is a great tool for removing unwanted weeds and grass while also breaking up the soil crust. This makes it easier for the garden to absorb nutrients and moisture. And this type of cultivator is run manually by pushed or pulled by a single person. For mall-scale farming, such as for the household's use or small market gardens etc. The present research brought out some important findings which have got a direct bearing on those involved in the transfer of technology and the making of policies.

A major number of the respondent belonged to a medium level of knowledge regarding farm mechanization practices by sericulture cultivation.

Especially in sericulture chopping, harvesting equipment, its operation, specific requirements like mulberry portable pruner, multi-crop chaff cutter, silkworm separating machine, motor-operated cocoon harvesters. Therefore, the researcher and extension personnel of the developmental departments should be guided and advised the farmers about its advantages or even difficulties very clearly.

The study indicated that though the sericulture activities are practicing by all most all irrigated farmers in the study area, their scientific knowledge about the farm.

Mechanization in sericulture crop and scientific adoption of the farm implements was up to the mark in certain implements.

The government should ensure that the subsidy or loan is available to the farmers at an adequate level before the season starts at a nearby place to improve the adoption level of the farm mechanization. After manufacturing the performance of a multifunctional agricultural machine was evaluated to find maximum field efficiency along with other parameters. The objectives specified are satisfied at the end of this project. Cultivator creates a perfectly formed bed of soil ready to embrace the roots of flowers and vegetables require tools and techniques suited to the task. the machine can sustain and faces frequently changing conditions.

To the extent that cultivating is done commercially today (such as in truck farming), it is usually powered by tractors, especially row-crop tractors. Industrial cultivators can vary greatly in size and shape, from 10 feet (3 m) to 80 feet (24 m) wide. Many are equipped with hydraulic wings that fold up to make road travel easier and safer. Different types are used for preparation of fields before planting, and for the control of weeds between row crops. The cultivator may be an implement trailed after the tractor via a drawbar; mounted on the three-point hitch; or mounted on a frame beneath the tractor. Active cultivator implements are driven by a power take-off shaft. While most cultivator are considered a secondary tillage implement, active cultivators are commonly used for primary tillage in lighter soils instead of ploughing. The largest versions available are about 6 m (20 ft) wide and require a tractor with an excess of 150 horsepower (110 kW) (PTO) to drive them. Field cultivators are used to complete tillage operations in many types of arable crop fields. The main function of the field cultivator is to prepare a proper seedbed for the crop to be planted into, to bury crop residue in the soil (helping to warm the soil before planting), to control weeds, and to mix and incorporate the soil to ensure the growing crop has enough water and nutrients to grow well during the growing season. The implement has many shanks mounted on the underside of a metal frame, and small narrow rods at the rear of the machine that smooth out the soil surface for easier travel later when planting. In most field cultivators, one-to-many hydraulic cylinders raise and lower the implement and control its depth.

Research and Experimental Work Done

For the design of the frame, the length of the frame and row to row spacing between tines were considered according to the crop to be sown and row to row spacing for intercultural operation. The mounting of tines on the frame was kept simple as well as rigid so that they were easy to shift to achieve desired row spacing and on other hand, enough to bear vibration and shocks during operation. The main objective of this project is to develop a mini cultivator for sugarcane agriculture. This innovation targets some of the objectives listed below.

- To decrease the operational cost by furtherintroducing new mechanisms
- Adjustable blade and tool's
- Highly economical
- Eco friendly
- Easy to operate and maintain
- Save farmers trouble and time
- The academic goal of this project is to develop an innovative, diverse applications, low maintenance

Basic Component Of Cultivator

Engine

An engine or motor, a machine designed to convert one or

more forms of energy into mechanical energy. We would be using a 100cc bike engine.

- Which would be used to drive back wheel
- It would be operated with the help of petrol

Figure 4

Tiller

- The tiller is used for plugging the field
- So, after the field is successfully plugged then the seed sowing operations can be performed

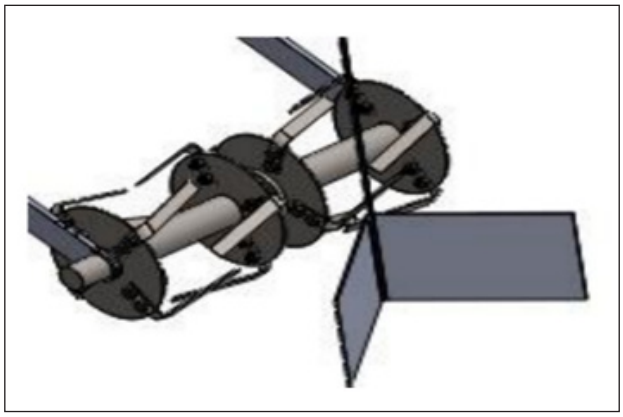

Figure 5.Tiller & Blade

Frame

In a Cultivator body frame, there is a connection between the side members and horizontal members, helping to offers proper strength to the structure. These cross members are the important parts of the frame.

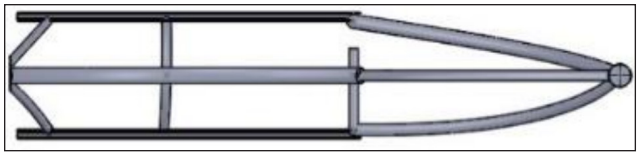

Figure 6.Body Frame

Belt & Pulley

Belt drives transfer movement from one rotating pulley to another, each held on a shaft. Shafts and pulley wheels can be made out of any material, whereas pulley belts are generally made from a soft, flexible material such as rubber. Grooves on the pulleys and belts help them to grip and turn.

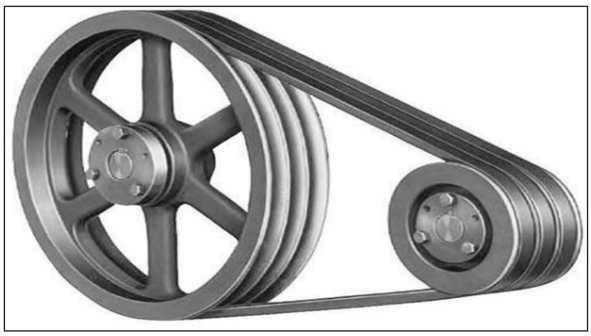

Figure 7.Pulley & Belt

Fabrication Work

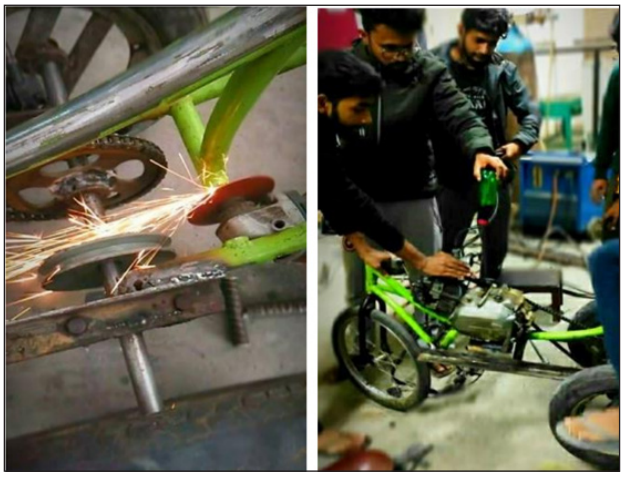

Figure 8(a).Fabrication Work

Figure 8(b).Final Product

Result & Discussion

The tractor-drawn prototype cultivator-cum-weed remove, and conventional weeds remove were evaluated in the laboratory. Firstly, both machines were calibrated in the laboratory for the tested for different type of tiller tool for removing weeds does not affect the removing rate at a 5% level of significance. The removing rate close to the

recommended removing rate for cultivator mounted weed removing was found 5,000 sft/ ha is to prepare a proper seedbed. For the crop to be planted and to control weeds (A weed may also be defined as any plant growing where it is not wanted. And to mix and incorporate the soil to ensure the growing crop has enough water and nutrients to grow well. In this we are using one-row type cultivator by attaching a one-row type cultivator you will have the ability to quickly and easily till each side of the row in your farms. A cultivator is a great tool for removing unwanted weeds and grass while also breaking up the soil crust. This makes it easier for the garden to absorb nutrients and moisture. And this type of cultivator is run manually by pushed or pulled by a single person. For small-scale farming, such as for the household's use or small market gardens etc.

Conclusion

This implement is very much helpful for small and marginal farmers and works very efficiently in sandy loam or loamy soil. Less cost of this implement can enhance the productivity with reduced labour charges, time and cost of operation of any farm activities in compare to manual operations. This is found in the study farmers are hiring implements on rent basis and facilitate their farm activities but due to demand of the implements at a time results in delayed cropping, which decrease the productivity. Low-cost mini power tiller is a great alternative of high-cost tractor for small and marginal farmers. Further after getting advantages of this mini power tiller, they are interested to buy additional attachments like trailer, reaper, potato digger, weeder etc. Fuel consumption is maximum one litre per hour. It can be also used for potato digging, harvesting by reaper, carrying farm residues if attached with trailer should become useful machine for internal cleaning of crops. The main purpose of this cultivator is to reduce manpower as in today's scenario labours are very hard to find as well as it reduces the working time. Most of our diets contain a touch of sugar/sweets so that a day's meal is not complete without sweets, and sugarcane is present throughout most of that sweet product. And most of the problems in the production of this sugarcane are faced only by the farmers, against the will or desire, the production of sugarcane has to be done with various activities, care has to be taken, weeds have to be cleaned by hand and harmful herbs have to be removed. Being small volume, light weight, simple structure and easy transfer in the farmland, the internal combustion engine mini-tiller is easy to operate. It takes a farmer one day to clean up 1/20 acre of land, which means he needs to clean up one acre of land at 20 days. The mini tiller is a kind of bike machinery rotating and soil plow is connected at the back of machine where and its operating comfort mainly relies on acceleration and the force and acceleration is controlled by hand of operator.

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