Design and Fabrication of Solar Powered Multifunction Weeder Machine

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Abstract— Agriculture being one of the major occupation in India, Agriculture plays a vital role in the Indian economy. Indian agriculture has registered impressive growth over last few decades. It is very essential to discover and implement new idea in this field, though lot of work has been done in this area. It is unfortunate that, these ideas are not being implemented properly in actual field. This is due to high cost and is complicated for rural people. Multipurpose agriculture or farming machine is basic and major machine involved in agriculture for maximum yielding. The Conventional method of weeding, watering, pesticide spraying and cutting is a laborious process and hence for that reason there is a scarcity of labours and basically, many farmers in India also use bullocks, horses and buffalo for farming operation. This will not satisfy need of energy requirement of the farming as compared to other countries in the world. This result in delayed agriculture crop production practices to overcome these difficulties, we are thinking that human and animal efforts can be replaced by some advance mechanism which will be suitable for small scale farmer from economical and effort point of view. So, we are developing this machine which will satisfy all this need and to solve labour problem. A solar powered multipurpose agricultural machine is designed for weeding, watering, pesticide spraying and cutting purpose.

Keywords: Agricultural, Solar, Weeder, Pesticide Spraying, Cutting

I. INTRODUCTION

Agriculture is the backbone of India. The history of Agriculture in India dates back to Indus Valley Civilization Era and even before that in some parts of Southern India. Today, India ranks second worldwide in farm output. The special vehicles plays a major role in various fields such as industrial, medical, military applications etc., The special vehicle field are gradually increasing its productivity in agriculture field. Some of the major problems in the Indian agricultural are rising of input costs, availability of skilled labour, lack of water and crop monitoring. To overcome these problems, the automation technologies were used in agriculture. The automation in the agriculture could help farmers to reduce their efforts. The vehicles are being developed for the processes for weeding, seed sowing, levelling and water spraying. All of these functions have not yet performed using a single vehicle. In this the robots are developed to concentrate in an efficient manner and also it is expected to perform the operations autonomously. The proposed idea implements the vehicle to perform the functions such as ploughing, seed sowing, mud levelling and water spraying. These functions can be integrated into a single vehicle and then performed.

Every year in INDIA, an average of 1980 Cr of rupees is wasted due to weeds. Our country faces the total loss of 33% of its economy from Weeds. The Losses are due to some of the following reasons, total loss of 26% from Crop Diseases, total loss of 20% from Insects and Worms, total loss of 6% from Rats. Has been Surveyed. Shrinking farm lands, acute labour shortage, decreasing income per acre of cultivation, and economic frustration are some of the key factors hurting a farmer's confidence in continuing farming. Weeding control is done by: mechanical weeding, thermal weeding: flaming, biological control, chemical control, and by farming pattern. It has always been a problem to successfully and completely remove weeds and other innocuous plants. Invariably, weeds always grow where they are not wanted. This work involved the design and construction of mechanical weeder, after discovering that tools such as cutlass and hoes require high drudgery, time consuming and high labour force. As a solution to these problems, mechanical weeder was designed and constructed. The mechanical weeder was made of two implements attachment i.e. the primary cutting edge which is in front to loose soil above and the secondary cutting edge which is behind to do cutting and lifting of weeds. The overall machine field efficiency was 98.67%. The Single Wheel Weeder being manufactured is the equipment, which is used for very special purpose when the weeding is required at narrow places or between rows. The blade is thin but very sturdy and tough besides, it is very safe to use and offers zero threat of hurting to the user, Other than the wheel, there is nothing mechanical in this single wheel weeder but, it works wonderfully under the condition where it is put into. This hassle free equipment requires no special maintenance. It is necessary to design the weeder which minimize the human effort and provide efficient work output. The tool which is designed is able to fulfill the present requirement for the weed control. The present design is directed to an improved manual tilling, mulching and weeding tool.

II. METHODOLOGY

Manual weeding requires huge labour force and accounts for about 25 per cent of the total labour requirement which is usually 900 to 1200 man M hours/hectares. This operation is mostly performed manually with cutlass or hoe that requires high labour input, very tedious and it is a time-consuming process. Moreover, the labour requirement for weeding depends on weed flora, weed intensity, time of weeding, and soil moisture at the time of weeding and efficiency of worker. Often several weeding operation are necessary to keep the crop weed free. Reduction in yield due to weed alone was estimated to be 16 to 42 % depending on crop and location which involves one third of the cost of cultivation.

Weeding and hoeing is generally done 15 to 20 days after sowing. The weed should be controlled and eliminated at their early stage. Depending upon the weed density, 20 to 30 percent loss in grain yield is quite usual which might increase up to 80 per cent if adequate crop management practice is not observed. Manual and mechanical techniques such as pulling, cutting, and otherwise damaging plants, may be used to control some

invasive plants, particularly if the population is relatively small. These techniques can be extremely specific, minimizing damage to desirable plants and animals, but they are generally labor and time intensive.

III. AIM OF PROJECT

The aim of the project is to design, construct and test manual weeder, to provide the best opportunity for the crop to establish itself after planting and to grow vigorously up to the time of harvesting.

IV. PROBLEM STATEMENT

Weeding with the use of tools like cutlass and hoe requires high labour force in a commercial farming system hence mechanical weeder is necessary to reduce the labour force. Environmental degradation and pollution caused by chemical is reduced by the use of Mechanical weeder. Low effective operation, low work effort and high time requirement for different types of hoe or cutlass, can be overcome with the use of mechanical weeder.

V. JUSTIFICATION

Presently in India, weeding with simple tools such as cutlass, hoe etc is labour intensive and intensive and time consuming. Thus, there is a need for the design of manually operated weeder for intensive and commercial farming system in India. One of the problems in crops and vegetables production is poor weed control; hence there is need of mechanical weeder to increase the production of these products.

VI. OBJECTIVES

- To reduce human effort in the agricultural field with the use of small machine.
- To perform all 4 operations at single time, hence increases production and saves time.
- To complete large amount of work in less time.
- The usage of solar can be utilized for Battery charging. As the Machine works in the field, the rays of the sun can be used for solar power generation

VII. LITERATURE REVIEW

The economic contribution of agriculture in India's GDP is continuously decreasing with the country's broad-based economic growth. Still, agricultural research and development (R&D) in India has made impressive contribution in the past. But the system is under significant stress today due to lack of clarity on focus and inefficient use of financial resources. Links among sister institutions have weakened and accountability has declined over time.

A weed is essentially any plant which grows where it is unwanted. A weed can be thought of as any plant growing in the wrong place at the wrong time and doing more harm than good. Weeds waste excessive proportions of farmers' time, thereby acting as a brake on development . Weeding is an important but equally labor intensive agricultural unit operation. There is an increasing interest in the use of mechanical intra-row weeder because of concern over environmental degradation and a growing demand for organically produced food. Today the agricultural sector requires non-chemical weed control that ensures food safety. Manual weeding is common in India. The use of sort handle hoe is effective and it is the most widely used weed control method. It is reported that manual weeding is labor-intensive, accounting for about 80% of the total labor required for producing food in India. Farmers using only hand hoe for weeding would find it difficult to escape poverty, since this level of technology tends to perpetuate human drudgery, risk and mystery. The use of herbicides has possible effect on desert encroachment and other adverse impact.

Zenon Pirowski et al (2009) in this paper, among other things, there were formulated requirements for shares of rotating and field ploughs in terms of casting material and construction of cast itself. Austempered ductile iron (ADI) was selected as casting material for testing shares of casts. This paper was suggested to replace beaten and welded elements of agriculture machines used to cut through soil by austempered ductile cast-iron. Such material and technological conversion should enable a longer life of these elements without an increase of production costs, and as a result it should increase competitiveness of the produced elements.

Jeevarathinam.A et al. (2014) in this paper was described the design modification and development of rotavator blade through the (CAD) interrogation method by modifying the design and also by modifying the material properties. Rotary tiller or rotavator is one of the tilling machines most suitable for seedbed preparation. In a Rotary tillage machine, Blades are the critical parts which are engaged with soil to prepare the land and to mix the fertilizer. These blades interact with soil in a different way than normal plows which are subjected to impact that create cyclic forces which result in fatigue failure of the blade. This actually decreases the service life of a blade. Therefore, it is necessary to design and develop a suitable blade.

Shridhar H S (2013) developed single wheel multi use weeder and it is manually operated. Weeder performs only normal weeding that is it only cut small size weed, it cannot work where stones and any obstacles are there. Some advantages of weeders are it is manually operated, offers zero hazardous, not require special type of maintains.

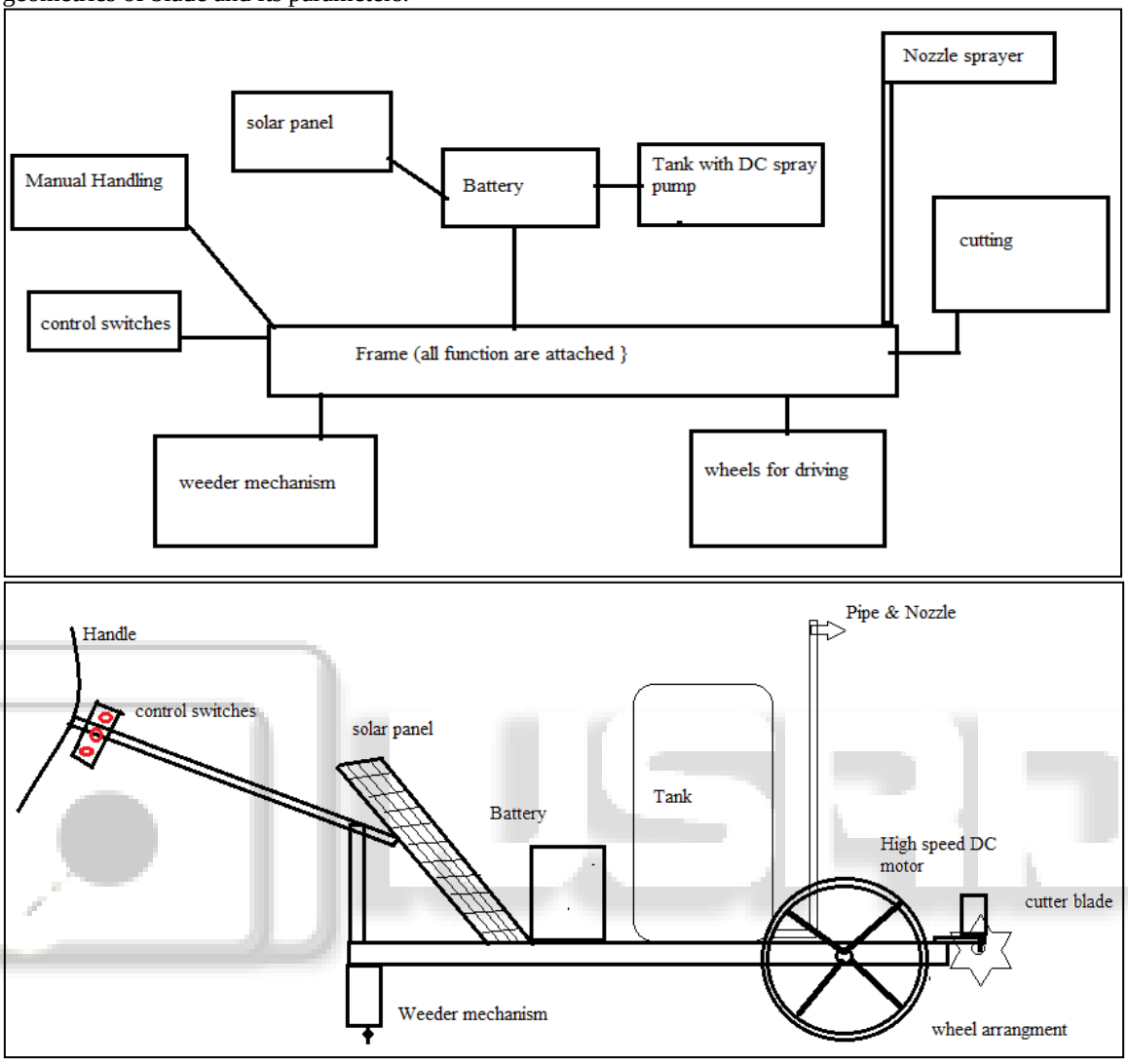
Mr. Mahesh Gavali, Mr.Satish Kulkarni had work on available portable weeders and power tillers in Indian market. They work on comparative analysis between them. They give information about different weeding method and which method is mostly acceptable by farmers. They give comparison basis on power source, power transmission method, engine power etc.

Subrata Kr. Mandal and his team work on soil blade interaction. For study of soil blade interaction they create soil bin. In soil bin all soil parameters like density, type of soil, moisture contain, hardness this are manually controlled. They obtained relation between moisture contain, speed, torque.

Tillage is one of important operation in agriculture. In tillers rotary blades plays main function, rotary blades contact with soil in a different way than normal plows and due to this blades are subjected to fatigue and wear. So it is

important to increase efficiency of blades or life of blade. Subrata Kr. Mandal, Somnath Mukherjee and Bhattacharya work on optimization of rotary blades, for this they were use different geometries of blade and its parameters.

VIII. BLOCK DIAGRAM:



IX. WORKING

The whole machine is drive with handle system through manual pressure. Two big wheels is arranged , so that whole machine can run efficiently. There is weeder mechanism is attached to bottom of frame. Its use for weeding operation in agriculture.

The whole system we attached is so portable that we can easily attached and detached all the function.

The power source use here is solar energy. Solar panel (12v 25w) collect the solar energy and convert into electrical energy. This electrical energy is stored in battery.

The stored energy in battery (12v 8 Amp) is used for various other function like, cutting, watering and pesticide spraying function.

DC high speed motor of 10000 RPM is used to cutting function. The blade system is around 5 inch in size.it can easily cuts the crops in farm.

DC liquid motor is attached on frame with input pipe in tank. And out pipe is used for watering function. For pesticide spraying function just attached nozzle for spraying on crops.

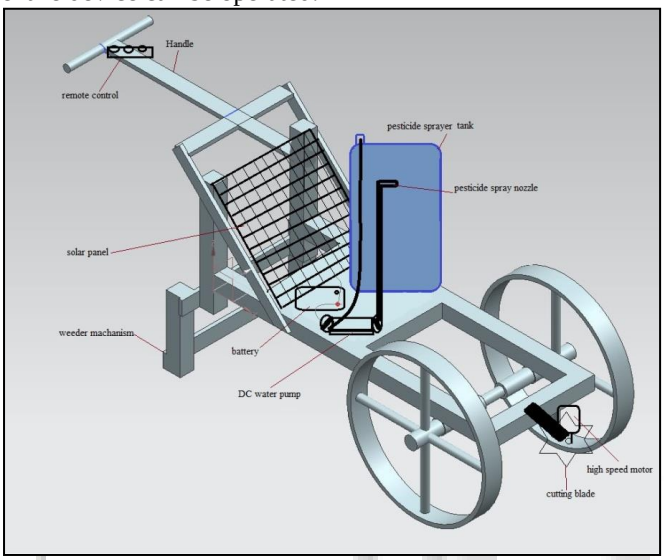
Whole function like, cutting , watering , pesticide spraying , Light are control with control box present at handle. In this way all system we connected to make it multifunction agriculture machine.

A. Components of multipurpose agro equipment

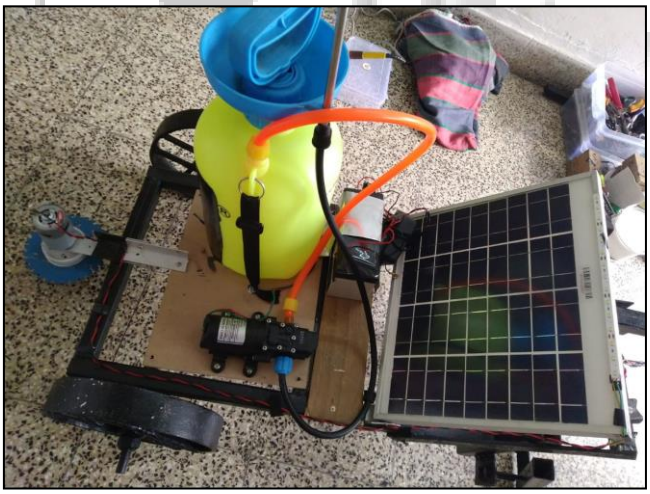
- Spraying fluid tank
- Spraying pipe
- Charging Module
- Solar Panel
- Batteries
- Cutter Blade
- DC Water Pump
- High Speed Motor
- Switch
- Frame
- Ground wheel
- Weeder mechanism

- Front LED light
- Remote Box

A frame is made up of iron which gives the desired strength and lightness, it includes all the equipment together i.e. weeder, watering , pesticide sprayer, and crop cutter. In this frame, a retractable link is fixed to the top end of which a solar photovoltaic panel is fixed that converts solar power into electricity. This electricity is then provided to the battery via a charging circuit and is used for charging the battery. Electric power from this battery is given to an electric motor via control switches, by controlling which entire device can be operated.



X. ACTUAL MODEL



XI. ADVANTAGES

The developed system used for spraying the fertilizer, pesticides, fungicides and insecticides.

- Easy in construction
- More economical
- Easy to clean and maintain
- It is a renewable energy powered
- It does not create air pollutant & noise
- Easy to handle
- Do not require fuel hence cost reduce & Light in weight.

XII. DISADVANTAGES

- Need DC power supply all time and quickly discharged.
- Need of skilled workers to drive and for maintenance.

XIII. LIMITATIONS

- The panels are weather dependent. Thus the power will have to be generated by any others means.
- There is a requirement to fill the sprinkler tank again with the pesticide after the quantity inside it gets over.

XIV. FUTURE SCOPE

- There could be continuous supply of liquid pesticide/ fertilizer generated for sprinkler.
- The Solar panel unit could be enhanced in order to generate more prolonged electric supply. Moreover, the electricity could be stored; to be used at night or in no sun condition.
- A more with greater efficiency could be used
- More equipment like soil testing tasks could be added to this project.

XV. RESULTS & DISCUSSION

The weeding test was performed on variety of crop. The test started 30 days after the previous weeding operation was finished. The crop was about 67 days old at the time of tests having row-to-row spacing of 600 mm. The average moisture content of the soil was 8.2 % at the time of testing. The average plant population per square meter area was 24 and average height of plant was 30 cm. It was observed that root zone depth differs for different types of weeds. Minimum root zone depth of 2 cm for *Jungli Gobi* and maximum depth of 10 cm for
Burmuda Grass was observed.

Five readings of travel speed were taken and average travel speed was calculated and used in the study. The average traveling speed was found to be 20 m/min. During testing it was observed that the traveling speed also depends on the parameters such as weight of the operator, height of the operator and physical condition of the operator. Therefore, to avoid the error in result analysis the subjects of more or less equal weight and anthropometry were selected for the study. The developed weeder was found easy to operate at the speed of 20 m/min. The field capacity of the developed weeder was calculated by selecting the representative three sample plots of size 150 x 2 m. The field capacity of the developed weeder was found out to be 0.048 ha/h, which was higher than the already available weeders. The probable reason behind this may be the 45 cm width of weeder, which was not previously tried. It was also observed that if the effective cutting width is reduced, the field capacity is also reduced. The field capacity of this developed weeder was also superior as compared to the available local weeders.

The average weeding efficiency for the developed weeder was found to be 92.5 %, which shows that the

weeder is efficient. It was observed that the weeding efficiency depends on the root zone depth of weeds, shape of blades, moisture content of the soil at testing site and cutting depth of the weeder blades. Draft is an important parameter in the development of weeder and it must be within the physical limits of the operator. The average draft required for weeding was found to be 39.15 kg. However, maximum pushing force for Indian agricultural work ranges from 25 to 30 kg.

XVI. CONCLUSION

The top concentration of our design is the cost and operational ease in case of small farm units. This multipurpose ago equipment is thus designed to reduce the cost of harvesting, spraying and cutting. In the development of multipurpose ago equipment we utilize the past data and techniques. In this way the design of multipurpose agro equipment is safe. Such human powered machine systems will help to a great extent in improving the production per acre and increase profitability of small and middle class farmers. A new type of multipurpose mechanism is fabricated which is different from other machines and will work on non-conventional energy source which is purely human operated. Such systems are of much importance in Asian countries, as almost all Asian countries are facing electricity and power scarcity which results in twelve to fourteen hours load shedding in rural areas especially in India. Therefore, there is the need to develop a locally, fabricated multiple multipurpose agro equipments.

Agricultural development plays important role as a driver of rural poverty reduction. The effort require to develop a weeder will meet the demand of farmers. The efficiency of weeder should be satisfactory and itis easy to operate. It was faster than the traditional method of removing weed. Less labor needed and it is more economical than hand weeding. Here do not use any fuel and power, Hence maintenance cost is very less. Cost of weeding by this machine comes to only one-third of the corresponding cost by manual laborers. The fabrication of Low cost Weeder is done with locally available material. The overall performance of the weeder was satisfactory.

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