JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Design and Manufacturing of Solar Operated Fertilizer Spreader

[1] Mr. S. N. Yadav, [2]R. B. Shinde, [3]P.R. Patil, [4]H. A. Rabade, [5]S. P. Kadavekar

[1]H.O.D., [2,3,4,5]Diploma Engineering students

Department of Mechanical Engineering,
Ashokrao Mane Polytechnic,Vathar, Kolhapur, Maharashtra, India

Abstract: India is agricultural based country. Our economy is also depending on agricultural related product. In the recent days, it has been found that farmers are unable to grain more crop production by use of conventional agricultural methods. The objective of this invention is to provide a simple and inexpensive fertilizer spreader, in a form of a 'walk-behind' device which may be easily and quickly pushed by the farmers for spreading solid fertilizers like urea. This is a type of spreader which can be operated manually for spreading granular materials in farms especially for solid fertilizers like urea. It will save time of fertilization and labor cost. A method is generated to spread the fertilizer over a fallow land by dropping the fertilizer over the impeller disc which spread fertilizer with centrifugal force. The project design divided into three level, top level, middle level and bottom level. Top level consist a solar module. Middle level consist a hopper, impeller disc and motor. The bottom level consists tires. The whole design is supported by frame and column. This project has solved the problem of traditional way of fertile.

Index Terms **- Fertilizer spreader, solar operated, centrifugal force, labor cost and time saving.**

I. INTRODUCTION

India is agriculture based country. Near about 70% people of our country are farmers. Our economy also depends on agricultural products. Nowadays tremendous changes have occurred in conventional methods of agriculture like seed plantation, irrigation system, pesticides and spray used. For developing our Economic condition, it is necessary to increase our agricultural productivity and quality also. Farming process includes many stages, out of which fertilization is one of the important stages and which is not exploded up to the mark up till now. Now-a-days, we are used to do spreading of fertilizer in traditional way which is time consuming, costlier as well as not provide comfort to the labor. Also, some tractor operated machines for spreading of fertilizer are available but they are very expensive for farmers. So, what we need is an alternative to the traditional as well as tractor operated fertilizer spreading machine which will fulfill all the requirements. So, we are going to design manually operated machine for fertilizer spreading by taking into consideration the user group and their needs which helps to them to work easy and functional.

Day by day the population of India is increasing and to fulfill the need of food modernization of agricultural sectors are important. Due to chemical fertilizers the fertility of soil is decreasing. Hence farmers are attracted towards organic farming. By mechanization in spraying devices fertilizers and pesticides are distributed equally on the farm and reduce the quantity of waste, which results in prevention of losses and wastage of input applied to farm. It will reduce the cost of production. It will reduce the cost of production. Mechanization gives higher productivity in minimum input. Farmers are using same traditional methods for spraying fertilizers and pesticides. Equipment is also the same for ages. In India there is a large development in industrial sectors compared to agricultural sectors. Conventionally the spraying is done by labors carrying backpack sprayer and fertilizers are sprayed manually. The efforts required are more and beneficial by farmers having small farming land. In India about 73% of population is directly or indirectly depends upon the farming. Hence it is said that India is an agricultural based country. But till now our farmers are doing farming in same traditional ways. They are doing seed sowing, fertilizers and pesticides spraying, cultivating by conventional methods. There is need of development in this sector and most commonly on fertilizers pesticides spraying technique, because it requires more efforts and time to spray by traditional way.

The proposed concept deals with the development of Solar operated Fertilizer Spreader. As shown in the conceptual diagram, the machine consists of solar panel which generates electrical energy. The generated electrical energy is stored in battery using the charge controller. The machine consists of a mechanism and a hopper to store solid fertilizers. The hopper can be opened and closed using hand. When the machine is started, the drive train uses solar energy to drive the motor which runs centrifugal dispensing mechanisms. The fertilizers are dropped onto the mechanism from the hopper which is dispensed in the field.

II. LITERATURE REVIEW:

There are different researchers who invented different types of fertilizer spreading machines. Chaudhari [1] studied the sugarcane plantation in India and need of an alternative to the traditional as well as tractor operated fertilizer spreading machine. In India near about 70% people of our country are farmers. Due to these reasons the author developed the machine which has minimal capital cost compared to traditional fertilizing equipment. Laghari [2] focuses on beneficial uses of fertilizer in agriculture. Soil contains various micro and macro elements which are essential for plant growth and yield. It is necessary to save important nutrient elements like nitrogen, phosphorus and potassium by application of chemical fertilizers. For certain situations broadcast applications can be an inefficient method of application because there is much greater soil to fertilizer contact in more fixation or tie-up of nutrient. Narode R. R [3] have generated a method to spread the fertilizer uniformly over a fallow land by dropping the fertilizer over the impeller disc. The system consists of a three wheels, two at the front and one at the back. These two wheels at the front are used to impel the fertilizer. The two hoppers are used to store the fertilizer; these hoppers are placed at some height from the wheel axle so that the fertilizer falls on to the impeller. The hopper is provided with flow control mechanism. In fertilization, the flow maintenance is necessary. Generally, every crop should get sufficient amount of fertilizer. This condition is satisfied by Spring Mechanism. Kweon & Grift [4] have proposed a method which employs control of the drop location of fertilizer particles on a spinner disc to optimize the spread pattern uniformity. The system contained an optical sensor as a feedback mechanism, which measured discharge velocity and location, as well as particle diameters to predict a spread pattern of a single disc. Das [5] have done a review of different fertilizer and pesticide spreaders. Author has sought attention towards growing population in India which is projected to be 1.6 billion in next few years. He also emphasizes that 73% of population is in Agricultural sector and out of that 65% farmers are small land and marginal farmers. In this he has discussed various types of spreaders and pesticides like Backpack sprayer, Lite-Trac, Motorcycle Driven Multi-Purpose Farming Device, Aerial Sprayer and their advantages & disadvantages.

Joshua [6] have worked on solar operated pesticide sprayer. Most of the increase in the area of irrigated land in the world has been through the increasing use of engine-driven pumps. However, the increasing price of oil-based fuel has reduced the margin to be gained by farmers from irrigation, since food prices have generally been prevented from rising in line with energy costs. Adamade [7] worked on mechanization is recognized as the necessary major means needed to accelerate agricultural production and create a period of surplus in Nigeria. Indeed, food sufficiency can only be attained in Nigeria by encouraging and promoting local designs and manufacture of implements and equipment at low cost. We have taken the useful data from this research paper. Kishore [8] described various machineries present in sugarcane farming such as Mechanized land preparation in which animal or power driven vehicles or tractors are used. Kshirsagar [9] have created a Multifunctional Agricultural vehicle which can perform many operations such as seed bowing, fertilizer spraying and grass eruption from roots. Small-size farms are a huge issue in mechanization because it is against of the “economics of scale”. These problems are classified into technological constraints, financial and economic problems, and environmental issues. Focuses on the basic problems faced by fellow farmers i.e. Seed sowing, fertilizers spraying and grass eruption.

III. DESIGN CONSIDERATIONS

Design consists of application of scientific principles, technical information and for development of new or improved machine or mechanism to perform a specific function with maximum economy & efficiency. Hence a careful design approach has to be adopted. The total design work has been split up into part: System design and mechanical design.

System design mainly concerns the various physical constrains and ergonomics, space requirement, arrangement of various components on main frame at system, man and machine interactions, no. of controls, working environment of machine chances of failure safety measuresto be provided, servicing aid, ease of maintenance, scope of improvement, weight of machine from ground level, total weight of machine and a lots more. In a system design we mainly concentrated on the following parameters, system selection based on physical constraints. While selecting any machine it is going to be used in large scale industry or small scale industry in our case it is to be used by small scale industries. So space is amajor constrain.

The mechanical design has directly norms with the system design. Hence the foremost job is to control the physical parameter, so that the distinction obtained after mechanical design can be well fitted into that.

Table No. 1 Difference in methods

S.N.	Parameters (per Acre)	Traditional method	Fertilizer spreader
1	Labor Cost in Rs.	300-400	100-150
2	Time in Hrs	2	1
3	No. of Labors	3	1
4	Fertilizer Saving in %	No Saving	30-40%

IV. CONSTRUCTION AND WORKING

This paper is based on manually fertilization process. A method is generated to spread the fertilizer over a fallow land by dropping the fertilizer over the impeller disc. The project design divided in to three level, top level, middle level, bottom level. Top level consists a solar module. Middle level consist a hopper, impeller disc, motor. The bottom level consists tires. The whole design is supported by frame and column.

Hopper

- ✓ Hopper is used to keep fertilizer.
- ✓ Hoper is used for convey the fertilizer to the rotating disc.

- ✓ In this machine material used for hopper is PVC.
- ✓ Cross section of the hopper is circular.
- ✓ At the lower end of the hopper short PVC pipe is attached.
- ✓ Flow control mechanism is providing in hopper.
- ✓ Specification: Dimension of hopper Diameter = 15 inch =40cm Height =8 inch =20cm

Rotating disc

- ✓ Rotating disc is look like impeller.
- ✓ Rotating disc is mounted on motor shaft.
- ✓ Hopper opens on rotating disc eccentrically and due to centrifugal force fertilizer spread in farm.
- ✓ Wood is used for making a rotating disc.
- ✓ Specification: Diameter =8 inch =20cm, Thickness =1cm

Vertical column

- ✓ In this project vertical column is used.
- ✓ In these project two vertical columns is used for support the solar plate, hopper, rotating disc, motor.
- ✓ Mild steel is use for making a vertical column.
- ✓ Vertical column is hollow and cross section of pipe is square.
- ✓ Specification: Height =15 inch =40cm, cross section = 4cm*4cm

Frame:

- ✓ In this project the frame works as a supporting structure.
- ✓ In this project the frame can carry whole the machine.
- ✓ The Aluminum material used for making a frame.
- ✓ At bottom of the frame wheel are attached.
- ✓ Specification: Length of plate = 40 cm, Thickness of each plate = 5cm

Wheels

- ✓ The wheels are designed to carry the load of the runner itself and mass placed at top.
- ✓ According to load wheels are selected from standard size.
- ✓ Four wheels are attached to the frame in order to move the machine in specific direction.
- ✓ The movements of these wheels are depends on workers applied force.
- ✓ Load of frame, speed these parameters are considered while selecting wheels.
- ✓ In our project we used two rubber wheels.

Motor

- ✓ Motor is one kind of prime mover of machine system which is used to supply power.
- ✓ In our project we used DC motor.
- ✓ It works on the principle of Lorentz Law.
- ✓ The basic working principle of a DC motor is, whenever a current carrying conductor is placed in magnetic field, it experiences a magnetic force
- ✓ In this machine motor is used for to rotate a rotating disc.
- ✓ The motor is attached to battery

Solar panel

- ✓ Solar panels collect energy from sun and convert it directly into electricity.
- ✓ A solar panel is made of a semiconductor material, usually crystalline silicon, which absorbs sunlight.
- ✓ This energy directly gets converted into electrical energy, which is why they are efficient and convenient to use.
- ✓ Most solar panel contains a top protective layer, two specially treated layers of silicon and a polymer backing layer.
- ✓ In our model, we used ten solar panels each made of polycrystalline cells.

BATTERY

- ✓ The battery is an electrochemical converting chemical energy into electrical energy.
- ✓ The main purpose of the battery is to provide a supply of current for electrolysis process and other electrical units.
- ✓ An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smart phones, and electric cars.
- ✓ When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode.
- ✓ The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device
- ✓ In our project we used lead acid battery of 12V

This paper is based on manually fertilization process. A method is generated to spread the fertilizer over a fallow land by dropping the fertilizer over the impeller disc. The project design divided in to three level, top level, middle level, bottom level. Top level consists a solar module. Middle level consist a hopper, impeller disc, motor. The bottom level consists tires. The whole design is supported by frame and column.

When we start the motor by solar energy, the impeller starts rotating. The fertilizer stored in the hopper is flow in downward direction due to gravity on the impeller. As the fertilizer fall on rotating impeller, due to centrifugal force it spreads the fertilizer uniformly in every direction without any wastage.

Fig. 1 Working Model

V. ADVANTAGES AND LIMITATIONS

Advantages:

- ✓ Time savings.
- ✓ Less fatigue to labor.
- ✓ High speed Fertilization.
- ✓ Applicable for small and medium farms.
- ✓ No electric power required.
- ✓ Easy to operate, as no skilled operator required.
- ✓ Easy to assemble.
- ✓ It is pollution free.
- ✓ Maintenance cost is low.

Limitations:

- ✓ Machine requires more effort in hard soil.
- ✓ Operating force varies from person to person.
- ✓ Manually operated, so it is difficult to run continuously.
- ✓ Difficult to operate in muddy farm

VI. RESULTS

By taking trials on the field of our machine and gathering all information of other possible methods we have got following results. The result obtained is compared as shown in bar charts:

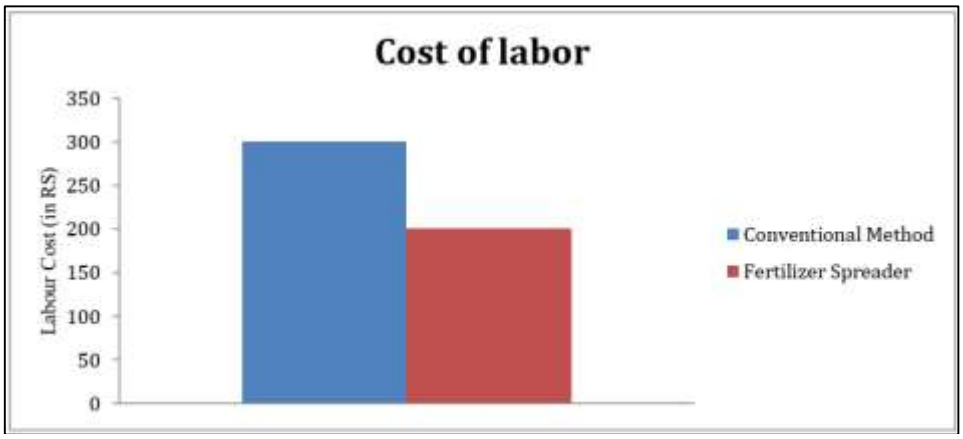

Fig. 2 Graph of Labor Cost

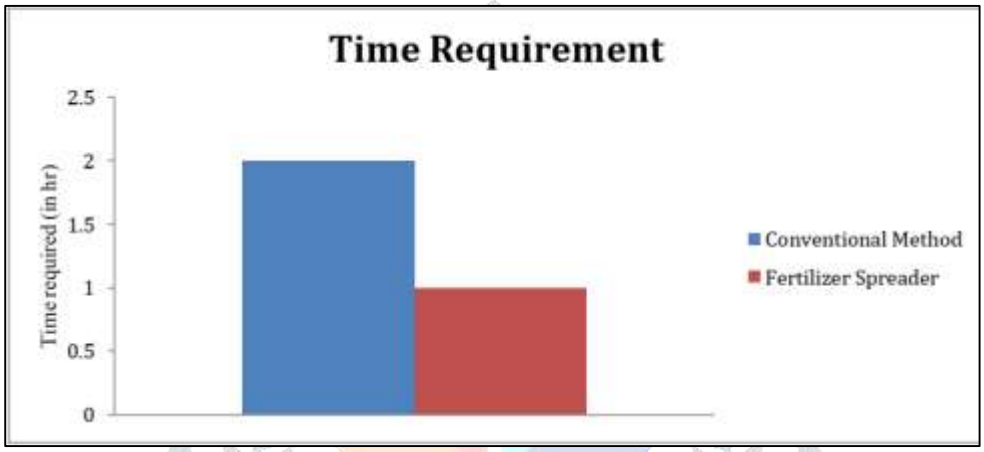

Fig. 3 Time Requirement

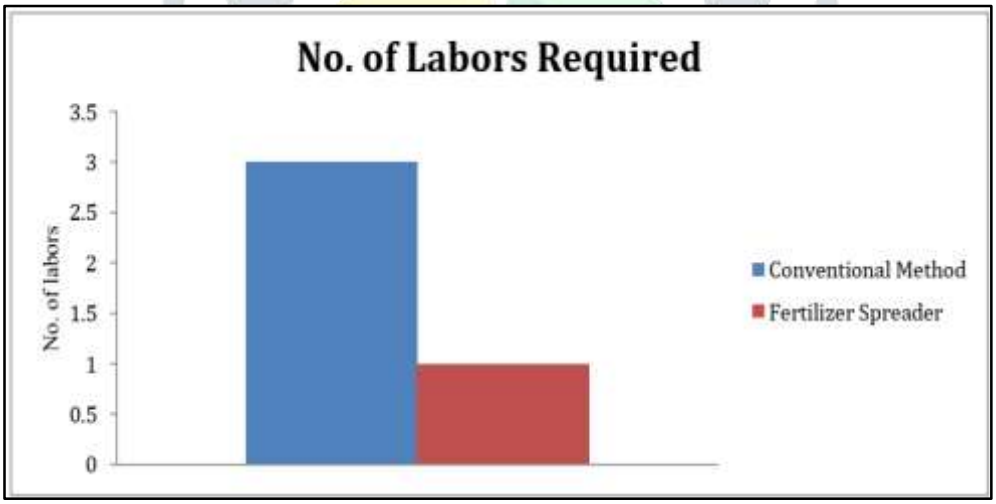

Fig. 4 Number of Labours required

VII. CONCLUSION

- ✓ The labor cost is reduced in fertilizer spreader
- ✓ The time fertilizing is reduced as compare to traditional method
- ✓ Less number of labors requires, only one person can operate the machine
- ✓ The wastage of fertilizer is also reduced with comparison to tradition method

References

[1] Shailesh Chaudhari, Mansuri Naeem, Prajapati Jigar, Prajapati Preyash; (2017); "Design and development of fertilizer spreader machine", 2277-9655,"International Journal of Engineering Sciences & Research Technology (IJESRT),1(3), 62-69.

[2] Mahmood Laghari, Naimtullah Laghari, Ali Raza Shah and Farman Ali Chandio; (2014); "Calibration and Performance of Tractor Mounted Rotary Fertilizer Spreader", International Journal of Advanced Research (IJAR)), 2(4),839-846.

[3] Narode R. R., Sonawane A. B., Mahale R. R., Nisal S. S., Chaudhari S. S. Bhane A. B. (2015); "Manually Operated Fertilizer Spreader", International Journal of Emerging Technology and Advanced Engineering (IJETAE), 5(2),369-373.

[4] Giyoung Kweon, Tony E. Grift ;(2006); "Development of a Uniformity Controlled Granular Fertilizer Spreader", American Society of Biological and
Agricultural Engineers (ASBAE), 2(4),1-14.

[5] Nitish Das, Namit Maske, Vinayak Khawas, Dr.S.K.Choudhary (2015) "Agricultural fertilizers spreaders and pesticides-A Review", "International Journal for Innovative Research in Science & Technology",1(11), 44-47.

[6] R. Joshua, V. Vasu and P. Vincent. (2010) "Solar Sprayer - An Agriculture Implement", "International Journal of Sustainable Agriculture", 2 (1),16-19.

[7] Admade C.A. and Jackson B.A. (2014) "Agricultural mechanization: A strategy for food sufficiency", Scholarly Journal of Agricultural Science, 4(3),152-156.

[8] Kishore N., Gayathri D., Venkatesh J., Rajeshwari V., Sageeta B. and Chandrika A. (2017) "Present mechanization status in Sugarcane – A review", International Journal of Agriculture Sciences, 9(22),4247-4253.

[9] Kshirsagar Prashant R, Kuldip Ghotane, Pritesh Kadam, Omkar Arekar and Ketan Insulkar.(2016) "Modelling and Analysis of Multifunctional Agricultural Vehicle", International Journal of Research in Advent Technology, Vol.4, No.1, January 2016 E-ISSN: 2321-9637, 4(1),53-57.

[10] D.A. Mada, Sunday Mahai.(2013) "The Role of Agricultural Mechanization in the Economic Development for Small Scale Farms In Adamawa State", The International Journal of Engineering and Science, 2(11), 91-96