

# The Implementation of Mechanized Sprayer for Agricultural Crops

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**Abstract**— The mechanization reduces the unit cost of production through higher productivity and input conservation. Farmers have been using the same methods and equipment for ages. In our country, farming is made traditionally. Besides that, there is a significant development in the industrial and service sectors compared to agriculture. Traditionally, the spraying is done by labor carrying a backpack-type sprayer, which requires more human effort. The wedding is generally made with the help of Bulls, which becomes costly for farmers having small farming land. So, to overcome these above two problems, a machine is developed, which will be beneficial to the farmer for the spraying and weeding operations. The result shows that the developed product is essential for farmers spraying the plants. Furthermore, the equipment was purposely designed for the farmers having small farming land, say 5-6 acres. It is suitable for scattering and weeding at a minimum cost for the farmer to afford it.

**Keywords**— Mechanism mounted on vehicle, Mechanization, Mechanical Sprayer, Reciprocating pump.

## I. INTRODUCTION

The spraying is customarily made by work conveying a rucksack sprayer, which requires progressively human exertion. For the most part, the wedding is finished with the assistance of Bulls for little land ranchers. Likewise, the seed planting application additionally completes with the aid of bulls, which in the present age, is tedious and difficult. So, to defeat these above issues, a machine is created, which will be gainful to the rancher for the showering and weeding activity alongside the seed planting application. A multifunction gadget will be helpful and can be used in various phases of farming, according to a prerequisite [1]. Creating nations in the Asian landmass have the issue of expanding populace and requesting ascend in farming items. Furthermore, the progression in horticulture is absent at the rancher's, despite everything utilized by the conventional techniques for the agribusiness sector [2].

To a great extent, in the Philippines, the farmers still use the traditional method of agriculture [3]. However, procuring from such a strategy isn't sufficient, and utilizing such a technique is costly [4]. The earnings from such a method are not enough, and using such a method is expensive. The time required for development and harvesting is likewise more when utilized traditional methods [5]. Therefore, using advanced machines in farming is imperative to build the efficiency of agriculture [6]. Hydraulic sprayers comprise a tank, a pump, a lance (for single spouts) or boom, and a nozzle (or numerous faucets). Sprayers convert a pesticide definition of one containing a blend of water (or another fluid compound transporter, for example, manure) and compound into beads, which can be enormous downpour-type drops or minor imperceptible particles. This

transformation is practiced by driving the shower blend through a splash spout under tension. The size of beads can be modified using distinctive spout sizes by adjusting the weight under which it is constrained or a blend of both. Huge beads have the benefit of being less vulnerable to splash float. However, they require more water per unit of land covered [6].

A definitive point of this task is that the farmer need not carry the whole sprayer pump on his shoulders, be that as it may, push the component mounted on the trolley to operate the pump and shower the pests. Hence, this causes the farmer to feel agreeable, loose, and less tiresome. The following point is to diminish human endeavors because of the consistent pumping activity for making pressure inside the pesticide sprayer and thereby give an appropriate domain to the client, decreasing the weariness load following up on the body.[7]

Furthermore, figure 1 shows the conceptual framework of the study. The researcher assembles all the parts of the mechanical sprayer before pouring water to the gallon, and after pouring, they started to push the mechanical, agricultural sprayer. While driving the mechanical, agricultural sprayer, the sprayer emits the water to the area it covers.

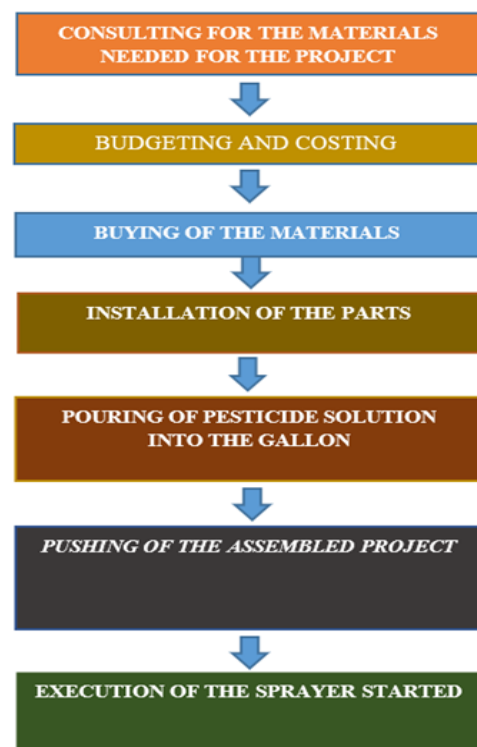


Fig. 1. Conceptual Framework of the Study

**Objective of the Study**

The study's specific objectives are to develop a capable agricultural sprayer.

- To decline work costs by propelling the splashing strategy
- To have ease when contrasted with the electrical sprayer and tractor type sprayer.
- To change bead size with pressure modifications without changing travel speed.
- The decline in the expense of the machine.

**II. METHODOLOGY**

The researcher used the deductive approach method in solving the query—the Plan-Do-Check-Act (PDCA) used to find a study solution. The researcher gathered, analyzed, checked the project output, and came up with a successful end product. Figure 2 shows the schema of the study.

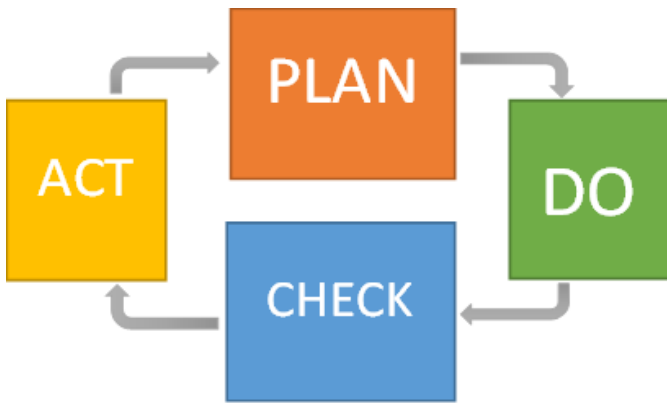


Fig. 2. Schema of the Study

**A. Plan**

**a. Design**

The researcher planned a simple project design so that it would be easy to fabricate, and one of the researchers aimed to do a project with cheap materials. The materials needed are 1mm thick angle bar, tank and sprayer, hoses, nozzle, sprockets, bearings, bicycle wheel, and roller chain are the primary materials required to fabricate the project. Table 1 contains the machine's specifications, and Fig. 3 shows the CAD model of the proposed design of the researcher.

TABLE 1. Specification of the machine

No.	Title	Value
1.	Wheel	15 inch
2.	Connecting Rod	9 inch
3.	Frame	48in x 13.5in x 38in
4.	Support Column	2 ft
5.	Main Driver Sprocket	8 in
6.	Driven Sprocket	5 in

The main components of the mechanized agricultural sprayer are as follows:

**Frame**

The primary capacity of the structure is to convey the whole assembly on it, so it must be sufficiently able to hold it. Therefore, the design of the vehicle is the main chassis. It is

made up of a 1inch thick angle bar, as shown in figure 4. It is the base of the sprayer on which the mechanism is mounted [7].

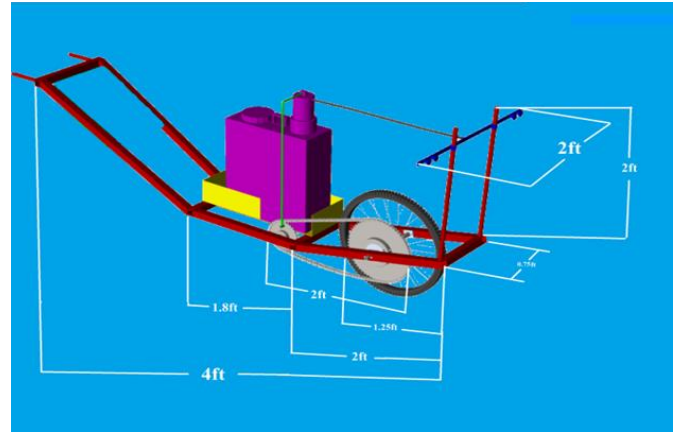


Fig. 3. 3D CAD Model



Fig. 4. Frame

**Main wheel**

The wheel is utilized to convey the entire get-together and move the machine starting with one spot and then onto the next by rotational movement of it. A bicycle wheel is a wheel, most generally a wire wheel, intended for a bicycle. A bicycle wheel is designed to fit into the edge and fork utilizing dropouts and hold the bicycle tire. To invent the typical rotation of a cart having a metal center, wire pressure spokes, and a metal or carbon fiber edge, which holds a pneumatic elastic tire. The researchers utilize tubeless tire-wheel [7]. Figure 5 shows a pictorial of the wheel.



Fig. 5. Main wheel

**Chain Drive**

In Fig 6. The chain drive is the power transmitting element of the system. It consists of a big sprocket, a small sprocket, and

a roller chain. The big gear is mounted on the driver shaft, and the small mounted on the drive shaft. The distance between the two sprockets is 24 inches approx. The diameter of the big gear is 8 inches, and a small sprocket is 5 inches.



Fig. 6. Chain Drive

*Sprayer with tank*

The sprayer is the component that converts mechanical movement into hydraulic energy. The piston moved into the cylinder and increased pressure in the tank with the help of the diaphragm. The maximum load that can build in the sprayer is 2 bars. It has 20-liter storage for agricultural fluid, which can be water or pesticide. It is fixed with the chassis and can be removed easily for refilling. Figure 7 shows the picture of the sprayer.



Fig. 7. Golden Harvest Sprayer with tank



Fig. 7. Nozzle

*Nozzle*

It is a gadget that changes over the weight vitality of liquid into dynamic energy, and a shower spout is an exactness gadget that encourages scattering fluid into a splash. The spout circulates a liquid over a territory [7].

*B. Do*

*Fabrication*

In Fig 8. The primary body is made of a 1mm thick point bar. The driver shaft is mounted on the case, and the central wheel is mounted on the pole. The pole is allowed to pivot on the bearing, which is appended to the body. The two bearings are utilized for the help of the driver shaft. The chain drive component is given in the framework to move the turn of the driveshaft to the determined axis chain drive instrument comprised of a larger sprocket, a little sprocket, and a roller chain. The large gear is mounted on the driver shaft, and a small pinion is mounted on the drive shaft. The determined shaft is likewise allowed to turn on the bearing, welded on the suspension. The direction is in a lot of two to help the measured shaft—the determined shaft furnished with two wrenches at each end. The spanners are utilized to transmit the pivoting movement to the arms of the sprayer through the interfacing bar. A sprayer is a gadget that changes mechanical vitality into pressure vitality, and the fluid in the sprayer compartment is splashed with the assistance of two spouts. It helps increment the effectiveness of the venture. As the vehicle moves, the principal wheel likewise pivots as for the ground, which further turns the driver shaft. The pole turns in the heading. The driver shaft gives its movement to the determined shaft with the assistance of a chain drive instrument. The measured shaft rotates the wrench, and the wrench provides the action to the associating bar—the wrench changes from the pole's turning motion to the arm's swaying motion.

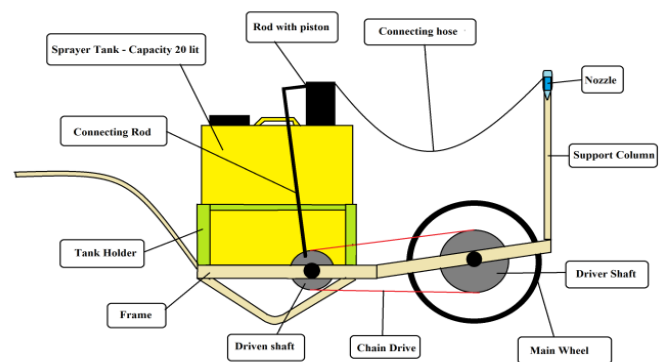


Fig. 8. Side View of the project

The arm is bent at the center to give the swaying movement of the arm. The component further transmits its action to the cylinder of the sprayer. The swaying motion of the wing changed over to the responding movement of the barrel. Furthermore, as the cylinder moves, the weight in the holder increments, and the liquid in the sprayer compartment is



showered with a spout that catches the load discharges. The ultimate result of the undertaking is that the push power of the administrator is changed over at last to pressure vitality and the liquid showered.

C. Check

Testing of the Project

The agricultural sprayer has tested on 02-02-2019, and the performance of the farming spray noted. And afterward, it is compared with the manual method.

TABLE 2. Testing Results

Manual Method	Proposed Machine
Can spray 2 acre in one day	Can Spray 5 acre of land in one day
Takes 30mins to be empty	Takes 18mins to be empty
Good in targeting	Focuses a required spot

The developed machine sprayed five (5) acres of land in one day, about 20,235 square meters, and was more than double when manually sprayed the crops. The applicator sprayer machine positioned itself in the space between two plots during pesticide can cover half of an acre after emptying one full tank in 18 minutes. The above application required ten (10) tanks of 20 liters of each pesticide solution to cover the whole vegetable farm of five acres in just a day. Therefore, ten tanks x 18 minutes is 180 minutes or three (3) hours of continuous spraying; if rest breaks and pesticide mixing are considered, one whole day is more than enough to accomplish the spraying activity.

The approximation of the farmland area of 5 to 6 acres was based on the researcher's speed in doing the actual spraying of a pesticide solution on existing farmland, as shown in Fig. 10. The rate of emptying 20 liters of pesticide contained in one sprayer tank was 18 minutes. From this premise, the resulting computation of 5 acres has thus arrived. The approximate distance covered by a tank of 20 liters of pesticide was 907.2 meters, following the speed formula equal to the product of space over time ( $0.84 \text{ m/s} \times 18 \text{ min} \times 60 \text{ s/min} = 907.2 \text{ m}$ ). If one acre is equivalent to 4,046.94 square meters and considering the emptying distance of 907.2 meters, the width of the farm plots shall be 4.46 meters. The 4.46 m can be configured into 4 - 0.75 m plots wide and 4 - 0.365 m wide alley/ workspace. One spraying pass by the mechanized agricultural sprayer can only cover two adjacent parcels, covering only half of an acre of farmland. For a farm area of five acres, considering the emptying distance of 907.2 m, the corresponding width is 22.3 m (5 x 4.46 m), consisting of 20 plots (5 x 4 plots), as previously mentioned above for one-acre farmland. Hence, ten sprayer tanks are needed for the whole 5 acres of farmland pesticide spraying.

D. Act

Application

The researcher applied the project at Sustainable Agriculture Techno-Demo Farm at SPAA Affiliated Poblacion, Alegria, Cebu. In the testing process, the researcher was assisted by the owner and caretaker of the farm. As a result, the machine or mechanism can be used successfully in vegetable farms such as pumpkins, tomatoes, etc. Furthermore, it can be

used in underdeveloped countries to advance agricultural techniques.

Furthermore, fig 9 shows the picture of the researchers and the assembled mechanical and agricultural sprayer, and figure 10 describes the automatic agrarian sprayer tested on the crops.



Fig. 9. Assembled Mechanical Agricultural Sprayer

TABLE 3. Budgeting and Costing

Title	Amount
Wheel	300
Angel Bar	760
Tank with sprayer pump	1970
Bicycle Chain	100
2 pcs Nozzles	150 (75 each)
Driver Sprocket	120
Flexible Hose	50
2pcs Bearings	320
Driven Sprocket	100
<b>Total:</b>	<b>3,510</b>



Fig. 10. Testing the Agricultural Sprayer

III. RESULTS AND DISCUSSIONS

The researcher was successful in the installation of a mechanical agricultural sprayer. They delivered an adequate, uniform dose of product to a target area safely and promptly without wastage. Wastage is any product not deposited in the target, including drift (vapor and droplet), run-off, and off-target deposition. Studies show that 80 percent of the product can be lost to drift and ground deposition in high-volume air blast applications. The end-product was functional on vegetables and root crops, and the mechanical, agricultural sprayer was designed for rocky and rough roads, unlike those conventional agricultural sprayers that need more personal work and are safe for operators because it lessens leakage and run-off to the skin.

If the farmers use the agricultural mechanical sprayer, the owner can save up to 20 percent of the labor cost compared to an electrical sprayer and tractor sprayer. However, it needs only

one operator; it is not suitable for large areas and only good for small spaces.

The mechanized agricultural sprayer's advantage is that it is user-friendly, with less effort and low maintenance. While in the manual method might damage the spine of the user, which may lead to a slipped disk or paralyze them. The mechanized agricultural sprayer gives the farmers ease to the job and hits two sides in one trip. The disadvantage of the project is that it only focuses on the ground. Figure 11 shows the finished output of the agricultural sprayer.



Fig. 11. Finished Output of the Mechanical Agricultural Sprayer

#### IV. SUMMARY, CONCLUSIONS, RECOMMENDATION

##### Summary

The researchers first gathered the needed materials, then started the plan for the fabrication, like welding, grinding, cutting, and polishing. The researchers made some errors in fabricating their project, but after a few mistakes, they came up with some ideas and new techniques for building their project. And then, the researchers planned to test their project in Alegria, and then the project was successfully functioning on a small vegetable farm.

##### Conclusion

The researcher concluded that the study was safe for farmers because the mechanized agricultural sprayer was designed to push and evenly distribute the mixture. The mechanism or vehicle is designed and made to increase the advancement in agriculture. It intended to overtake the traditional spraying methods by introducing advanced techniques for spraying. It works smoothly on flat land, and moderate movement is achieved on flat ground. It can help farmers increase agricultural productivity by increasing the output, decreasing labor costs, and reducing spraying time. It is made to be used for gardening and watering vegetable farms. The equipment was purposely designed for the farmers having small farming land, say 5-6 acres. It is suitable for spraying and weeding for the farmer to afford it at minimum cost. The equipment will result in more benefits when it is subjected to moist soil for weeding purposes; due to wet soil, and the weed cutter can easily penetrate and dig out the land and hence will efficiently accomplish the weeding process. The equipment's performance will increase when operating on a smooth or less uneven surface. Also, it will be more effective when used on crops with nearly similar heights and less space between two plants.

##### Recommendation

The researcher would like to recommend that future researchers improvise and further enhance the mechanical agricultural sprayer to provide better user convenience. For example, the researcher suggests an adjustable support column to improve its spraying efficiency. And putting pedals and extra wheels at the back to make it more productive and functional and upgrading the tank might be more convenient so that farmers and other individuals will soon no longer rely on too much human effort.

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