

## Modeling of Cycling Pedal for Agricultural Usage

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**ABSTRACT** - Pedal power is the transfer of energy from a human source through the use of a foot pedal and crank system. This technology is most commonly used for transportation and has been used to propel bicycles for over a hundred years. Less commonly pedal power is used to power agricultural and hand tools and even to produce electricity. Some relevance includes pedal powered grinders and pedal powered water wells. Some third world development projects currently transform used bicycles into pedal powered tools for sustainable development. The main aim of this project is to reduce the human effort for machining various materials. Now a days we are using hand pump in agriculture for spraying the insecticides in our farm and also we use hand operated fan for removing waste from grains. It is very harmful to our farmers. It cause total load on single hand and it require more effort for that man. Also it takes more time for these operations. After studying all these considerations, we are having some of the basic ideas to improve or easy this method to our farmers. By using pedal system it is so easy to operate above operations with less time and effort. We can use this pedal operated system for multiple applications in agriculture use.

**Key words** - Pedal Operate, Agricultural Unit, Human Efforts, Improvement in Basic Agricultural Unit.

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### I. INTRODUCTION

Rice is one of the most important grains in India. It is the staple food of the people in the eastern and southern parts of the country. India is one of the world's largest producers of white and brown rice and produces 20% of the world rice production. As rice is the basic food crop and being a tropical plant, Improper cleaning usually result in grain loss and lower head rice recovery in mills. Cleaning helps to reduce bulkiness during subsequent post harvest operations. You should remove straw pieces, unfilled grains and other foreign materials. Cleaning and winnowing can be done manually, using wind energy or with the use of machines. You can use traditional winnowers like the winnowing basket and wooden boxes with perforations & Chemicals are widely used for controlling disease, insects and weeds in the crops. They are able to save a crop from pest attack only when applied in time. They need to be applied on plants and soil in the form of spray, dust or mist. Insects are largely responsible for the crop destruction. Insecticides or pesticides, a man made or natural preparation are used to kill insects or otherwise control their reproduction. These herbicides, pesticides, and fertilizers are applied to agricultural crops with the help of a special device known as a "Sprayer," sprayer provides optimum performance with minimum efforts. The invention of a sprayer, pesticides, fertilizers, bring revolution in the agriculture or horticulture sector especially by the invention of sprayers, enable farmers to obtain maximum agricultural output. They are used for garden spraying, weed and pest control, liquid fertilizing and plant leaf polishing. There are many advantage of using sprayers such as easy to operate, maintain and handle, it facilitates uniform spread of the chemicals, capable of throwing chemicals at the desired level, precision made nozzle tip for adjustable stream and capable of throwing foggy spray, light or heavy spray, depending on requirement. Fig.1 shows the Traditional winnowing Wind winnowing is an agricultural method developed by ancient cultures for separating grain from chaff. It is also used to remove weevils or other pests from stored grain. Threshing, the loosening of grain or seeds from the husks and straw, is the step in the chaff-removal process that comes before winnowing. In its simplest form it involves throwing the mixture into the air so that the wind blows away the lighter chaff, while the heavier grains fall back down for recovery. Techniques included using a winnowing fan (a shaped basket shaken to raise the chaff) or using a tool (a winnowing fork or shovel) on a pile of harvested grain.



**Figure 1** Traditional winnowing

And fig.2. Shows the traditional spraying, the spraying is done by labor carrying backpack type sprayer. It requires more human effort. Hand operated rocker sprayer is also another technique that the farmers are using from the ages. The most commonly used sprayers are foot sprayer, knapsack sprayer, hand compression sprayer, garden sprayer.



**Figure 2** Traditional Spraying

### **1.1. Literature Review**

As per National Agricultural Research Institute improper cleaning usually results in grain loss and lower head rice recovery in mills. Cleaning helps to reduce bulkiness during subsequent post harvest operations. You should remove straw pieces, unfilled grains and other foreign materials. Cleaning and winnowing can be done manually, using wind energy or with the use of machines. You can use traditional winnowers like the winnowing basket and wooden boxes with perforations. If you do not clean your rice properly, you may face problems.

Rice with impurities will:

- deteriorate during storage
- reduce head rice yield
- damage your milling machine
- increase weight and bulkiness during handling

### **II. Method: Air cleaning using wind**

If you live in areas where there is high air velocity, air-cleaning will be most appropriate for you. You can also use electric fans to provide air for winnowing. Follow the steps below.

**Step 1. Layout a canvas**

Spread out a canvas on a flat surface to work on. You also use plastic and visqueen materials. Do not use materials that have rough surfaces on them.

**Step 2. Put seeds into a suitable container**

You can use a normal bucket if you wish. Make sure it is not too heavy for easy handling.

**Step 3. Position your stand**

Stand at right angles (90°) from the direction of the wind.

**Step 4. Pour the grains**

Pour the grains slowly against the wind. The wind will blow away the rubbish and empty grains from the good seeds. Repeat this process 2-3 times to properly clean the seed. [1]



**Figure 3** Conventional winnowing

So they suggest hand winnowing fan comprises of a mechanical link means provided with an extended handle to transmit muscle power in form of high-torque low-speed; a gear system with an input shaft mounted with 100 teeth gear and an output shaft mounted with 20 teeth gear for converting muscle power received from a mechanical link in the form of a high-torque low-speed to low-torque high-speed; belt and pulley systems which is connected to the output shaft of the gear system for transmitting mechanical energy to generator; generator to convert mechanical energy into electrical energy; and a storage system. The prime mover is preferably at least one human. It having better functionality than human effort.



**Figure 4.**Hand operated winnowing fan

As per the Girish T, Parameswaramurthy D in the human power generator, it works on the principle of convert muscular or physical energy of human being into the electrical energy by means of applying pulley arrangement. The pulley arrangement converts the efforts which is applied by human being into the rotating motion which is used to generate electricity and this electricity will be used as a preliminary requirement of electricity and also use of solar energy by means of solar cell for generation of electricity for use in stationary and mobile condition and also use of AC appliances by use of inverter. The device consists of two sprockets and are connected each other by the chain mechanism, at one end of the sprocket pedals are mounted. Centrifugal pump is connected by the V-belt from pulley. When the human pedals, the Centrifugal pump is actuated through the flywheel and the water can be pumped from sump to the tank. (As shown in fig) At the same time the attached dynamo (i.e., is mounted near the V-belt) runs and the mechanical energy is converted in to electrical energy, the generated electrical energy is stored in chargeable battery. The stored electrical energy is used whenever needed.[2]

### III. PROBLEM DEFINATION

Agriculture sector is facing problems with capacity issues, shrinking revenues, and labour shortages and increasing consumer demands. The prevalence of traditional agriculture equipment intensifies these issues. In addition, most formers are desperately seeking different ways to improve the equipment quality while reducing the direct overhead costs (labour) and capital. Thus, a significant opportunity rests with understanding the impact of a pesticide sprayer in an agriculture field. A pesticide sprayer has to be portable and with an increased tank capacity as well as should result cost reduction, labour and spraying time. In order to reduce these problems, there are number of sprayer introduced in the market but these devices do not meet the above problems or demands of the farmers. The conventional sprayer having the difficulties such as it needs lot of effort to push the liver up and down in order to create the pressure to spray. Another difficulty of petrol sprayer is to need to purchase the fuel which increases the running cost of the sprayer. In order to overcome these difficulties, I have proposed a wheel driven sprayer, it is a portable device and no need of any fuel to operate, which is easy to move and sprays the pesticide by moving the wheel. The mechanism involved in this sprayer is reciprocating pump, and nozzles which were connected at the front end of the spraying equipment.

#### 3.1. Drawbacks in Existing Sprayer Pumps

The Indian farmers (small, marginal, small and marginal, semi-medium) are currently using lever operated backpack sprayer. A backpack sprayer consists of tank 10 -20 litre capacity carried by two adjustable straps. Constant pumping is required to operate this which results in muscular disorder. Also, the backpack sprayer can't maintain pressure, results in drifts/dribbling. Developing adequate pressure is laborious and time consuming. Pumping to operating pressure is also time consuming. Moreover, very small area is covered while spraying. So, more time are required to spray the entire land. Back pain problems may arise during middle age due to carrying of 10-20 liter tank on back.



**Figure 5.**Conventional spraying method

#### 3.2. Problem Occurred During Winnowing Process:

Wind speed and direction can be highly variable, and is likely to be stronger than you probably need. Using the wind to clean your seed will work well if there's a significant difference in weight between your harvested seeds

and the chaff you're trying to get rid of. Grains are probably the best example – the grains seeds are dense, and the chaff is light and easily blown away.



**Figure 6** Traditional Winnowing

#### **IV. SOLUTION**

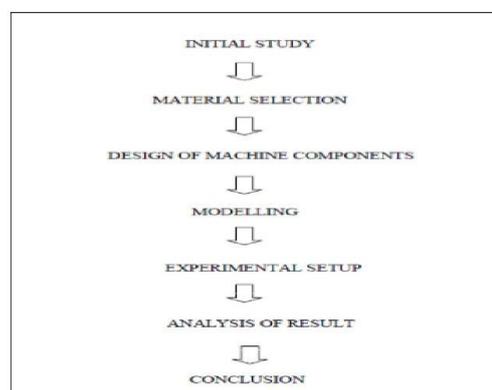
Bodies with cranking mechanism with pump being cranked and pushed and pulled to result in pumping, building the pressure in the tank for pesticide spraying. The body is fixed on the framed type structure and cranking is on the axle which pushes the piston rod in and out of the cylinder pumping the air pressure into the tank. There is a tank fitted on the frame through there is a main suction tank which consists of pesticide which the sprayer is connected on the protruded rod and jet is set for the required pitch. When the pedal is

##### **4.1.Steps in Methodology**

1. Study and analysis of working of conventional hand operated spraying pump and hand operated winnowing fan.
2. Study the various research papers published in this field.
3. Based upon this design and model a unit for easy spraying and winnowing process in agriculture field.
4. Select the material of unit components and study its properties.
5. Manufacturing of the unit.
6. Perform the experiment and analyze it.
7. Compare conventional hand operated spraying pump and winnowing fan and developed pedal operated spraying pump and winnowing fan.

driven then axle rotates and moves and simultaneously pump the liquid is affected. This equipment has a reciprocating pump which compresses liquid into the tank and pressurizes the spray mixture. The pressure slowly drops as the liquid is sprayed. The forward motion of the pedal drives the reciprocating pump to pump the liquid into the tank which maintains the pressure for the spraying. In this equipment the reciprocating pump take place reciprocating action by two methods one is by moving the equipment and another one is by pedaling the equipment in the stationary manner. Also, same body attaching winnowing fan system on same axle with a pulley. When pedal drives then it rotates pulley which in turns drives fan. The rotation of fan increases as revolution of pedal and pulley increases. This fan used for winnowing process. The system that enables the foregoing processing by a single individual has a pedaling mechanism for driving both the thresher and the winnower via a single drive member.

#### **V. METHODOLOGY**



## 4.2. Components of the machine

### 1] Frame

Base plate is the base member of the machine. The entire assembly of the machine is done on to the base plate. Base plate is structural mild steel.

Material – Mild steel

Shape – (L-angle)

### 2] Sprocket and Chain [Manual]

The Chain drives Consist of Outer Plates or Pin Link plates, inner plates or roller link plates, pin, bushes and roller. A pin passes through the bush which is secured in the holes of the roller between the two sides of the chain The Rollers are free to rotate on the bush which protects the sprocket wheel teeth against wear. The pins, bushes and rollers are made of alloy steel a bush roller chain is extremely strong and simple in construction it gives good services under serve conditions there is little noise with this chain which is due to impact of the roller in the sprocket wheels teeth. This Chain may be used where there is little lubrication.

### 3] Crank Mechanism

A crank is an arm attached at right angles to a rotating shaft by which reciprocating motion is imparted to or received from the shaft. It is used to convert circular motion into reciprocating motion, or vice-versa. The arm may be a bent portion of the shaft, or a separate arm or disk attached to it. Attached to the end of the crank by a pivot is a rod, usually called a connecting rod. The end of the rod attached to the crank moves in a circular motion, while the other end is usually constrained to move in a linear sliding motion. The term often refers to a human-powered crank which is used to manually turn an axle, as in a bicycle crankset or a brace and bit drill. In this case a person's arm or leg serves as the connecting rod, applying reciprocating force to the crank. There is usually a bar perpendicular to the other end of the arm, often with a freely rotatable handle or pedal attached.

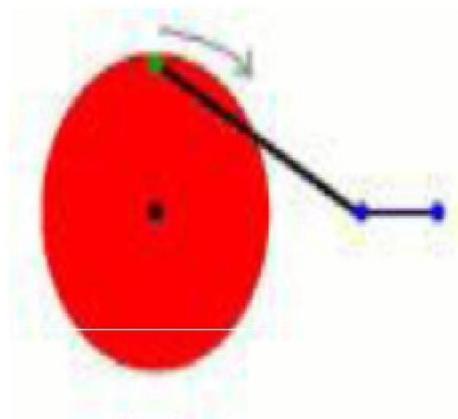
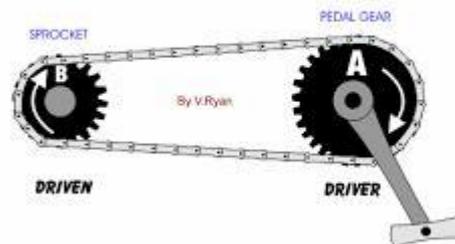


Figure 7 Crank mechanism

#### 4] Rope & Pulley

A rope and pulley system is characterised by two or more pulleys in common to a rope. This allows for mechanical power, torque, and speed to be transmitted across axes. If the pulleys are of differing diameters, a mechanical advantage is realised.

A rope drive is analogous to that of a chain drive, however a rope sheave may be smooth (devoid of discrete interlocking members as would be found on a chain sprocket, spur gear, or timing belt) so that the mechanical advantage is approximately given by the ratio of the pitch diameter of the sheaves only, not fixed exactly by the ratio of teeth as with gears and sprockets. Just as the diameters of gears (and, correspondingly, their number of teeth) determine a gear ratio and thus the speed increases or reductions and the mechanical advantage that they can deliver, the diameters of pulleys determine those same factors.

#### Specification of pulley

V-pulley

A-type Single Groove

Material – Mild Steel

Small Pulley Diameter - 2" Inches

Large Pulley Diameter - 15" Inches



Figure 9. Pulleys

#### 5] Single Rope Drive

It is made up of single flanged wheels linked by means of tense rope. The performance of this mechanism is similar to that of a simple belt drive. Every single flanged wheel couples two single wheels to the same axis or shaft. Audio and video players incorporate this configuration. Large multiplier speed ratios are achieved in this way. The speed ratio numerical value is obtained by multiplying the speed ratios of each stage in the configuration.

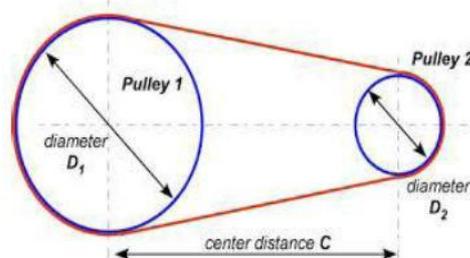


Figure 10. Single Rope pulley

### **6] Pedestal bearing**

A cylindrical hole formed in a cast iron machine member to receive the shaft which makes a running fit is the simplest type of solid journal bearing. Its rectangular base plate has two holes drilled in it for bolting down the bearing in its position as shown in the figure. An oil hole is provided at the top to lubricate the bearing. There is no means of adjustment for wear and the shaft must be introduced into the bearing endwise. It is therefore used for shafts, which carry light loads and rotate at moderate speeds.

Diameter - 20mm inner diameter with ball bearing.



**Figure 11** Pedestal bearing

### **7] Shaft**

A drive shaft, driveshaft, driving shaft, propeller shaft (prop shaft), or Cardin shaft is a mechanical component for transmitting torque and rotation, usually used to connect other components of a drive train that cannot be connected directly because of distance or the need to allow for relative movement between them. As torque carriers, drive shafts are subject to torsion and shear stress, equivalent to the difference between the input torque and the load. To allow for variations in the alignment and distance between the driving and driven components, drive shafts frequently incorporate one or more universal joints, jaw couplings, or rag joints, and sometimes a splined joint or prismatic joint.



**Figure 12.**Shaft

### **8] Spraying Rod**



**Figure 13** Spraying rod

### **9] Dynamo**

Dynamo can be used to convert mechanical energy to electrical energy. Alternating current can be produced normally using the dynamo. This current can power devices, which work on ac directly and can be converted and used for devices working on dc. The amount of power generated from a dynamo by pedalling is sufficient to power the devices, which require low power. Most of the electronic gadgets including mobile phones and iPods can be powered using this. These devices can be charged while either riding the bicycle or by keeping the bicycle stationary and pedalling. Dynamo is small, light weight, and is therefore best to use in bicycles.

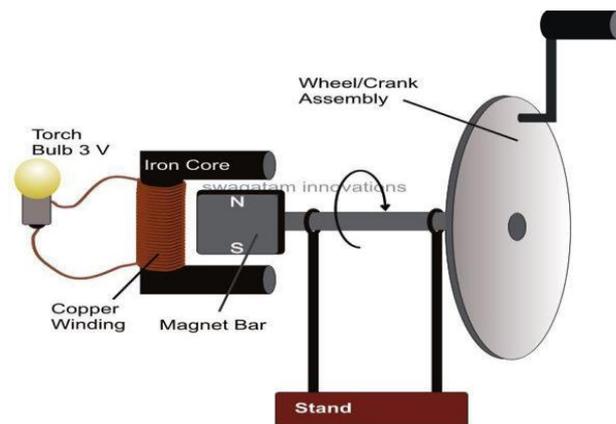


Figure 14. Dyanamo

The generation of electricity by a dynamo is based on a principle of magnetism called induction. When the lines of force that pass from the north to the south pole of a magnet are cut by a wire there is produced or induced in the wire a current of electricity. That is, if we take a loop or coil of wire which has no current in it and a magnet which also has no current, and move the loop or coil between the poles, a momentary current is produced. If a series of loops or coils are used instead of one loop, a current may be generated continuously. This method of generating electric current is called induction.

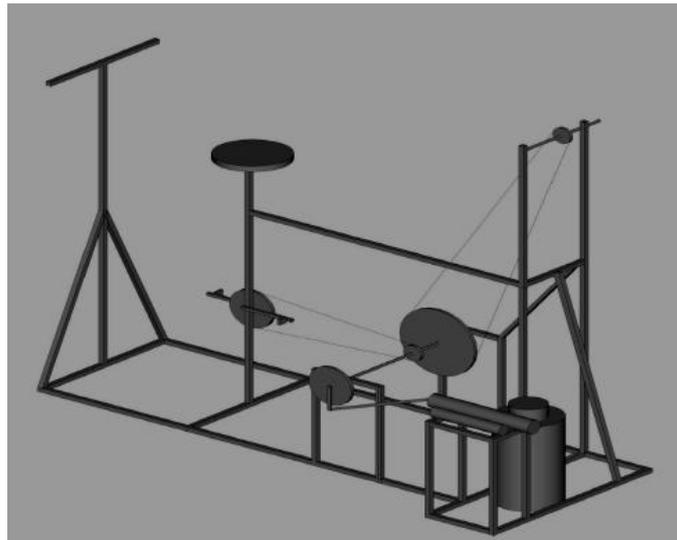
The strength of a current in electromotive force set up by induction depends upon:

1. The strength of the magnet,
2. The number of turns of wire in the coil or loop, and
3. The speed with which the magnetic lines of force are cut, that is, the speed at which the coil rotates.

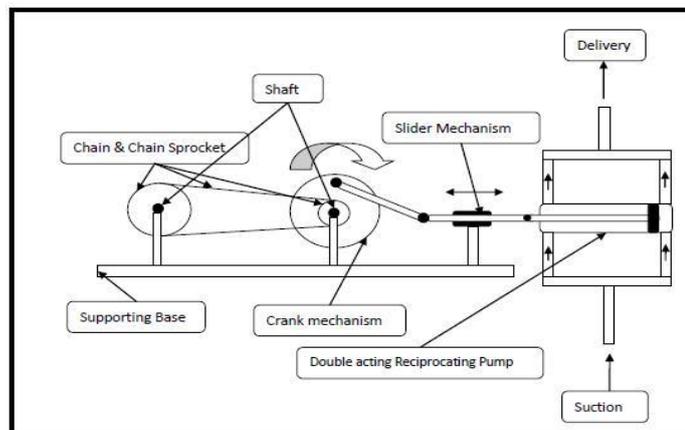
#### V. CONSTRUCTION

- Pedal is placed at the middle part of frame fitted with using arc welding.
- At the upper side of the frame, seat is mounted on frame with the help of nuts and bolts.
- Shaft is mounted on frame with the help of Pedestal Bearing.
- Two pulleys i.e. small & large pulley are mounted on each shaft.  
Development of Pedal Operated Unit For Agricultural Use
- These pulleys are connected to each other with the help of rope and this connection formed a single rope drive.
- With the help of this rope drive we can achieve increasing of speed.
- Big chain sprocket is connected to small chain sprocket with the help of chain on shaft and shaft has a cam on the one end.
- To this cam a crank-slider mechanism is connected in which a slider slides in a fixed path i.e. in horizontal path (to & fro motion).
- To the free end of the slider, a reciprocating pump is attached with the help of nuts and bolts.
- On same shaft big pulley is fixed with the help of nut.
- Another small shaft is mounted upper side of frame which is freely rotating.
- On this small shaft small pulley is fitted with using arc welding.
- At the one end of the same shaft fan is attached with interference fit.

**Figure 15** Block Diagram of Unit



**Figure 16** 3D Model of Unit



**Figure 17** Working model

## **5.1. SELECTION OF MATERIALS**

Selection of different materials actually depends on the below mentioned parameters.

### **Properties**

The material selected must possess the necessary properties for the proposed application. The various requirements to be satisfied can be weight, choosing of centrifugal pump, surface finish, rigidity, maintenance, service life, reliability etc. The following four types of principle properties of materials decisively affect their selection

1. Physical
2. Mechanical
3. From manufacturing point of view
4. Ergonomically

The various physical properties concerned are size, power consumption. The various Mechanical properties Concerned are discharge of pump, handling load. The various properties concerned from the manufacturing point of view are,

1. Structural frame ability
2. Pump ability
3. Fly wheel ability
4. Chain drive efficiency
5. Based on human factor the model is developed.

### **Manufacturing case**

Sometimes the based on the power consumption and output discharge of a fluid will affect the manufacturing cost of the pump.

### **Quality required**

This generally affects the manufacturing process and ultimately the material. For example, it would never be desirable to go for casting of a less number of components which can be fabricated much more economically by secondary machining process.

### **Type of pump**

As secondary main factor the type of pump should also be part of a quality of discharge of the pump, also the type of power utilized.

### **Discharge ability of pump**

Sometimes high dischargeable with low power consumption can be obtained, but sometimes the discharge will vary with respect to speed of the impeller.

### **Cost**

As in any case based on the power factor (efficiency of motor) used for the type of application for fluid pumping.

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## **VI. CONCLUSION**

- a. Decrease the time required for separation, dust, contaminations, impurities, and hauling from the heap of the harvested grains.
- b. And also to minimize labor cost, time and power.
- c. We can spray constantly due to constant pressure in pump
- d. We can spray up to height by using adjustable nozzle

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