

## Design and Development of Tapioca Harvesting Machine

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### ABSTRACT

Tapioca, a starch extracted from cassava root is cultivated around the hill stations. It grows up to a height of seven feet. The cassava roots are very strong and it requires to be harvested assiduously when using hand. Large scale harvesters have harvesting attachments attached to the tractor. But it may damage the cassava, so the design is proposed to make a harvesting machine which will harvest the cassava without any damage and to make an effective equipment available at nominal prices. This harvesting machine consists of linkages and gears are used to harvest tapioca. By applying load by using leg on pedal it converted into rotational motion by rack and pinion mechanism. This load is converted into reciprocating motion with high torque by using various gear arrangement. This high torqued rotational motion again converted into reciprocation motion by using rack and pinion mechanism. Then it convert to required motion by using linkage arrangement. Cassava catch by using fixture this fixture was activated by using linkage this activating link will activated by using hand it will be in near to left hand. Steering are provided to vehicle to control when moving in the field. These harvesting machines would be more helpful to farmers involved in low scale cultivation.

**KEY WORDS:** Tapioca Harvesting, farm Equipment, Agriculture.

### 1. INTRODUCTION

Tapioca is familiar crop which cultivated around Tamil Nadu. It was harvested by using hand, it is very difficult to harvest crop so we decide to make harvesting machine which should be economical and harvest the crop effective manner. That's way we make the harvesting machine which contains of linkage, gear, pivots, fixtures are used to make this machine very simple mechanism makes this machine to user friendly and less maintenance one. Gears are used as torque converting. Load was apply by using hand and it convert into high torque by using sequent of gears linkage and pivots are convert applied motion to required motion

Most of the Indian farmers economic is not good. So they not able to buy tractor so this kind of equipment's are help to harvest in low investment it reduce the harvesting wages of farmers it will more helpful to farmer.



**Figure.1. Cassava and Tapioca**

**Cassava and Tapioca:** Tapioca is a starch extracted from cassava (fig 1) root. This species is native to the North Region of Brazil but spread throughout South America. The plant was carried by Portuguese and Spanish explorers to most of the West Indies, and the continents of Africa and Asia, including the Philippines and Taiwan. It's a shrubby, tropical, perennial plant that is less common in the temperate zone. Tapioca thrives better in poor soils than any other major food plant. As a result, fertilization is rarely necessary.

**Necessity of Tapioca Harvesting Equipment:** Cassava is cultivated eighty percentage in Tamil Nadu. It is majorly cultivated around namakkal, erode, salem, Kanyakumari. It cultivate in 1.39 lakes hectares in Tamil Nadu. Most of the farmers are having below 2 hectares so they not using tractor for harvesting tapioca. They using daily wages peoples for harvesting it required more energy to harvest tapioca from field. Due to harvesting using daily wages people, wages for harvesting is accurse more it affect their profit. Existing model is an attachment which attached in tractor it damage the tapioca it affect its grade in market so we make this machine which harvest the crop without damaging the tapioca. So it help to increase their profit.

### 2. MATERIALS AND METHODS

**Construction:** The rack and pinion mechanism is used here to transmit high torque which requires less input power to carry heavy load. The racks is connect with a handle or a pedal as required and it is pivoted, which makes the lever like linkage. Gear train (set of three gears) is meshed with each other to convey the motion, where the 1<sup>st</sup> gear is in the ratio of 1:2 of pinions. The 3<sup>rd</sup> gear is connect with a other rack which makes the opposite motion of 1<sup>st</sup> rack and pinion set to move upwards. A fixture (fig.2) is provided to plug the cassava which act like hand, it is actuated by handle connect to the fixture by means of wires. The component is fixed within a frame which is made by square

bars. These whole assembled parts are placed over axles with wheel of large base and good height. Steering like attachment is provided to back wheel for easy operation.

**Material and Joints:** Considering machinability, weldability and bending moment, Mild Steel is chosen for fabrication. Mild steel refers to low carbon steel, which are usually used for structural applications. With too little carbon content to through harden, it is weldable, which expands the possible applications. Mild steel has a relatively low tensile strength, but it is cheap and malleable; surface hardness can be increased through carburizing. It is used where ductility or softness are important.



**Figure.2. Fixture arrangement**

#### Selection of joints:

**Permanent joint: (welded joint):** A welding joint is a point or edge where two or more pieces of metal or plastic are joined together. They are formed by welding two or more work pieces according to a particular geometry.

**Temporary joint: (Fasteners):** A fastener is a hardware device that mechanically joins or affixes two or more objects together. In general, fasteners are used to create non-permanent joints; that is, joints that can be removed or dismantled without damaging the joining components.

**Working of Tapioca Harvester:** In this system load can apply by hand or leg depending up on users need. Applied load converted into upward motion by using pivot and rack is connected with this, rack moves according to the movement of the lever. This rack is rotates gear, sequence of gears are arranged to increase the torque of applied one that makes the easy to harvest the cassava. Fixture is fixed in the other end of the machine it will catch either respect to the applying load to catch the cassava stem. High torque given to the lever is plug the tapioca from the sand. We can investigate the working of the tapioca harvesting equipment, with hand lever mechanism.

The cassava is under the land surface which is usually plugged manually by hands it is more time consuming one, so we decided to make a equipment which is simple and effective which doesn't require any fuel and other sources like electricity. A simple rack and pinion arrangement is used in this equipment to harvest the cassava by input of less power. Rack and pinion is used to change the linear motion of the rack to rotational motion. Series of gears are arranged to increase the amount of applied torque.

This high torque is again converted into linear motion by using rack (fig 3). The central point, pin, or shaft on which a mechanism turns or oscillates. It is used to activate rack. It converts downward movement of applied to upward motion. It act as a support to load applying member. It is used to catch the stamp of cassava to harvest. It activated by using wire and lever on that two side of the fixture are close together and catch the stamp with gripper. Caching capacity is depending upon amount of load given to the fixture so it is good to catch depend upon cassava.



**Figure.3. Rack and pinion arrangement**

Besides, harvesting in summer is more convenient than in the rainy season, particularly in transporting the produce to the tapioca traders and in preparing for the coming planting season. It is recommended that the farmers carry out a field test to assess the yield and starch content by randomly selecting one or two plots of the size 10-15 square meters, avoiding the best part of the land. After weighing the roots and converting to per unit land basis, the farmers should take a sample of 6-7 kg to the traders for testing of the starch content. Then the price of the tapioca can be calculated per kilogram. This will determine how much income per rai can be derived from the sale of tapioca. If it is not worth harvesting, then the farmers may defer the harvesting time until the price improves. However, if the harvest is prolonged, weeding may then be needed (Bansal, 2010; Gupta, 2009; Rattan, 2009; Freudenstein, 1954).

### 3. RESULTS

After complete the machine, it was taken into agricultural field and test the entire performance of the equipment. When the lever is actuated by hand or pedal the rack of 1<sup>st</sup> set moves towards upwards, which makes rotation in gear train it consist of 3 gears to increase torque and to supply in a same direction , at the other side the rack moves downwards which make the fixture moves upward with cassava holding with it. The fixture is actuated by the separate handle with wires. A set of wheel is steered by a rod to turn. The result of testing the machine shown below,

Force required = 6.6 Nm  
Angle of lever = 35 deg (downward movement)  
Velocity of fixture = 0.38 m/s

### 4. CONCLUSIONS

More up to date and better innovations dependably accompany time and it will help in decreasing the physical work and troubles in the areas where it is made use. What's more, for our situation, this equipment can harvest one cassava at a time. We apply load with the help of hand on the lever or by foot on the pedal. This lever connected with rack through pivot so direction of motion covert rack and pinion converts linear to rotational motion. By the above gear torque ratio applied torque is increase. This torque is help to pull the cassava from the land that converted into high power to other side of the equipment. It harvests tapioca without any damage. This is gives good grade to tapioca in the market that gives good price of crop. It can run in any kind of land it is four wheel help to run in any land. It reduce the amount of load apply to the machine.

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