Design and Fabrication of Grain Collector

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***Abstract*— A simple manually operated grain collector and bagging made of locally available materials using local manufacturing technology was designed, fabricated, and tested for collecting and bagging of grains(paddy) dried on concrete pavement. The invention belongs to the technical field of agricultural machines, and relates to a tool applied when grains are collected after being aired, in particular to a manual grain bagging machine. Grains are automatically loaded into a dustpan by pushing the manual grain bagging machine with hands, a hand wheel of a drive assembly is rotated so that a gear can push a rack to move upwards at first and then move horizontally, and a stop bar on the dustpan is blocked by a left arc baffle and a right arc baffle so that the dustpan can tilt to pour the grains into an opening bag. A simple manually operated grain collector and bagging had the following major components: frame, wheel, long pipe, vertical stand frame (bars), horizontal bars, collector, and bag. Radial flat bladed type base plate, slot bar, sweeping box, bagging area, frame and the conveyance system. Results showed significant differences on the collecting capacity, and noise level. Other parameters such as collecting efficiency, air velocity, augmented cracked grain percentage. The design was made based on certain assumptions and calculations and the collector was built, tested and evaluated.**

I. INTRODUCTION

Product design is the process of creating a new product which has to be accepted by the customers. In a broad concept, it is essentially the efficient and effective generation and development of ideas through a process that leads to new product. In a systematic approach, product designers will conceptualize and evaluate ideas, turning them into tangible inventions and products. The product designer's role is to combine art, science, and technology to create new products so, that the consumers can use. [1] To check the losses of agricultural grain crops in the field, it is needed to measure the amount of grains fall to the ground during harvest by combine. Separating the grains from the soil and collecting them from the ground and in the groove of the land by hand and by holders is a hard work and time consuming to that is not precisely done. Hence the need for a machine to collect the grains in the field has been identified. The development of a growing population increases the need of food day by day. This project aims to design and fabrication of collecting and storing of grains by manually. Main objective behind designing and fabricating the bagging and collecting of grains is to reduce the human effort and also reduce time taken for storing. This project mainly helpful to the former the problems faced by small scale farmers relating with availability of labors and cost of collecting and storing finally It is also capable of reducing time wastage, reduction in breakage of the grains.[1]-[7]

A review of the literature reveals that, different types of grain collector machines have been successfully used for grain colleting bagging machine. However, most of the studies deal with effect of change in power sources likes electrically operated, engine operated, hydraulically, Pneumatic machines etc. to run a machine and collecting grains. Survey also provides clear idea about the drawbacks of traditional type of grain collector machine and how this machine can overcome from these drawbacks. The benefit of manually mechanically operated systems and without using electric power source is not found in the literature till date. So, came to know there is no machine is used for collecting grains, therefore we develop our model to overcome those problems. The present work explores this possibility by mechanically operated collecting grains without use of electric power.

II. MATERIALS AND METHODS

2.1 Conceptual Framework

The traditional sun drying method of a paddy is still widely practiced by most farmers. The practice includes hauling of a paddy in bags to the drying area, spreading out the paddy in the drying floor using wide board, then evened and slightly furrowed with wooden rakes. Mixing and turning the paddy are done regularly to ensure that the paddy is dried evenly. After drying, the paddy is piled using a wooden board. After wards, the paddy is placed into a bag using a metal scoop (Panake). All of the above operations are done manually consuming too much time and effort. Collecting and bagging operation is considered one of the difficult tasks in sun drying. This study was then conceptualized by looking into existing designs of grain collector good features of the existing design were considered for adoption, adaptation, and simplification to come up with the prototype. Design requirements satisfying local condition were identified. Design data then were based on market information of available parts and components of grain collector. Based on design requirements and design data, a design drawing was prepared. Fabricated prototype was subjected to evaluation to determine its operating characteristics. Shows the conceptual framework of the study.

2.2 Problem Identification

Each and every day the prices of labour cost keep on fluctuating. They increase with higher rate but never fall down. So basically, it is important to design new equipment. By collecting the grains from labours, it takes a more time. Each person to lift a weight of about 8 to I5 kg, 50 kg bag loading stand food needs 3-6 times lower operational efficiency, labour intensive, and sometimes

encounter should rain the weather, the food collected will not timely rain.

2.3 Objectives

The main objective of this project work is to design and develop a manually operated grain collector that can be easily manufactured locally from available local materials and low cost it will replace the old traditional process.

A manually operated grain collector developed with major list of objectives.

- To fabricate and assemble the designed grain collector.
- Grain collector is small machinery for efficient collection of all types of small size grins.
- The machine has a simple construction and is light in weight which makes it easy to handle.
- To minimize manpower and reduce the hard work.
- To minimize the time for collecting.

III. METHODOLOGY

The methodology consists of the following steps

- Diagram and its working Principle
- Design process
- Proposed Procurement of raw materials
- Fabrication of individual parts
- Cost Estimation & Final Assembly

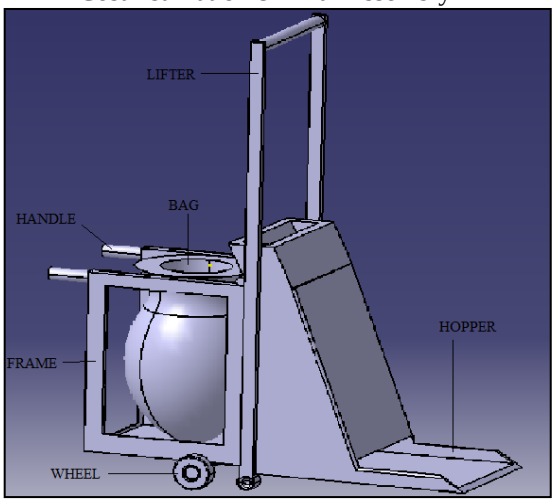

Fig 3.1 Proposed diagram of grain collector

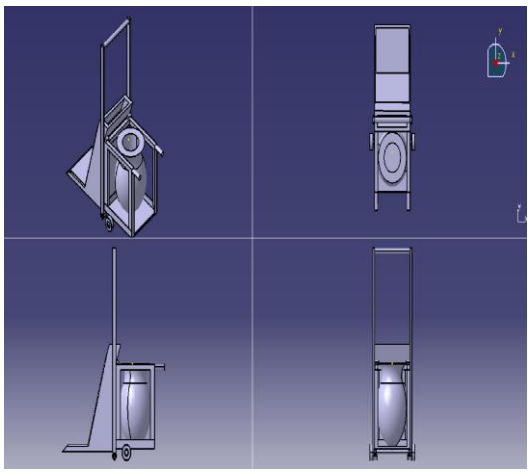

Fig 3.2 Sectional views of grain collector

3.1 Construction Details

The construction details of grain collector as shown in fig.3.1 this collector is developed to collect the grains from the floor. The current work divided into two portion front consists of hopper and back side consists of frame, handle and base plate. The frame is an important part of the collector and it must provide flexibility to withstand all loads and support for remaining parts of the collector. It is made up of mild steel L section having a height 31 mm, width 31mm and thickness 3mm. It consists of 11 L section pieces these L section mild steel pieces are welded. 3 pieces are cut into 550mm length, 4 pieces are cut into 755mm length and 4 pieces are cut into 610mm length. The two rectangular section mild steel are welded to reduce the bending of frame and increase the strength of the frame. The cross section of the rectangular section is 5mm×30mm and cut into 760mm length. At the bottom of frame base plate is fabricated and it is having thickness of 3mm and it is cut into 610mm×550mm cross section. The main function of the base plate is to takes the overall weight of the bag. The circular handle is made up of mild steel having a diameter of 32mm and 142mm length. There are two handles are welded to a top backside of the frame to move the collector towards grains which is spread over the floor. The lifter is made up of mild steel L section and one hallows circular tube. The L section material cut into 6 pieces, 2 pieces are cut into 1590mm, 2 pieces are cut into 590mm and remaining 2 pieces are cut into300mm. diameter of hallow circular shaft is 50mm, thickness is 3mm and length is 550mm. A solid circular shaft is made up of mild steel having length of 550mm and diameter is 25mm is welded to frame at the bottom. Wheels are attached to both ends of the shafts with the help of bearings and the diameter of wheels is 126mm and thickness is 20mm.

3.2 Working principal

The grains spread over the floor that can be lifted and collected by using this collector. Here the hopper will be provided at the front of the machine and bag is fixed back side of the machine. Machine can be operated manually when at rest position of the hopper the machine is moved the grains which is presented on the floor is to be collected in the hopper up to 4 to 5 kgs of grains. Handle which is connected to the hopper that can be pulled down word whatever grains present in the hopper is collected into the bag, this can be done up to fill the bag.

3.3 List of material used

Table 1 Details summary of materials used

Sl. No	Components	Material	Specification
1	Base Plate	Mild steel	Width: 550 mm Height: 610 mm Crosssection:550×3 mm
2	Wheels	Polymer	Wheel diameter: 125mm & thickness=25mm
3	Hopper	GI Sheet Metal	Upper width: 120 mm Lower width: 620mm, Height=550mm
4	Frame	Mild steel	W*H*T 31mm*31mm*3mm
5	Lifter	Mild steel	W*H*T 31mm*31mm*3mm

3.4 Fabrication Process

Metal fabrication is a value-added process that involves the construction of machines and structures from various raw materials. The process of fabrication is started in the fabrication shop on the basis of engineering drawings generated in the design process after assessing the capabilities of the shop with respect to metal cutting, foaming, welding and machining. Metal fabrication jobs usually start with shop drawings including precise measurements then move to the fabrication stage and finally to the assembly to the project.

The grain collector, mainly consist of six parts. They are as follows, Frame, Bottom plate, Hopper, Lifter, Handle, Wheels.

I. *Frame*

The frame is an important part of the equipment. It must provide flexibility which is equivalent of suspension to give good grip. So, the proposed mode equipment does not consist of any suspensions. It is made up of mild steel L-section having a cross section of 31mm X 31mm. It consists of 4 channels, which are cut into the length, of 610 mm and other 2 Pieces are cut into 550 mm length. And also, it can be arranged according to the need as shown in the figure. The arranged pieces are welded at the joining section to form the base frame of the equipment. The most traditional frame material, steel, has been used by frame builders for over a century. Many types of steel channels are available and the material is easy to bend and shape. It also offers excellent ride quality, durability and is easily repaired and affordable. And, while there are new steels almost impervious to corrosion, most types can rust if treated carelessly (protect that paint job).

II. *Bottom plate*

Bottom plate is made up of mild steel rectangular plate having a thickness of 3mm. Length and width of the plate is 610mmX550mm. This plate is welded to the frame of the collector and the main function of this plate is to place the bag as shown in figure.

III. *Hopper*

Hopper is used for the temporary storage of materials, they are designed so that stored material can be dumped are fed to process easily. Hopper specifications include volume capacity, weight capacity, depth or length, width or diameter, height and materials of construction. Most hoppers are made of plastic, metal or composite material. In this project hopper is made of galvanized sheet metal. These are value added steel products which are tough, sturdy, light weight, bright, corrosion resistant and easy to transport. These are usually produced in the thickness range of 0.15mm to 2.0mm and width range of 800mm to 1560mm. The metal sheets are fragile and highly deformable. The steel used is mild steel for forming, which is galvanized to increase the durability of the metal sheets and consequently allowing them to better withstand the weather.

IV. *Lifter*

The lifter is made up of mild steel L section and one hallows circular tube. The L section material cut into 4 pieces, 2 pieces are cut into 1590mm, 2 pieces are cut into 590mm and diameter of hallow circular shaft is 30mm, thickness is 3mm and length is 550mm joining is done by welding.

V. *Handle*

The circular handle is made up of mild steel having a diameter of 32mm and 142mm length. There are two handles are welded to a top backside of the frame to move the collector towards grains which is spread over the floor.

VI. Wheel

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. two wheels are attached to the frame in order to move the machine in specific direction the diameter of the is 125mm.

VII. *Final Model*

Fig 3.3 Final assembly of grain collector

IV. PERFORMANCE TEST

4.1 Performance Test

The testing is done by comparing the specifications of traditional or conventional methods with the collection of grains on the basis of labour required, labour cost and the time required for the collection of grains from the floor. Trial tests were conducted to see the time required for collecting of grains and to check that the grain collector equipment is functioning properly or not. The results show that they are functioning properly as expected.

4.2 Grains collecting time

Table 2 Details summary Grains collecting time

SL NO	Type of grain	Weight of grains in Kg	Labour's required	Time taken in Seconds
1	Corn	50	1	42
2	Paddy	50	1	52
3	Millet	50	1	46
4	wheat	50	1	43
5	Rice	50	1	47

V. RESULT AND DISCUSSION

Grain collector useful for collecting grains from the floor and a conceptual model was implemented and fabricated successfully. It has considerable potential to greatly increase the efficiency of collecting grain with comparison of other traditional available techniques. The main task now is to promote this technology and have available to users at an affordable price. The grain collector is made up of local components in workshop. This can be sourced at an inexpensive price from local traders. By using local materials, collecting of grains can be achieved.

Table 3 Comparison with traditional method

Sl. No	Parameter	Using human for collecting grains	Using grain collector equipment.
1	Grains in kg	50	50
2	Labours required	2	1
3	Labours cost per day (in Rs)	Rs.200	One-time investment
4	Time required	90 sec	42 sec

VI. CONCLUSION AND FUTURE WORK

A manual grain bagging machine that collects grains from the concrete pavement floor through the collecting bin and made to fall into the bag placed adjacent to it. This machine has vast application in India due to lack of electricity and investment for the poor formers. This became the main motivation to fabricate this manual bagging machine. This machine reduces the grain collecting time and labour cost. As the main goal to reduce the usage of electricity we don't suggest the future scope with motors rather the belt drive mechanism can be designed to reduce the time and mechanical force of labour or operator.

Advantages of the proposed manual grain collector

- Manually operated, no fuel and electricity
- Ease of operation
- Single user is sufficient
- Single time investment and life time validity.

VII. SCOPE FOR FUTURE WORKS

The present work may be extended in one of the following ways

1. Grain collector can be further implemented to fixing the motors to lift the grains. The system can be easily configured to require one.

2. It can be further implemented by using solar panels wth battery operated to run the vehicle.
3. The developed mini grain collector is larger in size and there is a scope for making it more compact and light in weight.

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