BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF ENGINEERING AND PHYSICS

DESIGN AND FABRICATE OF A SUNFLOWER THRESHER MACHINE

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A DESIGN PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE BACHELOR OF AGRICULTURAL ENGINEERING HONOURS DEGREE (BSC.A. E).

DECEMBER 2023

DECLARATION

I, Alan Chingoma B1953010, do hereby declare that this project is a result of my original design work, except where clearly and specifically acknowledged. It is being submitted to satisfy the requirements for the Bachelor of Science Honors Degree in Agricultural Engineering.

Signature________________________________Date15/12/2023.

For the above-mentioned project, I have supervised and am convinced
Project Supervisor: Eng. W. Zendera

Signature____________________

I certify that I have reviewed the design project and am confident that it complies with the requirements for project preparation and presentation set forth by the Department of Engineering and Physics. I, therefore, authorize the student to submit this project for marking.

DEDICATION

I dedicate this project to my family and friends for their financial and emotional support during the period of the project designing

ACKNOWLEDGEMENT

I thank the Almighty God for providing light during the course of the project designing. My sincere gratitude towards my supervisor Engineer W. Zendera for guidance, professional support, encouragement, and kindness. I Thank all my classmate for the support during the fabrication of the designed thresher. I would also want to thank my family for the financial support and dedication to motivate me.

ABSTRACT

Sunflower production is increasing in Zimbabwe, but farmers face problems separating the seeds from the sunflower heads. Sunflowers are traditionally threshed by beating the heads manually with a stick. The project focuses on solving the problem faced by the farmers in separating the seeds from the sunflower. Farmers use the manual methods due to unavailability of suitable machinery for sunflower threshing. During manual sunflower production, the most time and labor-consuming operation is the threshing of sunflower by beating the sunflower heads with a stick, rubbing wear heads against a rough metal surface or power tiller treading machine. The aim of the project is to fabricate a machine which will separate the seeds from the sunflower. The main components required to fabricate the machine are rotor, Shaft, Pulley, beaters, thresher box, Hopper, Tray, Sieves, engine, V-Belt and Bearings. The sunflower threshing unit operates on the principle of axial flow movement of the material. The sunflower is threshed in a closed threshing unit by rotating beaters where the seeds are separated from flower and husk of the flower is removed. The goal of this experiment is to design and develop a motor-driven machine that separates the seeds from the sunflower. An orthographic projection was drawn using AutoCAD software and threshing machine was then fabricated according to the drawing in the Bindura university workshop using locally available materials.

GLOSSARY AND TABLES OF SYMBOLS

Hp: Horse Power,
N: rotational speed, rpm;
ω: Angular speed rad/s,
db.: dry bases moisture content
V: velocity
CA: Conservation Agriculture
GDP A monetary measure of the market value of all the final goods and services produced in a specific period by a country or countries

1. Table of Contents

1. CHAPTER 1 INTRODUCTION

1.1. BACKGROUND

According to the FAO (2006), sunflower (Helianthus Annus) is one of the most major oil crops in the world and is fifth in terms of oil production. Given its high concentration of healthy fatty acids and cholesterol, sunflower oil has been recognized as a vital vegetable oil in many nations. Furthermore, of being used for oil purposes, it may also be used in some countries as a source of bio diesel, biogas, feed stock, and paper industries.

Zimbabwe its agriculture is divided into five natural areas. Crops are grown in the first three areas. Small scale community farms generated the majority of maize and basic foods, while bigger commercial farms concentrated on income crops like as tobacco, paprika, fruits, flowers, and cattle exports, giving much needed foreign currency for imports. Zimbabweans encounter a variety of problems in their agricultural pursuits, including a lack of finances to purchase supplies and equipment, inadequate rainfall in certain places, insufficient road networks to transport their goods, and a shortage of water according to FAO (2006).

Sunflower in Zimbabwe is usually cultivated by small scale farmers though the area under sunflower is on increase the sunflower planted nationally has climbed to nearly 140,000 hectares, according to the Crops, Livestock, and Fisheries Assessment report produced by the Agricultural Advisory and Rural Development Services (2022). Zimbabwe largely extract edible oil from soya-beans and cotton seed but output has not been adequate to feed local mills. Zimbabwe is importing between 55000 and 65000 tonnes of sunflower from South Africa per year According to herald article (2022). In 2022 the country crude oil worth approximately US$ 200 million according to statistics from the Zimbabwe National statistics Agency (2021) making it one of the most imported commodities in the country. Russia, Ukraine and Brazil are large producers of sunflower oil. The disruptions in the sunflower oil supplies due to Russia- Ukraine war triggered price increases in other edible oils such as olive, soya and palm, although they have now softened.
Given that Zimbabwe's climate is ideal for growing sunflowers, the government has included sunflower seeds to the list of agricultural inputs it provides to farmers. Minister for land, agriculture, fisheries, water, and rural development Dr. A. Masuka in the statement capture in herald news article (2022) stated that the government aims to plant 120 Hectares of sunflowers in rural areas. According to the minister in the herald article statement (2022), he said "at least 600 metric tons of sunflower seeds would be distributed to

farmers, and going forward, they will be included in the Pfumvudza/Intwasa farming inputs. Because we cannot keep importing cooking oil for use in homes", he claimed, "sunflower is a mandatory crop for everyone." Rural industrialization would result from the development, which would then spur rural growth and hasten the realization of Vision 2030 according to herald article (2022).

For agricultural growth and crop production in Zimbabwe, agricultural machinery is a crucial and essential component. The amount of time it takes farmers to execute agricultural operations is greatly reduced when farm machinery is used. One of the most significant oil seed crops in Zimbabwe is sunflower. In order to fulfill the nation's rising need for vegetable oil, production is anticipated to rise during the coming ten years. In this study report, the challenges farmers experience when harvesting sunflower seeds must be discussed. The seeds must be removed, which takes a long time and a lot of labour. Farmers have two options for removing the kernels: either manually or by relying on the industry to give them huge machinery to do so (Kazi et al., 2016). The manual approach, which is exceedingly troublesome and labor-intensive, wastes time and energy by removing the kernels by banging on the sunflower head. Traditional hand threshing has a relatively low yield and is dependent on the productivity and skill of the employees. The mechanized sunflower thresher is needed to replace the reduced manual labour, thresh sunflower in the fields, shorten the threshing time, improve the quality of threshed seed and increase the threshing efficiency. The measures of thresher performance are productivity, threshing efficiency, broken grains, grain loss, power consumption, cleaning efficiency, and specific energy (Kibria, 1995).

1.2. STATEMENT OF PROBLEM

Mechanization has had a significant influence on agricultural labour demand and supply, as well as farm profitability. It has also brought about significant changes in the agricultural terrain, including rural villages. In terms of sustainability and acceptance, foreign countries find it quite simple to embrace mechanized farming. In Zimbabwe, however, farmers find it difficult to embrace technology since most farm lands are held by small-scale farmers who cannot afford mechanized equipment. With all of the constraints, an attempt is being made to design a compact and economical equipment for Zimbabwean farmers. Harvesting is the most significant process in farming, accounting for around 30% of total output FAO (2006). Threshing is the most common post-harvest procedure conducted by several manufacturers, including Kurima Farm Solution (pvt) company, Zimplow (pvt) Ltd, Lovol construction and Agriculture company, Famec etc. These machines, however well-machined and bulky, are ideal for big farms with a minimum thresher length of 2m span and a price range of roughly US$450 to US$1500, which is rather costly. Because most farmers have small plots of land, the cost of owning huge machinery is not justified in terms of yields. The majority of these devices are developed for large-scale activities, which need sophisticated technology, high-skilled staff, and are not appropriate in all working conditions. While threshing sunflower manually by beating causes difficulties such as back pain, arm discomfort, is a laborious operation, time-consuming, labor-intensive, and has a high possibility of hurting fingers, the crop will be affected due to exposure to unseasonal rain and sun burn, which can reduce crop income and quality due to their high time consumption to thresh. There is high need for a low-cost portable threshing equipment that may be shared across the village to speed up the threshing process.

To solve this, in this project, the designing and fabrication of a sunflower thresher intending to minimize manual labor in sunflower production while enhancing threshing efficiency. It is easy to operate. The components are easily accessible; therefore, maintenance should be minimized. work is being carried out and efforts are being made to build tiny, inexpensive threshing machines. The document describe the design and fabrication of a sunflower thresher in order to create a foundation model of a sunflower thresher to achieve the goal.

1.3. AIM AND OBJECTIVES

Aim

The aim of this project is to design and fabricate a compact, affordable low cost sunflower thresher to minimize manual labour and increase rate, efficiency of sunflower threshing

Objectives

- Designing of a compact affordable sunflower thresher
- Fabrication of a sunflower thresher model
- Testing the model for efficiency, seed loss

1.4. JUSTIFICATION OF NEED

In agriculture there is high need to support opportunities that relieve the burden of labour shortages by facilitating timeliness and quality of product. There is high need of improving the quality of our farm produce and the easy of doing farming by increasing the efficiency and reducing manual labour. Farmers' key objectives are to decrease harvesting and time expenses. Model agricultural automation, lowering the cost of hiring harvesters, and using manual methods are all viable ways to do this, minimize drudgery, and shorten the harvesting period

2. CHAPTER 2 LITERATURE REVIEW

According to Food and Agricultural Organization (FAO), sunflower ranges second subsequent to soybean as an oil crop in the world. Sunflower is a good substitute when it's difficult to cultivate other crops due to climate hazards. There is high demand for sunflower because its oil is good for health as it contains low cholesterol. One kg of sunflower seeds yields 500 to 600 grams of oil, which is more than that of any other oil seeds (Anon., 2015). Sunflower oil contributes about 13% of the world edible oil production with high value (Gabagambi *et al.,* 2010). Due to its larger adaptation capability and higher oil quality, sunflower can be grown almost in all the regions of the world with high seed yield and oil content (Sencar *et al.,* 1991).

2.1. AGRICULTURE PRODUCTION IN ZIMBABWE

Farmers in Zimbabwe have been growing sunflowers on a limited basis since 1985. Farmers, on the other hand, are growing increasingly interested in cultivating this oil seed crop in order to obtain high quality oil at a lesser cost. After satisfying their family needs, they make a considerable profit from sunflower cultivation (Weiner, Moyo, Munslow and O'Keefe 1985; APRODEV, 2002). According to (Mutami 2015) Farmers in the country are producing sunflower as a climate change adaptation method and the government is now financially assisting Zimbabwean farmers by purchasing sunflower harvest from them. The government is expected to utilize the money saved on imports to train farmers and provide other assistance to make producing the oil-rich simpler herald article (2021). Many Zimbabweans will be able to find work in the sunflower industry. It will become a source of live hood for many rural dwellers who previously struggled to provide for their families but harvesting is still a challenge for sunflower farmer's herald article 2021)
Agriculture is the backbone of Zimbabwe's economy, supporting the bulk of the country's economic, social, and political life. As a result, APRODEV (2002) forecast that this condition will persist for the foreseeable future. According to Newitt (2007), the agriculture industry accounted for 18% of the country's GDP in 2005; both commercial and subsistence farming are conducted to produce a variety of crops and animals. However, a major share of economically manufactured items is often exported. Despite the fact that women contribute to agricultural output, males dominate the sector. Furthermore, according to Newitt (2007), Zimbabwe has abundant agricultural resources. In 2003, it was projected that 8% of the nation was under cultivation. Although the logging business is tiny and wood collected in Zimbabwe is largely used for fuel, forests encompass 45% of the nation. Zimbabwe is also mineral-rich; for example, gold has been mined since

ancient times, and the Great Dyke includes reserves of dozens of other profitable minerals APROVEV (2006). The rains provided by the Indian Ocean monsoons (seasonal winds) are critical to Zimbabwe's climate. Between October and March, the eastern section of the nation receives up to 1,000 mm (40 in) of rain; rain levels in the arid southwest are around half that amount Mutami (2015). Maize, cotton, sugar, groundnuts, beans, and cow peas are the main crops grown in Zimbabwean community lands. In commercial terms, minor crops such as beans, cow-peas, and groundnuts are regarded to be crops for women Mutami (2015). Tobacco, cut flowers, raw sugar cane, cotton, chilled vegetables, coffee, fruit, and tea are among the key commercial crops that produce cash revenue (APRODEV, 2002). Another important crop in Zimbabwe is maize. 80% of the population is directly involved in its manufacturing, according to APPRODEV (2002). The Zimbabwe Grain Marketing Board obtains 75% of its grain from smallholder/communal farmers.

Fig 1.1 show Matabeleland sunflower farming Zimbabwe 2021

2.2. SUNFLOWER HARVESTING

Sunflower threshing machines have gained increasing attention recently due to their potential to increase yield, save time and money and reduce risk of crop damage from traditional threshing methods Sudajan et al. (2002). This review presents a comprehensive look at the current literature on sunflower threshing machine designs, performance of machine designs, performance, models and applications. The majority of existing literature focuses on the performance, design and engineering of sunflower threshing machines. Performance of machines is assessed on technical parameters such as threshing efficiency, speed and throughput as well as on operational costs and time constraints.

Most studies note that while sunflower threshing machines offer higher threshing efficiencies than manual threshing methods, the cost of these machines can be high and the maintenance requirements can be time-consuming (Rashid et al. 2014). Several studies mention the potential to improve on current models and designs in order to achieve better cost-benefit ratios for sunflower threshing machines. Model and application of sunflower threshing machines have also been well explored in the literature surveyed. Different models of sunflower threshers have been designed for both the small and large scale market and these machines come in both mobile and stationary configurations. (Rashid *et al.,* 2014) stated that small scale models are often suitable for small farms and are sometimes powered by electric motors. Large scale models are often suitable for small farms and are sometimes powered by electric motors. according to large scale models are often hydraulic, treadle driven or self-propelled and can be used on large commercial farms. BRAC (2006) studies and highlighted that potential and efforts to develop application for sunflower threshing machines, such as autonomous automation, could lead to further cost and efficiency savings. Overall, Askari et al. (2008) suggests that sunflower threshing machines are a viable option for increasing yields while reducing risk of crop damage from manual threshing methods. Further research is needed to explore the potential applications of automated threshing machine and to identify design and engineering improvements which could result in cost- benefit ratios more favorable to farmers.

2.3. SUNFLOWER THRESHING

According to Kepner et al. (1978), threshing might be performed by the impact of a fast-moving member on the material, rubbing, squeezing pods, a combination of two or more of these operations, or any other technique of exerting the necessary pressures. According to Khan et al. (1992), the threshing drum can be positioned on two bearings and spins in a perforated trough-like element known as the concave. During threshing, he advocated that the crop be fed between the threshing drum and the concave, where it would be subjected to strong impact and frictional forces, which would dislodge grain from panicles. According to El-Sheikha (1994), threshing operation might be carried out using one or more of the following methods: Friction, Squeezing, Impact, Tension and Chopping. According to Bolaji (2000), the cylinder velocity, feed rate, and moisture content all had an effect on unthreshed grain losses and overall grain damage. Helmy et al. (2000) found that the spike-tooth drum (D3) and clearance ratio of 1.8 produced consistently higher performance assessment results for the upgraded thresher. The results also showed that the thresher's drum speed should be around 9.53 m/s for maximum performance, while the grain moisture percentage ranged from 15.4% to 20.9%. According to El-Haddad (2000), raising drum speed and reducing feed rate boosted threshing efficiency. According to Ajav and Adejumo (2005), threshing efficiency improved with increasing cylinder velocity at a given level of concave clearance and moisture content. They also said that the cylinder velocity had a substantial impact on total losses, with total losses being the lowest at 4.2 m/s and increasing as the cylinder velocity rose.

During a test of a power tiller controlled mini thresher, Askari et al. (2008) discovered that grain damage increased with rising peripheral speed and decreasing crop moisture content.

Ismail and Elhenawey (2009) tested is inducted on a pedal-operated sunflower thresher was designed and constructed to determine the optimal operating design via three levels of the pressure surface press on friction drum (2.0, 4.0, and 6.0 kg/cm2) for levels of friction drum speed (2.2, 3.7, 4.9, and 6.9 m/s), different radial curves of pressure surface (330,345 and 365 mm), and different resting times Ismail (2011) further confirmed in trials that the researched is designed to produce con-shelling with the lowest losses and powers based on key physical attributes of the corneas.

Ajayi (1991) discovered that crop moisture content affects the material capacity of a locust bean thresher. The cylinder speed was also discovered to have an influence on threshing efficacy. According to Khater (2000), lowering moisture content improves threshing efficiency and seed damage. He also stated that a moisture content percent of 14 is desirable since it results in the least seed damage, seed losses, and best threshing efficiency. According to Simonyan and Oni (2001), when moisture content decreases, threshing efficiency and extractor efficiency of locust bean rise. The cylinder speed was also discovered to have an influence on threshing efficacy. Schild et al. (1991) demonstrated that for sunflower threshing, the cylinder must rotate slowly enough to prevent shattering the seed, around 300 rpm. The concave must be open enough to prevent the head from grinding up.

Khater (2000) reported that the tested corn Sheller machine, utilized for sunflower threshing, performed best at 7.2 m/s drum speed, 14% seed moisture content, and 4.0 cm concave clearance. The criteria cost of the tested machine in perfect functioning order was 280 L.E. / feed. According to EL-Beba (2001), the optimal conditions for sunflower threshing are 13.6m/s drum speed, 15% seed moisture content, and a 4/2 (front / rear) drum - concave clearance ratio.

Mesquita and Hanna (1993) investigated two soybean threshing devices: standard combines and an experimental rubbing belt system. The energy required by traditional combines to thresh soybean was four times that of the rubbing belt system. Oil seed cultivation has declined over the years owing to a variety of technical factors such as a lack of appropriate technology (Miah et al., 2014).

Peeneejdangang (1997) reported that threshers designed for paddy and soybean threshing were tested for sunflower threshing and discovered that these threshers were unsuitable for sunflower threshing due to grain damage as high as 4- 10%, cleaning efficiency as low as 87-92%, and grain loss as high as 20-35%. Power sunflower threshing produced 10 kg/h/man and manual hand rubbing produced 1.5 kg/h, respectively (Goel et al., 2009).

Azharuddin et al. (2016) created a sunflower seed extraction machine with a threshing efficiency of 99.76%, nearly no seed damage, and a seed loss of 0.238%. Kakhandaki et al. (2012) investigated a sunflower thresher with an average output of 879 kg/h and a breakage rate of 1.84%.

BARI Farm Machinery Division (1993) previously produced a manual single-head sunflower thresher that was likewise difficult to use. Farmers use traditional ways since there is no adequate sunflower threshing equipment. Given the foregoing facts and the socioeconomic circumstances of the country's farmers, a program was devised to build and produce a motor-driven sunflower thresher and test its performance.

(Azharuddin et al., 2016; Chavoshgoli, 2012; Mirzabe et al., 2014). The mechanical methods of removing sunflower seeds are based on beating, friction and simultaneous beating and friction. The machines for removing sunflower seeds from the head are classified as: combined harvester machines and stationary thresher machines. The threshing unit plays a key role in determining the performance of a harvester machine (Sudajan et al., 2002).

Bansal and Dahiya (2001) studied the effect of threshing techniques on the quality of sunflower seeds. Sudajan et al. (2002) studied the effects of feed rate, drum, type of drum and drum speed on sunflower threshing. Sudajan et al. (2003) investigated power requirements and performance factors of a sunflower thresher. Sudajan et al. (2005) studied the effect of a number of drum characteristics on rasp-bar drum performance for threshing sunflowers.

Sudajan et al. (2005) constructed and built a sunflower threshing unit to examine the influence of machine and crop factors and to gather enough data for the best feasible thresher design.

Lofty (2009) created a system for separating sunflower seeds that uses both centrifugal and gravitational force. Ismail and Elhenaway (2009) improved the machine characteristics of a pedal-operated friction drum sunflower threshing machine. Threshing machine performance is measured in terms of threshing efficiency, cleaning efficiency, visible damage seed, threshing capacity, and specific energy consumption.

Mirzabe et al. (2016) investigated the influence of air-jet impingement parameters on sunflower seed removal from heads under static settings. Azharuddin et al. (2016) created and built a machine to separate the seeds from the head of a sunflower. They mentioned that the machine's essential components include Blades, Shaft, Pulley, Disk plates, Blower, Hopper, Tray, Sieves, Motor, V-Belt, and Pillow Block Bearings.

Goel et al. (2009) investigated the influence of moisture content (13.84, 11.23, 10.50, and 8.38% db.) in sunflower (MSFH-17 variety) with average head diameters of (16-19 cm) on the performance of two types of sunflower threshers, namely (wire mesh type and perforated GI sheet type). They discovered an inverse association between thresher capacity and threshing efficiency and sunflower moisture content, as well as a direct relationship between mechanical damage % and sunflower moisture content. The increase in threshing efficiency and thresher capacity as moisture content decreases is due to the ease of removing seeds from sunflower heads at low moisture contents, and the decrease in mechanically-injured seeds percentage could be due to short seed exposure time to the threshing cylinder.

Anil and colleagues (1998) designed and tested a sunflower threshing device. They investigated the impact of moisture content, feed rate, drum rotating speed, and concave clearance on threshing unit performance. The results showed that drum rotating speed, concave clearance, and moisture content all had a favorable effect on seed damage %, whereas feed rate dropped. The unit productivity rose as the rotating speed and feed rate of the drum increased. The findings showed that the ideal operating conditions were reached at a feeding rate of 180 kg/h, a drum rotational speed of 500 rpm, and a moisture content of 9%-13%. The increase in drum rotating speed causes an increase in both machine productivity and seed damage percentage of impact force which led to broken seeds. While the seed damage percentage decreased with the increase of both moisture content and concave clearance due to the increase of seeds ductility and threshing area.

Abdollahpour and Ghassemzadeh (2019) investigated the influence of drum speed, feed rate, and moisture content on threshing efficiency, separation efficiency, percentage of seed losses, and damaged seed for a sunflower produced thresher.

Sudajan, Salokhe, and Triratanasirichai (2002) investigated the influence of sunflower heads feeding rate and threshing drum peripheral speed with different drum types on the percentage of seed damage. The acquired data revealed that the seed damage %

increased with the increase in drum speed and feeding rate for all drum types, with the greater degree of impact exposed to the sunflower heads with the rise in drum speed.

Sudajan, Salokhe, and Chusilp (2005) investigated a rasp bar sunflower thresher's output capacity, power requirements, threshing efficiency, seed losses, and specific energy at various drum rotating speeds (650, 700, 750, 800, and 850 rpm) and feeding rates (2000, 2500, and 3000 kg/h) from sunflower heads. According to the findings, the ideal working conditions for reducing seed loss could be obtained at drum speeds ranging from 700 to 800 rpm (10.99 to 11.73 m/s), feeding rates ranging from 2000 to 3000 kg/h, concave clearance of 35 mm, and sieve meshing of 11*60.The feed rate, roller speed, concave clearance, and thresher all have a direct influence on how much sunflower is threshed, according to Ali et al. (2020).The method of operation of the threshing equipment determines the success of shattering the seed-head junction (El-Morsy et al., 2019).

Little published literature is available on edible sunflower thresher machines and their performance, power consumption and efficiency in Zimbabwe. Therefore, this study will conduct the design and fabrication of sunflower head thresher machine

3. CHAPTER 3:DESIGN SOLUTION, ANALYSIS AND SYNTHESIS

3.1. CONCEPT GENERATION

Initially, the following procedures were considered for thresher design and fabrication.

- An evaluation of the currently available sunflower seed harvesting machines, also known as sunflower threshing machines, in terms of cost and performance.
- A qualitative examination of the materials and components appropriate for the production of the threshing machine, as well as their market availability.
- Auto-CAD modeling software was used to create a model of the sunflower threshing machine.
- Fabrication of the threshing machine based on design and modeling specifications.
- Testing the machine's output and functioning under load and no load situations.

Calculations were performed to calculate the dimensions and other mechanical parameters such as stress, strain, and stiffness.

The engine-powered sunflower thresher will be designed with a variety of variables in mind, Feed rate, power required, shaft speed and other design characteristics will be taken into account. The engine, beaters, sieve, pulleys and belts, and bearings are the essential components of the sunflower thresher. The sieve separates the grains from the plucked sunflower head. Auto CAD drawing was used to create an orthographic projection. The sunflower thresher will be built according to the drawing using locally accessible materials. The dimensions will be lowered in order to minimize the price while maintaining the capacity. The space between the beaters and the sieve will be lowered.

Little structures go a long way in facilitating effective product development practices, and this method will be viewed by those who employ it not as a rigid process but rather as a starting point for continuous improvement and refinement. The five steps which are:

1. Gathering raw data
2. Interpret the raw data in terms of customer needs.

3. Establish the relative importance of the needs.
4. Reflect on the result and the process.

3.2. GATHERING OF DATA

During the project analysis information of the customer need and raw data was gathered by reviewing different international and national journal papers, observing the traditional method in use and the existing technical problems of a solution.

3.3. INTERPRETATION OF DATA

The project analysis reviews that smallholder farmers urgently need access to automation to boost both their labor and land production. Mechanization is necessary for small-scale farmers to boost output and enhance living conditions along the value chain of agricultural production as well as in primary agricultural production. Simple equipment that can be handled manually and needs little maintenance and repair is needed for small-scale farmers, who typically have less than 5 hectares of land. The current literature shows that efforts to mechanize sunflower threshing machine has been exercised since the beginning farm mechanization. The previous machines use the similar mechanism of rollers squeezing sunflower head. Efforts to conserve energy and provide clean and portable solution to the farming industries need to be monitored.

3.4. ESTABLISHING OF THE IMPORTANCE OF NEED

The development of a low cost threshing machine is there to increase land productivity by facilitating timeliness and quality of harvested seed. It also supports opportunities that relieve the burden of labor shortages and enable households to better withstand shocks. It increases the quality of seed produced since there will less damages.

3.5. DESIGN CONSIDERATION OF SUNFLOWER THRESHER

The following considerations will be addressed when creating the thresher:

- Machine capable of successfully threshing and cleaning.
- Machine that can be built using locally accessible resources.
- Machine with the least amount of loss due to threshing and separation.
- Machine capable of increasing the speed of threshing.
- Low cost and portable machine.

3.6. BASIC SELECTION CRITERIA OF MATERIALS

The parts of machine are chosen that they may last for longer period before any sign of damage may be noticed.

Strength

Before any construction work could be done, the behaviour of stress action on the machine parts will depend on the load that machine is to carry and this is very essential.

Cohesiveness

Machine parts will be prevented from moisture as to prevent corrosion of the machine. This is achieved by painting the machine parts.

Availability

This is one of the most important factors to be considered when selecting materials. The materials will be readily available at low cost to ease the construction work and maintenance. In respect of the above fact, the materials used in the production of this machine were sourced for locally in a

nearby market area.
Some criteria to consider are
- Durability
- Ease of handling
- Ease of maintenance
- Ease of manufacture
- Ease of mountable

- ✧ Ease of use
- ✧ Few disturbing factors
- ✧ Low complexity of components
- ✧ Low cost
- ✧ Low susceptibility of vibration
- ✧ Low wear of moving parts
- ✧ Many standards and bought out parts
- ✧ Portability
- ✧ Simple assembly

3.7. CONCEPTUAL DESIGN

Definition of Conceptual Design

The feasibility study of the sunflower threshing machine is the process by which its design is initiated, carried to the point of creating several possible solutions for the thresher, and narrowed down to a single best concept, this is conceptual design phase. The goal in this phase is to validate the need, produce several possible solutions, and evaluate the solutions based on physical reliability, economic, and financial feasibility.

Function tells what the product must do where as its form or structure, conveys how the product will do it. Decomposing complex problems into simpler sub-problems is essential because many design challenges are too complex to solve as a single problem. Consequently, decomposing the existing threshing machines into simpler sub problems to tackle the problems one by one the result show that:

- ✧ High operating cost
- ✧ High maintenance required
- ✧ Need efforts to operate
- ✧ huge

Conducting internal searches to find a new solution to satisfy the overall or sub-function. Finally, come up with the following solution.

- ✧ less effort to operate and low maintenance machine
- ✧ Lightweight and affordable

3.8. MACHINE DESCRIPTION

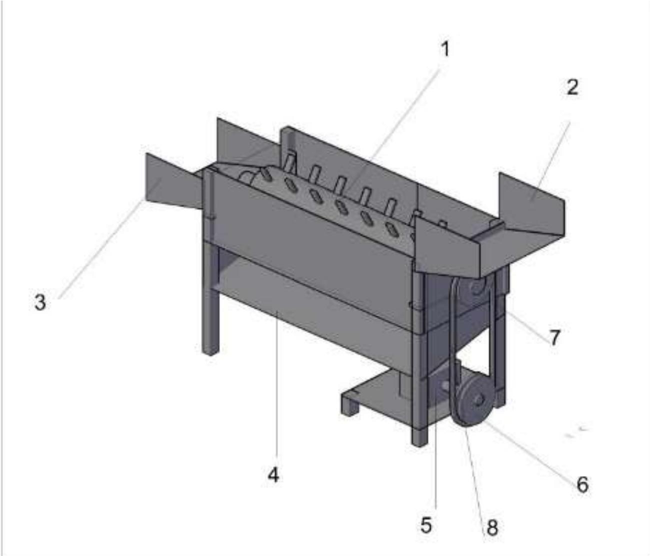
The thresher consists mainly of threshing drum, shaft, screen, threshing spikes like beater, feed tray, belt and pulley, bearing, outlet tray and petrol engine. The threshing drum carried the teeth and by welds and it will be fixed to the shaft by a flange. The drum will be enclosed in a top cover and a bottom screen and finally suspended on two sealed ball bearings bolted onto the rigid frame of the thresher. The top cover which had feed tray, outlet tray will be attached to the rigid structural frame of the thresher with welding. The screen will be firmly attached to the rigid structural frame by welds. An engine and belt drive will be used to connect the shaft carrying the threshing drum to the drive shaft through pulleys. The engine provided the primary motion that transmits torque through the pulleys. A pulley is attached to the shaft at one of the ends. Member frame is made from stainless steel of 2mm thickness while the support is made from angle iron of 30 x 30 x 5mm dimension. Stainless steel was considered for construction of parts since the machine is to be used to process edible crop.

3.9. MACHINE OPERATION

Harvested sunflower with the heads is introduced into the thresher through the feed tray to threshing drum. Impact, stripping and rubbing effects on the sunflower heads against the plates and the screen brings about removal and separation of the grains from the head. The spiral nature of the tooth wraps the whole head on the drum and moves along the length of the threshing drum in the forward direction until the materials under process reach the draw chute and then expelled at the peripheral of the machine. Seed is collected at the outlet provided after it has been removed from the heads.

3.10. PROCEDURE FOR SUNFLOWER THRESHING

Harvested crop is loaded onto the tray and fed into the opening between the cylinder and the screen at one end of the machine. The teeth on the threshing cylinder hit the material separating the seed from the head, and at the same time accelerating them around the cylinder. Majority of the seed will be threshed during initial impact but further threshing is performed as the material moves axially until the head is discharged at the opposite end. Threshed seed, including impurities such as leaves and short pieces of straw, pass through the openings in the screen.



2. inlet tray
3. outlet tray
4. seed tray
5.engine
6.Engine pulley
6. engine pulley
7. rotor pulley
8. belt

3.11. DESIGN CALCULATIONS.

3.11.1. The Main Frame

The main frame supports the entire weight of the machine. The total weights carried by the main frame are:

- weight of the threshing chamber;
- the collector and pot; and
- the bearings and pulleys.

The two design factors considered in determining the material required for the frame
are weight and strength. In this work, angle steel bar of 30mm by 30mm and 5mm thickness will be used to give the required rigidity.
Dimension = 700m $\times$ 380m $\times$ 1000mm

3.11.2. Inlet tray (hopper)

Inlet tray design is founded upon a common criterion for it to function. The tray will be designed to be a frustum, trapezoidal in shape and has the following dimensions that were chosen based on proportionality and aesthetics. The base part is of 30cm by 35.5 cm while the smaller part is also 6cm height with other side height of 10cm Elevation of 30^0 to the vertical. The volumetric and gravimetric capacities of the tray will be determined. The volumetric capacity of the inlet tray

Volume= (1/2 x b x h)- (A x h)
= (1/2 x0.355 x 0.3 x0.06)- ($0.1065m^2$ x 0.01)
=$2.13 \times 10^{-3}m^3$

The capacity of the tray is related to the volumetric capacity of the tray,
Mass=ρV
Where ρ of sunflower is $620kg/m^3$
Mass=620x$2.13 \times 10^{-3}m^3$
=1.32kg

3.11.3. Design of perforated screen/ sieve

Purpose of the screen is to act as a separator between the threshed sunflower seed and the sunflower heads. Screen plate with perforated oblong holes of this work. This will allow threshed sunflower seeds to escape into collector pot.
Sunflower seed size (pioneer seed) = diameter (100mm-300mm), Height (40-48mm)

Thickness(4-6mm) therefore a sieve size of 300mm sieve holes' diameter will be used.
Total area of sieve:
A=L x w
=0.7x 0.38
A=0.266m^2

3.11.4. Design of threshing cylinder

The width of the threshing machine is 380mm.since the width of sunflower heads is known. According to the survey I made the thickness of the sunflower head is 2cm -4cm. Assuming the clearance of the cylinder from the wall will be 3cm then diameter of rotation will be 320m

3.11.5. Number tooth on thresher bar

Length of tooth=70mm
Width of tooth=25mm
Spacing of tooth along the cylinder=30mm
Length of thresher bar 700mm
There are 14 tooth in a row x 4 rows on the cylinder= 56

3.11.6. Volume of threshing cylinder

$V=\pi r^2/4$ x length of thresher
The cylinder is hollow therefore the outer volume -inner volume
$V_{total}= V_{outer}-V_{inside}$
$= [\pi\ (0.08)^2/4 \times 0.7]- [\pi\ (0.075)^2/4 \times 0.7]$
$=5.32 \times 10^{-3} m^3$
Volume of tooth= 0.07 x 0.05 x 0.025
$=8.75 \times 10^{-5} m^3$
Total volume = $(8.75 \times 10^{-5} \times 56) + 8.75 \times 10^{-3} m^3$
$=5.32 \times 10^{-3} m^3$

3.11.7. Input power measurement

The input power measurement can be determined from the name plate information of the prime mover used to power the machine. The rated power output is 5hp/4000rpm

3.11.8. Power required to thresh sunflower

According to El-Sheikha, M.A. et al (2007) the speed of the thresher bar required to effectively thresh sunflower is 850rpm to 1200rpm assume 10% (db.) moisture content therefore the angular velocity and power required can be calculated basing on the assumption.

Determination of Angular Velocity of the thresher bar required, ω

The angular velocity, *ω*, is given by:
$\omega = 2\pi N/60$,
where:
N = speed of the thresher in p.m.
$N= 2\pi 850/60$
=89rad/s

Determination of Power Delivered by gasoline engine along the Length of Threshing Bars

From the available engine rating on the market a 5hp can suit best for the prototype design which has a rotational speed of 4000rpm
The torque, $T = P/\omega$
$\omega = 2\pi N/60$

$=2\pi\ (4000)/60$
$=418.8 rad/s$
Power= $5hp \times 0.746$
$=3.73$ KW
$T=3730/418,8$
8.9N.m

Torque delivered to the thresher bar by the engine
$N_1T_1=N_2T_2$
$T_2=(4000\times 8.9N.m)/850$
= 41.9N.m

Force Required to Thresh sunflower along the Length of the Threshing Bars
T=F × r
$F=47.5\times 0.16$
=7.6N

The force is due to the centripetal force of the thresher bar. The threshing bars, which are attached to the shaft contained in the threshing chamber, rotate with the shaft, giving rise to centripetal force:

$F= m\,\omega^2 r$,
where:
F = centripetal force;
m = mass of threshing bars;
w = angular velocity;
r = radius of the arm of the threshing bar.

Power required by the thresher bar
$P=\omega\ T$
$= 78.5 \times 47.5$
=3730W or 3.73KW

Pulley sizes

$N_1D_1 = N_2D_2$, or $N_1/N_2 = D_2/D_1$
Where
N_1= Angular speed of the engine (driver)
N_2=Angular speed of the engine thresher drum (driven)
D_1=Pulley diameter of driver (Engine)
D_2=Pulley diameter of driven (thresher drum)
$4000/850=D_2/75$
=352mm

Centre Distance of Belt

The maximum center distance of belt in use depends on the size of the two pulleys and is given as: $X_{max} = 2(D + d)$.

=2(352+75)

=855mm

Length of Belt

Belt length can be calculated if the diameters of both the bigger pulley and the smaller pulley and the belt Centre distance are known:
L = Centre distance radius of bigger pulley+ radius of smaller pulley
=600+150+37.5
=787.5mm

Power Transmitted by Belt

According to Hannah and Stephens (1970), the power transmitted by belt is given
by $P = (T1 - T2)\ V.$
But $V = (\pi DN)/60.$
where P are the power in (watt),
T1 are the belt tension in tight side,
T2 are the belt tension in loose side,
V are the belt speed (m/s)
smaller pulley diameter is D (m)
N are the belt speed (m/s)
Also, $T1/T2$ = Expo ($\mu\theta$ cosec β),
where:
β = groove semi-angle;
θ = angle of lap;
α = angle of contact at the smaller pulley;
μ = coefficient of friction.
The coefficient of friction for rubber belt on cast iron or steel operating on dry surface is $\mu = 0.3$ (Ogunwede 2003). The angle of lap for open V-belt drive is given as:
$\theta = (180 - 2\alpha) \times \pi/180$ rad. Also,
$\sin \alpha = (r2 - r1)/x$,
where:
x = distance between pulleys;
$r1$ = radius of smaller pulley;
$r2$ = radius of bigger pulley.
V=15.7

$3730=(T_1-T_2)15.7$………………………………………. (1)
$T1/T2$ = Expo ($\mu\theta$ cosec β)
Sin $\alpha = (352-75)/712.5$
$\alpha = (352.4-75)/712.5$
Sin $\alpha = 0.389$
$\alpha = 22.9^0$
$\theta = (180 - 2\alpha) \times \pi/180$

$\theta = (180 - 2(22.9)) \times \pi/180$

$=2.3^0$

$T1 / T2 = \text{Expo } (0.3 \times 2.2^0 \text{ cosec } 38^0)$

$T1 / T2 = 2.92$……………………………………………… (2)

$T_1 = 361.3N$

$T_2 = 123.7N$

Bearing selection and location

The bearing is selected based on the load carrying capacity, life expectancy, and reliability. The threshing force is either by impact loading or shearing force.

3.12. Design Calculation and Results

- The average cylinder speed for high and efficient threshing output was estimated at 850 rpm.
- volume of thresher bar, $V = 3.75 \times 10^{-5} m^3$
- Overall length of thresher frame L=0.7m; Height H = 1m; width W=0.38m
- Angular velocity of thresher bar ω = 78.5rad/sec
- Maximum force available along the threshing arm, F_{max}= 7.6N
- Threshing torque = 47.5$N.m$
- Power delivered by shaft along the length of threshing bars = 3.73KW;
- Prime mover (engine) = 5Hp.
- Speed of driver pulley, N_1 = 4000 r.p.m;
- Speed of driven pulley, N_2 = 850 r.p.m;
- Diameter of driver pulley, D_1 = 75mm;
- Diameter of driven pulley, D_2 = 300mm;
- Maximum center distance of belt, X_{max} = 787.5mm;

Length of belt, L = 1187.5mm

3.13. MATERIAL SELECTION

Table 1: Various component parts and materials used for construction

Machine component	Criteria for material selection	Material selected	dimension	Remarks
Feeding tray	It has to be strong and able to acquire more materials	Stainless steel of 2mm thickness	300mm x380mm x100mm	It does not twist and has ability to occupy more materials(Constructed)
Top cover	It must have ability to withstand spiral vibration and impact force reactions	Stainless steel of 2mm thickness	700mm x380mm	Durable (fabricated)
Threshing drum	It must have ability to withstand spiral vibration and impact	Stainless Steel plate of 2mm thickness is folded into drum.	700mm long and ф160mm	

	force reactions			
Tooth/Spike	Must be rigid and have strong impact force on materials to be threshed.	Stainless steel Flat bars and it is 5mm in thickness.	70mm height x 25mm width	It has strong and blunt edges for threshing (machined)

Screen/ Mesh/ sieve	Ability for ease of passage of materials under process	Stainless steel of 3mm thickness	Φ 300mm	Available (bought ready-made)
Belt	Must be strong and not flexible	Leather	A64	Stable (bought ready-made)
Pulley	Ability to have a good wear property	Cast iron block	Φ300mm Φ75mm	Bought ready-made
Bearing	Must be durable and strong and have ability to withstand load of the shaft for balancing.	Mild steel	Φ 20mm	Bought ready-made
Frame	Must be able to support the weight of the entire assembly	Angle iron of 6mm thickness	700mm x380mm x 900mm	Constructed
Bolts and nuts	Must be hard and durable	Alloy steel	They are of various sizes	Bought ready made
Prime mover	Must be a medium or high speed	Petrol engine	5hp	Bought ready made

3.12. DRAWINGS OF A WHOLE ASSEMPLY

Left Side view

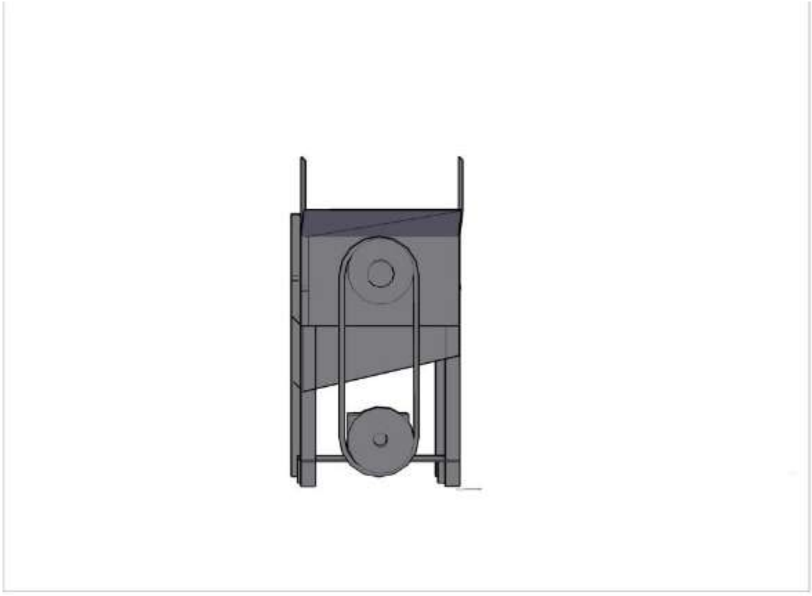


fig 3.1

Right Side-view

Fig 3.2

Top view

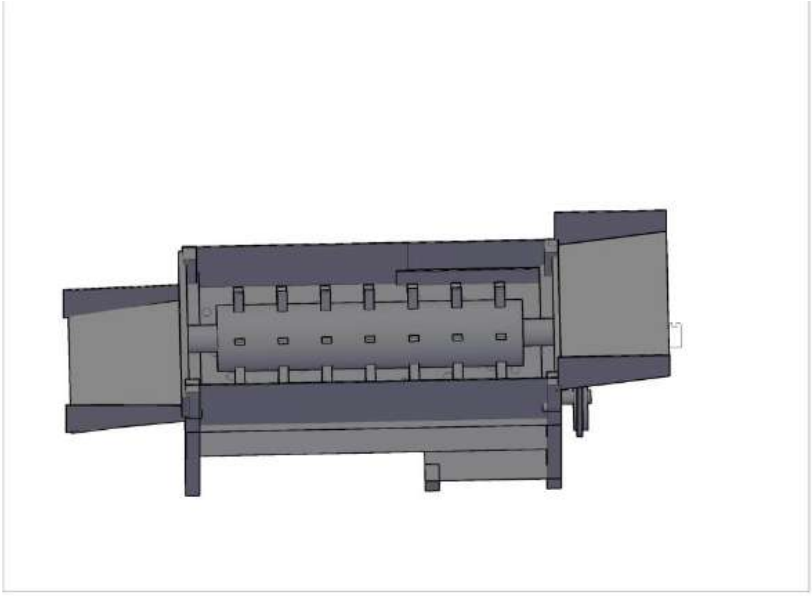


Fig 3.3

Top-side view elevation

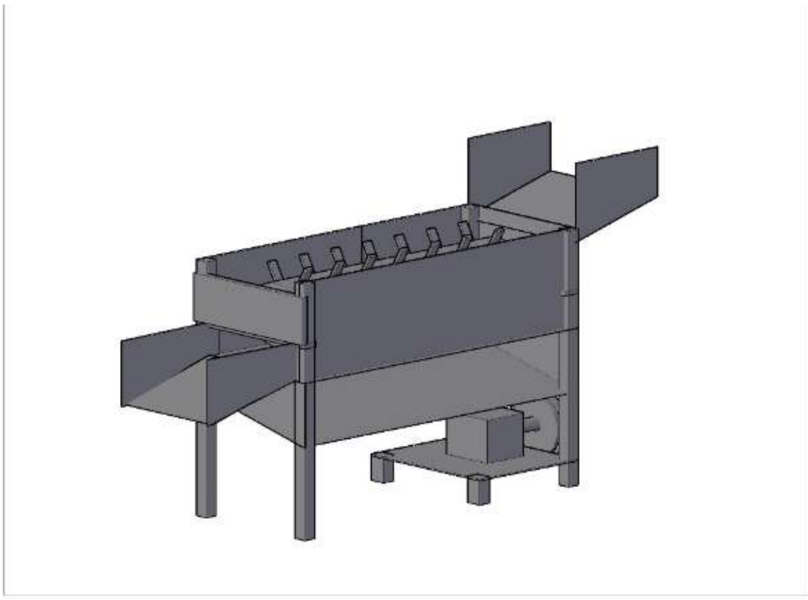


Fig 3.4

Front view

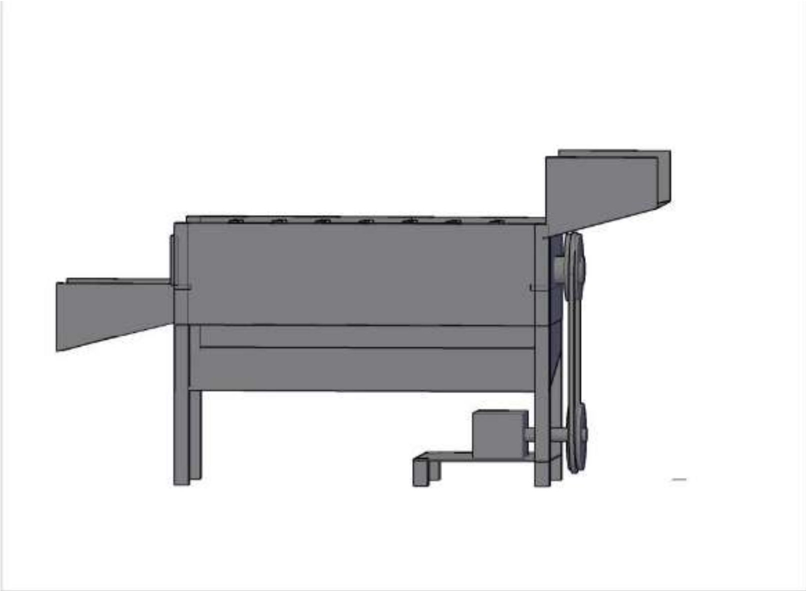


Fig 3.5

Top elevated view

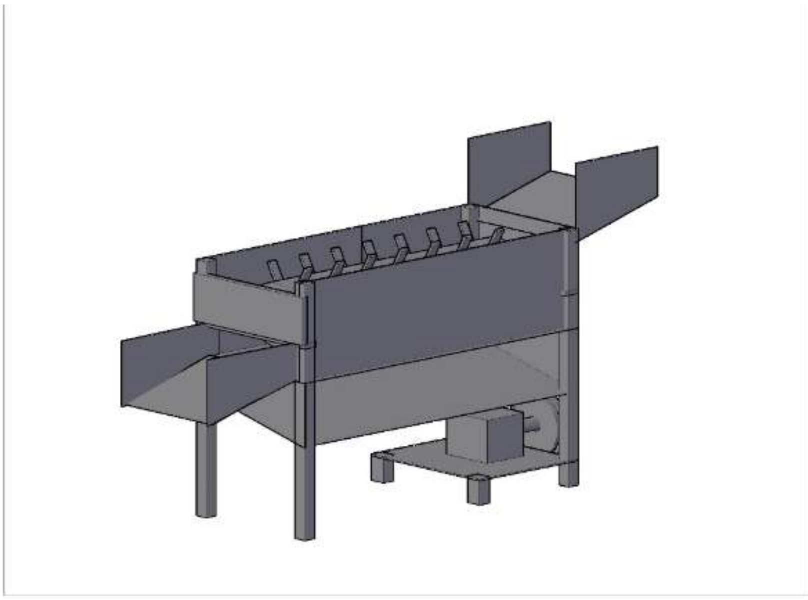


Fig 3.6

3.14. FABRICATION OF A SUNFLOWER THRESHING MACHINE

The manufacturing process used in the fabrication of sunflower thresher machines is such that the total cost of fabrication is low and also one that can make use of the available materials. The manufacturing process involved in this work includes the joining of metal parts by welding, cutting using grinder and using lathe machine. Each component of the machine is fabricated separately before they are joined or welded together.

Fabrication of Frame

Frame is the major support structure of the machine it withstands the load acting on the machine. All the components fabricated are assembled over the frame. The frame is made by using standard sections available i.e. the angle plates which are 30mm×30mm, 5mm thick and the angle is 90˚ between the adjacent plates. The angle plates are cut to the requirement and welded together for housing the machine components.

Fabrication of Threshing Rotor

It is the most important part of the machine used to beat and thresh the sunflower. Here, we are using peg tooth with an open threshing rotor. 4 sets each of 12 teeth are welded on the each of the 4 strips which are placed at 90˚ around the circular plate. The length of each blade is 44mm and its thickness is 5mm. The blades are placed at a distance of 64mm along the length.

Fabrication of Thresher box

The threshing rotor needs to be covered with a thresher box so as to thresh flowers within in this box. The threshing box cover houses the rotor with a clearance of 35mm. The thresher box comprises of the thresher rotor and the screen that separate the seed and seed and the head. The perforated screen will be welded inside the thresher box. Right end of the box is welded with an opening to allow flow of threshed waste.
Rotor is fabricated directly on to the thresher box. The box is of 700mm length and 380mm in width.

Power drive unit arrangement of Engine, Pulley, V-belt

The Power drive unit of the machine consists of 5Hp gasoline engine. The pulleys are designed to transmit power to the threshing rotor. The pulleys used are V-belt pulleys with a sheave present in them to accommodate V-belt. The rotor is welded with the bearings to allow free movement of the rotor.

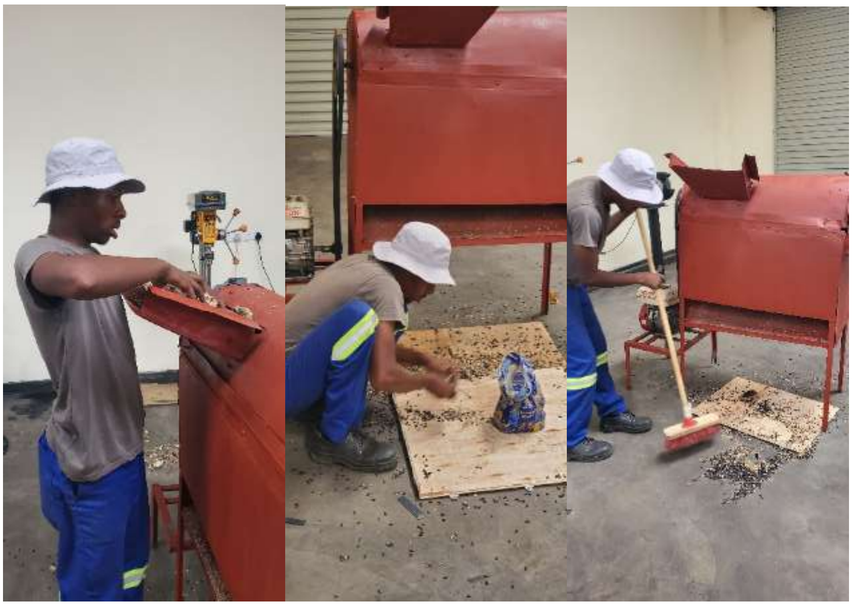
Fabrication of Screen

The screen's purpose is to function as a divider between the threshed seed and the head. Screens are made of woven wire or a plate with circular perforations. For this project, a woven wire will have used. This allows the threshed seed to escape into the collection

container.

Final machine

All the components are fabricated and assembled together on the frame in their designed positions. The frame houses all the components like engine, Bearings, Pulleys, Thresher box, Threshing Rotor, Collector sheet fabrication. The collector sheet work and Thresher box are welded to the frame. Finally, the machine is painted to prevent corrosion.



4. CHAPTER 4: RESULTS AND EVALUATION

4.1. THE RESULTS

sunflower physical properties

The average physical properties and characteristics of the sunflower plants, heads and seeds are summarized in the Tables. Some physical properties of sunflower plants, heads and seeds of variety vidok.

Plant head	169.86mm
Head diameter	214mm
Stem diameter	27mm
Seed diameter	100-300mm
Seed length	40-48mm
Seed thickness	4-6mm
Seed moisture	10%db

Threshing information

Total seed mass	501.6g
Mass of damaged seed	32 g
Mass of unthreshed seed	71 g
Mass of threshed seed	398,6 g
Mass of impurities	13g

4.2. PERFOMANCE TEST BASED ON:

4.2.1. THRESHING EFFICIENCY.

The threshing efficiency was calculated from the following relation

$$Eth = \frac{Ms - Mth}{Ms} \times 100$$

where:
Eth = threshing efficiency,
Mth =mass of un-threshed seed, kg
Ms = total seed mass, kg
The mass of the sunflower heads before threshing and after threshing was measured using a balance. The following results of the where obtained:

Therefore, the threshing efficiency of the machine

$$=\frac{501.6 - 71}{501.6} \times 100$$

=85.8%

4.2.2. CLEANING EFFICIENCY.

To determine the cleaning efficiency, the following relationship was used:

$$Eff = \frac{Ms - Ma}{Ms} \times 100$$

E_{ff}= cleaning efficiency, %

Ma = mass of impurities, kg

Ms = total seed mass, kg

Since the total mass of the seed has been recorded and the mass of the impurities therefore the cleaning efficiency can be calculated

$$= \frac{501.6 - 13}{501.6} \times 100$$

=97.4%

4.2.3. SEED DAMAGE.

The mass of visible and invisible damage seeds was used to calculate seed damage percentage was as follow:

$$\text{Seed damage} = \frac{\text{mass of visible and invisible damaged seed}}{\text{total weight of seed}}$$

$$= \frac{32}{501.6} \times 100$$

=6.4%

4.3. EVALUATION

4.3.1. THRESHING EFFICIENCY.

a. Effect of feeding rate.

The obtained results show the maximum threshing efficiency was 85.8% obtained when using threshing machine at feeding rate of 1.32 kg/min. with moisture contents of 10% of sunflower heads. On the other hand, increasing feeding rate from 1.32 to 2.5kg/min. reduces threshing efficiency for threshing machines

b. Effect of threshing drum speed.

It could be noticed that the lowest values of threshing efficiency were obtained at low drum speed, however the highest values of threshing efficiency were obtained at higher speed. As the drum speed increased the un-threshed seeds decreased. These results may be due to increasing the impact action of the threshing drum on the sunflower heads which is directly proportional with drum speed. Increasing the impact action due to increasing drum speed increased the kinetic energy of the threshing material which differ widely from seeds to sunflower heads trashes, consequently the seeds will be quicker and run away from the trashes. Therefore, the separating efficiency will be increased and increased the threshing efficiency. The results also cleared that at feeding rate of 2.5kg/min, increasing the drum speed increased threshing efficiency from 73.1 to 85.8%.

Effect of moisture content

It shows the maximum value of threshing efficiency of 85.8% was obtained at the lowest head moisture content (10 %db.) at drum speed of 850rpm. The main reason for these results could be explained as, by reducing moisture content of sunflower heads increased separation efficiency of seeds from heads consequently increase threshing efficiency.

4.3.2. CLEANING EFFICIENCY.

a. Effect of feeding rate.

The results show the increasing feeding rate from 1.32 to 2.5kg/min. the cleaning efficiency was decreased by 1.95% for sunflower heads. This is true, because the machine having sieves which greatly increase cleaning efficiency. The maximum cleaning efficiency of 97% was obtained when using machine at feeding rate of 1.32 kg/min under 10% heads moisture content.

b. Effect of threshing drum speed.

The results illustrate that the highest values of cleaning efficiency were obtained at drum speed of about 850 rpm at different feeding rate. The high drum speed increased the velocity of cleaning air results in higher capability of air to carry the foreign material and residual of sunflower heads from seeds consequently increased cleaning efficiency.

c. Effect of moisture content

The observed data show the reducing heads moisture content from 14% to 10 % increased the cleaning efficiency. The maximum values of cleaning efficiency of about 97% were obtained for threshing machine at the lowest head moisture content of about 10 % under drum speed of about 850rpm.

4.3.3. TOTAL SEED LOSSES

a. **Effect of feeding rate**

The maximum values of total seed losses percentage of 6.4% was obtained when the threshing machine at feeding rate of 1.32kg/min. On the other hands, increasing feeding rate from 1.32 to 2.5kg/min increased the total seed losses by12.07% sunflower heads moisture content.

b. **Effect of drum speed.**

The lowest values of the total seed losses were obtained at lower speed. However, the highest values of the total seed losses were obtained at high speed at different feeding rates. The results also cleared that at feeding rate of 1.32kg/min., increasing threshing drum speed decreased the total seed losses from 6.4% to 4.23 % However by increasing drum speed increased the total seed losses from 6.4% to 7.36 %

c. **Effect of moisture content**

The results indicate that by increasing the moisture content of sunflower heads increased the total seed losses at different drum speed. The results may be due to the increase of the grain moisture content of sunflower heads, thus the grains were not easily threshed and gave more total seed losses. The maximum values of total seed losses were obtained for the machine at the lowest head moisture content of about (10%) at drum speed of 850 rpm.

4.3.4. SEED DAMAGE

a. **Effect of feeding rate.**

Increasing feeding rate from 1.32 to 2.5kg/min. decreased the seed damage sunflower heads moisture content 10%. While, the highest level of feeding rate gave the lowest values of seed damage. The maximum seed damage percentage of 6.4% occurred when using machine at feeding rate of 1.32 kg/min under head moisture contents of 10%.

b. **Effect of threshing drum speed.**

The results Indicate that by increasing drum speed gave the lowest. Also, it could be noticed that the lowest values of seed damage were obtained at 850rpm however the highest values of seed damage were obtained when the speed was increased at different feeding rate.

c. **Effect of moisture content**

Increasing the moisture content of sunflower heads decreased the seed damage for the threshing machines at different drum speeds. The results may be due to the increase of grain moisture content which increase the elasticity of sunflower heads and seeds. The maximum values of seed damage of 6.4 % were obtained at the lowest level of head moisture content (10 %) at drum speed of about 850 rpm

4.4. POWER CONSUMPTION AND ENERGY REQUIREMENT.

Increasing drum speed increased the power consumption at feeding rate of 1.32 kg/min. and sunflower heads moisture content of 10%. Looking the results of power consumption and energy requirement it could be cleared that increasing feeding rate from 1.32 to 2.5 kg/min. tends to increase the power consumption.

4.5. COST-BENEFIT ANALYSIS

This is the approximation of the cost of a program, project, or operation. The cost estimate is the product of the cost estimating process. The cost estimate has a single total value and may have identifiable component values. The total cost of the tool includes the Raw Material Cost, Standard Material Cost, Engine Repairing Cost Machining Cost, Transportation Cost.

4.6. COST OF THRESHER

Bill of quantities

Part	**Quantity**	**Unit prize**	**Total cost**
Engine	1	$45	$45.00
Fuel	3litre	$1.20	$2.40
Engine oil	1litre	$1.00	$1.00
Pulley	300mm×1	$22.00	$22.00
Pulley	75mm×1	$15.00	$15.00
Bearings	20mm×2	$5.00	$10.00
Belt	A64×1	$6.00	$6.00
Shaft machining			$35.00
Metal sheets	3m×2m	$8.00/m^2	$48.00
Angle iron bars	6m×2	$7.00	$14.00
Sieve	1m×1m	$10.00	$10.00
Veranda bolts and nuts	50	$0.10	$5.00
Flat bars	6m×1m	$6.00	$6.00
Round tube	1m	$4.00	$4.00
Electric rods	1kg	$5.00	$5.00
Paint	1ltr	$5.00	$5.00
Labour			$20.00
Transport			$12.00
VAT 14.5%			$38.48
Total cost			**$303.48**

The total manufacturing cost of the thresher is 303.48 assuming VAT is 14.5%

4.7. SELLING PRICE OF THE THRESHER

the selling price of the machine can be calculated as follows.

The profit of the manufacturer = 20% of the total manufacturing costs
Adding 20% of the profit to the TMC

∴ Selling price = TMC + Value added Tax + Profit Margin
= 303.48+20%profit (60.698)
= \$364.176

4.8. COMPARISON OF THRESHING COST BY TRADITIONAL METHOD AND THRESHER

Cost of operating threshing machine

$$\text{Fuel consumption} = \frac{\text{fuel consumption}}{\text{time of consumption}}$$

Cost of threshing manually

Amount paid to the labor for 8 hours in most farms in Zimbabwe is \$5usd.
Total number of labor required in general to thresh 1 ton of sunflower is 10
cost = 5×10
=\$50

5. CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1. CONCLUSION

1. **THRESHING EFFICIENCY.**

   The maximum threshing efficiencies of 85.9% was obtained when using at feeding rate of 1.32kg/min. under sunflower heads moisture contents of 10%.

2. **CLEANING EFFICIENCY.**

   The maximum cleaning efficiency of 97% was obtained at feeding rate of about 1.32 kg/min. under heads moisture content 10%

3. **TOTAL SEED LOSSES**

   The maximum values of total seed losses percentage of about 6.4 was obtained when using threshing machine at feeding rate of 2.5 kg/min under heads moisture contents 10%

4. **SEED DAMAGE.**

   The maximum seed damage percentages of about 6.4% was obtained by using threshing machine at feeding rate of 1.32 kg/min. under head moisture contents 10%.

   The fabrication of sunflower threshing machine was successfully completed as per the design specifications. It is easy to handle and operate. This project has been designed to perform the required task taking minimum time and project is economically feasible and it can be further reduced, when produced on large scale. The project is very useful for farmers and works with the threshing efficiency of 85.8%. Seed damage is less and seed loss is almost zero

5.2. RECOMMENDATION

The following are recommended for the future improvement of the thresher:

- To obtain 100% cleaning efficiency of the sunflower seed I recommend the machine need to be accompanied with a fan inside the thresher box to blow the impurities.
- On results it shows that there is significate grain loss in the thresher box this should be minimized by a conical chamber to collect seed to minimize the loss at the outlet chamber.

- The thresher beaters seem to be long which sustain them to high shear and torsional force as a result they end up deforming. There is need to reduce the size of the beaters
- The machine should be strongly reinforced to reduce high movement due to the engine vibration.
- Further studies should be conducted to provide a mechanism that allow the adjustment of the space between the beaters and the sieve.
- Due to electricity power cut in the country and limited time some of the designs on auto CAD drawings where not properly implemented during fabrication. Power cuts affected the proper machining of some part like the shaft therefore affecting the movement of the rotor

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