



**BUSITEMA
UNIVERSITY**
Pursuing Excellence

**FACULTY OF ENGINEERING
DEPARTMENT OF CHEMICAL & PROCESS ENGINEERING
BSc. AGRO-PROCESSING ENGINEERING**

**DESIGN AND CONSTRUCTION OF A MOTORIZED BEAN THRESHER-CUM
WINNOWER**

BY

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ABSTRACT

Common bean (*Phaseolus vulgaris*) is a short season crop with most varieties maturing in a range of 2-4 months from emergence to physiological maturity and it's the most important legume in Uganda followed by ground nuts. Their importance is centered on the quantities of Carbohydrates, proteins, vitamins, fats, folic acid, minerals contained in their cotyledons, making it competing favorably as an energy source with root and tuber crops. They are also non-meat source of iron and relatively inexpensive compared to meat.

26% of the post-harvest losses are due to bean threshing and this is because 46% of farmers still use the traditional methods of threshing and most of them use manual winnowing methods. This results into the production of low-quality beans that fetch low prices, reduces the output, highly tedious, labor intensive and exposes farmers to ill health resulting from inhalation of dust.

Therefore, the aim of this project was to design, construct, test and carry out economic evaluation of bean thresher-cum winnower for medium scale farmers. This would improve their production and productivity of high-quality beans.

The design of the various machine parts was carried out by analysing forces acting on them which led us to selection of proper materials to withstand the forces to avoid failure. Stainless steels of various grades were the main materials recommended to be used because they are food grade, strong and durable. Engineering drawings of the various components were drawn before the various components were constructed and then machine parts fabricated.

A fully functional prototype resulted after all the above operations yielded results of optimum machine performance at a feed rate of 0.06Kg/s with a threshing and cleaning efficiency of 79.9% and 57.8% respectively. Seed damages of 8.3% and machine output of 101kg/hr of bean seeds. However, it was found out that the threshing and cleaning efficiencies decreased with increase in feed rate from 79.9% to 78.6% and 57.8% to 56.5% respectively. Mechanical seed damages also decreased with increase in feeding rate from 8.3 to 7.5%. The cleaning efficiency was low because the testing of the prototype was done using beans of small properties compared to design specifications. This was due to the difficulty to get beans of large sizes (NABE4, K132, NABE3) yet the concave sieve hole diameter was big. This therefore, compromised the blower efficiency because it could allow heavy chaffs to pass through the sieve which the blower can't handle. In

order to maximize the cleaning efficiency of the blower, sieve hole diameter should be reduced and conclusions be drawn appropriately.

The machine has a total cost of **2,536,650 UGX** which includes all the taxes, cost of material, machinery and hired labour to construct the machine plus overhead costs.

DECLARATION

I **MUGABI HENRY** solemnly declare to the best of my knowledge that the piece of this Report is as a result of my research and effort and it has never been submitted or presented to any University, College or any other Institution for an academic award.

MUGABI HENRY

Date: 15/5/2019

Signature: 



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My sincere thanks go to the Almighty God for the strength, health, wisdom, grace, and protection He has given to me all through.

I am very grateful to my beloved family whose dream and prayer has always been to see me reach this far and succeed in my studies and afterwards have a happy ending.

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May the ALMIGHTY GOD Bless you abundantly

LIST OF ABBREVIATIONS

ASTM	-	American Society for Testing and Materials
ASME	-	American Society of Mechanical Engineers
EAC	-	East African Community
ASFC	-	Appalachian Staple Food Collaborative
FAO	-	Food and Agriculture Organization
Ha	-	Hectares
HP	-	Horse Power
MAAF	-	Ministry of Agriculture Animal and Fisheries
Mt	-	Metric tones
MS	-	Mild Steel
NABE	-	Nambale
UEPB	-	Uganda Export Promotion Board
USD	-	United States Dollars
UBOS	-	Uganda Bureau of Statistics
PV	-	Present Value
NPV	-	Net Present Value

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CHAPTER ONE: INTRODUCTION

1.1 Background of the study.

Beans (*Phaseolus vulgaris* L) are some of the most important primary crops especially in developing world where they serve as staple food and cash crops. It's the most important plant for people of Uganda, providing carbohydrates (60-65%), proteins (21-25%), fats (less than 2%), vitamins and minerals (Broughton *et al.*, 2018), (Romero *et al.*, 2013).

In the EAC Region, Uganda is ranked second to Tanzania in the production of common beans (Kilimo Trust, 2012). Although Uganda's bean output has more than doubled, average bean yields in the country have been between 0.6 and 0.8 Mt/Ha even though yields higher than 1.5 Mt/Ha can be realized with improved varieties (Kenneth Waluse Sibiko .A, 2012).

More than half (53%) of the farmers in Uganda grow common beans with the highest production in Western (411,946 Mt) followed by Northern (251,219 Mt), Central (167,276 Mt) and Eastern (98,833Mt) and in terms of districts, its Ntungamo (137,899Mt), Mubende (78,027Mt), Amuru (74,671Mt) followed by Mbale (23,637Mt) (UBOS, 2017).

Due to the growing need in schools, barracks, institutions, hospitals, World Food Program (WFP), in Rwanda, South Sudan, and DR Congo among others where they are mostly exported, bean growing has transformed to be commercial. This puts Uganda among the top-10 producers of common beans in the world with about 1.5 million hectares cultivated (UBOS, 2015).

The post-harvest system of beans in Uganda involves a number of activities and operations; field drying, **threshing**, **winnowing**, farm drying, storage, processing, and quality control. **Threshing** is the removal of the seeds from the rest of the plant. **winnowing** is the removal of extraneous material like chaff from the threshed seeds.

In Uganda, medium -scale farmers (with 4-6ha) still use the traditional methods of threshing beans (Stick beating) and manual winnowing methods. This leads to increased Production of broken seeds due to uncontrolled beating and contaminated bean seeds with soils, sands, stones and metals which lowers their quality. Also manual winnowing is highly tedious, exposes farmers to ill health due to dust inhalation, wastages due to incomplete removal of threshed seeds from the extraneous matter, drudgery (Tibagonzeka et al., 2018).

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