BUSITEMA UNIVERSITY
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# FACULTY OF ENGINEERING

## DEPARTMENT OF AGRICULTURAL MECHANIZATION AND IRRIGATION ENGINEERING

# DESIGN AND CONSTRUCTION OF A MANUALLY OPERATED COFFEE GRADING MACHINE

**BY**

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# ABSTRACT

Uganda's economy is largely agro-based and in an attempt to improve the income base, the developing technology has to meet the needs of the farmers. Coffee is by far one of the most important export crops accounting for 20 – 30 % of the country's foreign exchange earnings; It has provided employment opportunities to several people through coffee related activities. In Uganda, the production level was 4 million 60 kg bags in 1999. The small scale farmers are capable of growing 0.5 to 2.5 acres, under natural Ugandan climatic conditions, and yields between 6- 10 bags per acre of Robusta coffee and 8-13 bags per acre of Arabica coffee.

One of the major challenges in coffee production at smallholder level in Uganda is the lack of appropriate machinery to grade coffee beans by size which saves time, and reduces drudgery during grading. The current traditional method for grading (hand picking) is labour intensive and time consuming, In a bid to improving quality of the beans, small scale farmers have massively responded to grading coffee beans by hand.

The main objective of this project was to design, construct, and test the capacity and efficiency of the proto-type. In achieving the above objective, the researcher has carried out necessary calculations needed in the design, construction and testing the capacity and efficiency of the proto-type. The machine is limited to grade Robusta coffee beans by size. Therefore, the project covered the design, construction and testing.

Using basic engineering principles and some physical properties of coffee beans such as, size, density and weight, the various components of coffee grader were designed, and fabricated. i.e The hopper, Main frame, Grading chambers (Trays), Power mechanism, The sieves perforations were obtained to be 6.5mm and 5.5mm diameter for first and second sieves respectively, A shaft having diameter of 14mm connects the cam to tray 1. The drive was got by hand cranking to shake the grading chambers.

# DEDICATION

This final year project is dedicated to my dear parents, Mr. Alioni Nicholas, Mrs. Aliyo Esther, and Brothers, Apiku Joel, Pario Moses who have helped me financially throughout my studies. Above all, may the Almighty God bless and reward you accordingly.

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Finally all my classmates and friends especially, Ssentongo David, Bwire Denis, Mutungi Shaka Douglas, Matua Samson, Amen Emmanuel, Abiyo Victor, etc. May the Almighty God reward you abundantly.

## DECLARATION

I hereby declare that this final year project report is my own original work and has not been submitted anywhere for an award.

Name OBETI GRISM LAWRENCE. Signature..... Date.....

**Names of Supervisors**

Lead supervisor; PROF. KANG IL YONG. Signature..... Date.....

Co-supervisor; MR. ODONG SAMUEL. Signature..... Date.....

# ACRONYMS

USDA.....United States Development of Agriculture.

UCDA.....Uganda Coffee Development Authority.

C.R.I.....Coffee Research Institute.

NARO.....National Agricultural Research Organization.

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## 1.1 Background

Coffee is one of the most popular beverage crops grown in many parts of the world. Main coffee producing countries include: Mexico, Indonesia, Brazil, Colombia etc. World coffee production in 2006/07 was 123.6 million bags (60 kg bags), (USDA June 2006).
In Africa, coffee is grown in few areas which include; Ethiopia, Kenya, Rwanda, Tanzania, Zimbabwe and Uganda. In Ethiopia, coffee is mostly grown in eastern and southern regions. In eastern Ethiopia, it is grown between 5,000 - 6,000 feet on small peasant plots and farms. They were all cultivated simply and processed by traditional dry method. Ethiopian coffee is characterized by winy and blueberry undertones, with good body and high acid. Southern Ethiopia produces washed coffees with fruity acidity and intense aromas.

Coffee as a commodity has continued to play a leading role in the economy of Uganda, contributing between 20 – 30% of the foreign exchange earnings, despite the vigorous efforts by Government to diversify the economy. Though large scale coffee producers are gradually emerging, the coffee sub-sector is almost entirely dependent on about 500,000 smallholder farmers, 90% of whose average farm size ranges from 0.5 - 2.5 hectares. The coffee industry employs over 3.5 million families through coffee related activities. The policy of the Uganda Government on coffee production since liberalization in 1991 had been and still is to gradually replace the old, diseased coffee trees with new genetically pure and high yielding coffee varieties at a rate of 5% per annum for *Robusta* and 2% per annum for Arabica for 20 years. This was expected to replace all old, unproductive coffee trees and optimize foreign exchange earnings to the country and payments to farmers, (UCDA 2007).

## 1.2 Coffee Processing

Coffee beans are first sorted and cleaned. Dirt, twigs, soil, undesired beans, and other debris are removed by winnowing with a sieve or by placing the harvest in a washing channel and allowing the ripe cherries to sink to the bottom and the rest to float to the top. Once clean, the coffee cherries are placed on a concrete floor and allowed to dry in the sun. They are raked or turned by hand for even drying. Mechanical dryers are used by some processing facilities to speed up the process once the coffee has spent some initial drying time in the

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