



FACULTY OF ENGINEERING
DEPARTMENT OF AGRICULTURAL MECHANISATION AND
IRRIGATION ENGINEERING

PROJECT REPORT
DESIGN AND CONSTRUCTION OF AN IMPROVED OX-DRAWN GROUNDNUT
DIGGER

AKIDING FLORENCEE

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Email: florenceaking123@gmail.com

Phone: +256 (0) 777652527

SUPERVISORS: Dr. Catherine Wandera

Mr. Atochon Samuel

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ABSTRACT

This project report comprises of five chapters; Chapter one presents background to worldwide groundnut production and consumption with specific emphasis on Uganda's progress in groundnut production. The problem considered in this study is presented in the problem statement and the justification, objectives and scope of the study are also presented.

Chapter two discusses the details of the various aspects involved in groundnut production with emphasis on the aspect of harvesting ; different harvesting techniques and the operation of the existing groundnut harvesters are presented

In relation to the objectives of this study, the methods and procedures that were followed in order to come up with the design of an improved ox-drawn groundnut digger, the procedures used to fabricate and test the performance of the prototype are also handled. Capacity of the developed digging machine is 0.22 acres/hr. The machine returns UGX 1.4 for every unit UGX shilling invested in it. The project engineering drawings are also presented.

DECLARATION

I AKIDING FLORENCEE declare that the work in this project report was carried out in accordance with the Regulations of Busitema University. The work is original except where indicated by special reference in the text and no part of the proposal has been submitted to any other university for examination and degree award. Any views expressed in the report are those of the author and in no way represent those of Busitema University.

SIGNED.....

DATE.....

APPROVAL

I hereby do present this project report for approval as supervised for the process for which it's being written.

Sign..... Date.....

Dr.Catherine Wandera

Sign..... Date.....

Mr. Atochon Samuel.

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DEDICATION

I dedicate this project report to my dear parents Mr.Acila Rogers and Mrs.Ocimwa Betty and my brothers and sisters; Enoch, Martin, Simon, Christine, Teddy, Catherine, Everline. Am very proud of you and without you I would not have reached this far. May God bless you abundantly?

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CHAPTER ONE: INTRODUCTION.

1.1 Background

Groundnut (*Arachis hypogea* L.), also known as peanut is a crop of global importance widely grown in the tropics and subtropics, being important to both smallholder and large commercial producers. Total world groundnut production for 2008 was 34.5 million metric tons (USDA), china being the leading producer with 42% of global groundnuts that year.

Groundnut is the second most important legume after beans (*Phaseolus vulgaris* L.) in Uganda (Alliance for a green revolution in Africa, 2014). Uganda produced 140,000 metric tons of groundnuts from 250,000 ha with most of the crop being grown in the eastern and northern part of the country (Kaaya, 2005)

With the costs of animal protein becoming increasingly prohibitive, groundnut is becoming an even more important source of protein. The grains can be used directly for food, or processed for cooking oil products. Groundnut grain has a good market demand. The groundnut oil has several uses but it is mainly used as cooking oil. It is used in many preparations, like soap making, fuel, cosmetics, shaving cream, leather dressings, furniture cream, and lubricants. Whole kernels are used for table purpose by frying, soaking, roasting and boiling and in different types of snacks. Roasted groundnut is the most popular way of eating. Kernels are also used as a spice in vegetables and as sprouts for salad. Groundnut cake; It is a good feed for animals and poultry due to its nutritive value and palatability. Groundnut shell; Groundnut shell has great potential for commercial use. It is used as a fuel, filler in cattle feed, hard particleboard, cork substitute, activated carbon.

Harvesting of groundnut is one of the areas of groundnut production that needs to be addressed due to the drudgery involved when leaves start yellowing and begins to fall down. This shows that the crop is ready for harvesting. At this stage, the pods become reticulate; the seed is separated from the shell of the pod. The plant could be either pulled and dug out and left on the field for two or three days for sun drying (Ademiyuli, 1997).

Manual harvesting is the most common practice in Eastern Uganda done by pulling and use of hoe. However this method is tedious and needs a lot of man power. Harvesting is majorly done by women and children. Mechanized agriculture has been introduced mainly use animal drawn

REFERENCES

- Bhandari v.b. (2007). Design of machine elements, second edition, isbn 0-07-061141-6. Tata mc graw-hill publishing company limited.
- Ademiyuli, y. S. (1997). Performance evaluation of tractor drawn groundnut digger/shaker for agricultural productivity. Ilorin: national agricultural research organisation (ncam).
- Ajit k. Srivastava, c. E. (2006). Engineering principles of agricultural machinery. Asabe.
- Alliance for a green revolution in africa, a. (2014). Establishing the status of post harvest losses and storage for major stable crops in eleven african countries (phase 11). Nairobi, kenya: agra.
- ASAE standards ep291.2. (n.d.). Terminology and definition for soil tool relationship.
- Benard, b. A. (1999).
- Bill a. Stout, c. B. (1999). "cigr handbook of agricultural engineering" ,vol. Lll: plant production. Isbn: american society of agricultural engineers publication.
- D. K. Okello, m. B. (2011). Overview of groundnuts reseach in uganda. University of georgia.
- Dupen, b. (2014). Applied strength of materials for engineering technology (6th ed.). Indiana university - purdue university fort wayne: research & creativity at ipfw.
- Hansen, m. S. (2011). Adoption of improved groundnut seed varieties. National agricultural rrsearch organisation (naro).
- Hearn, e. J. (1997). An introduction to the mechanics of elastic and plastic deformation of solids and structural materials. United kingdom: university of warwick.
- Kaaya, w. A. (2005). Post-harvest management of aflatoxin contamination in groundnuts. Wageningen academic publishers.
- USDA, data
- www.fao.org/nr/groundnuts.