BUSITEMA UNIVERSITY
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF AGRICULTURAL MECHANISATION AND IRRIGATION ENGINEERING

DESIGN AND CONSTRUCTION OF A TRACTOR DRAWN SWEET POTATO HARVESTING IMPLEMENT

BY

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A forth year project submitted to the Department of Agricultural Mechanization and Irrigation Engineering in partial fulfillment for the requirement for the award of the bachelor's degree in Agricultural Mechanization and Irrigation Engineering of Busitema University.

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DECLARATION

I KAYONDO EDWARD, hereby declare that information compiled in this project has been due to my efforts and to my understanding no one has ever submitted it to any institution of learning for any kind of academic award.

Signature: ..... **Date:** 6/6/2014

APPROVAL

I hereby present this project for the process its being written to be approved by the following people,

MAIN SUPERVISOR

Mr. ODONG SAMUEL ATOCHON

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ABSTRACT

Sweet potato(ipomoea batatas Lamk), a South America crop by origin (Austine 1988) and introduced by missionaries in Uganda in 1900s, is one of the most important crops in densely populated East African countries and is a major staple in Uganda. Its grown through-out the country as a subsistence food crop however major production areas include north eastern and south western regions of Uganda. It's considered a priority crop and its importance has increased significantly over the years. It's an important food and cash crop especially in highland areas like Kabale and food security crop consumed when there is shortage of major staple foods.

Some of the challenges by sweet potato farmers are inadequate disease free planting material, quality reduction of planting after a few years, inadequate crop market, crop pests like weevils, butterflies, droughts. But the most factor constraining production is high labor and transport costs. This is due to less people getting involved in crop production field activities as they are perceived as woman's activities, use of rudimentary tools in growing of crop like sticks and hand hoes in vine planting, checking on ready crops and crop harvesting which makes production labor intensive and time wasting. As a solution to sweet potato harvesting problem faced by farmers in Uganda, this project is geared to development of a tractor drawn sweet potato harvesting implement.

This project was meant to design and construct a tractor drawn sweet potato harvesting implement. To achieve the design and construction of the crop harvesting implement, analysis of forces in the machine components under loading conditions like soil resistive forces were done to acquire the dimensions of machine parts. The implement had the following main components:

- The digging unit made up of tines
- The vine cutting unit
- The cut vine collecting and diverting unit made of steel metal sheets
- The frame on to which different implement components were attached

Each component was designed using simple engineering design methods and materials for the components were selected basing on working conditions of the components.

During fabrication, the researcher used different machine component production technologies like welding, marking, cutting, bending, drilling, grinding, and machining after which components were assembled together to form an implement.

The implement was tested in the field using 11horse power tractor on two ridge parts, one was 3.58m and the second was 3.4 m long but both were 0.42m wide. Test parameters were percentage damage done on dug potatoes, implement digging rate, digging efficiency and the field capacity. For the 3.58m long ridge, the operating speed, percentage damage, digging rate, digging efficiency and field capacity were 3.22 km/hr, 38.9%, 2.25kg/s,60% and 0.031 ha/hr respectively and for 3.4m long ridge the operating speed, percentage damage, digging rate, digging efficiency and field capacity were 2.04 km/hr, 20%, 1.25kg/s, 45.4% and 0.025 ha/hr respectively

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A.S.A.E – American Society of Agricultural Engineers

C.I.P – International Potato Center

C.S.B – Counter Shear Blade

C.A.R.D.I – Caribbean Agricultural Research and Development Institute

eqn. – equation

E.P.A.R – Evans School Policy Analysis and Research

FAO STAT – Food and Agriculture Organization Statistics

f.s - frame support

I.B.M- Initial Bulk Modulus

i.f - Implement frame

MT – Metric Tonnes

N.U – Newcastle University

N.A.R.O – National Agriculture Research Organization

O.F.S.P – Orange Fleshed Sweet Potato

P.T.O – Power Take Off

PRAPACE – Eastern and Central African Irish Potato and sweet potato Net work

R.B – Rotating Blade

s.p - sweet potato

U.S- United States

V.C.U – Vine Cutting Unit

CHAPTER ONE: INTRODUCTION

1.1 Background

Uganda is the biggest producer of sweet potatoes (ipomoea batatas L) in Africa in terms of area harvested that is 170,000 ha under cultivation every year and production with an average output of 2 million tons (FAO STAT data 2010 and Bashaasha 2010). Sweet potato is a major crop in Uganda ranking third in cultivated areas following plantains and cassava (Aritua et al 2007). Sweet potato ranks fourth in gross agricultural production values. The central government of Uganda has recognized sweet potatoes as an important crop for the country and a research priority especially through establishing N.A.R.O potato

Sweet potato is grown in all districts of Uganda, however major production areas include northeastern and southwestern regions of Uganda (Hakiza et al., 2000). The major sweetpotato producing districts in Uganda are as follows. In the Eastern region, they include Mbale, Iganga, Kumi, Pallisa and Kamuli. In the Northern region, the districts of Kitgum, Gulu, and Apac are known to be high productivity areas. In the west, Hoima and Masindi are known for high production of sweet potato while in the central region there are the districts of Mukono and Rakai.

There has been a marked increase in production from 231,000 ha in 1980 to 572,000 ha in 2002 with corresponding outputs of 1.2 million MT and 2.5 million MT respectively (FAOSTAT database 2004). Unfortunately this has mostly been due to increases in land area under sweet potato production, rather than higher productivity per unit area. As area planted continued to expand, yields have been stagnating and even declining slightly from an average of 4.5 tons/ha in the period 1986 to 1994 to 4.2 tons/ha in the years from 1995 to 2002

Cultivation takes place mostly in subsistence systems using indigenous cultivars, with no application of productivity enhancing inputs or technologies such as fertilizers, pesticides or irrigation and faces a high incidence of diseases and pests. Sweet potato is a common staple food in about 90% of Ugandan households.

REFFERENCES

B. Bashaasha, R.O.M. Mwanga, C.Ocitti p' Obwwoya and P.T Ewell. (December 1995), Survey report on sweet potato in farming and food systems of Uganda.

Bill A., Stout. Cheze, Bernard (1999), C.I.G.R Hand book of Agricultural Engineering, published by A.S.A.E

Carribean Agricultural Research and Development Institute (C.A.R.D.I) Root and Tuber Commodity Group (April 2010) sweet potato technical manual

Harvest plus (2012), Uganda country report on orange fleshed potatoes

Sweet potato value chain in Uganda E.P.A.R Brief No.217 (January 2013)

Department of agriculture, forestry and fisheries, Republic Of South Africa (2011) sweet potato production guide

R.J Godwin and Spoor (1977) soil failure with narrow tines, journal of agricultural engineering research, 22(4) 213-228

G.J.Scott, J.Otieno, S.B Ferris, A.K.Mujaya and L.Maldonado (1997-98) C.I.P sweet potato in Uganda food systems on enhancing food security and alleviating poverty.

M.D.Zainul Abedin(September 1995),a thesis on Characterization of unsaturated soil behavior from penetrometer performance and critical state concept volume 1 and 2 N.U.

P.N.Wheeler and R.J.Godwin, (1996), soil dynamics of single and multiple tines at speeds up to 20km/hr journal of agricultural engineering research 63(3), 243-250.

H.P.W Jaya Suriya;V.M.Salokhe (2001),a review of soil tine model for a range of soil conditions Journal of agricultural Engineering Research 79(1),1-13.

Andrew Hall, Geofrey Bocket and Sillim Nahdy,sweet potato harvest systems in Uganda ,International potato center social science department working paper No.1998-7.

R.S.Khurmi and J.K.Gupta (2005), Text book of machine design.

Adel.H, Gholamrez.C, Mohamed Hussein.K, Seyed.R, Hassan.B, Siavash.A (2011),report on Mechanical strength testing of rose flower stem and picking force evaluation, Department of Agro-technology, University of Tehran, Iran.

Kenny.N, Bart.L, Erdel.K and Wouter.S (2014), Bulk compression characteristics of straw and hay, Journal of Bio-systems engineering, University of Leuven.

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