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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**

**KAYONDO EDWARD**

**BU/UG/2010/015**

**Tel: +2560757905741**

**Email;mrkayondoedward@gmail.com**



**SUPERVISORS**

**Mr. ODONG SAMUEL ATOCHON**

**Mr. SALANJAYE WILBERFORCE**

**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.**

**May 2014**

## 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

Sign..........

Date..........

### CO- SUPERVISOR

Mr. SALANJAYE WILBERFORCE

Sign.....

Date.....

## ABSTRACT

Sweet potato (*Ipomoea batatas* Lamk), a South America crop by origin (Austin 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. It's 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

## TABLE OF CONTENTS

<b>Contents</b>	<b>Page</b>
DECLARATION.....	i
APPROVAL .....	ii
ACKNOWLEDGEMENT .....	iii
ABSTRACT .....	iv
TABLE OF CONTENTS.....	vi
List of figures .....	ix
List of tables .....	xi
List of abbreviations .....	xii
CHAPTER ONE: INTRODUCTION.....	1
1.1 Background.....	1
1.2 Problem statement.....	2
1.3 Justification.....	3
1.4 Purpose of the designed project.....	3
1.5 Objectives.....	3
1.5.1 Main objective.....	3
1.5.2 Specific objectives.....	3
1.6 Scope of the project .....	3
CHAPTER TWO: LITERATURE REVIEW .....	5
2.1 An overview of sweet potato in Uganda.....	5
2.1.1 Origin of sweet potato .....	5
2.2 Importance of sweet potatoes in Uganda's food system. ....	5
2.3 Sweet potato varieties in Uganda. ....	6
2.4 Sweet potato production in Uganda.....	8
2.5 Land preparation for growing sweet potatoes .....	8
2.5.1 The advantages of planting on ridges and mounds are; .....	8

2.6 Sweet potato harvesting .....	9
2.6.1 Modes of harvesting include; .....	9
2.6.2 Methods of harvesting sweet potatoes .....	9
2.7 Some of the existing tractor drawn sweet potato harvesting implements .....	11
2.7.1 The combine sweet potato harvester .....	11
2.7.2 The turmeric potato harvester .....	12
2.7.3 The 4U-2B potato digger elevator harvester.....	13
2.8 The researcher's harvesting implement design .....	14
CHAPTER THREE: METHODOLOGY .....	15
3.0 Introduction.....	15
3.1 Assumptions made in the design of the potato harvester.....	15
3.2 General description of the machine.....	15
3.3 Design of a sweet potato harvesting implement .....	16
3.3.1 Design of the tines.....	16
3.3.2 Determining draw bar pull and power requirement during digging operation.....	26
3.3.3 The vine cutting unit.....	27
3.3.4 Determining point of balance along the frame.....	37
3.3.5 Designing the transport wheel shaft.....	38
Figure 3.18 Views of the transport wheels.....	40
3.3.6 Designing for depth of cut adjustment .....	40
Figure 3.19 views of the frame support on to transport wheel shaft .....	40
3.3.7 Designing the implement frame .....	40
3.3.8 Selection of the bearings.....	41
3.4 Construction of the sweet potato harvesting implement.....	42
3.4.1 Fabrication of machine parts.....	43
3.4.2 Assembly of the various machine parts .....	47
CHAPTER FOUR: ANALYSIS AND DISCUSSIONS .....	49
4.1 The vine cutting unit (V.C.U) .....	49
CHAPTER FOUR: ANALYSIS AND DISCUSSIONS .....	50
4.1 The vine cutting unit (V.C.U) .....	50
4.2 Tines .....	50

4.3 Operation of the implement .....	51
4.4 Forces acting on the implement.....	51
4.5 Draft and power requirements (D.P.R) of the implement .....	52
4.6 Testing the implement .....	52
4.6.1 Digging rate .....	52
4.6.2 Percentage damage made during sweet potato digging .....	53
4.6.3 Digging efficiency .....	53
4.6.4 Percentage damage made during sweet potato digging .....	53
4.6.5 Fuel consumption during operation.....	53
4.6.6 Implement field capacity .....	53
4.7 Vine cutting .....	55
4.7.1 Vine cutting rate.....	55
4.7.2 Vine Cutting efficiency.....	55
4.8 Care and maintenance of the harvesting implement .....	55
4.9 Economic analysis.....	56
4.9.1 Cost analysis for harvesting sweet potatoes using the sweet potato harvesting implement ...	57
CHAPTER FIVE: CONCLUSIONS, CHALLENGES AND RECOMMENDATIONS .....	60
REFERENCES.....	61
APPENDICES.....	62



## List of figures

Figure 2.1 white fleshed s.p on the left and orange fleshed s.p on the right.....	7
Figure 2.2 Farmers harvesting sweet potatoes manually.....	10
Figure 2.3 Farmers harvesting s.p using vibrating, single row, potato harvester.....	11
Figure 2.4 Combine sweet potato harvester.....	11
Figure 2.5 Turmeric s.p harvester.....	12
Figure 2.6 4UD-2B Potato digger and elevator harvester.....	13
Figure 3.1 Proposed sweet potato harvester.....	16
Figure 3.2 Forces acting on a single tine during machine operation.....	18
Figure 3.3 cross section through ridge within it during digging.....	19
Figure 3.4 Tine within the ridge during digging.....	20
Figure 3.5 Longitudinal section through the middle tine.....	24
Figure 3.6 Tine cross section.....	25
Figure 3.7 Tine views.....	26
Figure 3.8 Forces acting on the blade during cutting.....	28
Figure 3.9 Graph of plant shear strength against shear velocity.....	29
Figure 3.10 Graph of I.B.M against plant material moisture content.....	30
Figure 3.11 Plan and front views of the rotating cutting blade.....	31
Figure 3.12 Views of the bearing support and housing.....	32
Figure 3.13 Plan and end views of the counter shear blade.....	33
Figure 3.14 free body diagram of the v.c.u shaft.....	33
Figure 3.15 front and end views of the v.c.u drive wheel.....	36
Figure 3.16 front and end views of slope adjustment plate.....	37
Figure 3.17 vertical forces acting on the frame.....	38
Figure 3.18 views of the transport wheel.....	40

Figure 3.19 views of the frame support on transport wheel shaft.....40  
Figure 3.20 horizontal forces acting on the implement frame.....41  
Figure 3.21 plan view of the i.f after assembling v.c.b, tines, f.s and transport wheel on it.....48

## List of tables

Table 2.1 Sweet potato varieties grown in different regions in Uganda.....	7
Table 2.2 Orange fleshed sweet potato varieties introduced in Uganda.....	7
Table 3.1 Soil test results.....	17
Table 3.2 Sweet potato grading according to size.....	18
Table 3.3 Sample vine stem cross section sizes.....	27
Table 3.4 Change in plant moisture content with its bulk modulus.....	30
Table 3.5 Sample vine heights.....	35
Table 3.6 Materials used.....	43
Table 3.7 Tools used in the fabrication of the s.p harvesting implement.....	49
Table 4.1 Results from implement field tests.....	54
Table 4.2 Performance of the implement at varying speeds.....	54
Table 4.3 Costing of the harvesting implement.....	56

### **List of abbreviations**

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.

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