



**BUSITEMA  
UNIVERSITY**

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**DEPARTMENT OF CHEMICAL AND PROCESSING  
ENGINEERING**

**FINAL YEAR PROJECT**

**DESIGN AND CONSTRUCTION OF A MULTI-FRUIT WASTE SHREDDING  
MACHINE**

**CASE STUDY: UGANDA INDUSTRIAL RESEARCH INSTITUTE**

**BY**

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**Final year project report submitted to the Department of Chemical and processing Engineering in  
partial fulfillment for the requirements of the award of Bachelor's degree in Agro-Processing  
Engineering of Busitema University**

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## **ABSTRACT**

Uganda Industrial Research Institute fruit and vegetable pilot plant generate huge amounts of organic wastes during the processing of the fruits into juice, jam and concentrates. However, there are usually delays in the collection of this waste leading to improper sanitation within the company area, odor and harborage for harmful insects. Since this waste is organic in nature, it can be converted to fertilizer through composting or used as animal feed, which involve shredding the organic waste into smaller and uniform pieces.

The purpose of this study was to develop a multi-purpose fruit waste shredder system which is easy to maintain at an appropriate cost and that caters for all fruit waste material produced at UIRI as well as coping up with the increasing demand for utilization of fruit wastes in Uganda. The work specifically focused on wastes from passion fruit, mango and pineapple.

In order to achieve the above purpose, the methodology below was adopted; data collection which involved literature survey and reviews, and design procedure, different construction techniques, performance testing and economic evaluation of the shredder system.

The methodologies were met and the multi- purpose fruit waste shredder machine was designed, constructed, tested and economically evaluated. The machine basically comprises of a shredding chamber, and a motor (2HP, 1450rpm). The arrangement of these parts is connected by sprocket and chain, and pulley mechanism and the throughput capacity was 25.kg/hr.

## DECLARATION

I **NASSOZI SARAH** declare to the best of my knowledge that this project is as a result of my research and effort and it has never been presented or submitted to any institution or university for any academic award.

DATE ... 23<sup>rd</sup> / 05 / 2018 .....

SIGNATURE ..... 



## **APPROVAL**

This project has been submitted to the department of Agro processing Engineering for examination with approval from the following supervisors:

**Ms. NABATEREGGA RESTY**

SIGNATURE .....

DATE.....

**MAIN SUPERVISOR**

**Mr. SSERUMAGA PAUL**

SIGNATURE .....

DATE .....

**CO-SUPERVISOR**

## **DEDICATION**

I dedicate this report to my guardians **Madam Heidi** and **Rev. Fr. John Mayiga** for their love and continued support in my education, may the good lord bless you always.

## **ACKNOWLEDGEMENT**

First and foremost, I thank the Almighty God who has enabled me to do this project and granted me healthy life.

Secondly, in a special way I thank my guardians, relatives for their continued support and I extend my sincere gratitude to **Ms. NABATEREGGA RESTY** and **Mr. SSERUMAGA PAUL**, my supervisors for the guidance, advice, encouragement and reading through my final year project report.

Lastly, I would like to extend my appreciation to my friends and the APE class 2017 for their continued support and encouragement during the period of project report writing



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# CHAPTER ONE

## 1.0 INTRODUCTION

This chapter briefly describes the historical background of fruits, their wastes, the problems encountered with its wastes, and it gives a justification for the design and construction of a fruit waste shredding system. It also includes the objectives of the project and its scope.

## 1.1 BACKGROUND OF THE STUDY

Uganda, a country located in the Eastern part of Africa is blessed with abundant arable lands that support the growth of many agricultural products, with diverse species of fruits being predominant. Studies such as Romelle *et al*, 2016), have shown that the Global fruit production is experiencing a significant increase; with output annual growth rate of about 3 percent over the last decade. Uganda is one of the largest producers of fruits in East Africa, with a total land area of 19,981 hectares of which 70% of the land is cultivatable. A large variety of fruits are grown in Uganda, among which banana with 9.5 million Metric Tons cultivated annually by more than 75% of Ugandan farmers (Faostat, 2013). Others include mango, Pineapple, passion fruit, oranges, jack fruit, pawpaw and water melon.

Contrary, these fruits inherently produce huge amount of bulky cellulosic waste known as biomass during their processing into value added products such as juice, jam, and concentrate. This has been and is still big problem at Uganda Industrial Research Institute within the fruit and vegetable pilot plant where big quantities of organic wastes are generated during the processing of the fruits into juice, jam and concentrates. This has led to improper sanitation within the company area, odor and harborage for harmful insects. Furthermore, management of these organic wastes generated is economically expensive due to daily payments to the waste management authority (KCCA) that collects these wastes for land filling at Kitezi hence continuous adverse effects to the environment as well as limited available space of landfilling. Fruit wastes consist majorly of peels, core, seeds, and pomace.

Innovation in proper managing of such vast amount of waste or biomass is a continuous challenge and recent trends favor the utilization of such biomass for value added purposes to fulfill the need

in areas like renewable energy, fiber composites and textiles, food alternatives organic manure and livestock feed (Rosentrater *et al.* 2009; Padam *et al.* 2012).

The idea of utilizing fruit wastes basically the peels which in some fruits makes up 30% or more of the total weight, is gradually gaining popularity especially when researchers found that peels possessed better biological activities than other parts of the fruit (Moon and Shibamoto, 2009; Romelle *et al.*, 2016). Previously, attempts were made to utilize the fruit wastes essentially for compost as organic manures and livestock feeds to be economically attractive. Among the available methods, they include shredding that aims at increasing the surface area of the fruit waste products as well as reducing their bulky density to speed up the decomposition factor of these products and improving on the digestibility of feed materials for animals. However, most of these shredding techniques are too expensive in terms of maintenance and cost, limited to be applied to a specific fruit waste and they are inappropriate to the Uganda's economy.

Therefore, this study investigates and reviews the major composition of some selected fruit wastes produced at Uganda Industrial Research Institute and looks at developing an appropriate fruit waste shredder system that is easy to maintain at an appropriate cost and that caters for all fruit waste material produced at UIRI as well as coping up with the increasing demand for utilization of fruit wastes in Uganda. The work specifically focuses on wastes from passion fruit, mango and pineapple (Raji & Onu, 2017)

## **1.2 PROBLEM STATEMENT**

Uganda Industrial Research Institute fruit and vegetable pilot plant generate huge amounts of organic wastes during the processing of the fruits into juice, jam and concentrates. The generated wastes are not utilized but rather collected and dumped at Kiteezi landfill. However, there is usually delays in the collection of this waste leading to improper sanitation within the company area, odor and harborage for harmful insects. Since this waste is organic in nature, it can be converted to fertilizer through composting or used as animal feed, which involve shredding the organic waste into smaller pieces to reduce the bulky density, improve the decomposition factor and increase the digestibility of these wastes. Hence, there is a need to design and construct an appropriate shredding machine for these generated wastes. Shredding machine technology is not a



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