



FACULTY OF ENGINEERING AND TECHNOLOGY

**DEPARTMENT OF CHEMICAL AND PROCESS
ENGINEERING.**

**FEASIBILITY STUDY ON DENSIFICATION OF RICE STRAW
FOR BRIQUETTE PRODUCTION.**

CASE STUDY: PALLISA DISTRICT

NAMBUYA BIRAH

BU/GS23/MSE/12

SUPERVISORS

ASSOC.PROF. PETER TUMUTEGYEREIZE

Dr. CHRIS KAVUMA

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Abstract

This study focused on the design, fabrication, and performance evaluation of rice-straw briquettes using locally available materials in Pallisa District, Uganda. The research aimed to develop a low-cost, sustainable fuel alternative to charcoal and firewood by utilizing agricultural residues. The study followed an experimental research design where carbonized rice straw was combined with a composite binder made of cassava starch, clay, and molasses in ratios of 10%, 15%, and 20%. Briquettes were produced using a hand-operated mold and compacted at forces of 0.16 kN, 0.22 kN, and 0.31 kN.

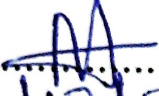
Mechanical and combustion properties including durability, compressive strength, bulk density, ignition time, burning rate, and calorific value were determined using standard procedures. Data were analyzed using mean $\pm$ standard deviation and graphical comparisons to assess performance differences among treatments. The economic analysis was conducted to determine production cost, market competitiveness, and potential charcoal substitution value based on the calorific value (14.74 MJ/kg) of the best-performing briquette batch.

Results showed that increasing binder ratio and compaction force improved briquette strength, density, and energy value. The total production cost was estimated at UGX 500 per kg, while the selling price ranged from UGX 1,500–2,500 per kg, confirming profitability. Energy equivalence analysis indicated that 1 tonne of briquettes substitutes approximately 491 kg of charcoal, showing significant potential for reducing deforestation and improving rural energy access.

Keywords: Rice straw, briquettes, binder ratio, compaction force, calorific value, economic feasibility, charcoal substitution.

Declaration

I, Nambuya Birah, candidate for the Master of Science in Sustainable Energy Engineering of Busitema University declare that this thesis report is my original work, except where due acknowledgement has been made and has never been presented for a degree in any other University and no part of this thesis is plagiarized work.

Signature.....

Date: 22/10/2025.....

Approval

This master's research titled "feasibility study on densification of unused rice straw for briquette production" prepared and submitted by Nambuya Birah in partial fulfillment of the requirements for the Master of Science in Sustainable Energy Engineering of Busitema University has been supervised and is ready for assessment.

Approved by:

Signature:.....

Date: 22/10/2025

Dr. Peter TUMUTEGYEREIZE

Associate Professor

Department of Chemical and Process Engineering

Signature:.....

Date: 23/10/2025

Dr. Chris Kavuma

Senior Lecturer

Department of Agricultural Mechanization and Irrigation Engineering

Dedication

This research is dedicated to my beloved husband Dr. Okoth David for encouraging me further my studies, financially and morally supporting me and taking care of the family during the time when I was so busy with the research and work obligations.

Acknowledgement

A master's research conducted after more than twenty years of practical work and experience in electrical engineering work which included domestic installation, industrial installation and solar energy systems I appreciate all people who trained me and who gave the opportunity to work in their companies for example Power Engineering Limited and EDCOM Limited. Above all, the following played extraordinary roles worth mentioning; Associate Professor Tumutegyereize Peter my mentor and main supervisor. He guided me and gave wise counsel on the choice of research topic despite having a variety of options. Dr. Kavuma Chris. constantly advised and worked together with me throughout the research process. Also, my colleagues Juma, Ibrahim, Godfrey and Job often encouraged me as we all looked towards finishing the master's academic journey in its stipulated time.

TABLE OF CONTENTS

Abstract.....	ii
Declaration.....	iii
Approval	iv
Dedication	v
Acknowledgement	vi
List of Figures.....	xi
List of Tables.....	xi
List of Acronyms	xii
CHAPTER ONE: INTRODUCTION.....	1
1.1 Background.....	1
1.2 Research Gap	3
1.3 Problem Statement	5
1.4 Research Objectives	5
1.4.1 Main objective	5
1.4.2 Specific Objectives	5
1.5 Research Questions.....	5
1.6 Justification of the Study.....	6
1.7 Significance of the Study.....	6
1.8 Scope of the Study	7
CHAPTER TWO: LITERATURE REVIEW	8
2.1 Introduction.....	8
2.2 Technical Aspects of Biomass Briquette Production	8

2.2.1 Feedstock Characteristics and Preparation.....	8
2.2.2 Moisture Content and Particle Size Optimization.....	9
2.2.3 Binder Materials and Their Functional Roles.....	9
2.2.4 Compaction Force and Pressure Effects.....	10
2.2.5 Briquetting Technologies and Equipment.....	10
2.2.6 Logistics, Feedstock Availability, and Supply Chain Considerations.....	10
2.2.7 Quality Control and Standardization.....	11
2.2.8 Environmental and Socio-Economic Aspects.....	11
2.3 Combustion Performance of Biomass Briquettes.....	11
2.4 Equipment Used in Briquetting.....	12
2.5 Binder Materials and Their Functional Roles.....	12
2.6 Compaction Ratios and Their Influence on Briquette Quality.....	13
2.7 Carbonization of Rice Straw.....	13
2.8 Comparative Case Studies in Rice Straw Briquetting.....	14
2.9 Methods of Briquetting.....	14
2.10 Factors Affecting Densification.....	15
2.11 Environmental Impacts of Rice Straw Management.....	15
2.12 Economic Viability of Briquette Production.....	16
CHAPTER THREE: METHODOLOGY.....	17
3.1 Research Design.....	17
3.1.1 Introduction.....	17
3.1.2 Research Approach.....	17
3.1.3 Study Area.....	18

3.2 Materials and Equipment.....	18
3.3 Equipment.....	19
3.4 Experimental Design	21
3.5 Experimental Procedures for Briquette Production and Testing	22
3.5.1 Material Preparation.....	22
3.5.2 Carbonization	24
3.5.3 Binder Preparation.....	24
3.5.4 Moulding of Briquettes	25
3.5.5 Moulding Process.....	31
3.5.6 Determination of Manual Compaction Forces	31
3.6 Methodes of Testing Mechanical Properties.	33
3.6.1 Durability (Drop Test)	34
3.6.2 Compressive Strength	34
3.6.3 Bulk Density	35
3.7 Evaluation of the Combustion Properties of Developed Briquettes.....	36
3.7.1 Ignition Time	36
3.7.2 Burning Time/ Burning Rate	36
3.7.3 Water Boiling Test	36
3.7.4 Determination of the Calorific Values.....	37
3.8 Evaluation of the Economic Viability of Rice Straw Briquette Production.....	37
3.8.1 Research Design	37
3.8.2 Data Collection	38
3.8.3 Cost and Revenue Estimation	38

3.8.4 Net Cash Flow (NCF) Determination	38
3.8.5 Net Present Value (NPV) Analysis	39
3.8.6 Sensitivity Analysis	39
CHAPTER FOUR: RESULT AND DISCUSSIONS.....	40
4.1 Moulding of Briquettes	40
4.2 Determination of Manual Compaction Forces.....	42
4.3 Durability by Drop Test.....	43
4.4 Compressive Strength	45
4.5 Bulky density	46
4.6 Evaluation of the combustion properties of developed briquettes results	48
4.6.1 Ignition Time	49
4.6.2 Burning Rate.....	49
4.6.3 Water Boiling Time.....	49
4.7 Effect on Calorific Value	54
4.8 Evaluation of the economic viability of rice straw briquette production	54
4.8.1 Availability of Raw Materials.....	55
4.8.2 Briquette Yield and Economic Return per Hectare	55
4.8.3 Charcoal Substitution Value and Economic Feasibility of Rice Straw Briquettes.....	59
CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATION	61
5.1 Conclusions	61
5.2 Recommendations	62
REFERENCES.....	63

List of Figures

Figure 1 showing the cutting of the rice straws from the garden using a hand sickle	23
Figure 2 showing the chopping of the rice straws in smaller pieces using a pang	23
Figure 3 Shows the Demisions of the Hand Held Mould Design.....	29
Figure 4 showing the Digital electronic personal scale	32
Figure 5 showing the digital sensitive scale	33
Figure 6 Shows Diagram for UTM compressive strength	35
Figure 7 Showing the Assembled Hand-Held Stainless-Steel Mold	42
Figure 8 Shows the grapgh durability by drop test.....	45
Figure 9 Presents Compressive strength using UTMs.....	46
Figure 10 show graph of Bulky density	48
Figure 11 shows a graph Ignition Time against sample I	51
<i>Figure 12 Showing a graph of Burning Rate against Sample ID</i>	<i>52</i>
Figure 13 Shows the graph of Water Boiling Test	53
Figure 14 Shows Variation of the Calorific values	54

List of Tables

Table 1 Shows Experimental Design	21
Table 2 showing the design parameters for the hand-held mold	25
Table 3 Strength Properties of Mild Steel (AISI 1020) and Their Relevance to the Hand-Held Mold.....	30
Table 4 showing the fabrication steps of the mold	30
Table 5 Presents Results of Tests on the Briquettes.....	44
Table 6 Shows Energy Results Analysis	50
Table 7 Shows Breakdown of Total Expenditures for Briquette Production	56
Table 8 shows the Financial Performance of Briquette Production under Varying Selling Prices	58

List of Acronyms

BU – Busitema University

DDI – Drop Durability Index

EDCOM – Electrical Design and Construction Management Limited

FAO – Food and Agriculture Organization

MJ/kg – Megajoules per Kilogram

SP – Sample Point

UGX – Uganda Shilling

UN – United Nations

UTM – Universal Testing Machine

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