

**IMPROVING THE USE OF WOOD SHAVINGS AND SAWDUST AS AN
ENVIRONMENTAL FRIENDLY ALTERNATIVE
SOURCE OF ENERGY**

BY

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**A DISSERTATION SUBMITTED TO GRADUATE SCHOOL IN
PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
AWARD OF MASTER DEGREE IN VOCATIONAL
PEDAGOGY OF KYAMBOGO UNIVERSITY**

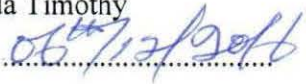
DECEMBER 2016

DECLARATION

I, Akunda Timothy, the undersigned do hereby declare that this research report submitted is my original work and has not been presented to any other University.

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APPROVAL

This dissertation has been written under our supervision and has been submitted for the award of the degree of Masters in Vocational Pedagogy of Kyambogo University with our approval as supervisors.


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LIST OF ACRONYMS

CBT	:	Competence Based Training
CHE	:	Council for Higher Education
CBED	:	Civil and Building Engineering Department
DIN	:	Deutsches Institut für Normung
ENR	:	Environment and Natural Resource
FW	:	Future Workshop
HOD	:	Head of Department
KYU	:	Kyambogo University
LAB	:	Laboratory
MVP	:	Masters in Vocational pedagogy
MDG	:	Millennium Development Goals
SD	:	Sustainable Developments
TVET	:	Technical Vocational education and Training
VET	:	Vocational Education and Training

ABSTRACT

This research project was carried out to improve the management of wood shavings and sawdust at Civil and Building Engineering Department, Kyambogo University (CBED). The objectives of the study were to: identify the current methods of disposing off wood shavings and sawdust at CBED, Kyambogo University; assess the environmental safety problems facing the Department of CBE arising from wood shavings and sawdust from Carpentry and Joinery Workshop; establish the methods of management of wood shavings and sawdust in selected workshops in Kampala and propose solution to problems facing the Department of CBE arising from wood shavings and sawdust from carpentry and joinery workshops in Kyambogo University.

A survey was conducted in ten selected workshops in Kampala underpin this study in order to establish the management of wood shavings and sawdust in Carpentry and Joinery Workshops. Questionnaires, interview and observation were the major instruments used for data collection.

The findings of the study indicated that: Heaping of wood shavings and sawdust was the most serious problem followed by Burning in open space, leaving to decompose and the use of closed dustbins were the current methods being used to dispose off wood shaving and sawdust at CBED, Kyambogo University. Littering, bad smell, skin and eye problems were among the environmental and health problems arising from wood shavings and sawdust at Carpentry and Joinery workshop, Kyambogo University. Selling, poultry, piggery and mulching were the methods of managing wood shavings and sawdust used in the selected workshops in Kampala. Briquette making was proposed by the researcher as the best proposed solutions of improving the management of wood shaving and sawdust at CBED, Kyambogo University.

It was concluded that burning in open space was the major current method of disposing wood shavings and sawdust; heaping and bad smell were the major environmental problem arising from sawdust; selling wood shaving and sawdust were done by majority of workshops and briquettes making was the best proposed solution for improving the management of wood shaving and sawdust.

It was recommended that: University management needs to embrace and support this research project of making briquettes from wood shavings and sawdust when training students in order to minimize the environmental degradation and health problems arising from the Carpentry and Joinery workshop at CBED, Kyambogo University. Management further needs to put in place appropriate methods of disposing off wood shavings and sawdust like selling, taking it to the farm to be used as feeds for piggery and poultry in the University farm and the management need to provide Personal Protective Equipment (PPEs) and ensure that they are properly used by the people using the Carpentry and Joinery workshop.

Key words: wood shavings and sawdust; management; environmental degradation; healthy problems.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

This research was conducted at the Department of Civil and Building Engineering of Kyambogo University. The research aimed at improving on wood shavings and sawdust management in the Department of Civil and Building Engineering when training students. There has been gradual increase in a number of students in Civil and Building Engineering Department enrolled for training, and this has caused the amount of wood shavings and sawdust to increase to a level where it has become an environmental problem as indicated in the Table 1.1.

Table 1.1: Number of students who graduated in CBED from 2001-2011

Course	Years										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Bachelor	44	53	76	79	98	95	94	107	108	32	106
Higher Diploma	-	30	21	16	35	33	43	22	44	31	43
Ordinary Diploma	77	-	36	22	53	32	42	41	26	43	39
Total	121	83	133	117	186	160	179	170	198	106	188

Source: (field data 2016)

Wood shavings and sawdust is a by-product of cutting, grinding, sanding or pulverizing wood or material that is composed of fine particles of wood (Green 2006). According to Brund land commission (1987), the impact of production on environment has been escalating since 1970's. While environmental protection is a practice of protecting the natural environment on individual organizational or governmental levels for the benefit of both the natural environment on individual organizational or governmental levels for benefit of both the natural environmental and humans, environmental degradation is basically anything and everything that differs from a natural process or structure. In other words, degradation of the environment has done significant damage to or a complete loss of an environmental process or structure. Environmental degradation is a much broader area than just pollution and touches upon all realms of life air, water and land. The Civil and Building Engineering

Department near Carpentry Work shop is the place where littering and deposit of wood shavings and sawdust takes place.

Action research is an approach that uses research findings to inform and shape personal and organizational action while future workshop is a method that enables a group of people to develop new ideas or solutions when working, for instance, with social problems. Through action research and future workshop that was carried out at Civil and Building Engineering Department (CBED) of Kyambogo University, the stakeholders who included lecturers, students, Head of Department (HOD) and the researcher agreed on a number of issues among which was the improper management of wood shavings and sawdust in the Carpentry and Joinery workshop that caused environmental degradation at CBED. Among the alternatives to which wood shavings and sawdust could be put to use included: source of energy used in kilns for burning bricks and cooking stove, improve wood shavings and sawdust for poultry use, manufacturing of boards, modifying and turning wood shavings and sawdust into fertilizers, to be used in agricultural farms, packing of wood shavings and sawdust in bags of different kilograms according to the customers' needs.

1.2 Personal and Professional Background

A researcher holds a Bachelor of Education in technological Studies of Kyambogo University and currently a student of Masters in Vocational Pedagogy with (17) seventeen years teaching experience of practical hands on work in a course unit of Building Construction within Civil and Building Engineering Department.

A researcher perform his tasks assigned to him diligently with the purpose of imparting up to date competences and improving the training among students. The first and second year under graduates and Diploma first and second year students offering course units in building construction and practical skills. Training in this course unit of building construction is a challenge, because the learners think Engineers should not become dirty with hands on work. It is my work as a technician and coach, to create awareness and motivate the students to participate in the hands on training, this making students their own learning/training processes.

Secondly, the lecturers give the theoretical part and then send students to the technicians. It is the work of technicians to make a connection between the practical and theoretical lectures. I hope to start my lectures with a bit of action research. When shall we have a tour of different sites or completed buildings so that students gain interest in the practical work of brick-laying?

Therefore, this action research would serve to improve training at the Department of CBE. Consequently as a researcher I became so interested in carrying out an action research following the previous mini project of action research which was conducted at the Department of Civil and Building Engineering Kyambogo University. This action research aimed at developing the personal understanding of how best are/an individual could improve wood shavings and sawdust management at CBE in active training practical skills.

1.3 Motivation for the Research

Having worked as a technician in charge of conducting practical work in Building Construction in the Department of Civil and Building Engineering for the last 17 years, the researcher has been keenly observing challenges affecting the carpentry and joinery workshop. The challenges include littering of wastes inappropriate places near carpentry workshop. Basing on the knowledge gained from theoretical course units for the Masters in

Vocational Pedagogy (MVP) programme and Vocational Action Research (VAR), he realised that there is need to improve the workplace and especially the situation at the carpentry and joinery workshop. In addition, the more he worked in the department, the more he noted the challenges in this workplace.

1.4 Situation Analysis

According to Situational Analysis conducted at CBED KYU wood shavings and saw dust management included: littering of wood shavings and sawdust near carpentry and joinery workshops both east and waste end, dumping wood shavings and sawdust anyhow in compound and heaping wood shavings and sawdust to inappropriate places. This has resulted into degrading the environment and became a healthy and safety problem to civil and building department community when training students.



Figure 1.1: Researcher is analyzing the situation at CBED (2016).

1.5 Future Workshop

The future workshop is a method that enables a group of people to develop new ideas or solutions when working, for instance, with social problems. Also future workshop is a method particularly suitable for participants who have little experience with processes of creative decision making, but work with children or youth, for example. The future workshop is also a working method suitable for self-controlled learning and aimed at the future.

The future workshop was held at CBE at Kyambogo University and it targeted HOD, lecturers, technicians, first year undergraduate students, first year and second year Diploma

students. The future workshop helped the researcher to identify the environmental degradation associated with Carpentry and joinery workshop and possible solutions.

The action research was then conducted in ten (10) selected carpentry and joinery workshops in Kampala. The data collected from these workshops formed the suggested recommendations to improve management of wood shavings and sawdust in the carpentry and joinery workshop at Civil and Building Department Kyambogo University.

According to UNDP's Unleashing Entrepreneurship report 2004, the report says that one of the pillars of entrepreneurship is: "Access to Skills and Knowledge". If the researcher designs a method for potential entrepreneurs (students, technicians and lecturers) to become actual entrepreneurs I feel I would have participated in making the world a better place. Especially if they embrace and support the idea of managing wood shavings and sawdust properly so as to improve the environment. A large part of economic values including forest by-products such as wood shavings and sawdust are increasing at local, national and global levels but are taken for granted by not being valued in monetary terms as supported by Yakobo et al., (2002). For instance:

- Wood shaving and sawdust is sold off by individuals in the department;
- Students are not trained to manage workshops and their by-products;
- There is careless burning of wood shavings and sawdust that leads to environmental degradation and air pollution and;
- The department is losing a product that would contribute to the income.

1.5.1 Application of future workshop to identify challenges in the DCBE

The Future Workshop as a research method was used to solve problems perspective of the future. It was originally developed for citizen groups with limited resources who wanted a say in the decision making process. The Future Workshop is defined as a technique meant to shed light on a common problematic situation, to generate visions about the future and to discuss how these visions can be realized (Jungk and Mullert, 1970) .The future workshop is made up of five phases namely: the planning phase, critique phase, utopian phase, reality phase, and the follow up phase, can be transferred to situations of educating and learning. This method has also been used in Norway for developing a work-based learning at the construction site (Sannerud, 2012).

The Future Workshop was then used to highlight challenges and find solutions to challenges in the DCBE. We started with the Work Process aimed at identifying the competencies required in the production of wood shavings and sawdust and Challenges encountered in the process of improving wood shavings and sawdust management.

The stakeholders brainstormed the challenges which were later coded and prioritized as follows:

- Bad smell as a result of rotting of wood shavings and sawdust,
- Lack of proper record keeping of sawdust and wood shavings that has been produced at the department,
- Improper storage of sawdust and wood shavings,
- Insufficient storage space of sawdust and wood shavings,
- Un improved dumpy bays for sawdust and wood shavings,
- Sawdust and wood shavings can become source of fire outbreak,
- Misuse of gazetted sawdust and wood shavings bays,
- Lack of sensitization in handling sawdust and wood shavings at Civil and Building Engineering Department and;
- Wood shavings and sawdust has degraded the environment at Civil and Building Engineering Department.

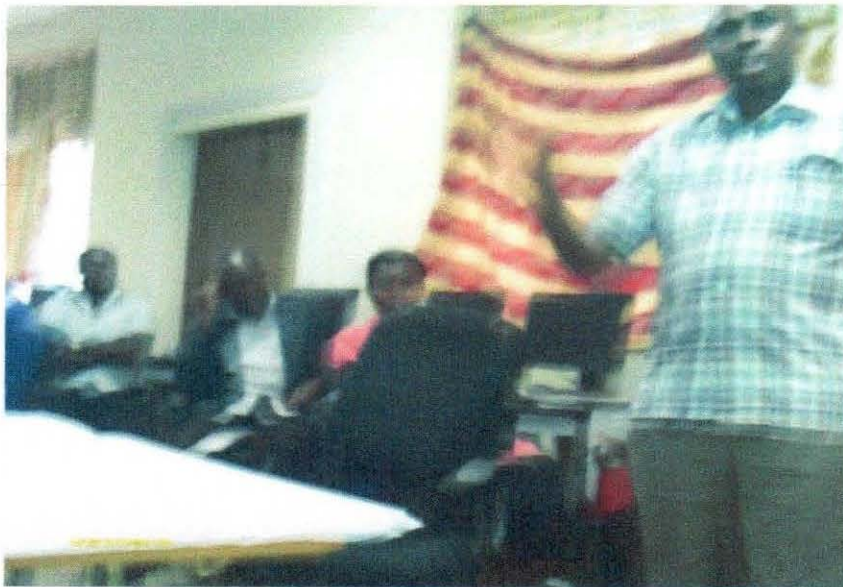


Figure 1.2: Stakeholders brainstorming the challenges (2016).

1.5.2 Outcomes of Future Workshop

The following were suggested as probable solutions to the identified problem by the stakeholders:

- Burning sawdust and removing ash from a bay where it was burnt,
- Put sign posts with in civil and building engineering department to remind the users and keep dumping w sawdust in a targeted bay,
- To put a penalty for misuse of the bay (Ugx. 100,000/=),
- To put rules at civil and building engineering department for guiding users of wood shavings and sawdust,
- Fencing the targeted bay,
- From different machines wood shavings and sawdust should be transported to the identified rooms for proper grading, sorting, and packing them, then be ready for transportation to the specified areas for use,
- To establish the quantities of wood shavings and sawdust that is generated at civil department,
- To design the store room in a targeted area for keeping wood shavings and sawdust.
- To put in place a proper record keeping of wood shavings and sawdust that has been produced every day in the workshop at civil department when training students,
- To put in place a sorting room of wood shavings and sawdust, so that it can be properly graded and sort out some impurities that would cause danger to the end users.

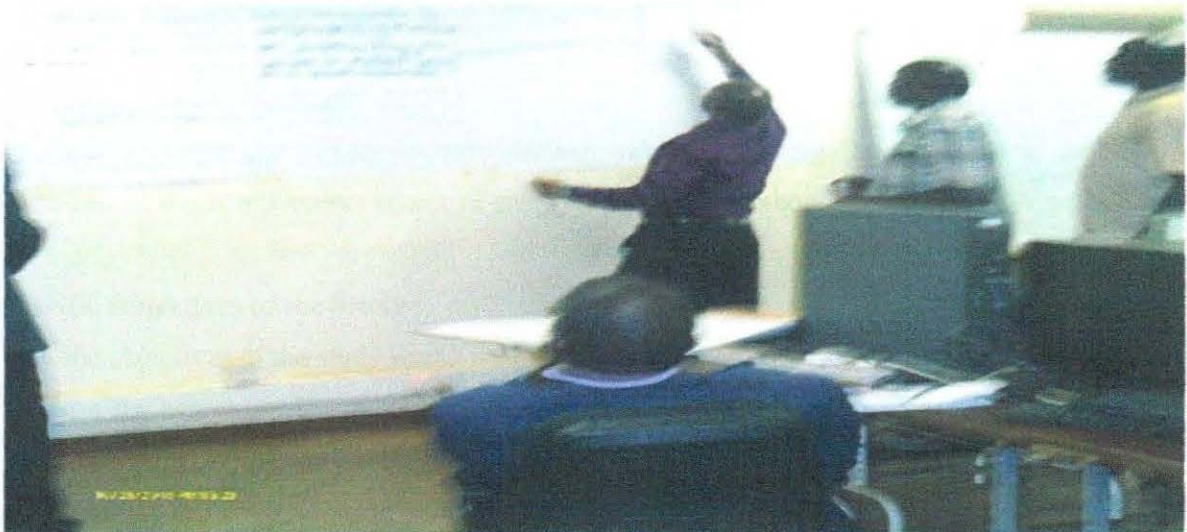


Figure 1.3: Stakeholders assessing the agreed tasks and responsibilities among themselves (2016).

1.6 Conceptual Background

Carpentry and joinery is a practical course, which requires both theory and hands on work experience. Theory is attained through classroom learning, while hands on is practiced in the workshop. Carpentry and joinery is a component of building construction. Since there has been gradual increase in the number of students in Civil and Building Engineering Department enrolled for training, this has caused the amount of wood shavings and sawdust to increase to a level where it has become an environmental problem.

The knowledge the researcher gained through the MVP empowered him to be creative in thinking and having the desire for positive intervention in practical training. It is his desire to see the environmental degradation, littering of wastes be stopped in the Department of Civil and Building Engineering. Yakobo et al., (2002) emphasize that direct use values of the environment and natural resources are those that are derived by consuming goods and services directly such as timber, building poles, local medicines, wild foods and recreation.

1.7 Problem Statement

The carpentry and joinery workshop in CBED produces wood shavings and sawdust as a waste when training students. Due to the increase in number of students in CBED, the amount of wood shavings and sawdust produced has increased to a level where it has become an environmental and safety problem. This study was to improve the use of wood shavings and sawdust as an environmental friendly alternative source of energy at CBED Kyambogo University

1.8 Purpose of the Study

The purpose of the study was to improve the use of wood shavings and sawdust as an environmental friendly alternative source of energy at CBED Kyambogo University.

1.9 Specific Objectives of the Study

The specific objectives of the study were:

- i. To assess current methods of wood shavings and sawdust management at the Department of Civil and Building Engineering in Kyambogo University,
- ii. To assess the environmental safety problems facing the Department of CBE arising from wood shavings and sawdust from carpentry and joinery workshop in Kyambogo University,

- iii. To establish the methods of management of wood shavings and sawdust in the selected Carpentry and Joinery workshops in Kampala,
- iv. To propose solution to problems facing the Department of CBE arising from wood shavings and sawdust from carpentry and joinery workshops in Kyambogo University.

1.9.1 Research Questions

The study was guided by the following research questions:

- i. What are the current methods of wood shavings and sawdust management at the Department of Civil and Building Engineering, Kyambogo University?
- ii. What are the environmental and safety problems facing the Department of CBE arising from carpentry and joinery workshop, Kyambogo University?
- iii. What are the methods of management of wood shavings and sawdust in in selected carpentry and joinery workshop in Kampala?
- iv. What are the possible solutions to the problems arising from Carpentry and Joinery workshop at the department of Civil and Building Engineering?

1.10 Justification of the Study

There is plenty of wood shavings and sawdust which is always generated from Building and Civil Engineering Carpentry and Joinery workshop, Kyambogo University which resulted into environmental, health and safety problems due to poor management. There is littering, heaping of wood shavings and sawdust, and bad smells from wood shavings and sawdust affecting civil engineering department community. This research project was to turn this problem of wood shavings and sawdust arising from carpentry and joinery into skills development for students and income generation for the department. One of the final products of this research is making briquettes which has reduced the amount of wood shavings and sawdust generated and has saved the Civil Engineering department Community and bypassers from the bad smell and other infections.

1.11 Significance of the study

The study, through collaboration with stakeholders in the department of civil and building engineering will generate income for the department through making briquettes from wood shavings and sawdust in the university. The health safety and environmental problem to civil department community will be solved. In addition, wood shavings and sawdust management will be improved upon as a cheap source of energy.

1. 12 Scope of the Study

1 .12.1 Geographical and time Scope

The study was carried out in the Department of Civil and Building Engineering, Kyambogo University for a period of six months.

1.12.2 Content Scope

Environmental safety problems facing the department of CBED arising from wood shavings and sawdust from carpentry and joinery workshop will be assessed. The solutions to problems facing the department of CBED arising from carpentry and joinery workshop wastes will be established and wood shavings and sawdust management in the department of civil and building engineering Kyambogo University will be improved.

1.13 Definition of Key Terms

Learning: Learning in this study refers to a holistic process of acquiring and developing new or existing knowledge, skills, attitudes, behaviours, understanding, values and wisdom which may occur as a result of experience, habituation or by conditioning and may occur consciously or unconsciously.

Teaching: a process or activities that a teacher is involved in to ensure that learning occurs. It involves helping, guiding, counselling and mentoring students so that they can learn.

Teacher: is seen as a facilitator, guide, coach, counsellor and mentor in the process of learning to enable students to learn.

Skills: In this study skills refer to the capability of accomplishing something with precision and certainty and the ability to perform a function, acquired or learnt with practice.

Environmental protection: is a practice of protecting the natural environment on individual organizational or governmental levels for the benefit of both the natural environment and humans.

Environmental degradation: is basically anything and everything that *deviates* from a natural process or structure.

1.14 Conceptual framework

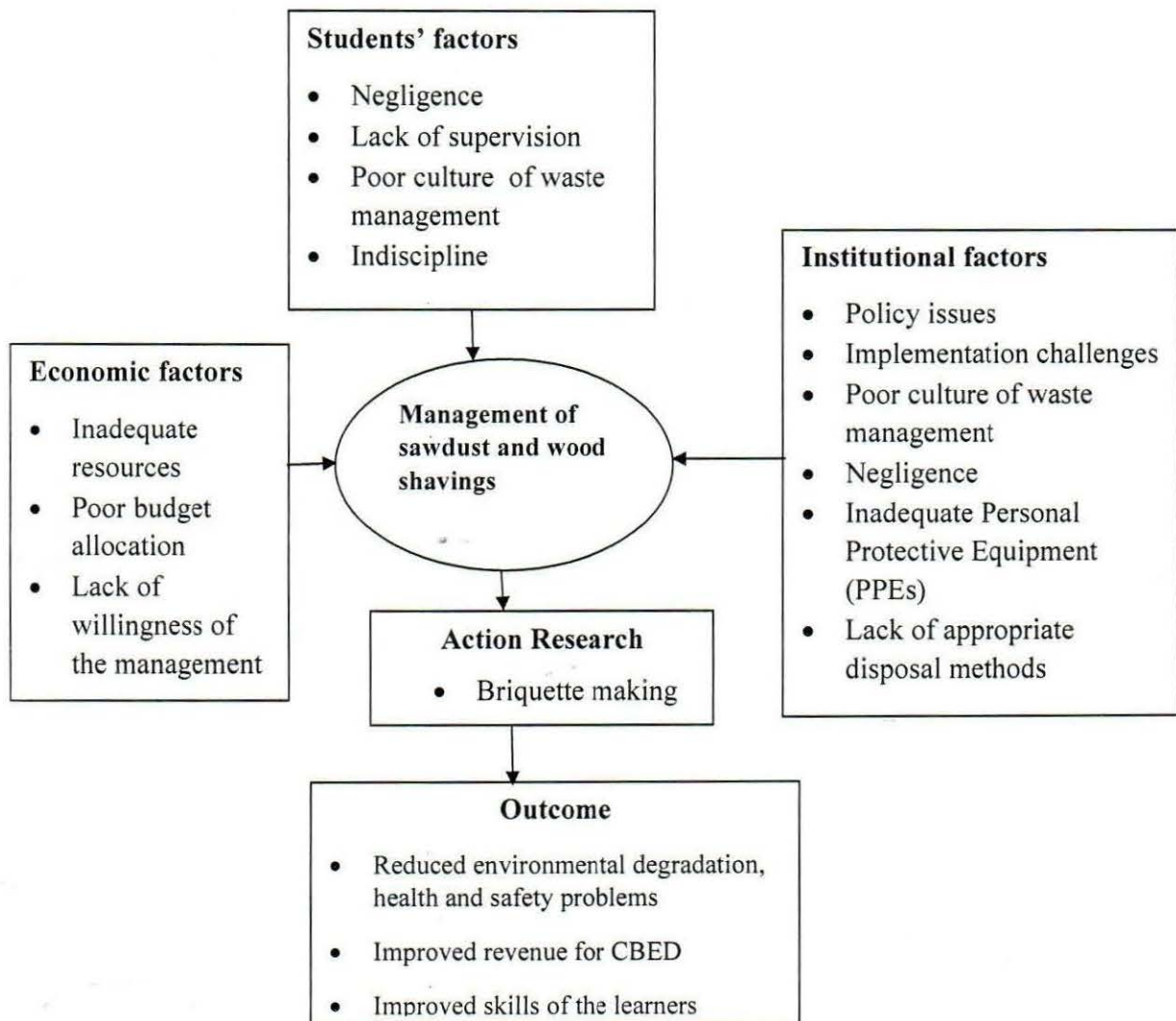


Figure 1.4: Conceptual framework

Source: **Developed from Literature review (Ganiron, 2012)**

The conceptual framework in Figure 1.4 depicts a diagrammatical presentation of the independent variables such as economic factors, institutional factors and students' factors influencing the management of wood shavings and sawdust negatively at Civil and Building Engineering Department, Kyambogo University resulting into dependent variables such as reduced environmental degradation, health and safety problems, improved revenue for CBED and improved skills of learners.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature of other scholars so as to provide the rationale of this topic. It presents pertinent topics in support to the management wood shavings and sawdust. The aim of this research is to improve wood shavings and sawdust management at Civil and Building Engineering Department.

2.2 Wood shavings and Sawdust Management in Workshops

Wood shavings and Sawdust is a by-product of cutting, grinding, drilling, sanding, or otherwise pulverizing wood with a saw or other tool; it is composed of fine particles of wood (Green, 2006). It can present a problem in manufacturing industries, especially in terms of its flammability. Wood shavings and Sawdust is the main component of particleboard. A major use of wood shavings and sawdust is for particleboard; because wood shavings and sawdust may be used for wood pulp.

Wood shavings and Sawdust have a variety of other practical uses, including serving as mulch, as an alternative to clay cat litter, or as a fuel. Until the advent of refrigeration, it was often used in icehouses to keep ice frozen during the summer. It has been used in artistic displays, and as scatter (Ganiron, 2013). It is also sometimes used to soak up liquid spills, allowing the spill to be easily collected or swept aside.

At sawmills, unless reprocessed into particleboard, burned in a wood shavings and sawdust burner or used to make heat for other milling operations, wood shavings and sawdust may collect in piles and add harmful leachates into local water systems, creating an environmental problem. This has placed small sawyers and environmental agencies in a deadlock.

Questions about the science behind the determination of wood shavings and sawdust being an environmental problem remain for sawmill operators (though this is mainly with finer particles), who compare wood residuals to dead trees in a forest. Technical advisors have reviewed some of the environmental studies, but say most lack standardized methodology or evidence of a direct impact on wildlife. They don't take into account large drainage areas so the amount of material that is getting into the water from the site in relation to the total drainage area is minuscule (Savie, 2010).

Other scientists have a different view, saying the "dilution is the solution to pollution" argument is no longer accepted in environmental science (Ganiron, 2013). The decomposition of a tree in a forest is similar to the impact of wood shavings and sawdust, but the difference is of scale. Sawmills may be storing thousands of cubic meters of wood residues in one place, so the issue becomes one of concentration. But of larger concern are substances such as lignin's and fatty acids that protect trees from predators while they are alive, but can leach into water and poison wildlife. Those types of things remain in the tree and, as the tree decays, they are slowly broken down. But when saw millers are processing a large volume of wood and large concentrations of these materials permeate into the runoff, the toxicity cause harmful to a broad range of organisms.

2.2.1 Uses of wood shavings and sawdust

Wood shavings and Sawdust can be used as alternative substitute for fine aggregate in concrete production (Ganiron, 2013). Sawdust should be washed and cleaned before use as concrete constituent because of large amount of bark which can affect setting and hydration of cement. Concrete obtained from sawdust is a mixture of sawdust, gravel with certain percentage of water to entrance the workability and full hydration of the cement which help in bonding of the concrete. Sawdust concrete is light in weight and has satisfactory heat insulation and fire resisting values. Nails can be driven and firmly hold in sawdust concrete compare to other lightweight concrete which nail can also easily drive in but fail to hold (ASEP, 2012).

As the construction community might well be aware of, incorporating organic materials into solid concrete is not such a good idea to begin with. First of all, its loose molecular structure would cause the structure to fail at a certain stage and second, it would compete and retard the hydration process of cement (Ganiron, 2012). Certain predictions state that if sawdust is mixed with cement and gravel, it might simulate a synthetic wood fiber bond found in trees.

A major use of wood shavings and sawdust is for particleboard; coarse sawdust may be used for wood pulp. Wood shavings and Sawdust have a variety of other practical uses, including serving as mulch, as an alternative to clay cat litter, or as fuel. Until the advent of refrigeration, it was often used in icehouses to keep ice frozen during the summer. It has been used in artistic displays, and as scatter in miniature railroad and other models. It is also sometimes used to soak up liquid spills, allowing the spill to be easily collected or swept

aside. As such, it was formerly common on barroom floors (Felman, 2005). It is used to make Cutler's resin. When mixed with water and frozen, it forms pykrete, a slow-melting, much stronger form of ice.

Wood shavings and Sawdust is used in the manufacture of charcoal briquettes. The claim for invention of the first commercial charcoal briquettes goes to Henry Ford who created them from the wood scraps and sawdust produced by his automobile factory (Green, 2006).

Cellulose, fiber starch that is indigestible to humans, and filler in some low calorie foods, can be and is made from wood shavings and sawdust, as well as from other plant sources (Nassauer, 2011). While there is no documentation for the persistent rumor, based upon Upton Sinclair's novel *The Jungle*, that wood shavings and sawdust was used as a filler in sausage, cellulose derived from sawdust was and is used for sausage casings (Savic, 1985). Sawdust-derived cellulose has also been used as a filler in bread.

Several studies regarding the use of compacted biomass as an energy source, focused on comparing the economical-environmental impact of compacted biomass as a substitute for traditional fuel materials with emphasis on the effect of greenhouse gases, in which the value of biomass briquettes are highlighted as a cost-effective option to reduce CO and CO₂ and meet the millennium development objectives according to the United Nations (Unidas, 2011). Other studies focused on analyzing the compacted biomass market, especially the briquettes and pellets in different European, American and Asian countries, mainly analyzing key factors of demand, in which the need for political support and promotion mechanisms are highlighted in order for this substitute to reduce heavy dependence on traditional fuels (Boukis, 2009; Ehrig, 2013). The main advantages attributed to these types of compacted biomass, compared to other types of biofuels, are higher energy density, lower transportation and storage costs, uniform product quality such as constant humidity content and higher mass fluency, among others (Nilsson, 2011; Samuelsson et al., 2009). The biomass briquettes and pellets are mainly produced from agricultural waste material, livestock, industrial/urban waste or a mixture thereof. However, the material mostly commonly used is a typical waste from the timber industry: wood shavings and sawdust. Compared to agricultural raw material, wood shavings and sawdust has a lower ash content, lower risks of corrosion and dirtying, requires high temperatures of ash deformation (>1200°C) and also requires no additives or

thickeners to increase production costs since humidity and the actual wood lignin work as natural adhesive (Jenkins et al., 1998).

Table 2.1 depicts a usage comparative between wood shavings and sawdust and other agricultural waste with regard to the main feature and advantage of these materials. The low percentage of ash content in dry material and the low percentage of Sulphur and chlorides in ash after the combustion.

Table 2.1: Usage comparative between wood shavings and sawdust and other agricultural waste

Technical features	Mass in kg of dry material	Ashes content (% of dry material)	Sulphur (% of ash)	Chlorine (% of ash)
Sawdust	20.3	0.6	0.003	0.001
Salix agricultural crop	20	2.9	0.03	0.03
Straw	18.9	5	0.08	0.12
RCG (grass adapted for cultivation)	19	4.5	0.09	0.09
Canamo (plant fiber)	19.1	2.3	0.06	0.01
Cereal residues	19.8	9.8	0.21	0.16
Ripe flour	19.5	7.4	0.91	0.03
Ripe cake	26	5.3	0.4	0.01
Distillery waste	21.2	5.6	0.62	0.28

Source: (Nilsson *et al.*, 2011)

In Peru, there are no design standards for compacted biomass as there are in European countries, where dimensions range from 6 to 8 mm in diameter for pellets and 7.5 to 9 cm for briquettes with length of 4 to 5 times the diameter size for the design of both (DIN, 1996). For industrial production of compacted biomass from sawdust, adequate process controls focused on risk management are required as this material is a forestry residue with one of the largest environmental impact, being a contaminant agent of soil and water. In addition, when

in the open, it is harmful to human health and a safety risk with regard to fire and spontaneous combustion (Fonseca and Tierra 2011). However, the basic process of making sawdust briquettes is not as demanding on the particle size, which reduces production costs compared to the process of pellet production. At the industrial level, drying is one of the most important stages as the combustion of wet wood waste reduces energy efficiency and increases hydrocarbon emissions and other unwanted particles, besides generating further problems in the compacting stage and causing crack problems in the briquettes (Stahl et al., 2004).

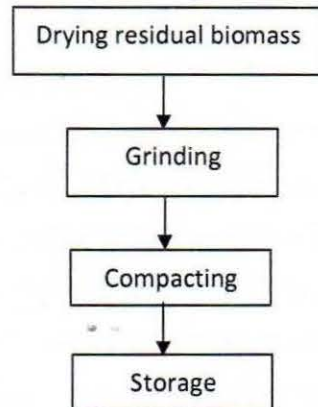
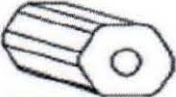






Figure 2.1: Compact process of residual biomass

Source: (Sánchez and Fernando, 2004)

Table 2.2 Briquette design

Pressure type	Shape	Material	Market
Extrusion		Mixed Wood	Belgium
Extrusion		Thick Wood	Germany
Vacuum chamber		Mixed Wood	Germany
Piston		Mixed Wood	Spain
Piston		Fine Wood	Austria

Source: Temmermana *et al.*, (2006)

Moreover, consumption of biomass briquettes for rural domestic use has shown to have better economic performance advantages over other traditional products such as firewood and charcoal (Walubengo, 1998). However, demand has been affected by social, cultural and industrial factors of traditional products. Its growth is based on the shortage of raw materials for the other traditional products, leading to the necessity for an alternative (Bhattacharya, 1985). People need to be trained on the use of briquettes from bio-fuels like wood shavings and sawdust, and the traditional stoves need to undergo improvements, an investment that is not very appealing to the people considering their low income (Wamukonya, 1995).

2.2.2 Procedure of the Making Briquettes

In the production of briquettes, different materials of wood shavings and sawdust can be used as long as it is considered waste. The focus of production of briquettes is based on three general activities of the basic production processes which are described as follows:

- a) Collection of raw materials. Sucking of wood shavings and sawdust from sawing machines to the company's raw material warehouse using a network of pipes and a suction motor. At this point, the wood shavings and sawdust has moisture content of greater than 10%.
- b) Drying of the raw material. At this point, the advantageous environmental conditions of the region play a significant role, allowing for the high temperatures that help reduce moisture humidity to less than 10% within 24 hours.
- c) Compacting. Use of a hydraulic piston briquetting machine, allowing for greater pressure of up to 5 MP and obtaining briquettes with a circular cross section of 6 cm in diameter and 12 cm in length. In all the activities, safety measures were implemented for those involved, which also reduced the environmental risks of the process (Fonseca and Tierra. 2011).

Table 2.3: Technical features of briquette

Technical features		
Feature	Standard/method	Unit
Calories power	ASTM D-2015-66(1972)	MJ x Kg
Bulk density	NTP 251,011	Kg x m ²
Moisture	Gravimetry AAOAC 1984	% (wet basis)
Ash content	ASTM D-1762	%
Volatile matter	ASTM D-1762	%
Fixed carbon	ASTM D-1762	%
Chlorine content	Argentometry	%
Sulphur content	Atomic absorption	%

2.3 Environmental safety problems arising from wood shavings and sawdust at the workshops

2.3.1 Environmental problems

Vocational education and training faces a number of challenges, including climate change, environmental degradation and scarcity of resources place great pressure on TVET to develop skills and competencies that can pave the way towards a green economy and society. Although Uganda's Environment and Natural Resource (ENR) sectors (agriculture, forests, wildlife, wetlands and others) contribute significantly to the economy, only a portion of their contribution is captured in official statistics (Yakobo et al., 2002). This reveals that a large part of economic values including forest by-products such as wood shavings and saw dust are increasing at local, national and global levels but are taken for granted by not being valued in money terms. Yet, the ENR sector could directly or indirectly support the livelihoods of many Ugandans in terms of poverty eradication strategies and employment. Out of the total size of Uganda's economy (as measured by conventional GDP), the environment and natural resource sector contributed 54.4 percent of total GDP in 1999 (MoFEP, 2000).

Yakobo et al., (2002) emphasize that direct use values of the environment and natural resources are those that are derived by consuming goods and services directly such as timber, building poles, local medicines, wild foods and recreation. Indirect use values, on the other hand, are those values derived by consuming or benefiting from critical ecological life supporting services of environment including protection of watersheds, controlling floods and storms, absorption of carbon dioxide (carbon sequestration) and regulating climate.

The high dependence of Uganda's economy on her environment and natural resource base implies that degradation of the environment undermines the potential for the economy to grow on a sustainable basis. The costs of environmental degradation in Uganda have been conservatively estimated to be between 4-12 percent of the gross national income (GNP).

2.3.2 Health and safety problems from wood shavings and sawdust

Airborne of wood shavings and sawdust accumulations present a number of health and safety hazards (Nyiszli, 2011). Wood shavings and dust become a potential health problem when, for example, the wood particles, from processes such as sanding, become airborne and are

inhaled. Wood shavings and saw dust is a known human carcinogen. Certain woods and their dust contain toxins that can produce severe allergic reactions.

Water-borne bacteria digest organic material in leachate, but use up much of the available oxygen. This high "biological oxygen demand" can suffocate fish and other organisms. There is an equally detrimental effect on beneficial bacteria, so it is not at all advisable to use wood shavings and sawdust within home aquariums, as was once done by hobbyists seeking to save some expense on activated charcoal.

People can be exposed to wood dust in the workplace by breathing it in, skin contact, or eye contact. The Occupational Safety and Health Administration (OSHA) has set the legal limit (permissible exposure limit) for wood shavings and sawdust exposure in the workplace as 15 mg/m³ total exposure and 5 mg/m³ respiratory exposure over an 8-hour workday. The National Institute for Occupational Safety and Health (NIOSH) has set a recommended exposure limit (REL) of 1 mg/m³ over an 8-hour workday (CDC - NIOSH, 2015).

2.4 Solutions to Environmental Safety Problems of Wastes in the Workshops

There are numerous challenges facing today's carpentry and joinery workshops. Some of the challenges are new to the industry, and some are centuries old. Many of these challenges are a direct result of production operations, while others as a result of indirect, peripheral activities. According to Brund land commission (1987), the impact of environmental issues on production has been escalating since the 1970's. Today, every vocation including carpentry and joinery is bound to clearly define duties and liabilities regarding the environment. This implies that all sectors of the industry are affected by one or more environmental issues. Therefore, strict regulation, permitting requirements, and enforcement are designed to protect human health and the natural environment. In my opinion, failure to comply with environmental regulations should result in project delay or termination, disqualification from future work opportunities, fines, civil action, and even criminal prosecution. Basing on the previously mentioned solutions, it is paramount that the carpentry and joinery workshop in Civil and Building Engineering Department Kyambogo University have full knowledge and understanding of environmental regulations and permit requirements. Major Federal regulations that apply to sawdust management activities in developed countries include the water pollution control act (clean water act), clean air act, resource conservation and recovery act, and the comprehensive environmental response compensation and liability act. Individual

states, counties, and municipalities in the developed world have laws that supplement or are even more stringent than the federal regulations in institutions of higher learning.

2.5 Conclusion

The literature by different scholars elsewhere who conducted similar research about wood shavings and sawdust management were reviewed in this chapter. The reviewed literature was used to compare this study with that of other scholars mentioned in literature in the discussion of the major findings of this study.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter presents the research methods used by the researcher in answering the research problem and the gathering of data to answer the research questions. This chapter includes the research design, study population, determination of sample size, sampling techniques and procedures, data collection methods, data collection instruments, validity and reliability tests, procedure of data collection, data analysis and ethical considerations.

3.2 Research Design

A research design is a specific plan or protocol for conducting the study which allows the investigator to translate the conceptual hypothesis into an operational one. This study used descriptive study design and a case study of research design. A case study is defined as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used (Yin, 1994). This research examined the environmental degradation, health and safety related issues of concerns by the stakeholders. One of the advantages of a case study design is that it gives a holistic analysis of complexities of action and meaning. Secondly, it allows for a close view of the subject under study. The thirdly, it increases the quantitative and qualitative as well as the historical approaches utilized in the study.

The research is action based. This implies that a wide variety of evaluative, investigative and analytical research methods designed to identify the problems or weaknesses whether organizational, academic or instructional will and have been applied to help educators develop practical solutions to address them quickly and efficiently as supported by Sannerud (2014). The process of wood shavings and sawdust management being action in nature in the department of civil and building engineering in Kyambogo University, it calls for an enquiry which is carried out in order to understand, evaluate and then change, in order to improve educational practice as supported by Bassey (1998). Hopkins (2002) maintains that 'action research combines a substantive act with a research procedure; it is action disciplined by enquiry, a personal attempt at understanding while engaged in a process of improvement and reform. Cohen and Manion (1994) describe the emergent nature of action research in their definition. They describe action research as essentially an on-the-spot procedure designed to deal with a concrete problem located in an immediate situation. This means that ideally, the

step-by-step process is constantly monitored over varying periods of time and by a variety of mechanisms (questionnaires, diaries, interviews and case studies, for example) so that ensuring feedback may be translated into modifications, adjustment, directional changes, redefinitions, as necessary, so as to bring about lasting benefit to the ongoing process itself rather than to some future occasion. Action research is a cyclical process that takes shape as knowledge emerges. Cycles converge towards better situational understanding and improved action implementation, and are based in evaluative practice that alternates between action and critical reflection.

This study carried out action research in which stake holders were met and the problem was identified as environmental degradation and health and safety related issues of the carpentry and joinery workshop. This was carried out using open ended questions, interview guides, observations and taking photos. Measures to solve the problem were marked out, the researcher being staff, in practical area was to work with students, staff and management to solve the problem. Solution of the problem was formulated and presented including fabrication of briquette machine. A survey was conducted to find out how ten selected workshops in Kampala are minimizing environmental degradation and managing health of employees and safety at the workplace in order to propose appropriate methods of managing wood shaving and sawdust.

3.3 Action Plan

An implementation work plan was designed by stakeholders and agreed on tasks and responsibilities each ones is going to take. The researcher followed up on these activities to check what has been done and if not why?

Conducting an action research forms a complete cycle of activities from democratically identifying the problem together with stakeholders to solving the problems of the affected community. The complete cycles of action research activities include the following: plan, act, observe, reflect, and plan again and the cycle continuous until the problem is solved as presented in figure 3.1.

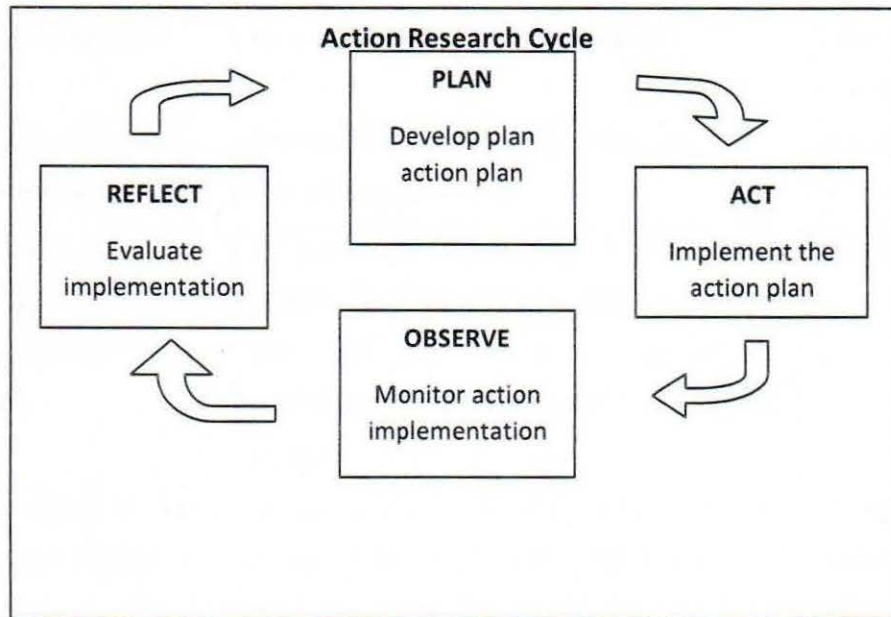


Figure 3.1: Action research cycle

Source: Sannerud (2015)

Plan

The stakeholders in the action research conducted met, identified the problem and developed an *action plan*, where members were assigned tasks to solve the challenges in the Management of Wood shavings and sawdust at the CBED Kyambogo University.

Act

The action plan was *implemented* by each stakeholder who included the students, the lecturers, technicians and the HOD of Civil and Building Engineering Kyambogo University.

Observe

The researcher regularly met the stakeholders to *monitor* the action implementation, and enable stakeholders to share their experiences and learn from each other.

Reflect

In the action research conducted, the researcher and stakeholders met to *evaluate* the successes and the challenges encountered in order to achieve the desired goal.

Planning

In the situation where success was not fully registered in the initial round of action research conducted, stakeholders brainstormed and developed an alternative *action* to solve the problem or subsequent problems. The detail schedule for action plan is presented in Table 3.1.

Table 3.1: Research Implementation Work Plan

S/N	Identified Challenges	Proposed Solutions by stakeholders	Stakeholders Responsible
01	Bad smell as a result of rotting of sawdust	Burning sawdust and removing ash from a bay where it was burnt	Management/ Students
02	Lack of proper record keeping of sawdust that has been produced at the department	To put in place a proper record keeping system of wood shavings and sawdust that has been produced every day in the workshop at civil department when training students.	Researcher
03	Improper storage of wood shavings and sawdust	To put in place a sorting room of sawdust, so that it can be properly graded and sorted out some targets that would cause danger to the end users	Management/ Student
04	Insufficient storage space of wood shavings and sawdust	Put sign posts with in civil and building engineering department to remind the users and keep dumping sawdust in a targeted bay.	Management
05	Un improved dumping bays for sawdust	Fencing and improving the targeted bay	Management
06	Wood shavings and Sawdust can become source of fire outbreak	To identify the store room in a targeted area for keeping wood shavings and sawdust.	Management/ Researcher
07	Misuse of gazetted sawdust bays	To put a penalty for misuse of the bay (100,000/=)	Management/ Researcher
08	Wood shavings and Sawdust has degraded the environment at Civil Department	To put rules around Civil and Building Engineering Department for guiding users of sawdust.	Management/ Lecturers
09	Lack of sensitization in handling sawdust at Civil Department	Awareness raising on handling wood shavings and sawdust at Civil Department	Researcher

3.4 Study Population

This was divided into two; the general research included industry and particular research at DCBE, and each had its study population. The study population for general research was drawn from the selected workshops in Kampala. These were obtained from yellow pages, Uganda small scale industries associations and Uganda manufacturers associations totaled up to 37 as indicated in the Table 3.2. To ensure that all representatives are obtained, the workshops were grouped according to their sizes which are proportional to the number of people, equipment and good state 4 were considered large 37.

Simple random sampling methods was also used to select students to participate in the study after purposively selecting their classes.

Table 3.2: Selected carpentry and joinery workshops in Kampala

Workshops in Kampala	Large	Medium	Small
Total workshops	8	12	17
Selected workshops	3	3	4

3.5 Sampling Techniques

Purposive sampling technique is a common non-probability technique where the researcher selects a sample basing on personal knowledge and experience of the group to be sampled. In addition, purposive technique was used because it provides the researchers with justification to make generalizations from the population that is being studied, whether such generalizations are theoretical or analytic in nature. The technique was used to give equal selection probability to the stakeholders (Amin, 2005). A table of targeted samples was obtained for the research activities. This was done to appropriately select students, lecturers, technicians, administrators and workshop owners as indicated in table 3.2.

3.6 Sample Size and Selection Criteria

Different selection criteria for each group of the study population were used. Out of the 55 students of bachelors and diplomas, we purposively selected 12 those with technical background in both carpentry and joinery. The second stage one lecturer and one technician from of CBED were selected using purposive sampling technique based on its usefulness in identifying the respondents. In the third stage one, administrator was selected randomly to act

as a key informant for the study. Lastly, ten workshop owners were selected randomly to act as key informant of the study as presented in Table 3.3.

Table 3.3: Sampling Procedure

Category	Total population	Sample population	Sampling strategy	Reason
Students	55	12	Random	Not to bias
Lecturers	15	1	Purposive	Knowledge able about the subject
Technicians		1	Purposive	Knowledge able about the subject
Administrators	2	1	Random	Not to bias
Workshop owners	37	10	Random	Not bias
Total	72	25		

Source: **Field data**

3.7 Types of data used

3.7.1 Primary sources of Data

Primary data collected related to variables in the study. In this case interviews were carried out on key informants this is because these were expected to be knowledgeable and direct information that was needed for the study.

3.7.2 Secondary sources of Data

Library and archival survey was used as a secondary source of data collection. According to Wangusa (2007) library and archival survey method of data collection enhances the analysis of the findings in relation to the objectives of the study as well as the relationship of the extension strategies used by the developed countries. The library and archival survey included documents such as reports, journals, conference proceedings and textbooks in relation to the study. Library and archival survey was further sought to validate the responses given by the stakeholders from the Department of Civil and Building Engineering in Kyambogo University through analysis of documents.

3.8 Data Collection Methods

The research started with the Work Process aimed at identifying the competencies required in the production of wood shavings and sawdust and challenges encountered in the process of improving of wood shavings and sawdust management. The Future Workshop was then used to find solutions to the challenges encountered when improving wood shavings and sawdust management. The stakeholders included; lecturers, technicians, administrators, students and researcher to get involved in skills development when improving wood shavings and sawdust management. Consequently, in order to determine competencies required at workplaces and challenges encountered by all stakeholders, research survey conducted in the following workshops; Master Wood in Luzira, White Rhino, Lugogo Vocational, Nakawa Vocational Kava International, Circular Workshop, Erima, World and Living, Awaka Home Interior and Kyambogo University. The findings from all the research conducted and actions taken are aimed at improving the management of wood shavings and sawdust at Civil and Building Engineering Department of Kyambogo University.

3.9 Data Collection Instruments

Data collection instruments included interview guide, camera, VIP cards and log book. These instruments gave the information needed about the research problem of the study.

3.9.1 Interview Guide

An interview guide was used to solicit information from the HOD who was the key informant. According to Amin (2005) interviews obtain information by means of spoken words and this is essential in obtaining more data and more clarity on the study problem. This was superior because it enabled the interviewer probe the selected top management officers until the relevant data was got.

3.9.2 Observation

Participant observation was employed to record pertinent happenings. Here the researcher used his eyes to observe how wood shavings and sawdust was being managed at the different workshops. He looked into the quantity being generated, the disposal methods, environmental degradation, health and safety and how the wood shavings and saw dust was being used for among others in term of management.

3.9.3 Sections of the Interview Guide

Wood shavings and Sawdust management: This section sought to find out if the Department had a good management of wood shavings and sawdust that could protect environmental degradation and safety hazards.

Work and training Environment: This section of the interview guide was used to find out if the Department had both good psychosocial and physical working and training environments. It also gave a detailed inquiry of how wood shavings and sawdust management ensured feedback, mentoring and coaching, learning and development, supervisors support and how work relationship initiated by management to ensure a conducive working and training environment for stakeholders (students, lecturers, technicians and HOD)

3.10 Validity

Validity and reliability were measures used for data quality control. This was done by ensuring acceptable levels of validity and reliability. According to Amin (2005), validity is useful in ensuring accuracy and acceptability of the data while reliability is concerned with the consistency of the results to yield similar results when the research is carried out by others. To ensure the validity of the data collected the data was coded, cross checked and edited by the researcher before the analysis.

3.11 Reliability

Reliability refers to the extent to which the research instrument will yield consistent findings Jonathan, (2012). This is the ability of an instrument to produce the same results whenever it is repeatedly used to measure a variable or concept from the same respondents even by other researchers. The researcher adopted a split-half as follows:

$$\frac{\text{Reliability}}{\text{Scores on total test}} = \frac{2 \times \text{reliability } \frac{1}{2}}{1 + \text{reliability } \frac{1}{2}}$$

In order to ensure the reliability of the research instruments, pretesting was done on some students at Kyambogo University and the necessary adjustment was done before proceeding to collect the data from the respondents.

3.12 Ethical Considerations

- Permission was first sought from the relevant authorities at Civil Department with an introductory letter from the Department of Art and Design, Kyambogo University.
- Academic ethical values of anonymity and confidentiality of respondents considered for the study were upheld.
- Respondents participated on a voluntary basis and a declaration of informed consent form was presented to the respondents.
- Respondents were assured that data collection was for only academic purposes and evidence would be destroyed after analysis of responses.

3.13 Conclusion

After successful completion of data collection and analysis using the methods, instruments and procedures described in chapter three, the findings of the study were then presented in chapter four.

CHAPTER FOUR

PRESENTATION, ANALYSIS AND INTERPRETATION OF FINDINGS

4.1 Introduction

This chapter sets out the presentation, analysis, and interpretation of the findings of the study which was conducted to devise ways of improving of wood shavings and sawdust management at Department of Civil and Building Engineering, Kyambogo University.

4.2 Demographic Characteristics of Respondents

This included sex, age brackets and main occupation of the respondents.

4.2.1 Sex of Respondents

Respondents were asked to state their sex and the response were presented in Figure 4.1.

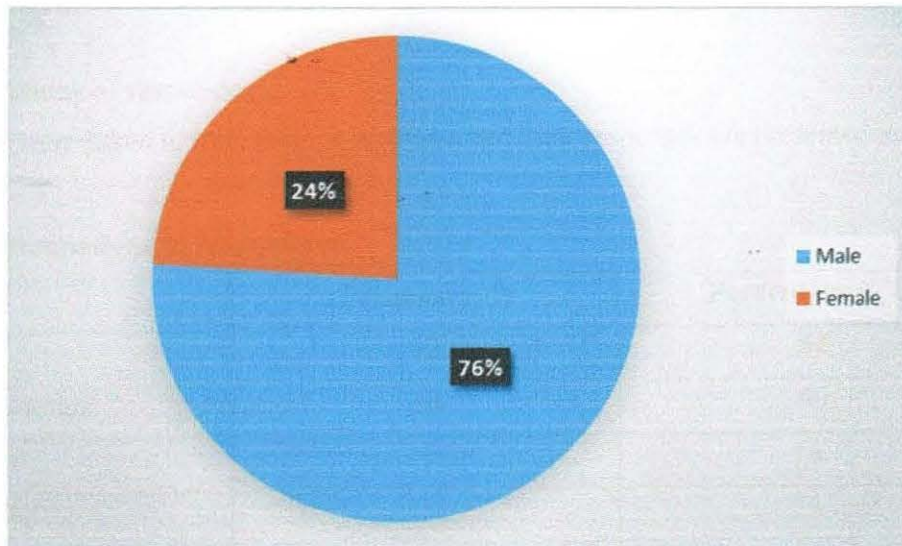


Figure 4.1: Sex of Respondents

The findings in Figure 4.1 show that majority of respondents were male 19(76%) compared to female 6(24%). There were more male than female because of nature of the civil engineering work that requires a lot of energy and according to African setting construction work were for men while women were responsible for house work.

4.2.2 Age brackets of respondents

Respondents were asked to state the age bracket in which they belong and their responses were presented in Table 4.1.

Table 4.1: Age brackets of the respondents

Occupations	Frequency (f)	Percentage ((%)
Under 25 years	12	48
25-29 years	1	4
30-34 years	2	8
35-50 years	4	16
Older than 50 years	6	24
Total	25	100

Source: Field data

The findings in table 4.1 show that most respondents were under 25 years 12(48%), followed by older than 50 years 6(24%), 35-50 years 4(16%), 30-34 years 2(8%) and 25-29 years 1(4%) only. Majority of the respondents were under 25 years because most of them were students and youth who were working in the workshops.

4.2.3 Occupations of respondents

Respondents were asked to state their occupations and their responses are presented in Table 4.2

Table 4.2: Occupations of respondents

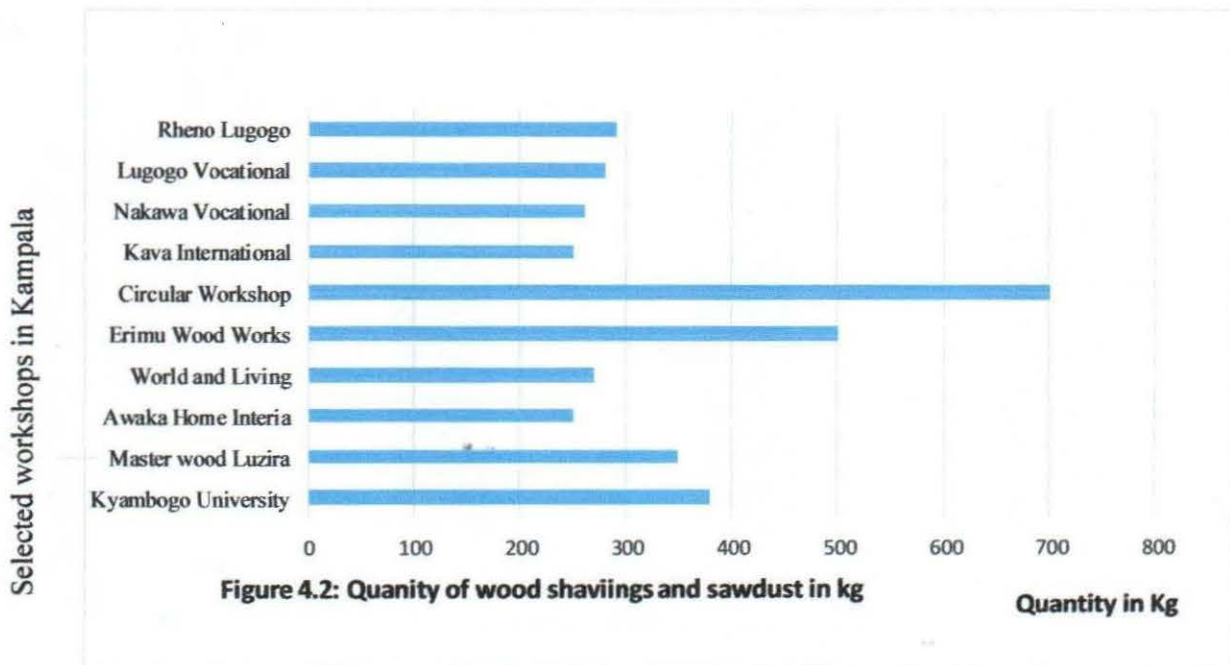
Category	Frequency (f)	Percentage ((%)
Students	12	48
Workshop owners	10	40
Technicians	1	4
Administrator	1	4
Lecturer	1	4
Total	25	100

Source: field data

The findings in Table 4.2 show that majority of the respondents were students 12 (48%), followed by workshop owners 10(40%), technician, administrator and lecturer with 1(4%) each.

4.2.4 Quantity of wood shavings and sawdust generated

Respondents were asked to indicate the quantity of wood shavings and sawdust generated from the workshop in kilogram per day and their responses were presented in the Figure 4.2.



Source: Field data

The findings in Figure 4.2 showed that Circular Saw Workshop is the leading producer of wood shavings and sawdust with 700kg per day, followed by Erimu Wood Work with 500kg per day, Kyambogo University 380kg per day, Master Wood Luzira with 350kg and the rest with less than 350kg production per day. Circular Saw Workshop and Erimu Wood Works Limited were the leading producers of wood shavings and sawdust because they have so many customers compared to the workshops.

4.3 The current methods of disposing wood shavings and sawdust

Respondents were asked to state the methods they use in disposing off wood shavings and sawdust from their workshops and their responses were presented in Figure 4.3.

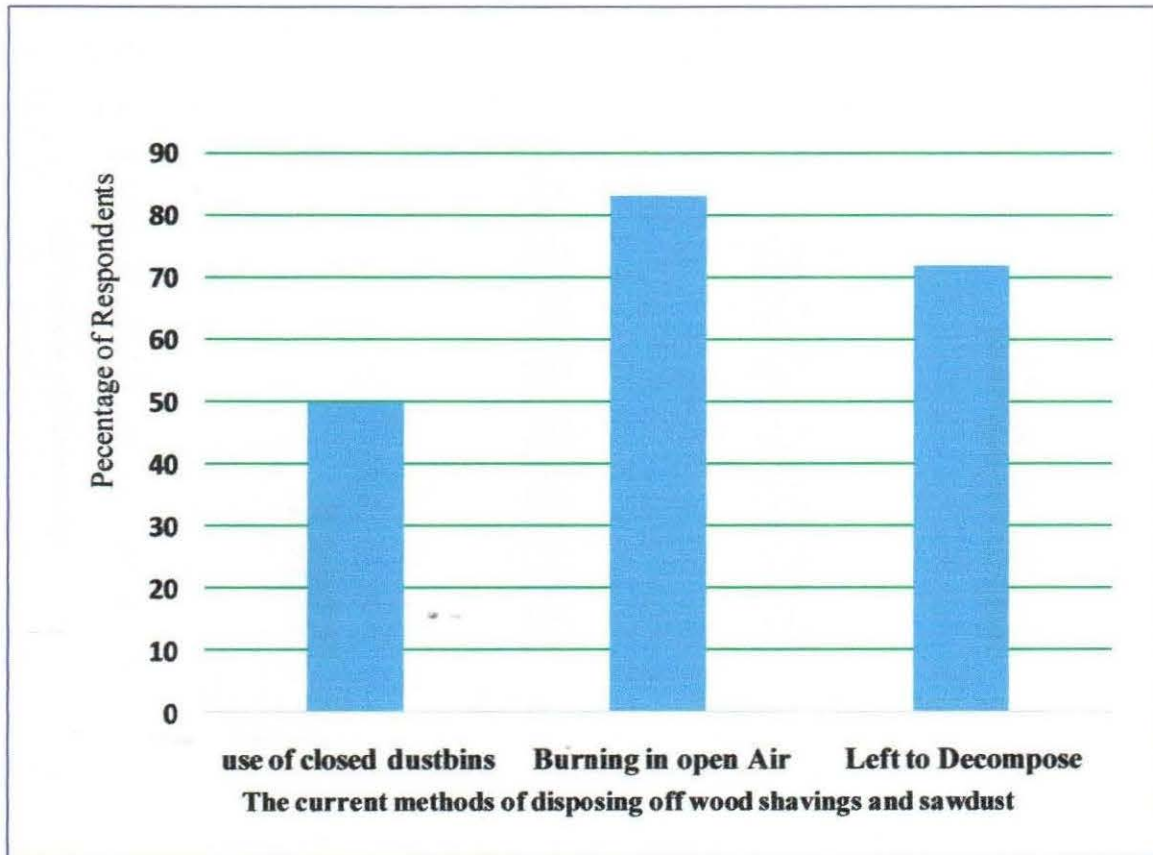


Figure 4.3: The current methods of disposing wood shavings and sawdust

Source: Field

The findings in Figure 4.3 show that majority of the respondents dispose off their wood shavings and sawdust by burning in open air (85%), followed by those who leave them to decompose (71%) and those who use closed dustbins (50%) only. Burning in open air and leaving it to decompose took the lead because most workshop owners do not want to incur cost of paying for the transport to safe disposal sites.

4.4 The environmental and safety problems of wood shaving and sawdust

These included both environmental and health problems.

4.4.1 Environmental problem of wood shaving and sawdust

Respondent were asked to state the environmental problems of wood shavings and sawdust on the environment and their responses were presented in Figure 4.4.

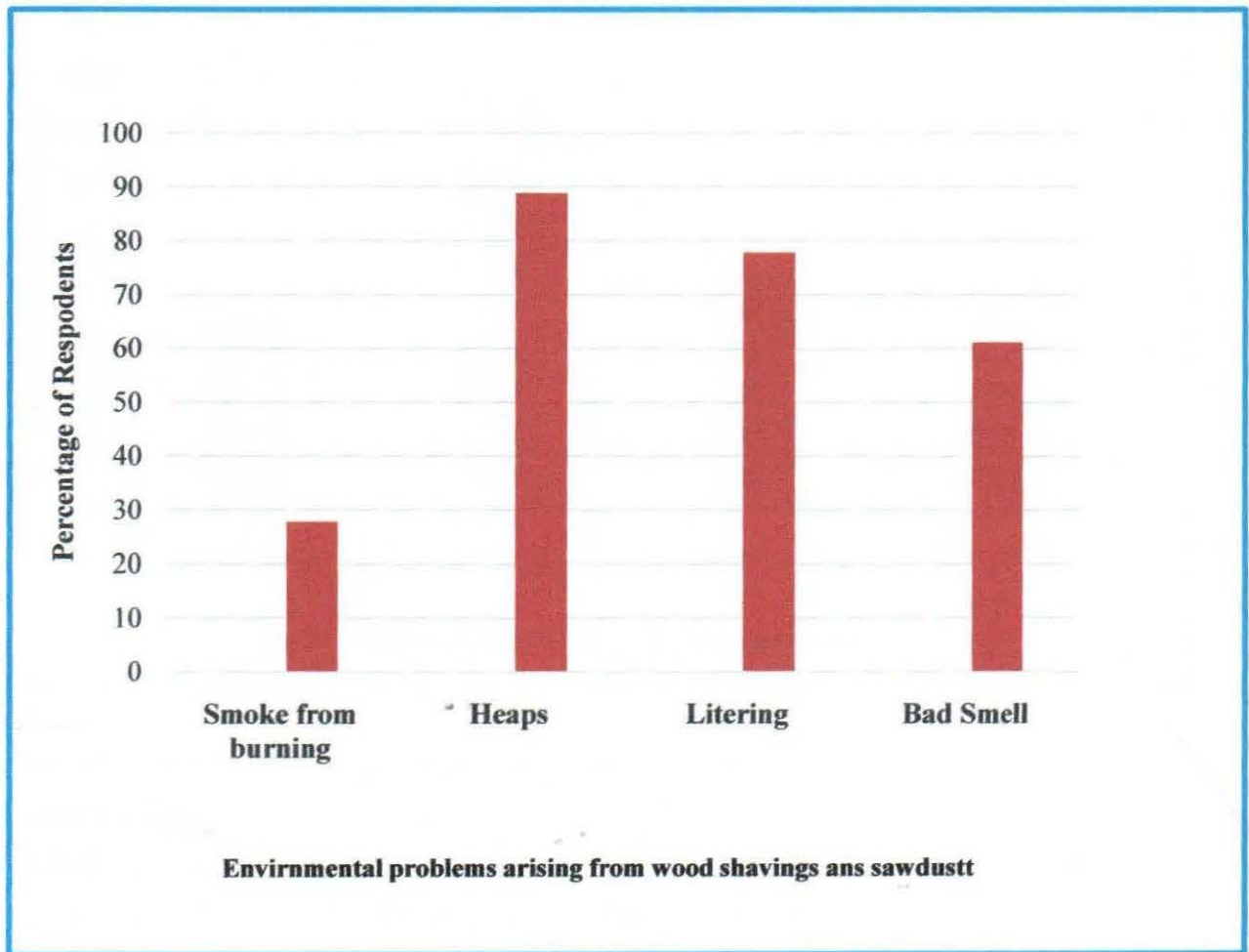


Figure 4.4: Environmental problems of wood shavings and sawdust

Source: Field data

The findings in Figure 4.4 show that the major environmental effect of wood shaving and sawdust was heaped with 90%, hence degrading the environment, followed by littering 78%, bad smell 62% and smoke from burning with 28% only. Heaping and littering took the lead because it makes the environment untidy.

4.4.2 Health and Safety problem of wood shavings and sawdust

Respondents were asked to indicate the health and safety problem arising from wood shavings and sawdust and their responses were presented in Figure 4.5.

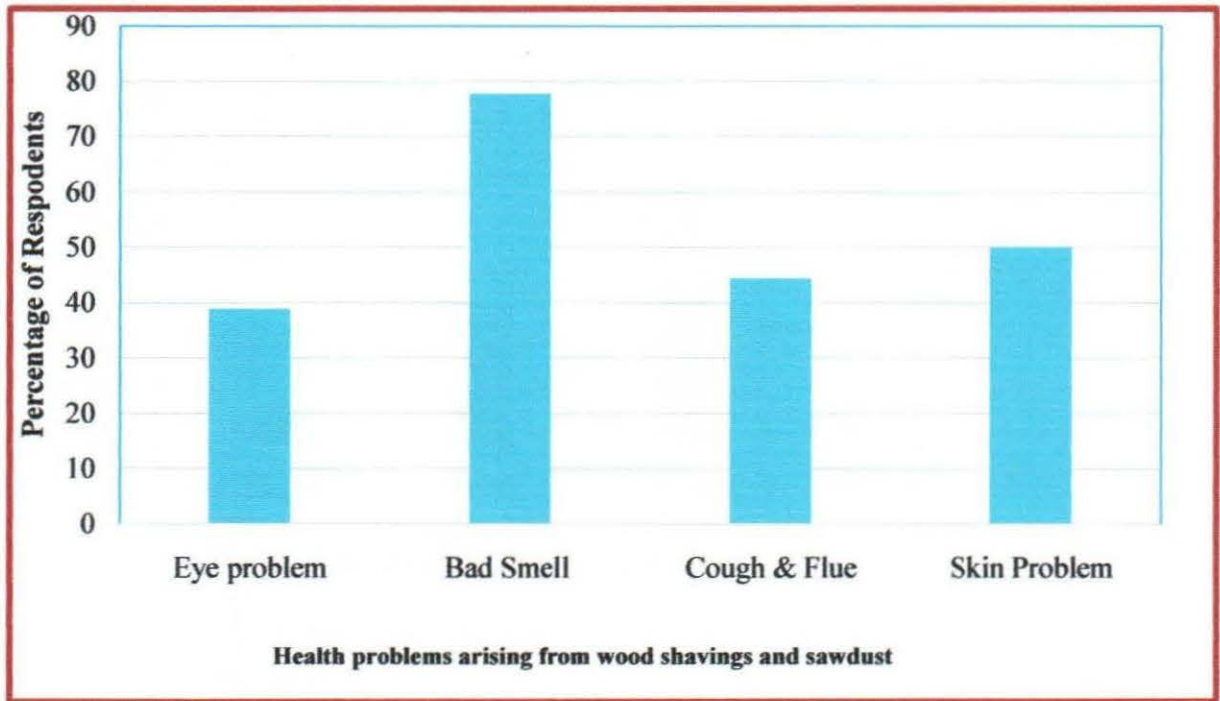


Figure 4.5: Health problems of wood shavings and sawdust

Source: Field data

The findings in Figure 4.5 show that the major safety problem arising from wood shaving and sawdust was bad smell (78%), followed by skin problem (50%), cough and flue (45%) and eye problem (39%) only. Bad smell and skin problems took the lead because wood shavings and sawdust contain toxins that can produce severe allergic reactions.

4.5 The methods of management of wood shaving and sawdust in selected carpentry and joinery workshops in Kampala

In order to establish the methods of management of wood shavings and sawdust, respondents were asked to state how they use wood shavings and sawdust generated from their workshop and the results are presented in Figure 4.6.

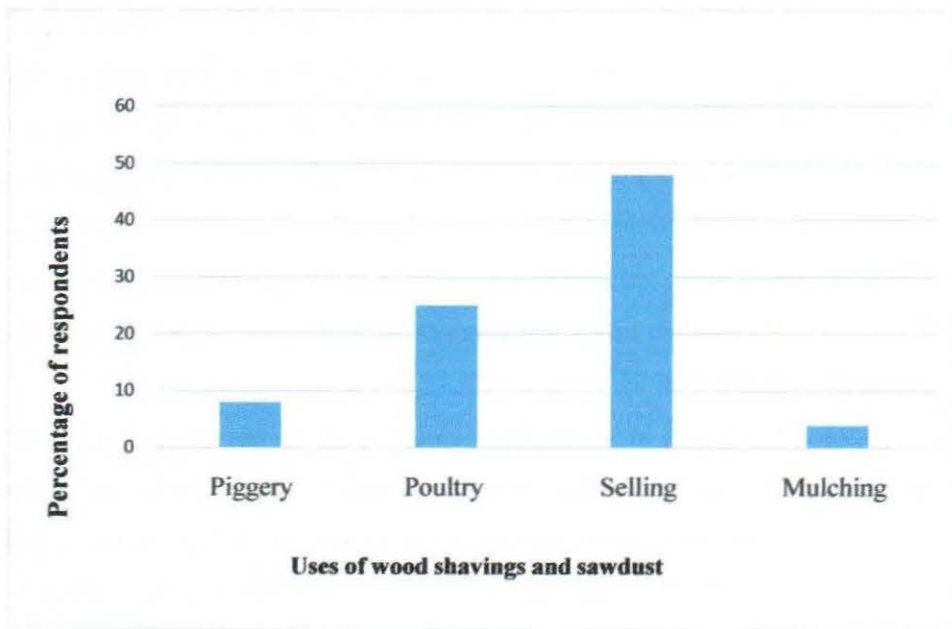


Figure 4.6: Uses of wood shavings and sawdust.

Source: Field data

The findings in Figure 4.6 show that most workshop owners were using their wood shavings and sawdust for selling (48%), followed by poultry (25%), piggery (9%) and Mulching (4%) only. selling was one of the highest use because most workshop owners have the ready available market especially Mukwano Group of Companies which buys it and use for steam generation for running their boilers.

4.5.1 Work Process Analysis

According to work process analysis conducted from Master Wood in Luzira and White Rhino near Lugogo, World and Living Mpererwe, Circular workshop Gayaza Road, Awaka near Uganda Baati, Kava international Kamuri Road Kireka, Erimu ltd in Nsangi, Swang sung Uganda ltd, Marks Processing Industries near ministry of works offices at Kyambogo, revealed that research from world of work indicated that the main buyer across the country is Mukwano companies' ltd who purposely to generate steam that is used in boilers in factory.

Also, the survey conducted in the world of work, revealed that wood shavings and sawdust management is done through collecting it from different sawing machines and end up disposing to one allocated store/room, drying of the collected wood shavings and sawdust to reduce the moisture humidity, grading wood shavings and sawdust in different thickness sizes, packing wood shavings and sawdust according to their sizes in sacks of 100kg and finally selling individually. The findings from all the research surveys conducted and actions taken, aimed at improving the management of wood shavings and sawdust at Civil and Building Engineering Department of Kyambogo University. In order to carry out qualitative research when improving wood shavings and sawdust management at CBED, collaboratively we involved all stakeholders who participated in the future workshop and these included lecturers, administrators, technicians, students and researcher.

4.6 Proposed solution to problems arising from wood shaving and sawdust at CBE

In proposing the solution to improve on the management of wood shavings and sawdust at the CBE department. The researcher and all stakeholders came up with an option of making briquettes from wood shavings and sawdust as presented in the next section.

4.6.1 Making briquettes from wood shavings and sawdust

The researcher used different materials and tools for making the briquettes.

4.6.2 Materials used for making briquette

- Wood shavings and sawdust
- Clay
- Crushed news pepper
- Binder (cassava flour mixed with water)

- Charcoal dust

4.6.3 Tools used

- Spades
- Sacks
- Moulds in different shapes and sizes
- Solid pallets
- Spaced pallets
- Rammer
- Board
- Containers
- Saucepan
- Hammer
- Tape measure

4.6.4 Procedures for making briquette

- i. Collecting of wood shavings and sawdust from different sawing machines to one allocated store/room.

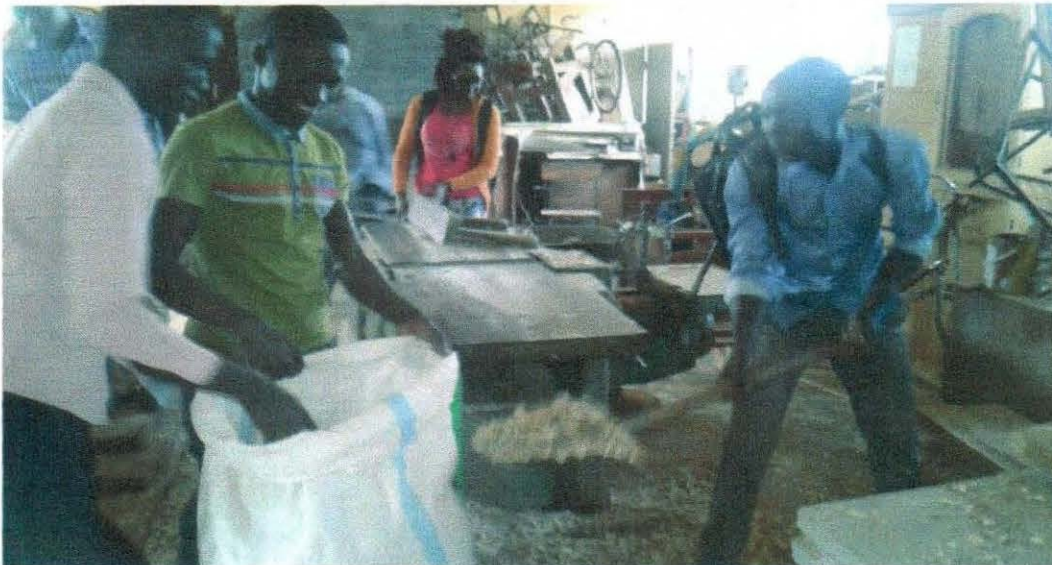


Figure 4.7: Researcher and the students collecting and packing in sacks wood shavings and sawdust (2016).

- ii. Transferring the collected wood shavings and sawdust packed in sacks to the store



Figure 4.8: Wood shaving and sawdust being stored by the researcher and students for further processing into briquette (2016).

iii. Sieving the materials to remove coarse particles





Figure 4.9: Researcher and the students sieving materials for briquette making (2016).

- iv. Cooking the cassava flour to be used as a binding material

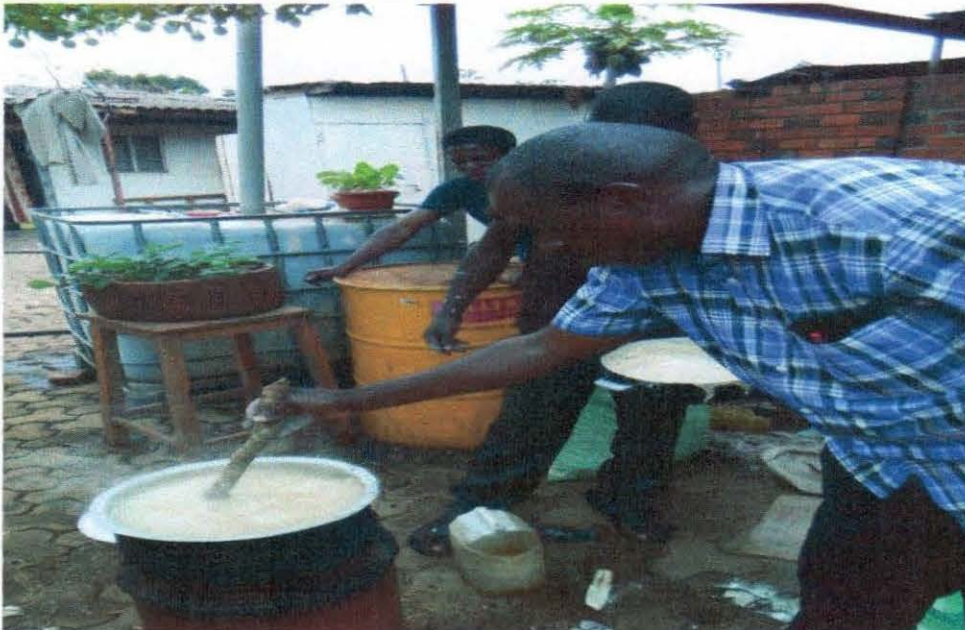


Figure 4.10: Researcher and the students cooking the cassava flour to make a binder (2016).

- v. Mixing of the sieved materials (wood shavings/sawdust, charcoal dust, crushed news pepper and clay) with the binder (liquid cassava flour)

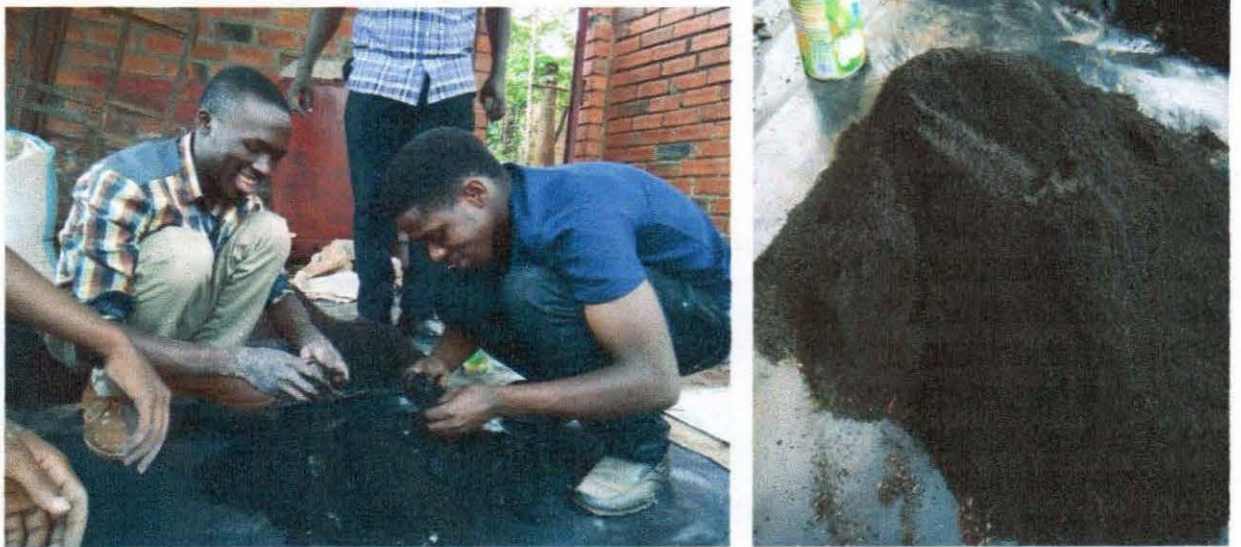


Figure 4.11: Researcher and the students mixing the raw materials for making briquettes (2016).

- vi. Setting up the moulds and pallets to be used in moulding of briquettes



Figure 4.12: Researcher and one of the students setting up moulds and pallets to be used in moulding of the briquettes (2016).

- vii. Compacting the mixed materials into moulds to make briquettes.



Figure 4.12: Researcher and students moulding briquettes (2016).

viii. Extracting the briquettes from the moulds



Figure 4.13: Researcher and students extracting briquettes from moulds (2016).

ix. Drying the briquettes



Figure 4.14: Briquettes produced by researcher and students being dried (2016).

CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the discussion, conclusions and recommendations from the findings of the study which was conducted to assess the management of wood shavings and sawdust at CBD, Kyambogo University. The findings of other researchers who carried out similar studies elsewhere were also compared with this study.

5.2 Discussion

5.2.1 The current methods of disposing off wood shavings and sawdust at CBED

Majority of the respondents indicated burning in an open air as being one of the major methods of disposing off wood shavings and sawdust at CBED, Kyambogo University. This is due to the fact that it is cheaper to burn wood shavings and sawdust in an open air space but this method is associated with the risk of fire out break and air pollution from the smoke. This finding is in agreement with (Fonseca and Tierra 2011) who stated that burning wood shavings and sawdust in an open air is harmful to human health and a safety risk with regard to fire and spontaneous combustion.

This finding is further supported by the interview the researcher had with one of the respondents who stated that *“We dispose off our wood shavings and sawdust by burning in open air because it is cheaper since we do not have means of transporting them to disposal site. However, there is risk of fire out break and air pollution arising from this method which we normally take precautions against them”*.

Leaving wood shavings and sawdust to decompose was also mentioned by most respondents in Figure 4.3 as the second major method of disposing of wood shavings and sawdust at CBED, Kyambogo University. This is because of lack of adherence to workshop regulations resulting into negligence by the workshop attendants leaving the wood shaving and sawdust to decompose instead of using proper disposal mechanisms. This finding is supported by the interview the researcher had with one of the respondents who stated that *“Wood shavings and sawdust are left to decompose because the bays for burning them became full and no effort has been made to construct new ones”*.

Use of closed dustbin was also mentioned by some respondents in Figure 4.3 as being one of the methods of disposing off wood shavings and sawdust at CBED, Kyambogo University. This is because it minimizes the contamination and pollution of the environment. This finding is in line with the interview the researcher had with one of the respondents who stated that *“We always use closed dustbin for keeping the wood shavings and sawdust because it prevent the contamination and control the bad smell arising from them”*.

5.2.2 The environmental and safety problem arising from wood shavings and sawdust at CBED

Most respondents where indicated heaping as being one of the major environmental problem arising from wood shavings and sawdust at CBED, Kyambogo University. This is because heaping wood shavings and sawdust degrades the environment. This finding is in agreement with (Nyiszli, 2011) who asserted that wood shavings and sawdust may collect in piles and add harmful leachates into local water systems, creating an environmental problem.

Littering was also indicated by most respondents in Figure 4.4 as being one of the major environmental problems arising from wood shavings and sawdust at CBED, Kyambogo University. This is because it makes the environment untidy and unsafe as it may injure the students during training. This finding is supported by the interview the researcher had with one of the respondents who stated that *“Wood shavings and sawdust has littered our environment causing injury to students, technicians and lecturers who always use the workshop”*

5.2.3 Health Problems of wood shavings and sawdust

Bad smell was mentioned by the majority of the respondents as being the major environmental problems arising from wood shavings and sawdust at CBED, Kyambogo University. This is due to the fact that as wood shavings and sawdust broken down by microorganisms, realizes bad smell as a result of toxin. This finding is in agreement with (Fonseca and Tierra 2011) who stated that, wood shavings and sawdust, when burnt in an open, it is harmful to human health and a safety risk with regard to fire and spontaneous combustion.

Further findings showed that skin, eye, cough and flue were some of the health problem arising from wood shavings and sawdust at CBED, Kyambogo University. This because

wood shaving and sawdust releases toxic chemical and fume that affect the workshop users and the surrounding people. This finding is in line with (CDC - NIOSH, 2015) which stated that people can be exposed to wood dust in the workplace by breathing it in, skin contact, or eye contact. The Occupational Safety and Health Administration (OSHA) has set the legal limit (permissible exposure limit) for wood shavings and sawdust exposure in the workplace as 15 mg/m³ total exposure and 5 mg/m³ respiratory exposure over an 8-hour workday.

5.2.4 The methods of management of wood shavings and sawdust

Selling was stated by most respondents as being one of the major methods used in managing wood shavings and sawdust in selected workshops in Kampala. This is because most workshop owners have ready market from Mukwano Group of Companies which buys it and use for steam generation for running their boilers. This finding concurred with (Ganiron, 2013) who stated that wood shavings and sawdust have a variety of other practical uses, including serving as mulch, as an alternative to clay cat litter, or as a fuel.

This finding is further supported by the interviews, the researcher had with one of the respondents who stated that *“We manage our wood shavings and sawdust by selling them to Mukwano Group of Companies and others who use them for poultry, piggery and mulching. But Mukwano is the leading buyer”*.

5.3 Proposed solution to problems arising from wood shaving and sawdust at CBE

Briquettes making was chosen by the researcher and other stakeholders as being one of the major options of improving the management of wood shavings and sawdust at CBED, Kyambogo University. This is because in training students, value addition is important and it is emphasized in national development. Mukwano industries buys at a cheap price and the utilization of wood shavings and sawdust will be based on how to turn wood shavings and sawdust into briquettes. This finding is supported by (Green, 2006) who asserted that wood shavings and sawdust is used in the manufacture of charcoal briquettes. The claim for invention of the first commercial charcoal briquettes goes to Henry Ford who created them from the wood scraps and sawdust produced by his automobile factory.

5.4 Conclusions

Burning in an open air, leaving to decompose and use of closed dustbins were the current methods being used to dispose off wood shaving and sawdust at CBED, Kyambogo University.

Heaping, littering, bad smell, skin and eye problems were the major environmental and health problems arising from wood shavings and sawdust at Carpentry and Joinery workshop, Kyambogo University. Heaping was the one with the most severe effect.

Selling, poultry, piggery and mulching were the major methods of managing wood shavings and sawdust used in the selected workshops in Kampala. Woods shavings and sawdust can be put to a better environmentally friendly and economical use for example briquettes making.

Briquette making was used by the researcher as the major option to the proposed solutions of improving the management of wood shaving and sawdust at CBED, Kyambogo University.

5.5 Recommendations

The University management need to embrace and support this research project of making briquettes from wood shavings and sawdust when training students in order to minimize the environmental degradation and health problems arising from the Carpentry and Joinery workshop at CBED, Kyambogo University. This could also provide students with production skills and generate income for the department and the University at large and latter for themselves after graduation.

The management need to put in place appropriate methods of disposing off wood shavings and sawdust like selling, taking it to the farm to be used as animal feeds for piggery and poultry in the University farm.

The management need to provide Personal Protective Equipment (PPEs) and ensure that they are properly being used by the people using the Carpentry and Joinery workshop. This could help to protect them against health and safety hazards arising from wood shavings and sawdust.

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APPENDIX I: QUESTIONNAIRE FOR WORKSHOP OWNERS /EMPLOYEES

Dear respondents, I am Akunda Timothy a student of Kyambogo University conducting a research on improving wood shavings and sawdust management in civil and building engineering department as part of the requirements for the award of a Masters Degree in Vocational Pedagogy of Kyambogo University. I am requesting you to participate in this study by answering the questions provided. The information given will be used for academic purpose only and will be treated with highest level of confidentiality.

Instruction:

Please tick the option(s) in the box or write the appropriate answer in the space provided.

Name of the institution/workshop:.....Location:.....

PART A: DEMOGRAPHIC INFORMATION		
1.1	Sex	1. Male <input type="checkbox"/> 2. Female <input type="checkbox"/>
1.2	Which age bracket do you belong?	1. Under 25 <input type="checkbox"/> 2. 25 to 29 <input type="checkbox"/> 3. 30 to 34 <input type="checkbox"/> 4. 35 to 50 <input type="checkbox"/> 5. Older than 50 <input type="checkbox"/>
1.3	What is the main occupation	1. Cleaner <input type="checkbox"/> 2. Employed <input type="checkbox"/> 3. Owner <input type="checkbox"/> 4. Technician <input type="checkbox"/> 5. Manager <input type="checkbox"/> 4. Other (Specify).....
SECTION B:IMPROVING WOOD SHAVINGS AND SAWDUST MANAGEMENT		
2.1	What quantity of the sawdust and wood shavings do you generate per day	1. 50-299kg <input type="checkbox"/> 2-300-499kg <input type="checkbox"/> 3. 400-599kg <input type="checkbox"/> 4-600kg & above <input type="checkbox"/>
2.2	What is the use of sawdust generated	1. Manure <input type="checkbox"/> 2. Poultry <input type="checkbox"/> 3. Selling <input type="checkbox"/> 3. Piggery <input type="checkbox"/> 4. Mulching <input type="checkbox"/> 5. Cushion <input type="checkbox"/> 6. Steam generation <input type="checkbox"/> 7. Briquette/pellets <input type="checkbox"/> 8. Others (Specify).....
2.3	Who is you main customer for your sawdust and wood shavings.	1-Mukwano <input type="checkbox"/> 2-Tororo Cement <input type="checkbox"/> 3-Crop farmers <input type="checkbox"/> 4-Poultry farmers <input type="checkbox"/> 4-Others (specify).....
2.4	If sold, how much do you sell per kilogram?	Price per kg UGX:.....
2.5	How do you process your wood shavings and sawdust before selling (briefly describe the process)	1-Only pack in sacks <input type="checkbox"/> 2-Sort and pack according to sizes <input type="checkbox"/> 3. Dry before packing <input type="checkbox"/>

		4-Others (specify)
SECTION C: ENVIRONMENTAL AND SAFETY PROBLEMS FACING SAWDUST MANAGEMENT		
3.1	Environmental problem(s) faced as a result of wood shavings and sawdust in your workplace	1-Smooke from burning <input type="checkbox"/> 2.Accumulation of wood shavings and sawdust heaps 3-Littering the compound <input type="checkbox"/> 4-others (specify).....
3.2	What have you put in place to mitigate the environmental problems arising from sawdust and wood shavings at your workplace?	1-Used of Personal Protective Equipment <input type="checkbox"/> 2-Use of closed dustbins <input type="checkbox"/> 3-Burring in pit <input type="checkbox"/> 4-Others (specify).....
3.4	Is the mitigation measures put in place against the environmental problem arising from sawdust and wood shavings at your work place adequate	1. Yes <input type="checkbox"/> 2. No <input type="checkbox"/>
3.5	Explain your answer in 3.4 above	
3.6	What do you think can be done to minimize the environmental problems arising from sawdust and wood shavings generated at your work place?	
3.7	What are some of the health and safety problems you are facing at your work place?	1-Cough <input type="checkbox"/> 2-Eyes problem <input type="checkbox"/> 3-Skin problem <input type="checkbox"/> 4-Bad smell <input type="checkbox"/> 5-Others (specify).....
3.8	What are some of the safety measures you have put inplace against health and safety problem at your workplace?	1-Use of Personal Protective Equipment <input type="checkbox"/> 2-Encloising the workshop <input type="checkbox"/> 3-Use of dustbin <input type="checkbox"/> 4-Signage <input type="checkbox"/> 5-Others (specify).....
3.9	What do you think can be done to minimize health and safety problem arising from sawdust and wood shavings at you work place?	
SECTION D: SOLUTIONS TO PROBLEMS FACING SAW DUST MANAGEMENT		
4.1	What has the management done to improve on sawdust management at your workplace?	
4.2	Do you think the management has done enough as far as management of sawdust and wood shavings is concern at your workplace?	
4.3	Give reasons for your answer in 4.2 above	

4.4	Propose the best solutions for improving sawdust and wood shavings management at your work place	

Thanks for your cooperation

**APPENDIX II: QUESTIONNAIRE FOR
LECTURERS/TECHNICIANS/ADMINISTRATORS**

Dear respondents, I am Akunda Timothy a student of Kyambogo University conducting a research on improving wood shavings and sawdust management in civil and building engineering department as part of the requirements for the award of a Masters Degree in Vocational Pedagogy of Kyambogo University. I am requesting you to participate in this study by answering the questions provided. The information given will be used for academic purpose only and will be treated with highest level of confidentiality.

Instruction:

PART A: DEMOGRAPHIC INFORMATION		
1.1	Sex	1. Male <input type="checkbox"/> 2. Female <input type="checkbox"/>
1.2	Which age bracket do you belong?	1. Under 25 <input type="checkbox"/> 2. 25 to 29 <input type="checkbox"/> 3. 30 to 34 <input type="checkbox"/> 4. 35 to 50 <input type="checkbox"/> 5. Older than 50 <input type="checkbox"/>
1.3	What is the main occupation	1. Lecturer <input type="checkbox"/> 2. Administrator <input type="checkbox"/> 3. Technician <input type="checkbox"/> 4. Other (Specify).....
SECTION B: IMPROVING WOOD SHAVINGS AND SAWDUST MANAGEMENT		
2.1	What is the use of sawdust generated at the Departmental workshop?	1. Manure <input type="checkbox"/> 2. Poultry <input type="checkbox"/> 3. Selling <input type="checkbox"/> 3. Piggery <input type="checkbox"/> 4. Mulching <input type="checkbox"/> 5. Cushion <input type="checkbox"/> 6. Steam generation <input type="checkbox"/> 7. Briquette/pellets <input type="checkbox"/> 8. Others (Specify).....
2.2	Who is your main customer for your sawdust	1-Mukwano <input type="checkbox"/> 2-Tororo Cement <input type="checkbox"/> 3-Crop farmers <input type="checkbox"/> 4-Poultry farmers <input type="checkbox"/>

		4-Others (specify).....
2.3	If sold, how much do you sell per kilogram?	Price per kg UGX:.....
2.4	How do you process your wood shavings and saw dust before selling (briefly describe the process)	1-Only pack in sacks <input type="checkbox"/> 2-Sort and pack according to sizes <input type="checkbox"/> 3. Dry before packing <input type="checkbox"/> 4-Others (specify)
SECTION C: ENVIRONMENTAL AND SAFETY PROBLEMS FACING SAWDUST MANAGEMENT		
3.1	What environmental problem(s) faced as a result of wood shavings and sawdust generated in your department?	1-Smooke from burning <input type="checkbox"/> 2.Accumulation of wood shavings and sawdust heaps <input type="checkbox"/> 3-Littering the compound <input type="checkbox"/> 4-others (specify).....
3.2	What have you put in place to mitigate the environmental problems arising from saw dust and wood shavings generated at your Department?	1-Use of Personal Protective Equipment <input type="checkbox"/> 2-Use of closed dustbins <input type="checkbox"/> 3-Burring in pit <input type="checkbox"/> 4-Use of enclosed rooms/stores <input type="checkbox"/> 5-Others (specify).....
3.3	What are some of the occupation health and safety problems arising from sawdust and wood shaving at your Department?	1-Cough <input type="checkbox"/> 2-Eyes problem <input type="checkbox"/> 3-Skin problem <input type="checkbox"/> 4-Bad smell <input type="checkbox"/> 5-Others (specify).....

3.4	What are some of the safety measure you have put in place against occupational health and safety problem arising from sawdust and wood shavings at your Department?	1-Use of Personal Protective Equipment <input type="checkbox"/> 2-Encloising the workshop <input type="checkbox"/> 3-Use of dustbin <input type="checkbox"/> 4-Signage <input type="checkbox"/> 5-Others (specify).....
3.5	What do you think can be done to minimize health and safety problem arising from sawdust and wood shavings at your Department?	
SECTION D: SOLUTIONS TO PROBLEMS FACING SAW DUST MANAGEMENT		
4.1	What has the management done to improve on sawdust and wood shaving management at your Department?	
4.2	Do you think the management has done enough as far as management of sawdust and wood shavings is concern at your Department?	
4.3	Give reasons for your answer in 4.2 above	
4.4	Propose the best solutions for improving sawdust and wood shavings management at your Department.	

Thanks for your corporation.

APPENDIX III: QUESTIONNAIRE FOR STUDENTS

Dear respondents, I am Akunda Timothy a student of Kyambogo University conducting a research on improving wood shavings and sawdust management in civil and building engineering department as part of the requirements for the award of a Masters Degree in Vocational Pedagogy of Kyambogo University. I am requesting you to participate in this study by answering the questions provided. The information given will be used for academic purpose only and will be treated with highest level of confidentiality.

PART A: DEMOGRAPHIC INFORMATION		
1.1	Sex	1. Male <input type="checkbox"/> 2. Female <input type="checkbox"/>
1.2	Which age bracket do you belong?	1. Under 25 <input type="checkbox"/> 2. 25 to 29 <input type="checkbox"/> 3. 30 to 34 <input type="checkbox"/> 4. 35 to 50 <input type="checkbox"/> 5. Older than 50 <input type="checkbox"/>
1.3	In what programme have you enrolled?	1. Diploma in Civil Engineering <input type="checkbox"/> 2. Bachelor in Civil Engineering <input type="checkbox"/> 3. Other (Specify).....
SECTION B: IMPROVING WOOD SHAVINGS AND SAWDUST MANAGEMENT		
2.1	What is the use of sawdust and wood shavings generated at the Departmental workshop?	1. Manure <input type="checkbox"/> 2. Poultry <input type="checkbox"/> 3. Selling <input type="checkbox"/> 3. Piggery <input type="checkbox"/> 4. Mulching <input type="checkbox"/> 5. Cushion <input type="checkbox"/> 6. Steam generation <input type="checkbox"/> 7. Briquette/pellets <input type="checkbox"/> 8. Others (Specify).....
2.2	Who is the end user of saw dust and wood shaving generated at the Department?	1-Mukwano <input type="checkbox"/> 2-Tororo Cement <input type="checkbox"/> 3-Crop farmers <input type="checkbox"/> 4-Poultry farmers <input type="checkbox"/> 4-Others (specify).....

2.3	How do you process your wood shavings and saw dust before storage (briefly describe the process)	1-Only pack in sacks <input type="checkbox"/> 2-Sort and pack according to sizes <input type="checkbox"/> 3. Dry before packing <input type="checkbox"/> 4-Others (specify)
SECTION C: ENVIRONMENTAL AND SAFETY PROBLEMS FACING SAWDUST MANAGEMENT		
3.1	What environmental problem(s) faced as a result of wood shavings and sawdust generated in your department?	1-Smooke from burning <input type="checkbox"/> 2.Accumulation of wood shavings and sawdust heaps <input type="checkbox"/> 3-Littering the compound <input type="checkbox"/> 4-others (specify).....
3.2	What has the management put in place to mitigate the environmental problems arising from saw dust and wood shavings generated at your Department?	1-Use of Personal Protective Equipment <input type="checkbox"/> 2-Use of closed dustbins <input type="checkbox"/> 3-Burring in pits <input type="checkbox"/> 4-Use of enclosed rooms/stores <input type="checkbox"/> 5-Others (specify).....
3.3	What are some of the occupation health and safety problems arising from sawdust and wood shaving at your Department?	1-Cough <input type="checkbox"/> 2-Eyes problem <input type="checkbox"/> 3-Skin problem <input type="checkbox"/> 4-Bad smell <input type="checkbox"/> 5-Others (specify).....
3.4	What are some of the safety measures put in place by the management against occupational health and safety problem arising from sawdust	1-Use of Personal Protective Equipment <input type="checkbox"/> 2-Enclousing the workshop <input type="checkbox"/> 3-Use of dustbin <input type="checkbox"/>

	and wood shavings at your Department?	4-Signage <input type="checkbox"/> 5-Others (specify).....
3.5	What do you think can be done to minimize health and safety problem arising from sawdust and wood shavings at your Department?	
SECTION D: SOLUTIONS TO PROBLEMS FACING SAW DUST MANAGEMENT		
4.1	What has the management done to improve on sawdust and wood shaving management at your Department?	
4.2	Do you think the management has done enough as far as management of sawdust and wood shavings is concern at your Department?	
4.3	Give reasons for your answer in 4.2 above	
4.4	Propose the best solutions for improving sawdust and wood shavings management at your Department.	

Thanks for your cooperation.

APPENDIX IV: OBSERVATION CHECKLIST

ID	Questions	Observed the following
1	Improving sawdust management	<ul style="list-style-type: none">• Packaging• Storage• Loading and off loading• Processing (sorting, grading and weighing)• Transporting• Selling• Others
2	Environmental and health problem arising from sawdust	<ul style="list-style-type: none">• Pollution• Litters in the compound• Personnel protective equipment (PPE)• Others
3	Solutions for improving sawdust management	<ul style="list-style-type: none">• Mitigation measures

External examiner

Name of Student	Akunda Timothy
Course/Degree	Master in Vocational Pedagogy
Title of Dissertation	Improving the Use of sawdust as an Environmental Friendly alternative source of energy
Faculty	Faculty of Vocational Studies
Institution	Kyambogo University

I/NO	FORMAT	COMMENTS	Action taken
1.0	Title	<ol style="list-style-type: none"> The title of the dissertation is: improving wood shavings and sawdust management in Civil and Building Engineering Department- Kyambogo University The title on the letter to the external examiner is: Improving the Use of Sawdust as an environmental Friendly alternative source of energy 	The candidate took the second title as recommended by the examiner
1.1	Background	<p>Introduction: Good</p> <ul style="list-style-type: none"> 1.3: be written as Motivation for research Situation analysis be rename 1.4 Current 1.4: work process Analysis should be in results 	<ul style="list-style-type: none"> 1.3: corrected as motivation for research Situational analysis renames as 1.4 Work process analysis transferred to results in chapter 4.
		Purpose of the Study and specific objectives: Clearly stated	
		Scope: Good	
		Justification: Fair	
		Significance: Good	
		Conceptual frame work: Good	
1.2	Problem statement	Should not include part of the solution	The solution bit of the problem statement deleted

2.0	Literature review	Relevant	
3.0	Methodology	Fair	
4.0	Results & discussion	<ul style="list-style-type: none"> • Explain relevance of Figure 4.1 • Reformat Figure 4.3 	<ul style="list-style-type: none"> • Figure 4.1 is relevant because both males and females operate workshops. • Figure 4.3 reformatted
5.1	Conclusion	The conclusions emerge from the candidate work	
5.2	Recommendations	The recommendations emerge from the candidate work	
Overall presentation		<p>The work done is good</p> <p>(a) The above mentioned corrections have to be carried out before final submission</p>	

Internal examiner of 27th October 2016.

Name of Student	Akunda Timothy, Reg. No. 14/U/12908/GMVP/PE
Course/Degree	Master in Vocational Pedagogy
Title of Dissertation	Improving the Wood Shavings and Sawdust Management in Civil and Building Engineering department-Kyambogo University
Faculty	Faculty of Vocational Studies
Institution	Kyambogo University

I/NO	FORMAT	COMMENTS	Action taken
1.0	Quality of dissertation	The report require further editing, rearrangement of content for logical flow of structural ideas. There is evidence of originality but this lack critical and coherency. The student need to be consistent with the font size and bolt where it is necessary. The student has to follow a required content flow of academic thesis. Comments have been made on page that I felt needed serous attention from the student.	The candidate addressed the necessary concerns raised by the examiner as indicated in the dissertation pages.
2.0	Content and standard of the research, quality of the supervision	The content in this report relatively inform the reader about the current situation in the context the research was conducted. There is more of report speech than a critical reflection into the issues highlighted in this report. The student is advised to use the APA format for academic theses. The student need to clarify and acknowledge reference used to relate issues shared in his report. The statement of the problem required further editing and clarification. I recommends the student to revisits his chapter one and relate it to the other sections of the report. The student needs to seriously reflect on his chapter 5 if he is to make an academic contribution in Vocational Education and Training	The student responded to the raised issues by the examiner.