

**THE ECONOMICS OF PAPER USE AND ITS IMPLICATIONS TO THE
ENVIRONMENT: A CASE STUDY OF SOKOINE UNIVERSITY OF
AGRICULTURE, TANZANIA**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTER OF SCIENCE
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ABSTRACT

Paper is an office necessity for some essential tasks, but it has an environmental cost. The economics of paper use and its implications to the environment in Institutions of high learning, using Sokoine University of Agriculture (SUA) as a case study was investigated and reported in this work. The objectives of the study were to determine the annual amount of paper used for different purposes at SUA; to estimate the annual cost of buying paper at SUA and to estimate the annual number of trees exploited in relation to the amount of paper consumed at SUA. A cross sectional design was used to collect information from all four Campuses at SUA. Twenty seven offices directly dealing with administrative and academic matters were purposively selected as source of data used in this work. Data was also obtained from six prominent stationery shops operating at SUA. The major paper using activities, i.e. meetings and examinations were the sampling units. Data on the annual amount of paper used for various activities at SUA was collected by a paper survey tool and interviews administered to appropriate paper purchasers and users at SUA. Simple calculations were used to address the cost incurred annually to buy paper at SUA. The annual amount of trees exploited from the environment to make paper used by SUA was estimated using a conversion ratio developed by FAO (1997). The investigation found that SUA has a total annual paper consumption of about 42 785 kg of white print/copier paper, 1137.5 kg of coloured print/copier paper, 198.4 kg of ruled paper and 352 kg of manila paper. In addition, it was found that SUA used 160 000 Examination answer booklets in the year. The annual cost of buying paper at SUA was found to be about 288 590 000 TZS. Environmental cost was estimated at about 1027 trees exploited to suffice annual paper use at SUA. Interventions are suggested to reduce consumption of papers, financial and environmental cost at SUA such as paperless meeting, paper reuse, two side printing, sharing of documents electronically and awareness creation on paper use.

DECLARATION

I, Jeniva Olengeile, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor concurrently submitted in any other Institution.

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The above declaration is confirmed by:

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DEDICATION

This Dissertation is dedicated to my beloved parents Mr. Israel Olengeile and Mrs. Mecktilda Olengeile and to my brothers and sisters, Edna, Fidelia, Nelson, Sadock and Leah Olengeile.

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LIST OF ACRONYMS AND ABBREVIATIONS

AASHE	Association for the Advancement of Sustainability in Higher Education
APP	Annual Procurement Plan
BOD	Biological Oxygen Demand
CEPI	Confederation of European Paper Industries
COO	Call Off Order
EAUC	The Environmental Association for Universities and Colleges
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization of the United Nations
FY	Fiscal Year
GPSA	Government Procurement and Service Agency
IIED	International Institute for Environment and Development
ITD	Information Technology Division
PCF	Processed Chlorine Free
PCW	Post-Consumer Waste
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SUA	Sokoine University of Agriculture
SUASAB	Sokoine University of Agriculture Students Accommodation Bureau
WWF	World Wildlife Fund

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Paper use seems to be indispensable though it has a great burden to the users. As many people who work in an office can attest, paper is ubiquitous (Sarantis, 2002). Paper is an office necessity for some essential tasks, but it has an environmental cost. Saving it reduces our impact into the environment because manufacturing of paper from trees requires a lot of natural resources including trees, water and energy (County, 2002).

About 300 million tons of papers are produced each year worldwide whereby its consumption globally has reached 366 million tons and is rising steadily at an annual rate of 3.6%. The U.S. is by far the world's largest producer and consumer of paper. Per capita U.S. paper consumption is over six times greater than the world average. In 2004 for instance, the United States used 8 million tons of office paper (3.2 billion reams), which is equivalent to 178 million trees (County, 2002).

Regardless of its importance, paper has been reported to have many adverse impacts to the environment, right from when it is manufactured until to time of its disposal, collectively known as paper pollution (US EPA, 2013). For example, Pulp and paper is the third largest industrial polluter to air, water, and land in both Canada and the United States, and releases well over 100 million kg of toxic pollution each year (Miner, 2010). Large amounts of paper are mostly manufactured from trees where over 30 million acres of forests are destroyed annually (Abramovitz, 1999). The process involves the production of pulps from trees, straws, cotton, and recycled papers. The process of making paper can either be chemical or mechanical.

The impact of paper on the environment continues even after being disposed because once in a landfill, paper has the potential to decompose and produce methane, a greenhouse gas with 21 times the heat-trapping power of carbon dioxide (Environmental Paper Network, 2011). Transportation throughout the trade system also has significant environmental impacts because harvested trees or recovered paper are transported to pulp mills, rolls of paper are transported to converters, and finished paper products are transported to wholesale distributors and then on to their retail point of sale. Transportation at each of these stages consumes energy and results in greenhouse gas emissions.

Production of recycled paper saves our natural resources because it is estimated that one-ton of recycled paper saves approximately 17 trees. In addition, it saves energy and water which was to be used in pulping (US Environmental Protection Agency, 2010). Producing recycled paper involves between 28–70% less energy consumption than virgin paper, saving 4 100 kWh of energy if ton of 100% recycled paper used and 7 000 gallons of water. It also keeps more than 60 pounds of pollution out of the air and saves 3.3 cubic yards of landfill space, which is increasingly important as many local landfills near their capacity. Recycled paper also produces fewer polluting emissions to air (95% of air pollution) and water green source (US Environmental Protection Agency, 2010).

Economically, people need to realize that the cost of buying paper is just the tip of the paper iceberg. Saving paper saves money due to the fact that, for each sheet of paper used, a company or institution incurs not only purchasing cost, but also a storage, copying, printing, postage, disposal and recycling costs.

The purpose of this study was to assess the economics of paper use in high learning institutions and its implication to the environment with Sokoine University of Agriculture (SUA) as a case study.

1.2 Problem Statement and Justification

Paper plays a great role in documentation of information, examinations and meetings in higher learning Institutions of Tanzania. Regardless of its importance, paper has been reported to have many adverse impacts to the environment right from when it is manufactured to the time of its disposal, collectively known as paper pollution (Environment Canada, 2006). In addition, the financial costs of paper extend far beyond just purchasing the paper. There are also costs associated with storage, lost documents, copying, document obsolescence, labor inefficiency, printing, postage, disposal and recycling costs (Sarantis, 2002).

There is scarce information on the use of paper in Institutions of higher learning worldwide. In addition, few studies regarding costs associated with consumption of paper in both monetary and the environment in institutions of higher learning is not comprehensive or uncertain. Brown *et al.* (2012) reported extensive use of paper at Humboldt State University in America. The University used 2 637 137 sheets of paper in the year 2009. However, consumption dropped to 1 900 696 and to 957 543 sheets in years 2010 and 2011, respectively. This drop was attributed to the policy of ‘pay only what you print’ introduced by the University (Brown *et al.*, 2012). In Canada, Krishnamurthy (2008) reported paper use at the University of Toronto, amounting to more than 1 billion sheets in 2005, with a price tag of approximately \$ 6 000 000.

Globally over 13 million hectares of forest are destroyed annually, of which more than 40% is used in the paper production (Judson, 2015). A study conducted by the Clark University (2015) in the US found that, the university uses 5 999 976 sheets of paper each year. This amount is equivalent to 720 trees harvested per year by the estimation that 1 tree is equivalent to 8333.3 sheets.

On the other hand there is little or no information regarding monetary costs associated with consumption of paper use in Institutions of higher learning particularly in Tanzania. Neither there is direct information related to the volume of trees exploited in relation to the amount of paper consumed, and its impact to the environment. Nevertheless, data on the volume of trees exploited in relation to the amount of paper consumed in higher learning institutions of Tanzania need to be addressed as we move ahead to address global policies on mitigating climate change through Reducing Emissions from Deforestation and Forest Degradation (REDD+) initiatives.

Sokoine University of Agriculture (SUA) uses a considerable amount of paper annually for various purposes, including meetings, documentations and examinations. However, there is no documentation on the amount of paper used, the associated costs of buying papers, and the volume of trees exploited in relation to the amount of paper consumption at SUA. This research therefore aimed at filling these knowledge gaps. The findings from this study suggest the best ways to reduce paper consumption at the University and hence saving money and our environment. This can inturn earn the university reputation for being environmentally conscious by working towards paper use reduction policies. This study also suggests best cost effective paper consumption strategies and alternatives to paper use.

1.3 Objectives of the Study

1.3.1 Main objective

The main objective of this study was to assess the economics of paper use in Institutions of higher learning in Tanzania, and its implications to the environment, using Sokoine University of Agriculture (SUA) as a case study.

1.3.2 Specific objectives

The specific objectives were;

- i. To determine the annual amount of paper used for different purposes such as meetings and examinations at SUA.
- ii. To estimate the annual cost of buying paper at SUA.
- iii. To estimate the annual number of trees exploited in relation to the amount of paper consumed at SUA.

1.4 Conceptual Framework

Paper use at SUA is influenced by a number of factors. These include University paper use policy; technology, number of students; duration of the degree programme; researches conducted; paper meetings, examinations and results. Academic and Administration units at SUA are the main paper consumers. Paper using activities in the mentioned units include University meetings, examinations; workshops and handouts. Over use of paper in the academic and administrative units results into deforestation due to logging activities, air pollution due to emissions of greenhouse gases during the paper production and waste paper in landfills, loss of water during the production, loss of biodiversity and land degradation. The following interventions may lead to reduction massive consumptions of papers; introduction of paper use policy; electronic storage; paperless meeting, paper reuse, share documents electronically and awareness creation on paper use. The mentioned interventions will lead to reduced paper use, hence reduced impact and sustainable forest leading to economic efficiency of paper. This will ensure sustainable supply of papers to users (Fig 1).

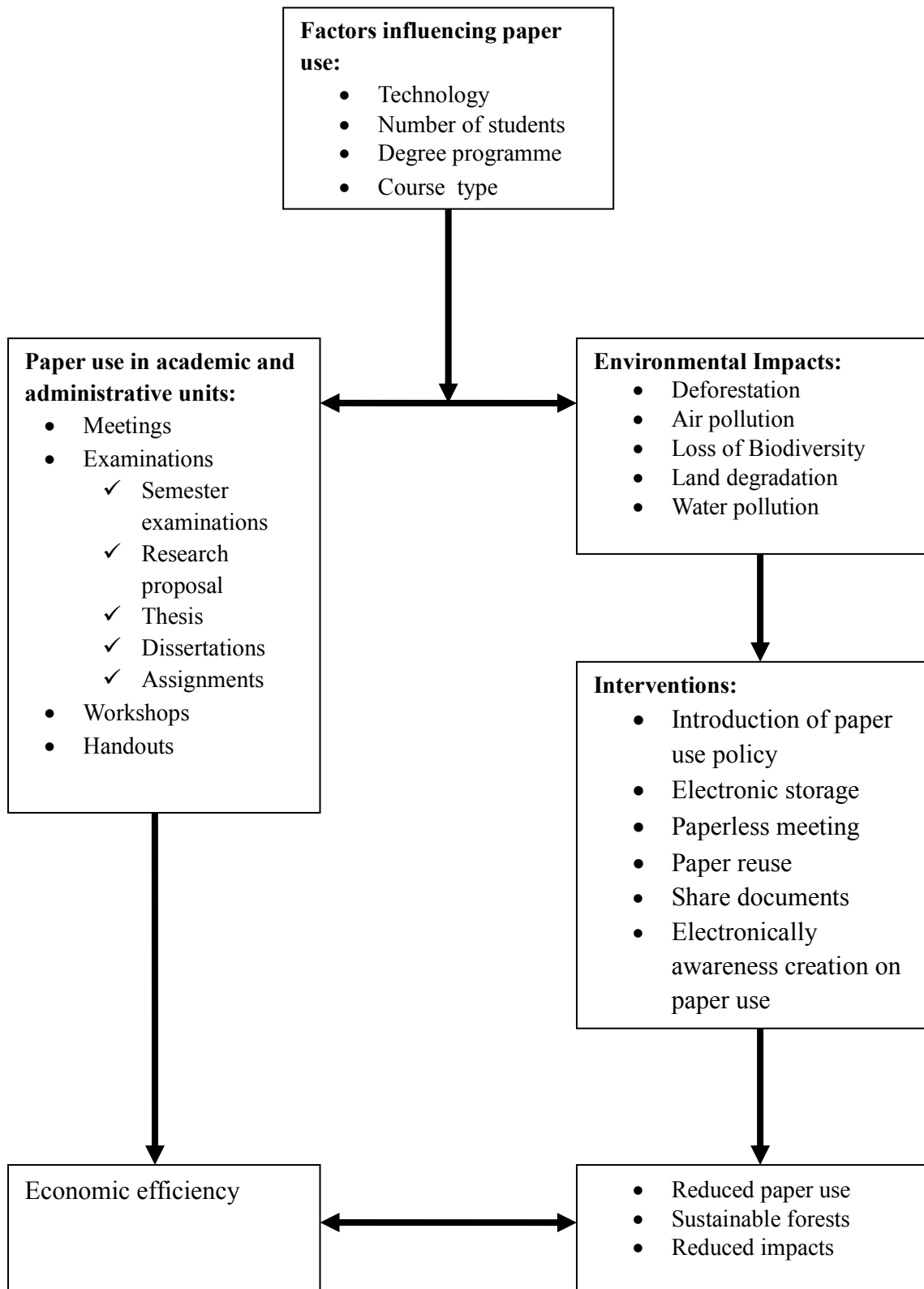


Figure 1: Conceptual framework linked with paper use at SUA

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview of Global Paper Production and Consumption

Paper is versatile product with many end uses varying from household papers, graphic and office papers to medical papers. Worldwide, 400 million tons of paper are produced each year where by its consumption globally has reached 366 million tons and is rising steadily at an annual rate of 3.6%. World demand for paper is expected to rise 25% by the year 2020 (Brett, 2013). The U.S. is by far the world's largest producer and consumer of paper. Average per capita paper use in the USA is 333 kg compared to the average per capital paper use of the worldwide which is 48kg (FAO, 1997).

According to FAO (2001), global paper products consumption has tripled over the past three decades and is expected to grow. In Tanzania, the most dynamic products are paper and paperboards whose demand has risen with economic growth in the country. Their demands rose by 75 000 tons in 2008 (Forestry Department, 1998).

Although paper is traditionally identified with reading, writing and communications, it has now been replaced by packaging as the single largest category of paper use at 41% of all paper used; and the paperless office, once predicted as a result of information technology (IT), has not transpired. It is estimated that 95% of business information is still stored on paper (IIED, 1996).

2.2 Global Production and Consumption of Paper

Pulp and paper is produced on all continents. The largest producer countries are; US, China, Japan and Canada, making up to more than half of the world's paper production.

Pulp and paper is primarily made out of wood fibres originating from natural forests or pulpwood plantations. Recycled fibre and other fibre sources such as agricultural residue are also utilized, and recycled fibre is becoming more commonly used in pulp and paper making. Many global pulp and paper companies are moving their production to the South due to lower production costs and proximity to fast growing pulpwood plantations. Hence, responsible pulpwood plantations practices are urgently needed (County, 2002).

In 2005, the total production of paper in Europe was 99.3 million tons which generated 11 million tons of waste, representing about 11% in relation to the total paper production. The production of recycled paper, during the same period, was 47.3 million tons generating 7.7 million tons of solid waste (about 70% of total generated waste in papermaking) which represents 16% of the total production from this raw material (Monte *et al.*, 2009).

Global paper consumption is at a record high level and it will continue to grow. *Per capita* consumption refers to the average consumption per person within a population thus reflects the level and dynamics of personal consumption. It is calculated by dividing the total quantity of material goods consumed (or their value) by the population. Per capita paper consumption varies a great deal by country and region in such a way that, the size is proportional to population in each country/region. For example, the global average in year 2013 (Fig. 2) was about 57 kilograms of paper per person. North Americans and Europeans used more than 200 kg each per year; China used 74 kg, while the average African used just 6.5 kg (Environmental Paper Network, 2008).

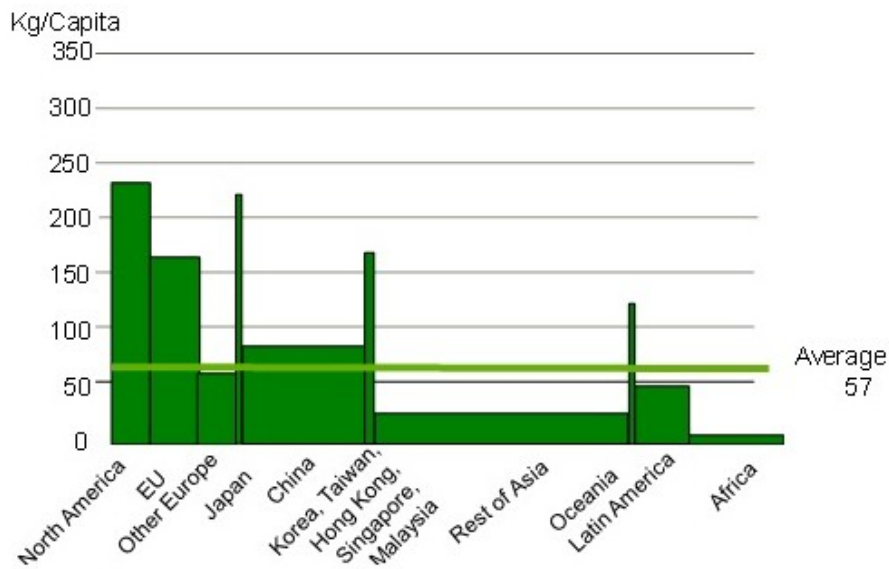


Figure 2: Global per capita paper consumption (Source: Risi, 2013)

2.3 Paper Consumption in Institutions of Higher Learning

Paper usage is a way of life in all Institutions of higher learning. Paper use in these institutions range from tissues to cardboard, notepads to exam books; and even paper reduction proposals are printed on paper. A research carried out by EAUC (2010) on paper consumption in Universities however, concluded that paper is often consumed wastefully.

According to the U.S. Environmental Protection Agency (2013), printing and writing papers typically found in a school or office environment are copier paper, computer printouts and notepads. Campos *et al.* (2009) found that paper consumption used to photocopy and print in six higher education schools at the University of Porto in Portugal varied among the institutions. It was observed that paper consumption rises at the beginning of the academic year and at the beginning of the examination periods, when compared to all other months.

At the Clark University in the United States, all paper used was produced from trees, using vast resources of energy and water. The amount of paper at the university was found to

increase as the population at Clark increased. It was found that the Faculty of Engineering was the largest consumer of paper sheets, consuming 5.5 million paper sheets in 2008, rising to 7 million sheets in 2009. The Nursing school had the lowest consumption, consuming only about 200 thousand copies during the two years.

Literature shows that, Yale University in New Heaven in the USA, has committed to reducing paper use by 10% between 2013 and 2016 so as to save money, improve efficiency and lessen its environmental impacts. In Fiscal Year 2011, for example, the University consumed 211 033 reams of paper in FY 2012, while paper consumption decreased by 2.4 percent to 203 236 reams. In 2013, Yale purchased 193 000 reams of paper, which equates to nearly 100 million sheets of paper (Roger, 2013).

Brown *et al.* (2012) found an extensive use of paper at Humboldt State University in Arcata, California whereby in year 2009, 2 637 137 sheets of paper were consumed, while in year 2010 the consumption rate dropped to 1 900 696 sheets due to 'pay only what you print' policy . In year 2011, the amount of paper consumed decreased to 957 543 sheets.

2.4 Per Capita Paper Consumption in Selected World Universities

Christopher (2012) found that 123 Faculty and Staff in Mueller building only at Pennsylvania State University collectively consumed 5.3 tons paper each year. The study further reported that by buying 100 percent post-consumer recycled paper and fully using that paper, could reduce its annual paper use by two-thirds, from just over 1 million sheets to approximately 300 000 sheets. Expressed on a per capita basis, a Mueller occupant would decrease his/her paper consumption from over 8000 to approximately 2700 sheets.

An environmental assessment focusing on paper consumption used to photocopy and print in six higher education schools at Porto in year 2008 and 2009 focusing three institutions

from the University of Porto (UP) specifically Faculty of Humanities (FLUP) and the Nursing school (ESEP) regarding the paper consumption per person, results showed that the Nursing school (ESEP), each person consumed around 120 paper sheets per year. In contrast, the Faculty of Humanities (FLUP) is the institution presenting the largest consumption, where each person consumed more than 900 paper sheets per year.

At Princeton University, each student in the diplomacy course printed on average 962 pages for all courses he or she took during the semester and in the undergraduate policy class, each student printed an average of 762 pages throughout the semester (Cass, 2010).

2.5 Paper Purchasing and Use Policy in Universities

Policy is a plan of action adopted by a person, group, or a Foundation. Paper Purchasing decisions are influenced with various factors such as environmental sustainability, price, person preference, department preference, past purchases and others. Several college institutions have implemented more sustainable paper purchasing policies as part of their involvement with the Association for the Advancement of Sustainability in Higher Education (AASHE).

Evergreen State College implemented paper purchasing procedures that listed four factors to be considered when ordering paper. When purchasing paper, the college considered environmental, economic supply and technological sustainability. Evergreen State College's policy statement says that, "the College endorses the production and use of paper that is not bleached with chlorine and chlorine derivatives and will, whenever possible, purchase 100% post-consumer recycled paper and/or paper made without trees (The Evergreen State College, 2011).

Princeton University's change in the paper purchasing policy came from its students where by the University now requires that all academic departments order 100% post-consumer waste (pcw) paper for their standard office needs and its price was reduced in exchange for a campus wide commitment to purchase all 100% pcw paper. One of the suggestions is to determine the current paper purchasing policy, followed by an evaluation. If a campus wide policy decision could not be made, Princeton recommended that that individual paper purchasers be contacted to gauge their interest in purchasing paper with recycled content (Princeton University, 2011).

From 2009, Drew University's administrative driven policy was that, the purchasing department at Drew University began purchasing 100% post-consumer content, 100% processed chlorine free (PCF) recycled paper to be used campus wide in all copiers and printers resulting into 204 trees being saved. This campaign was spearheaded by the Drew University Purchasing Department (Brazil, 2011).

2.6 Estimated Annual Cost of Buying Paper in Institutions of Higher Learning

According to Krishnamurthy (2008), the University of Toronto in Canada purchased more than 1 billion sheets of office paper in 2005, with a price tag of approximately \$6 million. It is further reported that the Michigan State University in the US do buy about 145 million sheets of paper (about 290 000 reams) in a year (Palmer, 2010). The most expensive recycled paper was around \$3.12 per ream (Badger) and the least expensive non-recycled paper was \$2.76 per ream (Hammer mill). However, if the university was able to reduce their paper consumption, they would only need to purchase 43 500 reams.

2.7 Impacts of Pulp and Paper Production to the Environment

2.7.1 Land, water and air pollution

Pulp mills contribute to air, water and land pollution in North America and Europe (US EPA, 2013). Eleven million tons of wastes are produced yearly by the European pulp and paper industry (Monte *et al.*, 2009). For example, Canada uses 6 million tons of paper and paperboard annually, and only 1/4 of Canada's waste paper and paperboard is recycled. Paper and paper products, accounts for more than 1/3 of all Canada's waste (WWF, 2015).

Discarded paper is a major component of many landfill sites, accounting for about 35 percent by weight of municipal solid waste (before recycling). Even paper recycling can be a source of pollution due to the sludge produced during de-inking (WWF, 2015). When paper rots or is composted it emits methane gas which is 25 times more toxic than CO₂ (WWF, 2015). In addition, the pulp and paper industry is the third largest industrial buyer of elemental chlorine, an air pollutant. Nitrogen dioxide (NO₂) sulfur dioxide (SO₂) and carbon dioxide (CO₂) are also emitted during paper manufacturing. Nitrogen dioxide and sulfur dioxide are major contributors of acid rain, whereas CO₂ is a greenhouse gas responsible for climate change (MacFadden and Vogel, 1996).

Paper production also causes water pollution. Waste water discharges for a pulp and paper mill contains solids, nutrients and dissolved organic matter such as lignin. It also contains alcohols, and chelating agents and inorganic materials like chlorates and transition metal Compounds. Nutrients such as nitrogen and phosphorus can cause or exacerbate eutrophication of fresh water bodies such as lakes and rivers. Organic matter dissolved in fresh water, measured by Biological Oxygen Demand (BOD), changes ecological characteristics, and in worst-case scenarios leads to death of all higher living organisms. Waste water may also be polluted with organochlorine compounds. Some of these are

naturally occurring in the wood, but chlorine bleaching of the pulp produces far larger amounts (WWF, 2014).

Pulp and paper industry is the fifth largest consumer of energy, accounting for 4% of the entire world's energy use, and in addition, the paper industry uses more water to produce a ton of product than any other industry (Paperless Project, 2013).

2.7.2 Deforestation

Worldwide consumption of paper has risen by 400% in the past 40 years, with 35% of harvested trees being used for paper manufacture. Ninety per cent of paper pulp is made of wood whereby over 60% of the roughly 17 billion cubic feet of timber harvested worldwide each year is used for paper and pulp. Paper manufacture is estimated to account for nearly 13 per cent of total wood use, and represents one per cent of the world's total economic output (IIED, 1995). According to Abromovitz (1998), 40% of the world's industrial logging goes into making paper, and this is expected to reach 50% in the near future.

Globally, approximately 7.2 million hectares of ancient forest has been logged, driven strongly by the demand for fibre for use in paper production (Australian Paper Conservation, 2004), resulting into loss of habitat and species endangerment, reduced climate regulation and erosion control capabilities, and weakened air and water cleaning potential (Paperless project, 2013).

Though paper can be made from a wide array of materials, the U.S. depends almost exclusively on wood. Approximately 70 percent of this comes from the southeastern U.S., which has become the largest pulp-producing region in the world. With an estimated 0.5

million hectares of forests cleared every year in the region, the impact of pulp and paper making on forests is significant.

Belgium uses more than eight trees-worth of paper per person per year with each member of society using the equivalent of 4.48 trees. France, Spain, Portugal, Ireland and China, uses 1.81 trees per person. Azerbaijan is the most tree-friendly nation, with only 0.16 trees per person being used each year (Ted, 2012).

According to Sheng *et al.* (2005), paper consumption by an Australian University had consequences for the environment thus the discussion on the University's commitment to environmental sustainability in terms of environmental ethics frameworks was done. The Information Technology Division (ITD) at an Australian university, 99 831 reams of paper were used from 1997 to the end of 2002. This represented the destruction of 5987 trees for student printing hence was an environmental concern. According to Clark University (2014) calculations, one tree is estimated to make 16.67 reams of copy paper or 8333.3 sheets; and accordingly, 720 trees were harvested each year to supply printer/copy paper for the university. However, it was estimated that by using paper of 30% recycled content, only 504 trees were needed to supply the university with its printer/copy paper for a year (Clark University, 2014).

2.8 Paper Policy and Regulation in Tanzania

All Accounting Officers were instructed to use electronic system in the distribution or dissemination of various Government documents exceeding fifty (50) pages with the exception of Votes which are required to distribute hard copies due to legal/regulations requirements. This measure aimed at reducing huge expenditure associated with the printing and photocopying of those documents and also conserves the environment (Tanzania Budget Speech, 2016/2017).

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Description of the Study Area

This study was conducted at Sokoine University of Agriculture (SUA). SUA is located in Morogoro Municipality, which is about 200 km west of Dar es Salaam.

The University is currently made up of four campuses: The Main Campus and Solomon Mahlangu Campus in Morogoro, Olmotonyi Campus in Arusha and the Mazumbai Campus in Lushoto, Tanga.

The University started as an Agricultural College established to offer diploma training in agriculture in 1965. Following dissolution of the University of East Africa and consequent establishment of the University of Dar es Salaam (UDSM) in July 1970, the College was transformed into a Faculty of Agriculture of the UDSM. Through a series of institutional transformations, in 1973 the Faculty of Agriculture expanded to accommodate Forestry and became a Faculty of Agriculture and Forestry. In 1976, veterinary training commenced and the Faculty was thereby renamed Faculty of Agriculture, Forestry and Veterinary Sciences. It was later transformed into a fully-fledged University through Parliamentary Act Nos. 6 and 14 of 1984, becoming SUA on 1st July 1984 with three Faculties of Agriculture, Forestry and Veterinary Medicine. Since then, other Faculties and Institutes have emerged. These include the Faculty of Science, Institute of Continuing Education (ICE), Sokoine National Agricultural Library (SNAL), Directorate of Research and Postgraduate Studies (DRPGS), and SUA Pest Management Centre (SPMC). These Acts have been repealed and the University is now operating within the frameworks of the

Universities Act No 7 of 2005 and SUA Charter and Rules, 2007 granted on the 5th March 2008.

Recently, some Faculties/Institutes/Departments have undergone restructuring. These are Faculty of Agriculture and Department of Agricultural Economics and Agribusiness to become Campus College of Agriculture and School of Agricultural Economics and Business Studies respectively, Development Studies Institute (DSI), SUA Centre for Sustainable Rural Development (SCSRD) and Department of Social Sciences of the Faculty of Science (DSS-FoS) to become Campus College of Social Sciences and Humanities; the Faculty of Forestry and Nature Conservation to become the Campus College of Forestry, Wildlife and Tourism; and the Faculty of Veterinary Medicine to become the Campus College of Veterinary and Medical Sciences. Restructuring has also resulted into the establishment of Directorate of Undergraduate Studies, Directorate of Intellectual Property Management and Linkages, Directorate of Consultancy and Services, and Centre of Information and Communication Technology.

SUA is currently offering 28 undergraduate and 37 postgraduate degree programmes, five Diploma and one certificate non-degree programmes. In addition, SUA offers one Postgraduate Diploma in Education (Appendix 1). The current academic members of staff stand at 539 and 823 administrative staff. The student population stands about 9500 that include both undergraduate and postgraduate levels.

3.2 Research Design

The study used a cross-sectional design which involved collection of data at a single point in time according to Kothari (2009). This type of study design utilizes different groups of

people who differ in the variable of interest at a time. Also it shares other characteristics such as socioeconomic status, educational background, and ethnicity.

3.3 Sampling Procedure

3.3.1 Sampling frame

The sampling frame was a list of paper consuming units at SUA. The lists are presented as Appendix 2.

3.3.2 Sampling units and sample size

Two major paper using activities from the major paper consumers at SUA as indicated below were the sampling units. The sampling units were meetings and examinations. Examinations included; continuous assessment tests, end of semester examinations, probation examinations, students' research proposals, research project reports, dissertations and theses for the year 2014/2015.

Thirteen offices directly dealing with academic matters were purposively selected as source of data used in this work. These included: The office of Deputy Vice Chancellor (Academic), four offices of the Principals/Deans, two offices of Directors; namely the Directorate of Research and Postgraduate Studies and the Sokoine National Agricultural Library. In addition, data was collected from the Computer Centre and from five randomly selected academic Departments from Colleges/Faculties.

In addition, fourteen administrative offices were also purposively selected as a source of data. These included: the Vice Chancellor, Deputy Vice chancellor (Administration & Finance), the Directorate of Solomon Mahlangu Campus, Olmotonyi campus, Mazumbai campus, Planning Department, Bursar's office, Dean of students, Estates Department,

Supplies Department, Chief Administrative officer, SUA Pest Management Centre, the SUA Centre for Sustainable Rural Development, SUA Students Accommodation Bureau (SUASAB), and the Farm Department.

Data was also obtained from six prominent Stationery shops operating at SUA (3 at the main campus and 3 at Solomon Mahlangu Campus, Mazimbu) which are mainly involved in printing and binding student's research reports was also used in this work.

3.4 Data Collection Methods

Paper survey tool (Appendix 3), adopted from Brazil *et al.* (2011) was used to collect information so as to address objectives (i) and (ii). Interviews were administered to appropriate officers, including: secretaries, human resource officers, purchasing officers of respective offices. To address objective (iii) simple calculations were made using results derived from objective (i), based on the conversion ratio (Appendix 4) by FAO (1997) and as was used by Clark University (2012).

3.5 Data Analysis

3.5.1 Annual amount of paper used at SUA

The amount of paper used per year at SUA was estimated by multiplying the average total number of scheduled meetings as per SUA Almanac by the average number of meeting documents and the average number of pages in each document.

The average annual number of paper used for examinations was estimated by summing up the amount of ruled paper used for continuous assessment tests in respective academic Departments and answer booklets used for end of Semesters 1, 3, 5, 7 and 9 end of Semesters 2, 4, 6, 8 and 10, and probation examinations in year 2014/2015.

The average annual amount of paper used for students' research proposals, dissertations and theses was estimated by multiplying the number undergraduate and postgraduate students' documents presented in year 2014/2015 by the average number of paper sheets making each proposal and research reports.

The average annual amount of paper used by prominent stationeries shops at SUA was estimated by the number of reams purchased and used per year by respective stationery shops.

3.5.2 Annual cost of buying paper at SUA

Total cost of buying paper at SUA was estimated by multiplying the total number of reams of paper used at SUA in the year by the prices of each paper type (i.e. 9 000 TZS for white print/copier, 15 000 TZS for coloured print/copier, 28 000 TZS for Manila, 6 000 TZS for ruled paper and 710 TZS for examination booklets).

3.5.3 Annual number trees exploited for SUA paper needs

Total number of trees exploited from the forest for annual SUA paper needs was estimated by dividing the average number of reams of paper used at SUA in a year by an estimated paper calculator factor of 1 tree is equivalent to 16.67 reams (FAO, 1997).

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 An Overview

The annual Sokoine university of Agriculture paper consumption, cost and the number of trees used to manufacture such amount of paper in year 2014/2015 was investigated and reported in this work.

SUA purchased and used various types of paper to suit various activities as reported and discussed under various subchapters in this work. The major paper consuming activities were found to be meetings, documentations and examinations as presented and discussed under various subchapters in this work.

4.2 Annual Paper Consumption at Sokoine University of Agriculture

4.2.1 Consumption by SUA campuses

SUA had an estimated annual consumption of 18 857 reams of various types of paper in the period 2014/2015 (Table 1). White print/copier paper was the most used paper; where about 42 785 kg were used, accounting for about 90.7% of all paper types used over the period. The second mostly used type was the ruled paper, where 198.4 kg (5.3%) were used during the period. Coloured print/copier and Manila paper ranked the third and fourth, where 1137.5 kg and 740 kg were respectively used during the period.

White print/copier paper is mostly used for routine office correspondences, printing of meeting documents and examinations. Ruled paper was found to be used only at the Main and Solomon Mahlangu campuses for continuous assessment tests, as the two are housing student populations. Coloured print/copier and Manila paper were mostly used to prepare meeting documents.

Table 1: SUA annual paper consumption

Campus	Paper type (kilogrammes)			
	Print/copier white	Print/copier/coloured	Manila	Ruled
Main	36 075	972.5	54	88.4
Mazimbu	4 960	157.5	4.8	110
Olmotonyi	1 250	5	1.2	0
Mazumbai	500	2.5	1.2	0
Grand total	42 785	1137.5	355.2	198.4

The main campus used more paper (Table 1). About 36 075 kg of white print/copier, 972.5 kg of coloured print/copier, 88.4 kg of ruled and 54 kg of Manila paper were used at the Main Campus during the period 2014/2015. This large consumption of paper at the Main Campus was due to the fact that most administrative activities are housed in the Main campus. In addition, most University meetings are held at the Main campus. Furthermore, all science based degree programmes are based at this Campus.

Solomon Mahlangu campus ranked the second due to academic activities accruing from academic programmes stationed at the Campus. Solomon Mahlangu campus used about 4 960 kg of white print/copier, 157.5 kg of coloured print/copier, 110 kg of ruled and 4.8 kg of Manila paper were used during the period. Olmotonyi campus ranked third using about 1250 kg of white print/copier, 5 kg of coloured print/copier and 1.2 kg of Manila paper, while Mazumbai campus used about 500 kg reams of white print/copier and 2.5 kg of coloured print/copier and 1.2 kg of Manila paper over the period.

These findings imply that, there is an extensive annual paper consumption at SUA because, a similar study conducted in 2009 at the Humboldt State University in California (USA) with more students, degree programs and Departments than SUA indicated that the University used 13 185 kg of paper (Brown *et al.*, 2012). This is about 31% of SUA's annual paper consumption.

4.2.2 Paper consumption by selected SUA offices

Paper consumption by individual SUA Academic and Administrative offices was also analysed and reported in this work. The amount of paper consumed by various SUA academic offices is presented in Tables 2, 3 and 4. Academic offices in this work were those offices dealing directly with academic matters. These included; the DVC (Academic), Principals/Deans' offices, Directorate of Research and Postgraduate Studies, Computer centre, the Sokoine National Agricultural library (SNAL) and academic Departments. SUA academic offices used different types and amounts of paper for different activities as presented in Table 2.

Table 2: Amount of paper consumed by selected academic offices at SUA

Office	Paper type (kilogrammes and booklets)				
	Print /copier	Print /copier	Examination		
	white	Coloured	Ruled	Manila	Booklets
DVC (Academic)	1 350	2 303	0	169.2	160 000
Principal/Deans	25 060	365	0	6	0
Computer centre	250	12.5	20	2.4	0
SNAL	125	7.5	14	2.4	0
DRPS	125	12.5		6	0
Departments	2 500	250	168	0	0
Grand total	29 410	877.5	202	186	160 000

The office of the DVC (Academic) which handles all end of Semester University and probation examinations used 160 000 examination booklets in the period 2014/2015 (Table 2). In addition, the office used 1350 kg of white print/copier paper for routine correspondences and for printing meeting documents over the period. The office of the DVC (Academic) also used 2303 kg and 169.2 kg of coloured and Manila paper, respectively for preparation of meeting documents.

The offices of Principals, Deans and selected Departments (those housing degree programmes) at SUA were the major users of white print/copier paper during the period. In the period 2014/2015, they used about 25 060 kg, which were about 64.4% of this paper type used at SUA in the period. The paper was mainly used for routine office correspondences and for the preparation of various meeting documents. In addition, the same offices used 365 kg of coloured print/copier papers (32%) for printing examinations and meeting documents over the period.

The College of Forestry, Wildlife and Tourism used more white and coloured print paper at the Principal's office when compared with other Colleges and Faculties at SUA (Table 3). The reasons behind this was that, all examination matters and Senate meeting documents are handled centrally by the office of the Principal, while in other Colleges and Faculties, examinations are handled by individual Departments (Table 4) and not directly by the Principal/Dean's offices.

Table 3: Annual paper consumption in SUA Colleges and Faculties

College/Faculty	Paper type (kilogrammes)		
	Print/copier colour		Manila
	Print/copier white		
Agriculture	360	62.5	1.2
Forestry, Wildlife & Tourism	24 012.5	175	1.2
Veterinary Medicine	327.5	112.5	1.2
Science	360	15	2.4
Grand Total	25 060	365	6

Those Departments with degree programmes and those handling large number of students had also considerable use of paper over the period as indicated in Table 4.

Table 4: Amount of paper consumed by selected SUA academic Departments

Departments	Paper type (kilogrammes)		
	Print/copier white	Print/copier coloured	Ruled
Education	375	25	10
Biometry	625	25	30
Vet. Anatomy	500	50	40
Agric Economics & Agribusiness	750	0	60
Soil Science	250	150	28
Grand total	2 500	250	168

SUA Administrative offices used also considerable amounts of various types of paper in 2014/2015 as presented in Table 5. Most paper was used to prepare documents for various University meetings.

The main paper users in this category were; the then SUA centre for Sustainable Rural Development (SCSRD) now under the College of Social Sciences and Humanities, the office of the Vice Chancellor, the office of the DVC (Administration & Finance), the Directorate of Solomon Mahlangu Campus, the office of the Dean of students and the SUA Pest Management Centre.

Table 5: Amount of paper consumed by SUA administrative offices

Office	Paper type (kilogrammes)		
	Print/copier white	Print/copier coloured	Manila
Vice Chancellor	1 250	100	48
DVC (A &F)	750	50	2.4
Pest Management Centre	1 125	2.5	1.2
SCSRD	3 000	5	1.2
Solomon Mahlangu	625	7.5	2.4
Planning	125	25	2.4
Bursar	200	2.5	0
Dean of Students	500	0	2.4
Supplies Department	225	2.5	0
Farm Department	125	0	0
SUASAB	75	0	0
CAO	125	0	0
Grand Total	7 375	195	60

4.2.3 SUA annual paper consumption by activity

The major paper consuming activities at SUA during the period 2014/2015 were meetings and examinations as presented in Tables 6 and 7. During the period 2014/2015, a total amount of 2992.5 kg of white print/copier paper, 125 kg of coloured print and 57.6 kg of Manila paper were used to prepare meeting documents for only few meetings listed in Table 6. Documents for the University Council meetings used about 1000 kg of white print/copier paper. In addition, 50 kg of coloured print and 2.4 kg of Manila paper were used for Council meetings. In addition, Senate and its committees used 1792.5 kg of white print/copier paper for meeting documents during the period.

Table 6: Estimated paper use for SUA Council and Senate meetings

Type of meeting	Paper type (kilogrammes)		
	White print/copier	Coloured Print/copier	Manila
Regular meetings of the university			
Council	1 000	50	24
Audit Committee of Council	100	25	12
Executive Committee of the Council	100	25	12
The Senate	542.5	12.5	6
Undergraduate Studies Committee of Senate	625	5	1.2
Postgraduate Studies Committee of Senate	625	7.5	2.4
Grand total	2 992.5	125	57.5

Colleges, Faculties and Directorates also used considerable amount of paper for various meetings during the period (Table 7). The amount of paper used to prepare meeting documents was 1387.5, 40 and 20.4 kg of print/white, print/coloured and Manila papers, respectively. The College of Agriculture used more paper to prepare meeting documents when compared with the others (Table 7). The College is the largest of all SUA colleges with most degree programmes and students at SUA (Appendix 2), and therefore had to prepare more documents for various university meetings.

Table 7: Annual paper use for meetings by Colleges, Faculties and Directorates

College/Faculty/Directorate	Meeting	Paper type (kilogrammes)		
		Print/white	Print/coloured	Manila
Forestry, Wildlife and Tourism	College Board	75	5	1.2
	Examiners Board	10	2.5	1.2
	Senate	27.5	2.5	1.2
	Subtotal (1)	112.5	10	3.6
Science	Faculty Board	65	2.5	1.2
	Examiners Board	300	2.5	1.2
	Senate	92.5	2.5	1.2
	Subtotal (2)	457.5	7.5	3.6
Agriculture	College Board	50	2.5	1.2
	Examiners Board	75	2.5	1.2
	Senate	390	2.5	1.2
	Subtotal (3)	515	7.5	3.6
Veterinary Medicine	Faculty board	7.5	2.5	1.2
	Examiners Board	225	2.5	1.2
	Senate	22.5	2.5	1.2
	Subtotal (4)	255	7.5	3.6
SNAL	Senate	37.5	2.5	1.2
	Examiners Board	10	5	1.2
	Subtotal (5)	47.5	7.5	2.4
Grand total		1 387.5	40	20.4

The second major paper consuming activity at SUA during 2014/2015 were students' examinations. SUA had three examination types in the year, apart from continuous assessment tests which are periodically handled by respective academic Departments. These examinations include; end of Semesters 1/3/5/7/9, 2/4/6/8/10 and Probation/Special/First sitting Examinations.

Mostly used types of paper for examinations were the white print/copier, ruled paper and examination booklets. White print and ruled paper types were mainly used for continuous assessment tests while examination booklets were used for end of Semester and probation examinations.

The amount of print and ruled paper used annually is already discussed under Colleges/Faculties and Departments in this work. In the period 2014/2015, SUA used 160 000 examination answer booklets as indicated in Table 8.

Table 8: Annual number of examination answer booklets used at SUA

Examination period	Number of booklets
Semesters 1/3/5/7/9	60 000
Semesters 2/4/6/8/10	60 000
Probation/special/first sitting	40 000
Grand total	160 000

4.2.4 Annual paper consumption by prominent stationery shops at SUA

Most student research project reports in the period were printed and bound by the six stationery shops operating at SUA as listed in Table 9. SUA stationery shops also offered printing and binding services to SUA administrative and academic members of staff. In year 2014/2015, the stationery shops used 3750 kg of white print/copier paper, 372.5 kg and 255 kg of coloured and Manila paper respectively for printing and binding services.

Table 9: Annual paper consumption by prominent stationery shops at SUA

	Paper type (kilogrammes)		
Stationery shops	Print/copier white	Print/copier coloured	Manila
Mazimbu campus			
CCM Stationery	700	25	12
The Mask Stationery	775	35	12
Mchina Stationery	750	37.5	2.4
Subtotal (1)	2 225	92.5	26.4
Main Campus			
Kabwanga Stationery	525	75	36
White Stationery	500	125	36
Henry Stationery	500	75	24
Subtotal (2)	1 525	275	96
Grand total	3 750	372.5	122.4

4.3 Annual Cost for Paper Procurement at Sokoine University of Agriculture

There is a centralized procurement Department at SUA. The current paper purchasing practice in the university follows the Public Procurement Act of 2011 and Public procurement regulations of 2013. Purchasing is normally done from suppliers who are permanent tenderers to the University. Paper is ordered depending on the need and the budget. The prices of paper however do fluctuate, depending on the value of the US\$ over the Tanzanian shilling. There are no environmental considerations in SUA paper procurement policy.

SUA purchased about 42 785 kg of white print/copier, 455 reams of coloured, 355.2 kg of Manila and 198.4 kg of ruled paper in 2014/2015, as reported in Table 1. In addition, SUA purchased 160 000 examination booklets (Table 8) during the period.

The total cost of the paper procured by SUA during the period 2014/2015 was about 288 691 000 TZS using the prices of paper during the study period as presented in Table 10.

The white print paper and the examination booklets used most of the money incurred during the period, accounting for about 93% of the total value.

Table 10: Total annual SUA spending on paper for the period 2014/2015

Paper type	Amount (kilogrammes)	Unit cost (TZS)	Total cost (TZS)
Print/copier white	42 785	9000	154 026 000
Print/copier coloured	1 130	15 000	6 825 000
Ruled	198.4	6 000	5 952 000
Manila	355.2	28 000	8 288 000
Examination booklets	160 000	710	113 600 000
Total			288 691 000

Comparison between campuses showed that the main campus spent more money while Mazumbai spent the least on paper purchases Table 11. The main Campus used 129 870 000 TZS to purchase various types of paper during the period, which was about 45% while Mazumbai spending 1 843 000 TZS (0.6%) of all money spent for paper in the period. This variation was brought about by the population and number of activities conducted in each campus.

Table 11: Comparison of annual spending on paper by SUA campuses

Campus	Paper type	Amount (kilogrammes)	Unit cost (TZS)	Total cost (TZS)
Main	Print/copier white	3 6075	9 000	129 870 000
	Print/copier coloured	972.5	15 000	5 835 000
	Ruled	88.4	6 000	2 652 000
	Hardcover	324	28 000	7 560 000
	Examination booklets	160 000	710	113 600 000
	Subtotal (1)			259 517 000
SMC	Print/copier white	4 960	9 000	17 856 000
	Print/copier coloured	157.5	15 000	945 000
	Ruled	110	6 000	3 300 000
	Hardcover	28.8	28 000	672 000
	Subtotal (2)			22 773 000
Olmotonyi	Print/copier white	1 250	9 000	4 500 000
	Print/copier coloured	5	15 000	30 000
	Manila	1.2	28 000	28 000
	Subtotal (3)			4 558 000
Mazumbai	Print/copier white	500	9 000	1 800 000
	Print/copier coloured	2.5	15 000	15 000
	Manila	1.2	28 000	28 000
	Sub-total (4)			1 843 000
	Grand Total			288 691 000

Cost comparison between SUA various offices (Table 12) showed that academic offices spent about 235 141 000 TZS on paper which was about 81.5% of the total money used, while Administrative offices ranked second, spending about 29 092 000 TZS (10.1%) of the total money over the period. This large proportion used in academic offices is due to the fact that most paper and hence more money was spent for academic matters, especially examinations.

Table 12: Comparison of annual spending on paper between SUA Academic and Administrative offices

Offices	Paper type	Amount (kilogrammes)	Unit cost (TZS)	Total cost (TZS)
Administrative	Print/copier white	7 375	9 000	26 550 000
	Print coloured	195	15 000	1 170 000
	Hardcover	58.8	28 000	1 372 000
	Subtotal (1)			29 092 000
Academic	Print/copier white	29 410	9 000	105 876 000
	Print coloured	877.5	15 000	5 265 000
	Hardcover	186	28 000	4 340 000
	Ruled	202	6 000	6 060 000
	Examination booklets	160 000	710	113 600 000
	Subtotal (2)			235 141 000
Grand Total				264 233 000

Further analyses were made to compare cost of paper between Colleges/Faculties, Directorates, Centres and selected academic Departments with large number of students (Tables 13, 14 and 15).

Colleges and Faculties spent about 92 546 000 TZS during the period (Table 13). The College of Forestry, Wildlife and Tourism spent more money on paper over the period amounting to 87 523 000 TZS, followed by the College of Veterinary and Medical Sciences which spent 1 882 000 TZS, the College of Agriculture which spent 1 699 000 TZS and the Faculty of Science which spent 1 442 000 TZS in the period 2014/2015.

Table 13: Comparison of annual spending on paper by SUA Colleges/Faculties

College/Faculty	Paper type	Amount (kilogrammes)	Unit cost (TZS)	Total cost (TZS)
Agriculture	Print/copier white	360	9000	1 296 000
	Print/copier coloured	62.5	15 000	375 000
	Hardcover	1.2	28 000	28 000
	Subtotal (1)			1 699 000
Forestry,	Print/copier white	24012.5	9000	86 445 000
Wildlife & Tourism	Print/copier coloured	175	15 000	1 050 000
	Hardcover	1.2	28 000	28 000
	Subtotal (2)			87 523 000
Veterinary & Medical Sciences	Print/copier white	327.5	9000	1 179 000
	Print coloured	112.5	15 000	675 000
	Hardcover	1.2	28 000	28 000
	Subtotal (3)			1 882 000
Science	Print/copier white	360	9 000	1 296 000
	Print/copier coloured	15	15 000	90 000
	Hardcover	2.4	28 000	56 000
	Subtotal (4)			1 442 000
	Grand Total			92 546 000

Comparison between SUA Directorates and Centres (Table 14) showed that the Directorate of Research and Postgraduate Studies ranked the first, spending 2 308 000 TZS while Sokoine National Agricultural Library spent 944 000 TZS during the period.

Table 14: Comparison of annual spending on paper by Directorates and Centres

Directorate/Centre	Paper type	Amount (kilogrammes)	Unit cost (TZS)	Total cost (TZS)
DRPGS	Print/copier white	625	9000	2 250 000
	Print/copier coloured	5	15000	30 000
	Hard coloured	1.2	28000	28 000
	Subtotal (1)			2 308 000
Computer centre	Print/ copier white	250	9000	900 000
	Print/copier coloured	12.5	15000	75 000
	Ruled	20	6000	600 000
	Subtotal (2)			1 575 000
SNAL	Print/copier white	125	9000	450 000
	Print/copier coloured	7.5	15000	18 000
	Ruled	14	6000	420 000
	Manila	2.4	28000	56 000
	Subtotal (3)			944 000
	Grand total			4 827 000

Comparison between selected Academic Departments housing degree programmes (Table 15) showed that the Department of Agricultural Economics and Agribusiness (AEA, now the School of Agricultural Economics and Business Studies) ranked the first, spending 4 500 000 TZS, followed by the Department of Veterinary anatomy in the College of Veterinary and Medical Sciences which spent 3 750 000 TZS during the period.

Table 15: Comparison of annual spending on paper between selected academic

Departments				
Department	Paper type	Amount (kilogrammes)	Unit cost (TZS)	Total cost (TZS)
Education	Print/copier white	375	9000	1 350 000
	Print/copier coloured	25	15 000	150 000
	Ruled	50	6000	300 000
	Subtotal (1)			1 800 000
Biometry	Print/copier white	500	9000	1 800 000
	Print/copier coloured	25	15 000	150 000
	Ruled	30	6000	900 000
	Subtotal (2)			2 850 000
Veterinary Anatomy	Print/copier white	625	9000	2 250 000
	Print/copier coloured	50	15 000	300 000
	Ruled	40	6000	1 200 000
	Subtotal (3)			3 750 000
AEA	Print/copier white	750	9000	2 700 000
	Ruled	150	6000	1 800 000
	Subtotal (4)			4 500 000
Soil Science	Print/copier white	250	9000	900 000
	Print/copier coloured	150	15 000	900 000
	Ruled	28	6000	840 000
	Sub-total (5)			2 640 000
	Grand total			15 540 000

Annual spending on paper for meetings at SUA

SUA used paper worthy 15 215 000 TZS for various meeting documents in the period 2014/2015 (Table 16). Senate and associated committees meeting documents spent about 8 822 000 TZS which accounted for about 58% of the total amount spent. The University Council and its committees meeting documents used paper worthy 3 810 000 TZS, while Colleges/Faculties and associated committees spent 2 583 000 TZS for meeting documents.

Table 16: Annual cost of paper used for preparation of meeting documents

Meeting	Paper type	Amount (reams)	Unit cost (TZS)	Total cost (TZS)
The University	Print/copier white	700	9 000	2 520 000
Council and associated committees	Print/copier coloured Manila	75 36	15 000 28 000	450 000 840 000
	Subtotal (1)			3 810 000
Senate and associated committees	Print/copier white Print/copier coloured Manila	1 792.5 27.5 9.6	9 000 15 000 28 000	8 433 000 165 000 224 000
	Subtotal (2)			8 822 000
Colleges/Faculty Boards and associated committees	Print/copier white Print/copier coloured Manila	610 22.5 10.8	9 000 15 000 28 000	2 196 000 135 000 252 000
	Subtotal (3)			2 583 000
	Grand total			15 215 000

4.4 Estimation of the Number of Trees Exploited for Annual Paper Use at SUA

The number of trees exploited annually to suffice SUA paper requirements in 2014/2015 was estimated to be about 1027 trees (Table 17), based on the calculation factor of 16.67 white print/copier reams from one tree (FAO, 1997; Clark University, 2012).

This figure may however, be larger when other paper types are included in the calculation. This estimated amount implies that SUA paper consumption has a considerable impact to the environment. A similar study conducted at Clark University (2012) showed that the University used paper worthy 504 trees in a year.

Table 17: Estimated annual number of trees exploited for paper used at SUA

Campus	Print/white (kilogrammes)	No. of Trees
Main	36 070	866
Mazimbu	4 960	119
Olmotonyi	1 250	30
Mazumbai	500	20
Grand total	42 785	1 027

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study examines the economics of paper use in high learning institutions and its implication to the environment with Sokoine University of Agriculture (SUA) as a case study. The specific objectives of the study were: - to determine the annual amount of paper used for different purposes such as meetings and examinations; to estimate the annual cost of buying papers and; to estimate the volume of trees exploited in relation to the amount of paper consumed at SUA.

Key findings indicate that about 160 000 Examination booklets, 17114, 452, 992, and 294 reams of print/copier white, copier coloured, ruled and manila papers respectively were consumed in a year 2014/2015. It is therefore concluded that there is extensive paper consumption at SUA more especially during University management meetings since when printing of meeting documents' is involved except in few offices like SNAL where projection is used in some of the meetings specifically during the Faculty board making paper consumption rate lower compared to other offices. However, assignments as one of the paper activity at SUA are printed and not submitted via emails making paper consumption higher as well. Moreover it can be concluded that the university policy is silent on the paper use and its implication to the environment thus making paper consumption unsustainable. Furthermore, printing at SUA is done on one side thus consuming more papers.

More so, key findings indicate that about 288 691 000 TAS is used for buying papers at the university. It is therefore concluded that, much of the university's budget for

Stationery is used for buying papers due to high paper demand of which in turn make the entire University's budget to be more higher.

In the same veins, key findings indicate that about 1027 trees were exploited annually to supply papers at SUA. Study on the paper use at SUA with implications to the environment was specifically to forests where it can be concluded that which is about one hectare of forestland is exploited for papers to supply at SUA.

5.2 Recommendations

Sokoine university of Agriculture uses a considerable amount of paper in a year, which in turn has cost to the Institution and to the environment. However, the amount of paper used at SUA can be minimized if SUA will put in place a paper use reduction policy which will include the following recommendations:

- i. The University to encourage paper users to opt for two sides printing.
- ii. The university to conduct paper-less meetings by encouraging people to use their computers for reviewing documents and note-making.
- iii. The university to encourage sharing information by projecting it.
- iv. The university to encourage the use of message programs such as email to exchange information.
- v. The university to encourage that reports, forms and announcements to be put on a central bulletin board or electronically on the University Website rather than producing printed versions.
- vi. The university to encourage review and edit of draft documents on-screen by using the word processing "track change" feature instead of printing out hard copies for markup.
- vii. The university to encourage the use electronic storage whenever practical instead of storing hard copies.

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APPENDICES

Appendix 1: SUA Administrative and Academic Units

- 1 The Vice Chancellor's Office
- 2 The Deputy Vice Chancellor (Academic) office
 - a Admissions Office
 - b The Office of the Dean of Students
 - c Examinations Office
 - d Students Records Office
3. The Deputy Vice Chancellor (Administration & Finance) office
4. College of Agriculture
 - a. The office of the Principal
 - b. The Department of Food, Nutrition and Consumer Studies
 - c. The Department of Agricultural Extension and Community Development
 - d. The Department of Engineering Sciences & Technology
 - e. The Department of Crop Science & Horticulture
 - f. The Department of Soil and Geological Sciences
5. College of Forestry, Wildlife and Tourism
 - a. The office of the Principal
 - b. The Department of Ecosystems and Conservation
 - c. The Department of Forest Products and Technology
 - d. The Department of Forest Operations Management and Techniques
 - e. The Department of Natural Resources Assessment and Management
 - f. The Department of Tourism and Recreation
 - g. The Department of Wildlife Management

6. College of Veterinary and Medical Sciences

- a. The office of the Principal
- b. The Department of Veterinary Medicine & Public Health
- c. The Department of Veterinary Surgery & Theriogenology
- d. The Department of Veterinary Microbiology & Parasitology
- e. The Department of Veterinary Physiology, Pharmacology, Biochemistry & Toxicology
- f. The Department of Veterinary Pathology
- g. The Department of Veterinary Anatomy

7. Faculty of Science

- a. The Dean's Office
- b. The Department of Physical Sciences
- c. The Department of Biological Sciences
- d. The Department of Mathematics & Biometry
- e. The Department of Informatics
- f. The Department of Education

8. College of Social Sciences and Humanities

- a. The office of the Principal
- b. Departments:-
 - Development Studies
 - Language studies
 - Policy planning and Management
 - Centre for Gender studies.

9. School of Agricultural Economics & Agribusiness

- a. Office of the Dean

10. The Institute of Continuing Education
11. The Directorate of Research & Postgraduate Studies
12. The Sokoine National Agricultural Library
13. The Directorate of Solomon Mahlangu Campus
14. The Computer Centre
15. The SUA Centre for Sustainable Rural Development
 - a. Section of Socio-economics
 - b. Section of Resource Management
 - c. Section of Environmental Conservation
16. The SUA Pest Management Centre
17. The Chief Planning Office
18. The Bursar's Office
19. The Corporate Council's office
20. The Office of the Estates Department
21. The Office of the Public Relations Officer
22. The Office of the Resident Medical Officer
23. The Office of the Chief Internal Auditor
24. The office of the Chief Supplies Officer
25. The Office of the Chief Administrative officer
26. The SUA Farm office
27. The SUASAB office
28. Olmotonyi Training Forest Campus
29. Mazumbai Training Forest Campus

Appendix 2: Academic programmes offered at SUA

A: Undergraduate Certificate Programmes

1. Certificate In Information Technology -Duration 1 year

B: Undergraduate Diploma Programmes

1. Diploma in Information Technology -Duration 2 years
2. Diploma in Information and Library Science -Duration 2 years
3. Diploma in Records, Archives and Information Management -Duration 2 years
4. Diploma in Tropical Animal Health and Production -Duration 2 years
5. Diploma in Laboratory Technology -Duration 2 years

C: Undergraduate Degree Programmes

1. Bsc. (Agricultural Economics and Agribusiness) – Duration – Duration 3 years
2. Bsc. (Applied Agricultural Extension) – Duration 3 years
3. Bsc. (Agricultural Education) – Duration 3 years
4. Bsc. (Agricultural Engineering) – Duration 4 years
5. B.sc. (Bio-process and Post-Harvest Engineering) – Duration 4 years
6. B.sc. (Irrigation and Water Resources Engineering) – Duration 4 years
7. Bsc. (Agriculture General) – Duration 3 years
8. Bsc. (Horticulture) – Duration 3 years
9. Bsc. (Agronomy) – Duration 3 years
10. Bsc. (Animal Science) – Duration 3 years
11. Bsc. (Aquaculture)– Duration 3 years
12. Bsc. (Range Management) – Duration 3 years
13. Bsc. (Food Science and Technology) – Duration 3 years
14. Bsc. (Family and Consumer Studies) – Duration 3 years
15. Bsc. (Human Nutrition)– Duration 3 years

16. Bsc. (Forestry)– Duration 3 years
17. Bachelor of Tourism Management– Duration 3 years
18. Bsc. (Wildlife Management)– Duration 3 years
19. Bachelor of Veterinary Medicine – Duration 5 years
20. Bsc. (Biotechnology and Laboratory Sciences)– Duration 3 years
21. Bsc. (Environmental Science and Management)– Duration 3 years
22. Bsc. (Informatics)– Duration 3 years
23. Bsc. Education(Chemistry & Biology)– Duration 3 years
24. Bsc. Education(Geography & Biology)– Duration 3 years
25. Bsc. Education(Chemistry & Mathematics)– Duration 3 years
26. Bsc. Education(Informatics & Mathematics)– Duration 3 years
27. Bsc. Education(Geography & Mathematics)– Duration 3 years
28. Bachelor of Rural Development– Duration 3 years

D: POSTGRADUATE DEGREE PROGRAMMES

D1: Postgraduate diploma

COLLEGE OF AGRICULTURE

School of Agricultural Economics and Agribusiness

1. Postgraduate Diploma in Agricultural Economics

FACULTY OF SCIENCE

Department of Education

2. Postgraduate Diploma in Education

D2: MASTERS PROGRAMMES

COLLEGE OF AGRICULTURE

Department of Agricultural Economics and Agribusiness

1. Master of Science in Agricultural Economics (MSc. Agric Econ)

2. Master of Science in Agricultural and Applied Economics (MSc. Agric. and Applied Econ)
3. Master of Business Administration (Agribusiness) – MBA (Agribusiness)

Department of Agricultural Education and Extension

4. Master of Science in Agricultural Education and Extension (MSc. Agric. Education and Ext.)

Department of Agricultural Engineering and Land Planning

5. Master of Science in Agricultural Engineering (MSc. Agric. Eng.) Degree Programme
6. Master of Science in Irrigation Engineering and Management
7. Master of Science in Land Use Planning and Management

Department of Animal, Aquaculture and Range Sciences

8. Master of Science in Tropical Animal Production (MSc. Tropical Animal Production)

Department of Crop Science and Production

9. Master of Science in Crop Science (MSc. Crop Science)

Department of Food Science and Technology

10. Master of Science in Food Science (MSc Food Science)
11. Master of Science in Human Nutrition

Department of Soil Science

12. Master of Science in Soil Science and Land Management (MSc. Soil Science)

COLLEGE OF FORESTRY, WILDLIFE AND TOURISM

13. Master of Science in Forestry (MSc. Forestry)
14. Master of Science in Wildlife Management (MSc. Wildlife Management)
15. Master of Science in Management of Natural Resources for Sustainable Agriculture (MSc. MNRSA)

16. Master of Science in Ecosystems Science and Management
17. Master of Science in Agroforestry
18. Master of Science in Forest Resources Assessment and Management
19. Master of Science in Forest Products and Technology
20. Master of Science in Environmental and Natural Resources Economics

COLLEGE OF VETERINARY AND MEDICAL SCIENCES

21. Master of Veterinary Medicine (MVM)

Department of Veterinary Anatomy

22. Master of Science in Anatomy (MSc. Anatomy)
23. Master of Science in Applied Cell Biology (MSc. ACB)

Department of Veterinary Medicine

24. Master of Preventive Veterinary Medicine (MPVM)
25. Master of Science in Public Health and Food Safety
26. Master of Science in Epidemiology
27. Master of Science in Natural Products Technology and Value Addition

Department of Veterinary Microbiology and Parasitology

28. Master of Science in Applied Microbiology
29. Master of Science in Parasitology
30. Master of Science in Molecular Biology and Biotechnology
31. Master of Science in One Health Molecular Biology (MSc. One Health Mol. Biol.)

Department of Veterinary Pathology

32. Master of Science in Clinical Pathology
33. Master of Science in Veterinary Pathology

Department of Veterinary Physiology, Biochemistry, Pharmacology and Toxicology

34. Master of Science in Comparative Animal Physiology (MSc. CAP)

- 35. Master of Science in Biochemistry (MSc. Biochem.)
- 36. Master of Science in Clinical Chemistry (MSc. Clin. Chem.)
- 37. Master of Science in Pharmacology
- 38. Master of Science in Applied Toxicology

Department of Veterinary Surgery and Theriogenology

- 39. Master in Veterinary Surgery (M. Vet. Surg.)
- 40. Master in Applied Veterinary Anesthesiology (MSc. Appl. Vet. Anaesth.)
- 41. Master of Science in Animal Reproduction and Biotechnology (MSc An. Repr. Biotech.)

COLLEGE OF SOCIAL SCIENCES AND HUMANITIES

- 42. Master of Arts in Rural Development
- 43. Master of Arts in Project Planning Management and Evaluation

D3: PhD PROGRAMMES

PhD by Coursework and Research

COLLEGE OF AGRICULTURE

Department of Soil Science and Department of Agricultural Engineering and Land Planning

- 1. PhD. (Soil and Water Management)

PhD by Research Only

ALL COLLEGES, FACULTIES AND SCHOOLS

PhD by Research only in the respective areas of specialization

Appendix 3: Paper Survey Tool

Name of surveyor: Miss Jeniva Olengeile (Msc ENAREC Student)

Name.....

1. How is paper purchased throughout the university?
 - Who is responsible for purchasing paper?
 - What department are they in?
 - Is there a centralized procurement department or do multiple people purchase throughout the university? If purchasing is not centralized, is there a way to make sure any changes in purchasing policy are communicated to all paper purchasers in the university? Is it done (purchasing) online or done from retail outlets, vendors or printers?
2. During the academic year what type(s) of paper do you purchase (Manila paper, Ruled Paper, Print/copier Paper, Coloured print paper, Examination Answer booklets)? _____
3. Which suppliers do you use for each of your paper products?
4. What are your current paper procurement policies or criteria you apply to paper purchases? Are environmental considerations weighed? Can you integrate environmental specifications into your paper procurement policy?
5. For each of the products currently purchased, can you work with your existing suppliers to substitute products that are environmentally superior (e.g., products with higher recycled content, and processed chlorine-free)? Can you substitute products without increasing cost? If costs will increase, can this be counterbalanced by paper reduction measures, or considered as part of a public relations budget?

6. If existing suppliers are not able to provide environmentally preferable products, can you switch suppliers?
7. How much does each type of paper cost? / Price difference between the paper types.
- Manila paper
 - Ruled Paper
 - Print/copier Paper
 - Colored print paper
 - Examination Answer booklets
8. During the academic year how much paper do you purchase on average per order?
-

9. Are the prices of paper fluctuating?

Types:		Reasons
Photocopier:	High.....
	Low.....
How frequent?.....		
If no why?.....		

10. How frequently do you purchase paper in a given semester?
-

11. How much of each type of paper is purchased?

12. On average, what is the amount of money do you spend per order?
-

13. What factors impact your choice of paper? **Rank as follows (1-4): 1 is most important, 4 is least important**

Personal Preference_____

Instructor/Faculty/department preference_____

Price _____

Other _____

Office Supply, Purchases and Usage Spreadsheet

Office Supply	Date of Purchase	Amount Purchased	Date of next Purchase

Appendix 4: Paper calculation factors according to FAO (1997)

1. 1 ton of paper = 400 reams = 200 000 sheets
2. 400 reams of paper is equivalent to 1.25 acres of pine forest
3. 1 ton of A4 paper = 400 reams = 200 000 sheets equals to: 3.47 tons of wood is equivalent to 24.29 trees.
4. 1 tree makes 16.67 reams of copy paper or 8333 sheets
5. 1 ream (500 sheets) uses 6% of a tree
6. 1 ream of manila sheets = 100 sheets = 1.2 KG
7. 1 ream of ruled papers = 400 sheets = 0.2 KG
8. Average per capita paper use in the USA is 333 Kg.
9. Average per capital paper use worldwide is 48 Kg.