GREEN INFORMATION TECHNOLOGY PRACTICES AND ENVIRONMENTAL MANAGEMENT PERFORMANCE IN THE BANKING INDUSTRY IN KENYA

ANGELA KAMARU

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DECLARATION

This project is my original work and has not been submitted to any other university for award of a degree.

Signature…… Date……..

Angela Kamaru

D61/62831/2010

This project has been submitted for examination with my authority as the university supervisor.

Signature…… Date……..

James T. Kariuki

Lecturer

School of Business,

University of Nairobi

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DEDICATION

I dedicate this project to My Loving parents Mr. and Mrs. Kamaru for their encouragement during this entire MBA course who have passed the respect for education, Brothers Clement and Vincent for their advice whenever I needed it, my Loving Sister Magdaline for the her guidance while carrying out the study and mostly my daughter Imani Njeri for her perseverance when I had to stay late as I study.

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ABBREVIATIONS AND ACRONYMS

ATS	:	Allowance Tracking System
BI	:	Behavioral Intention
CBK	:	Central Bank of Kenya
CRT	:	Cathode Ray Tubes
EMCA	:	Environmental Management and Coordination Act
ETS	:	The Emissions Tracking System
IT	:	Information Technology
PEOU	:	Perceived Ease of Use
PU	:	Perceived Usefulness
RAM	:	Random Access Memory
SN	:	Subjective Norm
SO_2	:	Sulphur Dioxide
TAM	:	Technology Acceptance Model
TRA	:	Theory of Reasoned Action
IISD	:	International Institute for Sustainable Development
UNESCO	:	United Nations Educational and Scientific Organization

ABSTRACT

The purpose of this study was to establish how green information technology practices affect environmental management performance among commercial banks in Kenya. The study sought to achieve two specific objectives: establish the extent of adoption of green information technology practices by commercial banks in Kenya and determine the impact of green information technology on environmental management performance in Kenya. The study took a descriptive research design where all the 43 commercial banks were involved in the study. The study findings reveal that most commercial banks in Kenya have adopted the following green information technology practices: implementation of paperless banking systems; purchasing of energy efficient computers, putting in place energy efficient networks; adoption of greed data centers; embracing virtualization, server consolidation technology; use of cloud computing; adoption of ERP systems and use of real-time processing of transactions. The commercial banks have started to embrace recycling of electronic waste. The study found a strong positive correlations between improved environmental management and adoption of paperless banking system, purchase of energy efficient computers and recycling of electronic waste. The regression results showed that the adoption of green IT accounts for 76.7 percent of the environmental management performance of commercial banks in Kenya.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

One of the biggest challenges that is facing humanity currently is the deteriorating environmental conditions. Some of these conditions are irreversible and this posses a major threat to life. Many countries around the globe are now becoming more concerned with sustainability issues in order to integrate social and environmental issues in business operations. Business organizations all over the world are now more concerned with implementation of strategies that can enable them reduce environmental degradation. Among these strategies, adoption of appropriate information technology has featured prominently among many organizations around the globe (Sala, 2010).

According to Jerie & Munyavi (2011), many organizations across the globe have adopted information technology in their operations with the aim of reducing environmental degradation. They further argue that most institutions of learning have adopted information technology in the learning environment and this is one important step in reduction of the volume of paper used. Adamson, Hamilton and Hutchison (2005) also assert that most organizations operating in developing countries are to a very great extent embracing the use of information technology as a tool in environmental management. Business organizations have the responsibility of reducing environmental pollution and degradation by ensuring that the information technology they adopt is environmentally friendly. For instance, reduction of electronic waste is paramount and this can be achieved through ensuring that they are

manufactured from fewer toxic substances, are easily recyclable, are energy efficient or can utilize renewable sources of energy and can easily be upgraded.

Most business organizations are also finding relevant applications of information technology in environmental management such as the use of paperless transaction processing, use of information technology to reduce vehicle transportation and recycling of electronic items to reduce environmental pollution through disposal of obsolete equipment. The many applications of information technology in environmental management have made it possible for the organizations to integrate IT in managing the environment (Adamson, et al., 2004).

1.1.1 Green Information Technology

There are several definitions of Information Technology (IT). According to (Zalzadeh, (2012) information technology is a generic term that covers the acquisition, processing, storage and dissemination of information. It involves the application of computers and communication technology in the task of information handling. The commercial use of IT encompasses both computer technology and information communication technology. United Nations Educational and Scientific Organization (UNESCO) also defines IT as scientific technology and engineering disciplines and the management techniques used in information handling and processing their application, computers and their interaction with men and machines and associated social, economic and cultural matters.

Rouse (2015) asserts that the term information technology was coined by the Harvard Business Review, in order to make a distinction between purpose-built machines designed to perform a limited scope of functions and general-purpose computing machines that could be programmed for various tasks. As the IT industry evolved

from the mid-20th century, it encompassed transistors and integrated circuits -- computing capability advanced while device cost and energy consumption fell lower, a cycle that continues today when new technologies emerge (Rouse, 2015).

IT includes several layers of physical equipment such as computer hardware, virtualization and management or automation tools, operating systems and application software used to perform essential functions. User devices, peripherals and software, such as laptops, smartphones or even recording equipment, can be included in the IT domain. IT can also refer to the architectures, methodologies and regulations governing the use and storage of data (Bigelow, 2015). Business applications include databases like Servers, transactional systems such as real-time order entry, email servers such as exchange, web servers, customer relationship management and enterprise resource planning systems. These applications execute programmed instructions to manipulate, consolidate, disperse or otherwise affect data for a business purpose (Bigelow, 2015).

Green IT refers to environmentally sound IT. It's the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems such as monitors, printers, storage devices, and networking and communications systems efficiently and effectively with minimal or no impact on the environment. Green IT also strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities. Thus, green IT includes the dimensions of environmental sustainability, the economics of energy efficiency, and the total cost of ownership (Murugesan, 2008).

1.1.2 Environmental Management

According to the Environmental Management and Coordination Act (EMCA) 2012, environmental management refers to the protection, conservation and sustainable use of the various elements or components of the environment. The Act further defines the environment as the physical factors of the surroundings of human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants and the social factor of aesthetics and includes both the natural and the built environment (GoK, 2012). The Act provides guidelines that are to be followed by both individuals and organizations in protecting and managing the environment. It also outlines the consequences that will be met when an organization or individual violates the provisions of the Act.

The objective of environmental management is to achieve improved human life quality. It involves the use of resources to administer the use of both natural and economic goods and services. Environmental management is therefore based on the principles of achieving natural balance. Environmental management uses systems analysis and conflict resolution to distribute the costs and benefits of development activities throughout the affected populations and seeks to protect the activities of development from natural hazards. Conflict identification is one of the more important tasks in environmental management planning and the resolution of conflicts is a fundamental part of what makes up "environmentally sound development (Clarke, 2012).

Organizations of all kinds are increasingly concerned with achieving and demonstrating sound environmental performance by controlling the effect of their activities, products and services on the environment, consistent with their

environmental policy and objectives. They do so in the context of increasingly stringent legislation, the development of economic policies and other measures that foster environmental protection, and increased concern expressed by interested parties about environmental matters and sustainable development. (Csaba & Nickolet, 2008). Environmental management is therefore not the conservation of the environment solely for the environment's sake, but rather the conserve-action of the environment for humankind's sake (Csaba & Nickolet, 2008).

Information technology plays a very significant role in the management of the environment. Most organizations are now interested in adopting information technology that has limited harm to the environment. For instance, every computer generates some level of carbon dioxide and information technology has ensured that the volume of carbon dioxide generated is minimized as much as possible through green IT practices (Clarke, 2012).

1.1.3 The Banking Industry in Kenya

The Central Bank of Kenya CBK (2014) indicates that the banking industry in Kenya comprise of 43 commercial banks, 1 mortgage finance company, 6 deposit taking microfinance institutions, 5 representative offices of foreign banks, 115 foreign exchange bureaus and 2 credit reference bureaus. The assets of the banking industry in Kenya are more than Ksh2.8 trillion. The banking industry grew by 8.0% in 2013 and 9.8% in 2014 while the economy grew by 6.1 % and 5.1% in 2013 and 2014 respectively. This was driven by financial infrastructure that has enabled financial inclusion. The growth of micro deposit accounts (accounts with average balances of Ksh 100,000 and below) has been a critical contributor to the development and deepening of the banking sector. The number of loan accounts remains low at just

over 2.3 million and will need to increase substantially to catalyze reduced unit costs of loans (CBK, 2014).

The banking industry in Kenya faces a number of challenges. One of the challenges relates to competition from mobile service providers. Local mobile money transfer services like Mpesa and Airtel money have brought in a lot of competition to banks. Since the introduction of these technologies, many people are finding it easier to save and transfer money through these mobile money transfer services as opposed to banks (Wameyo, 2012). In as much as local banks are making profits, there is still room to realize more earnings if some of the issues affecting them are addressed. Commercial Banks in Kenya are also forced to implement new types of information technology as they experience growing numbers of customers. Adoption of these IT systems for instance paperless banking is one of the technologies that has been adopted by a number of commercial banks (Wameyo, 2012).

1.2 Research Problem

Information technology is one of the innovations that have contributed significantly to the economic development of many nations across the globe. There is also evidence that information technology has assisted in improving activities in other sectors such as social and environmental aspects. Innovations in information technology have made it possible to substitute material and labour intensive processes with those that rely heavily on information technology and have positive impact on environmental management (Frans & Julia, 2001). For instance, there is increased use of recycled materials in the production of various IT components thus reducing the use of virgin materials from the environment. When companies engage in the purchase of IT components that are made of recycled material, they encourage better environmental

management. However, many companies are yet to utilize information technology in a manner that will enhance environmental management performance.

Kenya is among the countries in the world that have experienced adoption of information technology in many sectors of the economy including in the banking industry. Research conducted on information technology and environment reveals that information technology can improve environmental management. For instance according to a study carried out by Blas (2004) on information technology and its role as the basis for market based environmental policies, it was established that information technology reduces paperwork and filing costs, and provides public information online through its database registries, making the system transparent and credible as well as permitting electronic reporting, verification, and processing of emissions data. Tomlinson (2010) also conducted a study on information technology for environmental sustainability. The study revealed that by enabling innovations in infrastructure, education, personal change, community in involvement, and many other domains, Green IT can help people live more sustainable lives. Ngniatedema and Li (2014) also carried out a study on green operations and organizational performance. The study revealed that green operations have an impact on organizational performance. In Kenya, Waema and Muriuki (2008) carried out a study on e-waste management in Kenya. Cherutich (2013) also conducted a study on e-waste management in Kenya. The study revealed that mobile phone companies in Kenya recycle and export e-waste. The study revealed that recycling of e-waste can greatly reduce pollution.

Research on information technology and environmental management is scarce more especially in Kenya. The use of information technology seems to be on the increase

and yet no study has attempted to establish how it can be utilized to manage the environment. Studies (Blaas, 2004; Tomlison, 2010) reveal that IT has the potential of enhancing environmental management in other countries. The study will therefore focus on the Kenyan banking industry since it is one industry that has extensively adopted information technology in their operations. The study sought to establish how information technology is used by commercial banks in Kenya as an environmental conservation tool. This study therefore sought to bridge this gap by answering the question: what is the impact of green information technology on environmental management performance in the banking industry in Kenya?

1.3 Research Objectives

The objectives of the study were to:

i. Establish the extent of adoption of green information technology practices by commercial banks in Kenya.

ii. Determine the impact of green information technology on environmental management performance in Kenya.

1.4 Value of the Study

This study will be beneficial to a number of people. Researchers have indicated that information technology can assist in environmental management performance. The findings from this study will assist in providing more knowledge on this theoretical relationship. It will provide more insight into this area.

The findings of this study will also provide relevant information that will be important to the management of commercial banks in Kenya. It will assist them to understand the role of green information technology in environmental management performance.

This will be important in making decisions related to information technology and environmental management in the banking industry.

The research findings will also be important to policy makers both in the government and non-governmental organizations interested in the use of green information technology in environmental management. They will get access to more current and relevant information that will enable them develop appropriate policies on information technology and environmental management performance.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of relevant literature on green information technology and environmental management performance. Among the issues reviewed include the theoretical review that explores relevant theories and an empirical review that focuses on studies that have been carried out in this area.

2.2 Theoretical Foundation

There are several theories that explain the application of green information technology in various sectors. This study will be guided by two theories that explain how green information technology is adopted by organizations to assist in environmental management performance. The two theories that form the basis of this study are the Diffusion of Innovations Theory and the Technology Acceptance model which are discussed next.

2.2.1Diffusion of Innovations Theory

Diffusion of innovations theory seeks to explain how innovations are taken up in a population. An innovation is an idea, behaviour or object that is perceived as new by its audience. Diffusions of innovations theory take a radically different approach to most other theories of change. Instead of focusing on persuading individuals to change, it sees change as being primarily about the evolution or “reinvention” of products and behaviours so they become better to fit the needs of individuals and groups. In this theory, it is not the people who change but rather the innovations. This theory also seeks to explain why some innovations spread faster than others. The theory posits that there are five factors that determine the diffusion of an innovation.

One of these factors is the relative advantage associated with the innovation. If an innovation is perceived to be better than an idea that it supersedes, then it is likely to diffuse faster. On the other hand if an innovation is perceived to be compatible with the existing values and practices then it will diffuse faster (Robinson, 2009). This implies that IT that are inclined towards environmental management are more likely to spread faster among commercial banks in Kenya. For instance most commercial banks are implementing paperless banking systems because they know it will reduce costs and also reduce paper work thus assisting in environmental management.

Robinson (2009) further asserts that simplicity and ease of use is one of the factors that determine the diffusion of an innovation into the population. Simplicity refers to the degree to which an innovation is perceived as difficult to understand and use. New ideas that are simpler to understand are adopted more rapidly than innovations that require the adopter to develop new skills and understandings. The other factor that can also influence the diffusion of an innovation relates to the degree to which it can be tried or experimented on a limited basis. The last factor that can influence the diffusion of an innovation relates to how easier it is for individuals to see the results of an innovation, the more likely they are to adopt it. Visible results lower uncertainty and also stimulate peer discussion of a new idea, as friends and neighbours of the adopter often request information about it. This theory is important in explaining the diffusion of technological innovations that are essential in the management of the environment.

2.2.2 Technology Acceptance Model

The Technology Acceptance Model (TAM) was developed by Davis (1986) to explain computer usage behavior. The theoretical basis of the model was the Theory

of Reasoned Action (TRA). The goal of TAM is to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations. TRA is a widely-studied model from social psychology which is concerned with the determinants of consciously intended behaviors. According to TRA, a person's performance of a specified behavior is determined by his or her behavioral intention (BI) to perform the behavior, and BI is jointly determined by the person's attitude (A) and subjective norm (SN) concerning the behavior in question.

The TAM uses TRA mentioned above as a theoretical basis for specifying causal linkages between two key sets of constructs: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), and user's attitude (A), behavioral intentions (BI) and actual computer usage behavior. PU is defined as the user's subjective probability that using a specific application system will increase his or her job performance within an organizational context. PEOU refers to the degree to which the user expects the target system to be free of effort. Both PU and PEOU predict attitude toward using the system, defined as the user's desirability of his or her using the system. A and PU influence the individual's BI to use the system (Malhotra & Galleta, 1999). Actual use of the system is predicted by BI. Effective use of new information technologies is likely to require more than simple compliance. A failure to develop psychological attachment among potential users may require the organization to bear the increased costs associated with more sophisticated control systems and/or diminishing performance returns on increasing information technology investments. Having a user base that shares the values underlying effective use of new information systems can ensure that users act instinctively to utilize information technology in an effective manner (Malhotra & Galleta, 1999). This theory is relevant in explaining the

acceptance of computer technology by organizations as one important way of environmental management. The perceived usefulness of information technology and its ease of use in environmental management performance will largely determine its acceptance among commercial banks in Kenya.

2.3 Green IT and Environmental Management Performance

Green IT refers to environmentally sound IT and it involves the practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems such as monitors, printers, storage devices, and networking and communications systems efficiently and effectively with minimal or no impact on the environment. Green IT also strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities. Thus, green IT includes the dimensions of environmental sustainability, the economics of energy efficiency, and the total cost of ownership, which includes the cost of disposal and recycling (Murugesan, 2008).

Recent changes in ICT use globally have impacted the environment negatively in terms of waste and energy consumption but have also the potential to support environmental sustainability activities such as the targets set within the Millennium Development Goal (MDG) number 7 (MDG7) of ensuring global environmental sustainability (Murugesan & Laplante, 2011). New technologies provide utilities for knowledge acquisition and awareness, early evaluation of new knowledge, reaching agreements and communication of progress in the interest of the human welfare. This includes ethical aspects of protecting human life as well as aspects of consumer safety and the preservation of the natural environment (Murugesan & Laplante, 2011).

According to IISD (2007), it is becoming increasingly clear that it is unlikely to avoid major environmental challenges resulting from unsustainable practices to date. The most prominent example, climate change, is already noticeably triggering changes in agriculture, the incidence of forest fires, flood and drought patterns, the movement of invasive species, and biodiversity, just to name a few. The Internet and information and communication technologies (ICTs) are transformative technologies in that they put intelligence at the edges of networks, thereby maximizing users' capacity to create and adapt. Examples of such transformation include using ICTs to improve practices in agriculture and forestry; monitor air and water pollution; improve disaster warning and relief; improve the efficiency of the energy, transportation, and goods and services sectors; and harness social networking for transformative change. At the same time, the sustainability of these technologies must also be managed to avoid unintended consequences such as increased consumption and environmental damage from electronic waste.

Although ICTs have their own negative environmental impacts, they may also support the development of a green economy through their demonstrated connection to economic growth, and their enabling effects through application to increased efficiencies in energy use, production and distribution. Most importantly, their potential systemic effects could result in the transformation of the behaviour, attitudes and values of individuals as citizens and consumers, as well as economic and social structures, and governance processes (IISD, 2007).

2.4 Empirical Review

Adamson et al. (2005) conducted a study on the environmental impact of computer information technology in an institutional setting. The study involved a case study of Guelph University. The main objective of the study was to establish whether there

was efficient use of energy and proper disposal of obsolete IT components at the university. The findings from the study reveal that both the inefficient use of energy and the manufacturing and disposal of computer systems leads to the generation and release of toxic compounds into the environment.

A study was also carried out by Rikhadson (2001) on corporate environmental management and information technology. The study involved a case study of an international firm. The findings from the study reveal that information technology has changed, is changing and will continue to change the face of business as we further enter the Information Society. It would be difficult for a company to function effectively without the aid of various information technologies, such as accounting software, production software, the Internet, computer networks and telecommunications devices. The study also recommends for a standard framework that will assist organizations to better implement environmental management practices.

A similar study was also carried out by Tomlison et al. (2010). The study focused on greening through information technology. It focused on the use of information technology in achievement of environmental sustainability in Britain. The study took a survey approach focusing on several organizations across the industry. It was established that individuals and institutions have an important role to play in the utilization of information technology to manage the environment.

One of the primary institutional contributions of Green IT is through improved infrastructures. Smart energy grids enable more efficient power utilization. Improved transportation systems reduce fuel use while optimizing the movement of people, objects, and materials around the world. More effective waste management systems

can facilitate more comprehensive recycling and salvaging of useful materials after their initial usage is complete Tomlison (2010). Tomlison (2010) further reveal that green IT can also improve large-scale planning and policy decisions.

In another study by Blars (2004) on information technology as the unsung hero of market based environmental management policies, several issues were established. The study focused on the utilization of information technology in the reduction and management of Sulphur Dioxide emissions in the USA. It took the form of a survey of several organizations. The study findings established that information technology is what has made the sulphur dioxide emissions trading program work in some countries such as the United States of America. The key elements based on information technology that have been particularly crucial are the allowance tracking system (ATS), the emissions tracking system (ETS), and the continuous emissions monitoring systems (CEMS).

Gowa (2009) also conducted a study focusing on the best practices in environmental information management in Africa. This was a case study of Uganda and its main objective was to establish how information technology enhanced environmental management. The study findings reveal that information technology can provide a basis for better decision making concerning environmental management. The underlying assumption is that good information management practices which would eventually be positively reflected by an enhanced environment and improved quality of life of the people.

A study was also carried out by Cherutich (2013) on e-waste management in Kenya. The study focused on mobile phone waste management among mobile phone companies in Kenya. The study took the form of a survey involving key stakeholders

in the mobile phone sector in Kenya. The findings reveal that both economic and social upgrading is occurring in Kenya. Social upgrading was evident since the mobile industry has employed many people directly and indirectly. Economic upgrading was also evident since the mobile phone industry in Kenya is the leading source of government revenue through tax. It has also led to the use of several mobile phone applications that include m-agriculture, m-commerce, m-education, m-governance, and m-health.

2.5 Summary

From the literature review contained in this section, two important theories that relate to green information technology and environmental management performance have been revealed. The first theory is the diffusion of innovations theory which is important in explaining the diffusion of green technological innovations that are essential in the management of the environment. The other theory is the technology acceptance model that explains how perceived usefulness of green information technology and its ease of use in environmental management performance will determine its acceptance among commercial banks in Kenya.

The study also section has also reviewed both international and local literature on green information technology and environmental management performance. The studies so far reviewed reveal diverse findings. No studies have however attempted to focus on the impact of green information technology and environmental performance management. This leaves a research gap that needs to be bridged.

2.6 Conceptual Framework

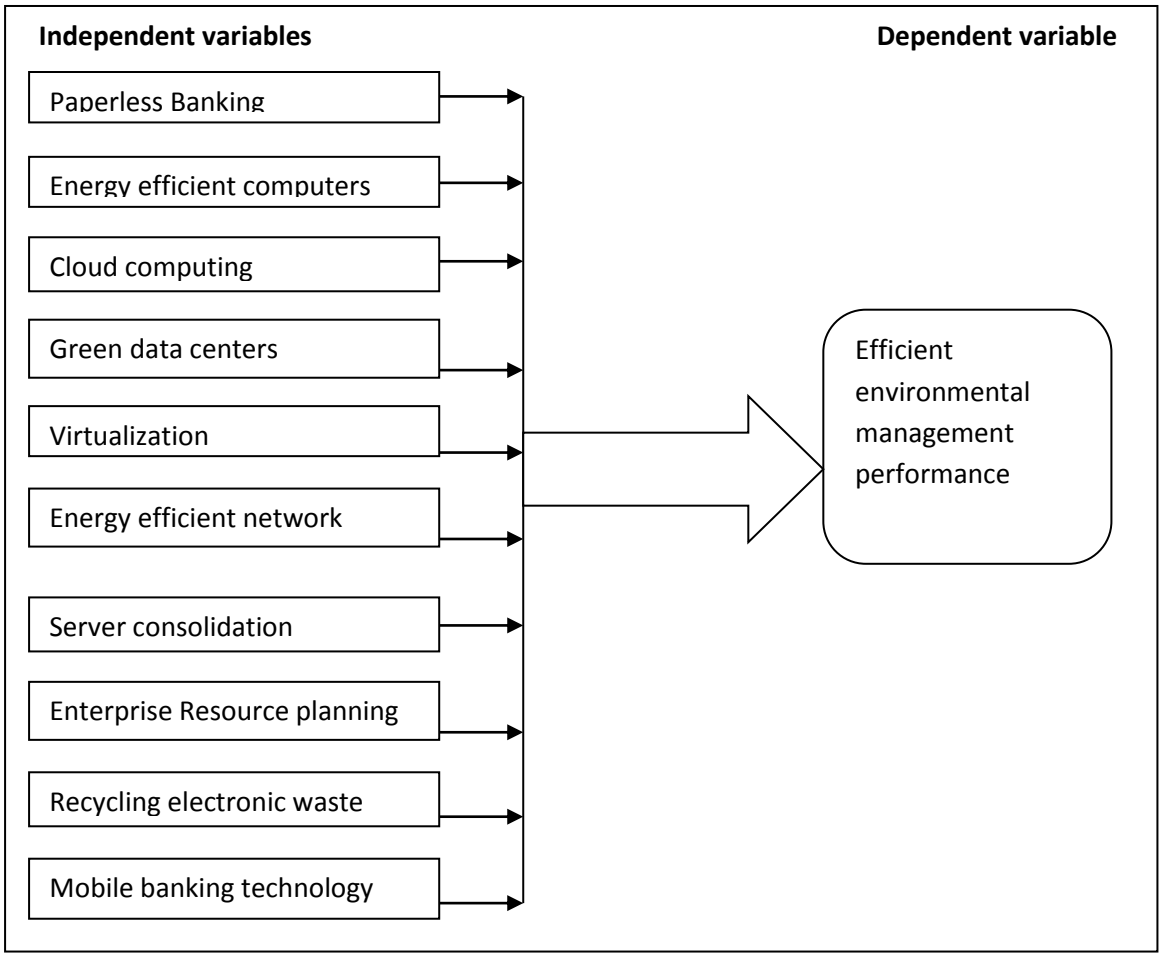

Figure 2.1: Information technology and environmental management

The above conceptual framework reveals the relationship that exists between the types of information technology adopted by the commercial banks and their impact on environmental management. The independent variables represent the various types of environmental management enabling information technologies which if adopted by an institution will assist in enhancing management of the environment.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the methodology that was used in carrying out the study. It explains the research design that was employed, the target population, the sample size and sampling technique applied, the data collection instruments as well as the data analysis technique.

3.2 Research Design

The research design used was descriptive research. Descriptive research portrays an accurate profile of persons, events, or account of the characteristics, for instance behavior, opinions, abilities, beliefs, and knowledge of a particular individual, situation or group (Burns & Grove 2003). The descriptive method was preferred because it ensures complete description of the situation being investigated (Kothari, 2008).

3. 3 Target Population

According to Sander (2005) target population refers to the elements about which information is wanted or the totality of elements which are under discussion and about which information is desired. In this study information was required from commercial banks in Kenya. CBK report (2014) indicated that there were 43 commercial banks in Kenya. All the 43 commercial banks comprised the target population for this study. Since the target population was small, there was no need for sampling. All the 43 commercial banks participated in the study. Two respondents were picked from each of the commercial banks. One respondent was the corporate relationship manager and

the other was the IT manager. These two were chosen because they have knowledge in IT and environmental management. This brought the number of respondents to 86.

3.4 Data Collection

The study utilized primary data that was collected through a questionnaire. The questionnaire contained both open and closed ended questions. The questionnaire had three sections: Section A of the questionnaire contained data on the demographic information of the respondents; section B of the questionnaire sought data on the types of green information technology adopted by commercial banks in Kenya. The last section sought data on the impact of information technology on environmental management. This assisted in establishing the relationship between IT adopted and their impact on environmental management.

3.5 Data Analysis

Data was analyzed using descriptive statistics specifically mean, frequencies, percentages, and standard deviations. The demographic data was analyzed using the mean and standard deviation; the extent to which commercial banks have adopted information technology was analyzed using frequencies and percentages, the effect of information technology on management of environment was analyzed using correlation and regression analysis between adoption of IT and environmental management practices implemented by commercial banks. The findings were presented in tables. The following multiple regression model was used in conducting regression analysis:

$$\mathbf{Y= a + b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7+b_8x_8+b_9x_9+b_{10}x_{10}} + e$$

Y = Environmental management performance;

x1 = Paperless Banking

x2 = Energy efficient computers

x3 = Cloud computing

x4 = Green data centers

x5 = Virtualization

x6 = Energy efficient network

x7 = Server consolidation

x8 = Enterprise Resource planning

x9 = Recycling electronic waste

x10 = Mobile banking technology

b1 to b10 = Regression coefficients for each independent variable

e = Error term.

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSIONS

4.1 Introduction

The purpose of this study was to establish how green information technology practices affect environmental management performance among commercial banks in Kenya. The study sought to achieve two specific objectives: establish the extent of adoption of green information technology practices by commercial banks in Kenya and determine the impact of green information technology on environmental management performance among commercial banks in Kenya. The findings are presented next.

4.2 Response Rate

Out of the 86 questionnaires that were administered, 70 questionnaires were received from the respondents as shown in the Table 4.1.

Table 4.1: Response Rate

Response	**Frequency**	**Percent**
Returned	70	81.4
Not Returned	16	18.6
Total	**86**	**100.0**

The results in Table 4.1 reveal that 70 out of the 86 questionnaires administered were returned. This implies that the study achieved a response rate of 81.4 percent. According to Sivo, et. al., (2006) a response rate of between 65 percent to 75 percent is acceptable for the results to be considered valid. This response rate was therefore considered sufficient enough to enable the researcher to generalize the findings

concerning the effect of green information technology on environmental management performance among commercial banks in Kenya.

4.3 Demographic Information

The researcher sought to find out demographic information from the respondents to determine whether they were suitable to provide relevant and reliable data for the purpose of establishing how green information technology affects environmental management among commercial banks in Kenya. The data was subjected to descriptive statistics and the results are presented in Table 4.2.

Table 4.2: Distribution of Respondents by Demographic Information

Designation		**Level of education**		**Duration in current position**		**Bank size**		**Ownership structure**	
IT manager	50%	Diploma	14%	Less than 3 years	12%	Less than 10 branches	10%	Local ownership	87%
Corporate relationship manager	50%	Degree	56%	3-6 years	8%	11-50 branches	75%	Foreign ownership	13%
		Masters	25%	6-9 years	64%	More than 50	15%		
		Ph.D.	5%	More than 10 years	16%				
Total	**100%**		**100%**		**100%**		**100%**		**100%**

The results in Table 4.2 reveal that 50 percent of the respondents were IT Managers and 50 percent were corporate relationship managers. This implies that respondents were equally spread between IT and corporate relationship managers. On the level of education, 56 percent of the managers had a bachelor's degree, 25 percent had a Master's degree, 14 percent had a Diploma and 5 percent had a PhD. This is an indication that most of the respondents had relevant training qualifying them for their respective positions. Concerning the years of experience 64 percent had worked for 6 to 9 years, 16 percent more than 10 years, 12 percent less than 3 years and 8 percent 3

to 6 years. This is a confirmation that they had enough experience and could therefore provide reliable and relevant information. The study further established that most of the banks are medium sized banks with 11 to 50 branches as indicated by 75 percent of the respondents. On the ownership structure it was clear that 87 percent of the commercial banks are locally owned.

4.4 Extent of Green Information Technology Adoption

The study sought to establish the extent to which commercial banks in Kenya have adopted green information technology. The respondents were provided with 10 popular green information technologies and were required to indicate the extent to which each one of them has been adopted in their respective commercial banks. The responses were analyzed and the results are presented in Table 4.3.

Table 4.3: Extent of Green Information Technology Adoption

Extent of adoption	Very great extent (%)	Great extent (%)	Moderate extent (%)	Small extent (%)	Very small extent (%)	Total (%)
Implementation of paperless banking system	-	60.0	28.6	8.6	2.8	100.0
Purchase of energy efficient computers	-	20.0	55.0	20.0	5.0	100
Use of cloud computing	37.2	48.6	11.4	2.8	-	100
Establishment of a green data center	-	32.0	46.0	12.0	10.0	100
Embracing Virtualization	57.2	28.6	11.4	2.8	-	100
Implementing energy efficient networking in the bank	35.8	50.0	7.1	7.1	-	100
Server consolidation technology	45.0	50.0	3.0	2.0	-	100
Use of enterprise resource planning system	88.6	4.3	2.8	-	4.3	100
Recycling and reuse of electronic waste	4.3	7.2	82.8	-	5.7	100
Use of online real-time transaction processing	35.0	45.0	15.0	5.0	-	100

4.4.1 Adoption of Paperless Banking

The study sought to establish the extent to which commercial banks in Kenya have adopted the paperless banking information system. The results in Table 4.3 show that majority of the commercial banks in Kenya (60 percent) have adopted the technology to a great extent; 28.6 percent have adopted it to a moderate extent; 8.6 percent to a small extent and 2.8 percent to a very small extent. This is an indication that most of the commercial banks have in place a paperless banking technology that enables them to reduce paperwork and hence reduce the impact of their operations on the environment.

4.4.2 Purchase of Energy Efficient Computers

On the purchase of energy efficient computers, the findings in Table 4.3 reveal that 20 percent of the banks have bought energy efficient computers to a great extent. It is also evident that 55 percent to a moderate extent and 20 percent to a very small extent. This is an indication that commercial banks in Kenya are realizing the significance of having energy efficient computers and are interested in purchasing them.

4.4.3 Use of Cloud Computing

The study sought to establish whether commercial banks in Kenya have adopted cloud computing as part of their green information technology practices. The results in Table 4.3 show that 37.2 percent of the commercial banks in Kenya have adopted cloud computing to a very great extent; 48.6 percent to a great extent; 11.4 percent to a moderate extent and 2.8 percent to a small extent. This is an indication that most of

the commercial banks in Kenya have opted to enhance environmental management performance by choosing to practice cloud computing.

4.4.4 Establishment of a Green Data Centre

Concerning the establishment of a green data centre by commercial banks as one of the green information technology practices, The findings in Table 4.3 show that 32 percent of the respondents confirmed that their commercial banks have established a green data center to a great extent; 46 percent to a moderate extent; 12 percent to a small extent whereas 10 percent to a very small extent. The results are a clear indication that commercial banks in Kenya are adopting green data center information technology as one way of enhancing environmental management performance.

4.4.5 Embracing Virtualization

Establishing whether commercial banks in Kenya have adopted virtualization as one of their green IT practices was also necessary. Virtualization refers to the creation of a virtual resource such as a server, desktop, operating system, file, storage or network. Under virtualization it is possible for a firm to run multiple operating systems on a single hardware. The results as tabulated in Table 4.3 show that majority of the commercial banks (57.2 percent) have adopted virtualization technology to a very great extent and 28.6 percent to a great extent. This implies that commercial banks have managed to reduce computer hardware through virtualization thus reducing computer related waste.

4.4.6 Energy Efficient Networking

Concerning an investigation on whether commercial banks have adopted energy efficient networking as part of their green IT practices, the results in Table 4.3 show that 35.8 percent of the commercial banks in Kenya have put in place energy efficient

networking systems to a very great extent; 50 percent to a great extent and 7.1 percent to a moderate and very small extent respectively. This implies that commercial banks in Kenya are keen on enhancing environmental management performance by ensuring that there is high efficiency in energy utilization.

4.4.7 Adoption of Server Consolidation Technology

The results on adoption of server consolidation as shown in Table 4.3 show that 45 percent of the commercial banks in Kenya have adopted server consolidation technology to a very great extent; 50 percent of to a great extent; 3 percent to a moderate extent and 2 percent to a small extent. This implies that most of the commercial banks have reduced the number of servers required thus reducing emissions and energy required to run them. This practice is essential for efficient environmental management performance.

4.4.8 Use of Enterprise Resource Planning System

The study sought to establish whether commercial banks in Kenya have adopted the use of an enterprise resource planning system (ERP). An ERP system is a computer based software that integrates all the functions of an organization and enables information sharing. The results shown in table 4.3 indicate that 88.6 percent of the commercial banks in Kenya have adopted an enterprise resource planning system to a very great extent.

4.4.9 Recycling of Electronic Waste

On whether commercial banks in Kenya practice recycling of electronic waste as one of the practices of enhancing environmental management performance, the results in table 4.3 show that 82.8 percent of the commercial banks have embraced recycling of electronic waste to a moderate extent. This is an indication that recycling of electronic

waste which is a very significant practice in enhancing environmental management performance has not been largely embraced by commercial banks in Kenya.

4.4.10 Use of Real Time Transaction Processing System

Concerning the adoption of real time transaction processing, the findings illustrated in the table 4.3 indicate that 35 percent of the commercial banks in Kenya have adopted real-time transaction processing systems to a very great extent; 45 percent to a great extent; 15 percent to a moderate extent and 5 percent to a small extent. This is an indication that majority of the commercial banks are keen on enhancing environmental management performance through implementation of IT systems that support this activity.

4.5 Relationship Among Variables

In order to establish the nature of the relationship that exists between the green IT practices adopted and environmental management performance, a correlation analysis was conducted. Pearson's correlation coefficient was obtained and the results are indicated in the correlation matrix in Table 4.4.

Table 4.4: Pearson's Correlation Matrix

Variable	Improved environmental management	Paperless banking system	Energy efficient	Cloud computing	Green data centers	Virtualization	Energy efficient networks	Server consolidation	Use of ERP	Recycling of electronic waste	Real time processing
Improved environmental management	1.000										
Paperless banking system	.964**	1.000									
Energy efficient computers	.836**	-0.142	1.000								
Cloud computing	.721**	.352	.054	1.000							
Green data centers	.814**	.448*	-.113	.413	1.000						
Virtualization	.753**	.339*	.242	.118	.215	1.000					
Energy efficient networks	.621	.003	.181	.445	.352	-.406	1.000				
Server consolidation	.668	.126	.076	.391	-.584*	.258	.123	1.000			
Use of ERP	.544*	.213*	-.056	.411	-.575	-.124	.025	.356	1.000		
Recycling of electronic waste	.862**	-0.125	.009	.147	.339	.007	-.007	-.371	.021	1.000	
Real time processing	.431*	-0.141	.624	.422	.621	.212	.373	.481	.228	.384	1.000

**. Correlation Significant at the 0.01 level (2-tailed)

*. Correlation Significant at the 0.05 level (2-tailed)

The findings in Table 4.4 show a strong positive correlation between improved environmental management and adoption of green information technology. A strong positive correlation of 0.964 was observed between environmental management and implementation of paperless banking system. This was an indication that implementation of a paperless banking system significantly improved environmental management performance. A strong positive correlation of 0.836 was found between improved environmental management and purchase of energy efficient computers. This was an indication that the purchase of energy efficient computers by commercial banks improved environmental management performance. Similarly, a strong positive

correlation of 0.862 was found between environmental management and recycling of electronic waste. This implied that adoption of recycling practices by commercial banks improved environmental management. It was revealed that there was a strong positive correlation between cloud computing and improved environmental management of 0.721. Green data Centers and environmental management had a strong positive correlation of 0.814.

On the other hand, there was a moderate positive correlation between improved environmental management and energy efficient networks of 0.621. Further, it was observed that there was a moderate correlation of 0.67 between server consolidation and environmental management and another one between ERP and environmental management of 0.544.

4.6 Effect of Green IT on Environmental Management Performance

The study sought to determine the effect of green IT practices on the environmental management performance. A regression model was used, the independent variables are: Paperless banking, Energy eff. comps, Cloud computing, Green data Centre's, Virtualization, Energy eff. Networks, Server consolidation, Use of ERP, recycling and Real time processing. The dependent variable is improved environmental management performance.

Table 4.5 Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.889[a]	.767	.566	1.334

a. Predictors: (Constant), Paperless banking, Energy eff. comps, Cloud computing, Green data Centre's, Virtualization, Energy eff. Networks, Server consolidation, Use of ERP, recycling and Real time processing

The coefficient of determination is 0.767 which implies that green IT practices implemented by commercial banks explains 76.7 percent of the improved environmental management performance.

4.6.1 F-Test for the Model

The study conducted analysis of variance to determine whether there was a statistically significant relationship between the variables as shown in Table 4.6:

Table 4.6 Analysis of Variance (ANOVA)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.617	10	1.1617	7.849	.000[b]
	Residual	8.712	59	.148		
	Total	20.329	69			

a. Dependent Variable: improved environmental management performance

b. Predictors: (Constant), Paperless banking, Energy efficient computer, Cloud computing, Green data Centre's, Virtualization, Energy eff. Networks, Server consolidation, Use of ERP, recycling and Real time processing

The result in Table 4.6 shows the regression model has an F Value of 7.849 and P value <0.05 and hence the model is statistically significant.

4.6.2 Model Coefficients

Model coefficients were used to show the direction of the relationship between the variables. The results are shown in the Table 4.7.

Table 4.7 Model Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.463	1.299		2.666	.004
	Paperless banking (x_1)	-.641	.139	-.126	-2.115	.044
	Energy eff. comps (x_2)	.026	.109	.035	.241	.810
	Cloud computing (x_3)	-.028	.168	-.025	-.167	.868
	Green data Centre's (x_4)	.008	.112	.012	.075	.941
	Virtualization (x_5)	.302	.098	.153	1.044	.061
	Energy eff. Networks (x_6)	1.304	.112	.296	3.827	.000
	Server consolidation (X_7)	1.204	.098	.288	2.983	.002
	Use of ERP (X_8)	.957	.127	.313	2.513	.009
	Recycling (X_9)	-.047	.100	-.061	-.468	.642
	Real time processing (x_{10})	-.355	.163	-.349	-2.180	.033

a. Dependent Variable: Improved Environmental Management Performance

The regression model obtained for this study is as follows;

$Y= 3.463-.641X_1 +1.304X_6 +1.204X_7 +.957X_8 -.355X_{10}$

Where Y= Improved environmental management performance

X_1 =Paperless banking

X_6 =Energy efficient networks

X_7 =Server Consolidation

X_8 =Use of ERP

X_{10} = Real time processing

Energy efficient computers, cloud computing, green data Centre's, virtualization and recycling were excluded from the regression model because they were statistically insignificant since their p-values were above 5 percent.

4.7 Discussion and Findings

The findings show that most commercial banks adopted paperless banking technology as one way of enhancing environmental management performance. According to Mulvaney, D. (2011) the most common environmental change within banks was the move toward paperless transactions (e.g. Internet banking, direct deposits and mobile banking). From the findings of this sudy banks purchased energy efficient computers which led to reduced electricity costs and improved efficiency. Adoption of virtualization by commercial banks led to reduced volume of electronic waste. ICT has the potential to virtualize processes that would otherwise consume considerable amounts of material and energy, virtual meetings, for instance, could avoid 97–98% of the CO2 emissions of physical meetings (Hischier & Hilty, 2002).Further, energy efficient networks that enabled banks to mitigate cost of energy and depletion of virgin resources for the generation of energy that was required to run the networks.

The correlation results found that there was positive relation between improved environmental management and adoption of paperless baking system, green data Centre's and recycling of electronic waste. The regression analysis results revealed that adoption of green information technologies explains 76.7 percent of the variance on environmental performance management by commercial banks in Kenya. The regression model was found to be statistically significant since its p-value was less than 5 percent. Further, paperless banking, energy efficient networks, server consolidation, use of ERP and real time processing were statistically significant because their p-values were less than 5 percent.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This study was carried out to determine the effect of green information technology adoption on environmental management performance by commercial banks in Kenya. This chapter presents the summary of findings, conclusion, recommendations and suggestions for further research.

5.2 Summary of Findings

The study findings revealed that majority of the commercial banks had adopted paperless banking technology as one way of enhancing environmental management performance. It was evident from the research findings that most of the commercial banks are purchasing energy efficient computers. This enables the banks to reduce the cost of electricity that is consumed by the hardware they install. The study further established that most of the commercial banks have embraced cloud computing as one way of reducing the purchase of computers and radiations that emanate from them.

It was further established that establishment of green data centers is among the green information technologies that are currently being embraced by the commercial banks although it has not been widely implemented. The findings further revealed that most of the commercial banks have also embraced virtualization to enable them run several operating systems using few hardware computer equipment. This significantly enables the banks to reduce the volume of electronic waste that is generated by them. In addition to adopting virtualization, it was also evident from the research findings that most of the commercial banks in Kenya have put in place energy efficient networks

that enable them reduce the cost of energy and depletion of virgin resources for the generation of energy that is required to run the networks.

It was also observed from the research findings that most of the commercial banks in Kenya have adopted server consolidation technology. The study further established that most of the commercial banks had adopted the use of ERP systems that enables them to integrate the functions of the banks. Recycling of electronic waste was found to be adopted although most of the commercial banks have not embraced this to a large extent.

Strong positive correlations were observed between improved environmental management and adoption of paperless baking system, green data centers and recycling of electronic waste. The regression analysis results revealed that adoption of green information technologies explains 76.7 percent of the variance on environmental performance management by commercial banks in Kenya. The regression model was significant since its P- value was 0.000 which was way below the acceptance limit of 0.005.

5.3 Conclusion

Commercial banks in Kenya have adopted the following green information technology practices: implementation of paperless banking systems; purchasing of energy efficient computers, putting in place energy efficient networks; adoption of green data centers; embracing virtualization, server consolidation technology; use of cloud computing; adoption of ERP systems and use of real-time processing of transactions. The commercial banks have also started to embrace recycling of electronic waste although it is not largely practiced. There is a strong positive correlation between improved environmental management and adoption of paperless

banking system, use of energy efficient computers and recycling of electronic waste. Finally, adoption of green information technology explains 74.3 percent of the environmental management performance of commercial banks in Kenya.

5.4 Recommendations

The study has established that most of the commercial banks have not embraced recycling of electronic waste. It will be important for the banks to embrace this concept since it can significantly assist in the enhancement of environmental management performance.

The regression findings reveal that adoption of green information technology explains a significant portion of environmental management performance among commercial banks. It will be important for the commercial banks to embrace these technologies more since they play a very significant role in environmental management performance.

5.5 Suggestions for Further Research

Changes in information technology occur quite frequently. As a result of these frequent changes, new information technologies are likely to be invented that support more efficient management of the environment. It will therefore be necessary to replicate this study after another 3 years to establish the position. A comparative study needs to be carried out to compare the findings of the banking industry with another industry to ascertain whether the green information technologies adopted are the same and if they have the same effect on environmental management performance.

5.6 Limitations of the Study

This study focused on adoption of Green Information Technology and their impact on environmental management in Kenya. The findings are therefore applicable only to the banking industry in Kenya.

Information Technology changes rapidly. The findings of this study may only be valid as long as the Information Technologies are still applicable. In case they become obsolete or new ones are invented that lead to more efficient management of the environment, then the findings may not remain relevant.

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APPENDIX: Research Questionnaire

Section A: Demographic Information

Please tick the most appropriate answer

1. Name of Bank……..

2. Designation

☐ IT Manager
☐ Corporate relationship Manager

3. Highest level of Education

☐ Diploma
☐ Degree
☐ Masters
☐ Ph.D.

4. Duration in Current Position

☐ Less than 3 years
☐ 3-6 years
☐ 6-9 years
☐ More than 10 years

5. What is the size of your bank based on branch network

☐ Small (less than 10 branches)
☐ Medium (between 11 and 50 branches)
☐ Large (Over 50 branches)

6. Bank ownership

☐ Local ownership
☐ Foreign ownership

Section B: Extent of green information technology adoption

Please indicate the extent to which the bank has adopted the following technology.

No.	Green Information Technology	Very great extent	Great extent	Moderate extent	Small extent	Very small extent.
1	Implementation of paperless banking system					
2	Purchase of energy efficient computers					
3	Use of cloud computing					
4	Establishment of a green data center					
5	Embracing Virtualization					
6	Implementing energy efficient networking in the bank					
7	Server consolidation technology					
8	Use of enterprise resource planning system					
9	Recycling of electronic waste					
10	Use of online real-time transaction processing					

Section C: Impact of green IT on environmental management performance

Please indicate the extent to which you agree with the following statements on the impact of the various types of IT on environmental management in your organization.

No.	Impact	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
1	Investment in appropriate IT has enabled the bank reduce cost of electricity					
2	Less paper is used in the bank due to investment in IT					
3	The bank has reduced electronic waste					
4	IT has led to efficient use of					

	energy in the bank					
5	Reuse and recycling of IT, has reduced pressure on environmental resources.					
6	In overall adoption of IT by the bank has reduced environmental pollution.					
7	Recycling electronic waste has reduced use of virgin materials from the environment.					
8	Use of green IT has reduced unnecessary radiation to the environment.					
9	Green IT disposal practices has reduced damping if electronic waste to the environment.					
10	Adoption of IT improves efficiency in environmental management.					