AN ASSESSMENT OF ENVIRONMENTAL SUSTAINABILITY PRACTICES IN CONSTRUCTION INDUSTRY. A CASE STUDY OF TILISI DEVELOPMENT PROJECT SITE, KIAMBU COUNTY, KENYA

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Department of Geography and Environmental Studies

DECLARATION

This research project is my original work and has not been presented for an award of a degree or any other academic credit at the University of Nairobi or any other institution.

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C50/84265/2015

Sign……. …… Date……

Supervisors

This research project has been submitted for examination with our approval as university supervisors.

DR. JAMES MORONGE

Sign…… Date……

DR. MARTIN MARANI

Sign…… Date……

DEDICATION

To my late Dad *George Koigi Ndung`u*

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVIATIONS

BORAQS	-	Board of Registration and Quantity Surveyors
EA	-	Environmental Audit
EBK	-	Engineer Board of Kenya
EIA	-	Environmental Impact Assessment
EIK	-	Environment Institute of Kenya
EMCA	-	Environmental Management and Coordination Act
EMP	-	Environmental Management Plan
ESMP	-	Environmental and Social Management Plan
DOSHS	-	Directorate of Occupational Safety and Health Services
GDP	-	Gross Domestic Product
ILO	-	International Labour Organization
ISK	-	Institute of Surveyors Kenya
KPHC	-	Kenya Population and Housing Census
NCA	-	National Construction Authority
NEMA	-	National Environment Management Authority
OSHA	-	Occupational Safety & Health Act
PPE	-	Personal protective equipment
SPSS	-	Statistical Package for the Social Sciences
UNEP	-	United Nations Environment Programme
WHO	-	World Health Organization

ABSTRACT

Construction industry in many developing countries continues to be a key pillar of economic development. In Kenya, the industry contributes to gross domestic product and creation of employment. Even with these contributions, the industry has played a detrimental role of environmental damage. The aim of this study was to assess environmental sustainability practices that were undertaken at construction sites in Kenya through a case study of the construction at Tilisi Development Project in Kiambu County. The guiding objectives were to establish environmental management practices that were undertaken at the project site, to evaluate the challenges experienced during their implementation and to examine challenges that were faced by stakeholders towards compliance to rules and regulations in environmental practices. Based on the aforementioned objectives, the study hypothesized the null hypothesis that environmental management practices do not have a significant relationship with sustainable construction at the construction site. Target population comprised of Tilisi management, workers under different contractors, officials in government and professional bodies, and neighboring community. A census study was adopted for Tilisi management staff and on neighboring community members whereby the entire population formed the sample size of the study. The method used to select contractor workers was stratified random sampling while official from government agencies that deal with environmental and construction regulations and certification were selected using purposive sampling method. Data was collected using questionnaires, interview guide, and through observation. The themes that formed the focus of the study were borrowing from BREEAM that accord themes that construction sites should conform to in order to achieve sustainable environment. The themes include: natural resources extraction, energy use and conservation, water use and conservation, as well as health, safety and environmental responsibility. The results showed that there were minimal steps taken by the project management to reduce natural resource extraction from nature as indicated by (69.5%) of the workers. Green energy use and conservation was not given much emphasis as indicated by (88.8%).Tilisi workers were neither skilled on efficiency and sustainable water use (70.1%) nor skilled on waste management as indicated by (70.1%). It was also noted that Tilisi project was not designed to actively promote workers and general societal health and safety (64.7%). Inadequate workers training (73.0%) was the main challenge towards implementation of sustainability environmental practices and corruption by governing bodies came out as the main factor (84.5%) contributing towards noncompliance to rules and regulations in environmental practices. The null hypotheses that that environmental sustainability practices do not have a significant relationship with sustainable construction at the construction site was tested and rejected using Pearson's Chi-Square (X2) test at 0.05 significance level. This study showed that construction sites are marred with inefficient sustainability environmental practices such as lack of water management system, poor natural resources extraction, inadequate occupational safety and health measures, and environmental responsibility measures thereby contributing to environmental damage. This study recommends implementation of adequate training for contractors and workers for awareness creation of sustainable construction as well as instilling in them current adequate for effective implementation of regulations to enhance sustainable.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Globally, issues on environmental degradation have continued to attract attention of environment professionals. This is revealed through numerous environmental initiatives, which are supported by documented agreements, laws, rules and regulations formed to specifically anchor environmental sustainability (Ashna et al., 2017). One of them is Brundtland Report, (1989) that states that sustainable development should help the current generation to meets their everyday needs without hindering the ability of forthcoming generations to cater for their needs".

Because of the construction of facilities and amenities, the nation is able to meet its everyday needs for shelter, roads, telecommunications, water supply and energy generation among other needs (Kheni, 2008; Abubakar, Abdullahi &Bala, 2018). The increasing population has however increased the demand for these services thereby increasing the rate of environmental degradation. In spite of these occurrences, sustainable construction is encouraged so as to reduce its overall ecological footprint. Current global urbanization makes it even more imperative that constructed facilities should conform to sustainability aspects in environment, economic, and socially well-being (Zhao et al., 2012).

Sustainable construction requires that the design is environmentally friendly such as use of natural lighting. The material performance throughout the life cycle also taken into consideration to reduce greenhouse gas emissions. Economically sustainable construction considers aspects such as use renewable energy, waste recycling, rainwater harvesting and conservation (Zhao et al., 2012) while socially sustainable construction seek to adherence to the stipulated ethical standards throughout the project life cycle. Some of the social aspects include promotion of good living and working conditions as well as health and safety of workers and end users of the projects (Mahamadu, Baffour Awuah & Booth, 2016).

The Council of Green Building expressed its concerns on the sectors rate of consumption more than 400 million tons of material annually stating that this practice is contributing to environmental damage. Khasreen (2009) supports the statement through his finding that the industry is a major consumer of about 50% of natural resources for construction purposes. Further, Khasreen (2009), states that about 50% of greenhouse gases in the atmosphere is emitted from the construction industry thereby contributing to global warming. All in all efforts have been made to mitigate these negative externalities by encouraging uptake to recycle industrial waste where possible and encouraging rain and storm water harvesting (Yuksel, 2018).

In Kenya, the construction industry also plays a significant role in supporting livelihoods through contribution of 7% of the gross domestic product (GDP) and supporting 9% of the workforce (KNBS, 2018).In spite of the economic benefits accrued from the construction sector, the sector has also impacted the environment in a negative way(Ibid; Husin, 2008). Construction activities that largely impact the environment negatively include removal of vegetation cover to pave way for construction, excavation, trenching, drilling, extraction of raw materials such as sand, degradation of air quality through emission of gases and dust, noise and production of solid and waste water (Menzel & Gutierrez, 2010).

Kenya's environmental sustainability concept is anchored in the Environmental Management and Coordination Act (EMCA), which is managed by NEMA, the government lead agency charged with the implementation of all policies, and coordination over all environmental issues matters.

In regards to the construction industry in Kenya, EMCA provides for environmental protection through requirements for environmental assessments for all new developments, environmental audits for completed projects that are in operation and monitoring or projects in the construction phase, environmental restoration orders for projects whose operations are against the stipulated rules, as well as conservation and easement orders. The Environmental and Social Impact Assessments is a requirement for

all new projects and provides for decision making by all stakeholders through stakeholders participation.

Despite the existence of these guidelines, environment performance in the construction industry has largely remained unsatisfactory (Ibid; Husin, 2008). This is noticeable through the negligible or outright non-compliance with the set guidelines and regulations (Smallwood *et al.*, 2008). Inadequate enforcement capacity, ignorance or lack of awareness by developers to comply were some of the contributing factors to non-compliance (Muiruri, 2012). Non-compliance therefore remains a challenge achieving sustainability in the construction industry.

Tilisi Development Ltd. is a master planned development on 387 acres in Limuru Kiambu County. Tilisi envisioned a development with world class infrastructure and would eventually encompass a warehousing and logistics park, residential, educational, medical, recreational, hospitality, commercial and retail outlets with the aim of offering a corporate and community experience. The Tilisi aims at providing fully-serviced vacant land parcels for investors to purchase and develop. Phase one is complete and works have recently commenced on Phase Two which is the focus of this study. The key focus on this Phase Two is the development of economic infrastructure that comprise of internal access roads, drainage, water supply, a sewerage treatment and disposal system, a solid waste collection and disposal system, power supply and telecommunication.

1.2 Statement of the Problem

Although construction industry in Kenya is experiencing rapid growth, the industry continues to generate negative environmental impact on the environment. This is mainly due to unsustainable use of natural resources, and high waste generation and poor waste management, emission of greenhouse gases and unsustainable energy use in all phases of the construction cycle (Onkangi et al. (2018). This has called for better and efficient ways of operation to rectify the currently inefficient modes of construction (Adetunji*et al,* 2003).

Huge strides have however been made in advocating for best environmental sustainability practices at construction sites in Kenya. The country has established a National

Environment Policy (2013) and harmonized environmental laws in Kenya under the Environmental Management and Coordination Act (EMCA) 1999 to coordinate environmental management. There is also the National Environment Action Plan, NEAP, (GoK, 1994) that emphasizes the need for environmental impact assessment (EIA) on all new construction projects.

From the aforementioned, it can be argued that there seems to be sufficient environmental sustainability guidelines in the construction industry. However, there are indications of insufficient enforcement (Muiruri, 2012) and environmental disregard at the construction sites. This can be because of inadequate resource mobilization strategy, and funding framework, insufficient public understanding of the consequences of poor environmental management practices coupled with high cost of construction, insufficient availability of environmentally friendly or green products and the generally acknowledged high level of corruption and unnecessary bureaucracy that hinders compliances to the laws (Mustaffa, 2009) a situation that is making is difficult to achieve sustainability (Asan&Akasah, 2015; Kiganda, 2016).

A review of the studies done shows that Ng'ang'a et al. (2017) conducted a study to examine the health and safety practices at construction sites within in Nairobi county, Kenya. Kemei, Kaluli and Kabubo (2015) also conducted a study on assessment of occupational Safety and Health in Construction Sites in Nairobi County. In another study, Gichamba, and Kithinji, C. (2019) assessed the influence of environmental regulations in the performance of construction projects in Nairobi County, Kenya. None of this study has looked at environmental sustainability practices in construction industry in Kenya. It is as a result of this gap that this study purposed to assess the environmental management practices undertaken at Tilisi construction sites in Kiambu County with specific objective of identifying barriers in implementation of best environmental practices and challenges towards compliance to the existing environmental sustainability laws and regulations.

1.3 Research Questions

i. What are the environmental management practices undertaken at the Tilisi project site?
ii. What are the challenges in implementing environmental practices at the Tilisi project site?
iii. What are the challenges towards compliance to rules and regulations in environmental practices?

1.4 Objective of the Study

General Objective

The study purposed to assess the environmental sustainability practices undertaken at Tilisi Construction site in Kiambu County.

Specific Objectives of the Study

i. Assess the environmental management practices undertaken at Tilisi development project site.
ii. Evaluate challenges in implementing environmental practices at Tilisi construction site.
iii. Examine challenges towards compliance to statutes, rules and regulations in environmental practices.

1.5 Hypothesis

The study sought to test the hypothesis that:

H_0: Environmental management practices do not have a significant relationship with sustainable construction at the construction site.

H_1: Environmental management practices do have a significant relationship with sustainable construction at the construction site.

1.6 Significance of the Study

The study was of importance to the management at construction companies and building contractors. The findings were aimed at highlighting the environmental practices at construction sites that may improve the sustainability of construction projects. The study

was also meant to help contractors and employees at construction sites to monitor, evaluate and mitigate environmental impacts.

The findings were also aimed at enlightening and giving insight to other construction stakeholders; such as the clients and employees (site workers), on how they could work together to jointly promote sustainable environmental practices for the well-being of construction projects.

The study was also aimed at assisting regulatory agencies to highlight any identified gaps in implementation of environmental practices as guided by Kenyan law. This study was intended to help regulatory authorities to enhance effectiveness in carrying out their core mandate of ensuring that all construction sites adhere to the statutory requirements in terms of environmental protection. It was desired to also trigger policy formulation by the regulatory agencies, either in improvement of the existing regulations or enhancement of compliance to environmental regulations pertaining to construction sites in Kenya.

The study findings may also give insight to the government as it implements its big four agenda, and more specifically on affordable housing. The study can inform the developers of the environmental management practices and how they can be integrated into mixed-use development.

It is purposed that the study would open more areas with gaps that need further research to enhance posterity thereby benefitting researchers and scholars. The findings would add more input or critique existing knowledge on environmental practices and sustainable construction and would also be a reference point for future scholars.

1.7 Scope and Limitations of the Study

Scope of the Study

The study was limited to the Tilisi Project site in Limuru in Kiambu County. The County is an immediate neighbor to the north of Nairobi County. Tilisi project is a master planned development set on 387 acres of land in Rironi in the outskirts of Limuru town.

The entire project was executed in four phases and phase Two was the focus of this study. Phase Two entailed laying down of the infrastructure i.e. Internal access roads and

drainage network, water supply network, laying of wastewater and disposal management system, solid waste collection and disposal system, power supply network and telecommunications network.

The target population comprised of workers directly or indirectly involved in construction particularly the Tilisi construction site. These includes, the Tilisi management, Government agencies and professional bodies such as National Environment Management Authority (NEMA), National Construction Authority (NCA), Environmental Institute of Kenya (EIK), Board of Registration of Architects and Quantity Surveyors (BORAQS), Engineer Board of Kenya (EBK), Institute of Surveyors of Kenya (ISK) as well as the Architectural Association of Kenya (AAK). The adjacent community was also involved in the study.

Limitations of the Study

The study envisaged some challenges especially during the data collection process. These were:

Confidentiality

Some employees at the site were not willing to open up due to the confidential nature of the developer's protocol hence the researcher was required to assure the respondents that the research was purely for academic purposes and not accessible to the public.

Lack of Cooperation

A number of workers were not willing to cooperate. The researcher was patient with them and objectively explained to them the requirement as academic and how the project would benefit from the research findings. The researcher also clarified to the respondents on how the study would benefit their surroundings.

Fear of Victimization

Some of the workers were not uncomfortable to give accurate information as they though the management would use the study against them. They thought that they were putting their jobs at risk by giving important information and data affecting them in the course of execution of their duties. In order to curb this, the researcher convinced them by

producing a letter from the University of Nairobi which indicated that the research was purely for academic purposes and not be intended for any malpractice.

1.8 Definitions of Key Terms used in the Study

Environment is both the physical or built environment factors surrounding a construction site

Environmental impact assessment is a systematic evaluation conducted to assess potential environmental impacts of a programme, activity or project and to recommend ways of mitigating environmental impacts.

Environmental management is a process that seeks to achieve protection and conservation of natural resources.

Infrastructure is the physical facilities and systems that help a nation to operate such as road networks, schools, hospitals, telecommunication connection, drainage systems and connection to electricity supply network.

Sustainable construction is practice that ensure that structures are environmentally friendly economical and socially viable throughout the structure life cycle. (Hassan, 2012).

Master plan development is one that provides a conceptual layout giving a projection including future site population and amenities.

Mixed-Use Development is one that comprise of a mixture of land zones such as residential, commercial, cultural, institutional, and/or industrial uses.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Literature review explores other scholars' contributions and empirical evidence on the research topic under the study. The empirical review is presented as guided by study objectives and it highlights the identified knowledge gaps. The chapter also outlines the theoretical framework guides the study. The chapter also covers the conceptual framework of the study and maps the relationship among independent variables and dependent variable.

2.2 Environmental Management Practices at Construction Sites

Construction is one of the main contributor to economic growth as such the construction sector should be viable economically as well as in social and environmental aspects (Hassan, 2012).Globally, the construction industry contributes to global warming through emission of for about 23% of greenhouse gases and dust particles into the atmosphere (Huang et al., 2018). Over extraction of about 50% of all-natural resources used for construction, and production of about 50% of all solid waste leads to environmental degradation (Probert et al., 2010). This rate of degradation has so far encouraged creation of environmental awareness in an effort to shift towards sustainable construction (Tam et al., 2006; Ding, 2008).

A considerable number of studies both at global and regional scale have been used to establish the environmentally sustainability practices. This study borrowed from Building Research Establishment Environmental Assessment Methodology (2009). The methodology (Figure 1) provides themes or criteria that construction sites should adhere to in order to attain sustainable environment. The themes provided are as shown in figure 1 below.

Figure 1: Environmental Sustainability Practices

Themes for sustainable construction sites and supporting authors

Environmental sustainable consideration in construction projects	Araújo (2010)	Thomas et al, (2013)	Buson et al. (2009)	Carvalho and Rabechini (2011)	DJSI (2013)	Elkington(2012)	ETHOS (2012)	Fellows and Liu(2008)	Rodríguez-López (2010)	GRI (2013)	Thomas and Costa, (2017)
Natural resources consumption	✓	✓	✓	✓ `		✓	✓	✓	✓	✓	✓
Solid Waste	✓	✓	✓	✓ `		✓		✓	✓	✓	✓
Energy efficiency	✓	✓	✓	✓ `	✓			✓	✓	✓	✓
Water and biodiversity conservation		✓		✓ `	✓			✓	✓	✓	✓
Air, water and soil Pollution		✓					✓	✓	✓	✓	✓

Source: (Phoya 2018)

Themes identified in figure 1 above supported by the indicated authors have formed the focus of this study. They include - natural resources extraction, energy use and conservation, water use and conservation, as well as health, safety and environmental responsibility as discussed herein.

a. Natural Resource Management

Successful implementation of construction works depends on the quality of work as well as well as the availability of resources, Lamet et al., (2009). The resources include but not limited to raw materials, water, energy and soil. The current state of the global environmental condition evidenced by degradation of ecosystem because of increasing extraction and consumption of natural resources beyond the rate of replenishment (Pearson, 2009).

b. Water Use and Conservation

Water is very crucial in the construction industry as it is used in almost all processes of construction (Waylenn C. *at all.* 2011). Some of the processes include but not limited to domestic use such as consumption by construction workers, general site activities like

cleaning of tools and plant equipment, mixing of construction material such as cement, sand and gravel, groundwork's, including drilling, sprinkling water to reduce dust, developing of boreholes (Waylenn, at all. 2011).

In consideration of all the processes that require water in construction it is therefore paramount to conserve and use it efficiently. Waylenn*at all*. (2011), gives the hierarchy that should be followed. First option entails elimination of water wastage on site, second option is the improvement of efficiency of water use, and lastly the practice of harvesting rain water.

Waylenn`s report is supported by the Chinese University of Hongkong, 2013 that state that water usage at the construction sites should be conserved and water leakage should be avoided. The University further prescribes other measures of conserving water and includes recycling of treated water for non-portable uses. The University also supports the idea of harvesting rain water and directing storm water to water channels to avoid destroying habitats that may also water increase pollutants (Burger, 2016).

Wastewater produced at construction sites should be well managed to prevent groundwater contamination and natural waterways pollution (Kim et al., 2005; Netregs, 2012). Among the management measures include but not limited to directing effluent to siltation facilities like U-channels and obtaining valid licenses for every discharge points for effluent draining to public drains. Any muddy water should be sedimented to remove mud before discharge and the discharge should adhere to regulations conditions. Treated wastewater can be reused for dust suppression where possible. Other measures of managing sewerage such as using septic tanks should also be employed.

c. Waste and Emission Management

In any construction process it is guaranteed output of solid waste. The efficient management of this waste is vital to avoid soil and water pollution. Chinese University of Hong Kong 2013 provides a solid waste management plan as follows: That construction wastes should be segregated at source and licensed waste collector should be engaged to dispose of waste. Also where practical, useful waste should be re- used or recycled. The

waste management plan further give guidelines as to how asbestos waste should be handled and handled by licensed waste collector.

According to (Gangolells*et al.,* 2014), proper planning and management can go a long way in minimizing generation of waste throughout the construction process. The waste can potentially be recycled.

Chinese University of Hong Kong 2013 states that all chemicals and chemical wastes should be handled with care and information on the chemicals should be easily available. Chemical wastes should be stored separately with clear signage and should be collected by licensed chemical waste collector for proper disposal.

Other than solid and waste water from construction sites, noise emanating from construction sites can also cause annoyances (Abdul-Rahman *et al*., 2016). As a mitigation measure, Abdul-Rahman et al., 2016 advises there be frequent servicing of machinery and rescheduling of construction activities prescribed time. This is meant to ensure minimal disturbance to the community living adjacent the construction sites. For instance (EMCA, 2009) prohibits emissions higher than the stipulated levels to avoid annoyance to the general public.

Emission from construction sites not only cause air pollution, but also play a major contributor to material deterioration (Ivaskova*et al* (2015). As a mitigation measure, Chinese University of Hong Kong 2013, recommends covering of all materials on site and regular sprinkling of water to suppress dust during dry weather. The stockpiles shall be handled with great care to avoid dust emission. It is encouraged to reuse the treated wastewater for dust suppression and control vehicular movement.

In Kenya, Gichamba and Kithinji (2019) investigated the influence of environmental regulations on the performance of construction projects in Nairobi County. The specific objectives were to determine the influence of water regulations, waste management regulations; noise and vibrations regulations; and physical planning regulations at construction sites in Nairobi County. The study found that water regulations and waste management regulation have significant influence on performance of construction projects. Noise and vibration regulations were found to have little significance on

performance of construction projects while physical planning regulation had an insignificant influence on performance of construction projects. The study recommended that construction firms should conduct environmental impact assessment for them to enhance accessibility of construction permit from relevant authorities. Construction firms should use recycling, open dumping and landfilling to improve on waste management among the construction firms.

2.3 Challenges in Implementation of Environmental Sustainability Practices

In spite of the benefits accrued from the construction industry Leiper et al., (2003) has noted the slow adoption to sustainable approaches in the construction industry. Zhou and Lowe (2003) reports that the challenges in implementation to environmental sustainability practices is due inadequate awareness and knowledge of the economic benefits that can be accrued from such efforts. This argument is further supported by Sodagar & Fieldson (2008) who noted additional construction cost as a discouraging factor towards efforts made to achieve sustainable construction. Another challenge noted by Pitt et al., (2009) is the poor implementation of building regulations anchored in the rule of law to enforce sustainable construction.

Onkangi et al. (2018) examined the barriers, drivers, and adoption levels of environmental management practices in Construction sites in Nairobi. The paper established that the challenges to implementation of environmental management practices in Kenya were: unavailability of sustainable materials thus impedes apt environmental management through material selection. Financial costs also acts as a barrier (major barrier), as it is seen to reduce profit margins. Other barriers include incompetent environmental manager, insufficient incentives to support environmental management practices mainstreaming into the construction sector, lack of top management support, lack of environmental awareness and low technical qualification of workers.

2.4 Challenges towards Compliance to Regulatory Framework

Some of the factors leading to calls for environmental sustainability practices at construction can be pointed to aggressive enforcement, social awareness surrounding public health, environmental footprints and natural resource protection.

Kenya has so far pursued initiatives to cater for its growing population such as the big four agenda. In order to mitigate environmental issues that result from construction, the government has made it imperative to harmonize environmental regulations under the Environmental Management and Coordination Act (EMCA) 1999for coordinating environmental management. This Acts emphasize that all new development should undertake environmental impact assessment (EIA) and subsequent issuance of licenses.

The importance of EIA is that it assesses potential environmental impacts from construction activities and identifies measures to mitigate them, while maximizing on the positive impacts. EIA plays an important role in facilitating informed decisions-making on proposed development (GoK, 2002). Given the extensive impacts construction industry has on the environment, it is imperative that construction proponents adhere to the EIA guidelines for socio-economic and environmental soundness of any project.

It is evident that sufficient environmental sustainability guidelines exist in the construction industry as set out in law. However, there are indications of little or total lack of enforcement. This could be due to lack of clear and well-defined oversight authorities, lack of will by developers to adhere to the rules (Muiruri, 2012).

A study by Njoroge (2013) on how the existing regulatory framework promotes sustainability in the construction sector in Kenya revealed that the regulatory framework has not been adequately enforced to promote construction sustainability.

There are many cases on environmental disregard at the construction sites because the most basic and elementary environmental practices are disregarded. Casual labourers are mostly unaware of any existing environmental guidelines or precautions in a construction site. Also, as a way of developers to try and break financially even, some developers cut costs and may overlook the requirements of environmental management. Such an attitude is costly in the long run, as the developer has to bear environmental remediation costs of pollution and consequently might slow down the project progress.

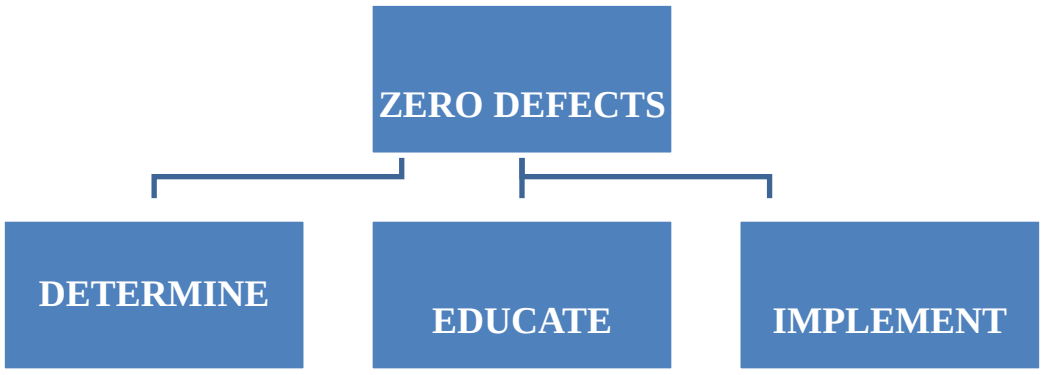
2.5 Theoretical Framework

This section discusses theories developed by other authors and scholars and which relate the concepts in this study. This study was based on Zero Defects Theory.

Zero Defects Theory

The Zero Defects Theory originated from Phillip Crosby as seen in his book Quality is Free. The International Organisation for Standardization (ISO) defines a defect as not meeting the intended usage requirements (ISO 8402, 1994). It is lacking or not achieving the expected standards (Alsadey, Omran &Pakir 2010). This occurs when there is inadequacy between the standards that are laid and the actual delivered standard. According to Evans (2011), the basic elements of Crosby's Zero Defects can be summed up as Determine, Educate and Implement, as shown in Figure 2 below. First, determine the product acceptance criteria and the faultless procedure for attainment of the same. Second, educate the delivery team thoroughly on the acceptance criteria and the faultless procedure. Thirdly, implement the procedure exactly as defined to achieve the acceptance criteria.

Figure 2: The Absolutes of Zero Defects



Source: Evans, 2011.

The concept behind Zero Defects is performance or adherence to agreed specifications. Zero defects are the acceptable standard for quality and that quality is defined as conformance to standards (Lyndsay, 2013). The substance of this theory is defect prevention through getting the job right the first time (Watson, 2005). This does not mean perfection but rather that the product undeniably and without deviation meets the standards, specifications or acceptance criteria.

Prevention defects costs less than correcting defects. Cost is usually accrued as defects are noted and corrected further away from the source (Watson, 2005). This can be demonstrated by an example from construction. For instance, in a construction site where the contractor does not adhere to the specified safety and environmental standards, and a defect is later noted; it would be costly to redo the work to ensure it adheres to the environmental standards; as compared to if it was done when construction works were ongoing. Achieving Zero Defects quality leads to savings in rework, scrap, resolution of errors, and warranty expenses (Evans, 2011). Watson (2005) insists that constructing buildings/structures according to the design is the most cost-effective way to achieve quality and he further asserts, "The proof is in preventing defects and not finding them and fixing them fast" (p. 66). The literal meaning is that the process is 100% error free (Alsadey, Omran & Pakir 2010).

In relation to this study, this theory emphasizes on adherence of laws and regulations in construction sites. This includes adherence to the laid down environmental standards. It can therefore be concluded that the design of a construction project that leads to flawless attainment of required standards is the aim of Zero Defects. Moreover, the cost of designing and implementing such a system is less than the cost of defect rectification.

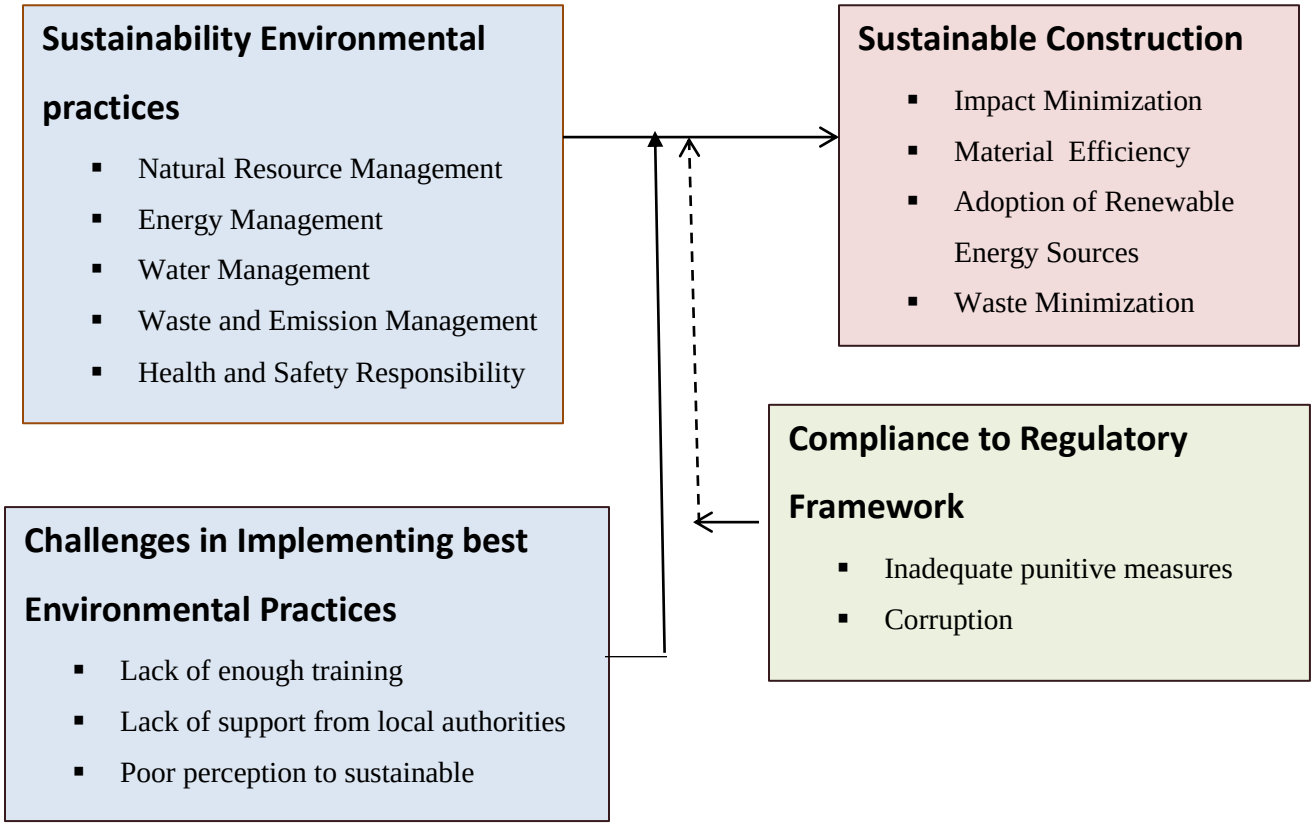
2.6 Conceptual Framework

A conceptual framework is a hypothesized model that shows link between and among the variables synthesizing the portrayed idea in a systematic way to provide meaning. In the conceptual framework presented in Figure 3, the independent variables are the environmental sustainability practices that include Natural Resource Management, Water Management, Construction Solid Waste Management, Waste Water and Sanitation Management, Noise Control Management, Air Pollution Management. The dependent variable is Sustainable Construction. The Regulatory framework regime also serves as the intervening or moderating variable as shown in figure 3 below.

Figure 3: Conceptual Framework.

Illustration of the Conceptual framework

Independent variables Dependent Variable



Source: Researcher, 2019

The Figure 3 shows the linkage of sustainability environmental practices towards sustainable construction sites. One of the sustainability environmental practices is natural resources management. Natural resources are mainly used as the basic materials used at construction project (Nagaraju, *et al* 2012). However, the present global environmental degradation is a consequence of the increasing extraction and consumption of natural resources at an unsustainable rate (Pearson, 2009).

Water is a vital commodity in the construction industry as it is used in many processes at different levels of construction (Waylenn at al., 2011) hence efficient practices should be encouraged to attain efficient water use in construction sites.

Solid Waste is one of the main construction outputs that impact on the environment. Measures such as segregation at source should then be put in place to enhance recovery and recycling of useful items, such as paper, metals and plastics according to Chinese University of Hong Kong (2013).

Construction sites also cause noise distress and annoyances resulting from construction activities such as site traffic and running of machinery engines Abdul-Rahman et al., (2016). Measures should be put in place to control noise such as having regular servicing of machinery and scheduling of noisy activities during the day.

Air pollution from construction activities such as dust and gaseous emission is an important consideration toward sustainability on construction sites, Ivaskova et al (2015). As a dust control measure, reuse of treated wastewater for dust suppression is encouraged. Vehicular control to minimize dust is also encouraged alongside sprinkling of water for dust control.

The conceptual framework also shows the moderating role of regulatory frameworks towards sustainable construction. The Government has mandated relevant institutions such as NEMA to enforce environmental laws and regulations such as the Environmental Management and Coordination Act (EMCA) 1999. The National Environment Action Plan, NEAP, (GoK, 1994) and the National Environment Policy (2013) emphasize the need for Environmental Impact Assessment (EIA) on all new construction projects and inclusion of public participation in decision making regarding new projects.

2.7 Knowledge Gaps and Focus of Study

Sustainability in the construction sector is an area that continues to gain the attention of environmental professionals. Sustainable construction simply means that the execution of the construction project should be economically, socially and environmentally viable and should last long to serve future generations (Hassan, 2012).The International Labour Organization (ILO) has developed eight principles for sustainable construction. The principles include “reduction of resource consumption, re-use and recycling of resources where applicable, protection and conservation of natural resources, elimination of toxins and gaseous, application of life-cycle costing on the entire life cycle of the project, and

focusing on quality of the end product or structure" (ILO, 2012, Pg.2). Sustainable construction relies on these principles for framing sustainable development through promoting safety, health, and environmental quality of life of people working in the construction industry (Boileau, 2016). Nationally there is also evidence of sufficient documented laws, rules and regulations pertaining to environmental practices. There are also the government agencies and professional bodies mandated to oversee and enforce the regulations.

In spite of these, there is still a gap that is noticeable through non-compliance to regulations (Gambatese et al., 2007) due to reasons such as inadequate enforcement capacity by regulators.

Existing empirical literature reveals that there are various studies conducted at global, regional and local level that have failed to address the missing link that this study aimed to link. In addition, the variables studied in each study were different and unique as well as the context of the studies is different. Some studies have been conducted in more developed economies and therefore cannot be to gauge the Kenyan context on sustainable construction. A new study was necessary to fill the gaps left by the previous studies. The need to address these gaps was the key motivation for undertaking this research.

CHAPTER THREE

3.0 STUDY AREA AND RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research methods that were used in this research study. It outlines the study area, the research designs that were employed, identifies the study population, mode of data collection and instrument as well as pilot testing. It also outlines how data was analyzed and presented. The chapter ends with a highlight of how ethical issues were handled while conducting the study.

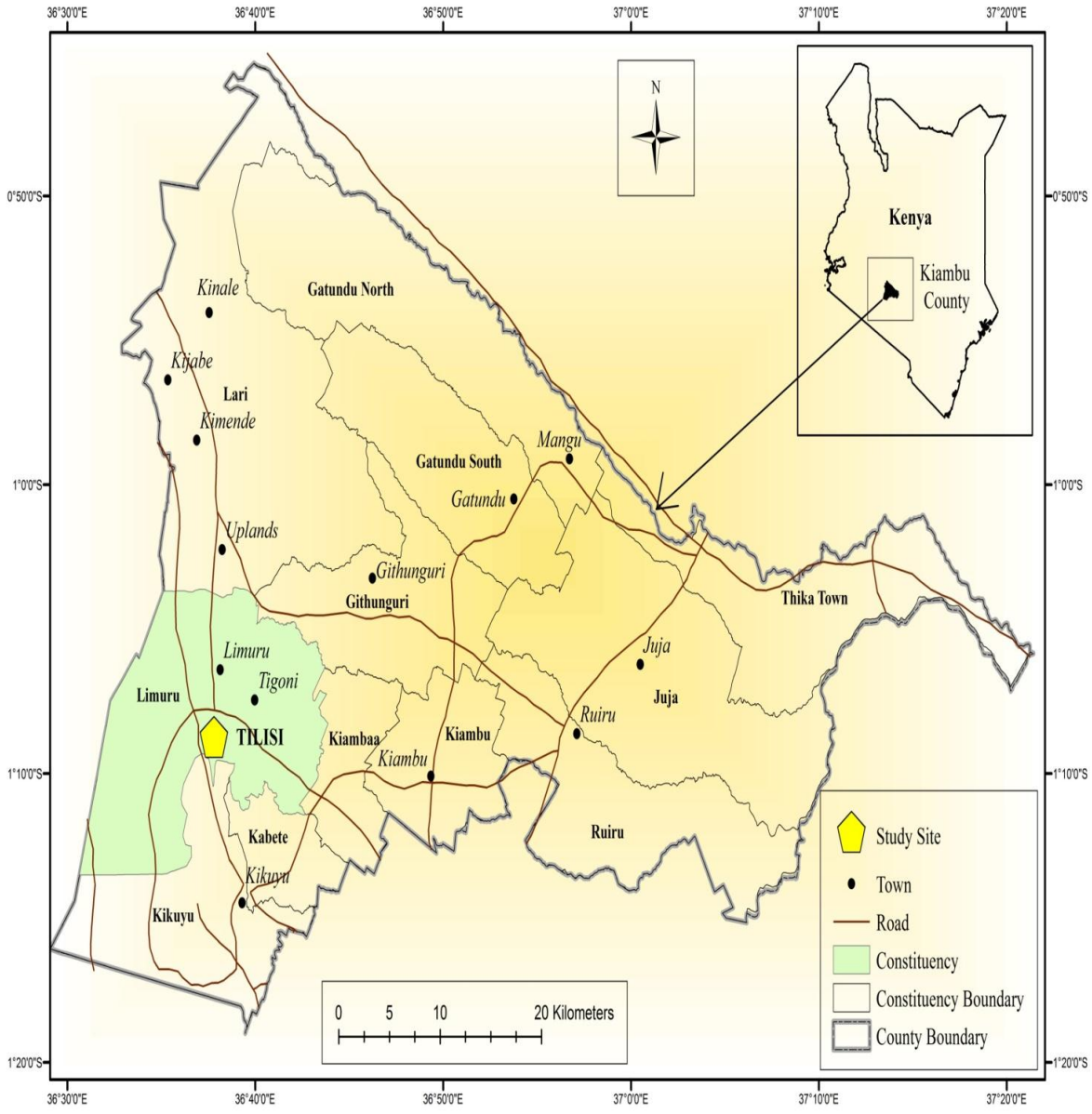
3.2 Study Area

Geographical Location, Size and Population

Study area is located in Rironi, Kiambu County with site coordinates 1° 8'1.92"S, 36°38'42.12"E; 1° 8'51.18"S, 36°39'15.51"E; 1° 9'27.12"S. The site is about 30 km North West from Nairobi on the Nairobi-Nakuru Highway and 4 km from Limuru town. It is located on the lower highland zone of Kiambu County and has a population of 2,417,735 KPHC (2019). The site covers an area of 387 acres. This was an agricultural land owned by dairy farmers. Tilisi Developments Ltd; a privately-owned business enterprise has proposed to construct a mixed use development. This is designed as a controlled and zoned development that comprised of residential, an industrial park, commercial, educational and health facilities.The area the project is being carried out is covered by well drained soils. These soils are varying from red loam soil to dark brown clays with acid humus topsoil.

The figure below shows the study area

Figure 4: Location context of the study area



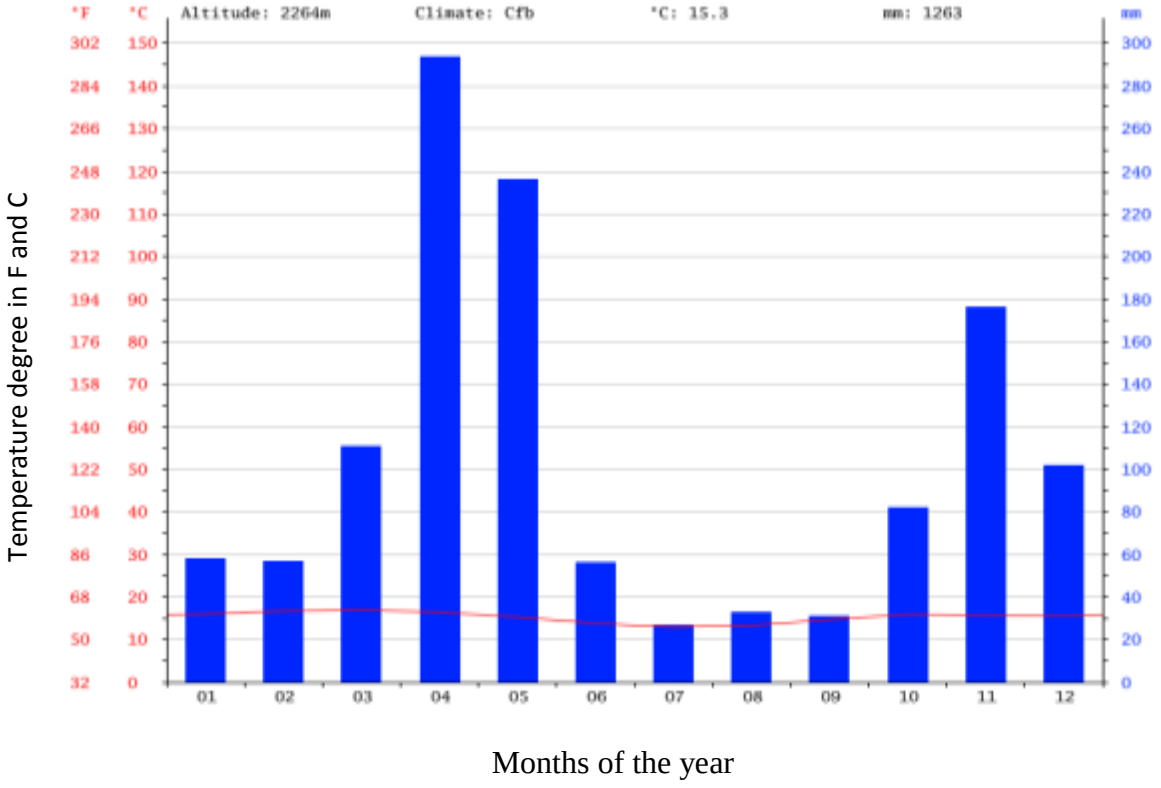
Source: Researcher, 2019

Topography, Climate and Rainfall

The study area is within the political electoral Limuru Constituency a lower highland topographical zone of plateaus and a significant number of high-elevation plains. The area lies between 1,500-1,800metres above sea level as cited in the Kiambu County

Integrated Development Plan 2018-2022. The study area receives a significant amount of rainfall even during its dry months. July receives the least amount of rainfall and has a monthly average of 27mm. April receives the highest amount of rainfall and has a monthly average of 294 mm. The variation in the precipitation between the driest and wettest months is 267mm.Bearing in mind the topography and climatic conditions of the area, it is necessary to find out how Tilisi project have observed issues such as natural resource extraction and, water use and conservation. The following figure 5 shows the climate graph of the study area in Limuru.

Figure 5: Climate of Limuru showing mean annual rainfall of study area

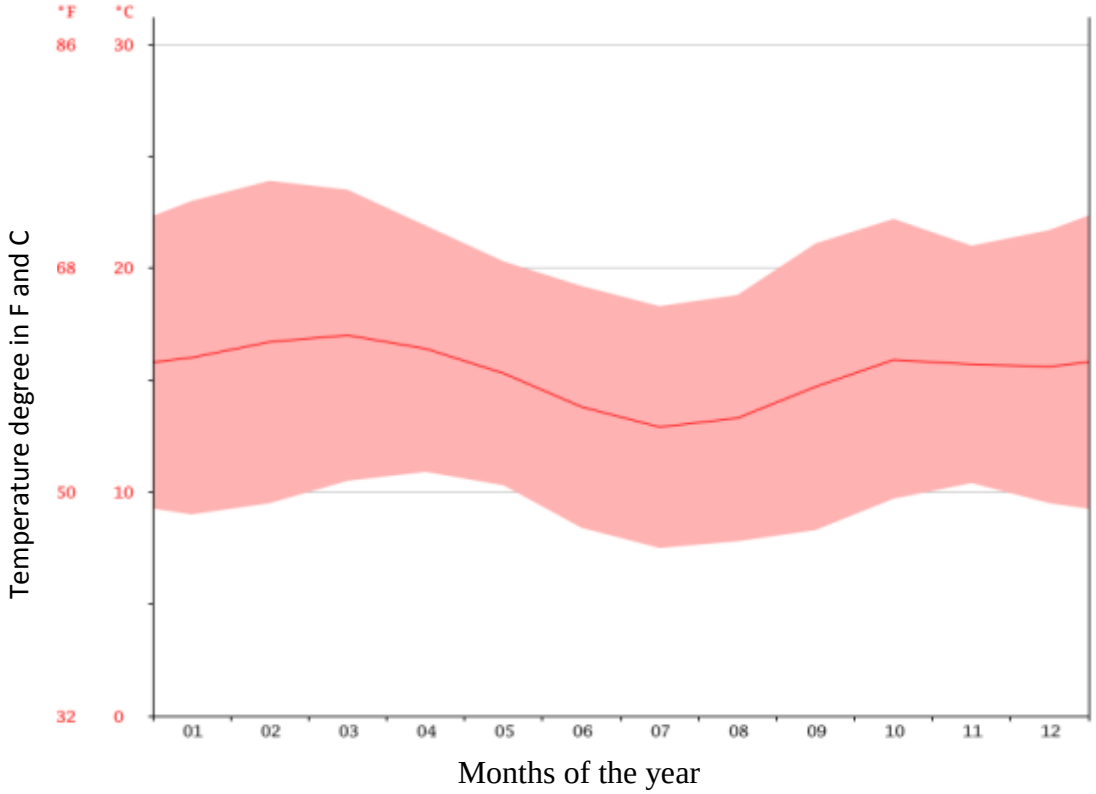


Source: *https://en.climate-data.org/location/57587/*

Temperatures in Limuru are highest in March at 17.0°C and lowest on average in July at 12.9°C. The variation in temperature throughout the year is 4.1 °C.

The figure 6 below shows the mean temperature of study area.

Figure 6: Mean temperature of study area



Source: https://en.climate-data.org/location/57587/

Economic Activities

The study area is located in Kiambu County that has an estimated population of 1,766,058 people comprising of 870,200 males and 892,857 females according to the Kenya Population and Housing Census (KPHC) of 2019. The poverty rate in Kiambu County is 25 per cent while Kenya's national average is 46 per cent.

The agriculture sector is the main is the contributor to economic development activity in Kiambu County. It provides livelihood through creation of employment, food security and contribution to overall socio-economic wellbeing. Sustainable construction projects, have to be environmentally, economically, and socially viable; and therefore it would be necessary to know how Tilisi project benefits the community around it.

3.3 Research Methodology

Research Design

Research design is a guide that assist the researcher in the various stages of research in order to come up with solutions to problems (McLaughlin, 2012). This research is a descriptive research, which seeks to establish the environmental sustainability practices at a construction site as well as establish the challenges towards compliance and non-compliance to rules and regulations in environmental practices. Bernard, 2012, recommends descriptive research because the researcher is able to observe and describe the behavior of a subject without affecting them. This study adopted a case-study approach to ascertain environmental sustainability practices amongst Tilisi construction workers. Use of case-study allowed data to be collected in a natural setting and context (Bernard, 2012). The case study methods, also enabled the researcher go beyond the quantitative statistical results and understand the behavioral conditions through the worker`s perspective (Zainal, 2007). The designs also facilitated the use of a questionnaire to collect both quantitative and qualitative data for the study. Key informants also provided material crucial to data interpretation.

This study targeted workers working with the following sub-contractors: Internal roads, electrical, telecommunication, water supply, wastewater drainage, landscaping and fencing.

Key informants were also drawn fromthe Tilisi Management, Government lead agencies and Professional bodies. These included: County Environmental Officer, NEMA, EBK, NCA, EIK, BORAQS, AAK and ISK. The adjacent local community was also included.

As per the literature review, environmental sustainability practices are carried out by the above stated groups and were therefore ideal to gather information from. The unit of analysis was the worker.

Population and Sample

3.3.2.1 Target Population

Target population was made of four groups of stakeholders in the Tilisi Construction site in Kiambu County. The population comprised of 4 Tilisi Project Management staff,

366workers to Tilisi Project, 9 government agencies and professional bodies, and 48 households in the neighborhood community. The distribution of the target population is shown in Table 1.

Table 1: Target *Population*

Target groups	Total Population	% Percentage
Tilisi Management	4	1
Contractors Workers	366	86
Government and Professional bodies	9	2
Community	48	11
Total	**427**	**100**

Source: (Researcher, 2019)

Sample Design (Sample Size and Sampling Procedure)

3.3.3.1 Determination of Sample Size

For the population in *Group 1* (Tilisi Project Management), *Group 3* (Government and Professional agencies) and *Group 4*(Neighborhood Community), a census study was adopted whereby the entire population formed the sample size of the study.

For *Group 2* population (Contractors Workers) the Cochran formula (1977) formula was applied to determine a desirable sample size. The Cochran formula is appropriate for finite population because it enables the researcher to calculate a suitable sample size. The formula also provides as well as a desired level of precision Catherine, Douglas and Were (2017). The formula is shown below:

$$n = \frac{N}{1 + N\,(d)^{2}}$$

Where; n = is the preferred sample size, (When the entire target population is less than 10,000)

N = is the target population and

D = is the acceptable margin of error estimated at 0.05 (at 95%).

$d^2 = (0.05)^2 = 0.0025$

Therefore, Sample size (n) =

$$n = \frac{366}{1 + 366(0.0025)}$$

n = 191 respondents

The sample was distributed based on the population sub-groups (strata) of the field of contractors as shown in Table 2.

***Table 2*: Desirable Sample sizes**

Field of Contractors	No. of workers	Calculation	Desirable size
Internal Roads	99	99÷366x191	52
Electrical	62	62÷366x191	32
Telecommunication	22	22÷366x191	11
Water supply	24	24÷366x191	13
Wastewater drainage	26	26÷366x191	14
Landscaping	62	62÷366x191	32
Fencing	71	71÷366x191	37
Total	**366**		**191**

Source: Researcher, 2019

3.3.3.2Sampling Procedure

Sampling procedure depicts how the sample was determined. Sampling determines the accuracy of the research results. The following sampling techniques were applied for the four population categories.

Group 1 (Management)

In *Group 1* population (Tilisi Project Management) a census study was adopted whereby the entire population was picked for the study. A Census was appropriate since the population was a small group which included both the senior and middle level managers. The total number was four (4) managers who were in charge of various aspects of the project, they include: the project CEO and the deputy, the project manager, site manager. According to Cooper and Schindler (2011) a census is applicable when the population is small and has different element. When the population is small with varied element, any representative may not adequate to generalize the finding of the target population.

Therefore, a census study was deemed appropriate for the study of this category. The sample size of the management is as shown in Table 3.

***Table 3*: Tilisi Management Sample Size**

Tilisi Management	**No.**
Senior Management	2
Middle Management/Supervisor	2
Total	**4**

Source: (Tilisi Development Ltd, Site Project Manager Records 2019)

Group 2 (Contractors)

For *Group 2* population (Contractors Workers), selection of contactors to participate was determined using random sampling method. This method gave each worker an equal chance to participate in the study (Bernard, 2012).

This was the main group of interest in this study and formed the bulk of the respondents. According to records held by the Tilisi Site engineer, there were seven (7) sub-contractors as of April 2019 and were contracted for Internal Roads, Electricals, Telecommunication, Borehole/Water supply, Wastewater drainage, Landscaping and Perimeter wall fencing.

Firstly, the researcher used a stratified random sampling method. This sampling method provided greater precision thereby reducing sampling error (Bernard, 2012).

The contractor workers were categorized into strata shown Table 4.

Table 4: Contractor Workers

Field of Contractors	Total No. of workers	Sample Required
Internal Roads	99	52
Electrical	62	32
Telecommunication	22	11
Borehole/Water supply	24	13
Wastewater drainage	26	14
Landscaping	62	32
Fencing	71	37
Total	**366**	**191**

Source: (Tilisi Development Ltd, Project Manager 2019)

Group 3 (Government Agencies and Professional Bodies)

For *Group 3* (Government and Professional agencies) purposive/ judgmental sampling method was adopted whereby the study targeted only those government officers that deals with environmental issues in the construction sector in Kenya. These included officers from NEMA, DOSHS, and NCA. The selected institutions included the Kiambu County Safety Inspectorate, National Environment Management Authority (NEMA), Directorate of Occupational Safety and Health Services (DOSHS), National Construction Authority (NCA), Environment Institute of Kenya (EIK), Board of Registration of Architects and Quantity Surveyors (BORAQS), Engineers Board of Kenya (EBK), Institute of Surveyors Kenya (ISK) and Architectural Association of Kenya.

Each head of the compliance (environmental) department within the institution was purposively chosen to take part in the study. Nine (9) respondents were drawn from these agencies and professional bodies for interview (Appendix IV) and formed the core key informants to this study.

Purposive sampling narrows down on particular elements of a target population most importantly aiming at those best suited with information required for the research. With the purposive sampling method the researcher could target niche demographics to obtain specific data points (Bernard, 2012).

Group 4 (Community)

For *Group 4*population (Neighborhood Community), a census study was adopted whereby the whole population formed the sample size of the study. The neighborhood communities are the individual and households around Tilisi Project who can be affected by the project. The neighborhood community was involved in the study as it was directly or indirectly affected by environmental practices undertaken at the construction site.

There were 48 households in the study area according to the area's Government Administration's Chief. A census study was carried out where each unit (household) was considered for the study. A census was carried out since the population was small and the households had different characteristics. In this scenario, selecting any sample would not sufficient to representative the population (Cooper and Schindler (2011). So, all the 48 households were picked for the study.

Methods of Data Collection

Data was collected from both primary and secondary sources. Secondary data was gathered from books, published journals, online publications and government and County reports. Primary data was gathered using questionnaires, interview guide, and observation as detailed below.

a. Questionnaire surveys for contractor workers and neighborhood households

The questionnaire was used to collect data from workers at the construction site (see Appendix V) and neighborhood communities (see Appendix VII). Questionnaire was preferred because it was efficient, cheap and easy to administer, they were relatively easy to analyze, and they were simple and quick for the respondent to complete and collect data in a standardized way (Kothari, 2008). The respondents were issued with a cover letter providing an explanation on the need for the research and providing assurances that all responses would be confidential. The researcher was assisted by research assistants to administer. This was important so as to explain the questions to the respondents to ensure they understand the questions well, which increases the response rate. Major variables that were measured include water use and conservation, waste and emission management and health, safety and environmental sustainability practices at Tilisi construction site.

b. Key Informants Interviews for Tilisi Project Managers, government agencies and professional bodies

Interview was also conducted through the use of an interview guide. The interview guides were applied to Tilisi Project Managers, government agencies and professional bodies. The interview guide was to help probe deeper from the key informants such as officers from NEMA and other agencies. Interviews gave the researcher the opportunity to elicit information and to observe the subject and the situation to which the subject was responding to (Mugenda, 2008). In this study the interview guide was used to probe practices through which the lead agencies contributed to environmental sustainability at construction sites and the challenges these institution were undergoing in their effort to enforce compliance to rules and regulations. Secondary data was also obtained from literature materials such as books; published and unpublished theses, journal articles and relevant reports from the government. Some of information sought from secondary data includes environmental sustainability practices undertaken in other construction site globally, regionally and locally.

c. Observations

Observation was applied to the project site though use observation schedule, where various things were observed and photographs taken in some instances. The researcher went further and systematically observed environmental issues at the Tilisi Project construction site and identified activities or conditions that were likely to cause environmental harm. Since the researcher sought to understand and obtain sufficient information about environmental practices amongst construction workers, the researcher spent more time at the construction site. This way, the researcher collected much more information regarding environmental practices and compliance. As a result, observations were made by making randomized visits in order to observe the activities that occurred in the construction sites during the range of shifts; early morning, mid-morning, afternoon and evening. The observation was conducted with the aid of a checklist (Appendix (VI) which was designed to reflect environmental issues related to the study. The checklist was based on general environmental mitigation issues as detailed in the Environmental Impact Assessment Environmental Management Plan and the EMCA Act 1999.

Furthermore, a field notebook and a camera were used to make collected data more efficient and comprehensive.

d. Photography

Photography was used to represent observed information. The viewer would be able to analyze and interpret the photographs and synthesize information in order to understand the activities or proceedings (Petersen and Ostergaard, 2003). Using digital cameras the researchers were able to collect information on use of raw materials from nature, waste management, water use and conservation and use of PPEs for workers welfare.

Pre-testing Data Collection Instruments

A pilot study is as a small-scale study that the researcher uses to measure the adequacy of research tools before proceeding to the main study (Hazzi & Maldaon, 2015). This is done to detect weakness in design and instrumentation. Winter and Dodou (2012) noted that a small-scale study is done to determine the reliability of the research instrument. According to Mugenda and Mugenda (2008),this kind of initial study is usually a 1% to 10% of the sample size. Based on this argument, the pilot study sample size was 10 respondents that helped test the reliability of the questionnaire. Pre-testing helpedto improve or correct any anomalies in the questionnaire and improved the data collection tools so as to collect valid and reliable data.

Validity of Data Collection Instruments

Validity refers to the assurance of whether an indicator (or set of indicators) that is meant to gauge a concept is adequate to measures that concept (Bryman & Bell, 2011). This study adopted content validity. Content validity of an instrument is improved through expert judgment. To ensure content validity, the questionnaires were taken through informal tests to assess whether each question in the questionnaire was essential. Essential responses on from the tests were evaluated by a content validity ratio, and those meeting statistical significance value were retained (Cooper & Schindler, 2011).

Reliability of Data Collection Instruments

Bryman, (2012) states that a measuring instrument is used to measure the reliability to show if it provides consistent results. Cronbach's Alpha (α) generated from the internal

consistency technique was used to measure internal consistency and to ensure that they measured the same construct with consistence. Cronbach's Alpha (α) between 0 and is used to evaluate rate consistency in the test (homogeneity) (Sushil & Verma, 2010). Reliability coefficient of 0.7 was typically undertaken as given measure to show an acceptable level of internal reliability (Bryman, 2012).

Data Collection Procedures

After receiving an introductory letter from the department and a permit from the National Commission for Science, Technology and Innovation (NACOSTI) to proceed with the research, the researcher wrote an introductory letter to all the targeted respondents requesting for permission to use them as respondents in the research. Once permission was obtained, the researcher, with the help of research assistants administered the questionnaire and conducted interviews with the respective respondents. Each questionnaire had an introductory letter attached on it in which the aim of the research was explained to the prospective respondent. A lead contact person in each of the sections of the respondentswas identified. The lead contact person's responsibility was to constantly remind the respondents to complete the questionnaire and to collect the same.

3.4 Data Analysis and Presentation

The collected data was examined thoroughly to ensure there were complete and understandable. Data was analyzed using the Statistical Package for Social Sciences (SPSS Version 22). The study sought to assess the environmental sustainability practices at a construction site, by undertaking a case of Tilisi Development Project site, Kiambu County. The study was anchored on four specific objectives: (i) Assess environmental practices implemented at Tilisi project site; (ii) Evaluate challenges in sustainability environmental practices at Tilisi project site, and (iii) Examine challenges towards compliance to rules and regulations in environmental practices.

In order to achieve objective one and two, data was analyzed using descriptive statistics by use of bar and pie charts, frequency and percentage and distribution tables. Descriptive Statistics was applied since the data collected was quantitative data. To achieve objective three, content analysis was employed to analyse the results of the study. The qualitative data was categorized in themes and ported in narrative form along with

quantitative presentation. Content analysis was applied since the data collected was qualitative data, which was generated from the open-ended questions from the interview schedules.

To test hypothesis of the study, Chi Square statistic was applied to help test relationships between variables. The null hypothesis was used to show that no relationship existed between the variables in the population.

3.5 Ethical Considerations

The study observed a number of ethical practices in the study. One, the researcher sought permission and approval from the relevant institutions and participants. Participants were given an informed printed consent form to get a brief overview about the study. This was in line with Pickard (2012) observation about participant consent, noting that participants must understand the objectives of the study before agreeing to participate. This made them comfortable with the research.

Another critical aspect is the confidentiality of respondents especially on data obtained from the interview. To ensure confidentiality, the respondents were not required to indicate their names on the questionnaire. The information given by the respondents was treated confidentially and was used only used by the researcher for research purposes.

The researcher also avoided plagiarism when carrying out the study. Plagiarism is an academic offense, which was avoided by attributing the source of information through in-text citation and acknowledgement of the source in a reference section.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Introduction

The chapter presented the results and discussion as guided by objectives of the study. The objectives were to establish the environmental management practices undertaken at Tilisi development project site; to evaluate challenges in implementing sound environmental practices at Tilisi construction site; and to examine challenges towards compliance to statutes, rules and regulations in environmental practices. The findings are analyzed through descriptive and inferential analysis and presented in tables, charts and graphs.

4.2 Response Rate

Table 5 shows the response rate of the study. It was necessary to establish the response rate to establish whether the response rate was adequate for the study to make inferences on the study objectives.

***Table 5*: Response Rate**

Response Rate	**Sub-Contractor Workers**		**Neighborhood Community**		**Tilisi Management**		**Government and Professional bodies Officials**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Responses	187	98	46	96	4	100.0	9	100.0
Non-Response	4	2	2	4	-	-	-	
Total Sample Size	**191**	**100.0**	**48**	**100.0**	**4**	**100.0**	**9**	**100.0**

Source: Primary data (2019)

The study sample consisted of one hundred and ninety-one (191) sub-contractor workers, and 48 neighborhood community members who filled the questionnaires. Out of this sample, one hundred and eighty-seven (187) questionnaires for sub-contractor workers and forty six (46) questionnaires for neighborhood community members were returned for analysis. This represents a response rate of 98% and 96% respectively. This rate was considered adequate for data analysis since according to Best and Khan (2006), return rates of more than 70% is considered very good.

The sample also consisted of four (4) management staff of Tilisi Project and nine (9) government and professional bodies' officials, to whom interviews were conducted using interview schedules. All the interviews for the management staff of Tilisi Project and government and professional bodies' officials were successfully conducted.

4.3 Reliability Results

Cronbach's Alpha test evaluated the reliability of the data collection instruments and the constructs that were measured. As shown in Table 6, the Cronbach's alpha value of the various questions representing the research objectives in the questionnaire were above the threshold value of 0.7.

Table 6: **Reliability test Results**

Reliability Statistics		
Category of questions	**No. of Items**	**Alpha Value**
Environmental Sustainability Practices At Tilisi Development Project Site.	11	0.7680
Challenges in Implementing Environmental Sustainability Practices	5	0.7852
Challenges Towards Compliance or Non-Compliance To Rules and Regulations in Environmental Practices	2	0.8087
Sustainable construction	4	0.7395

Source: Researcher, (2019)

A Cronbach's alpha of more than 0.7 shows the reliability of the data collection instrument (Sekaran, 2003). The Cronbach's alpha value identified therefore implies that the questionnaire was reliable. This implies that the items in the questionnaire have high internal consistency.

4.4 Characteristics of the Sample

This section showed the demographic information and characteristics of the respondents involved in the study. These include gender, age of the respondents, level of education, terms of employment and work specialization.

Table 7 presents the demographic information of the sub-contractor workers, while Table 8 presents the demographic information of neighborhood community members who took part in the study.

***Table 7*: Demographic Information of the Sub-Contractor Workers**

Characteristic	Categories	Gender		Total for category	%	Total Sample
		Male	Female			
Age	Below 20	10	3	13	7%	187
	20-30	102	11	113	60%	
	31-40	40	4	44	24%	
	Above 40	16	1	17	9%	
Level of Education	No formal schooling	3	0	3	1%	187
	Primary	13	3	16	9%	
	Secondary	97	7	104	56%	
	Tertiary	55	9	64	34%	
Terms of employment	Permanent	15	0	15	8%	187
	Contractual	151	19	170	91%	
	Did not disclose	2	0	2	1%	
Work specialization	Skilled	63	2	65	35%	187
	Unskilled	105	17	122	65%	

Source: Researcher, (2019)

The results showed that the female respondents were the minority at 19 out of 187 representing a 10.2% whereas the male respondents were the majority (168) representing 89.8%. In terms of age, 13(7%) were below 20 years, 113(60.4%) were between 20-30 years, 44 (23.5%) were 31-40 years and 17(9.1%) were above 40 years of age. Most of the workers were youths under years. An explanation to this could be the energy-intensive manner of the activities in construction sites.

In terms of education, it was established that 3(1.6%) had no formal education, 16 (8.6%) had Primary level of education, 104(55.6%) had secondary level of education and 64(34.2%) had tertiary level of education. Therefore, this insinuates that majority of those interviewed had attained basic formal educational to comprehend sustainable environmental sustainability practices. This justifies the use of self-completion questionnaires as majorities were in a position to appropriately fill the questionnaires.

The high number of those who had at least attained primary education could be because of location of the project site in a peri-urban area with many schools available. Tertiary institutions are very few and far apart, the nearest one being about 15 kilometers away. This and the societal lethargy towards vocational training could explain why the number of tertiary education graduates is low.

On employment terms, 15(8.0%) of the research participants revealed that were in permanent/full time employment while 170(90.9%) were contractual and 2(1.1%) did not disclose. The study on work specialization of the Tilisi Project workers also established that 65(34.8%) were skilled and 122(65.2%) were unskilled. According to Geneva ILO News (2001), these findings could be because most construction jobs are considered as entry points for those with minimal education in some developing countries. Jobs at construction sites are rarely a choice but rather a result of circumstances. The Geneva report also cites "evidence from various parts of the world to indicate that construction workers do not view their employment in a very favorable light: construction is regarded almost everywhere as a low status job" hence the high number of those on contract or short-term basis at the Tilisi construction site.

***Table 8*: Demographic Information of the Neighborhood Community Members**

Characteristic	Categories	Frequency	%	Total Sample
Gender	Male	8	17	46
	Female	38	83	
Age of respondent	Below 20	1	2	46
	20-30	4	9	
	31-40	29	63	
	Above 40	12	26	
Level of Education	No. formal schooling	7	15	46
	Primary	12	26	
	Secondary	25	54	
	Tertiary	2	4	

Source: Researcher, (2019)

Results in Table 8 shows that most of the community members (83%) were female while 17% were male. On the other hand, 63% of community members who took part in the study were in between the age of31-40 years, 26% were aged above 40 years, 9% aged between 20-30 years while 2% were aged below 20 years.

54% of the respondents indicated that they had reached secondary level, 26% had reached primary school level, 15% indicated that they had no formal education from school while 4% had reached tertiary level.

4.5 Environmental Management Practices at Tilisi Development Project Site

In this segment, the study sought to assess the environmental management practices undertaken at Tilisi development project site. The themes discussed herein include: natural resources extraction, energy use and conservation, water use and conservation, wastes and emission as well as health, safety and environmental responsibility.

4.5.1 Natural Resource Extraction

The researcher sought to find out from the construction workers whether the Tilisi Project takes constant steps to reduce natural resource extraction (stone/brick, sand, timber, cement, metal, etc.) from nature. The results in Table 9 show that majority of respondents 130 (69.5%) strongly disagreed, 43(23.0%) disagreed with the statement while 14(7.5%) were not sure. From the findings, it shows that, the perception of sub-contractor workers points to a lack of adequate measures to minimize resource extraction from nature.

***Table 9*: Natural Resource Extraction**

	Tilisi project takes constant steps to reduce natural resource extraction (stone/brick, sand, timber, roofing, cement, metal, etc.) from nature			Total
	Strongly Disagree	Disagree	Not sure	
Skilled	44	13	8	65
	67.7%	20.0%	12.3%	100.0%
unskilled	86	30	6	122
	70.5%	24.6%	4.9%	100.0%
Total	130	43	14	187
	69.5%	23.0%	7.5%	100.0%

Source: Researcher (2019)

The researcher also sought to know whether on overall, natural resource extraction by Tilisi Project is aimed at leaving a minimal footprint on the planet. The findings indicated that 19(10.2%), 28(15.0%) and 131(70.1%) were not sure, disagreed and strongly disagreed respectively that the overall, natural resource extraction by Tilisi Project aims at leaving only a minor footprint on the environment. Only a small percentage agreed 9(4.8%).

This shows that the perception sub-contractor workers are that natural resource extraction by Tilisi Project does not aim at leaving only a minor footprint on the environment. This means that there are concerns on the matter of natural resource extraction in respect to impact on the environment.

From the above findings, Tilisi Project did not put in adequate measures to minimize resource extraction from nature. The project also did not seem to aim at leaving only a minor footprint on the environment. This raises concerns on the environment impact of the project. These findings corroborate with DEH (2006) who indicated that, in the construction industry, raw material for construction were mainly extracted from nature. Traditionally these raw materials have relatively been in plenty and capable of being used for a long period of time.

At the inception of the Tilisi Project, the management carried out change of land use from the then agricultural zone to commercial usage. Two assessments i.e. a strategic

environmental assessment as well as an environmental impact assessment (EIA) were carried out in an effort to mitigate expected negative impacts from the construction activities. One of the proposed mitigation measures was to create awareness amongst the workers on the importance of efficient use of resources.

The finding that 69.5% strongly disagreed that overall, natural resource extraction by Tilisi Project is aimed at leaving a minor footprint on the environment could be attributed to lack of involvement of the workers in planning or budgeting for raw materials. Other than consideration of the high cost of the raw materials, the workers did not attribute the "need to use the resources efficiently" to prevention of depletion of these resources from nature. They also did not consider extraction of these resources as resulting to environmental degradation.

On further observation, the researcher noted several environmental practices being employed on site. The following plate 1 shows some of the sustainability practices at Tilisi construction site.

Plate 1 *shows (a) land as a natural resource, (b) soil being compacted, (c) timber and sand at the contractor's yard, (d) timber being used, (e) excavated soil, (f) gravel on site*

***Plate 1*: Natural Resources being used on Site**

Source: Field visit, (2019)

4.5.2 Green Energy Use and Conservation

The study sought to find out how energy was used and conserved at the Tilisi Project construction site and whether employees were trained on energy efficiency and sustainable energy use. The results are summarized in Table 10 below.

***Table 10*: Green Energy Use and Conservation**

	Tilisi project uses green energy to power activities			Total
	Strongly Disagree	Disagree	Not sure	
Skilled	59	3	3	65
	90.8%	4.6%	4.6%	100.0%
Unskilled	107	15	0	122
	87.7%	12.3%	0.0%	100.0%
Total	166	18	3	187
	88.8%	9.6%	1.6%	100.0%
	Tilisi project employees have been trained on energy efficiency and sustainable energy use			Total
	Strongly Disagree	Disagree	Not sure	
Skilled	59	6	0	65
	90.8%	9.2%	0%	100.0%
Unskilled	100	22	0	122
	82.0%	18.0%	0%	100.0%
Total	159	28	0	187
	85.0%	15.0%	0%	100.0%

Source: Researcher, (2019)

Findings showed that that out of 187 respondents, 166(88.8%) strongly disagreed and 18(9.6%) disagreed that the Tilisi Project uses green energy to power activities. This indicates that the Tilisi Project did not use green energy to power activities, and this has a likelihood of polluting the environment. This points to lack of an environmentally friendly source of energy to power activities in the project.

On whether the Tilisi Project employees have been trained on energy efficiency and sustainable energy use, it was realized that out of 187 respondents, 159(85.0%) strongly disagreed and 28 (15.0%) disagreed. This is highly indicative of the probability of energy wastage during implementation of this project.

Discussions with contractors revealed that some of the contractors use fuel with low carbon emission, and they use machines and vehicles that are more energy efficient. Contractors also ensured they service their plants and generators as often as possible. This was however a subject for a scientific expert opinion to measure the efficacy and veracity of the claims especially in the context of the perception that the fossil fuel available in the market is adulterated and has high Sulphur content.

The management also said they maximize on the use of renewable energy. In spite of this knowledge on the need to use an electricity master switch, the management said they had not installed one to turn off all electrical appliances to prevent wastage. According to a study done by Phoya (2018) on sustainable construction sites in Tanzania, the findings showed that machinery that were more energy efficient were highly preferred followed by the installation of a master switch and lastly the use of fuel efficiency plants and vehicles for construction purposes. The findings are in line with Chan *et al.* (2009), whose research was on market for green buildings in Asian cities and Ndayirajile, (2006), who studied the Modelling of Energy Use at Construction Site both found that mitigation of emission of greenhouse gases and other pollutants are some of the best practice that contributes to the environmental protection.

The high number of respondents at (85.0%) who strongly disagreed that workers at Tilisi project had been trained on energy efficiency and sustainable energy use could be attributed to the fact that workers had not seen any source of green energy such as solar panels on sites. The finding could be because the study was mainly based on construction of infrastructure such as roads that entailed laying of water supply features and waste water connection and that did not require electricity as compared to the construction of buildings that are connected to the electricity grid.

4.5.3 Water Use and Conservation

Water use and conservation is another key element in environmental sustainability practices that the researcher was keen to assess. The study enquired from the construction workers whether they had been trained on water efficiency and sustainable water use and whether water management system was designed to maximize on sustainable water use

and conservation. The response on issues of water use and conservation were summarized in Table 11below.

***Table 11*: Training of water use**

	Tilisi project employees and managers have been trained on efficiency and sustainable water use			Total
	Strongly Disagree	Disagree	Not sure	
Skilled	47	11	7	65
	72.3%	16.9%	10.8%	100.0%
unskilled	84	35	3	122
	68.9%	28.7%	2.5%	100.0%
Total	131	46	10	187
	70.1%	24.6%	5.3%	100.0%
	Overall, Tilisi Project water management system is designed to maximize on sustainable water use and conservation			Total
	Strongly Disagree	Disagree	Not sure	
Skilled	26	32	7	65
	40.0%	49.2%	10.8%	100.0%
unskilled	30	81	11	122
	24.6%	66.4%	9.0%	100.0%
Total	56	113	18	187
	29.9%	60.4%	9.6%	100.0%

Source: Researcher, (2019)

Efficient and sustainable use of water resource is a key factor in sustainable environment management practices. Respondent working at the Tilisi Project were asked whether the employees and managers were trained on efficient and sustainable water use. The response was negative with 131(70.1%) strongly disagreed and 46(24.6%) disagreed. The conclusion that can be drawn from this response is that, workers in this project are not equipped with knowledge on importance of efficient and sustainable water use. Deliberate training of such perceived peripheral matters as sustainable water use could either be inference as a cost cutting measure by the management, or a task to be undertaken much later when the individual owners commence with the construction of their homes.

In terms of overall Tilisi Project water management system being designed to maximize on sustainable water use and conservation, the response was 56(29.9%)strongly disagreed, 113(60.4%) disagreed with the statement with only a few indicating they were not sure on the water management system.

Observation showed that water is used for purposes of mixing raw materials such as cement and sand as shown in plate (2d), sprinkling of working areas to control dust as shown in plate (2c) as well as for human consumption in (2b). Although construction is still on-going, there was evidence of water efficient plumbing features such as gutters and tanks as well as durable taps as shown in plate (2a).

The strategic environmental assessment report and the Environmental Impact Assessment showed that the management is keen on treating of grey water to be used for landscaping. However, there was no evidence of a master plan on future intensions in matters of water use and conservation.

The high number of respondents at (70.1%) who strongly disagreed that Tilisi project employees and managers had been trained on efficiency and sustainable water use could be because at the time of the research, Tilisi had already dug 2 boreholes on sites and hence there was no shortage of water for the construction and domestic needs. The management and contractors were therefore not keen on actual training of workers to use water efficiently. Rainwater harvesting was also observed on site as shown on plate (2a) showing that contractors were aware of the need to harvest water. However, the awareness did not trickle down to the construction workers. The plate 2 below shows the rain water harvesting as shown by gutters on (A), water storage tanks (B), use of water for containing dust on work areas on (C) and use of water to mix the raw materials on (D).

Plate 2: Water harvesting and usage on site

Source: Field visit, (2019)

4.5.4 Waste and Emission Management

The researcher also assessed the waste and emission management as an environmental sustainability practice at the construction site. When asked if Tilisi project employees have been trained on waste minimization i.e. reduces, reuse, or recycle waste respondent indicated as follows: 131(70.1%) strongly disagreed and 56(29.9%) disagreed. This showed a perception that those employees at this project are not adequately equipped with skills on waste minimization.

The results are summarized in Table 12 below.

***Table 12*: Training on waste minimization**

	Tilisi project employees have been trained on waste minimization i.e. reduce, reuse, or recycle waste			Total
	Strongly Disagree	Disagree	Not sure	
Skilled	50	15	0	65
	76.9%	23.1%	0%	100.0%
Unskilled	81	41	0	122
	66.4%	33.6%	0%	100.0%
Total	131	56	0	187
	70.1%	29.9%	0%	100.0%
	Tilisi project employees have been trained on reduction of noise emissions			Total
	Strongly Disagree	Disagree	Not sure	
Skilled	45	18	2	65
	69.2%	27.7%	3.1%	100.0%
unskilled	82	38	2	122
	67.2%	31.1%	1.6%	100.0%
Total	127	56	4	187
	67.9%	29.9%	2.1%	100.0%
	Overall, Tilisi Project waste and emissions management system is designed to contribute minimal impact on the environment			Total
	Strongly Disagree	Disagree	Not sure	
Skilled	46	11	8	65
	70.8%	16.9%	12.3%	100.0%
unskilled	89	26	7	122
	73.0%	21.3%	5.7%	100.0%
Total	135	37	15	187
	72.2%	19.8%	8.0%	100.0%

Source: Researcher, (2019)

To manage construction waste effectively there is need for cooperation of sub-contractor to plan the procedure for material acquisition and storage on-site. Phoya (2018) on her study on the perspective of contractors' practices toward sustainable construction sites in Tanzania, separation of waste and the recycling of materials were considered to be the main training in waste management. Her findings indicated that these practices were moderately implemented on site indicating that there were no adequate measures for waste management in construction sites.

The high number of respondents at (70.1%) who strongly disagreed that Tilisi project employees had been trained on waste minimization i.e. reduce, reuse, or recycle waste could be attributed to the fact that Tilisi had not engaged a NEMA licensed waste collectors to collect and dispose of the waste. Instead the workers were used to burning waste on site that resulted to emission of smoke and dust as shown in plate 3 (A).

The following plate ***Plate 3*** *shows (a) burning of cement bags on site (b) waste timber on site* shows waste on site. It is expected that all waste is collected by a licensed waste collector. (B) Shows waste timber that the contractors said is given out to a neighboring school for use as firewood.

Plate 3: Waste heaps on site

Source: Field visit, (2019)

The researcher also sought to find out whether Tilisi project waste and emissions management system is designed to contribute to minimal impact on the environment. 72.2% strongly disagreed, 19.8% also disagreed and 8% were not sure whether the system has any impact on the environment.

This finding is contrary to that done by Yates (2013) who studied sustainable methods for waste management in construction, and Menard, (2017) who examined on waste management practices in construction sites in Hong Kong. They both found out that waste from construction activities were valuable and could be re-used thereby minimizing the need to extract more construction resource from nature.

The researcher sought to find out whether Tilisi project employees have been trained on reduction of noise emissions.

Results in Table 12 show that 127 (67.9%) strongly disagreed and 56 (29.9%) disagreed. The result above shows that employees at Tilisi project have never been trained on reduction of noise emissions and they are likely to contribute towards noise emissions.

Asked whether on overall, Tilisi Project on emissions management system is designed to contribute minimal impact on the environment the respondents indicated as follows.

The results showed that 135(72.2%) strongly disagreed and 37(19.8%) disagreed. This forms majority of respondents hence it can be deduced that inadequate systems for waste and emissions management were the likely reasons for negative environmental impacts.

The high number of respondents at (72.2%) who strongly disagreed that on overall, Tilisi Project waste and emissions management system was designed to contribute minimal impact on the environment. This could be because Tilisi had not engaged a NEMA licensed waste collector and the fact that waste was usually burnt on site resulting to emission of dust and smoke.

4.5.5 Health, Safety and Environmental Responsibility

The study sought to find out whether Tilisi project is designed to actively promote workers as well as general societal health and safety and the findings are as follows in table 13.

***Table 13*: Workers health and safety**

	Tilisi project is designed to actively promote worker(s) as well as general societal health and safety			Total
	Strongly Disagree	Disagree	Not sure	
Skilled	26	35	4	65
	40.0%	53.8%	6.2%	100.0%
unskilled	31	86	5	122
	25.4%	70.5%	4.1%	100.0%
Total	57	121	9	187
	30.5%	64.7%	4.8%	100.0%

	Tilisi project actively implements actions to reduce rates of injury, occupational diseases, and work-related fatalities among its workers				Total
	Strongly Disagree	Disagree	Not sure	Agree	
Skilled	26	33	1	5	65
	40.0%	50.8%	1.5%	7.7%	100.0%
unskilled	30	79	9	4	122
	24.6%	64.8%	7.4%	3.3%	100.0%
Total	56	112	10	9	187
	29.9%	59.9%	5.3%	4.8%	100.0%

Source: Researcher, (2019)

The results indicated that 57(30.5%) Strongly disagreed and 121(64.7%) disagreed. Therefore, the project is not designed to actively promote worker(s) as well as general societal health and safety.

On further enquiry on whether the Tilisi Project actively implements actions to reduce rates of injury, occupational diseases, and work-related fatalities among its workers, the respondents responded as shown in table 13. About 56(29.9%) strongly disagreed and 112(59.9%) disagreed that Tilisi project does not adequately implements actions to reduce rates of injury, occupational diseases, and work-related fatalities among its workers. The researcher however found evidence of the management's efforts in providing protective equipment to key areas of work. Though inadequate, it cannot be said that there are no efforts to provide the same to all employees. Loss and pilferage were attributed to such equipment missing.

A research done by Tam and Fung, 2011 also showed that inadequate measures to address workers safety at construction sites. They identified a number of causes that

influence safety performance in the construction industry. They include poor awareness of safety issues, inadequate training and reluctance to put in resource on for safety measures.

On further observation as shown on ***Plate 4*** *(a) PPEs for workers (b) Workers at work in PPEs* it was evident that some workers had been provided with PPEs.

Plate 4: PPEs provided to workers on site

Source: Field visit, (2019)

The (59.9%) of the respondents who disagreed that Tilisi project actively implements actions to reduce rates of injury, occupational diseases, and work-related fatalities among its workers could be attributed to the fact that there was not first aid room on site and the first aid kit was not adequately stocked. Workers said that there were only given pain killers and bandaged in case of an injury. The workers also claimed that it was difficult to pass down information on injury as they were not aware who to approach. In terms of PPEs the workers were also reluctant to say whether they were adequately provided with them. Although the majority were seen having PPEs, the workers claimed it was a long process to request and be issued with them. They also claimed that incase of PPE worn out they were not provided with new ones and it was their personal responsibility to buy a second set for themselves.

Generally, the researcher sought to find out whether on overall Tilisi project is designed to promote environmental sustainability and the respondents gave the following findings in table 14.

***Table 14*: Promotion of Environmental Sustainability**

	Overall Tilisi project is designed to promote environmental sustainability					Total
	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree	
Skilled	14	36	6	6	3	65
	21.5%	55.4%	9.2%	9.2%	4.6%	100.0%
Unskilled	12	86	16	7	1	122
	9.8%	70.5%	13.1%	5.7%	0.8%	100.0%
Total	26	122	22	13	4	187
	13.9%	65.2%	11.8%	7.0%	2.1%	100.0%
	Tilisi Project has designed and actively implemented environmental sustainability criteria					Total
	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree	
Skilled	17	31	5	6	6	65
	26.2%	47.7%	7.7%	9.2%	9.2%	100.0%
unskilled	39	44	24	12	3	122
	32.0%	36.1%	19.7%	9.8%	2.5%	100.0%
Total	56	75	29	18	9	187
	29.9%	40.1%	15.5%	9.6%	4.8%	100.0%
	Overall, Tilisi Project is designed to contribute significantly to fighting climate change					Total
	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree	
Skilled	1	5	50	6	3	65
	1.5%	7.7%	76.9%	9.2%	4.6%	100.0%
unskilled	18	32	62	3	7	122
	14.8%	26.2%	50.8%	2.5%	5.7%	100.0%
Total	19	37	112	9	10	187
	10.2%	19.8%	59.9%	4.8%	5.3%	100.0%

Source: Researcher, (2019)

Further enquiry on whether on overall Tilisi project is designed to promote environmental sustainability. The response indicated that 26(13.9%) strongly disagreed and 122(65.2%)

disagreed. This study therefore concluded that Tilisi project is not designed to promote environmental sustainability.

A question on whether Tilisi Project had designed and actively implemented environmental sustainability criteria showed the following findings. It was established that 56(29.9%) strongly disagreed, 75(40.1%) disagreed, whereas 29(15.5%) were not sure and 18 (9.6%) agreed and 9(4.8%) and strongly agreed. It can be concluded that 70% (131) disagreed with the statement that Tilisi Project has designed and actively implemented environmental sustainability criteria.

In terms of Tilisi Project being designed to contribute significantly to fighting climate change the following findings were brought up as shown in Table 21.

The findings indicated that 112 (59.9%) were not sure, 37(19.8%) disagreed and 19 (10.2%) strongly disagreed. This could be said that majority of the employees at the Tilisi Project were both not sure and disagreed that the project is designed to contribute significantly to fighting climate change

The study went further to enquire whether on overall, the Tilisi Project has effectively communicated its sustainability message to all/most stakeholders including employees, investors, regulators, neighbourhood community, and other environmental sustainability interest groups.

The high number of respondents at (59.9%) who were not sure whether on overall, Tilisi Project is designed to contribute significantly to fighting climate change could be because the term “climate change” was too technical for them.

4.5.5 Communication on Sustainability Efforts

On whether Tilisi Project had effectively communicated its sustainability message to all/most stakeholders including employees, investors, regulators, neighborhood community, and other environmental sustainability interest groups, the results were as shown table 15 below.

***Table 15*: Communication on Environmental Sustainability**

	Overall, the Tilisi Project has effectively communicated its sustainability message to all/most stakeholders including employees, investors, regulators, neighborhood community, and other environmental sustainability interest groups					Total
	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree	
Skilled	1	6	50	5	3	65
	1.5%	9.2%	76.9%	7.7%	4.6%	100.0%
unskilled	18	4	62	31	7	122
	14.8%	3.3%	50.8%	25.4%	5.7%	100.0%
Total	19	10	112	36	10	187
	10.2%	5.3%	59.9%	19.3%	5.3%	100.0%

Source: Researcher, (2019)

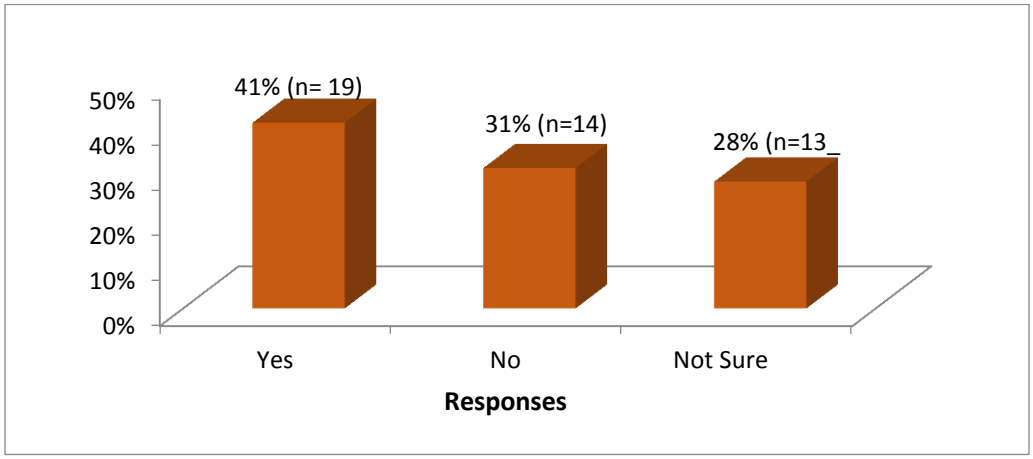
The findings indicated that 112(59.9%) were not sure, 36(19.3%) agreed, while 19 (10.2%) strongly disagreed. It can be concluded that majority of the employees at the Tilisi Project were not sure and disagreed that the Project has effectively communicated its sustainability message to all stakeholders including employees, investors, regulators, neighborhood community, and other environmental sustainability interest groups.

The above finding could be because the contractors were not carrying out meetings to emphasize on the sustainability environmental practices discussed above. Although a good number had seen the environmental impact assessment report on the signboard, majority did not have an understanding of the importance of the Environmental Management Plan that is provided for the site.

4.5.6 Public Consultation on the Project

The study further enquired from the community members in the neighborhood whether public consultation was done before the project was started. The findings are presented in Figure 7 below.

Figure 7: Response on public consultation on Tilisi development



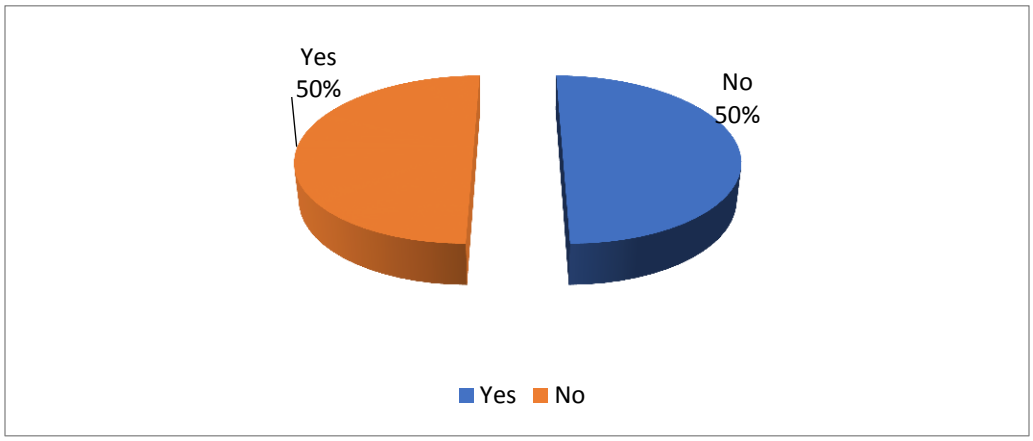
Source: Researcher, (2019)

The results in Figure 6 show that 41% of the respondents reported that public consultation was done before the Tilisi project was started. However, 31% indicated that no consultation was done while 28% indicated that they were not sure whether consultation was done before the Tilisi project was started.

4.5.7 Relationship between the Community and the Project

The community members were asked to indicate whether the community related well with the project. The respondents gave their responses as shown on figure below 8.

Figure 8: How community related with Tilisi project



Source: Researcher, (2019)

As shown in Figure 8, 50% of the respondents indicated that the community related well with the project proponent. A similar percentage revealed that the community did not relate well with the project. From the findings, the perception of the community neighborhood is that a substantial number of members of the public did not relate well with the Tilisi, which raises questions on why some community members did not relate well with project.

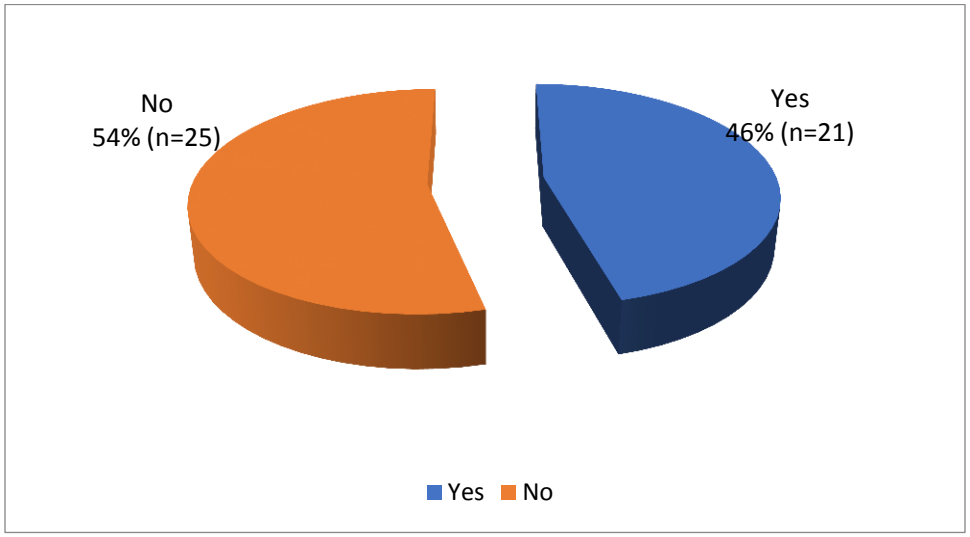
To have an understanding of this, the study further enquired from the community neighborhood on how Tilisi project would build a strong long-term relationship with the community. The respondents indicated, to build a strong long-term relationship, Tilisi project should employ the youth from the community around the project and train the community on environmental matters. In addition, the respondents stated that the project should provide social amenities and also improve community infrastructure such as roads.

This shows that the community could relate well with the project that is environmentally and socially viable. According to Khasreen (2009) a construction project should be responsible for environmental impacts. The above findings agree with Hassan (2012) who indicates that a sustainable project should be viable both economically as well as socially and environmentally so as benefit both for current and future generations.

4.5.8 Benefits of the Project to the Community

The community members in the neighborhood were further asked to indicate whether the community around the Tilisi project benefited from the project. The results are presented in figure 9 below.

***Figure 9*: Whether Tilisi Project Benefits the Community**

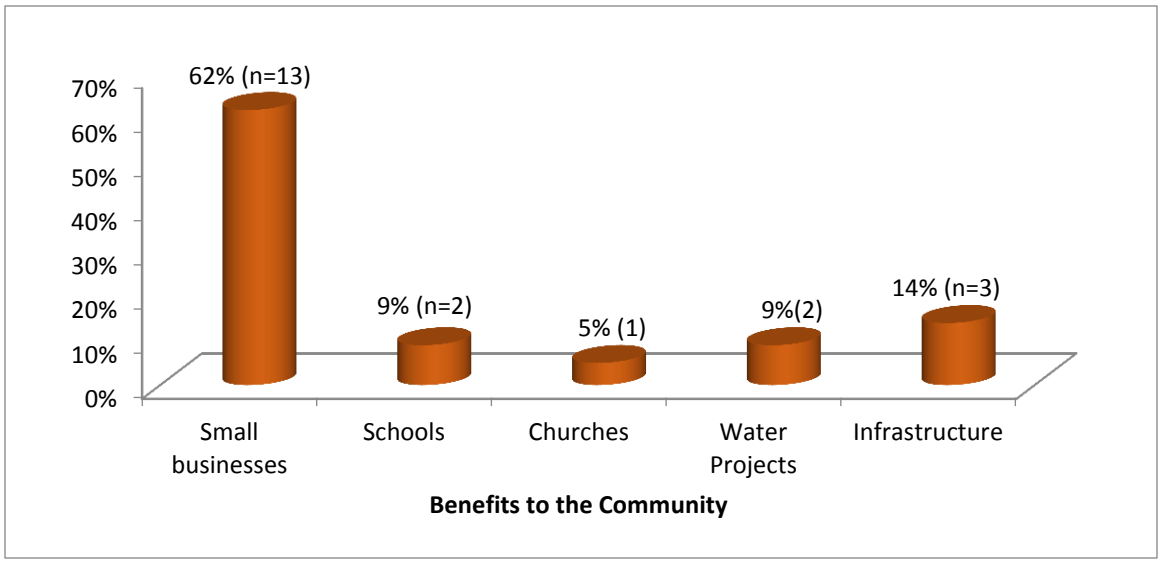


Researcher (2019)

As shown in Figure 9, 54% of the respondents indicated that the community around the Tilisi project had not benefited from the project. However, 46% were of the opinion that the community around Tilisi project had benefited from the project.

The researcher further enquired how the community around Tilisi project had benefited. The responses are presented in Figure 10.

***Figure 10*: Benefits of the Project to the Community**



Researcher, (2019)

Out of the respondents who indicated that the community had benefitted from Tilisi project, majority of the respondents (62%) indicated that the community members had benefitted by setting up small businesses around the project. A further 14% indicated that the community had benefitted with infrastructure set up while 9% indicated that the community had benefitted with schools and water projects respectively. This shows that the community has benefited both socially and economically from Tilisi project. Thereby agreeing with Hassan (2012), who indicated that a sustainable project should be viable economically, socially as well as environmentally for the benefit of the current and future generations.

4.5.9 Suggestions to Improve Environmental Sustainability

The community members were asked to give suggestions on how environmental sustainability can be improved in the construction industry in Kenya. The respondents suggested that the youth should be supported to start tree nurseries. They also suggested improvement in water management systems, help community with rain water harvesting, train the community on waste disposal and also improve on solar lights for improved security.

This shows that the community is concerned about environmental impacts by construction projects. These results agrees with Tam et al. (2006) and Ding (2008) who indicated that assessing environmental impacts in construction industry showed the importance of creating awareness on the measures to attain sustainability.

4.6 Challenges in Implementing Environmental Sustainability Practices

This section evaluated the challenges experienced during implementing environmental practices at Tilisi construction site. The study enquired out from the construction workers on the challenges faced in an effort to implement environmental sustainability practices.

4.6.1 Commitment by Management

The construction workers were asked whether lack of commitment by management was a challenging factor in implementation of environmental sustainability practices. The findings are presented in Table 16.

Table 16: **Response on Lack of Commitment**

	Lack of commitment by management is a challenging factor in implementation of environmental sustainability practices			Total
	Not sure	Agree	Strongly Agree	
Skilled	8	12	45	65
	12.3%	18.5%	69.2%	100.0%
Unskilled	11	27	84	122
	9.0%	22.1%	68.9%	100.0%
Total	19	39	129	187
	10.2%	20.9%	69.0%	100.0%

Source: Researcher, (2019)

In the table above analysis showed that 129(69.0%) strongly agreed and 39(20.9%) agreed that lack of commitment by the management is a challenging factor in implementation of environmental sustainability practices. Therefore, there likelihood environmental sustainability practices are not adequately implemented.

Lack of commitment by management to address environmental sustainability practices was identified in a research done by Tam and Fung, 2011. They identified how evidence of lack of management commitment is brought up. It was noted that there is poor environmental sustainability awareness from top leaders, when there is inadequate training on efficient environmental sustainability practices. Lack of commitment is also evident when there is reluctance to input resource on environmental sustainability and safety. Failure of the management to engage a certified skilled labor, lack of motivation to invest in innovative technology on safety and poor structuring of how information should be dispended.

Although it was evident that the management was aware of sustainability environmental practices as it carried out a changed of user, SEA and EIA, it was evident that workers had a different opinion. The high number of respondents at (69%) who strongly agreed that there was lack of commitment by management to implement environmental sustainability practices could be attributed to the fact the management had not emphasized the need to engage a NEMA licenced waste collector. The management had not emphasized the need to have a fully stocked first aid kit and it had not communicated effectively the need to train workers on sustainability environmental practices.

From the finding, the management did not effectively commit to implementation of environmental sustainability practices in the construction site. This concurs with Muiruri (2012) who revealed that there are many cases on environmental disregard at the construction sites because the most basic and elementary environmental practices are disregarded.

4.6.2 Workers Regular Training

The study also sought to find out whether workers are regularly trained on environmental sustainability practices and it was found out that the majority at 73.8% strongly disagreed to have been trained.

Table 17: **Training on Environmental Sustainability**

	Workers have regular training on implementation of environmental sustainability practices				Total
	Strongly Disagree	Disagree	Not sure	Agree	
Skilled	45	8	6	6	65
	69.2%	12.3%	9.2%	9.2%	100.0%
Unskilled	93	20	3	6	122
	76.2%	16.4%	2.5%	4.9%	100.0%
Total	138	28	9	12	187
	73.8%	15.0%	4.8%	6.4%	100.0%

Source: Researcher (2019)

As per above table, 15% disagreed to having been trained while 4.8% were not sure. Only 6.4% agreed to have been trained on environmental sustainability practices. This therefore concludes that there is a high possibility that there is no training on the implementation of environmental sustainability practices. This is evident as there are no toolbox meetings meant to train the workers or provide awareness on environmental sustainability practices.

4.6.3 Support from Government Agencies

The respondents were asked whether there is enough support from Government Agencies at the County level (local authorities) on implementation of environmental sustainability practices. The finding were that 112(59.9%) agreed and 19 (10.2%) strongly agreed that there is enough support from local authorities as detailed in the table below.

***Table 18*: Support from Government Agencies at the County Level**

	There is enough support from government agencies specifically at the County authorities) contributing to successful implementation of environmental sustainability practices			Total
	Not sure	Agree	Strongly Agree	
Skilled	21	36	8	65
	32.3%	55.4%	12.3%	100.0%
unskilled	35	76	11	122
	28.7%	62.3%	9.0%	100.0%
Total	56	112	19	187
	29.9%	59.9%	10.2%	100.0%

Source: Researcher, (2019)

This finding was indicated by those workers who knew that Tilisi project undertaken an environmental impact assessment. Evidence of this had been highlighted in the project detail board at the gate. A discussion with a NEMA official established the institution has not managed to give full support to construction site. The official said, "*There have been inadequate resources such as funds, manpower and tools like vehicles. This result to minimal inspections by NEMA officials where we narrow down to inspecting only the bigger projects assumed to be of high risks or inspecting projects that have a lot of public interest or complaints" [JK, 16/7/2019]*.

The officer also said, "*Another challenge that we face is political interference, lack of willingness by contractors to comply with regulations*". The officer went further to say "*Another challenge that we experience is the zoning dynamics whereby land use changes impact the environment negatively. An example is the encroachment of way leaves, riparian and open spaces as a result of successful change of user"*.

In a different interview with a DOSHs official, the officer said, "*it is a challenge to give full support to construction sites in Kenya. This is because we don't have reliable data on all construction sites, no reliable data on accident cases at construction sites because most contractors do not report all the accidents*". Further, the DOSHs officer said, "*The laws on occupational safety and health are not strictly enforced. Safety rules in most construction sites do not exist and the regulatory authority is weak in enforcing the regulations effectively because of inadequate man power and financial resources*."

The DOSHs official also said, "*Work Injury Benefits processing take a lot of time of the officers and support staff time leaving them with little time to perform other official duties as specified in their performance contracts. This has been largely attributed to the inability of the Directorate to attract and retain adequate number of qualified personnel*". "*Another challenge faced by our field officers is lack of transport to cover all workplaces within their jurisdiction". "This resulted in officers not reaching all areas that fall under them and in most cases inspections carried out concentrated within a small area within Nairobi's environs".*

The findings shows that due to the challenges faced by the enforcing bodies, for example lack of adequate funds, lack of reliable data on all construction, lack of adequate qualified personnel; there was minimal inspections. Hence, there has been no adequate support by the government bodies and from local authorities in the implementation of environmental sustainability practices. This agrees with Muiruri (2012) who revealed that even though there are sufficient environmental sustainability guidelines and law in the construction industry, there are indications of little or total lack of enforcement. This could be due to lack of clear and well-defined oversight authorities, lack of will by developers to adhere to the rules.

4.6.4. Perception on increased construction cost

When asked if increased construction, cost is a challenging factor in the implementation of environmental sustainability practices. The respondent indicated that 122(65.2%) and 28 (15.0%) agreed and strongly agreed as shown in the table 19 below.

Table 19: **Perception on Construction Cost**

	Perception that increased construction cost is a challenging factor in the implementation of environmental sustainability practices				Total
	Disagree	Not sure	Agree	Strongly Agree	
Skilled	2	10	49	4	65
	3.1%	15.4%	75.4%	6.2%	100.0%
unskilled	7	18	73	24	122
	5.7%	14.8%	59.8%	19.7%	100.0%
Total	9	28	122	28	187
	4.8%	15.0%	65.2%	15.0%	100.0%

Source: Researcher, (2019)

Perception on increase cost of construction as a result of cost incurred in sustainability efforts has been a hindrance to complying to set rules on environment management in construction site. In an interview with a NEMA official, the officer said, "*The notion of increased cost has continued to be a hindrance even after the scrapping of the EIA submission fee. Before then developers were expected to part with 0.1% of the total construction budget. This usually added to the construction cost a perception that has remained to- date. Currently the developers are expected to apply for licenses such as effluent discharge license at a fee thereby increasing the operation cost of developments".* This shows that the additional costs that emanates from license fees from NEMA and other governing bodies in the construction industry were seen as an increased cost of construction projects. The perception of increased cost of construction hindered some project managers and contractors from implementation of environmental sustainability practices. Muiruri (2012) however warns that such an attitude is even more costly in the end, as the developer has to bear environmental remediation costs of pollution and consequently slow down the project progress.

4.6.5 Perception on unnecessary efforts towards environmental sustainability

The study also sought to establish the perception on unnecessary efforts towards environmental sustainability. The findings are detailed in the table 20 below.

***Table 20*: Perception on environmental sustainability efforts**

	Perception that efforts towards environmental sustainability is unnecessary is a challenging factor in implementation of environmental sustainability practices				Total
	Disagree	not sure	Agree	strongly agree	
Skilled	14	44	7	0	65
	21.5%	67.7%	10.8%	0.0%	100.0%
unskilled	19	78	16	9	122
	15.6%	63.9%	13.1%	7.4%	100.0%
Total	33	122	23	9	187
	17.6%	65.2%	12.3%	4.8%	100.0%

Source: Researcher (2019)

Most of the workers at 65.2% were not sure whether efforts towards environmental sustainability were necessary. Most of the arguments were that impacts at construction

sites cannot be prevented as long as construction is ongoing. In interview with a NEMA official, the officer said "*most developers perceive environmental impacts as short term hence there being no need to put much effort to mitigate them*". He also said, "*The main focus of the developers is finalizing the completion of their project with minimal cost*". From the views of NEMA, it can be deduced that most developers did not pay much emphasis on the short term and long-term environmental impacts of construction works.

4.7 Challenges towards Compliance to National rules and Regulations in Environmental Practices

In this segment the study sought to examine challenges towards compliance to statutes, rules and regulations in environmental practices. The information was gathered from official in government agencies officers that deals with environmental issues in the construction sector in Kenya.

Inadequate Punitive Measures by the Government

In an attempt to establish the challenges that hinder compliance of rules and regulation in environmental practices, the researcher sought to find out if inadequate punitive measures by the government are a challenging factor towards compliance to rules and regulations in environmental practices. The study revealed that 149 (79.7%) strongly agreed, 19 (10.2%) agreed and 19 (10.2%) were not sure as shown in table 21 below.

Table 21: **Adequacy of Punitive Measures**

	Inadequate punitive measures by the government is a challenging factor towards compliance to rules and regulations in environmental practices			Total
	Not sure	Agree	Strongly Agree	
Skilled	9	2	54	65
	13.8%	3.1%	83.1%	100.0%
unskilled	10	17	95	122
	8.2%	13.9%	77.9%	100.0%
Total	19	19	149	187
	10.2%	10.2%	79.7%	100.0%

Source: Researcher, (2019)

One of those who strongly disagreed claimed, "*Over time there have been environmental injustices in the country that NEMA fail to follow up on. An example is encroachment of MAU forest, reclamation of wetlands and encroachment of way leaves".*

In a discussion with NEMA official, the officer said "*there are several punitive measures undertaken by the agency whenever there is a non-compliance case. Among the measures carried out include suspension of license of construction sites that have not complied to set rules and regulations, arrests, prosecution and fines to developers, closure of non-compliant sites. The court ruling can include improvement notice issued to the developer or contractor as well as restoration orders".* From the views of the government officials, there are adequate laws and several punitive measures have been put. This agrees with Muiruri (2012) who revealed that that there are sufficient environmental sustainability guidelines in the construction industry as set out in law.

Corruption by Governing Bodies

The researcher sought to find out whether corruption by governing bodies is a contributing factor towards non-compliance to rules and regulations in environmental practices. The indicated as follows: 158(84.5%) strongly agreed and 19 (10.2%) agreed only 10(5.3%) were not sure.

The researcher also sought to find out whether corruption by governing bodies is a contributing factor towards noncompliance to rules and regulations in environmental practices. The findings are as shown in the table 22 below.

***Table 22*: Opinion on Corruption by Government Bodies**

	Corruption by governing bodies is a contributing factor towards noncompliance to rules and regulations in environmental practices			Total
	Not Sure	Agree	Strongly Agree	
Skilled	6	5	54	65
	9.2%	7.7%	83.1%	100.0%
unskilled	4	14	104	122
	3.3%	11.5%	85.2%	100.0%
Total	10	19	158	187
	5.3%	10.2%	84.5%	100.0%

Source: Researcher, (2019)

The majority (84.5%) strongly agreed that corruption by governing bodies is a contributing factor towards non-compliance to rules and regulations in environmental practices. Although the respondents did not link their opinion on Tilisi construction site, they gave a generic view that government bodies are prone to corruption and political interference thereby hindering their progress on enforcing the implantation the environmental laws. This claim was reinforced in a discussion with NEMA official who said, "*There are some corrupt officials who issue licenses upon being issues with bribery*". This means that compliance to rules and regulations in environmental practices was being hindered by corruption practices between developers and officials from government bodies mandated to enforce the laid down rules and regulations.

4.8 Hypothesis Testing

Chi square test was used to evaluate whether there is an association between environmental sustainability practices and sustainable construction at construction sites. Chi test is associated with likelihood ratio and Linear by linear association. Linear by linear association model measures association of two variables where a change in one of the variables is associated with a proportional change in the other variables.

Research test the null hypothesis that aims to show that there is no significant difference between the expected and the resultants findings. Testing of the null hypotheses is based on the fact that if the *p* value for the determined Chi-square is $p > 0.05$, then the null hypothesis is accepted. The following table 23 shows the Chi square results.

***Table 23*: Chi-Square Test**

Chi-Square Test Results

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	397.162[a]	186	0.000
Likelihood Ratio	288.274	186	0.000
Linear-by-Linear Association	75.564	1	0.000
N of Valid Cases	187		

a. 156 cells (94.5%) have expected count less than 5. The minimum expected count is .07.

Source: Researcher statistics

The results as indicated in Table 23 depict a chi-squared test statistic of 75.564 which shows Chi-Square, likelihood ratio and linear-by-linear association p=0.000, which is < 0.05.Thus, there is a significant link between environmental sustainability practices and sustainable construction. This therefore means that we reject the null hypothesis that environmental management practices do not have a significant association with sustainable construction at the construction site; and instead accept the alternative hypothesis that environmental management practices does have a significant association with sustainable construction at the construction site.

CHAPTER FIVE

5.0 SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter shows a detailed summary of the main findings and the resultant conclusions, and suggested recommendations.

5.2 Summary of findings

The first objective was to establish environmental sustainability practices that were undertaken at Tilisi construction site. On the issue of natural resource extraction, it was found that Tilisi Project did not take sufficient steps to reduce natural resources extraction. It was also revealed that there was insufficient water use and conservation system in place as there was no water management system designed to maximize on sustainable water use and conservation. Waste minimization was another key issue that the researcher sought to find out. The results revealed that employees at the project were not adequately equipped with skills on waste management. Tilisi workers had not been trained on reductions management strategies as well. Findings on well-being of the workers and the general society health and safety indicated that the Tilisi Project did not actively implement actions to reduce rates of injury, occupational diseases, and work related fatalities among its workers. This could also be the reason why a substantial number of members of the public did not relate well with the project. The project was therefore deemed as not having implemented any action to protect its workers from occupational risks. Overall, it was revealed that Tilisi project was not designed to promote environmental sustainability as it was also established that it did not have a designed and actively implemented environmental sustainability criteria. Communication on environmental sustainability message to its stakeholders including employees, investors, regulators, neighborhood community, and other environmental sustainability interest groups was also deemed to be poor. This goes further to show that Tilisi Project was not designed to contribute significantly to fighting climate change.

The second objective of this study was to determine challenges in implementing sound environmental practices at Tilisi construction site. Results showed that lack of commitment by management was a challenging factor as indicated by majority (69.0%) of the respondents. Inadequate workers' training on efficient environmental sustainability practices was also indicated to be a barrier in the implementation of environmental sustainability practices. Another challenge that was highlighted was the inadequate support from local authorities, corruption as well as perception of increased cost of construction.

The third objective was to identify challenges towards compliance to statutes, rules and regulations in environmental practices. It was revealed that inadequate punitive measures by the government were a challenging factor towards compliance to rules and regulations in environmental practices. It was also found out that corruption by officials in government bodies was a contributing factor towards non-compliance to rules and regulations in environmental practices.

5.3 Conclusions

The following were the main conclusions and recommendations of the study.

On environmental management practices at Tilisi Development project site, it was concluded that natural resource extraction is taken for granted. Workers believe that there is plenty of raw resources such as timber, cement, gravel, soil and water from nature that are far from being depleted. The management was however seen to be aware of environmental sustainability practices. The contractors are also seen to be aware of sustainability environmental practices. This is drawn from the field observation that showed some of the sustainability practices being carried out at the site. The project however did not actively promote worker(s) as well as general societal health and safety.

The study also concludes that there were challenges that hindered effective implementation of sound environmental practices at Tilisi construction site. Some of these challenges include lack of commitment by management; inadequate workers' training on efficient environmental sustainability practices as well as inadequate support from local authorities. Perception of increased cost of construction was also cited as a key challenge that hindered effective implementation of sound environmental practices.

The study also concludes that there were challenges towards compliance to statutes, rules and regulations in environmental practices. One of the challenges is inadequate punitive measures put by the government towards compliance to rules and regulations in environmental practices. The respondents felt that the measures were not punitive enough to enhance compliance. Corruption by officials in government bodies that enforces compliance was also cited as a contributing factor towards non-compliance to rules and regulations in environmental practices.

5.4 Recommendations

The following are recommendations of the study:

To Contractors

The following environmental sustainability practices should be implemented on site.

In terms of waste management there should be efforts to recycle and reuse construction waste as much as possible as well as ensuring that all non-recyclable waste is cleared from site at the earliest opportunity and disposed of appropriately in designated disposal sites to avoid pile ups. This should be done by engaging a NEMA licensed waste collector.

As a measure to reduce wastage the contractors should ensure construction material requirements are carefully budgeted to avoid leftovers. Materials sort should also be durable to minimize the need of replacement.

There should be measure to train workers on efficient use of water to avoid wastage in construction activities.

Energy use and conservation should be emphasized on site by maintaining equipment and machinery to manufactures' specifications and ensure that the equipment are regularly serviced.

Ensure workers are well trained on environmental sustainability practices. It is recommended there be regular meeting with workers before and after work to remind them of environmental sustainability that should be carried out at every stage of the work.

In terms of health, safety and environmental responsibility, the contractors should purpose to comply with OSHA, 2007 and all other relevant regulation governing health and safety at workplaces. There should be a well developed and implemented site specific Emergency Response Plan and all personnel on site made aware of its procedures.

To reduce noise generation hooding should be done to shield the equipment and use equipment installed with noise abatement devices as much as possible. Contractors should go further to ensure the use of rated equipment in welding and related works that would generate minimal noise on site.

Project Management/Proponent

For water, use and conservation the management as well as contractors should ensure that there is rain water harvesting system with adequate provision of storage tanks and retention facilities for water for domestic and construction use.

Information on energy conservation should be well communicated from the top management and contractors to workers to ensure there is minimal idling of machinery, minimal burning on waste on site.

For effective implementation of environmental sustainability practices, it is recommended that there be commitment by management. Commitment can be shown in terms of engaging trained personnel's like environmental experts.

Government lead agencies

Support from local authorities to implement environmental sustainability practices at construction site should be enhanced. The government is called upon to ensure sufficient funding to the lead agencies so as to enable them carry out regular inspections.

Awareness should be created to the general public and particularly to the developers that efforts to implement environmental sustainability are well worth and beneficial to all, and this should not be ignored. Even though the efforts incur extra cost, the developers stand to benefit from green rating. This usually has a ripple effect on increased property preference by potential clients thereby increasing the value of the property.

In an effort to encourage adherence to set environmental regulations it is recommended that there be punitive measures to law breakers and to any government lead official who is found corrupt.

Neighborhood Community

The members of the community should put pressure to ensure that construction projects adheres and implements sustainable environmental practices which promotes general societal health and safety even in the future. The community should understand that poor environmental practices at a construction site could affect them negatively or expose them to risks and safety issues.

5.5 Areas for Further Research

There is need for further research to determine the more professional expert opinion on the different aspects of natural resource extraction, pollution and emissions. The study relied more on people perceptions. The professional opinion should be based on substantial statistics to determine the actual amount natural resource extracted that are used at a particular construction site. This will go a long way in determining the actual amount of pollution and emission being discharged from construction sites.

The study also recommends that a similar study be conducted on other construction projects all around the country for comparison of results. This would give a clearer picture on the environmental sustainability practices undertaken at construction projects in the country.

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APPENDICES

Appendix I: School Introductory Letter

UNIVERSITY OF NAIROBI

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

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P.O. BOX 30197-00100
NAIROBI
KENYA

2nd April 2019

The Director,
National Commission for Science & Technology
Nairobi, Kenya.

Dear Sir/Madam,

RESEARCH PERMIT: MARY VIOLET WANJIKU KOIGI

This is to confirm that the above named is a Master of Arts student (Registration Number – C50/84265/2015) at the Department of Geography and Environmental Studies, University of Nairobi registered.

MS. Koigi is currently undertaking research on a topic titled: **Sustainable Construction in Kenya: An Assessment of Occupational Safety and Environmental Sustainability practices at Tilisi Multipurpose Development Project Site, Kiambu County.**

Any assistance accorded to her will be highly appreciated.

CHAIRMAN
Department Of Geography
& Environmental Studies
UNIVERSITY OF NAIROBI

Dr. Shadrack Kithiia
Ag. Chairman, Department of Geography & Environmental Studies

Appendix II: Researcher Introduction Letter

15th July 2019,

Dear Respondent,

RE: RESEARCH STUDY

My name is Mary Violet Wanjiku Koigi, a student at the University of Nairobi. As a requirement for the award of the Degree of Masters of Arts in Environmental Planning and Management, I am conducting a research study on ***"An assessment of Environmental Sustainability Practices at in Kenya. A case of Tilisi Development project site, Kiambu County".***

A key component of this study is obtaining important input from related government agencies such as National Environment Management Authority, Site Managers at Tilisi Development and tapping into knowledge and experience of the Tilisi construction workers.

You are therefore kindly requested to provide your comments by filling the questionnaire attached to this letter. Your participation is voluntary and all collected data will be handled with the utmost confidentiality. Any recorded interview will be destroyed as soon as it has been transcribed. The information obtained will be used solely for educational and research purposes.

Your response is highly appreciated.

Yours faithfully,

Violet Koigi

Appendix III: Research Permit

THIS IS TO CERTIFY THAT:
MS. MARY VIOLET WANJIKU KOIGI
of UNIVERSITY OF NAIROBI, 286-218
Ngecha,has been permitted to conduct
research in *Kiambu County*

on the topic: *SUSTAINABLE CONSTRUCTION IN KENYA: AN ASSESSMENT OF OCCUPATIONAL SAFETY AND ENVIRONMENTAL SUSTAINABILITY PRACTICES AT TILISI MULTIPURPOSE DEVELOPMENT PROJECT SITE, KIAMBU COUNTY.*

for the period ending:
23rd April,2020

Permit No : NACOSTI/P/19/36172/29519
Date Of Issue : 25th April,2019
Fee Recieved :Ksh 1000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

Appendix IV: Key Informant Interview Schedule for Tilisi Management

1. What is Tilisi's policy on environmental sustainability?
2. As a project, what have you committed towards promoting Environmental Sustainability?
3. What challenge(s) have you encountered in implementing environmental sustainability practices at the construction site?
4. How often do you have inspections visits by Regulatory Agencies?
5. How does the neighboring community stand to benefit from sustainability practices of Tilisi Development?
6. Do you have a grievance handling procedure for both the workers and community?
7. What suggestions would you give for the future of the Construction Industry in Kenya on matters related to environmental sustainability?

Appendix V: Survey Questionnaire for Tilisi Construction Workers

Kindly go through the instructions relevant to each question and identify the correct answer for each question. *Please put **a tick** in the right place.*

Section A: Demographic Information

1. Gender:
   Male ( )Female ( )
2. Age of respondent
   Below 20 years ( ) 20-30 years( ) 31-40 ( ) Above 40 years ( )
3. Indicate level of education reached
   No formal schooling ( ) Primary education ( )
   Secondary education ( ) Tertiary ( )
4. What is your type of employment at this construction site?
   Permanent/Full-Time ( ) Contractual ( )
   Others (specify)……..
5. What is your area of work specialization?
   Skilled ( ) Unskilled ( )
   Specify specialization of work……..
6. Which contractor do you work with?
   Internal Roads ( ) Electrical ( )
   Telecommunication ( ) Water supply ( )
   Wastewater drainage ( ) Landscaping ( )
   Fencing ( )

Section B (Objective 1)

A) Environmental Management Practices At Tilisi Development Project Site, Kenya

(a) Natural Resource Extraction

1. Tilisi project takes constant steps to reduce natural resource extraction (stone/brick, sand, timber, roofing, cement, metal, etc.) from nature

Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer (what really are the things Tilisi is doing?) ----------
--------- ----------

2. Overall, natural resource extraction by Tilisi Project aims at leaving only a minor footprint on the environment

Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------

(b) Energy Use and conservation

1. Tilisi project uses green energy to power activities
   Strongly Agree Agree Not sure Disagree Strongly Disagree

   Explain your answer ----------
   ---
2. Tilisi project employees have been trained on energy efficiency and sustainable energy use
   Strongly Agree Agree Not sure Disagree Strongly Disagree

   Explain your answer ----------

(c) Water Use and Conservation

1. Tilisi project employees and managers have been trained on water efficiency and sustainable water use
   Strongly Agree Agree Not sure Disagree Strongly Disagree

   Explain your answer ----------
   ---
2. Overall, Tilisi Project water management system is designed to maximize on sustainable water use and conservation
   Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------

(d) Waste & Emissions Management

1. Tilisi project employees have been trained on waste minimization i.e. reduce, reuse, or recycle waste
   Strongly Agree Agree Not sure Disagree Strongly Disagree

   Explain your answer ----------
   ---

2. Tilisi project employees have been trained on reduction of noise emissions

Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------
---

3. Overall, Tilisi Project waste and emissions management system is designed to contribute minimal impact on the environment

Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------

(e) Health, Safety and Environmental Responsibility

1. Tilisi project is designed to actively promote worker(s) as well as general societal health and safety

Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------
---

2. Tilisi project actively implements actions to reduce rates of injury, occupational diseases, and work related fatalities among its workers

Strong Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------

(f) Concluding Questions

1. Overall Tilisi project is designed to promote environmental sustainability

Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------
---

2. Tilisi Project has designed and actively implemented environmental sustainability criteria

Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------
---

3. Overall, Tilisi Project is designed to contribute significantly to fighting climate change

Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------
--- ----------

4. Overall, Tilisi Project has effectively communicated its sustainability message to all/most stakeholders including employees, investors, regulators, neighborhood community, and other environmental sustainability interest groups
   Strongly Agree Agree Not sure Disagree Strongly Disagree

   Explain your answer ----------

Section C (Objective 2)
B) Challenges in Implementing Environmental Sustainability Practices

What do you think are the challenges in implementing environmental sustainability practices on site? Tick where appropriate

1. Lack of commitment by management is a challenging factor in implementation of environmental sustainability practices
   Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------
----

2. Workers have regular training on implementation of environmental sustainability practices
   Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------
----

3. There is enough support from local authorities contributing to successful implementation of environmental sustainability practices
   Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------

----

4. Perception that increased construction cost is a challenging factor in the implementation of environmental sustainability practices
   Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------
---

5. Perception that efforts towards environmental sustainability is unnecessary is a challenging factor in implementation of environmental sustainability practices
   Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------

Section D (Objective 3)

B) Challenges Towards Compliance or Non-Compliance To Rules and Regulations in Environmental Practices

3. Inadequate punitive measures by the government is a challenging factor towards compliance to rules and regulations in environmental practices
   Strongly Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------
---

4. Corruption by governing bodies is a contributing factor towards noncompliance to rules and regulations in environmental practices
   Strong Agree Agree Not sure Disagree Strongly Disagree

Explain your answer ----------

Appendix VI: Interview Schedule for Lead Government Agencies (NEMA.DOSHS, NCA)

1. How does your work contribute to project environmental sustainability?
2. What would you say is the challenge towards compliance or non-compliance to rules and regulations pertaining to your docket?
3. Do you offer environmental sustainability training or sensitization within your regulatory framework?
4. How often do you conduct inspection / compliance audits in the construction sector in the County?
5. What is the rate of compliance to construction regulations regarding environmental sustainability within your docket?
6. What are your penalties for non-compliance to laws and regulations?
7. What are your future proposals for an enhanced sustainable development of the construction industry in Kenya?
8. Is there convergence of the different institution mandate towards achieving a common objective and unity of purpose for the betterment of the construction industry?

Interview Schedule for Professional Bodies (BORAQS, EBK, ISK, EIK, IEK)

1. How does your work contribute to project environmental sustainability?
2. Do you offer environmental sustainability training or sensitization within your framework?
3. What are your future proposals for an enhanced sustainable development of the construction industry in Kenya?

Appendix VII: Neighborhood Community Survey Questionnaire

Kindly go through the instructions relevant to each question and identify the correct answer. *Please put (√) in the right place.*

A: Demographic Information

1. Gender

   Male ( )Female ( )

2. Age of respondent

   Below 20 years ( ) 20-30 years( ) 31-40 ( ) Above 40 ( )

3. Indicate level of education reached

   No formal schooling ( ) Primary ( ) Secondary education ( ) Tertiary ( )

B: Sustainability Environmental Practices

4. Was there public consultation before the project was started?

   Yes ( ) No ( ) Not Sure ( )

5. Has the community related well with the project?

   Yes ( ) No ( )

6. Has the community benefited from the project?

   Yes ( ) No ( )

   If yes above, explain

   - Small businesses ( )
   - Schools ( )
   - Churches ( )
   - Water projects ( )
   - Infrastructure ( )
   - Environmental projects ( )
   - Any other……..

7. What would Tilisi do to build a strong long-term relationship with your community?

   ……

8. What suggestions would you give towards improved environmental sustainability in the construction industry in Kenya? …….

Appendix VIII: Observation Checklist

Environmental Sustainability Practices	**Yes**	**No**
Are there landscaping measures?		
Are there water use and conservation measures?		
Waste management measures?		
Noise and vibration control measures?		
Air pollution control measures		
Are there housekeeping measures?		
Are there Wastewater management measures?		
Are there green energy and conservation measures?		

Appendix IX: Time Schedule

Activity	**Time**
Proposal	May 2019
Proposal presentation	June, 2019
Addressing proposal defense comments	June, 2019
Reconnaissance visit to the project site	July, 2019
Pretesting pf research tools	July, 2019
Data collection	July, 2019
Data analysis	August, 2019
Project report writing	October, 2019
Project defense	November, 2019
Addressing project defense comments	December, 2019
Submission of Project paper	December, 2019

Appendix X: Turnitin Report