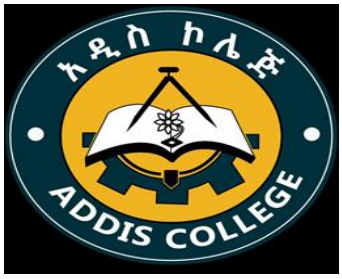

ADDIS COLLEGE

FACULTY OF ENGINEERING

DEPARTMENT OF CONSTRUCTION TECHNOLOGY AND MANAGEMENT

Determination of Sustainable Building Projects in Akaki Kality Sub-City

A Thesis Submitted to the School of Graduate Studies of Addis College in Partial Fulfilment of the Requirements for the Award of the Degree of department of Construction Technology Management

By: Habtemariam Haile

Advisor: Belete Ejigu(Dr)

October, 2024

Addis Ababa, Ethiopia

Addis College

School of Graduate Studies

Department of Construction Technology and Management

Determination of Sustainable Building Projects in Akaki Kality Sub-City

A Thesis Submitted to Addis College the School of Graduate Studies in Partial Fulfilment of the Requirements for the Degree of Master of Science in Construction Technology and Management

By: Habtemariam Haile

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Declaration

I, the undersigned, declare that the study entitled "Determination of Sustainable Building Projects in Akaki Kality Sub-City" is the result of my effort and study that all sources of materials used for the study acknowledged. I have conducted the study independently with the guidance and comments of the research advisor.

This study has not been submitted for any degree in any other university. It is all sources of material used for the thesis have been fully acknowledged and conducted for the partial fulfillment of the Degree of Master of Science in Construction Technology and Management.

Habtemariam Haile	----------	----------
Author	**Signature**	**Date**

Statement of Certification

This is to certify that Habtemariam Haile has carried out her project work entitled "Determination of Sustainable Building Projects in Akaki Kality Sub-City". This work is original in nature and is suitable for submission for the award of Master of Science in Construction Technology and Management.

Belete Ejigu(Dr)	----------	----------
Advisor name	Signature	Date

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First, I would like to gratefully acknowledge the Almighty God with his Mother St. Merry for guiding and protecting me in every aspect of my life. My deepest gratitude goes to my advisor Belete Ejigu (Dr), for all their limitless effort in guiding me through my work. I went to say “thank you very much” to my family and friends for your effort from the beginning to the end of this research work, I would like to thank Addis College School of Graduate Studies Department of Construction Technology, Akaki Kality building permit and control authority, and the respondents for their willingness in participating in the research. I am also grateful to my family for their unwavering love and support. Finally, I appreciate the contributions of the study participants, without whom this work would not have been possible.

Thank You!!!!

Abstract

Construction is one of the largest consumers of energy, material resources, and water, making it a formidable polluter. Sustainable building projects that have no substantial environmental impact are critical to every economy. Sustainable construction buildings are increasingly recognized as crucial components of global efforts to mitigate climate change, conserve natural resources, and enhance societal well-being. This study for identify Determinants of Sustainable Building Projects, with a specific focus on Akaki Kality Sub-City, Addis Ababa, Ethiopia. Sustainable building projects are critical and increasingly recognized as crucial components of global efforts to mitigate climate change, conserve natural resources, and enhance societal well-being. The research to identify explores key aspects of sustainable building projects, including the Existence of Environmental Policy, the existence of Environmental Material, and Education and Awareness regarding sustainable projects. A descriptive and explanatory research design was used to attain the objective of the study. Through a mixed-method approach, involving both qualitative interviews and quantitative surveys, the study gathers insights from project managers, contractors, and procurement officers involved in building projects within the sub-city. The sample size of the study was 53 and a purposive sampling approach was used. A structured questionnaire was used to collect quantitative data on the determinants of sustainable construction buildings in the study area. The collected data was analysed using multiple regression analysis through SPSS version 26. Multiple regressions were used to examine and quantify how these variables on the dependent variable. The results of the study showed that there was strong evidence of a relationship between the $\hat{y}(SB)=.439+.121EP+.296EM+.698EA+.271$. *existence of environmental policies, the existence of environmental policies, the existence of awareness and education, and the dependent variable sustainable construction building at the 0.05 level of significance. The findings highlight the challenges faced during procurement, such as delays, cost overruns, and contractor performance issues. Additionally, the research identifies the challenges, and best practices that can improve sustainable projects. The study concludes with recommendations for enhancing sustainable building practices to support successful commercial building projects in Akaki Kality Sub-City.*

Keywords: Environmental Material, Environmental Policy, Awareness, Sustainable

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Acronyms

LCA	Life Cycle Assessment
LLD	Leadership in Energy and Enviromental Desing
BREEAM	Building esearch establishment environmental assessment method
GTP	Growth and Transformation Plan
CRGE	Climate Resilient Green Economy
AAUTF	Addis Ababa Urban Age Task Force
SPSS	Statisticai Package for Social Science

1. Introduction

1.1 Background of the Study

The building industry is critical to every economy, but it also has a substantial environmental impact. Construction is one of the largest consumers of energy, material resources, and water, making it a formidable polluter (Doe, 2023). Sustainable building projects are increasingly recognized as crucial components of global efforts to mitigate climate change, conserve natural resources, and enhance societal well-being. These projects encompass a range of construction practices aimed at minimizing environmental impact, reducing energy consumption, maximizing resource efficiency, and promoting occupant health and comfort (Smith, 2022).

The significance of sustainable building projects cannot be overstated in the context of today's environmental challenges. The construction industry is a significant contributor to global carbon emissions, resource depletion, and waste generation. Embracing sustainable practices in this sector is essential for achieving international climate targets, such as those outlined in the Paris Agreement. Moreover, sustainable buildings offer economic benefits through reduced operating costs, improved asset value, and enhanced market competitiveness (World Green Building Council, 2020).

The urgency of integrating sustainability into the construction industry stems from its significant environmental impact. Buildings account for approximately 40% of global energy use and 33% of greenhouse gas emissions, making sustainable construction practices crucial for achieving climate goals (UNEP, 2019; IEA, 2020). Determining sustainable building projects requires overcoming challenges such as high upfront costs, limited availability of skilled labor, and regulatory barriers (Gossling & Scott, 2020; World Green Building Council, 2021).

Despite the growing awareness and adoption of sustainable practices, the construction industry still faces challenges in fully integrating sustainability into project planning, design, construction, and operation phases. Existing literature and case studies highlight varying degrees of success and barriers encountered in implementing sustainable building principles across different geographical regions and project types (UNEP, 2019). Anigbogu, Natalia A. (2011) defined Sustainable construction as a way for the building industry to move towards achieving sustainable development (Anigbogu, Natalia; 2011). Anigbogu, Natalia A. (2011) found that the existence of friendly environmental building materials, the existence of environmental policies,

and awareness and education affected the practice of sustainable building construction culture, which is people's collective deep-held values and beliefs, is found to be a critical factor in determining sustainable building constructions.

Majority of the existing studies on sustainable buildings systems was done in economically developed countries, the green building evaluation systems are influenced by situation in the country of origin that makes the international standards not to be suitable for developed countries like Ethiopia *(*Taffese & Abegaz, 2019). However, there are some research works on sustainable building projects in Addis Ababa, Ethiopia that focus on various factors. The factors that are identified include policy and regulations, financial considerations, material availability and cost, stakeholders' engagement, social and cultural factors, and climate and environmental considerations. Kiflome Haile (2022) investigated the factors affecting the development of sustainable building projects in Addis Ababa focusing on Addis Ketema Sub-city. Kiflome Haile (2022) found that the adoption and implementation of sustainable building in the study area are influenced by political and socio-economic barriers, financial and economic factors, technological barriers, material factors, and environmental factors. The study recommended the necessity of creating awareness among stakeholders concerning the benefits of sustainable building.

Taking Akaki-Kality Sub-city where most of the buildings that have been built are served mostly for commercial purposes but lack the basic components of sustainable building principles. The challenges include but is not limited to existing policy and regulation, implementation incapability, and high initial cost (Aste et al., 2020). Due to these and other factors the area is prone to significant environmental degradation through high energy consumption, greenhouse gas emissions, water use, and waste generation. Therefore, it is crucial to identify the critical bottlenecks challenging the development of sustainable building principles to develop a proper approach for successfully promoting and implementing its practices. Thus, this paper intends to assess the major factors affecting sustainable building projects in Addis Ababa, focusing on the Akaki-Kality Sub-city.

1.2 Statement of the Problem

Despite advancements, the adoption of sustainable building practices varies widely across regions and project types. Challenges include high upfront costs, limited availability of skilled

labor, and regulatory barriers (Gossling & Scott, 2020; World Green Building Council, 2021). Determining sustainable building projects involves implementing strategies to address these barriers, including cost-effective technologies, supportive policies, and stakeholder engagement (Sustainable Buildings and Construction Programme, 2020).

Akaki Kality sub-city, located in the southern part of Addis Ababa, Ethiopia, has been actively pursuing sustainable building projects as part of its urban development strategy. This area has experienced rapid urbanization and population growth, leading local authorities to prioritize environmentally friendly construction practices to mitigate environmental impacts and improve quality of life. Akaki Kality sub-city has embarked on several sustainable building projects aimed at integrating green building principles into urban development. Projects include initiatives to improve energy efficiency, utilize renewable energy sources, and enhance water management practices (Addis Ababa City Government, 2023). The aim of the study is typically to investigate and assess the extent to which building projects in the Akaki Kality sub-city adhere to sustainable building practices. Not only to determine the current status of sustainable building projects in the Akaki Kality sub-city but also to provide a holistic analysis that informs future strategies and actions towards achieving more sustainable urban development in the region.

Traditional construction practices often contribute significantly to environmental degradation through high energy consumption, greenhouse gas emissions, water use, and waste generation. In the Akaki Kality sub-city, rapid urbanization and construction activities may exacerbate these impacts, putting pressure on natural resources and ecosystems. The study addresses concerns related to resource scarcity and waste generation in construction projects. It examines how unsustainable practices, such as excessive use of non-renewable materials and inefficient waste management, contribute to resource depletion and environmental pollution in the sub-city.

Akaki Kality sub-city, like many urban areas, faces challenges related to climate change impacts such as heatwaves, flooding, and extreme weather events. Unsustainable building practices can exacerbate vulnerability to these risks by not incorporating climate-resilient design principles (IPCC, 2021; UN-Habitat, 2016). According to (Smith et al., 2022; UN Environment, 2018; World Green Building Council, 2020) the determination of sustainable building projects involves a multidimensional approach to assessing, promoting, and improving the adoption of sustainable practices in construction. This research contributes to advancing environmental stewardship,

enhancing building performance, and supporting long-term sustainable development goals. This study refers to the central research question or issue that the study aims to address. In this case, the study seeks to investigate and understand the factors such as existence of environmental material, environmental policy, and awareness, and challenges related to sustainable building projects specifically within the Akaki Kality Sub-City.

1.3 Research Objectives

1.3.1 General Objective

The general objective aimed to assess the determinants of sustainable building projects in Addis Ababa Akaki Kality Sub-city.

1.3.2 Specific Objectives

The specific objectives of a study on the determinants of sustainable building projects in the Akaki Kality sub-city would typically focus on addressing the following objectives.

1. Understanding factors of that sustainable building construction projects in the study area.
2. Assessing how education and awareness variables affect the growth of sustainable construction projects in the Akaki Kality Sub-city.
3. Evaluating how the existence of sustainable environmental material affect the development of sustainable building projects in the Akaki-Kality Sub-city.
4. To assess how environmental policy variables affect sustainable building construction projects in the research area.

1.4 Research Questions

In this study, the following research issues were attempted to be addressed:

RQ1. What are the factors that affect sustainable building construction projects in the study area?

RQ2. How do education and awareness affect the adoption of sustainable construction practices?

RQ3. How does the existence of friendly environmental materials affect the development of sustainable building projects in Akaki Kality Sub-city?

RQ4. How does the existence of environmental policies affect the development of sustainable building projects in Akaki Kality Sub-city?

1.5 Scope of the Study

1.5.1 Geographically

The study focused on Akaki Kality Sub-city in Addis Ababa. This study aims to assess the determinants of sustainable construction buildings, focusing on critical factors that impact sustainable building principles. The study analyzed buildings under development and completed and also mass demolition and urban renewal projects in the Akaki Kality sub-city. It was thought that significant information could be acquired. Comparative analysis with other regions or cities to benchmark Akaki Kality sub- city's sustainability efforts and identify best practices.

1.5.2 Thematic Scope

The study involved engagement with key stakeholders such as developers, architects, engineers, and local government officials. Their perspectives and inputs were crucial for understanding challenges, and opportunities related to sustainable construction projects in the Akaki Kality sub-city. It examined the effect of existing environmental policies frameworks and regulations, the existence of environmental materials, and awareness that influence sustainable building practices in the Akaki Kality sub-city. Recommendations for policy enhancement initiatives may be provided based on the findings.

Based on the findings, the study developed actionable recommendations and guidelines for enhancing sustainable building practices in the Akaki Kality sub-city. These recommendations focused on overcoming barriers, promoting awareness, and fostering the adoption of sustainable construction methods. The scope of the study was comprehensively exploring sustainable building projects within the Akaki Kality sub-city, aiming to provide insights, recommendations, and strategies to support the transition towards more sustainable urban development practices in the region.

1.5.3 Timporary

This research is bounded in time between June 2023 to October 2024. Results found in other time ranges may be different from this paper.

1.6 Significance of the Study

The findings of the study can inform the development of local policies, regulations, and incentives that promote sustainable construction practices. This includes aligning with national

and international sustainability targets and frameworks, thereby fostering a supportive regulatory environment. Also engaging with local stakeholders, including developers, architects, and government officials, can facilitate knowledge exchange and capacity building in sustainable construction methods. This can empower the local community to implement and advocate for sustainable practices beyond the scope of the study.

Ultimately, the study contributes to the long-term sustainability of the Akaki Kality sub-city by promoting holistic urban development strategies that balance economic growth, environmental stewardship, and social equity. It lays the groundwork for a more resilient and liveable urban environment for current and future generations. The significance of the study lies in its potential to drive positive change towards sustainable urban development in the Akaki Kality sub-city, benefiting the environment, economy, and quality of life for its residents while setting a precedent for sustainable development practices globally. The study documenting and showcasing successful case studies and best practices can serve as a model for other regions or cities facing similar urban development challenges. It demonstrates leadership in sustainable urban planning and construction innovation.

The findings of this study can help the Sub-city adopt how sustainable building practices can lead to economic benefits such as reduced operating costs (e.g., energy and water savings), increased property values, and enhanced market competitiveness for developers and property owners in the Akaki Kality sub-city. This can attract investment and stimulate economic growth in the area. Sustainable buildings are designed to be more resilient to climate change impacts such as extreme weather events and temperature fluctuations. Implementing climate-resilient design principles can improve the adaptability and durability of buildings in the Akaki Kality sub-city, enhancing community resilience. By assessing and promoting sustainable building practices, the study can contribute to reducing the environmental footprint of construction activities in the Akaki Kality sub-city. This includes lowering carbon emissions, conserving natural resources, and minimizing waste generation, thus supporting broader environmental sustainability goals.

1.7 Limitations of the Study

One significant limitation could be the availability and quality of data related to sustainable building projects in the Akaki Kality sub-city. To overcome these challenges this research paper

conduct training before data collection, and conduct reliability and validity test. Access to comprehensive and up-to-date data on construction practices, environmental impacts, and socioeconomic factors may be limited, which could affect the depth and accuracy of the study's analysis. The effectiveness of the study's recommendations could depend on the level of stakeholder participation and engagement. Challenges in gaining buy-in from developers, local authorities, and community members may limit the implementation of proposed sustainable building practices.

Urban development is inherently dynamic, with continuous changes in policies, technologies, and socio-economic conditions. The study's findings may be influenced by evolving trends and developments that occur during the research period, potentially impacting the relevance of recommendations over time. In addition, the study may encounter limitations related to existing policies and regulatory frameworks that either support or hinder the adoption of sustainable building practices. Addressing policy barriers effectively may require broader systemic changes beyond the study's scope. Even if efforts were made to mitigate these limitations through rigorous research methodologies and stakeholder collaboration, there were potential limitations such as data availability, resource constraints, and the dynamic nature of urban development.

1.8 Definition of Terms

Sustainable Building: Sustainable building refers to the design, construction, and operation of buildings that aim to minimize their environmental impact while maximizing resource efficiency and promoting occupant health and well-being.

Energy Efficiency: Energy efficiency in buildings involves designing and implementing measures to reduce the amount of energy required for heating, cooling, lighting, and other building operations without sacrificing comfort or performance.

Water Efficiency: Water efficiency pertains to practices, technologies, and strategies that reduce water consumption within buildings, including efficient fixtures, recycling systems, and water-efficient landscaping.

Renewable Energy: Renewable energy refers to energy derived from natural resources that are replenished on a human timescale, such as solar, wind, geothermal, and biomass energy, used to power buildings and reduce reliance on fossil fuels.

Urban Sustainability: Urban sustainability refers to the capacity of cities and urban areas to maintain and improve the quality of life for their residents while reducing their environmental impact and ecological footprint.

Stakeholders: Individuals or groups that have an interest or stake in the outcome of a project. In the context of sustainable building projects, stakeholders include building owners, occupants, designers, contractors, regulators, and the community.

1.9 Organization of the Study

The study is going to be organized into five chapters. The first chapter covers the introduction, statement of the problem, objectives, justification and significance, the scope, and the organization of the thesis. The second chapter deals with the review of related literature. Accordingly, the theoretical literature review, empirical evidence, and conceptual framework of the study were addressed. The third chapter describes the research methodologies. In the fourth chapter, the collected information is described analysed, and interpreted. The conclusion and recommendation part are presented in the fifth chapter. At last, references, an appendix, and data-gathering tools such as questionnaires and interview questions were annexed.

2. Literature Review

2.1 Introduction

Sustainable building projects have garnered significant attention in recent years due to the increasing awareness of environmental issues, resource depletion, and the need for sustainable development. The construction industry, being one of the largest consumers of natural resources and a significant contributor to environmental pollution, plays a crucial role in this context. Sustainable building practices aim to minimize the negative environmental impacts of construction activities while enhancing the economic and social benefits.

This chapter reviews the existing literature on sustainable building projects with a specific focus on the context of the Akaki Kality Sub-City. It provides a comprehensive overview of the key concepts, theoretical frameworks, and empirical studies relevant to sustainable construction. The literature review is structured to first discuss the general principles and definitions of sustainable building, followed by an exploration of the factors influencing the adoption of sustainable practices in construction. It also examines the specific challenges and opportunities associated with implementing sustainable building projects in urban areas, with a particular emphasis on developing regions.

Furthermore, this chapter highlights the importance of stakeholder involvement, policy frameworks, and the existence of environmental materials in promoting sustainable construction. It critically analyses previous research findings, identifies gaps in the existing literature, and outlines the areas that require further investigation. By establishing a solid theoretical and empirical foundation, this literature review aims to provide a clear understanding of the determinants of sustainable building projects and their implications for the Akaki Kality Sub-City.

2.2 Theoretical Literature Revies

The conceptual framework for sustainable building projects is grounded in several key theories and models that have been developed to understand and guide sustainable practices in the construction industry. This section explores these theoretical foundations, providing a basis for analysing sustainable building projects in the Akaki Kality Sub-City.

Sustainable Development Theory: Sustainable development, as defined by the Brundtland Commission in 1987, refers to development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This theory underpins the concept of sustainable building by emphasizing the balance between economic growth, environmental protection, and social equity. In the context of construction, sustainable development involves creating buildings that are energy-efficient, environmentally friendly, and socially responsible (World Commission on Environment and Development, 1987).

Sustainable development theory emphasizes the need for development that meets present needs without compromising future generations' ability to meet their own needs. This theory provides a holistic approach to development, balancing economic growth, environmental protection, and social equity. In the context of sustainable building projects, sustainable development theory underscores the importance of designing and constructing buildings that are environmentally responsible, economically viable, and socially beneficial.

Triple Bottom Line (TBL) Framework: The Triple Bottom Line (TBL) framework, introduced by John Elkington in 1994, expands the traditional reporting framework to include social and environmental performance in addition to financial performance. This approach encourages organizations to measure their success not just by profit but also by their impact on people and the planet (Elkington, J., 1997). In sustainable building projects, the TBL framework is used to evaluate environmental sustainability (e.g., energy use, waste reduction), social sustainability (e.g., community benefits, health, and safety), and economic sustainability (e.g., cost savings, long-term value) of construction practices (Elkington, J., 1997).

Life Cycle Assessment (LCA): Life Cycle Assessment (LCA) is a methodological framework used to assess the environmental impacts of a process from cradle to grave. In the context of sustainable building, LCA involves evaluating the environmental impacts associated with all stages of a building's life, from material extraction and construction to operation and demolition. This comprehensive approach helps identify opportunities for reducing environmental impacts and improving resource efficiency throughout the building's lifecycle.

A systematic process for evaluating the environmental impacts associated with all stages of a product's life, from raw material extraction through production, use, and disposal. In the context

of buildings, it helps identify opportunities to improve environmental performance throughout the building's lifecycle.

Green Building Rating Systems: Green building rating systems, such as LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Method), and Green Star, provide standardized criteria for evaluating the sustainability performance of buildings. These systems assess various aspects of a building's design, construction, and operation, including energy efficiency, water use, indoor environmental quality, and material selection. They serve as valuable tools for promoting sustainable practices and benchmarking the performance of sustainable building projects (Green Building, 2024).

Stakeholder Theory: Stakeholder theory posits that organizations should consider the interests and impacts of all stakeholders, including customers, employees, suppliers, community members, and the environment, rather than focusing solely on shareholders. In sustainable building projects, stakeholder theory emphasizes the importance of engaging and collaborating with various stakeholders throughout the project lifecycle to ensure that their needs and concerns are addressed. This collaborative approach can enhance the social and environmental performance of construction projects and foster community support.

Innovation Diffusion Theory: Innovation Diffusion Theory was developed by Everett Rogers, and explains how new ideas and technologies spread within a society or organization. This theory is relevant to sustainable building projects as it highlights the factors that influence the adoption of sustainable practices and technologies in the construction industry. These factors include relative advantage, compatibility, complexity, trialability, and observability. Understanding these factors can help identify strategies to promote the adoption of sustainable building practices in the Akaki Kality Sub-City.

2.2.1 Definition of Key Terms and Concepts

Understanding the key terms and concepts related to sustainable building is crucial for a comprehensive analysis of sustainable building projects. This section defines the primary terms and concepts used throughout this study.

Sustainability: Sustainability is the capacity to endure or remain viable over time, particularly regarding the balanced development of social, economic, and environmental needs. In building

construction, it emphasizes practices that are eco-friendly, socially responsible, and economically viable.

Sustainable Building (Green Building): The practice of designing, constructing, and operating buildings in a way that reduces or eliminates negative impacts on the environment and human health. It involves efficient use of resources, reducing waste and pollution, and enhancing occupant health and productivity.

Energy Efficiency: The goal of reducing the amount of energy required to provide products and services. In buildings, this can be achieved through various means such as improved insulation, energy-efficient windows, and high-efficiency HVAC systems.

Renewable Energy: Energy generated from natural resources that are replenished constantly, such as solar, wind, and geothermal energy. Incorporating renewable energy sources into building projects reduces reliance on fossil fuels and decreases greenhouse gas emissions.

Resource Efficiency: The practice of using materials and resources sustainably, minimizing waste, and maximizing resource utilization. This includes using recycled materials, reducing material consumption, and reusing materials when possible.

Indoor Environmental Quality (IEQ): The quality of the indoor environment as it relates to the health and well-being of building occupants. It includes factors such as air quality, lighting, thermal comfort, and acoustics.

Sustainability Indicators: Metrics used to measure the sustainability performance of a building or project. These indicators can include energy consumption, water usage, waste generation, carbon footprint, and occupant satisfaction.

Urban Sustainability: The application of sustainable development principles in urban areas to create liveable, resilient, and environmentally friendly cities. It involves integrated planning and management of urban resources to enhance quality of life while minimizing environmental impact.

Built Environment: The human-made surroundings that provide the setting for human activity, including buildings, infrastructure, and public spaces. Sustainable practices in the built environment aim to reduce environmental impacts and enhance social and economic benefits.

2.3 Benefits of Sustainable Building Projects and Barriers to Implementation

2.3.1 Evaluate the Benefits of Sustainable Building Projects

Economic Benefits Empirical evidence supports the economic benefits of sustainable building projects. Kats (2003) conducted a comprehensive study in the United States and found that green buildings achieved significant cost savings through reduced energy and water use, as well as lower maintenance costs. Additionally, a study by Eichholtz, Kok, and Quigley (2010) demonstrated that green buildings command higher rental rates and property values compared to conventional buildings, indicating strong economic incentives for adopting sustainable practices.

Environmental Benefits: The environmental benefits of sustainable building projects are well-documented in empirical studies. For example, research by Newsham et al. (2009) in Canada showed that LEED-certified buildings have lower energy consumption and greenhouse gas emissions compared to non-certified buildings. A study by Zhang et al. (2011) in China found that green buildings contribute to significant reductions in water usage and waste generation, highlighting their positive environmental impact.

Social Benefits: Empirical studies have also explored the social benefits of sustainable building projects. Heerwagen (2000) found that green buildings with enhanced indoor environmental quality, such as improved air quality and natural lighting, are associated with higher occupant satisfaction and productivity. A study by Singh et al. (2010) in the United States showed that green buildings positively impact occupant health, reducing symptoms such as respiratory issues and headaches, thereby contributing to overall well-being.

2.3.2 Identify the barriers to implementing Sustainable building projects

Financial Barriers: Empirical research indicates that financial barriers are a significant challenge in implementing sustainable building projects. A study by Häkkinen and Belloni (2011) in Finland found that the high initial costs of green building technologies and materials deter many developers from adopting sustainable practices. Similarly, research in India by Gupta and Chandiwala (2010) highlighted that the lack of financial incentives and affordable financing options are major obstacles to green building implementation. Environmental regulations frequently offer financial incentives, such as tax breaks or refunds, for adopting sustainable practices. According to Wang et al. (2018), these incentives can have a considerable impact on developers' decisions to adopt sustainable building techniques and invest in green technologies.

The initial expense of environmental materials can inhibit many Ethiopian builders. According to Gashaw's (2021) research, despite the long-term benefits, hefty upfront prices sometimes discourage stakeholders from investing in environmentally friendly products. Financial incentives and government support may be required to address these issues.

Technical Barriers: Technical barriers, such as the lack of knowledge and expertise, are frequently cited in empirical studies as impediments to sustainable building practices. For instance, a study by Darko and Chan (2017) in Hong Kong found that inadequate technical skills and limited access to sustainable building technologies hinder the adoption of green practices. Additionally, research in South Africa by Van Wyk and Chege (2004) emphasized the need for specialized training and education programs to build technical capacity in the construction industry.

Regulatory and Policy Barriers: Empirical studies have identified regulatory and policy barriers as significant challenges to sustainable building implementation. A study by Zuo and Zhao (2014) in Australia found that inconsistent and unclear regulations create uncertainty and impede the adoption of green building practices. Similarly, research in Nigeria by Windapo and Goulding (2015) indicated that the lack of enforcement of existing building codes and regulations poses a barrier to sustainable construction.

Cultural and Behavioral Barriers: Cultural and behavioral factors are also critical barriers to sustainable building adoption. A study by Jaillon and Poon (2009) in Hong Kong found that resistance to change and traditional construction practices hinder the acceptance of green building technologies. In the United States, research by Hoffman and Henn (2008) highlighted that cultural attitudes and behaviors significantly influence the willingness to adopt sustainable practices, emphasizing the need for public awareness campaigns and behavioral incentives.

Public Awareness and Support: The existence of environmental policies can raise public awareness of sustainability issues, resulting in increased demand for green buildings. Sinha et al. (2021) found that measures that promote public awareness can result in a market-driven push for sustainable construction techniques.

High Implementation Costs*:* While rules can encourage sustainable activities, the high initial costs of compliance can discourage stakeholders from implementing environmentally friendly

practices. Mosaico et al. (2021) contend that these costs frequently surpass perceived benefits, limiting the efficacy of environmental programs in fostering sustainability.

Inconsistent Regulations: Inconsistencies in environmental policies between government levels can confuse and impede compliance among construction players. Alsharif et al. (2020) argue that a lack of regulatory consistency might lead to fragmentation in sustainable building techniques and hinder progress toward sustainability goals.

2.4 Conceptual Literature

This section reviews the conceptual literature relevant to each research objective of the study on sustainable building projects in the Akaki Kality Sub-City.

2.4.1 Key Factors Influencing the Adoption of Sustainable Building Practices

Sustainable building practices involve the design, construction, and operation of buildings in an environmentally responsible and resource-efficient manner. Key concepts include energy efficiency, water conservation, use of sustainable materials, and indoor environmental quality. The literature highlights several factors influencing the adoption of these practices, including regulatory frameworks, market demand, technological advancements, and stakeholder awareness.

Environmental Policies: Regulatory frameworks, government policies, and regulations play a critical role in promoting sustainable building practices. Studies have shown that stringent building codes, environmental regulations, and incentives for green building can significantly influence the adoption of sustainable practices. For instance, the introduction of energy performance standards and mandatory green building certifications can drive the construction industry towards sustainability.

Numerous studies have demonstrated the impact of regulatory frameworks and policy incentives on the adoption of sustainable building practices. For instance, Qi et al. (2010) found that stringent building codes and environmental regulations in China significantly increased the implementation of green building technologies. Similarly, studies in the European Union have shown that policies such as subsidies for energy-efficient renovations and mandatory green certifications have led to higher rates of sustainable building adoption (Kibert, 2016). (Zuo and

Zhao, 2019; Tzeng et al., 2020) Indicated the effect of environmental regulation and frameworks on sustainable construction buildings.

Environmental Materials: Advancements in building technologies, such as energy-efficient HVAC systems, renewable energy integration, and sustainable building materials, facilitate the adoption of sustainable practices. The literature emphasizes the importance of innovation in reducing the environmental impact of buildings and improving their performance. Adoption of new technologies often depends on factors such as cost, compatibility with existing systems, and the availability of skilled labor. (Mohammad and Pasquire, 2021; Ashby and Johnson, 2020; Zainon, 2017) Indicated that the choice of environmental materials plays a crucial role in sustainable building projects as they significantly influence energy efficiency, resource conservation, and overall environmental impact.

Studies have shown that technological advancements facilitate the adoption of sustainable building practices. For example, Hwang and Tan (2012) found that the availability of advanced green building technologies, such as high-efficiency HVAC systems and renewable energy systems, was a significant factor in the adoption of sustainable practices in Singapore. Additionally, empirical research in Germany by Rehm and Ade (2013) highlighted that technological innovations in building materials and construction methods contribute to the broader adoption of sustainable building practices.

Awareness and Engagement: Awareness and engagement of stakeholders, including architects, builders, developers, and occupants, are crucial for the successful implementation of sustainable building practices. Educational programs, professional training, and stakeholder collaboration can enhance understanding and commitment to sustainability. The literature suggests that increasing stakeholder awareness through information dissemination and participatory approaches can lead to greater adoption of sustainable practices. (Hammed et al., 2020; Hwang and Tan, 2012) indicated that increasing understanding among construction professionals such as architects, civil engineers, and others promotes sustainable building construction projects.

Market Demand The demand for sustainable buildings is driven by increasing awareness of environmental issues among consumers and investors. Market demand for green buildings is influenced by factors such as the rising cost of energy, consumer preference for environmentally friendly products, and the perceived health benefits of sustainable buildings. Conceptual

literature suggests that market forces can be a powerful driver for the adoption of sustainable building practices.

Empirical research indicates that market demand and consumer awareness are critical drivers of sustainable building practices. A study by Dodge Data & Analytics (2018) revealed that market demand for green buildings in the United States has been growing steadily, driven by factors such as rising energy costs and increased consumer preference for environmentally friendly buildings. In Australia, Wilkinson et al. (2013) found that tenant demand for healthier and more sustainable office spaces has encouraged developers to invest in green building projects.

Stakeholder Engagement: Empirical studies emphasize the importance of stakeholder engagement in promoting sustainable building practices. For instance, a study by Othman and Elsayed (2012) in Egypt found that involving stakeholders, such as architects, engineers, contractors, and building occupants, in the planning and design phases of construction projects led to better implementation of sustainable practices. Similarly, research in the United States by Ahn et al. (2013) indicated that stakeholder collaboration and education are essential for overcoming barriers to sustainable building adoption.

2.4.2 Effect of Existence of Environmental Policy on Sustainable Building

Environmental policies are critical in supporting sustainable building practices because they set frameworks, laws, and incentives that direct the construction industry's actions toward environmental responsibility. This literature review assesses the impact of environmental regulations on sustainable building development, highlighting the role of regulatory frameworks, compliance drives, and impediments in meeting sustainability goals.

Environmental regulations establish a regulatory framework that demands sustainable construction methods. According to Zuo and Zhao (2019), government restrictions such as building codes and energy efficiency standards are critical drivers of sustainability in urban development projects. Policies frequently encourage or require the use of green building certifications (e.g., LEED, BREEAM), which can improve the sustainability of new buildings. Tzeng et al. (2020) claim that environmental regulations that incentivize certification efforts result in higher building performance requirements and lower environmental footprints.

2.4.3 Effect of Existence of Environmental Material on Sustainable Building

While ecologically friendly materials might result in long-term savings, the initial price can be prohibitive for some projects. According to Mohammad and Pasquire (2021), initial material costs can discourage builders from using sustainable methods, especially in economically disadvantaged areas. Environmental materials, such as recycled steel and sustainable timber, have a reduced carbon footprint than conventional materials. According to Ashby and Johnson (2020), using recycled materials can help reduce greenhouse gas emissions from material manufacturing and transportation.

The use of renewable and recycled materials increases resource efficiency in building. Dincel et al. (2019) argue that innovative materials and processes, such as hempcrete and bamboo, can replace traditional materials while effectively utilizing renewable resources. Environmental materials improve indoor air quality (IAQ) by lowering hazardous emissions. Kamaruzzaman and Zainon (2017) discovered that low-VOC (volatile organic compound) materials increase IAQ, resulting in a healthier living environment.

2.4.4 Effect of Existence of Awareness on Sustainable Building

Awareness and education about sustainable building techniques are critical for increasing the use of environmentally friendly construction methods. This literature review investigates how awareness campaigns and educational initiatives affect stakeholders in the building sector, such as architects, builders, legislators, and the general public, resulting in better sustainability outcomes. Increased understanding of sustainable building methods informs stakeholders about the advantages of environmentally friendly materials, energy-efficient designs, and waste-reduction strategies. According to Hwang and Tan (2012), increased understanding among construction professionals' results in better decision-making and promotes sustainable project management practices. Public knowledge helps consumers to seek out sustainable alternatives, creating market demand for green buildings. A study by Hammed et al. (2020) found that consumers with a higher understanding of sustainability issues are more likely to choose green buildings, influencing developers to prioritize sustainable practices.

Training and Capacity Building*:* Education activities dedicated to construction professionals help them improve their knowledge and abilities in sustainable design and building methods. According to Korkmaz et al. (2010), educational programs can effectively bridge the knowledge gap, allowing professionals to successfully use sustainable procedures and materials.

Integrating Sustainability into Curricula: Incorporating sustainability concepts into university curricula can provide future architects and engineers with the tools needed to design and create sustainable buildings. Parkin et al. (2014) suggest that academic institutions play an important role in molding emerging professionals' values and attitudes toward sustainability.

*2.4.4.1 Barriers to Awareness and Education***:**

Various barriers on awareness and education affect the practice of sustainability in construction projects. These barriers significantly hinder the implementation of sustainable practices. These barriers include:

Lack of Comprehensive Programs: Despite the importance of awareness and education, there is sometimes a dearth of planned and comprehensive educational programs focused on sustainable building techniques. Asif et al. (2013) found that insufficient training and education can result in a knowledge gap, impeding the development of sustainable construction techniques.

Resistance to Change: Although awareness campaigns can promote sustainable practices, some industry stakeholders may resist changing traditional practices due to perceived risks or costs associated with new methods. According to Othman et al. (2021), this resistance can stall progress toward adopting sustainable buildings despite increased awareness.

2.5 Empirical Literature Review

This section reviews the empirical literature relevant to each research objective of the study on sustainable building projects in the Akaki Kality Sub-City.

2.5.1 Empirical Literature Review on Ethiopian Case

In Ethiopia, the growing focus on sustainable building practices is essential for addressing environmental challenges and fostering economic development.

2.5.1.1 Empirical Literature Review on the Effect of Education and Awareness

Awareness and education are critical in promoting sustainable practices throughout the construction business, influencing stakeholders ranging from government agencies to local communities. Ethiopians' awareness of sustainable building principles is still developing. Tadesse and Mulugetta (2019) found that, while there is a rising understanding of the need for sustainability, many stakeholders are unaware of specific sustainable practices and materials.

Increasing community awareness is critical for promoting sustainable development in the building industry.

Increased consumer understanding influences their preferences for sustainable structures. According to Gebreegziabher et al. (2021), informed customers are more inclined to support environmentally friendly housing efforts, increasing demand for sustainable building approaches. This rising demand encourages developers to include greener methods in their designs. Education and training programs for architects, engineers, and construction workers improve skills in sustainable building methods. Molla and Chetu (2018) underline the importance of focused instructional initiatives that focus on sustainability in building. Such programs can greatly improve stakeholders' knowledge and capacity in implementing sustainable practices.

Mesfin and Desalegn (2020) argue that Ethiopian universities must incorporate sustainable practices into their training programs to produce a workforce that values environmental sustainability in construction. Traditional building practices in some Ethiopian villages may be resistant to current sustainable alternatives due to cultural linkages. According to Gashaw and Getahun (2021), addressing cultural preconceptions and incorporating local knowledge into sustainability education is critical for the successful adoption of green construction methods. A significant impediment to the adoption of environmentally friendly materials in Ethiopia is a lack of awareness among builders and consumers about their benefits. Daba and Abebe (2020) found that raising awareness and educating stakeholders about the benefits of environmentally friendly materials is critical for increasing adoption and utilization.

2.5.1.2 Empirical Literature Review on Effect of Environmental Materials

The increasing necessity of sustainable development has pushed environmental materials to the forefront of Ethiopia's construction sector. These materials are critical in reducing the building sector's environmental imprint, boosting energy efficiency, and increasing the overall sustainability of construction methods. This literature review looks at the impact of environmental materials on sustainable building in Ethiopia, with an emphasis on availability, application, and challenges.

Bediye and Eniang (2020) investigate the feasibility of employing recycled materials in construction, such as recovered wood and recycled steel, to contribute to the sustainability of building projects. The use of environmentally friendly materials has a considerable impact on building energy efficiency. Taffese and Moges (2021) found that elements like insulated

concrete forms and energy-efficient glass can improve thermal performance and reduce energy consumption for heating and cooling in Ethiopian structures. This reduction in energy usage helps to reduce environmental effects. In addition to energy efficiency, the adoption of ecologically friendly materials can have a considerable health advantage for residents. Alemayehu et al. (2022) found that materials free of volatile organic compounds (VOCs) and other toxic chemicals contribute to healthier indoor environments, which are crucial for residents' well-being.

2.5.1.3 Empirical Literature Review on the Effect of Environmental Policies

The construction business in Ethiopia confronts substantial obstacles in promoting sustainable building techniques, owing mostly to growing urbanization and economic development pressures. Environmental policies provide an important framework for leading the transition to sustainable building by encouraging energy-efficient practices, the use of sustainable materials, and reducing environmental consequences.

The Ethiopian government has implemented various measures to promote sustainable development, most notably the Growth and Transformation Plan (GTP). According to Zemedeneh (2020), the GTP prioritizes environmental sustainability and encourages the adoption of sustainable practices in the building and real estate industries, laying the groundwork for future laws and incentives. The Ethiopian Environmental Protection Authority has implemented policies to encourage sustainable land use and construction methods. According to Hailu and Daba (2021), compliance with these standards is critical for the development of sustainable buildings since they require Environmental Impact Assessments (EIAs) for construction projects.

Environmental policies encourage the use of green building materials. Tesfaye and Gashaw (2022) discovered that rules encouraging the use of local and eco-friendly materials have resulted in improved awareness and application of sustainable materials in construction projects, while acceptance remains variable due to compliance issues. Environmental policies have helped improve energy efficiency in Ethiopian structures. According to Abebe and Taffese (2021), policies concentrating on energy conservation measures in buildings are beginning to have positive outcomes, particularly in terms of lowering energy prices and reducing dependency on nonrenewable energy sources. One of the most critical difficulties in Ethiopia is the ineffective enforcement of environmental legislation. Ayele et al. (2021) found that, despite the existence of

extensive environmental legislation, poor enforcement and oversight prevent effective compliance, limiting the potential advantages of these policies on sustainable building practices. Lack of awareness among stakeholders also impedes the effectiveness of environmental regulations. According to Bediye and Tan (2020), many builders and developers lack the requisite knowledge and resources to comply with environmental requirements, resulting in inadequate implementation of sustainable methods.

2.5.2 Empirical Literature on Strategies for Promoting Sustainable Building Practices

To promote sustainable construction buildings different strategies can be followed these include:

Policy and Regulatory Strategies: Empirical evidence supports the effectiveness of policy and regulatory strategies in promoting sustainable building practices. Deng and Wu (2014) in Singapore demonstrated that the introduction of mandatory green building codes and financial incentives led to a significant increase in the number of sustainable building projects. Similarly, research in Germany by Mlecnik et al. (2010) showed that supportive policies and regulations, such as tax incentives and subsidies, effectively encourage the adoption of green building practices.

Financial and Economic Strategies: Empirical studies highlight the importance of financial and economic strategies in promoting sustainable building practices. A study by Li et al. (2013) in China found that providing financial incentives, such as grants and subsidies, significantly boosts the adoption of green building technologies. Additionally, research in the United States by Fuerst and McAllister (2011) indicated that market-based mechanisms, such as green bonds and carbon pricing, are effective tools for financing sustainable building projects.

Educational and Training Strategies: Empirical research underscores the necessity of educational and training strategies for promoting sustainable building practices. A study by Abidin and Pasquire (2007) in Malaysia found that incorporating sustainability into educational curricula and providing professional development programs for construction practitioners enhances the adoption of sustainable practices. Similarly, research in the United Kingdom by Häkkinen et al. (2013) highlighted the importance of continuous learning and certification programs to keep industry professionals updated on sustainable technologies and practices.

Technological and Innovation Strategies: Empirical studies support the role of technological and innovation strategies in advancing sustainable building practices. For instance, a study by

Zhang et al. (2013) in the United States found that investing in research and development of green building technologies, such as renewable energy systems and energy-efficient materials, drives the adoption of sustainable practices. Research in Japan by Asif et al. (2007) demonstrated that showcasing pilot projects and demonstration buildings can effectively promote the benefits and feasibility of sustainable building practices.

Community Engagement and Awareness Strategies: Empirical evidence highlights the significance of community engagement and awareness strategies in promoting sustainable building practices. A study by Kibert (2013) in the United States found that public awareness campaigns, workshops, and community consultations are effective in raising awareness and gaining public support for green building projects. Similarly, research in Canada by Cole (2011) emphasized the importance of involving community members in the planning and decision-making processes to ensure the acceptance and success of sustainable building initiatives.

2.6 Policy and Strategies

This section examines the policies and strategies relevant to the determination and promotion of sustainable building projects in Akaki Kality Sub-City. The analysis focuses on existing frameworks, proposed initiatives, and best practices from other regions to provide a comprehensive understanding of how sustainable building practices can be effectively implemented and supported.

2.6.1 Existing Policies and Regulatory Frameworks

Ethiopia has implemented a variety of policies and regulatory frameworks to promote sustainable development, urban planning, environmental protection, and economic growth.

National Building Codes and Standards: In Ethiopia, the building codes and standards play a significant role in guiding construction practices. The current national building codes incorporate some elements of sustainability, such as energy efficiency requirements and water conservation measures. However, the extent to which these codes are enforced and updated remains a challenge. Strengthening and regularly updating these codes to include comprehensive green building standards is essential for promoting sustainability.

Environmental Policies: Ethiopia's environmental policies, including the Climate Resilient Green Economy (CRGE) strategy, aim to achieve sustainable development while minimizing the country's greenhouse gas emissions. The CRGE strategy includes specific goals for the building

sector, such as improving energy efficiency and promoting the use of renewable energy in buildings. Implementing these policies at the local level, including Akaki Kality Sub-City, can drive the adoption of sustainable building practices.

Incentive Programs: Incentive programs, such as tax breaks, grants, and subsidies, are crucial for encouraging developers and property owners to adopt sustainable building practices. While Ethiopia has introduced some incentives for renewable energy projects, there is a need to expand these incentives to cover a broader range of sustainable building practices. Developing targeted financial incentives can reduce the initial cost barriers associated with green building technologies and materials.

2.6.2 Proposed Initiatives and Strategies

To ensure the widespread adoption of sustainable building practices, it is essential to strengthen regulatory frameworks. This includes updating national and local building codes to incorporate comprehensive green building standards and ensuring their enforcement. Additionally, establishing mandatory green building certification programs can set clear benchmarks for sustainability and encourage compliance.

Financial and Economic Strategies Economic strategies to promote sustainable building include providing financial incentives, such as grants, loans, and subsidies, for green projects. The literature also suggests implementing market-based mechanisms like carbon pricing and green bonds to support sustainable construction. Encouraging private sector investment through public-private partnerships can further enhance funding for sustainable projects. Proposed strategies include:

Offering tax credits for buildings that meet specific sustainability criteria can motivate developers to invest in green technologies and practices.

Providing subsidies and grants for sustainable building materials, energy-efficient systems, and renewable energy installations can lower the financial burden on developers.

Developing green financing mechanisms, such as low-interest loans and green bonds, can facilitate access to capital for sustainable building projects.

Investing in research and development (R&D) of sustainable building technologies is crucial for advancing green construction practices. Proposed initiatives include providing grants for research institutions and companies, implementing pilot projects to showcase innovative sustainable building practices and demonstrate their feasibility and benefits, and Facilitating the transfer of sustainable building technologies from developed countries to Ethiopia through partnerships and collaborations.

Educational and Training Strategies: Education and training are vital for building the technical capacity needed for sustainable building practices. The literature highlights the importance of incorporating sustainability into educational curricula for architecture, engineering, and construction management. Proposed strategies include:

Incorporating sustainability into the curricula of architecture, engineering, and construction management programs in universities and technical schools.

Offering continuous professional development programs and certification courses for construction industry professionals.

Conducting public awareness campaigns to educate property owners, developers, and the general public about the benefits of sustainable buildings.

Community Engagement and Awareness Strategies: Engaging the community and raising awareness about the benefits of sustainable building practices are crucial for gaining public support. The literature recommends conducting awareness campaigns, workshops, and public consultations to inform and involve stakeholders. Collaborative approaches that involve community members in planning and decision-making processes can enhance the acceptance and success of sustainable building projects. Establishing platforms for collaboration among government agencies, the private sector, academia, and civil society to develop and implement sustainable building initiatives. Encouraging public-private partnerships to leverage resources and expertise for sustainable building projects.

Policy and Regulatory Strategies To promote sustainable building practices, the literature recommends the development of comprehensive policy and regulatory frameworks. These can include mandatory green building codes, financial incentives, tax breaks, and subsidies for

sustainable projects. Strong enforcement mechanisms and regular updates to regulations are also crucial.

Technological and Innovation Strategies: Promoting research and development in sustainable building technologies is essential for advancing sustainability in construction. The literature suggests investing in innovative technologies, such as renewable energy systems, energy-efficient building materials, and smart building technologies. Supporting pilot projects and demonstration buildings can showcase the benefits of sustainable practices and encourage wider adoption.

2.6.3 Best Practices from Other Regions

Green Building Councils Many countries have established Green Building Councils (GBCs) that promote sustainable building practices through certification programs, advocacy, and education. For example, the U.S. Green Building Council (USGBC) and the Green Building Council of South Africa (GBCSA) have successfully advanced green building practices in their respective countries. Establishing a similar council in Ethiopia can provide a structured approach to promoting sustainability in the construction sector.

Comprehensive Green Building Policies Countries such as Germany and Singapore have implemented comprehensive green building policies that include stringent building codes, financial incentives, and public awareness campaigns. These policies have resulted in significant advancements in sustainable building practices. Adopting similar comprehensive policies in Ethiopia can create a supportive environment for green building initiatives.

Sustainable Urban Planning Cities like Copenhagen and Vancouver have integrated sustainable building practices into their urban planning frameworks. These cities have implemented policies that encourage high-density, mixed-use developments with green building features. Learning from these cities, Akaki Kality Sub-City can incorporate sustainable building principles into its urban planning to create a more sustainable and liveable environment.

2.7 Good Practices or Best Experience

This section reviews good practices and best experiences related to sustainable building projects from both developed and developing countries. These examples provide valuable insights and

lessons that can inform the promotion and implementation of sustainable building practices in the Akaki Kality Sub-City.

2.7 Developed Countries

United States: LEED Certification: The United States Green Building Council (USGBC) developed the Leadership in Energy and Environmental Design (LEED) certification, one of the most widely recognized green building certification programs globally. LEED provides a framework for identifying and implementing practical and measurable green building design, construction, operations, and maintenance solutions. LEED-certified buildings in the United States have demonstrated significant energy savings, reduced water consumption, and improved indoor environmental quality. The success of LEED has been driven by a combination of stringent standards, market demand, and government incentives, making it a model for other countries to follow.

Germany: Passive House Standard: Germany is known for its rigorous Passive House (Passivhaus) standard, which focuses on energy efficiency and building performance. Passive House buildings use significantly less energy for heating and cooling compared to conventional buildings, achieved through high levels of insulation, airtight construction, and energy-efficient windows. The success of the Passive House standard in Germany is attributed to strong regulatory support, financial incentives, and extensive training programs for architects and builders. This standard has been widely adopted in Europe and is being increasingly recognized globally for its effectiveness in reducing energy consumption and greenhouse gas emissions.

Sweden: Sustainable Urban Planning in Stockholm Stockholm's Hammarby Sjöstad is a notable example of sustainable urban development. This district integrates green building practices, renewable energy systems, and efficient waste management to create a sustainable living environment. Key features include the use of district heating, solar panels, and green roofs, as well as an emphasis on public transportation and pedestrian-friendly infrastructure. The success of Hammarby Sjöstad is due to comprehensive planning, stakeholder collaboration, and a strong commitment to sustainability from both the public and private sectors. This integrated approach serves as a benchmark for sustainable urban development.

2.7.1 Developing Countries

Different developing countries have a variety of experience in the practice of sustainable buildings. The following are some experiences:

India: India's Green Rating for Integrated Habitat Assessment (GRIHA) is a national green building rating system designed to suit the country's unique climatic conditions and development priorities. GRIHA promotes sustainable building practices by evaluating the environmental performance of buildings over their lifecycle. Successful implementation of GRIHA has been supported by government incentives, mandatory compliance for certain building types, and extensive awareness campaigns. Examples of GRIHA-certified buildings in India have shown reductions in energy and water consumption, as well as improved occupant health and comfort. This system demonstrates how localized rating systems can effectively promote sustainability in developing countries.

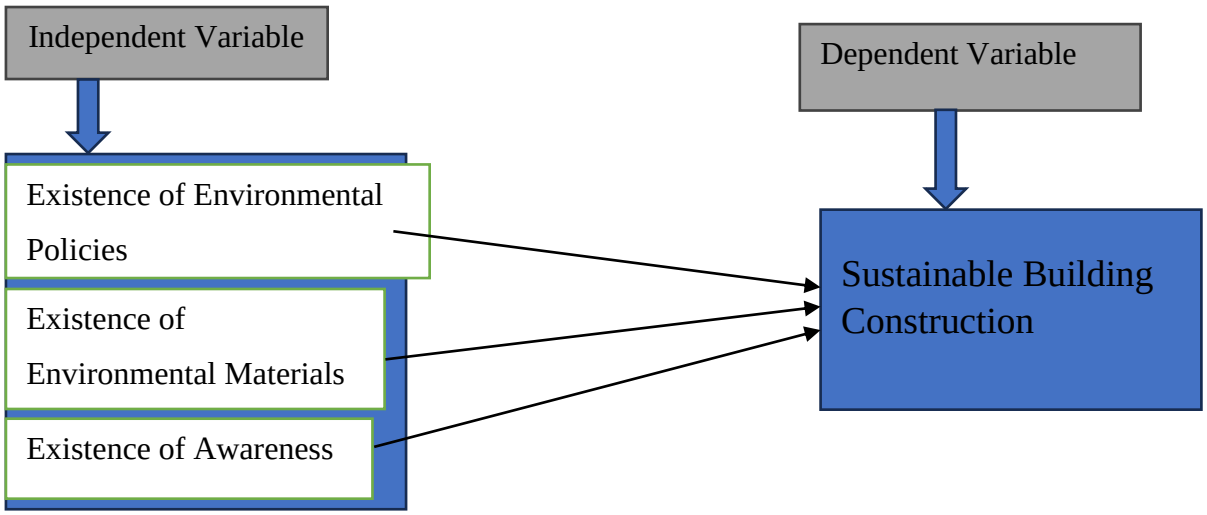
South Africa: Green Building Council of South Africa (GBCSA) The Green Building Council of South Africa (GBCSA) has been instrumental in advancing sustainable building practices in the country. GBCSA introduced the Green Star SA rating system, which assesses the environmental impact of buildings in terms of energy use, water efficiency, materials, and indoor environmental quality. Successful projects, such as the No.1 Silo building in Cape Town, have achieved significant sustainability milestones, including energy savings and reduced carbon footprints. GBCSA's efforts have been supported by government policies, industry partnerships, and educational initiatives, highlighting the importance of a coordinated approach to green building promotion.

Kenya: Adoption of Sustainable Building Materials Kenya has made strides in sustainable building through the adoption of locally available and environmentally friendly building materials. The use of stabilized soil blocks, bamboo, and recycled materials in construction projects has reduced environmental impact and construction costs. Projects such as the Eco-House in Nairobi demonstrate the feasibility and benefits of using sustainable materials. Support from non-governmental organizations, community involvement, and government policies promoting sustainable construction practices have been key factors in the success of these initiatives. This approach emphasizes the importance of context-specific solutions and local resources in promoting sustainability in developing countries.

2.8 Conceptual Framework

A theoretical model that identifies the topics being studied and their connections is called a conceptual framework. The purpose of the conceptual framework is to arrange the study's concepts and highlight conceptual differences, processes, or ideas. The independent variables in the study includes existence of environmental materials, environmental policy, and awareness and education regarding sustainable construction building. The study investigates the effect of these independent variables on dependent variable (sustainable buildings construction).

Figure 2.1 Conceptual Framework



2.9 Research Gap

Some works consider the determination of Sustainable Building Projects in different areas of Ethiopia as well as Addis Ababa. Different researchers (Abebe and Taffese, 2021; Ayele et al., 2021; Tesfaye and Gashaw, 2022) indicated that policies concentrating on energy conservation measures in buildings are beginning to have positive outcomes, particularly in terms of lowering energy prices and reducing dependency on nonrenewable energy sources. In addition, rules encouraging the use of local and eco-friendly materials have resulted in improved awareness and application of sustainable materials in construction projects, while acceptance remains variable due to compliance issues. Even if there exists extensive environmental legislation, poor enforcement and oversight prevent effective compliance, limiting the potential advantages of these policies on sustainable building practices.

The importance of using environmentally friendly materials like insulated concrete forms and energy-efficient glass in building energy efficiency was investigated by (Taffese and Moges,

2021; Taffese and Moges. 2021; Alemayehu et al., 2022). Different scholars investigated the importance of awareness and education in promoting sustainable practices throughout the construction business, influencing stakeholders ranging from government agencies to local communities (Gashaw and Getahun, 2021; Gebreegziabher et al., 2021, Daba and Abebe, 2020). These scholars indicated that improving the knowledge of stakeholders, consumers, and contractors in sustainability in the building can greatly improve stakeholders' knowledge and capacity to implement sustainable practices. However, these researches have limitations in investigating the effect of education and awareness, the existence of environmental materials, and the existence of environmental policies.

There is an absence of detailed case studies on successful sustainable building initiatives within Akaki Kality, which can serve as models for future projects. Hence, there are limited works in the Akaki-Kality sub-city that consider the effect of Environmental Policies, the Existence of Environmental Materials, and Awareness and Education on the dependent variable of Sustainable Building Construction.

3. Research Methodology

3.1 Introduction

This chapter provides an overview of the exploration methodology used in the course of this exploration process. It discusses the research area, research design, and identification of the population and the sample of the study. It also established the tool that was used in the data collection and the system of data analysis.

3.2 Description of Study Area

Akaki Kality is an area in the southern part of Addis Ababa, the capital city of Ethiopia. It is one of the ten sub-cities of Addis Ababa and is known for its diverse mix of residential, industrial, and commercial activities. Akaki Kality is located in the southern part of Addis Ababa, Ethiopia. It is bordered by other sub-cities such as Bole and Nifas- silk Lafto.

The area consists of various construction projects including residential housing developments, commercial construction works, and infrastructure including schools, health canters, religious institutions, and recreational facilities to support the community's needs. Like many parts of Addis Ababa, Akaki Kality also faces challenges such as inadequate infrastructure in some areas, traffic congestion, and limited use of sustainable construction projects. This area is selected due to the industrial zone of the city as well as the country. The ongoing construction development initiatives aim to address these issues and improve overall liveability and sustainability. However, the construction works lack sustainability due to the lack of environmentally friendly materials, awareness and education, and lack of environmental regulations and policies.

3.3 Research Design

According to Mouton J. (2001), a research design is a person's intended course of action or blueprint for conducting research. The way a researcher plans to conduct research is known as research design. The type of exploration for this study was the explanatory and descriptive type of exploration used to understand the relationship between variables and draw a better conclusion.

The descriptive research design helps in gathering information and explaining how the sustainable building construction variables affect sustainable building in further detail. This system aims to address the target of the study by probing the connection between the variables of

the study (Kothari, 2004). In descriptive research, the essential focus is to describe specific opinions and to examine the relationships and variations in the relevant variables by studying a large sample of the population Lee and Ling (2008).

Descriptive research is critical for understanding the numerous aspects that influence sustainable construction, such as legal frameworks, environmental materials (technical breakthroughs), awareness, and existing trends and issues. Researchers can collect information from a diverse range of stakeholders using descriptive approaches, including builders, architects, policymakers, and community members. This wide approach provides a more comprehensive understanding of the various aspects that drive sustainable construction, which is essential for guiding future research.

A variety of qualitative and quantitative exploration ways are used in the descriptive exploration design to gather the information that would help in directly defining an exploration problem. The descriptive exploration design aspects like the sample size concerning the target population, the variables under the study, the approaches to the exploration, and the styles employed in data collection. The major significance of descriptive research design is a description of the state of affairs as it has been at present. The study applied descriptive and explanatory research designs.

Explanatory research design refers to research that explores a certain phenomenon with the primary aim of understanding and explaining a phenomenon or situation using descriptive statistics. Explanatory research is used to get clarity and define the problem at hand clearly. An explanatory case study can be defined as the relationship between cause and effect, and clarifying how the events take place (Yin RK, 2013). According to Imas (2009), the explanatory case study investigates links among variables and usually involves multi-method considerations. In addition, it also examines processes and procedures at several places.

An explanatory research approach can help researchers establish cause-and-effect relationships, allowing them to determine which factors are the most important drivers of sustainable practices. The use of both descriptive and explanatory research approaches improves the study of factors influencing sustainable construction buildings by offering a full understanding of the issue and developing links between factors. As an explanatory study, the researcher aims to establish the relationship between the determinants of sustainable buildings and sustainable building constructions to add to the existing literature on the subject matter.

3.4 Research Approach

The study was conducted using quantitative data (formal survey) and qualitative document review components were conducted. Quantitative data is more suitable for highly structured research that may be statistically measured Bloomfield, J., & Fisher, M. J. (2019). A quantitative survey is the best choice when one is to use it for an investigation to describe the degree of relationship between the variables. Qualitative methods through interviews and focus groups discussion, can reveal nuanced views and underlying challenges and stakeholders' attitude in practice of sustainable construction buildings in Akaki-Kality sub-city.

In this study mixed research approach helps to study the factors influencing sustainable construction buildings that provide a comprehensive understanding of the topic. Since, sustainable construction is influenced by a variety of factors, including existence of environmental materials, environmental policies, and awareness aspects. Mixed methods allow for the integration of qualitative insights (stakeholder perceptions, and challenges) with quantitative data (existence of environmental materials, environmental policy, and awareness and education) providing a fuller picture by cross-validate findings. mixed methods research approach is particularly suited to exploring the multifaceted nature of research as it leverages the strengths of both qualitative and quantitative methods to generate comprehensive, actionable insights.

3.5 Population, Sample, and Saming Design

3.5.1 Population

According to Hair et al. (2010), the target population is said to be a specified group of people or objects for which questions can be asked or observed to develop required data structures and information. The study population for this research was selected among the ongoing building projects in the Addis Ababa Akaki Kality sub-city during the research period. According to the data from the Addis Ababa City Administration Building permit and control authority, there are about 20 private building construction projects. From 13 sites respondents were selected in the form of clients (including building owners), contractors and consultants registered with the sub-city building permit authority office, construction offices in the Sub-city and Wereda level, such as construction managers and team leaders, employees/technical experts made up of

civil/construction engineers, architects, designers, financial analysts, quantity surveyors, and sanitary engineers.

3.5.2 Sampling Technique and Sample Size

In 2023 G.C, there were 172 employees both from the Akaki Kality sub-city and the corresponding woreda construction offices. Additionally, 55 contractors and 58 consultants who were registered and had gotten their construction permits from the mentioned sub-city were presently working on the Akaki-Kality Sub-city, depending on the size of the projects. The sample size of target sites was determined by using the following formula as used by different researchers (Hassanein & Hanna, 2008).

$$n = \frac{n'}{1+\frac{n'}{N}} - - - - - - - - - - - eq\ 3.1$$

Where; n′ is the sample size from a finite population, which can be calculated using

n'$= s^2/v\text{^}2 - - - - - - eq$ 3.2

Where

V: Standard error of sample population equals 0.05 for the confidence level 95 %=1.96

S: Standard error variance of population elements, where $s^2 = (1 - P)$; maximum at $P = 0.5$

n: sample size from finite population

N: Total population (20 active private construction building projects at the time of study)

$$n' = \frac{s^2}{v^2} = \frac{(0.5)^2}{0.05^2} = 100$$

The sample size was calculated as

$$n = \frac{n'}{1+\frac{n'}{N}} = \frac{100}{1+\frac{100}{20}} = 16.66 \sim 17$$

Seventeen (17) sites therefore should be studied. However, due to time and budget constraints, this research paper purposively selected 13 sites from the 17 sites. The selection criteria are based on the distance from the researcher, the activeness of the project, and others. On each site; an average of 5 questionnaires were distributed randomly to site workers in the form of clients, civil engineers, architects, designers, financial analysts, and contractors. Therefore, a total of 60

questionnaires were distributed.

3.5.3 Sampling Techniques

Two broad categories of sampling designs are probability and non-probability sampling designs. From these, the researcher employed a non-probability sampling approach. Purposive sampling method from the non-probability sampling approach. For this study, the purposive sampling technique was used for the group of employees to select. A purposive sample refers to the selection of units based on personal judgment rather than randomization (Tongco, M. D. C., 2007). The purposive (non-probability) sampling technique may be used with both qualitative and quantitative research techniques and is most effective when one needs to study a certain cultural domain with experts within. According to Tongco, M. D. C. (2007), choosing the purposive sample is fundamental to the quality of data gathered; thus, the reliability and competence of the informant must be ensured. To get the right response from respondents, and increase the quality of data this research paper employs a purposive sampling method.

This research article employs purposive sampling because the primary goal of this study is to gather in-depth information from certain populations with specific knowledge connected to sustainable construction in order to yield deeper insights into the complexity and nuances of sustainable practices. This may comprise architects, engineers, project managers, and sustainability consultants. Purposive sampling is especially well-suited for study on the factors influencing sustainable construction buildings because it allows for the inclusion of relevant expertise, various views, and detailed data, all of which are essential for comprehending complex phenomena.

3.6 Data Sources and Types

3.6.1 Primary Sources

The researcher used primary data to get a picture of the present situation regarding the determinants of sustainable building construction. Accordingly, primary data was collected from the Employees of the construction sites by using a structured questionnaire.

3.6.2 Secondary Sources

In addition to primary sources, the researcher used secondary data such as relevant journal articles, books, and the Internet. Secondary sources of data were also used to support the primary sources of data. The secondary data were formerly collected by someone other than the

investigator himself, and as such the problems associated with the original collection of data don't arise then. The Secondary data was collected from the reports and other relevant documents to obtain qualitative data regarding the determinants of sustainable building construction practices in Akaki-Kality. Moreover, primary data was collected to obtain quantitative data regarding sustainable building construction.

3.7 Methods of Data Collection

3.7.1 Questionnaire

This study was conducted and evidence was collected from the primary data sources. On data collection methods five-point Likert scale standard questionnaires were prepared in English. The questionnaire used in this study was chosen as the means of gathering data from participants to verify the hypothesis. All the required permissions were taken from the construction sites for conducting the survey. After all the procedures, the questionnaires were distributed and the respondents filled them out. The responses of the respondents were measured using a five-point Likert scale. The questionnaire was divided into 2 sections namely 1, and 2. Section 1 of the questionnaire collected the socio-demographic information of respondents. Section 2 of the questionnaire addressed the objective of the study which assesses the determinants of sustainable building construction variables such as sustainable building construction (dependent variable), and independent variables such as awareness and education, environmental materials, and environmental policies. This questionnaire presented statements about the determinants of sustainable building constructions which the respondents are supposed to rate on a scale of 1 to 5 rated from 1=strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=strongly agree.

3.7.2 Interviews

The data were collected using questionnaires and close-ended interviews. Interviews were conducted with sample respondents to clear points and get their full understanding and challenges regarding the determinants of sustainable building construction in the Akaki Kality sub-city.

3.7.3 Direct Observation

In addition to questionnaires and interviews, the researcher made a direct observation. A direct observation was made for different reasons i) to establish criteria for what qualifies a building project as sustainable (e.g., energy efficiency, water conservation, use of sustainable materials,

waste management, social equity), and ii) to create a list of building projects currently underway, recently completed, or planned within Akaki Kality Sub-City using site visit. The observation helps to collect quantitative data like gathering data on the number of sustainable practices implemented (e.g., percentage of recycled materials used), and qualitative data like analyzing notes and interviews for themes and insights regarding community perception and satisfaction with the projects.

3.8 Methods Data Analysis and Presentation

The data collected were analysed through a quantitative type of explanatory analysis method. Both descriptive and inferential statistics were applied in the study. Descriptive statistics helped the researcher to summarize and present the data in statistical arrangement. Given that, statistical techniques such as mean, frequency, and standard deviation were used to analyze and describe the data and also to interpret the results accordingly.

In addition, inferential statistics has been used to allow the researcher to facilitate the identification of important patterns, to identify the possible associations among variables, to evaluate the extent of the determinants of sustainable building constructions, and also to make the data analysis more meaningful and utilized SPSS Version 26 shall be used to encode and analyzed the data. The descriptive statistics were discussed based on frequency tables to provide information on the demographic variables.

3.8.2 Model Specification

Based on the conceptual framework of the study, the following Regression model was developed. Thus, parameters for the following functional relationships were estimated using the Regression model. Regression is opposed to other techniques as it is a widely accepted model in many of the studies carried out on innovative product adoption (Alireza et al., 2010; Alenezi et al., 2010). Regressing the dependent variable over independent variables helps to know the impact of each independent variable on the dependent variable. Moreover, the significance of each of the independent variables was determined based on their p-values. According to the coefficients of each of the independent variables, the use of the financial performance was determined as follows. Based on the above information, the Regression model was education and awareness (EA), Environmental Policies (EP), Environmental Materials (EM), and the dependent variable (Sustainable Buildings).

SB=f (EA, EP, EA)

Y(Sustainable Building)=α+β1EP+β2EM+β3EA+ε

Where:

SB--------->Sustainable Building,

α----------> Intercept value of the regression surface,

EA----------> Education and Awareness

EP---------> Environmental Policies

EM--------> Environmental Material,

ε ----------> Error term for any missing variable in the behavior of the human account.

3.8.1 Level of Significance

The level of Significance In this study was 5% which means that all statistical tests were done and compared against the 5% level of significance.

3.9 Data Quality Assurance

3.9.1 Validity

The researcher consulted the to determine whether there was a causal relationship between the study's independent and dependent variables to test the validity of the study's instrument. As advised by Greener (2008) to improve the questionnaire's face validity and entice and motivate respondents to engage in the study, the researcher self-administered the questionnaire and explained the instrument's concepts to the respondents.

The questionnaires were derived from various journal articles, and to test their validity, the researcher distributed five of the questionnaires as part of a pilot study. This allowed the researcher to identify any discrepancies between the research instruments and the research questions and techniques, which were then corrected and modified. Improvements were made based on the results of the pilot test, and it was ultimately determined to be valid and dependable. Cronbach's alpha was used to assess the data's reliability.

3.9.2 Reliability Analysis

Reliability measures consistency in producing similar results on different but comparable occasions. If research is said to be reliable that means if it is replicated, similar or identical results are shown. If researchers know that their research is reliable then there is less risk of their taking a

chance pattern or trend exhibited by their sample and using it to make assumptions about the population as a whole Churton& Brown (2017).

Cronbach's Alpha (a) was conducted to test the reliability of the instrument, since it is the most common measure of scale, Cronbach's Alpha (a) greater than 0.600 is very acceptable (Cronbach's, 1951). According to Cohen and Sayag, (2010), also states that Cronbach's Alpha (a) greater than 0.700 is very acceptable. According to Nunnaly (1978), the minimum acceptable level of Cronbach's alpha is 0.7. In other words, data was collected through an instrument whose Cronbach's alpha value is equal to or greater than 0.7 and meets the minimum standard for internal consistency. The researcher has undertaken a reliability analysis for the Linkert scale questionnaire the numbers of items considered in the analysis are the variables and the Cronbach's Alpha result shows it is reliable. So, the result of Cronbach's alpha depicted that there is no internal consistency among the questions developed and distributed and there are reliable to predict the relationship between the dependent variable and the predictors besides the Cronbach's alpha with the value 0.918 assured us this.

3.10 Ethical Consideration

Ethics is one of the major considerations in research. The researcher of this study was subject to ethical considerations, such as, the research work was started after getting the willingness of the study organization by providing the letter of request for cooperation obtained from Addis College; the respondents were informed about the objective of the research before they are asked to give their answer; the respondents were assured that there will be of no any risk come on to them, because of the study and results of the study; and respondents were not asked of their personal information like their name, race, religion or other related private information.

4. Result and Discussion

4.1 Introduction

This chapter explores the use of the Statistical Package for the Social Sciences (SPSS) for data display and analysis, which is a crucial component of our thesis. To obtain significant insights, validate research hypotheses, and reach conclusions, data must be presented clearly and thoroughly. We can have a thorough grasp of the research objectives by using this chapter as a link between the data collection phase and the interpretation of findings.

The main goal of data presentation is to logically arrange, condense, and visually depict the information that has been gathered. This makes it easier to communicate complex material simply and succinctly, which promotes a deeper comprehension of the research topic. Effective data presentation strategies can make the study findings more credible and persuasive, making it easier for the audience to understand the underlying patterns and trends.

4.2 Questionnaire Response

The quality of respondents and their response rates to questionnaires are important factors in determining how reliable and successful the data collecting is. Although a well-crafted questionnaire might provide insightful information, its real worth is found in the caliber of the answers it receives. The quality of a respondent is based on several characteristics, including their willingness to answer thoughtfully and accurately, their comprehension of the questions, and their memory of pertinent details. To produce a representative sample of respondents, it is imperative to employ appropriate sampling strategies, such as random selection and representation of varied demographics. Additionally, clear instructions, adequate phrasing of questions, and effective data validation techniques add to the overall quality of the responses, ensuring that the collected data is dependable and suitable for analysis and decision-making purposes.

4.2.1. Questionnaire Response Rate

The result provides an insight into the distribution and response rates of questionnaires among different groups. Out of the total 60 questionnaires, 53 questionnaires were returned. This indicated that 88.33% of the distributed questionnaires were returned. Whereas, the unresponsive

rate was found to be 7(11.77%). Among the 53 returned questionnaires, 16(30.18%) of them were successfully filled and returned by contractors. Similarly, 12(22.64%) questionnaires were filled and returned by consultants. The remaining questionnaires were returned by project managers, Architects, and Technical Experts constituting 9(16.98%), 7(13.207%), and 9(16.98%) respectively. Table 4.1 shows the returned questionnaires among different positions.

Table 4.1 Returned questionnaires among different job positions

Position held by respondent			
		Frequency	Percent
Valid	Engineer (Contractor)	16	30.18
	Consultants	12	22.64
	Project Manager	9	16.98
	Architects	7	13.2
	Technical Experts	9	16.98
	Total	**53**	**100.0**

4.2.2. The Respondents' Educational Background

This research paper constitutes different respondents from different educational backgrounds. Based on the data collected from the questionnaires, it is evident that out of a total of 53 respondents, the distribution of educational qualifications varied significantly. The respondents included individuals with diverse educational backgrounds. Table 4.2 indicates that none of the respondents held a PhD, suggesting that the sample lacked individuals with the highest level of academic achievement and specialization in a particular field. MSc/MBA degree holders accounted for 20 respondents, making up 37.73% of the total. BSc/BA degree holders comprised the largest group, with 28 respondents, representing 52.8% of the sample. Those with a diploma and others constituted the majority, with 5 respondents, making up 9.433% of the total. Overall, the majority of respondents possessed a first degree, while the smallest proportion had a Diploma degree or a PhD. Figure 4.1 shows the percentage of the level of education of respondents. It indicates that half of the respondents to the questionnaires were holders of first-degree holders.

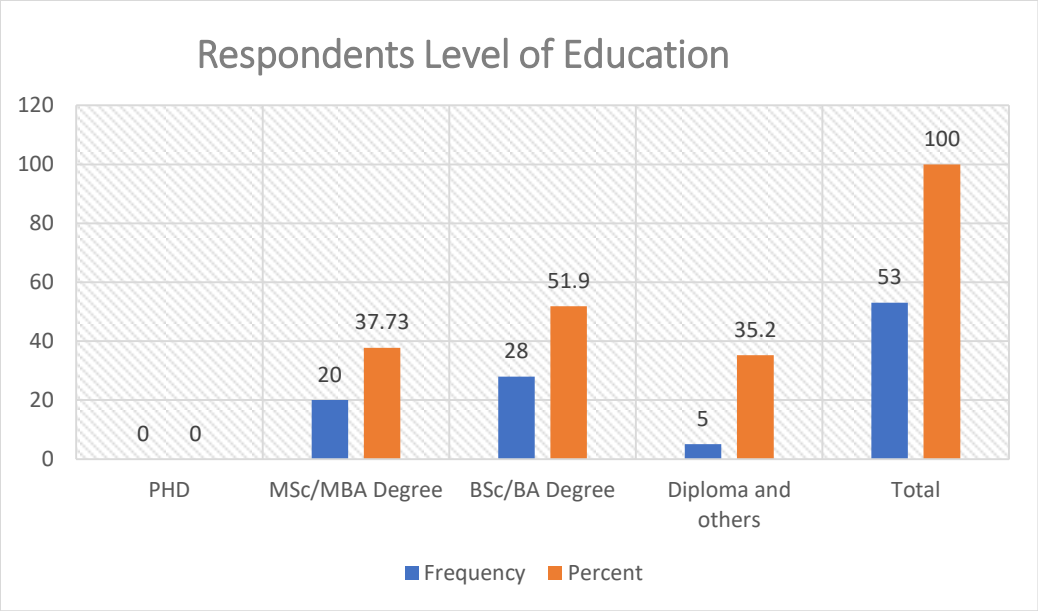


Figure 4.1 Respondents' level of education

4.2.3. The Work Experience of Respondents

53 people in total responded to the survey; the results are displayed in Table 4.3. Roughly 14(26.415%) of the total respondents, indicated that they had fewer than 6 years of service experience. Of the respondents, 16(39.622) individuals selected the 6-10 years' experience. Furthermore, nine people, or roughly 16.98% of the sample stated that they had served for eleven to fifteen years. Lastly, five respondents 6(11.32%), and 3(5.66%) of the sample have 16-20, and above 21 years of work experience. These results offer insightful information on the survey respondents' distribution of service years, which helps to clarify the group's makeup and experience levels. These findings show a wide variety of service years. Table 4.3 shows the work experience of respondents in the study.

Table 4.2 Work Experience Characteristics of Respondents

Variable	Characteristics of Respondents	Frequency	Percentage (%)
Work experience	Below 6 Years	14	43.39
	6-10 Years	21	30.18
	11-15 Years	9	16.98
	16-20 Years	6	9.43
	Above 21 Years	3	5.66
	Total	**53**	**100**

4.3 Reliability Result

The Cronbach's alpha testing model has been used for the internal consistency test. As a result, the total scale dependability of this study is 0.6964, which is nearly equal to or more than 0.700, as shown in the table above. According to Sekaran (2006), a Cronbach's alpha value of 0.7 serves as a benchmark for approving or disapproving reliability. The outcome thus demonstrates the excellent reliability of the study's Cronbach's alpha coefficient. The reliability result in this study was found to be .811 which is greater than the benchmark (0.7). Hence, the responses are reliable. The reliability of the questionnaire administered using SPSS version 26 is displayed in Table 4.4 below.

Table 4.3 Reliability Result

Category	**Reliability Statistics**	
Independent Variables	**No of Items**	**Cronbach's Alpha**
Environmental Material	10	.834
Environmental Policy	8	.827
Awareness and Education	9	.772
Overall Reliability		**.811**

As indicated in table 4.4, for sustainable building project indicators, the existence of environmental materials, environmental policies, and awareness and education factors Cronbach’s alpha results in .834, .824, and .7722 respectively. All items which exceed 0.7,

indicate good reliability. In short nuts, the responses generated for the dependent variable (sustainable construction buildings) and independent variables (existence of environmental materials, conforming of environmental policies, awareness, and education factors) used in this research indicate good reliability enough for data analysis.

4.4 Descriptive Statistics of Sustainable Construction Building

Table 4.5 indicated below shows the descriptive statistics of sustainable construction building. As indicated in the table and taking 3.0 as a mid-point, a mean of 3.58(SD=1.420) respondents agreed on the effect of environmental policy on sustainable construction buildings. This indicated that there is a significant agreement on effect of environmental policy on sustainable construction. Regarding effect of environmental material and awareness a mean of 3.90(SD=3.1.0381), and 3.62(SD=1.060) respondents agreed. The result indicated that there is a significant agreement on effect of these variables. The results indicated that the existence of supportive environmental regulations and policies, existence of environmental materials, and existence of awareness on the importance sustainable construction building determine the practice of sustainable construction buildings. The overall mean of 3.70 respondents agreed on the effect of these variables on practice of sustainable construction buildings. Table 4.5 below shows descriptive statistics of sustainable construction building.

Table 4.4 Descriptive Statistics of Sustainable Construction Building

Descriptive Statistics			
	N	Mean	Std. Deviation
Effect of Environmental Policy on Sustainable Building	53	3.58	1.420
Effect of Environmental Material on Sustainable Building	53	3.90	1.0381
Education and Awareness on Sustainable Building	53	3.62	1.060
Overall mean	**53**	**3.70**	

4.5 Descriptive Analysis of Independent Variables

4.5.1 Descriptive Analysis of Effect of Environmental Policy on Sustainable Buildings

Regarding the effect implementation of stringent policies on the sustainability of construction buildings, and in the reduction of the carbon footprint of construction projects mean of (mean=3.58, SD=1.365), and a (mean of 3.60, SD=1.446) respondents agreed respectively. This indicated that environmental policies positively affect the construction of sustainable buildings and the reduction of carbon emissions. This is due to these regulations guiding the use of recycled or rapidly renewable resources, promoting practices that minimize waste generation, encourage recycling and reusing materials, and lead to less landfill waste. Hence, regarding the role of environmental policies in promoting the use of renewable energy sources in construction projects a mean of 3.34 respondents agreed respectively.

Environmental policies help in creating healthier and more comfortable indoor environments in buildings. Regarding this issue, a mean of (mean=3.38, SD=1.319) respondents agreed. This is due to these regulations often setting limits on indoor air pollutants, which helps to reduce the concentration of harmful substances such as volatile organic compounds (VOCs), and carbon monoxide, and encourage the use of eco-friendly and non-toxic building materials. Hence, these regulations lead to healthier air for occupants.

Regarding the priority of compliance with environmental regulations for construction companies, and the importance of investing in sustainable construction technologies a mean of 3.49 (SD=1.463) and 3.89 (SD=1.249) respondents agreed respectively. This means that providing standards with energy efficiency standards, the use of eco-friendly materials, and standards on water and air quality is important and should be given priority. The overall mean regarding the existence of environmental policy a mean of **3.683** respondents agreed. This needs investment by the government and private organizations in building sustainable construction technologies. Table 4.6 shows descriptive statistics of environmental policy.

Table 4.5 Descriptive Statistics of Environmental Policy

Descriptive Statistics			
	N	Mean	Std. Deviation
The implementation of stringent environmental policies positively impacts the sustainability of construction buildings.	53	3.58	1.365
Environmental regulations help in reducing the carbon footprint of construction projects.	53	3.60	1.446
Environmental policies play a crucial role in promoting the use of renewable energy sources in construction projects.	53	3.34	1.192
Environmental policies help in creating healthier and more comfortable indoor environments in buildings.	53	3.38	1.319
Compliance with environmental regulations should be a priority for construction companies.	53	3.49	1.463
Investing in sustainable construction technologies is a wise decision for future-proofing buildings	53	3.89	1.249
Environmental policies encourage innovation and creativity in the construction industry.	53	4.17	1.069
Building designs that adhere to environmental standards enhance property value and attract more tenants.	53	4.02	1.152
Overall Mean	**53**	**3.683**	

4.5.2 Descriptive Analysis of Effect of Environmental Materials on Sustainable Buildings

The availability of environmentally friendly materials is a key factor in promoting the sustainability of construction buildings. Regarding the availability of eco-friendly materials, and the importance of using environmentally-friendly materials in construction for reducing carbon footprint a mean (mean=3.72, SD=1.231), and (mean=3.45, SD=1.030) respondents agreed respectively. This means that the availability of eco-friendly materials helps to i) lower carbon footprint compared to traditional materials, ii) enhance the energy efficiency of buildings, and iii) drive market demand for sustainable construction practices. Regarding the importance of sustainable construction practices by using environmental materials for a greener future, and to

the overall energy efficiency and performance of sustainable buildings, a mean of 3.57(SD=1.337) and 3.08 (SD=1.591) respondents agreed respectively.

Incorporating environmental materials into construction projects has enormous benefits for instance it can lead to long-term cost savings and benefits (mean=3.62, SD=1.333). To attain these benefits i) governments and regulatory bodies should promote the use of environmental materials in construction through incentives and policies (mean=3.62, SD=1.274), and ii) individuals should support a construction project that uses environmental materials compared to traditional materials (mean=3.55, SD=1.264). Generally, Policies encourage the use of sustainable materials, such as recycled or rapidly renewable resources, reducing the environmental impact of extracting new materials. In general, a mean of 3.51 respondents agreed on the importance of the existence of environmental materials for sustainable building construction projects in the study area. Table 4.7 indicates the descriptive statistics of the existence of Environmental Material in the study area.

Table 4.6 Descriptive Statistics of Environmental Material

Descriptive Statistics			
Statements	N	Mean	Std. Deviation
The availability of environmental materials significantly impacts the sustainability of construction buildings.	53	3.72	1.231
Using environmentally-friendly materials in construction is important for reducing the carbon footprint of buildings.	53	3.45	1.030
Sustainable construction practices, which include the use of environmental materials, are essential for a greener future.	53	3.57	1.337
The increased availability of environmental materials makes it easier for construction companies to adopt sustainable practices.	53	3.47	1.353
Environmental materials contribute to the overall energy efficiency and performance of sustainable buildings.	53	3.08	1.591
Incorporating environmental materials into construction projects can lead to long-term cost savings and benefits.	53	3.62	1.333

I would be more likely to support a construction project that uses environmental materials compared to traditional materials.	53	3.55	1.264
Governments and regulatory bodies should promote the use of environmental materials in construction through incentives and policies.	53	3.62	1.274
Overall Mean	**53**	**3.51**	

4.5.3 Descriptive Analysis of Effect of Awareness on Sustainable Buildings

Education and awareness regarding sustainable construction buildings can significantly help in numerous ways. i) it leads to reduced energy consumption in buildings (mean=3.40, SD=1.405), ii) it positively impacts the longevity of sustainable construction buildings (mean=3.66, SD=1.3300), iii) helps to minimize the carbon footprint of buildings (mean=3.58, SD=1.420), iv) essential for creating a more sustainable future (mean=3.00, SD=1.581), v) help to reduce waste generation during the construction process (mean=.3.02, SD=1.407), vi) it leads to innovation in sustainable construction practice (mean=3.36, SD=.982), and it increases the demand for sustainable buildings in the market (mean=3.08, SD=1.053) respondents agreed respectively. Hence, to get these significances, it is important to increase awareness regarding sustainable building certification by attending LEED and BREEAM certifications (mean=3.62, SD=1.060). The knowledge and awareness about sustainable construction can influence decision-making processes in building design and construction. Generally, regarding the significance of awareness and education on the practice of sustainable construction buildings in the study, there is a mean of 3.444 respondents' agreement. Table 4.8 shows descriptive statistics of awareness and education on sustainable construction building.

Table 4.7 Descriptive Statistics of Education and Awareness

Descriptive Statistics			
	N	Mean	Std. Deviation
Education and awareness about sustainable construction practices can lead to reduced energy consumption in buildings.	53	3.40	1.405
Knowledge about sustainable materials can positively impact the longevity of sustainable construction buildings.	53	3.66	1.300
Awareness of environmentally friendly construction techniques can help minimize the carbon footprint of buildings.	53	3.58	1.420
Education on sustainable construction practices is essential for creating a more sustainable future.	53	3.00	1.581
Increased awareness of sustainable building certifications such as LEED or BREEAM can lead to more sustainable construction practices.	53	3.62	1.060
Knowledge about sustainable construction can influence decision-making processes in building design and construction.	53	3.38	1.244
Education and awareness about sustainable construction can help reduce waste generation during the construction process.	53	3.02	1.407
Increased awareness of green building technologies can lead to innovation in sustainable construction practices.	53	3.36	.982
Awareness of the benefits of sustainable construction can lead to increased demand for sustainable buildings in the market.	53	3.08	1.053
Overall Mean	**53**	**3.344**	

4.6 Correlation

A correlation coefficient expresses quantitatively the magnitude and direction of the linear relationship between two variables, Pearson correlation coefficient reveals the magnitude and direction of relationships and the intensity of the relationship (-1 to1). In this section, a correlation analysis was done to establish whether relationships exist between sustainable building construction in the Akaki Kality sub-city and explanatory variables; Environmental Policies, Environmental Material, education, and Awareness. The results would enable the researcher to determine the regression on the dependent variable. The researcher used one of the most commonly used types of correlation coefficient which is the Pearson correlation coefficient method because of the statistical accuracy that usually results from this method to determine whether there are significant relationships between the dimensions of sustainable building

construction. The following Pearson's Product Moment Correlation Coefficient relationship was computed.

The relationship between Environmental Policies and Sustainable building construction.

The relationships between the Existence of Environmental Material and Sustainable building construction.

The relationship between Awareness and Education and Sustainable building construction. Table 4.9 show correlation result of the study.

Table 4.8 Correlation Result

Correlations					
		Mean Environmental Policy	Mean Environmental Material	Mean Education and Awareness	Mean of Sustainable Building
Mean of Sustainable Building	Pearson Correlation	.768**	.833**	.895**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	53	53	53	53
**. Correlation is significant at the 0.01 level (2-tailed).					

According to Pallant (2013), the strength of the relationship between variables is comprised of -1 to and 1 When the relation equals zero it means that there is no relation at all. When it is on the negative side, it means that this relationship is negatively impacting the dependent variable. However, when it goes to +1, this relation means that it is impacting positively the variable. In general, when the correlation is .10 to .29, this correlation is small. When the correlation is between .30 to .49 it means that this correlation is medium finally when the Pearson correlation is ranged from .50 to 1.0; it means that this correlation is large or strong. This research paper used Pearson correlation coefficients r and P-value to test the hypothesis whether to accept or reject the hypotheses.

There is a significant positive correlation between Environmental Policy with Sustainable Building ($r = .768$, $p=.000<.05$), indicating that enforcing environmental policies, standards,

regulations practices enhance sustainable building construction. The correlation between environmental policy and sustainable building is a synergistic relationship where effective policies drive the adoption and implementation of sustainable practices in the construction industry. By establishing guidelines, providing incentives, and promoting accountability, environmental policies play a pivotal role in fostering a built environment that is sustainable, efficient, and healthy for its occupants and the surrounding ecosystem. This correlation ultimately contributes to a more sustainable future, addressing the urgent challenges posed by climate change and environmental degradation.

Table 4.9 demonstrated that there is a strong positive correlation between the existence of environmental materials and sustainable building construction (r = .833, p =.000<=.005) indicating that the existence of environmental materials highly improves the construction of sustainable buildings in multiple dimensions. The availability of eco-friendly materials not only facilitates the adoption of sustainable practices but also enhances environmental performance, economic viability, and community well-being. As demand for sustainability continues to grow globally, the interplay between environmental materials and sustainable construction will likely become increasingly significant, driving innovation and improving the built environment.

As shown in Table 4.9 there is a strong positive correlation between awareness and education, and sustainable building construction (r=.895, p=.000<=0.05). The positive correlation between education level and adoption of sustainable practices indicates that more educated professionals are likely to adopt these practices. Practice of sustainable building construction requires a knowledge, understanding, and public consciousness about sustainability's impact on construction practices, design choices, and the adoption of eco-friendly technologies. This knowledge acquired through participation in awareness programs significantly influences adoption rates, suggesting that outreach efforts can enhance sustainability in construction. Generally, the analysis emphasizes the importance of environmental policies, the existence of environmental materials, and knowledge and awareness on sustainable building construction, in improving the practice of sustainable building construction.

4.7 Assumptions

Meeting the assumptions of regression analysis is necessary to confirm the obtained data. Truly represented the sample and the researcher has obtained the best results (Hair et al., 1998).

Three assumptions for regression analysis used in this study were discussed for the individual variables: multicollinearity, linearity, and Normality. In the following paragraphs, each The assumption is explained.

4.7.1 Multicollinearity

in multiple regression analysis, multicollinearity refers to the correlation among the independent variables (Anderson et al., 2011; Hair et al., 2006). Multicollinearity is a potential problem if the absolute value of the sample correlation coefficient exceeds 0.7 for any two of the independent variables, (Anderson et al., 2011). Hair et al. (2006) argued that a correlation coefficient below 0.90 may not cause serious multicollinearity problems, as cited by Muhammed (2012). Multi-collinearity can also be detected using tolerance value and variance inflator factor (VIF) value. An insignificant tolerance value point to the variable under discussion is almost a perfect linear combination of the independent variables already in the equation and should be dropped out from the equation. In regression, multi-collinearity occurs when independent variables in the regression model are more highly correlated with each other than with the dependent variable when the independent variables in the regression model are highly correlated with one another; they are measuring the same thing. In other words, when two variables are highly correlated, they both communicate essentially similar information. One way to assess multi-collinearity is to examine correlations among the independent variables. If a correlation matrix demonstrates correlations of 0.90 or higher among the independent variables, there may be a problem with multicollinearity. Multi Collinearity does not exist among all the independent variables provided that the tolerance value of all the independent variables was greater than 0.1 and the VIF values of all the independent variables are also less than 10. As you can see from the table below all independent variables are greater than 0.1 and the VIF value of all the independent variables is also less than 10.

Table 4.2 Multicollinearity Result

Coefficients			
Model		Collinearity Statistics	
		Tolerance	VIF
1	Mean Environmental Policy	.353	2.831
	Mean Environmental Material	.276	3.630
	Mean Education and Awareness	.232	4.310

a. Dependent Variable: Mean of Sustainable Building

4.7.2 Linearity Assumption

The linearity of the relationship between the dependent and independent variables represented the

The degree to which the change in the dependent variable is associated with the independent variable (Hair et al., 1998). In a simple sense, linear models predict values falling in a straight line by having a constant unit change (slope) of the dependent variable for a constant unit change of the independent variable (Hair et al., 1998). Malhotra et al. (2007 as cited in Devika, 2012) discussed that conventional regression analysis will underestimate the relationship when nonlinear relationships are present, i.e., R2 underestimates the variance explained overall and the betas underestimates the importance of the variables involved in the non-linear relationship. To test this assumption, we need to examine the bivariate correlation for each pair of variables to make sure that we do not detect any non-linear correlation. To determine whether the relationship between the dependent variable: sustainable building constructions, and independent variables: environmental policies, environmental materials, awareness, and education is linear; plots of the regression residuals through SPSS software were used.

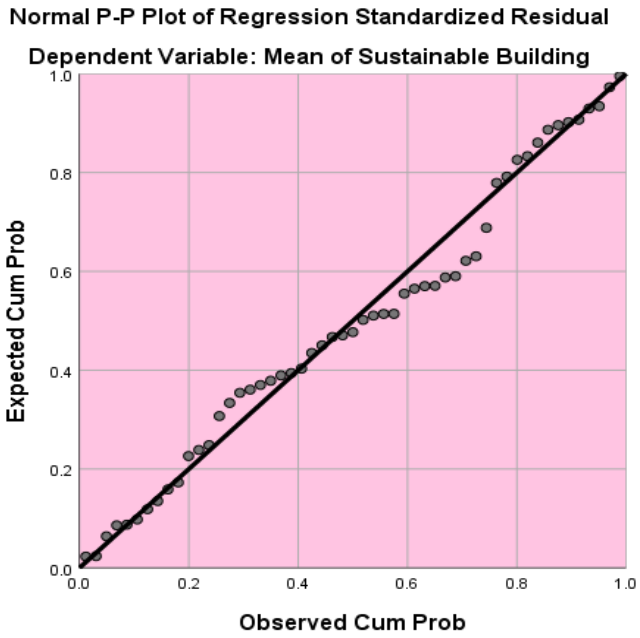


Figure 4.2 Linearity P-Plot

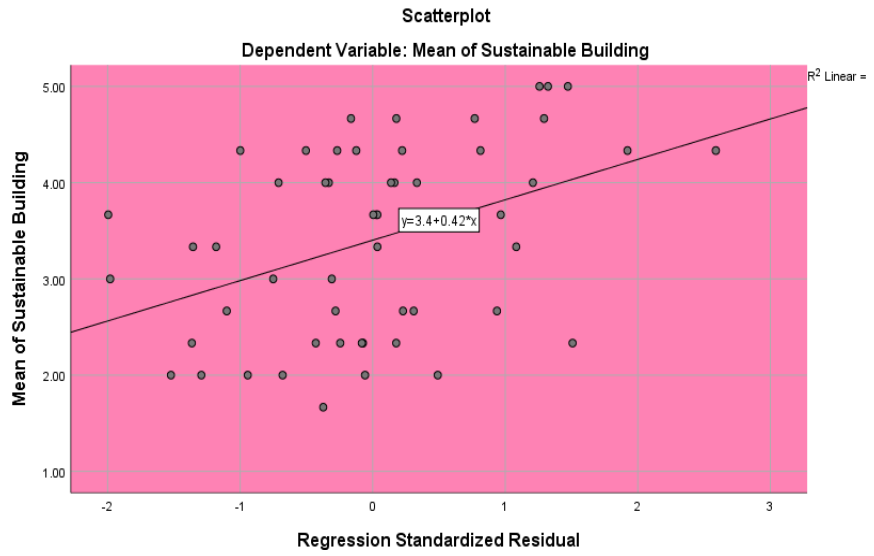


Figure 4.3 Scatter Plot

As we can see from Figures 4.2, and 4.3 above, the model follows the assumption of linearity or there is linearity between a dependent variable and independent variables. To see the linearity between each dependent variable (sustainable building construction), and independent variables: environmental policies, environmental materials, awareness, and education linear refer to the appendix attached at the back.

4.7.2 Normality Test

In terms of this assumption, a check for normality of the error term is conducted by a visual Examination of the normal probability plots of the residuals. Malhotra et al. (2007) propose that normal probability plots are often conducted as an informal means of assessing the non-normality of a set of data. According to Hair et al. (1998), the plots are different from residual plots in that the standardized residuals are compared with the normal distribution. In general, the normal distribution makes a straight diagonal line, and the plotted. Residuals are compared with the diagonal (Hair et al., 1998). If a distribution is normal, the residual line will closely follow the diagonal (Hair et al., 1998). Malhotra et al. (2007) explain that the "correlation coefficient" will be near unity if the data fall nearly on a straight line. The "correlation coefficient" will become smaller if the plot is curved.

The normality probability plots were plotted to assess normality. The P-P plots were approximately a straight line instead of a curve. Accordingly, the residuals were deemed to have a reasonably normal distribution, as suggested by Hair et al. (1998). The Skewness value indicates the symmetry of the distribution while kurtosis provides information about the peak of the distribution. A positive Skewness value indicates a right (positive) skew while a negative value indicates a left (negative) skew. The higher the absolute value is the greater the skew (Tabachnick & Fidell, 2001).

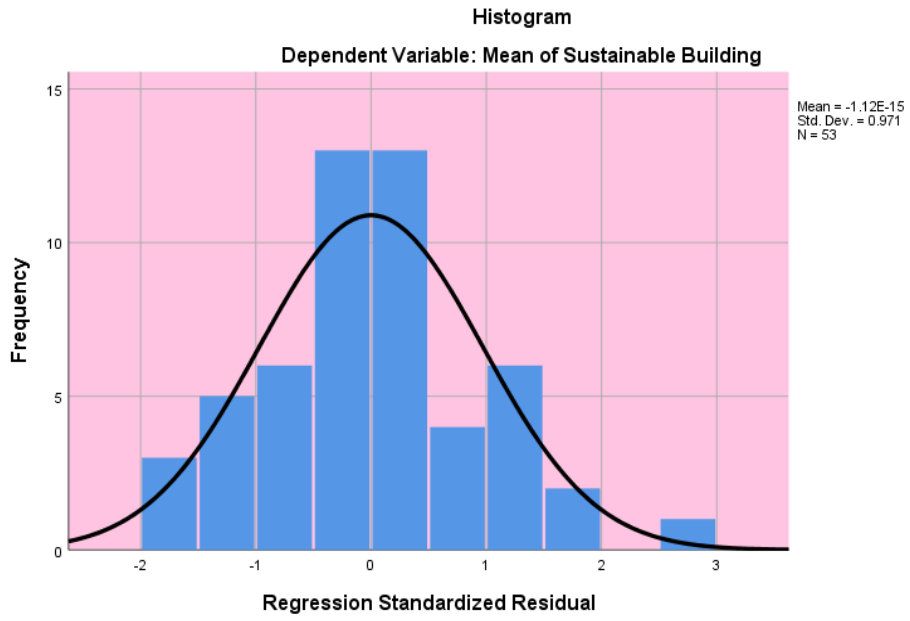


Figure 4.4 Normality Plot

As we can see from Figure 4.4 above, shows the frequency distribution of the standardized residuals compared to a normal distribution. As you can see, although there are some residuals (e.g., those occurring around 0) that are relatively far away from the curve, many of the residuals are fairly close. Moreover, the histogram is bell-shaped which leads to inferring that the residual (disturbance or errors) are normally distributed. Thus, no variations of the assumption normally distributed error terms. Thus, from an examination of the information presented in all three tests, the researcher concludes that there are no significant data problems that would lead to say the assumptions of Classical linear regression have been seriously violated.

4.7.3 No Auto Correlation Test

The degree of similarity between a particular time series and a lagged version of itself over subsequent time intervals is represented mathematically by autocorrelation Smith, T. (2023, March 20). The Durbin-Watson test is the most widely used technique to measure test autocorrelation. A statistic called Durbin-Watson is used to identify autocorrelation in regression analysis Smith, T. (2023, March 20). Because the existence of one does not necessarily indicate the occurrence of the other, autocorrelation is problematic Smith, T. (2023, March 20). Because autocorrelation denotes a lack of independence between variables, it presents a challenge for the majority of statistical tests. The Durbin-Watson test of the study variables is displayed in Table 4.11 below.

Table 4.10 No autocorrelation test

Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.909[a]	.827	.816	.41986	2.157
a. Predictors: (Constant), Mean Education and Awareness, Mean Environmental Policy, Mean Environmental Material					
b. Dependent Variable: Mean of Sustainable Building					

The output of the Durbin-Watson test ranges from 0 to 4. According to the Durbin Watson test, if the Durbin Watson (D.W) coefficient value in the model summary table:

D.W value is closer to 2 suggesting that the regression model has no autocorrelation

D.W value closer to 4 suggests that the regression model has a negative autocorrelation exists, and

D.W value closer to 0 suggests that the regression model has a Positive autocorrelation

In our study the Dubin Watson (D.W) value (1.996) is very close to 2, Hence, our regression model is free from autocorrelation problems, and can directly go through our regression model.

4.8 Multiple Regression Analysis

This study used a multiple linear regression model to predict the implementation of sustainable construction buildings. The prediction was carried out based on the effect of the three

predictors/explanatory variables existence of Environmental buildings, Environmental Policies, and Awareness and Education among stakeholders. Besides, the coefficients for each explanatory variable generated from the model were subjected to a t-test, to test each of the hypotheses under study. The study hence came up with a model summary, the ANOVA, and the regression model confidence as presented in Tables 4.12, 4.13, and 4.14.

4.8.1 Model Summary

Table 4.3 Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.909[a]	.827	.816	.41986
a. Predictors: (Constant), Mean Education and Awareness, Mean Environmental Policy, Mean Environmental Material				

As shown in Table 4.12, the overall model statistics of the dependent variable sustainable building construction practice, R=.827 indicates that there is a positive correlation between the dependent variable sustainable building construction and the independent variables' Existence of Environmental Material, Existence of Environmental Policy, and Awareness and Education regarding sustainable construction building practice factors. The result indicated that about 82.7% of the variations/changes in Sustainable Building construction were attributed to the effect explained by repressors namely; the Existence of Environmental Material (EM), the Existence of Environmental Policy (EP), and Awareness and Education (EA). The remaining 17.3% of the variation in sustainable construction building practice (SB) was due to factors that are not included in this model, and the errors in the data collection process. The findings suggested that the independent variables are an important tool for the sustainable construction of buildings in the Akaki Kality sub-city.

4.8.2 ANOVA

Table 4.12 ANOVA

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	41.220	3	13.740	77.941	.000[b]
	Residual	8.638	49	.176		
	Total	49.857	52			
a. Dependent Variable: Mean of Sustainable Building						
b. Predictors: (Constant), Mean Education and Awareness, Mean Environmental Policy, Mean Environmental Material						

As can see the ANOVA model in Table 4.13 indicates that the regression model was too adequate. The F-ratio was 77.941 and the p-value was .000 since less than a .05 level of significance alpha, thus we reject all the values of coefficients equal to zero, and conclude that at least one independent variable has a significant effect on sustainable construction buildings. In addition, from the above analysis of variance, the researcher could see the significant value of the model is below 0.05. Then the model is fit and all the variables (independent variable) could explain the dependent variables hence the model fitness is assured by the significance value. So, the researcher could go to the next step to see the model summary result which is the R^2 and adjusted R^2.

4.8.3 Coefficient Model

Table 4.13 Coefficient Model

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.439	.271		1.617	.0112
	Mean Environmental Policy	.121	.111	.109	1.088	.0282
	Mean Environmental Material	.296	.137	.245	2.162	.036

	Mean Education and Awareness	.698	.143	.603	4.882	.000
a. Dependent Variable: Mean of Sustainable Building						

The multiple linear regression model that was used $Y= \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_{4+} \beta_5 x_{5+} e$ Where dependent variable Y shows Sustainable Building construction (SB), independent variable x_1 shows Environmental Policy (EP), x_2 shows Environmental Material (EM) regarding, x_3 shows Education and Awareness (EA) regarding, and eis the error term. The result equation of the regression model from Table 4.14, coefficients of the independent variables were $\hat{y}$(SB)=.439+.121EP+.296EM +.698EA+.271.

4.9 Results and Discussion

4.9.1 Effect of Environmental Policy on Sustainable Construction Projects

The research finding of this research concluded that the existence of compliance with environmental policy has a significant effect on the practice of sustainable construction buildings. Strengthening compliance with environmental mechanisms, and expanding incentives programs to encourage greater adoption of environmental policies has a coefficient estimate of (β1=.121 sig-value=.0282<.05). Introduction of environmental policies regarding energy codes, waste recycling policies, carbon emission, and use of renewable energy policies has a positive effect on the practice of sustainable building construction, thus the higher the compliance of environmental policies, the greater the result and success for the practice of sustainable building construction. Hence, holding the remaining two variables in the study constant, one unit increase in environmental policies results in .121 increases in the practice of sustainable construction buildings. As a result, consideration of compliance with environmental policies plays an important role in boosting the practice of sustainable construction.

The findings of this article were validated by Gashaw D. H, et al. (2018), who emphasize the need of establishing and enforcing environmental rules in construction to prevent negative environmental impacts and promote sustainable growth in metropolitan settings.

4.9.2 Effect of Existence of Environmental Material on Sustainable Construction Projects

The result of this paper indicated that the existence and availability of environmentally suitable materials have a significant positive effect on the practice of sustainable construction building. The existence of environmentally friendly materials that reduce carbon emissions, and renewable

materials has a coefficient estimate of (β2=.296 sig-value=.036<.05). The existence and availability of building materials that lower energy consumption, and reduce Carbon dioxide (CO_2) emission per building compared to conventional materials, and the existence of environmentally friend materials have a significant effect on the practice of sustainable building constructions. Hence, holding the remaining two variables in the study constant, one unit increase in the existence of environmental materials results in .296 increases in the practice of sustainable construction buildings. As a result, consideration of the availability and existence of environmental materials plays an important role in boosting the practice of sustainable construction. The correlation and regression result shows the impact of environmental materials on sustainable building practices.

The results in this study confirmed by (Ali et al., 2020; Patnaik, B, 2021) that indicates conventional building materials (iron, cement and concrete) are not produced in sustainable ways. The production and transport of conventional materials lead to relatively high levels of greenhouse gas emission. However, locally produced and used building materials such as Bomboo, manufactured sand, Straw Bales, Ferrock Cement, C & D waste do not cause substantial CO2 emissions. Ali et al.0 (2020) indicated that these materials are available or arranged easily in Ethiopia. These locally formed materials can be used to reduce construction cost in Ethiopia, helps to transform the construction industry by addressing all the environmental concerns of sustainability, drops Co_2 emission and transportation cost. Even if the magnitude varies, the study by Kiflom Haile (2022) also confirmed the effect of environmental material and technological factors on sustainable construction buildings. Kiflom Haile (2022) found that one percent increase in the material and environmental factors increases the adoption of sustainable building materials 0. 316%. The result in this section indicated that existence and availability of environmental materials affects sustainable construction buildings.

4.9.3 Effect of Existence of Awareness on Sustainable Construction Projects

The result of this paper indicated that the existence of awareness and education among stakeholders regarding sustainable construction has a significant positive effect on the practice of sustainable construction building. The existence of education and awareness has a coefficient estimate of (β3=.698 sig-value=.000<.05). Awareness and education are essential components in promoting sustainable building construction practices. By providing training and education on

sustainable development concepts and values, individuals in the construction industry can develop the knowledge and skills necessary to implement more sustainable building methods. This, in turn, can lead to improved energy performance, reduced environmental impacts, and a more sustainable built environment. Hence, holding the remaining two variables in the study constant, one unit increase in the existence of education and awareness results in .698 increases in the practice of sustainable construction buildings. The result found in this section was supported by the recommendation given by Kiflom Haile (2022) recommended that creating awareness of among stakeholders regarding the benefit of sustainable building is crucial. Another study by Hammed et al. (2020) found that consumers with a higher understanding of sustainability issues prefer to choose green buildings that influences developers to prioritize sustainable practices.

4,10 Interview Responses

This research paper has interviewed key respondents regarding the challenges in developing sustainable constructions. The first interview question was identifying the main challenge of using environmental material.

An architect indicated that “One of the main challenges we face is the lack of availability of sustainable materials locally. While Ethiopia has abundant natural resources, the supply chains for eco-friendly products, like recycled materials or sustainably sourced timber, are underdeveloped. This leads to increased costs and delays when sourcing these materials from long distances”. A construction manager stressed that there is often a perception that environmental materials are more expensive, which can be a deterrent for clients. A Civil Engineer who has more than 6 years of experience indicated that “the infrastructure to support sustainable building practices is not fully established. For instance, there are few regulations or incentives from the government that promote the use of eco-friendly materials. Without stronger policies or support systems, it becomes challenging for us to commit to sustainable construction”. Regarding the logistic challenge, the civil engineer highlighted that “there are often logistical challenges associated with transporting these materials, especially in remote areas where access to roads can be poor. It can make projects less viable financially”. The other challenge in using environmental materials was highlighted by a consultant “Awareness and education about the benefits of using environmental materials in construction are still limited in Ethiopia. Many architects and builders lack the necessary training on how to incorporate these

materials effectively. This gap in knowledge affects the acceptance of environmental materials in mainstream construction practices".

From the interview responses regarding the challenges of using environmental materials, this research paper concluded that supply chain issues, cost perception, lack of awareness, weak regulatory frameworks, rapid urbanization, and logistic challenges are the main factors. Addressing these challenges would likely require concerted efforts from the government, industry stakeholders, and educational institutions to foster a more sustainable construction culture in Ethiopia.

The second interview question raised was to identify issues that challenge the implementation of sustainable construction building policies and regulations. The Architect indicated that he found that many environmental policies are not aligned with the local context. For instance, requirements for certain sustainable materials may be impractical given their availability and cost in our region". This misalignment makes it difficult for architects and builders to implement these policies effectively. The other challenge indicated by respondents was the lack of financing. Many sustainable construction practices require investment in new technologies or materials, which can be risky for developers. Without financial incentives or support like grants or low-interest loans, it's hard for businesses to justify the transition to more sustainable methods".

A construction environment regulatory officer indicated that "There seems to be a gap in awareness about the importance of environmental policies among local communities and construction stakeholders. Without widespread understanding and support for sustainable practices, policy implementation becomes a challenge, as communities may not see the benefits or may resist change. A construction permit officer of the sub-city highlighted that "Our educational institutions often do not incorporate sustainability into their curricula, which leads to a workforce untrained in environmental construction practices. This gap creates a cycle where policy recommendations are not being effectively translated into practice because the professionals involved lack the necessary knowledge and skills.

The interview responses found in this research paper was supported by a technical report done by Addis Ababa Urban Age Task Force (AAUTF, 2022). The task force divided these barriers into 3 categories such as regulatory, financial, technical, organisational, value chain and consumer

barriers. These barriers have a mutual relationship provider, users, the product and related services, which leads to sets of nested barriers. According to (AAUTF, 2022), one of the biggest obstacles in Ethiopia is the belief that industrialized materials, including concrete blockwork, are dependable and up-to-date building materials. Concrete and steel are frequently seen as superior than organic materials like clay and straw. From the interviews and documents, this research paper concludes that awareness gaps, urban development pressure, financial barriers, enforcement issues, and educational gaps are the main challenges affecting the implementation of sustainable building policies. Hence, this research paper concludes that addressing these challenges would require a collaborative approach that involves government authorities, industry stakeholders, educational institutions, and community engagement to create a more supportive framework for sustainable construction practices in Akaki-Kality.

5. Conclusion and Recommendation

5.1 Conclusion

From the results found in this paper, it recommends the following main points:

The first objective of the study was to identify factors that determine sustainable construction development in the study area. The literature reviews and results of the study found that the existence of environmental material, environmental policy, and awareness and education significantly determine sustainable construction buildings.

The second objective of the study was to assess the effect of awareness on development of sustainable construction buildings. The correlation and regression indicated that the existence of awareness and education among stakeholders regarding sustainable construction has a significant positive effect on the practice of sustainable construction building. While holding other variables constant, one unit increase in the existence of education and awareness results in .698 increases in the practice of sustainable construction buildings. The analysis supports the hypothesis that both education and awareness positively impact the adoption of sustainable building practices. Generally, the coefficients of the independent variables were $\hat{y}(SB)=.439+.121EP+.296EM+.698EA+.271$.

The third objective of the study was to identify the effect of environmental policies and regulations on development of sustainable construction buildings. The existence of environmental policies regarding energy codes, waste recycling policies, carbon emission, and use of renewable energy policies has a positive effect on the practice of sustainable building construction. This paper concluded that a one-unit increase in environmental policies results in .121 increases in the practice of sustainable construction buildings in the Akaki-Kality sub-city.

Locally produced and used building materials such as Bomboo, manufactured sand, Straw Bales, Ferrock Cement, C & D waste do not cause substantial CO2 emissions. The correlation and regression result show that the existence and availability of building materials that lower energy consumption, and reduce Carbon dioxide (CO_2) emission per building compared to conventional materials, and the existence of environmentally friend materials have a significant effect on the practice of sustainable building constructions. One unit increase in the existence of environmental materials while holding others constant results in .296 increases in the practice of sustainable construction buildings.

From the interviews, this research paper concludes that awareness gaps, urban development pressure, financial barriers, enforcement issues, and educational gaps are the main challenges affecting the implementation of sustainable building policies.

5.2 Recommendation

From the results and discussion made, this research paper recommends the following

The use of renewable resources, supports local communities, and supports the selection of materials that require less energy and reduce the overall carbon footprint of the building.

This research paper recommendations, stakeholders (private and government contractors, civil engineers, and government construction offices) to enhance the sustainability of building projects, reduce environmental impacts, and contribute to healthier living spaces.

Regarding awareness and education, this research paper recommends the increasing of educational opportunities and awareness campaigns for construction professionals, contractors, and consultants.

From the interview responses regarding the challenges of using environmental materials, this research paper concluded that supply chain issues, cost perception, lack of awareness, weak regulatory frameworks, rapid urbanization, and logistic challenges are the main factors. To have a sustainable construction building a collaborative approach that involves government authorities, industry stakeholders, educational institutions, and community engagement to create a more supportive framework for sustainable construction practices is required.

5.3 Future Work

Here are some recommendations for future research based on the limitations of this study:

This research paper recommends investigating the other independent variables like political, economic, quality, and other factors that hinder sustainable construction projects.

This study used a relatively small sample size and focused only on the Akaki-Kality sub-city. Future research could use a larger and more diverse sample to confirm the findings of this study and examine the relationship between the independent variables and the dependent variable in different contexts.

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Questionaries

Addis Collage

Department of Construction Technology Management

Post Graduate Program in Masters of Construction Management

Questionnaire to be filled by Project Manager and Employees

Dear Respondents: - My name is **Habtemariam Haile. I** am studying Masters of Construction Technology Management at Addis College. Now I'm going to conduct a study on the "Determinants of Sustainable Building Construction in Case of Akaki Kality Sub-City". Dear respondent, I would like to express my deep appreciation for your generous time and honest and prompt responses.

Objective: -This questionnaire is designed to collect data about the "Determinants in Sustainable Building Construction projects in Akaki-Kality". The information that you offered me with this questionnaire was used as primary data in my study which I am conducting as a partial fulfilment of the requirements for the Master of Construction Management. Therefore, this research aims to identify the main determinants of sustainable building construction and to draw up possible recommendations for the successful implementation of sustainable building projects.

General Instructions

In all cases where answer options are available, please tick (√) in the appropriate box. **Confidentiality**:-I want to assure you that this research is only for academic purposes authorized by the Addis College. No other person will have to access this collected data.

If you have any queries concerning the questionnaire, please contact me:

Name: Habtemariam Haile

Phone Number: 0901256244

Email: habtemariamhaile425@gmaile.com

Part One: Personal Information

1. **Education Background**

   Diploma ☐ BA/BSC ☐ MBA/MSC ☐ Ph.D ☐

2. **Work Experience**

   2-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ Above 20 ☐

3. **Position**

   Clients ☐ Contractors ☐ Consultant ☐ Civil engineers ☐ architects

   Designers ☐

Part Two:

Determinants of Sustainable Building Construction Projects Below are several determinants of sustainable building construction projects. From your experience, please express your opinion on the importance of the following factors as key determinants of sustainable building construction projects within the Akaki Kality building Construction project. (Please tick (√) the appropriate box).

SECTION I： Determinants of Sustainable Building Projects

Rank the following items in terms of the degree of their prevalence in the study area by putting a tick (P) under the Strongly Agree (SA)= 5, Agree (A)=4, Neutral (N)= 3, Dis-Agree (DA)= 2, Strongly Dis-Agree (SDA)= 1.

No	Statement Regarding Environmental Policies	Degree of response				
		1	2	3	4	5
1	The implementation of stringent environmental policies positively impacts the sustainability of construction buildings.					
2	Environmental regulations help in reducing the carbon footprint of construction projects.					
3	Environmental policies play a crucial role in promoting the use of renewable energy sources in construction projects.					
4	Environmental policies help in creating healthier and more comfortable indoor environments in buildings.					
5	Compliance with environmental regulations should be a priority for construction companies.					

6	Investing in sustainable construction technologies is a wise decision for future-proofing buildings.					
7	Environmental policies encourage innovation and creativity in the construction industry.					
8	Building designs that adhere to environmental standards enhance property value and attract more tenants.					

No	**Statement Regarding Environmental Materials**	**Degree of response**				
		1	**2**	**3**	**4**	**5**
1	The availability of environmental materials significantly impacts the sustainability of construction buildings.					
2	Using environmentally-friendly materials in construction is important for reducing the carbon footprint of buildings.					
3	Sustainable construction practices, which include the use of environmental materials, are essential for a greener future.					
4	The increased availability of environmental materials makes it easier for construction companies to adopt sustainable practices.					
5	Environmental materials contribute to the overall energy efficiency and performance of sustainable buildings.					
6	Incorporating environmental materials into construction projects can lead to long-term cost savings and benefits.					
7	I would be more likely to support a construction project that uses environmental materials compared to traditional materials.					
8	Governments and regulatory bodies should promote the use of environmental materials in construction through incentives and policies.					
9	Education and awareness about the benefits of environmental materials are crucial for driving their adoption in the construction					
10	The availability of a variety of environmental materials gives builders more flexibility in creating sustainable and innovative designs.					
No	**Statement Regarding Education and Awareness**	**Degree of response**				
		1	**2**	**3**	**4**	**5**

1	Education and awareness about sustainable construction practices can lead to reduced energy consumption in buildings.					
2	Knowledge about sustainable materials can positively impact the longevity of sustainable construction buildings.					
3	Awareness of environmentally friendly construction techniques can help minimize the carbon footprint of buildings.					
4	Education on sustainable construction practices is essential for creating a more sustainable future.					
5	Increased awareness of sustainable building certifications such as LEED or BREEAM can lead to more sustainable construction					
6	Knowledge about sustainable construction can influence decision-making processes in building design and construction.					
7	Education and awareness about sustainable construction can help reduce waste generation during the construction process.					
8	Increased awareness of green building technologies can lead to innovation in sustainable construction practices.					
9	Awareness of the benefits of sustainable construction can lead to increased demand for sustainable buildings in the market.					

No	**Statement**	**1**	**2**	**3**	**4**	**5**
1	Education and Awareness determine sustainable construction building.					
2	The existence of Environmental Materials determines the sustainable construction of buildings.					
3	The existence of Environmental policies determines the sustainable construction of buildings.					

Interview Questions

1. Challenges of using environmental materials in sustainable construction buildings in the Akaki-Kality Sub-City?
2. Challenges of implementing a sustainable policy in sustainable construction buildings in the Akaki-Kality Sub-City?
3. Your final comment to address these challenges