THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

FACULTY OF ARTS AND SOCIAL SCIENCES

DEPARTMENT OF SOCIAL SCIENCES AND DEVELOPMENT STUDIES

SOAPSTONE MINING AND ENVIRONMENTAL SUSTAINABILITY: A CASE STUDY OF TABAKA REGION, KISII COUNTY

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A THESIS PRESENTED TO THE FACULTY OF ARTS AND SOCIAL SCIENCES IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR MASTER OF ARTS DEGREE (MDS)

NAIROBI, KENYA

SEPTEMBER 2026

DECLARATION

This research proposal is my original work and has not been submitted or presented at any other university for academic credit. All materials and ideas drawn from the work of other scholars and sources have been duly cited and acknowledged in this document.

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This work was accomplished under the auspices of the department and has passed all the required stages with the approval of the Directorate of Research, Innovation and Graduate Training.

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DEDICATION

I dedicate this thesis to my family; whose love, prayers, encouragement and unwavering support have been a constant source of strength throughout this journey. This achievement is deeply cherished and shared with you.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to God for His grace, strength, and guidance throughout the long journey of completing this thesis.

I am deeply grateful to my supervisors, Dr. Frida Nyiva and Dr. Reginal Nalughala for their invaluable guidance, constructive feedback, patience, and support throughout the research process. Your contribution was instrumental in shaping and completing this study.

I also extend my appreciation to the management and staff of CUEA for the support and resources provided during my studies. My sincere thanks also go to the respondents, key informants, and all those who participated in the study for their time and valuable contributions. Finally, I am immensely grateful to my family and friends for their unwavering encouragement, patience, prayers, and support throughout this fulfilling journey. Your belief in me kept me going, especially during the challenging moments.

To everyone who contributed, directly or indirectly, to the successful completion of this thesis, thank you.

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ABSTRACT

Environmental sustainability in mining is a global concern, yet empirical evidence on the environmental impacts of soapstone mining in Kenya remains limited. This study assessed the environmental effects of soapstone mining, examined stakeholder roles, evaluated waste management practices, and established sustainability strategies in Tabaka, Kisii County. Using a descriptive research design, 365 respondents, comprising miners and county officials, were sampled using the Yamane formula. The study employed semi-structured questionnaires, Key Informant Interviews, and five Focus Group Discussions to collect data. Quantitative data were analysed using SPSS through descriptive statistics, multiple regression, one-way ANOVA, chi-square tests, Friedman's test, and cross-tabulations, while qualitative data were thematically analysed. The findings provided insights into the environmental effects of soapstone mining, stakeholder contributions, waste disposal practices, and strategies for enhancing environmental sustainability in the industry. Results showed major impacts: 69.67% of respondents reported quarry water accumulation, 55.46% vegetation loss, 41.80% landscape alteration, and 41.26% debris heaps; fewer common effects included water and noise pollution (14.75% each) and garbage dumping (13.38%). ANOVA revealed marginal differences by occupation ($F=7.62$, $p=0.050$), with sculptors (mean=2.42) and excavators (mean=2.04) most affected. Community participation (62.30%) and sustainable policy adoption (59.56%) were the most supported strategies, followed by county/NEMA interventions (30.33%) and quarry rehabilitation (15.57%). Chi-square tests showed no significant association between stakeholder roles and strategy preferences ($\chi^2=35.62$, $p=0.150$), though cross-tabulations indicated role-specific patterns. Friedman's test confirmed significant strategy ranking differences ($\chi^2=72.34$, $p<0.001$), prioritising participation (mean rank=1.82) and policies (mean rank=1.95). Qualitative findings echoed the quantitative results, highlighting economic dependence on mining, environmental degradation, institutional gaps, and grassroots measures such as reforestation. In conclusion, soapstone mining in Tabaka caused significant environmental disruption, requiring multi-stakeholder collaboration, strong policy enforcement, and participatory governance aligned with local contexts. The findings addressed a key knowledge gap and offered evidence-based guidance for sustainable mining policy in Kisii County.

CHAPTER ONE

1.1 Background to the Study

Mining refers to the extraction of the geological materials that are valuable and found within the Earth. In conducting mining, it is often a requirement to gather as much of the materials that cannot be grown by the agricultural processes. Examples of things that are mined include clay, gravel, potash, rock salt, gemstones, coal, and metals, Ores are the products that come about from mining and once they are mined or extracted, they are sold for profits (White, 2020). The mining can also involve the extraction of resources that are non-renewable that include water, natural gas and petroleum. Activities associated with mining can lead to environmental impacts that have negative consequences regardless of whether the mining is complete or is still taking place. In turn, this has made many nations in the world to have regulations and laws that will decrease the impact it is associated with.

Soapstone is a metamorphic rock composed primarily of talc, a soft magnesium-based mineral. Minerals commonly found alongside soapstone, often as a result of leaching, contribute to its striations and variations in colour. Soapstone has long been valued for its softness and workability; it can be cut using basic tools such as a knife and shaped into a wide range of forms, including architectural elements, countertops, sculptures, and carvings of varying sizes. These properties make it a versatile and commercially significant material in both artisanal and industrial contexts.

The environmental dimension of soapstone mining is closely tied to the broader concept of environmental sustainability, which Morelli (2011) defines as a condition of balance, resilience, and interconnectedness within ecological systems that allows human societies to meet their needs without exceeding the regenerative capacity of supporting ecosystems, thereby preserving biological diversity for present and future generations. Environmental

sustainability also encompasses the maintenance of natural resources and the promotion of conditions that enable the earth's systems to function in ways that benefit both current and future generations.

At the international level, the United Nations has come up with a development policy on sustainability that encourages its member states to keenly follow. The purpose of this policy is to ensure that those who engage in mining are able to benefit from it, but not at the cost of the environment and the community. Companies and governments should be able to recognise the social impacts that are associated with mining and then implement regulations and laws that are appropriate (Sustainable Development Agenda, 2015). Globally, the soapstone is mined in certain parts of the world such as Finland, India, Brazil, Canada, South Africa and Indonesia. Mining takes place when the soapstone is extracted from its natural occurring habitat by human beings. In the Ouro Preto region of Brazil, located in Minas Gerais State, there are several soapstone quarries that exploit this rock as dimension stone. Rodrigues and Lima (2012) examined purer ways of production in the soapstone industry in Ouro Preto, Brazil, and found that low recovery rates during quarrying and artisanal processing resulted in substantial quantities of soapstone residues. The lack of controlled disposal of soapstone powder was identified as a potential environmental problem. The study demonstrated that the residues could be recovered and reused for various industrial applications, thereby reducing the environmental burden associated with waste disposal while creating potential economic benefits. The findings underscore the importance of waste minimisation, resource recovery, and cleaner production as key strategies for enhancing environmental sustainability in soapstone mining.

In the example of Finland, Luukkonen et al. (2019) examined the potential for enhancing environmental sustainability through the utilisation of soapstone waste. The study observed that soapstone processing generated substantial quantities of waste powder, with approximately

60–75% of the processed material becoming waste. Much of this waste was traditionally disposed of in landfills, creating environmental and resource-efficiency concerns. The study showed that soapstone waste could be used as a raw material for producing alkali-activated binders with satisfactory mechanical and durability properties. The findings therefore emphasized on the importance of waste recovery and value addition as strategies for improving environmental sustainability in the soapstone industry. The study further demonstrated that sustainable management of soapstone mining should not only focus on reducing environmental degradation but should also promote resource efficiency and the reuse of mining and processing waste.

In the case of South Africa, artisanal and small-scale dimension-stone mining supports rural livelihoods but may also contribute to landscape alteration, environmental degradation, and occupational health risks. A study of artisanal sandstone mining in QwaQwa, Free State Province, found that mining activities affected the natural landscape, while transportation and processing contributed to environmental impacts (Agwa-Ejon & Pradhan, 2018). These findings are relevant to the present study in Tabaka, Kisii County, where soapstone mining provides employment and income but also contributes to vegetation loss, landscape alteration, quarry water accumulation, and waste generation. The South African experience in this scenario, highlights the importance of environmental assessment, stakeholder involvement, and sustainable mining practices in dimension-stone mining.

Environmental sustainability practices are common and there are even laws in the mentioned nations that ensure no one can engage in soapstone mining without adherence to them (Diego & Godfrid, 2017).

Soapstone has been mined in various parts of the world for centuries. In Norway, for instance, soapstone quarrying has a long history and remains economically significant, operating within

established environmental sustainability frameworks. At the regional level, soapstone is also mined across several African countries, including Tunisia, Egypt, and Angola, where the resulting products are sold locally and exported to international markets, making a positive impact to national economies (Rodriguez, 2012). Environmental sustainability however continues to be a persistent challenge across the African continent. Key obstacles include strained relationships between stakeholders and artisanal miners, corruption, and poor management of revenue distribution all of which make it difficult to achieve sustainable mining outcomes (Tost et al., 2018).

Kenya is well known for its soapstone production, particularly in the Tabaka region of Kisii County. The soapstone found in Kisii consists largely of massive, impure talc, with its degree of softness largely determined by the talc content. It is important to that; lower talc concentrations enhance the ease with which the material can be carved. These soapstone deposits are located within the former Gucha District now part of South Mugirango, and the village of Tabaka. The village of Tabaka is now renowned globally for its production of soapstone (Buyeke & Njoroge, 2015). Despite this profile, the level of environmental sustainability in the Kenyan soapstone sector remains relatively minimal. Achieving meaningful improvement will require the active participation of miners themselves in shaping and implementing sustainable practices (Kinyua, Atambo, & Ongeri, 2011).

The legal framework for environmental management in Kenya is provided by the Environmental Management and Coordination Act of 1999, which places responsibility on county governments to monitor, assess, and enforce environmental conservation and restoration. As the late Nobel Peace Prize Wangari Maathai noted, meaningful sustainability requires a fundamental shift in how human beings relate to the environment (Kushner, 2009). The present study is premised on the recognition that soapstone mining, if left without adequate

oversight, poses real risks to environmental sustainability in Kisii County, and that addressing these risks requires evidence-based knowledge about the industry's current impacts and the strategies best suited to the local context.

1.2 Statement of the problem

The existing studies on mining in Kenya including those by Buyeke and Njoroge (2015), Akama (2018), Kinyua, Atambo, and Ongeri (2011), Wakio et al. (2021), Mbaka and Rono (2022), and Tampushi et al. (2022) have largely focused on economic, hospitality, and general sustainability dimensions of extractive industries. It thus means that the soapstone mining industry's environmental sustainability information and knowledge is quite scarce. The result is that it might reach some point whereby future generations will not be able to earn a living or even survive off the soapstone mining. Environmental degradation is likely to continue further, and this has severe consequences for all those that are involved such as loss of biodiversity, human and wildlife conflicts, soil erosion and pollution. Therefore, it cannot be denied that there is an existing research gap, and the reason as to why the proposed study should be conducted.

There are environmental issues that are associated with mining activities, and specifically in the soap stone industry. It has been widely mentioned that land degradation has occurred at the Tabaka region. In turn, the water catchment areas that are suitable for the purpose of farming have been destroyed (Davies & Osano, 2005). Vegetation has also been depleted and especially at the terrain that is quite hilly, and this is what leads to soil erosion. A disease such as malaria has continued to spread rampantly since the soap stone quarries are most times left uncovered; in turn becoming one of the negative consequences of environmental degradation on soapstone mining. Additionally, under surface and surface water has also been polluted and the ever-increasing deforestation has affected the rainfall patterns. Consequently, the farmers who live

within the soapstone mining region are not able to effectively predict the seasons when planting can occur. In the long-run, it has an effect on the food security in that the levels tend to be low.

Evidently, it seems that the soapstone mining industry in Kisii does not promote environmental sustainability (Akama, 2018). There is also a need for this particular research to bridge the already existing gap as it is related to environmental sustainability issues. The environmental implications of soapstone mining in Tabaka are increasingly concerning given the scale of extraction and the extent of land affected by quarrying activities. Previous studies have reported that soapstone quarrying occupies up to 22% of farmland in parts of the Tabaka region and has contributed to soil erosion, weathering, and mass movement (Tilji, 2018). In addition, studies have documented substantial quantities of soapstone extracted from the area, with some mining sites producing more than 50 tonnes of soapstone per week (Rumbe, 2021). These figures demonstrate the considerable scale of mining activity and its potential to exert sustained pressure on land and other environmental resources. Despite these concerns, there remains limited empirical evidence on the current environmental effects of soapstone mining and the effectiveness of stakeholder interventions and sustainability strategies in Tabaka. This gap underscores the need for research to provide evidence that can inform appropriate environmental management and sustainable mining practices in the area.

In conducting this study, it will be possible to suggest and come up with suitable strategies that can lead to improved environmental sustainability practices that can be adapted in the Kisii soapstone mining industry.

1.3 Research Objectives

The general objective guiding this study is to assess environmental sustainability in the Tabaka, Kisii County soapstone mining industry.

1.3.1 Specific Objectives

1. To investigate the extent of environmental effects of the soapstone mining industry in Tabaka, Kisii County.
2. To investigate the role of stakeholders involved in promoting soapstone mining industry in Tabaka, Kisii County.
3. To establish suitable environmental sustainability strategies for the soapstone mining industry in Tabaka, Kisii County.
4. To assess the waste management practices associated with soapstone mining in Tabaka, Kisii County.

1.3.2 Research Questions

The research questions that the proposed study seeks to answer include;

1. What is the extent of the environmental effects of the soapstone mining industry at Tabaka, Kisii County?
2. What is the role of stakeholders of the soapstone mining industry in Tabaka, Kisii County in promoting environmental sustainability?
3. What are the suitable environmental strategies needed for the soapstone mining industry in Tabaka, Kisii County?

1.4 Justification of the study

The provided research serves the purpose of establishing the extent at which the Kisii soapstone mining industry is associated with the issue of environmental sustainability. In turn the stakeholders such as the people that are directly involved in mining, those living in the areas where the mining takes place, and interested stakeholders such as the county government and those that purchase the soapstone products, among others can benefit from the research results in terms of strategies and policies likely to come about. In addition, the chosen research design

will be a descriptive research design since it enables the researcher to obtain in-depth information regarding the phenomenon of interest. Surveys and interviews will be incorporated into the research strategy in the form of structured questionnaires, focus groups and key informant interviews to collect data that will provide an exploration into environmental sustainability in soapstone mining in Kenya.

1.5 Significance of the study

There is growing interest among policymakers, practitioners, and researchers in understanding how extractive industries can operate sustainably. In Kenya, however, soapstone mining in the Tabaka region has largely continued to depend on manual, low-technology methods with limited adoption of environmentally responsible practices (Buyeke & Njoroge, 2015). This has contributed to persistent challenges including land degradation, deforestation, and water pollution, yet the empirical evidence needed to guide intervention remains thin.

With specifics regards to the mining of soapstone in Kisii at the Tabaka region, there is a need to be informed about whether environmentally sustainable practices are effective in their sector. It is also key to be informed regarding the role of stakeholders in promoting such efforts since they have been proven to be leading when it comes to promotion of the practice. There is also scant information of the potential that the soapstone mining industry in Kenya has with regards to contributing towards environmental sustainability. It is most especially among the nations in the developing world that have weak and challenging institutions. The purpose of this particular study is to fill the existing gaps through the examination of environmental effect of soapstone mining. There will also be an exploration into the strategies that can lead to environmental sustainability using the efforts of the stakeholders present in this mining industry. Within a larger and broader extent, the study will lead to more discourse on the best

practices for addressing environmental sustainability taking place in different parts of the world.

1.6 Scope and Delimitation of the study

This particular study will be conducted within the Tabaka region of Kisii County. Additionally, it will focus on the soapstone sites that are present in the above-mentioned area. It will specifically be in sites where the soapstone is being mined. However, it will exclude the sites whereby the soapstone products are being sold. The sites being targeted together with the stakeholders are the individuals that are indirectly and directly linked to the soapstone mining at Tabaka.

In terms of delimitation of the research, it is highly likely that not all the stakeholders that are responsible for environmental related issues associated with soapstone mining will be approached. It means that there are diverse respondents from the population that have an influence on the environmental sustainability practices and strategies in soapstone mining.

1.7 Limitation of the study

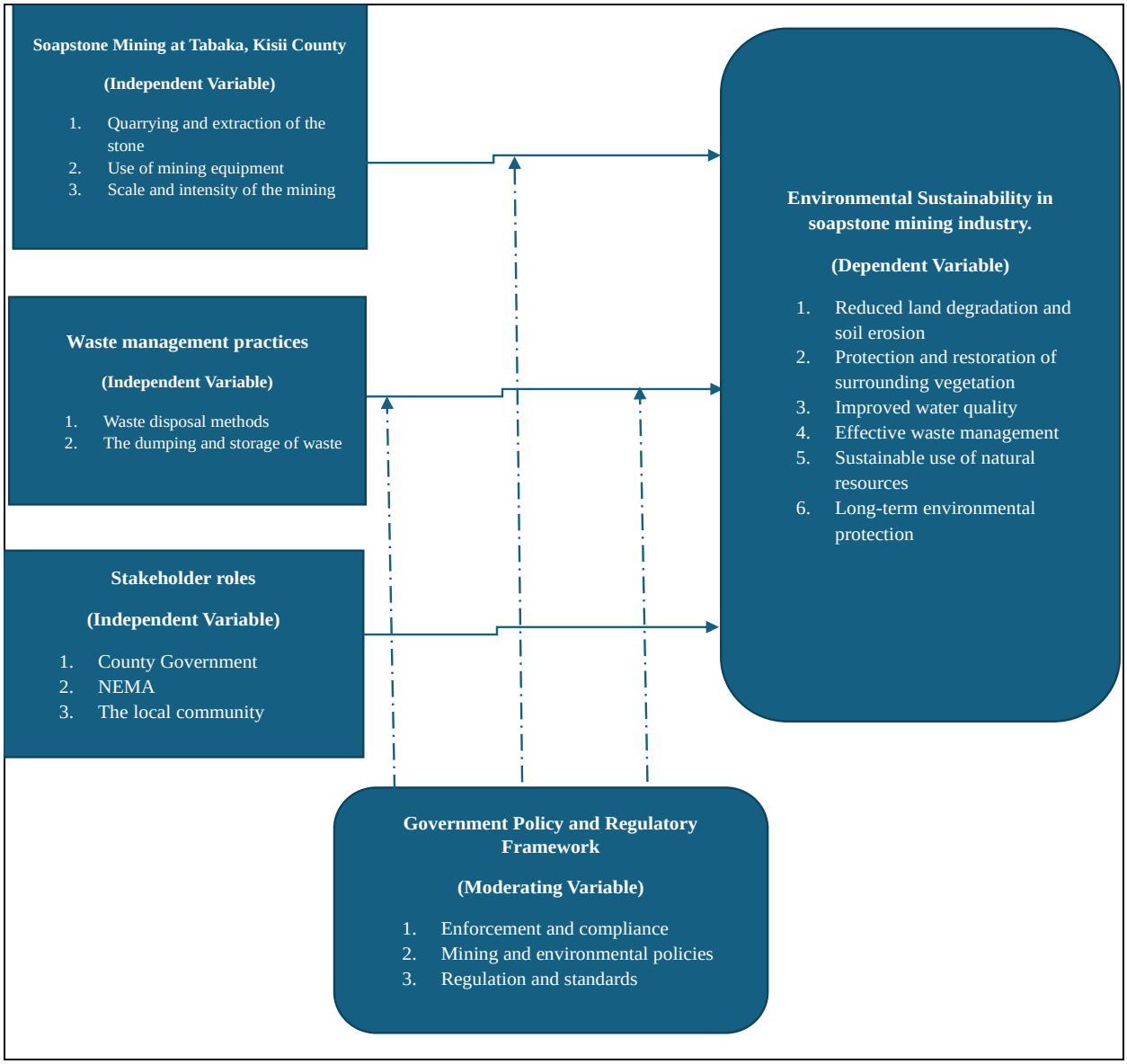
One of the main limitations that was expected in this study was the absence of a comprehensive, up-to-date database listing soapstone miners and relevant stakeholders in the Tabaka area. To address this, field visits to the mining sites were conducted in order to identify and recruit miners directly, and had engagements with community members and the relevant county office for stakeholder identification.

Another challenge involved the language of data collection. Since questionnaires were administered in English, research assistants with knowledge of the local Kisii dialect were engaged to assist respondents who required translation. These assistants also played a role in capturing qualitative responses during interviews, which were subsequently translated for

analysis. Their involvement was essential to the accuracy and completeness of the data collected.

1.8 Conceptual Framework

Figure 1.8.1 Below is a depiction of a conceptual framework for the purpose of promoting environmental sustainability in the soapstone mining industry at Tabaka, Kisii county.



(Author, 2026)

The conceptual framework displays soapstone mining activities in Tabaka as the independent variable. These activities are directly interconnected to environmental effects; the dependent variable which include mining waste, pollution, destruction of vegetation, and general waste generation.

The act of soapstone mining, waste management practices and stakeholder involvement are treated as the independent variables whereas government policy and regulatory framework are treated as a moderating variable. The degree and quality of government policies and regulatory frameworks is expected to either mitigate or exacerbate the environmental effects of mining, depending on the nature of engagement and the extent to which environmental obligations are enforced.

Environmental sustainability strategies including law enforcement, awareness campaigns, and regulatory action by agencies such as NEMA are identified as key mechanisms for addressing consequences that mining has on the environment. These strategies are expected to promote sustainable practices and reduce negative environmental impacts.

The framework suggests that soapstone mining activities directly produce environmental effects. Government involvement and the formation of suitable policies on the other hand, serve as moderating factors that shape overall environmental sustainability outcomes. It is important to note that, whereas the literature identifies specific impacts such as land degradation, deforestation, and water pollution, there is limited clarity on which sustainability strategies are most effective within the specific context of Tabaka. This study seeks to address that gap by identifying and evaluating strategies appropriate to the local environment, and by clarifying the roles different stakeholders can play in supporting their implementation.

1.9 Definition of key terms and concepts

Environmental Effects- Any change that has the capability of having an impact on the environment, and it leads to changes such as seen in the quality and condition of the habitats, biodiversity, and air, water and soil quality (Emmanuel, Jerry, & Dzigbodi, 2018). This study will specifically focus on identifying the environmental effects that come about from soapstone mining as they are a threat to environmental sustainability and it will be obtained from the structured surveys filled in by the respondents and also from the interviews. The environmental effects will be measured based on the observable impact that they have on the environment.

Environmental Sustainability- This is a known condition that involves interconnectedness, resilience and balance, which allows for the human society to have the ability of satisfying the needs that it has. At the same time, it cannot exceed the existing capacity of the supporting ecosystems as this is needed to continue for the purpose of regenerating services that are important for meeting the needs as compared to using actions that can diminish the biological diversity (Morelli, 2011). In this study, environmental sustainability will be used as a key variable that provides information on aspects such as strategies, and how it can be achieved in the soapstone mining industry at the Tabaka region of Kisii county. Information on environmental sustainability will be obtained from the respondents through the structured surveys and interviews and it will be measured based on the ability of the soapstone mining to bring about sustainability in the environment.

Mining- A process that involves the extraction of materials that are useful and found on earth. It includes substances such as iron ore and gold (Sonter, Ali, & Watson, 2018). In the study, focus is on soapstone mining, and it is known as being an activity that affects biodiversity through its indirect and direct processes. To be able to gain deeper insight into the soapstone

mining, respondents will be subjected to interviews and structured survey to better be informed about this concept.

Stakeholders- As theory has originally defined it, stakeholders are present in the form of an individual or groups that are affected or can be affected by certain issues. They are viewed as being important when it comes to provision of information on matters such aA s those of the environment (Schiller et al., 2013). The study will focus on the stakeholders associated with soapstone mining in Tabaka, Kisii county, and it includes those living in the community and those working in the county department of trade and industry. The stakeholder information will be obtained from the key informant interviews and thereafter, the transcribed information will be thematically analysed.

CHAPTER TWO

2.1 Relevant Theories

This chapter presents the literature reviewed in relation to environmental sustainability in the soapstone mining industry. It provides the theoretical and conceptual foundations that support the study and reviews empirical studies that are relevant to the environmental effects of soapstone mining, waste management practices, stakeholder roles, and environmental sustainability strategies. Additionally, the chapter identifies the existing gaps within the literature that the study seeks to address.

2.2 Theoretical Framework

A theoretical framework seeks to explore theories that are available with regards to a presented issue. Furthermore, it serves the purpose of coming up with hypotheses that are possible to be tested, as well as their relationship to the phenomena being tested. Observations and occurrences that take place on a daily basis can be explained when using an appropriate theoretical framework.

This study incorporates insights from two theories: Stakeholder Theory and Green Economy Theory. These theories offer a coherent lens through which to examine the relationship between soapstone mining, environmental sustainability, and the roles of various actors in the Tabaka context. Stakeholder Theory informs the study's approach to identifying and engaging relevant parties in the research process. The Green Economy Theory on the other hand situates the study within a broader understanding of the relationship between economic activity and environmental health.

Stakeholder Theory

Stakeholder Theory was developed by Ian Mitroff in 1983. The theory argues that when organizations or entities are successful, it is the stakeholders that need to benefit in the given

process. The stakeholders do not often anticipate the magnitude of the benefits that they will receive. Stakeholders involve entities such as foreigners, government, investors, those involved in selling and buying of products, and even the local community where operations take place. It is important to note that according to this theory, the stakeholders should be viewed on the basis of individuals or categories that are affected by the activities of entities. Most importantly, the stakeholder theory has led to improved Corporate Social Responsibility practices as most interest groups tend to advocate for such issues that are of interest to the shareholders.

In the soap stone mining industry such as the one that exists in Kenya, there are some key stakeholders that are involved. They all usually have various interests, values as well as demands, and specifically some are related to matters of environmental sustainability. In recent times, the stakeholders within the region of Tabaka have called for more environmental sustainability practises in order to promote their interests. A number of them have called for more environmentally friendly methods of mining that will lead to a reduction of land and noise pollution (Akama 2018).

The local communities have in the recent years been identified by the stakeholder theory as being quite key and powerful stakeholders. Based on this, it is important that those in the soapstone mining industry are able to have meaningful interactions with them in order to become more informed about the desired environmental sustainability practices. They are known to have the ability of conferring social licenses that are needed to operate as well to prevent environmental risks and disruptions from taking place (Fassin, 2012). Moreover, those involved in the mining practices will make suitable adjustments to their practices based on the feedback, urgency of claims, legitimacy and power of their stakeholders.

In coming up, with this study, the stakeholder theory serves quite an important stance that needs to be known. First, it makes it be known that those in the mining industry need to come up with

effective strategies that will lead to more interactions with their stakeholders. Secondly, the theory is arguably useful as it is an approach to matters on environmental sustainability since it focuses on a broad scope, and this is the social environment whereby mining activities occur. Most notably the theory provides an in-depth understanding into matters of why the soapstone miners might and should promote the sustainability of their environment. However, the only drawback about the theory is that not all the interests of the stakeholders will always be met at one particular time. Therefore, by including the notable concepts of this theory, it becomes easy to find out more regarding the Tabaka soapstone mining industry and how it addresses issues on environmental sustainability.

The theory does however have its limitations. Looking at the different stakeholders, it can often prove difficult to balance their often-competing interests. For example, miners are likely to prioritise the business side of the industry hence focusing on income and a livelihood, whereas communities may want both economic benefits and protection of their land and water resources. Despite the theory identifying all these varying interests, it does not always provide a clear guide that is suitable when it comes to determining which stakeholder interest should take priority whenever there is a conflict.

Green Economy Theory

The Green Economy Theory is grounded in the principle that human activity and natural systems must function together in harmony, in a way that meets the needs of both. It also serves the purpose of meeting the needs of both parties in a simultaneous manner. Further, it is supported by the United Nations Environmental Program (2011) that proposes that in order to achieve green, there must be fairness and efficiency. The International Chamber of Commerce has highlighted that in order to achieve a green economy whereby environmental sustainability thrives. In turn, it becomes easy for social development to be promoted for the good of all those

that are involved (Cato, 2009). The theory is thus focused on providing an explanation on the interactions that exist between individuals and the environment whereby they live and conduct activities for various purposes. Economic decisions have to be related to an ecosystem to some extent and this is applicable to the economic activity of soapstone mining.

Attention should be paid to the natural resources that are present within a given environment and or economy. In paying attention to this, benefits will come about such as those that come from economic activities such as soapstone mining. The natural environment should be healthy enough and this takes place when the individuals can coexist well with the nature as well as to protect it even though they benefit from some of its products. In any economy, such as the Kenyan one and specifically at Tabaka, Kisii county, environmental sustainability is sure to lead to improved benefits. It cannot be denied that the green economy theory advocates for the reduction of ecological scarcities and environmental risks (Cato, 2009). Later on, it can lead to the environmental sustainability and the preservation of the environment to avoid degrading it.

There are six key sectors that are present in any green economy. They include the land management, waste management, water management, sustainable transport, green buildings and renewable energy. It is argued that there is no one size fits all in the green economy theory as the strategies used in promoting it should be tailored made to suit the specific industries. Based on this information, it is recommended that industries such as the one that focuses on soapstone mining is able to identify the specific areas that need to go green as this will promote environmental sustainability (Lodhia, 2018).

The green economy's strength lies on the fact that it is extremely pivotal for this study as it is applicable in environmental sustainability matters within the Tabaka, Kisii county soapstone mining industry. Mining has some adverse impacts and risks and most especially on the local communities' livelihood's and natural environmental (Akama, 2018). It sometimes goes to an

extent whereby the local mining industry is described as being a dirty business, a reputation that should be given to any entity. Miners in the soapstone industry tend to seek approval from their constituents in the local and global environments whereby operations take place. They want to be known and seen as being trust worthy, descent and sustainable, which is in line with the green economy theory (Gill, Ansari, & Tufail, 2021). Therefore, the Green Economy Theory provides an integrated lens for examining how the soapstone mining industry can sustain its economic benefits while promoting environmental protection and the sustainable use of natural resources.

In terms of limitations however, the Green Economy theory can be viewed as overly broad. This is in the sense that, it makes it quite difficult to translate into specific actions or measurable outcomes. Concepts such as resource efficiency, social inclusion, sustainable production and environmental protection for example, are valuable, but the theory does not always specify how these principles should be implemented in a particular local context. This is relevant to Tabaka region mainly because strategies that may be technically or economically feasible in developed mining regions may not necessarily be practical for small-scale and artisanal miners.

2.3 Literature Review

Environmental Sustainability

The concept of environmental sustainability has its origins in the 1987 Brundtland Commission, which described sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs. Since then, the United Nations has developed this understanding to incorporate human wellbeing in a broader perspective, including access to clean water and air, health, education, and the protection of natural beauty. Environmental sustainability has also been described as the ability

to maintain natural capital that is, to preserve the practices and conditions that contribute to long-term environmental quality (Vintó, Sanmiquel, & Freijo, 2014).

The environmental aspect of sustainability is widely regarded as foundational, given its close relationship to human survival. Mining that takes place without regard for environmental sustainability not only degrades ecosystems but ultimately weakens the social and economic systems that depend on them (Dong & Hauschild, 2017). The concept includes changes across multiple indicators, including biodiversity loss, freshwater use, pollution levels, ozone depletion, and climate change all of which are relevant in mining contexts.

In practice, environmental sustainability is assessed through several criteria. One is the sustainable use of renewable resources, which should not be misused at rates exceeding their natural regeneration capacity. The principle of assimilation capacity is another aspect, which holds that environments have limited abilities to absorb waste and pollution without irreversible degradation (Dong & Hauschild, 2017). These criteria are directly relevant to soapstone mining, where the extraction of a finite resource must be weighed against the environmental systems that mining activities affect.

The role of human agency is essential to the achievement of environmental sustainability. Individuals, communities, and industries all have the ability to push for change, and industries specifically, given their scale can produce substantial environmental outcomes. Renewable energy adoption and green technologies are among the tools available to industries seeking to reduce their environmental footprint (Moldan, Janouskova, & Hak, 2017).

A number of analytical perspectives on environmental sustainability have been identified in the literature, including ecological, normative, integrated, and dynamic perspectives (Vintó, Sanmiquel, & Freijo, 2014). This study is primarily informed by the dynamic perspective, which demands ongoing assessment of emerging risks to the environment arising from socio-

economic activities such as mining (Mulligan, 2014). In relation to this perspective, environmental sustainability is not a static condition but an active process of monitoring, adapting, and responding to change a practice that requires the involvement of all relevant stakeholders.

In line with this perspective, Morelli (2011) argues that meeting the needs of both current and future generations involves attention to institutional, environmental, and socio-economic factors, including the links between them. Two conditions are identified as vital: flexible and responsive governance structures, and feedback mechanisms capable of monitoring and addressing emerging environmental issues.

Environmental effects of mining activities

In conducting mining activities, there are some core benefits that come about as seen both globally and locally. The activities associated with mining lead to production of materials that can be used to come up with useful products. However, there is a great downside that comes about in the engagement of mining activities, and especially to the environments where this takes place. The effects are usually felt on the soils, water and air as these are key components of the environment. One such example is that that when the mining takes place such as that of soapstone, it can lead to soil erosion (Chauhan & Meena, 2018). It is important that those responsible for conducting the mining activities are well informed about the well-being, together with the welfare of current generations. They should make it mandatory that they do not compromise the future generation's quality of life by the activities they choose to do that can be detrimental to the environment.

The human activity of mining that involves exploiting soapstone rocks mostly comes about due to economic reasons. Furthermore, the operations can lead to biodiversity erosion and habitat destruction in the areas whereby the mining takes place. Other environmental related issues

that occur and are seen include inappropriate dumping of the waste that comes from the mining activities and the landscape destruction, including even noise, water and air pollution (Barkemeyer et al., 2015; Dibal et al., 2016). Based on this, there is a key hazard that is caused by the mining activities and they are felt on the environment. The consequences of the soapstone mining on the environment due to practices that are deemed as being unsustainable need to be addressed as they can play an important role in promoting the mining activities in an acceptable manner.

The society whereby the mining activities take place can inform as to whether those living there have an understanding concerning the environmental effects. Most times, it is only when the observable environmental effects are witnessed that people start to complain about it. To some extent, there might be an issue of ignorance about environment related issues linked to mining activities. Other individuals will choose to rather go silent on the issue as it is far beyond them. The environment whereby the mining occurs have ecological functions, and if left to wither away will have adverse consequences (Vintro, Sanmiquel, & Freijo, 2014). Ultimately, concerns regarding environmental impacts brought about by mining have made the stakeholders to greatly embrace the concept of environmental sustainability.

In the soapstone mining industry, the economies of the local regions where it occurs have improved to some extent. In the region of Ouro Petro located in Brazil, many benefits have been witnessed due to the intense mining of soapstone (Rodriguez, 2012). In mining soapstone, there is a substantial amount of waste that comes about in the form of powder as well as rock debris. In situations whereby it is not handled or disposed of well, it is sure to have an effect on the environment. Minimization of the mentioned practice has managed to go ahead by adding value to the by-products. Insecticide has also been produced from the waste as well as even being used as a key ingredient in the paper related industry. The example of Brazil clearly

demonstrates that through innovative environmentally sustainable practices, the environmental effects of the soapstone mining can be minimised.

It is almost mandatory throughout the world that all entities that are involved in the mining related activities respond in a positive manner to the any environmental challenges. Assumption of responsibilities among all that participate in promoting environmental sustainability should exist, and this is by following the available policies. In turn, those in the mining of soapstone should be able to have suitable strategies that can deal with the environmental effects that come about. The external stakeholders often keep the mining industry entities on their toes so that they can comply with existing environmental laws (Shameilah, 2016). Evidently, environmental sustainability is a key agenda for the mining industry for those that want to survive and become economically viable.

Environmental strategies for environmental sustainability in the mining industry

There is a lot of importance associated in the promoting environmental sustainability through proper integration and balance. Furthermore, a natural environment has been found to be the key idea behind, which sustainability tends to rest. Consequently, it leads to socio-economic development, and thus creating the base for environmental sustainability to thrive. It means that the environment should always be prioritised in order to avoid its degradation. Decision makers must ensure that they protect the environment and promote its sustainability (Khalili, 2011). However, the mentioned approach usually tends to be quite difficult when it comes to implementation since it does not focus on the fact that there are many dimensions associated with environmental sustainability.

Decisions should be made to promote environmental regulations that are strict, and this can include protecting the areas that are near the location whereby mining activities are taking place. Monitoring compliance and strict conditions need to be regulated, and most especially

in areas whereby mining activities are responsible for the creation of jobs and revenue for the communities where they serve. Additionally, mining activities should be able to promote environmental sustainability, and this will be possible through having effective and appropriate environmental strategies. Consequently, it dictates that those in the mining industry can do what is possible and necessary to minimise the negative impacts to the environment. There is also a great need to improve the accountability and response to issues that are related to the environment. Environmental Management Systems are being implemented mostly in the mining activities that take place in the developed nations (Gill, Ansari, & Tufail, 2021). The systems have been found to be quite comprehensive to the point whereby they are fully capable of predicting environmental issues likely to occur. Support has also been received by the local communities whereby they exist as their efforts to improve environmental sustainability are being noticed.

Practices associated in addressing environmental sustainability have been found to lead to positive impacts on mining together with improved ecological quality that takes place long-term (Tost et al., 2018). The practises that lead to environmental sustainability tend to include the adoption of processes that lead to efficiency processes and new technologies. An argument presented by Silvestre (2014) is that there is need for technologies that are clean and suitable for the mining industry as this automatically leads to sustainability performance. Negative environmental impacts are greatly reduced when the practices are done in an effective and efficient manner that is evidence based. As seen in most developing nations whereby the mining occurs, environmental sustainability is challenged when the practices are not followed through. Additionally, self-regulation and regulatory compliance are key strategies that are often used by those in mining activities and in the sector in general to promote practices that lead to environmental sustainability. In a developing nation such as Kenya whereby soapstone mining occurs, it is important for the two mentioned issues to be present.

Policies and code of conduct are also two other key strategies that are known to bring about success when it comes to the promotion of environmental sustainability in the mining industry. One such example is that in Spain, those involved in mining of metals and mineral have introduced sustainable and ethical policies that serve the purpose of improving environmental sustainability. Green economic activities should also be introduced as key processes of the mining activities, and this will also lead to more improved profits. In the European nations, the European Union has done a lot to ensure all its members that participate in mining are informed and follow sustainable practices (Souza et al., 2016). The mentioned strategies can be implemented in the Kenyan soapstone mining industry for promotion of environmental sustainability.

Globally, the environmental impacts associated with mining and even including soapstone mining has mandated the need for strategies that will lead to environmental sustainability. The strategies have been embraced as concerns have mostly been raised by stakeholders concerning harmful trajectories associated with mining operations. One such example is that in Ghana whereby gold mining takes place, the environmental led to adoption of environmentally sustainable practices (Njeru & Kragt, 2015).

Rehabilitation of the land whereby mining occurs is a strategy that is being implemented worldwide. Waste from mining activities should be handled in a manner that will not lead to negative environmental effects being experienced. Success usually comes about when both those conducting the mining practices, community members and the government collaborate. In turn, it becomes possible for the improvement and maintenance of life quality as well as even the environment for the future and current generations. It even means that all those who benefit from the resource such as soapstone in this study are met. There is also the accounting

of the needs including even being able to secure the fact that all the stakeholders can participate in the making of decisions (Bice, 2014).

Role of stakeholders in promoting environmental sustainability in the mining industry

Environmental sustainability in the mining sector would be difficult to achieve through top-down regulation alone; it needs the active engagement of stakeholders who bring diverse expertise, interests, and forms of accountability to the table. Stakeholders are defined as individuals or entities affected by or affecting the outcomes of mining activities. They have both the right and the ability to shape the direction of environmental governance. Their value judgements, are often central to determining which environmental issues are prioritised and how they are addressed (Philips, 2012).

Corporate Social Responsibility (CSR) has become a vital expression of stakeholder engagement in the mining industry. Mining firms and individual miners engage in CSR partly to contribute to community welfare and partly to protect their reputations. Practically, CSR contributions in mining communities regularly include investments in health infrastructure and educational facilities. However, such contributions have been scarce in the Tabaka region, and the ability of stakeholders to grant social licences depends on the quality and continuity of community engagement (Esau & Malone, 2013).

In using the example of the Kisii soapstone mining industry, those responsible for such activities have to respond to their stakeholders who have the right of pursuing a legitimate interest. Evidently, there is a complex relationship between stakeholders and the ones that are engaging in the mining activities. In the mining sector, the stakeholders have different interests, values and demands, and this requires that those specifically engaged in the mining activities to pursue some forms of trade-offs. Their power and legitimacy are often viewed as being the bases by which those in mining can make their decisions. The stakeholder power also comes

with a consideration for opportunities and threats that the individual stakeholders present to those engaged in the mining activities. One such example is that local communities continue to be powerful stakeholders within the realm of the mining sector. It is on the basis that they can confer social operation licenses needed for operations. Moreover, according to Prono and Slocombe (2012), the stakeholders have the power of preventing social risks and disruptions that can threaten the operations of those in the mining sector.

The government in the form of a stakeholder can greatly influence environmental sustainability within the regions whereby mining takes place. It should come up with standards and frameworks that can manage the aspects associated with the environment. In addition, the government should take an active stance on the creation of an environment that can be shared as well as regulated. Consequently, it can lead to the understanding of responsibility and roles of the other stakeholders and even the government, and thus the promotion of environmental sustainability. According to Manetti and Toccafondi (2014), the government should be entrusted with the rights and responsibilities of even the other stakeholders. The environment and human rights of the citizens should be protected such as by the redistribution of the wealth that comes from the mining activities.

The government is also a known custodian of the minerals found in a country and has to make sure that there are environmentally sustainable practices during extraction as mentioned by Kabai (2013). The presence of a policy framework on environmental issues should be present, and it should have standards and norms that can lead to economic and social benefits. It is unfortunate that in the developing nations including Kenya, there are no proper set guidelines that can address environmental sustainability issues. Environmental laws are lax, and this promotes the resource depletion and increase in pollution and other environmental degradation activities.

2.4 Research gaps

Literature on environmental sustainability provides very scarce information related to soapstone mining. This is despite the fact that the practice of mining soapstone takes place in both developing and developed nations. Globally, there has been mention of environmental sustainability as it is a key issue and sustainability is in line with most plans, programs and policies (Zvarivadza, 2018; Vintro, Sanmiquel, & Frejio, 2014). However, it is important to be informed that limited information exists with regards to soapstone mining and environmental sustainability. Additionally, the studies that exist are mostly on the mining of minerals and metals such as gold and aluminium as well as the environmental effects they are associated with. Consequently, this has created a gap in the literature on the existence of knowledge on environmental sustainability in soapstone mining and specifically in the Kenyan setting.

CHAPTER THREE

This chapter outlines the methodology used in this study. It describes the research design, the study area, the target population, and the sampling techniques used to select respondents. In addition, this chapter explains the data collection tools and procedures, the steps taken to ensure reliability and validity, the data analysis procedures, and the ethical considerations observed throughout the research process.

3.1 Research Design

According to Kothari (2012), a research design refers to a known framework that is used in the examination and collection of the variables included in the study. Furthermore, the research design to be used in this particular study will be a descriptive research design that uses the mixed methods that are qualitative and quantitative. Specific reference will be made to the soapstone mining industry at the Tabaka region in Kisii County. Surveys and interviews will be incorporated into the research strategy in the form of structured questionnaires, focus groups and key informant interviews to collect data that will provide an exploration into environmental sustainability in soapstone mining in Kenya.

3.2 Study Population

The study population in this study was drawn from Tabaka, Kisii County. According to the Kenya National Bureau of Statistics (2019), the area has an approximate total population of 30,000 individuals, of whom around 1,200 are directly employed in the soapstone mining sector.

3.3 Target Population

The target population consists of individuals whose characteristics are directly relevant to the research objectives and who are positioned to address the research questions (Creswell, 2014). Specifically, the study targets soapstone miners working in Tabaka and key county staff from

the Department of Energy, Water, Environment, and Natural Resources. The combined target derived from the population is 4,200 individuals as derived from the Kenya National Bureau of Statistics (2019).

3.4 Sample and Sampling Techniques

The study employed a mix of stratified sampling and simple random sampling to select respondents from the target population in Tabaka, Kisii County. It is important that the sampling techniques are chosen well and the sampling is done in a careful manner for the purpose of having a sample size that is manageable. Having a sample size that can be managed will bring about efficiency in this study in the form of human resources, finance and even time management. Worth mentioning is that the selection of the sample size tends to depend on credibility, usefulness and the inquiry purpose including even what will be done with regards to the available resources and time.

In terms of sample frame**,** it contains a list that has all the people that are part of the population whereby the sample is being derived from. In this particular study, a map of Tabaka region where the soapstone mining takes place will be used to come up with the sample frame. The map will have information on the areas that will be sampled as this will provide insight on where the researcher will gather data from the respondents within Tabaka in Kisii County. Evidently, the sample frame will contain the area whereby all those that are involved in the mining of soapstone are located thus assisting in obtaining respondents for them.

The sample size was determined using Yamane's (1967) formula:

$$n = N / (1 + N(e^2))$$

Where n is the sample size, N is the population size, and e is the margin of error. With a target population of 4,200 and a precision level of 0.05, this yields a sample size of 365 respondents. Questionnaires were administered to all selected respondents.

3.5 Tools of Data Collection

The tools to be used in the proposed study will collect primary data from the respondents. The tools will specifically have information on the role of the stakeholders in promoting environmental sustainability, environmental sustainability strategies and the environmental effects associated with soapstone mining. The use of the semi structured questionnaires and FGDs has been chosen since it reduces financial constraints and saves on time. Open ended questions are also included as the respondents will be able to give as much information as possible. With regards to the interview guide, it will ensure that the researcher can obtain the needed information from the respondents, and it is qualitative in nature.

In this study, the methods to be employed include key informant interviews and focus group discussions to collect data for objective 2 and questionnaires to collect data for 1 as well as using secondary literature to collect data for objective 3. Multiple methods of collecting data leads to triangulation that can assist in the circumvention of errors that come about in data collection, and this leads to increased credibility of anticipated results.

3.6 Reliability and Validity

Validity refers to the extent to which a research instrument accurately measures the constructs it is intended to measure (Sahu, 2013). Content validity was established through expert review involving professionals in environmental sustainability. This included officers from the county government and NEMA. The instruments were revised based on reviewer feedback.

Reliability on the other hand, refers to the consistency with which an instrument produces results that are stable (Bryman, 2011). Internal consistency was assessed using Cronbach's alpha coefficient, with a threshold of 0.7 set as the minimum acceptable level. Items that reduced the reliability coefficient were assessed and refined before the commencement of the main data collection.

3.7 Data Analysis Procedures

The collected data were cleaned, coded, and entered into IBM SPSS Statistics, where they were analysed using appropriate statistical techniques. The quantitative data were analysed using descriptive statistics, which included frequencies, percentages, means, and standard deviations. Cross-tabulations were used where appropriate in order to compare responses across respondent categories. Inferential tests including one-way ANOVA, chi-square, and Friedman's tests were also applied to specific research questions as was stated in Chapter Four.

The qualitative data from the Focus Group Discussions and Key Informant Interviews were analysed thematically. The transcripts were read carefully to identify initial codes based on recurring ideas and patterns relevant to the research objectives. The codes were then grouped into broader themes, which were reviewed and refined for accuracy. The themes were subsequently used to interpret the findings and provide deeper contextual insights into the study.

3.8 Pilot Study

A brief pilot study was conducted a few months prior to the main data collection in order to assess the clarity and suitability of the research instruments. Feedback from the pilot study was in turn used to make the necessary adjustments to the instruments before the main data collection. The pilot study helped refine the interview questions, identify and correct questions

that were potentially biased and provided a clearer guide for data collection and improve the accuracy and relevance of the results.

3.9 Ethical Considerations

This study was conducted in agreement with the established principles of reach ethics which demand that participant's rights, dignity and well-being are protected throughout the research process (Mugenda & Mugenda, 2011). Their participation was entirely voluntary. The respondents were briefed on the study's objective, their expected role, and their right to withdraw at any stage without any consequence. Prior to commencement of the study, the researcher obtained an introduction letter from the Department of Social Sciences and Development Studies at the university. The researcher subsequently applied for and obtained a research permit from the National Commission for Science, Technology and Innovation (NACOSTI), authorizing the researcher to conduct the study.

The privacy of the participants was maintained throughout. The data were accessible only to the researcher and stored securely, and questionnaires did not capture identifying information such as the participants' names. Questionnaire items were written in a clear a neutral language which was verified by conducting a pilot study prior to the data collection. During the analysis, findings were reported objectively, without selective interpretation.

CHAPTER FOUR

RESULTS AND INTERPRETATION

4.0 Introduction

This chapter presents data and findings on environmental sustainability in Tabaka's soapstone mining industry, which were organised around the three research objectives. These include; environmental effects of mining, stakeholder roles in promoting environmental sustainability, and suitable environmental strategies. A total of 366 questionnaires were distributed and feedback successfully received. This chapter begins with an analysis of respondents' demographic characteristics in order to provide a clear context and is followed by the presentation of findings for each objective.

Quantitative data are analysed using descriptive statistics and inferential techniques including ANOVA, chi-square, and Friedman's tests where applicable. Qualitative data from focus group discussions and interviews are analysed thematically. The results are presented in tables.

4.1 Environmental effects of the soapstone mining industry

This section presents the environmental effects of soapstone mining as reported by the 366 respondents who participated in this research. The findings presented are broadly consistent with previous studies on artisanal and small-scale mining, which have recorded vegetation loss, land disturbance, and water accumulation in abandoned quarry pits as common consequences of unmanaged extraction (Mugenda & Mugenda, 2011).

The respondents were asked to specify which of the nine environmental effects they had observed in connection with mining activities. These include water pollution, noise pollution, loss of vegetation, heaps of debris, accumulation of water in quarries, alteration of the natural landscape, garbage dumping in quarries, reduced slope angles, and air pollution.

Looking at the findings, the most commonly reported effect was the accumulation of water in quarries, cited by 255 respondents (69.67%), this was followed by loss of vegetation at 55.46% (n=203). These findings therefore suggest that these two impacts are the most visible and frequently experienced within the study area. Effects that were moderately reported included alteration of the natural landscape (41.80%, n=153) and heaps of debris (41.26%, n=151). Landscape transformation was understood by respondents in terms of visible changes such as excavation pits, uneven terrain, and abandoned quarry sites.

As presented in **Table 1**, the less frequently reported effects included water pollution and noise pollution (14.75% each, n=54), and garbage dumping in quarries (13.38%, n=49). Reduced slope angles (1.37%) and air pollution (0.55%) were hardly mentioned. Noting that the data reflects respondents' perceptions rather than direct environmental measurements, low reporting rates on these items most likely indicate limited observation or awareness as opposed to an absence of the effects themselves.

Table 1: Environmental Effects Reported by All Participants (n = 366)

Environmental Effect	Frequency (n)	Percentage (%)
Accumulated water in quarries	255	69.67%
Loss of vegetation	203	55.46%
Alteration of natural landscape	153	41.80%
Heaps of debris	151	41.26%
Water pollution	54	14.75%
Noise pollution	54	14.75%
Garbage dumping in quarries	49	13.38%
Reduced slope angles	5	1.37%
Air pollution	2	0.55%

In order to better understand how environmental effects are distributed across various groups, Table 2 breaks down findings by their occupational role. Participants were distributed as follows: customers (33.11%, n=121), sculptors (29.05%, n=106), excavators (17.57%, n=64), traders (17.57%, n=64), designers (1.35%, n=5), collectors (0.68%, n=2), wholesale purchasers (0.68%, n=2), and residents (0.68%, n=2).

Table 2: Environmental effects across occupational roles

Activity	WP	NP	LV	HD	AW	LA	GD	RS	AP
Excavator (64)	54 (84.38%)	54 (84.38%)	22 (34.38%)	0 (0%)	22 (34.38%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Sculptor (106)	0 (0%)	2 (1.89%)	94 (88.68%)	61 (57.55%)	61 (57.55%)	7 (6.60%)	45 (42.45%)	2 (1.89%)	0 (0%)
Customer (121)	0 (0%)	0 (0%)	40 (33.06%)	40 (33.06%)	86 (71.07%)	86 (71.07%)	0 (0%)	0 (0%)	0 (0%)
Trader (64)	0 (0%)	0 (0%)	40 (62.50%)	42 (65.63%)	54 (84.38%)	42 (65.63%)	2 (3.13%)	0 (0%)	0 (0%)
Designer (5)	0 (0%)	0 (0%)	5 (100%)	0 (0%)	0 (0%)	0 (0%)	5 (100%)	2 (40%)	0 (0%)
Collector (2)	0 (0%)	0 (0%)	2 (100%)	0 (0%)	2 (100%)	2 (100%)	0 (0%)	0 (0%)	0 (0%)
Wholesale (2)	0 (0%)	2 (100%)	0 (0%)	0 (0%)	2 (100%)	2 (100%)	2 (100%)	0 (0%)	0 (0%)
Resident (2)	0 (0%)	0 (0%)	0 (0%)	2 (100%)	2 (100%)	2 (100%)	0 (0%)	0 (0%)	0 (0%)

WP=Water Pollution; NP=Noise Pollution; LV=Loss of Vegetation; HD=Heaps of Debris; AW=Accumulated Water; LA=Landscape Alteration; GD=Garbage Dumping; RS=Reduced Slope; AP=Air Pollution

The results presented in Table 2 suggest that the perception of environmental effects is closely linked to proximity to and involvement in mining operations. Excavators reported high levels of water and noise pollution (84.38% each), thus reflecting immediate exposure to active operations. Sculptors reported the highest rates of vegetation loss (88.68%) and large levels of debris and water accumulation (57.55% each). Customers and traders who are less directly involved in extraction primarily reported more spatially visible effects: 71.07% of customers and 84.38% of traders noted water accumulation in quarries, while landscape alteration was widely observed by both groups (71.07% and 65.63% respectively). Results for the occupational categories that are of a smaller size should be interpreted cautiously given their sample sizes.

4.1.1 ANOVA Analysis of environmental effects across occupational roles

In order to assess whether the mean number of environmental effects reported differed greatly across occupational groups, a one-way ANOVA was conducted. The dependent variable was the number of effects identified by each participant and the occupational role served as the independent variable.

Table 3: ANOVA Results for the number of environmental effects by activity

Source	SS	df	MS	F	p-value
Between Groups	267.99	7	38.28	7.62	0.050
Within Groups	703.01	358	1.96	—	—

The ANOVA yielded an F-statistic of 7.62 with degrees of freedom (7, 358) and a p-value of 0.050. Although the result is borderline in terms of conventional significance levels, it is still

in line with the observation that certain roles; specifically, those closest to the mining sites report a broader range of environmental issues.

The group means additionally illustrate this trend; where sculptors reported the highest average number of effects at 2.42, excavators followed with an average of 2.04, traders averaged 1.92, and customers averaged 1.45. These figures support the conclusion that how close an individual is to the mining operations shows a correlation with higher environmental impact awareness. The research question in this study sought to assess the extent of the environmental effects of the soapstone mining industry in Tabaka. The study findings show that these effects are both widespread and interconnected, with over two-thirds of the participants (69.67%) reporting quarry water accumulation and more than half (55.46%) observing vegetation loss. These statistics highlight serious disruptions to ecological systems, including altered hydrological flows, deforestation, and changes in the functionality of the land.

Moderate but still significant effects, such as landscape alteration (41.80%) and heaps of debris (41.26%), further illustrate the mining industry's physical impact on the land scape. These are likely to contribute to long-term degradation of soil and terrain. Meanwhile, effects such as water and noise pollution (each at 14.75%) and garbage dumping in quarries (13.38%) show that human health and sanitation may also be at risk. The ANOVA results shown in the data confirm that the observed severity and breadth of environmental impacts varies by role, with sculptors and excavators reporting the highest number of effects, due to their continuous exposure to quarry conditions. This suggests that those that are closest to extraction and processing activities possess the highest level of awareness on the negative environmental consequences. In conclusion, the extent of environmental effects is substantial, both in frequency and diversity. These findings strongly affirm the research hypothesis and emphasize

on the urgent need for environmental regulation, community involvement, and sustainable mining practices in the region.

4.2 Role of stakeholders in promoting environmental sustainability

4.2.1 Stakeholder activity distribution

This study's survey engaged 366 respondents; those who are directly involved in or affected by soapstone mining in Tabaka, Kisii County. These stakeholders were characterized by their roles in the mining sector, which included activities such as excavation, sculpting, trading, and purchasing. The objective of this research was to identify each group's contribution towards environmental sustainability. The majority of respondents were customers who constituted of (33.06%) and sculptors (28.96%). This indicates a strong representation of individuals involved in the processing and consumption stages of the soapstone industry. Excavators and traders accounted for an equal share a total share of (17.49%) each, whereas designers, collectors, wholesale purchasers, and residents formed a much smaller segment of the population constituting of (0.55% to 1.37%).

Respondents were requested to suggest strategies for improving environmental sustainability within the mining industry. The strategy that was most frequently mentioned was community participation (62.30%), followed closely by sustainable policies at (59.56%). County government or NEMA interventions (30.33%) and quarry rehabilitation (15.57%) were relatively supported, whereas a small fraction (6.83%) proposed other strategies such as education and reforestation. These descriptive findings show a clear consensus across stakeholder categories that environmental sustainability in Tabaka's soapstone mining requires both grassroots involvement and supportive policy frameworks. Community participation most likely relates with those most exposed to environmental degradation hence sustainable policies are perceived as necessary for systemic change.

Table 4: Stakeholder activity and suggested sustainability strategies (n = 366)

Activity	Count	(%)	Community Part.	Sustainable Policies	County/NEMA	Quarry Rehab	Other
Customer	121	33.06	67 (55.10%)	74 (61.22%)	39 (32.65%)	17 (14.29%)	7 (6.12%)
Sculptor	106	28.96	77 (72.09%)	64 (60.47%)	27 (25.58%)	17 (16.28%)	7 (6.98%)
Excavator	64	17.49	39 (61.54%)	34 (53.85%)	22 (34.62%)	15 (23.08%)	5 (7.69%)
Trader	64	17.49	39 (61.54%)	37 (57.69%)	20 (30.77%)	8 (11.54%)	5 (7.69%)
Designer	5	1.37	3 (50.00%)	3 (50.00%)	3 (50.00%)	0 (0.00%)	0 (0.00%)
Collector	2	0.55	2 (100%)	2 (100%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Wholesale	2	0.55	0 (0.00%)	2 (100%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Resident	2	0.55	2 (100%)	0 (0.00%)	0 (0.00%)	2 (100%)	0 (0.00%)
Total	366	100	228 (62.30%)	218 (59.56%)	111 (30.33%)	57 (15.57%)	25 (6.83%)

4.2.2 Chi-Square test of independence

A chi-square test of independence was conducted in order to evaluate whether strategy preferences were greatly different across stakeholder groups. The test produced a chi-square statistic of 35.62 with 28 degrees of freedom and a p-value of 0.150 (Table 5). Since this

exceeds the 0.05 significance threshold, the findings show no statistically significant connection between the stakeholder role and preferred sustainability strategy. Respondents across various occupational categories were in agreement on appropriate approaches to environmental sustainability, suggesting that concerns about environmental degradation are widely shared rather than confined to specific groups. These results should be interpreted cautiously given the very small sample sizes in some stakeholder categories.

Table 5: Chi-Square test of independence – Stakeholder role vs. Sustainability strategy

Test	Value	p-value
Pearson Chi-Square (df = 28)	35.62	0.150

4.2.3 Cross-Tabulation of strategy preferences by stakeholder activity

While the chi-square test found no statistically significant overall difference, a cross-tabulation using row percentages shows meaningful patterns in how different stakeholders prioritise specific strategies (Table 6).

Table 6: Cross-Tabulation of strategy preferences by stakeholder role

Activity	Community Part.	Sustainable Policies	County/NEMA	Quarry Rehab	Other
Excavation (64)	39 (61.54%)	34 (53.85%)	22 (34.62%)	15 (23.08%)	5 (7.69%)
Sculptor (106)	77 (72.09%)	64 (60.47%)	27 (25.58%)	17 (16.28%)	7 (6.98%)
Customer (121)	67 (55.10%)	74 (61.22%)	39 (32.65%)	17 (14.29%)	7 (6.12%)
Trader (64)	39 (61.54%)	37 (57.69%)	20 (30.77%)	8 (11.54%)	5 (7.69%)
Designer (5)	3 (50.00%)	3 (50.00%)	3 (50.00%)	0 (0.00%)	0 (0.00%)
Collector (2)	2 (100%)	2 (100%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Wholesale (2)	0 (0.00%)	2 (100%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Resident (2)	2 (100%)	0 (0.00%)	0 (0.00%)	2 (100%)	0 (0.00%)

Looking at Table 6, sculptors show the strongest support for community participation (72.09%), this could be attributed to their daily exposure to the physical consequences of mining. Customers and traders lean more towards sustainable policies (61.22% and 57.69% respectively), a pattern that is consistent with value-chain research; hence suggesting that actors further from extraction sites tend to favour formal governance mechanisms. Excavators on the other hand, are most supportive of quarry rehabilitation (23.08%) and government interventions (34.62%), reflecting a more direct experience with landscape degradation. The two resident respondents concurrently endorsed both community participation and quarry rehabilitation, thus highlighting their immediate stake in environmental outcomes. Collectively, these patterns suggest that in spite of there being a broad unanimity on the

importance of environmental sustainability, specific strategy preferences are shaped by each group's position within the mining ecosystem.

4.3 Suitable environmental strategies

To assist in the regulation of the environmental impacts of soapstone mining, there are five main categories that emerged from the data collected. The respondents were put in the following classifications: excavators, sculptors, traders, customers, designers, collectors, wholesale purchasers, and residents.

The study begins with examining the overall occurrence of proposed strategies and then breaks it down by stakeholder roles to uncover context-specific priorities. Lastly, the Friedman's test is used to determine whether the strategies differ significantly in stakeholder preference. Participants were requested to suggest strategies that could enhance environmental sustainability in the soapstone mining industry. The five major categories that emerged within this study include: community participation, sustainable policies, County Government and NEMA interventions, quarry rehabilitation, education and reforestation. Overall, community participation was the most frequently suggested strategy, with 228 respondents (62.30%), followed closely by sustainable policies, selected by 218 respondents (59.56%). County Government and NEMA interventions were suggested by 111 respondents (30.33%), while quarry rehabilitation was endorsed by 57 respondents (15.57%). Only 25 respondents (6.83%) proposed other strategies such as education or reforestation.

These regularities indicate a clear inclination toward strategies that involve the community and policy reform. The emphasis on participation and governance highlights the stakeholders' belief in systemic, long-term approaches to environmental sustainability. In order to better understand how different stakeholders prioritize environmental strategies, cross - tabulations were

conducted. The data shows variation in strategic preferences based on the nature of each group's involvement in the soapstone industry.

Table 7: Suggested environmental strategies by stakeholder activity (n = 366)

Activity (n)	Community Part. Count (%)	Sustainable Policies Count (%)	County/NEMA Count (%)	Quarry Rehab Count (%)	Other Count (%)
Excavation (64)	39 (61.54%)	34 (53.85%)	22 (34.62%)	15 (23.08%)	5 (7.69%)
Sculptor (106)	76 (72.09%)	64 (60.47%)	27 (25.58%)	17 (16.28%)	7 (6.98%)
Customer (121)	67 (55.37%)	74 (61.16%)	39 (32.23%)	17 (14.05%)	7 (5.79%)
Trader (64)	39 (61.54%)	37 (57.81%)	20 (31.25%)	10 (15.63%)	5 (7.81%)
Others (11)	7 (63.64%)	5 (45.45%)	3 (27.27%)	3 (27.27%)	3 (27.27%)
Total (366)	228 (62.30%)	218 (59.56%)	111 (30.33%)	62 (16.94%)	27 (7.38%)

The review in Table 7 confirms quite a number of patterns. Sculptors show the greatest support for community participation (72.09%) given their close involvement in soapstone mining. Customers and traders favour sustainable policies more strongly. This reveals that those further along the value chain place greater weight on formal regulatory solutions. Excavators present the strongest preference for quarry rehabilitation (23.08%) and government interventions (34.62%), reflecting those that have a direct experience with landscape degradation at quarry sites.

4.3.1 Friedman's Test Analysis

The Friedman’s non-parametric test was used to assess whether respondents ranked the five environmental strategies differently.

Table 8: Friedman's Test results for environmental strategy rankings (n = 366)

Strategy	Mean Rank	Frequency (n)	Percentage (%)
Community Participation	1.82	228	62.30%
Sustainable Policies	1.95	218	59.56%
County Government/NEMA Interventions	3.12	111	30.33%
Quarry Rehabilitation	3.78	57	15.57%
Other (Education, Reforestation)	4.33	25	6.83%
Test Statistic (χ^2)	72.34	—	—
Degrees of Freedom (df)	4	—	—
p-value	< 0.001	—	—

The Friedman’s test as shown in Table 8 confirmed statistically significant differences in how strategies were ranked ($\chi^2 = 72.34$, df = 4, $p < 0.001$). Community participation (Mean Rank = 1.82) and sustainable policies (1.95) are frequently ranked as the all the categories, which in turn confirms the descriptive findings.

Conversely, other strategies (Mean Rank = 4.33), such as education and reforestation, received the lowest overall prioritization. The low p-value (< 0.001) portrays that these rankings are not due to chance, rather, reinforcing the reliability of the stakeholder preferences observed.

The combined use of frequency analysis, breakdowns on specific stakeholder classifications, and use of the Friedman’s test provides a thorough view into the research question: *What are the suitable environmental strategies that are needed for the soapstone mining industry in*

Tabaka, Kisii County? The analysis shows that the most supported and consistently prioritized strategies are those that emphasize active community engagement in environmental matters and the development of sustainable policy frameworks to help guide and regulate mining practices. Although these two approaches form the basis of stakeholder preference, government interventions and quarry rehabilitation also emerge as important. This particularly has been shown to affect stakeholders who are directly involved in mining activities. This pattern suggests that participatory approaches and long-term regulatory planning are viewed as effective and sustainable. Collectively, these findings depict a clear and informed agreement among stakeholders on strategies that are both inclusive and grounded in policy reform within the soapstone mining context.

4.4 Qualitative data findings

The study involved five Focus Group Discussions (FGDs), and each comprised of six participants. Through these FGDs, effective qualitative data that was aligned with the quantitative findings was generated. Looking at all the groups, a consistent picture that emerged was that of a community that depends largely on soapstone mining for its livelihood, is environmentally aware, and one that is ready and willing to engage in sustainability efforts to salvage their environment for future purposes.

A matter that seemed to be recurring in every focus group discussion was the community's livelihood as the key driver of mining activity within the Tabaka region. A significant number of the participants described mining as a livelihood that was inherited from previous generations with the only other substitute being farming. One sculptor stated that, *"Most of us inherited this work from our parents from a young age. There are no factories here. We mine to feed our families"* (Participant 3 - FGD 2). This dependence on mining across different

generations was relating to the quantitative observation that a large fraction of respondents was directly involved in excavation and sculpting.

The focus groups also confirmed both social and economic benefits of soapstone mining, particularly its role in sustaining livelihoods within the region. Participants oftenly mentioned being able to pay school fees for their children, build homes, or invest in small businesses using proceeds from soapstone. A female trader stated that, *"Through soapstone, I have educated my three children and even managed to build a house"* (Participant 5 - FGD 1). This is significant aspect was key to nearly every group in the study, which in turn showed confirmation of the quantitative data that placed economic benefits as a key theme in participants' responses.

Environmental degradation also emerged as an essential theme across all FGDs. The respondents described visible and rather concerning consequences of mining, which include unfilled quarry pits, soil erosion, water pollution, and deforestation. *"Some places are so badly dug they look like death traps. During rains, the pits collect water and become a safety hazard"* (Participant 4 - FGD 3), stated a youth excavator. Others mentioned health issues linked to dust and poor waste management. These perceptions strengthened the quantitative evidence that environmental degradation is widely recognized by community members, particularly those closest to the quarry sites.

It is important to note that participants reported a number of challenges when addressing these environmental issues. Among the most commonly cited barriers were the lack of formal training, weak enforcement of environmental regulations, and insufficient support from government institutions. An elderly sculptor stated that, *"People talk about sustainability, but there are no trainings or follow-ups. We just survive"* (Participant 6 - FGD 4). This sentiment was echoed across all five groups, showing a clear picture of the quantitative findings where

institutional support like the County Government or NEMA interventions were acknowledged but were not prioritized as the most effective strategy.

Participants outlined several ongoing sustainability efforts regardless of these constraints. These included informal reforestation, use of community self-help groups, and safer mining techniques promoted through peer learning or support from NGOs. One of the residents stated that, *"We planted trees with a CBO last year to reduce erosion"* (Participant 2 - FGD 5). Although these actions were generally localized and erratic, they demonstrated a strong willingness among community members to engage in environmental stewardship. This thus aligned closely with the large number in regularity of community participation strategies identified in the quantitative data.

During discussions regarding the roles of various stakeholders, participants voiced a number of different views. Even though they recognized the potential importance of institutions like NEMA and the County Government, they were generally critical of their lack of presence or commitment when most needed. *"NEMA only comes during accidents or when there's media attention"* lamented one of the traders (Participant 1 - FGD 3). On the other hand, community members, local leaders, and artisanal groups were viewed as more proactive and accessible, which mirrors the survey data that placed more emphasis on community-level strategies than on formal government interventions.

When it came to the recommendations, the participants advocated for greater involvement in environmental planning, more consistent training, and stricter but fair regulation. They emphasized that sustainable practices must be economically practical and culturally sensitive. *"Train us, involve us, and enforce the rules equally. We are ready, but we need guidance and support",* urged one of the female sculptors (Participant 4 - FGD 2). These qualitative perspectives strongly support the survey's prioritization of participatory environmental

governance and the development of sustainable policy frameworks. Collectively, the qualitative and quantitative findings paint a very clear picture of a community that is economically dependent on soapstone mining, greatly aware of its environmental consequences, and eager to participate in sustainability solutions. This is as long as the proposed efforts are inclusive, well-supported, and responsive to their lived realities.

Table 9: Thematic Analysis of Focus Group Discussions (FGDs)

Theme	Summary of Codes	Interpretation
Drivers of Soapstone Mining	Economic need, cultural heritage, skill transfer, lack of alternatives	Mining is sustained by economic dependency and inherited practices.
Perceived Benefits	Employment, income, education, infrastructure, tourism	Mining contributes significantly to local livelihoods and development.
Environmental Effects	Land degradation, water pollution, deforestation, poor waste disposal	Mining has adverse impacts on local ecosystems and landscapes.
Sustainability Challenges	Weak enforcement, lack of awareness, informal mining, low training	Environmental sustainability is constrained by poor regulation and knowledge gaps.
Strategies in Use	Community sensitisation, reforestation, local rules, NGO training	Grassroots efforts are being used but remain localised and sporadic.
Stakeholder Roles	County government, NEMA, community leaders, NGOs, miners	Participants favour participatory, community-led engagement over top-down oversight.
Recommendations	Policy enforcement, training, environmental monitoring, infrastructure support	Sustainable mining requires inclusive policymaking and tangible institutional support.

Key Informant Interviews:

The Key Informant Interview data were analysed thematically by identifying recurring views, opinions, and experiences related to the research objectives. The emerging themes were compared with the findings from the Focus Group Discussions to provide additional context and support interpretation of the quantitative findings.

The Key Informant Interviews revealed that land degradation was one of the major environmental concerns associated with soapstone mining in Tabaka. Respondents from the County Government and community leadership noted that quarrying activities left open pits and altered the landscape, while miners highlighted the accumulation of stone debris around quarrying and carving areas. These responses were grouped under the theme of landscape and land degradation and complemented the quantitative findings on the environmental effects of soapstone mining.

Comparison of Quantitative and Qualitative Findings

The quantitative findings showed that quarry water accumulation, vegetation loss, landscape alteration, and debris heaps were among the major environmental effects associated with soapstone mining. Similarly, the qualitative responses from the Key Informant Interviews and Focus Group Discussions described open quarry pits, destruction of vegetation, accumulated stone debris, and changes to the natural landscape. The two sets of findings therefore agreed that soapstone mining activities contributed significantly to environmental degradation in the study area. The qualitative responses provided additional explanations of how these effects occurred and their implications for the local community.

Objective 1: Environmental effects on soapstone mining

The quantitative findings indicated that quarry water accumulation, vegetation loss, landscape alteration, and debris heaps were among the major environmental effects associated with

soapstone mining. These findings were consistent with the qualitative responses, in which respondents described open quarry pits, accumulated stone debris, destruction of vegetation, and changes to the natural landscape as common consequences of mining activities. The qualitative findings therefore provided contextual explanations for the patterns observed in the quantitative data by illustrating how mining and carving activities contributed to environmental degradation in the study area.

Objective 2: Waste Management Practices

The quantitative findings on soapstone waste disposal practices were compared with the qualitative responses from miners, community members, and key informants. The qualitative findings indicated that soapstone waste was often accumulated around quarrying and carving sites, with limited opportunities for proper disposal, reuse, or recycling. These findings complemented the quantitative results by providing explanations for the observed waste management practices and highlighting the environmental challenges associated with the accumulation and disposal of soapstone waste.

Objective 3: Stakeholder Roles

The quantitative findings showed the extent to which different stakeholders participated in promoting environmental sustainability in the soapstone mining industry. The qualitative findings supported these results by highlighting the roles of miners, community members, County Government officials, NEMA, community leaders, and other organisations in environmental management. However, the interviews and focus group discussions also revealed challenges such as weak enforcement, limited awareness, inadequate collaboration, and insufficient resources. These qualitative insights helped explain why stakeholder participation and environmental interventions may not always translate into effective environmental sustainability outcomes.

Objective 4: Environmental sustainability strategies

The quantitative findings identified community participation and sustainable policy adoption as among the most preferred strategies for promoting environmental sustainability. These findings were reinforced by the qualitative responses, which emphasised the importance of community sensitisation, reforestation, environmental education, policy enforcement, and quarry rehabilitation. The qualitative data further explained that effective implementation of these strategies would require collaboration among miners, local communities, government agencies, and other stakeholders.

Looking at both the qualitative and quantitative data conducted in this study, it is evident that the findings are consistent with previous studies on soapstone quarrying and mining activities in Kenya. The present study found that quarry water accumulation, vegetation loss, landscape alteration, and debris heaps were among the major environmental effects of soapstone mining. Similarly, Rumbe (2021) reported that artisanal mining in Tabaka contributed to soil erosion, landslides, river siltation, and changes in the physical landscape. Tilji (2018) also established that soapstone quarrying accelerated weathering, soil erosion, and mass movement, while reducing land available for farming. In addition, Okong'o et al. (2021) found that vegetation clearing, topsoil removal, and excavation in the Gucha South soapstone quarrying areas resulted in significant environmental and socio-economic effects. These findings agree with the present study and confirm that soapstone mining activities continue to exert pressure on land, vegetation, and other environmental resources in the Tabaka region.

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

This chapter analyses the findings on environmental sustainability in Tabaka's soapstone mining industry. It incorporates them with the research objectives discussed in this study. Looking at both quantitative and qualitative results from Chapter 4, it compares them with existing literature, addresses the environmental effects, stakeholder roles, and sustainability strategies. It reviews the theoretical implication for the study and also addressed the implication of the study findings to the field of Development Studies. This chapter also concludes with proposals for stakeholders and discusses ways in which research in the future can help reduce the existing scarce information on the subject at hand.

Theoretical Implications of the Study

The study contributes to Stakeholder Theory by demonstrating the importance of involving different stakeholders in addressing environmental challenges associated with soapstone mining. The findings indicate that miners, community members, the County Government, NEMA, and other relevant stakeholders have varying but connected roles in promoting environmental sustainability. The study further demonstrates that stakeholder participation alone may not be sufficient unless it is supported by effective collaboration, environmental awareness, policy implementation, and enforcement. This suggests that Stakeholder Theory is relevant in explaining how the interests and responsibilities of different actors influence environmental management outcomes in artisanal and small-scale mining communities.

The study also contributes to Green Economy Theory by demonstrating the need to balance economic livelihoods from soapstone mining with environmental protection and resource conservation. The findings show that mining activities provide important economic benefits to

the local community but may also result in environmental degradation through land disturbance, vegetation loss, water accumulation, and waste generation. The study therefore supports the Green Economy perspective that economic activities should promote resource efficiency, minimise environmental harm, and encourage sustainable production practices. In particular, the findings on waste management, community participation, quarry rehabilitation, and policy enforcement demonstrate the importance of integrating environmental sustainability into local economic activities.

Overall, the study demonstrates that Stakeholder Theory and Green Economy Theory are complementary in explaining environmental sustainability in the soapstone mining industry. Stakeholder Theory helps explain the roles and interactions of different actors, while Green Economy Theory provides a basis for understanding how mining activities can be undertaken in ways that support livelihoods while reducing environmental degradation. The study extends the application of these theories to the local context of soapstone mining in Tabaka, Kisii County.

Environmental effects of the Soapstone Mining Industry

The study shows that soapstone mining in Tabaka leads to detrimental impact on the environment. It reveals that quarry water accumulation was at (69.7%) and vegetation loss (55.5%) as the most prevalent effects. These findings are in line with prior studies in the Kenyan context indicating that quarrying activities do often lead to erosion of vegetation and deterioration of land. In recent studies for example, Barchok et al. (2024) documented an 18.24% decrease in vegetation cover in Narok between 2010 and 2022. This was linked to an increase in stone quarrying within the area (Barchok et al., 2024). Relatably, Abaho (2024) reported significant declines in plant diversity and rather increased soil erosion in Uganda's Kabale district that resulted from stone quarrying within the region (Abaho, 2024). Slightly

moderate effects such as landscape alteration at (41.8%) and debris heaps at (41.3%) also correspond closely with reports by Omondi et al. (2022) in Kenya's Nyakach region, where quarrying led to soil loss and diminished land usability (Omondi et al., 2022). These presented comparisons support the conclusion that increased mass removal of rock and an overload in artisanal mining certainly disrupts physical landscape and visual appeal.

While water and noise pollution (both 14.8%) were less frequently reported, as well as garbage dumping (13.4%), these effects show similar documented concerns within quarries in Kiambu County where dust and runoff-related pollution affected vegetation health and community well-being, affecting up to 87.5% of plants and converting 70.8% of land into stagnant water bodies (Wangela & Shah, 2021). It has been proved in fact that the finding of water-filled quarries resonates with common consequences of abandoned pits that have been reported across Kenyan mining contexts (Maalim, 2022). The activity-based variation in perceptions where sculptors reported the highest average number of effects (2.42), followed by excavators (2.04) resonates with Rumbe (2021), whose research in Tabaka found that those who are closely associated and are involved in mining reported more critical environmental degradation, including landslides, soil erosion, and siltation (Rumbe, 2021).

Although our one-way ANOVA rendered only marginal significance ($F = 7.62$, $p = 0.050$) in effect differences across activity groups, the trends presented are in line with the geological assessments in Kisii County that highlight slope disruption and safety risks at quarry sites that are poorly handled. Fredrick et al. (2023) stated that slope angles up to 69° and safety factors averaging 0.565 mean that quarry walls are unstable (Fredrick et al., 2023). As a result, this supports the study's observation that roles that are closer to quarry operations tend to perceive more environmental degradation. Collectively, the study's results confirm that the extent of environmental effects from soapstone mining in Tabaka is major and could be viewed as quite

complex, particularly in terms of water related disruptions and vegetative degradation. The cross-study consistency enhances the credibility of the findings and highlights the urgent need for better policy interventions and sustainable quarry management strategies.

Role of stakeholders in promoting environmental sustainability

Stakeholder views in Tabaka portray a wide agreement in community participation and the need for sustainable policy frameworks as the major factors that would help towards the enhancement of environmental sustainability. This is in line with Machuma et al. (2022), who found that inclusive stakeholder engagement greatly enhances the sustainability of community initiatives in Kenya, and with Kibii and Ndolo (2021), who also highlighted that environmental compliance knowledge among quarry workers makes participatory mechanisms vital for improving regulation adherence.

It was revealed in the study that most sculptors (72.09%) were strongly in support for community participation. This reflects their daily closeness to mining sites and is consistent with community-driven sustainability models in Kenyan contexts (Machuma et al., 2022). On the other hand, the preference among customers and traders for sustainable policies (61.22% and 57.69% respectively) aligns with Ochiai et al. (2022), who observed that value-chain actors in Ghana tended to favour formal governance mechanisms. Excavators' stronger support for quarry rehabilitation (23.08%) reflects reclamation priorities that have been identified in Kenyan mining surveys (Kibii & Ndolo, 2021).

Whereas the chi-square test found no statistically significant overall difference in strategy preferences ($\chi^2 = 35.62$, $p = 0.150$), the cross-tabulation in the data reveal significant role-specific emphases backing the argument by Kiio and Muna (2020) that stakeholders' lived experiences play an important role in shaping their sustainability preferences. Effective

environmental governance in Tabaka will therefore need to accommodate both the broad consensus and the contextually specific priorities of different stakeholder groups.

Suitable Environmental Strategies

The study analysis demonstrates a strong consensus among stakeholders in Tabaka that community participation and sustainable policy frameworks are the most suitable environmental strategies for soapstone mining. This is in line with empirical evidence such as Mutu and Gachengo (2023), who stated that stakeholder participation greatly enhances performance of community water and development projects in Kirinyaga County (Mutu & Gachengo, 2023). Sculptors and other on-the-ground actors emphasized that community-driven approaches consistent with Karatina et al. (2022), which underscored that incorporating community participation, moderated by formal legal-political frameworks, helps in the support and promotion of long-term sustainability of development projects in Kenya (Karatina et al., 2022). Similarly, high support for sustainable policies among value-chain actors echoes findings that regulatory frameworks are valued by stakeholders for ensuring environmental compliance and equity (Ochiai et al., 2022).

Support for quarry rehabilitation among excavators shows that their first-hand experience with ecological degradation, echoes international assessments that reclamation and restoration are very critical elements that are responsible for resource extraction (Kafu-Quvane et al., 2024). Additionally, involving stakeholders in co-created projects significantly improves accountability and uptake, as shown by Mganga et al. (2023) in community-based research initiatives underscoring the role of context-specific collaboration in sustainability outcomes (Mganga et al., 2023). Collectively, these findings suggest that effective environmental strategy for Tabaka's soapstone sector must work towards promoting inclusive stakeholder engagement, policy-driven regulations, and site rehabilitation.

5.2 Conclusions

Environmental effects of the Soapstone Mining Industry

Soapstone mining in Tabaka, Kisii County, throughout this study is strongly viewed as a major reason for negative environmental impacts. The accumulation of quarry water, vegetation loss, landscape alteration, and debris heaps are the most frequent effects portrayed in this study. These impacts collectively point to a constant negative change of the area's physical and ecological landscape. While effects such as water, noise pollution and garbage dumping were less frequent, their presence brings to light a bigger issue of regarding public health and sanitation concerns. The differences in occupations in reported effects with sculptors and excavators consistently observing more, suggests that the closeness to mining operations acts as an essential factor that shapes environmental experience. Therefore, without stronger enforcement of environmental regulations and more responsible mining practices, these impacts are likely to become worse and greatly affect the existing pressures on natural resources and public health within the region.

The role of stakeholders in promoting environmental sustainability

It is very clear in this study that stakeholders across the soapstone mining sector share a very similar view of environmental sustainability needs, even where their specific priorities vary. The study shows that community members, sculptors, traders, customers, and county officials all agree to the fact that there is need for a range of stakeholder approaches that combine grassroots participation with institutional oversight. Currently, efforts by community groups and NGOs, though being of great importance, they remain fragmented and with limited resources. In order for there to be impactful progress, formal coordination between local actors and regulatory institutions, with roles that have been clearly defined and accountability mechanisms will be of essence. The evidence in this study therefore suggests that stakeholders

are willing participants in sustainability efforts. What is largely missing however, is structured support and the enforcement capacity to make those efforts effective and sustained.

Suitable environmental strategies

Stakeholders in this study highlight both participatory approaches and regulatory frameworks as the major features to the achievement of long-term sustainability. In addition to this, the importance of institutions working in collaboration and the restoration of the environment is shaped by the specific roles and experiences of various actors within the mining ecosystem. These insights therefore point to the need for integrated, participatory frameworks that are responsive and beneficial to both community needs and environmental priorities. Incorporating environmental strategies with lived realities on the ground fosters not only ecological resilience but also community togetherness and accountability. A participatory, policy-led design holds promise for transforming mining practices into more sustainable, equitable, and community-empowering processes in the region.

5.3 Recommendations

The study contributes to the body of knowledge by providing empirical evidence on environmental sustainability in the soapstone mining industry in Tabaka, Kisii County. While previous studies have examined soapstone mining in relation to livelihoods, economic activities, and environmental degradation, this study brings together these dimensions to provide a broader understanding of the sustainability challenges facing the industry.

The study contributes contextual knowledge by documenting the environmental effects associated with soapstone mining, including quarry water accumulation, vegetation loss, landscape alteration, and the accumulation of stone debris. It further contributes to knowledge by examining waste disposal practices and highlighting the need for improved waste management, reuse, and recycling of soapstone waste.

In addition, the study demonstrates the importance of stakeholder involvement in promoting environmental sustainability. By incorporating the perspectives of miners, community members, government officials, and other relevant stakeholders, the study provides a more comprehensive understanding of the roles and responsibilities required to address environmental challenges in the mining sector.

The study also contributes practical knowledge by identifying community participation, environmental awareness, policy implementation, stakeholder collaboration, and quarry rehabilitation as important approaches for improving environmental sustainability. These findings provide a basis for policymakers, environmental agencies, county governments, and local communities to develop and implement appropriate interventions for sustainable soapstone mining.

Theoretically, the study contributes to the application of Stakeholder Theory and Green Economy Theory in the context of artisanal and small-scale mining. Stakeholder Theory helps explain the importance of collaboration among different actors, while Green Economy Theory provides a framework for balancing economic livelihoods with environmental protection and resource conservation. Overall, the study extends existing knowledge by applying these theoretical perspectives to the specific context of soapstone mining in Tabaka, Kisii County

Environmental Effects of the Soapstone Mining Industry

- In order to assess the extent to which environmental effects affect soapstone mining in Tabaka, Kisii County, it is recommended that the County Government and NEMA work towards implementing strict environmental management frameworks that prioritize quarry rehabilitation, reforestation, and sustainable mining practices. This should also include those that are tailored to the specific impacts identified within the region. Without timely intervention, continued environmental deterioration may compromise

of both natural resources and public health. Sustainable practices are a major aspect to protecting the region's future.

Role of Stakeholders in Promoting Environmental Sustainability

- To enhance environmental sustainability in Tabaka's soapstone mining industry, all stakeholders specifically those classified under sculptors, excavators, traders, and local residents are recommended to be formally incorporated when it comes to the design and implementation of community-based environmental management plans. This is key when it comes to ensuring that their roles directly influence sustainable mining.

Suitable Environmental Strategies

- To promote sustainable environmental practices in Tabaka's soapstone mining industry, local and national stakeholders should prioritize the integration of community participation into environmental governance, supported by enforceable sustainable mining policies tailored to the region's ecological and socio-economic realities.

5.4 Proposed Areas for Further Research

Based on the findings and limitations of the study, several areas for further research are recommended. First, future studies could adopt a longitudinal research design to examine the long-term environmental effects of soapstone mining in Tabaka, Kisii County. Such studies would provide a better understanding of changes in land degradation, vegetation loss, quarry water accumulation, and landscape alteration over time.

Second, comparative studies could be conducted in other soapstone mining areas in Kenya to establish whether the environmental challenges identified in Tabaka are similar to those experienced in other mining regions. This would provide a broader basis for developing policies and interventions for environmental sustainability in the soapstone mining sector.

Third, further research could examine the economic and environmental trade-offs associated with soapstone mining. Such a study would assess the relationship between the livelihoods and economic benefits derived from the industry and the environmental costs associated with mining activities.

Fourth, future studies could investigate the effectiveness of stakeholder interventions, including government policies, environmental monitoring, community sensitisation, and quarry rehabilitation programmes, in promoting environmental sustainability. This would help establish which interventions are most effective in reducing environmental degradation.

Finally, further research could explore opportunities for sustainable waste management and the reuse or recycling of soapstone waste. Such studies could identify alternative uses for soapstone debris and offcuts, thereby reducing environmental pollution and creating additional economic opportunities for local communities.

In conclusion, this study examined environmental sustainability in the soapstone mining industry in Tabaka, Kisii County, Kenya. The study was guided by the recognition that soapstone mining is an important economic activity that provides employment, income, and supports the livelihoods of many households in the area. However, the findings demonstrate that the economic importance of the industry exists alongside significant environmental challenges that require attention from all stakeholders.

The study established that soapstone mining activities have contributed to quarry water accumulation, vegetation loss, landscape alteration, and the accumulation of stone debris. These environmental effects were associated with excavation activities, the opening of quarry pits, vegetation clearance, and inadequate management of mining waste. The findings further indicated that waste disposal and management practices remain inadequate, particularly in relation to the reuse, recycling, and proper disposal of soapstone offcuts and debris. Without

appropriate interventions, continued mining activities may intensify environmental degradation and reduce the capacity of affected land and natural resources to support future generations.

The study also established that environmental sustainability in the soapstone mining industry cannot be achieved by one stakeholder acting independently. Miners, community members, county government officials, environmental agencies, local leaders, traders, and other actors have complementary responsibilities in promoting sustainable mining practices. Although various stakeholders have made efforts to address environmental challenges, gaps remain in environmental awareness, coordination, policy implementation, monitoring, and enforcement.

Overall, the study concludes that sustainable soapstone mining requires a balance between economic development and environmental conservation. The continued contribution of the industry to local livelihoods should be supported by measures that minimise environmental harm and promote responsible resource use. Strengthening stakeholder collaboration, improving waste management, enforcing environmental regulations, increasing community participation, promoting environmental education, and rehabilitating degraded mining sites are essential for achieving this balance.

The study therefore concludes that environmental sustainability in Tabaka's soapstone mining industry is attainable where economic interests, environmental responsibilities, and stakeholder actions are integrated within a coordinated and enforceable framework. Such an approach would enable the industry to continue supporting local development while safeguarding the environment for present and future generations.

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APPENDICES

Appendix I: Consent Form

Dear Participant,

In making a decision to take part in the presented research study, it is quite of importance that you are able to read as well as understand explanations that will be present. Furthermore, the consent form provides information on withdrawing, declining, right to engage in participation and confidentiality, the potential benefits and risks, as well as purpose.

I am currently studying at the Catholic University of Eastern Africa taking up a course in Development Studies. I am thus conducting the study 'Environmental Sustainability in the Soap Stone Mining Industry' and it will take place at Tabaka within Kisii County. The study will manage to collect the needed data that shall be used in informing environmentally sustainable practices among those that participate in soapstone mining. It will also be instrumental in leading towards the development of strategies by the concerned stakeholders to improve soapstone mining practices for the benefit of the community where it takes place.

Information that you as the respondent will provide shall at all times be treated with the utmost confidentiality. There is no individual or entity that it beyond this study's framework who will have access to the confidential information. It is also expected that the maximum time to be taken in completing this questionnaire is 20 minutes. Most importantly, participating in this study is voluntary, and in a situation whereby one feels the need to withdraw at any moment, they are free to do so without any repercussions.

Most importantly, the study will not pose any form of discomfort, economic, social or physical risk to the participant. In participating in this study, one will have an opportunity to provide the

knowledge and information one has concerning improvement of soapstone mining practices that can lead towards environmental sustainability.

In reading the above provided information and you feel like you would like to receive more clarification, you are free to do so.

I have therefore read the above presented information and I am also well informed that there will be a copy of the exact consent form made available. It will contain all the information that is relevant, and in case I am not able to participate, I can voluntarily withdraw and this is without any form of prejudice.

Participant: _____

Signature: _____ **Date:** _____

Researcher: _____

Signature: _____ **Date:** _____

Appendix II: Questionnaire

QUESTIONNAIRE

GENERAL INFORMATION

Kindly respond to the provided questions by responding truthfully and appropriately either by filling in or ticking in the provided spaces. You are free to use English, Kiswahili, Kisii or any other local dialect.

Date: …….

A. SOCIO-DEMOGRAPHIC INFORMATION

1. Gender: Male ☐ Female ☐
2. Age:

   ……
3. Marital Status: Single ☐ Married ☐ Divorced ☐ Separated ☐

   Widower ☐ Widow ☐
4. Highest Education Level: Primary ☐ High school ☐ College ☐ University ☐

B. SECTION I: MINING RELATED ACTIVITIES

5. Name of the Soapstone Quarry:

   ……

   ……

   ……..
6. What is your specific activity at Tabaka?

   …….

   ……..

……

……

…….....

7. Why do you work in Soapstone Mining Related Activities?

……

……

……

……

8. Do you work all through the year?

Yes ☐ No ☐

9. Which is the best season of the year to conduct the mining activities?

Dry Season ☐ Rainy Season ☐

C. SECTION II: Factors affecting Soapstone Mining

10. Please Tick the factors you believe are responsible for influencing Soapstone Mining:

a. Weather Seasons ☐
b. Mining equipment costs ☐
c. Government Influence ☐
d. Political Influence ☐
e. Availability of Customers ☐
f. Environmental Regulations ☐
g. Interference by Middle Men ☐

D. SECTION III: Effects of Soapstone Mining on the Environment

11. Please tick the applicable effects that soapstone mining has on the environment.

    a. Quarries will large volumes of accumulated water ☐

    b. Quarries used as garbage dumping sites ☐

    c. Loss of vegetation ☐

    d. Reduced slope angles ☐

    e. Alteration of the natural landscape ☐

    f. Heaps of debris near the quarries ☐

    g. Water Pollution ☐

    h. Air Pollution ☐

    i. Noise Pollution ☐

E. SECTION IV: Disposal of Soapstone Waste Products

Please select or tick the response that applies best to your situation.

a. Dumping in other unused quarries ☐

b. Dumping in fields and farms ☐

c. Dumping by the roadside ☐

d. Dumping in authorised dump sites ☐

e. Selling ☐

f. Storing them next to the carving sites ☐

g. Others

……

……

……

……

F. SECTION V: Stakeholders with Environmental Sustainability Responsibility

Please select or tick the response that resonates with you with regards to the above statement.

a. National Government
b. County Government
c. NEMA
d. Law Enforcement
e. Community Members
f. Soapstone Mining Business Members
g. Others……

……

……

……

G. SECTION VI: Suitable strategies for improvement of Environmental Sustainability

Please select or tick the response that resonates with you with regards to the above statement.

a. Introduction of environmentally sustainable policies
b. Interventions by county government
c. Increasing community participation
d. Increasing business community participation
e. Improved interventions by NEMA
f. Others……

……

Appendix III: Focus Group Questions

1. What factors are responsible for influencing soapstone mining at Tabaka?
2. What benefits have come about from soapstone mining at Tabaka?
3. What environmental effects have you witnessed or heard of as a consequence of soapstone mining at Tabaka?
4. What challenges have you experienced in trying to maintain environmental sustainability at Tabaka?
5. Which strategies are you using to promote environmental sustainability with regards to soapstone mining at Tabaka?
6. Which stakeholders do you believe have and can play a role in ensuring soapstone mining at Tabaka is environmentally sustainable?
7. What recommendations can you provide to NEMA, and the government in response to improve the soapstone mining at Tabaka?

Appendix IV: Key Informant Interview Guide

The questions below will guide the researcher throughout the interview schedule:

Objective 1: Environmental Effects - To investigate the extent of environmental effects of the soapstone mining industry in Tabaka, Kisii County.

1. What are the major environmental effects have you observed that are associated with soapstone mining in Tabaka, Kisii County?
2. In your view, how has soapstone mining affected land, vegetation, water resources and the landscape in the area?
3. Which environmental effects of soapstone mining do you consider the most significant, and why?

Objective 2: Waste Management Practices - To assess the waste disposal practices associated with soapstone mining and their implications for environmental sustainability in Tabaka, Kisii County.

1. During the process of soapstone extraction, processing and carving, what types of waste are generated and how are they currently being managed?
2. In your view, what are some of the environmental challenges that arise from the current disposal and accumulation of soapstone waste?
3. What measures do you think could be adopted to improve the management, reuse or recycling of soapstone waste in Tabaka?

Objective 3: Stakeholder Roles - To examine the role of stakeholders in promoting environmental sustainability in the soapstone mining industry in Tabaka, Kisii County.

1. What roles do the different stakeholders, including miners, the community, the County Government and NEMA, currently play in promoting environmental sustainability in soapstone mining?
2. How effective do you think is the collaboration among the different stakeholders in addressing the environmental challenges associated with soapstone mining?
3. What challenges limit stakeholder participation and what do you feel could be done to strengthen their roles in promoting environmental sustainability?

Objective 4: Environmental Sustainability Strategies - To establish suitable environmental sustainability strategies for the soapstone mining industry in Tabaka, Kisii County.

1. What measures are currently being implemented to promote environmental sustainability in soapstone mining, and how effective are they?
2. Which strategies do you consider most appropriate for reducing the environmental effects of soapstone mining in Tabaka?
3. What improvements are needed in areas such as quarry rehabilitation, waste management, community participation, policy implementation and environmental enforcement to promote sustainable soapstone mining?

Appendix V: Data Collection Letter

THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

Faculty of Arts and Social Sciences

Department of Social Sciences and Development Studies

17th April 2024

The Director
National Commission for Science, Technology and Innovation
Box 30623 - 00100
NAIROBI – KENYA

Dear Sir/Madam,

RE: EDITH MAGOMA NYAMICHABA **REG. NO. 1032434**

I am writing to introduce to you **Edith Magoma Nyamichaba** who is a finalist student pursuing Masters of Arts in Development Studies Degree at The Catholic University of Eastern Africa, Nairobi – Kenya, and to request you to assist her to accomplish her academic research requirements.

Edith has completed all course work requirements for this programme. However, every student in the programme is required to conduct research and write a report/thesis submitted during the final years of studies.

Accordingly, Edith's research topic has been approved. She will conduct research on the following topic:

"Environmental Sustainabilityin the Soap Stone Mining Industry: A Case of Kisii, Kenya"

Thanking you in advance for any assistance given to Edith.

Sincerely yours,

THE CATHOLIC UNIVERSITY OF EASTERN AFRICA HEAD OF DEPARTMENT 17 APR 2024 P.O. Box 62157-00200, NAIROBI

17/04/2024

Dr. Mary Mutisya
Head, Department of Social Sciences and Development Studies

THE CATHOLIC UNIVERSITY OF EASTERN AFRICA (CUEA) P.O. BOX 62157 00200 Nairobi – KENYA
Tel: 020-2525811-5, 8890023-4, Fax: 8891084, Website: www.cuea.edu
Founded in 1984 by AMECEA (Association of the Member Episcopal Conference in Eastern Africa)

Appendix VI: Research Approval Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **949372**

Date of Issue: **17/July/2025**

RESEARCH LICENSE



This is to Certify that Ms.. Edith Nyamichaba of Catholic University of Eastern Africa, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kisii on the topic: ENVIRONMENTAL SUSTAINABILITY IN THE SOAP STONE MINING INDUSTRY: A CASE OF KISII, KENYA for the period ending : 17/July/2026.

License No: **NACOSTI/P/25/4177068**

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Appendix VII: Plagiarism Certificate

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I HEREBY CONFIRM THAT **EDITH MAGOMA NYAMICHABA** REG NO: **1032434**, SUBMITTED A CHECK OF ANTIPLAGIARISM ON EVALUATION OF **ENVIRONMENTAL SUSTAINABILITY IN THE SOAP STONE MINING INDUSTRY: A CASE OF KISII, KENYA. A RESEARCH PROPOSAL PRESENTED TO THE FACULTY OF ARTS AND SOCIAL SCIENCES IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR MASTER OF ARTS DEGREE (MDS) AT THE CATHOLIC UNIVERSITY OF EASTERN AFRICA, KENYA.**

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